Okavango Delta

World Heritage Nomination Dossier

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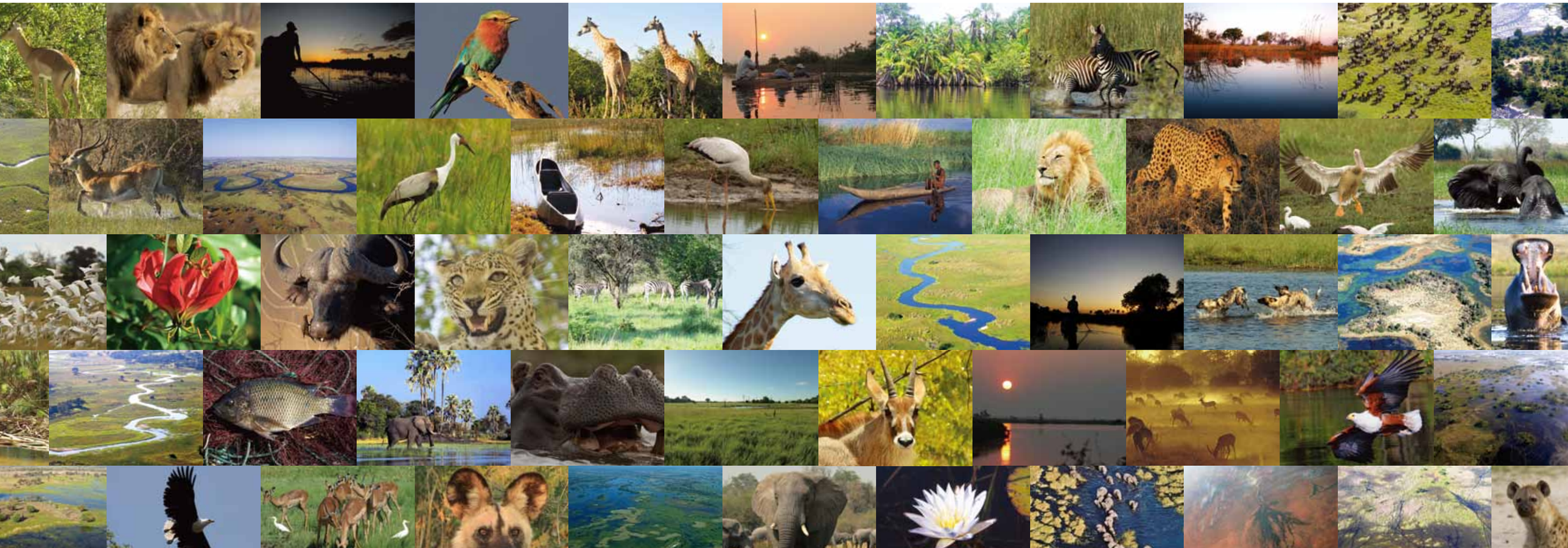

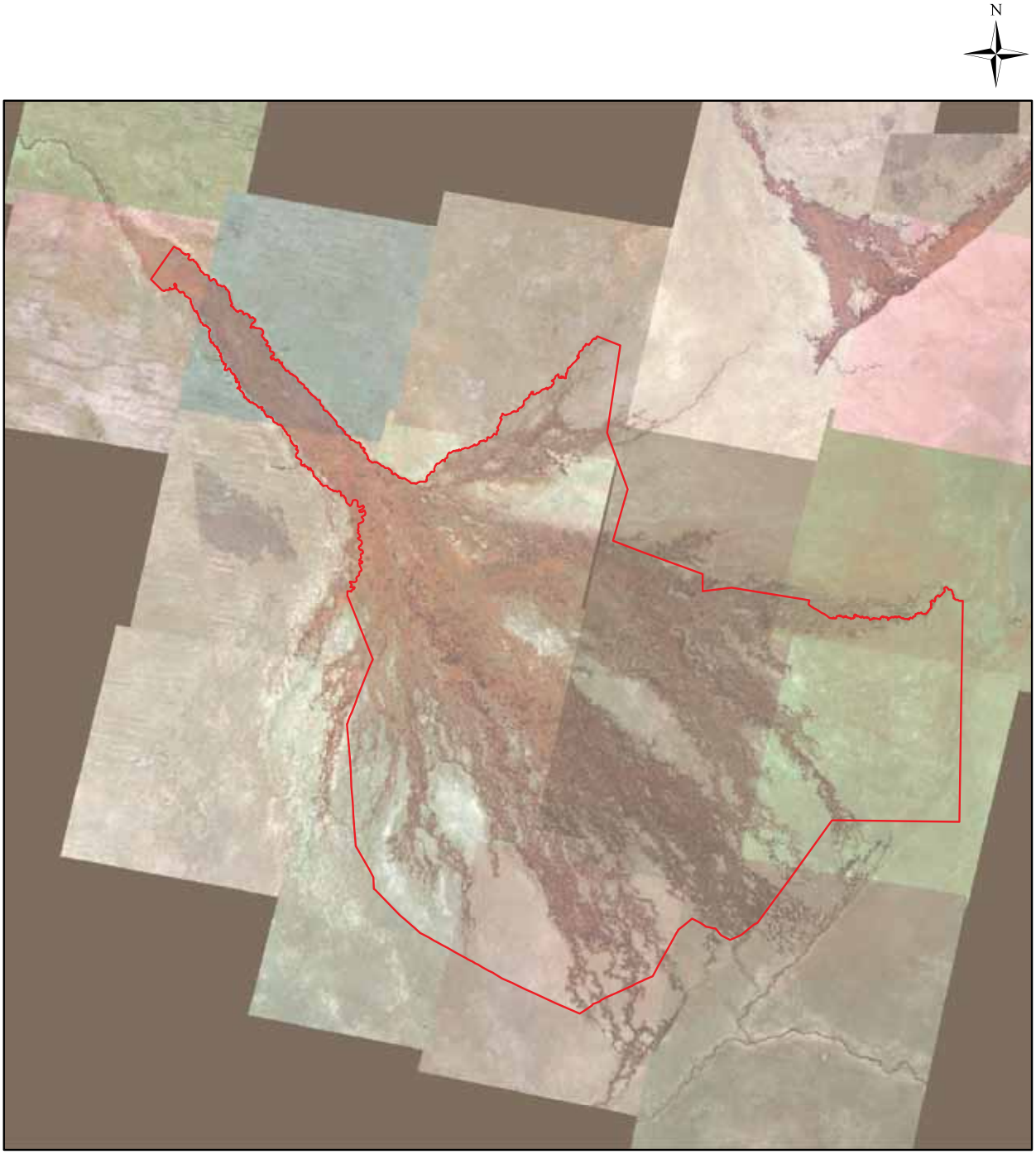

1 : 1 500 000

Core Zone Boundary

Source data Spot 4 Image 2009
Prepared by Department of Surveys and Mapping
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Okavango Delta : Satellite Image

Okavango Delta

World Heritage Nomination Dossier

Nomination dossier to UNESCO for inscription into
the World Heritage List

2013
Republic of Botswana

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Abbreviations

AWHF	African World Heritage Fund
BTO	Botswana Tourism Organisation
BTV	Botswana Television
CBD	Convention on Biological Diversity
CBNRM	Community Based Natural Resources Management
CBNRMP	Community Based Natural Resource Management Projects
CBPP	Contagious Bovine Pleuro Pneumonia
CEO	Chief Executive Officer
CHA	Controlled Hunting Area
CHDA	Centre for Heritage Development in Africa
CoR	Certificate of Rights
CITES	Convention on International Trade in Endangered Species
CPUE	Catch Per Unit Effort
CSO	Central Statistics Office
CSAG	Climate System Analysis Group
DANIDA	Danish Development Agencies
SIDA	Swedish International Development Agency
DDC	District Development Committee
DEA	Department of Environmental Affairs
DFRR	Department of Forestry and Range Resources
DLUPU	District Land Use Planning Unit
DNMM	Department of National Museum and Monuments
DoT	Department of Tourism
DWA	Department of Water Affairs
DWNP	Department of Wildlife and National Parks
EIA	Environment Impact Assessment
ENWC	Eastern National Water Carrier
FAO	Food Agricultural Organisation
FPSG	Fixed Period State Grant (FPSG)
GCMs	Global Circulation Models
GDP	Gross Domestic Product
GIS	Geographic Information System
GoB	Government of Botswana
IUCN	World Conservation Union
IBA	Important Bird Areas
IMP	Integrated Management Plan
KAZA-TFCA	Kavango-Zambezi Trans frontier Conservation Area
LIMID	Livestock Management and Infrastructure Development

MEAs	Multilateral Environmental Agreements
MMEWR	Ministry of Minerals, Energy and Water Resources
MEWT	Ministry of Environment, Wildlife and Tourism
MGR	Moremi Game Reserve
MoH	Ministry of Health
MOZ	Makgadikgadi-Okavango Zambezi Basin
NBSAP	National Biodiversity Strategy and Action Plan
NES	National Ecotourism Strategy
NG	Code name for Ngamiland Concession Area(s)
NRP	Natural Resources People
NWDC	North West District Council
NWHC	National World Heritage Committee
OBIS	Okavango Basin Information System
ODIS	Okavango Delta Information System
ODRS	Okavango Delta Ramsar Site
ODMP	Okavango Delta Management Plan
OKACOM	Permanent Okavango River Basin Water Commission
ORI	Okavango Research Institute
OUV	Outstanding Universal Value
OWMC	Okavango Wetlands Management Committee
PATTEC	Pan African Tsetse and Trypanosomiasis Eradication Campaign
RDL	Red Data List
SADC	Southern African Development Community
SACCNET	Southern Africa Climate Change Network
SMEC	Snowy Mountains Engineering Corporation
SOIWPD	Southern Okavango Integrated Water Development Plan
SWC	Site Working Committee
TDS	Total Dissolved Salts
TFCA	Trans Frontier Conservation Area
TLB	Tawana Land Board
TGLP	Tribal Grazing Land Policy
UB	University of Botswana
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNCLOS	United Nations Convention on the Law of the SEA
UNESCO	United Nations Educational and Scientific and Cultural Organisation
UNEP	United Nations Environmental Program
UNFCCC	United Nations Framework for Convention on Climate Change
WHC	World Heritage Centre
WMA	Wildlife Management Area
WWF	Worldwide Fund for Nature

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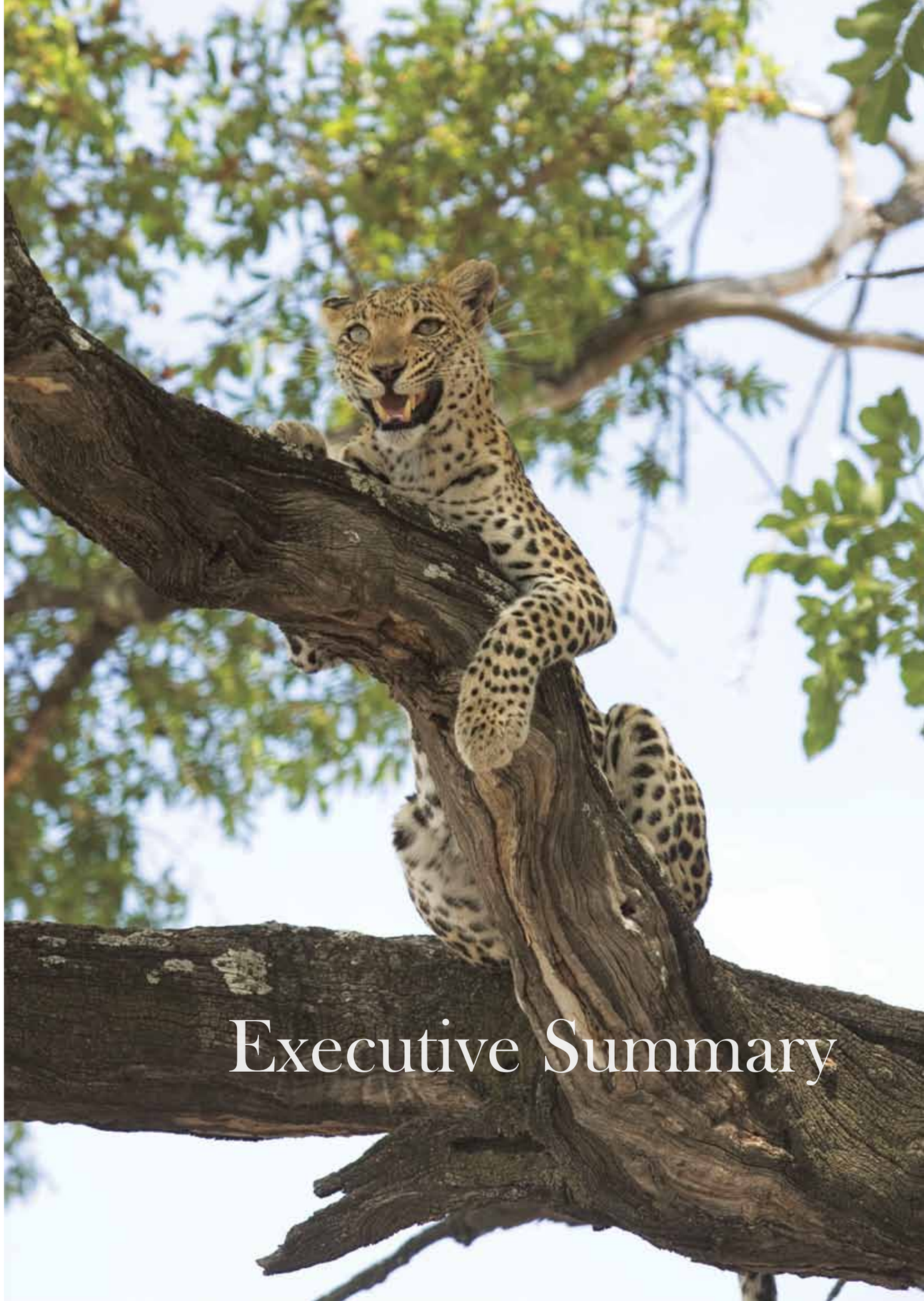
Introduction

There are some, but not many, wetlands in the world that can be compared to the Okavango Delta System. The few that can be compared are in South America, Europe, Asia and Africa. Certainly the inland delta systems outside of Africa are entirely different ecological systems supporting their own unique biodiversity. Only three large (greater than 20 000 km^2) low gradient inland delta systems have developed on the continent of Africa. Although they all share similarities in form and function the Okavango Delta is the only mega inland delta system south of the equator. Moreover, it is the only inland Delta that floods in the dry season - a unique hydrological event that defines this system.

This scenically spectacular and biodiversity rich inland Delta has been selected for nomination as a World Heritage Site based on three of the four natural criteria. The Okavango Delta system is a national asset and enjoys multi-layered protection through Botswana's national vision, laws, policies, plans and strategies; regional protocols and ratified international conventions. The property falls within the Kavango-Zambezi Trans-frontier Conservation Area (KAZA) which includes conservation areas in Angola, Namibia, Zambia and Zimbabwe. In addition, the Permanent Okavango River Basin Water Commission (OKACOM) jointly managed through a tripartite agreement between Botswana, Namibia and Angola oversees the management and use of the system on a sustainable basis and thus contributes towards its conservation.

Over 95% of the population of the Okavango Delta directly or indirectly depend on the natural resources found in the wetland to sustain their livelihoods. Local communities in the site derive part of their livelihood from fishing, which is a complementary activity to a myriad of livelihood strategies ranging from crop production, livestock rearing, basket making, beer brewing, and harvesting of wood, reeds and medicinal plants. Dry land farming is practiced mainly at subsistence level. Reeds, papyrus and palms are used for building homes, making mats and baskets - the latter being for local consumption as well as for sale to tourists. The Hambukushu ethnic group are the original makers of the baskets that have made Botswana famous for the craft.

In conclusion, globally few other wetlands are as aesthetically beautiful, have outstanding natural processes and phenomena, have significant areas of flooded grasslands, or are as well protected and managed and are species rich as the Okavango Delta property. In a world-wide biodiversity comparison of seven globally important wetlands, of which six are located in tropical and sub-tropical areas, the Okavango Delta has the highest number of reptiles and bird species, second highest number of plant and mammal species, and third highest number of fish species. Local people are also a vibrant and traditional part of the area, practicing African rural agricultural systems based largely on traditional knowledge and thereby living sustainably on its resources as they have done for hundreds if not thousands of years. Therefore, the Okavango Delta remains globally outstanding and is, we believe, worthy of inscription as a natural World Heritage Site under three World Heritage natural criteria (namely, vii, ix and x).



Executive Summary

Executive Summary

STATE PARTY

Botswana

REGION

Ngamiland District

NAME OF PROPERTY

Okavango Delta

GEOGRAPHICAL COORDINATES

The Okavango Delta Property lies between 21° 45′ E 23° 53′ E and 18° 15′ S 20° 45′ S. The approximate centre of the site lies within the Moremi Game Reserve at 19° 17′ S and 22° 54′ E.

DESCRIPTION OF THE BOUNDARY OF THE NOMINATED PROPERTY

The boundaries of the property are described in Map 1.e.5 of the dossier, and in 'The Atlas' in Appendix 1. The land uses within the core zone comprise communal areas, Moremi Game Reserves (MGR) and Wildlife Management Areas (WMAs) where the primary land-use is non-consumptive photographic tourism. The majority of the core zone is designated cattle-free and therefore commercial agriculture does not take place within it. Such activity does take place in parts of the buffer zone, which include small settlements, with some arable land and grazing areas. However, the buffer zone comprises the dry season dispersal areas of large herbivores such as Elephants, Buffaloes and Zebras. It is large enough and intact enough to ensure the seasonal grazing patterns and thus sustainability of these herbivores, and also their accompanying predators.

LOCATION MAP OF THE OKAVANGO DELTA

1 : 2 000 000

Area of Core Zone: 1 650 350 ha
Area of Buffer Zone: 3 487 870 ha

Total Area of Property: 5 138 220 ha

Coordinates of Center of Property: -19.283 22.810

epared by Department of Surveys and Mapping
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Legend

- Center of Property
- Settlements
- Core Zone Boundary
- Buffer Zone
- Tarred Road
- Gravel/Sandy Road
- International Boundary
- District Boundary
- Okavango Delta

JUSTIFICATION STATEMENT OF OUTSTANDING VALUE

a) Brief Synthesis

The Okavango Delta is a large low gradient alluvial fan or 'Inland Delta' (half the size of Belgium) with permanent swamps approximately 6 000 km^2 in size, with an additional 7 000 to 12 000 km^2 of seasonally flooded grassland. It is Africa's largest endorheic delta, i.e. outflows do not reach the sea, being Africa's third largest alluvial fan. Furthermore it is near pristine being a largely untransformed wetland system. The biota has uniquely adapted their growth and reproductive behaviour, particularly the flooded grassland biota, to be timed with the arrival of flood-water in the dry, winter season of Botswana.

b) Justification for criteria

vii. Outstanding natural beauty of the Okavango Delta

Permanent crystal clear waters and dissolved nutrients transform the otherwise dry Kalahari Desert habitat into a scenic landscape of exceptional and rare beauty, and sustain an ecosystem of remarkable habitat and species diversity, thereby maintaining its ecological resilience and amazing natural phenomena.

ix. Significant ecological and biological processes of the Okavango Delta

The annual flood-tide, which pulses through the wetland system every year, revitalizes ecosystems and is a critical life-force during the peak of the Botswana's dry season (June/July). The Delta's diversity of sub-Saharan plants and animals is comparable with the species diversity elsewhere on the continent.

x. In situ conservation of the rich biodiversity of the Okavango Delta

The Okavango sustains robust populations of some of the world's most endangered large mammals, such as Cheetah, Wild Dog and Lion, adapted to living in this wetland system. This rich biodiversity also sustains the needs of local communities. Botswana supports the world's largest population of Elephants, numbering around 130 000, for which the Okavango is a core area for this species survival. The Okavango Delta is a refuge for biodiversity including Africa's mega-fauna, particularly during the dry season. The system maintains a species rich assemblage of plants and animals including populations of a number of globally threatened species. The diversity of plant species is exceptional with an average of 210 species per square kilometre. There are over 480 different bird species in the property, of which 24 are globally threatened.

The area is thus internationally recognized as a key site for the conservation of birds and is a UNESCO listed Ramsar Site incorporating three Important Bird Areas (IBAs). Some 29 species of larger mammals as well as 69 species of smaller mammals are present. Some of the mammals are relatively restricted to the area mainly due to their habitat preferences, such as Sitatunga, Red Lechwe and Southern Reedbuck antelopes. In the Okavango Delta several species of mammals are also considered vulnerable or endangered and are protected by National and International protocols.

c) Statement of integrity

The Okavango Delta is a vast, natural, scenically spectacular, inland Delta or Alluvial fan systems whose waters never reach the sea draining instead into the desert sands of the Kalahari Basin and the extensive Makgadikgadi Salt Pans. It is an undisturbed natural ecologically functional area of sufficient size of about 16 500 km^2 to comprehensively accommodate and represent all its features and its natural biophysical processes that maintain and support its communities of plant and animal species.

The Okavango Delta provides vital ecosystem services, and is an important source of fresh-water in an otherwise arid region. The Delta supports the livelihoods of approximately 157 000 local people in 2011, most of who depend on its resources - not just for water, but also materials for building, and plants and animals for food and medicines. A large percentage of the community also obtains direct employment through a thriving eco-tourism industry.

d) Requirements for protection and management

The nominated site is in a largely unaltered condition, with the vegetation and animal groups in a robust state, and with the property under good conservation management by the authorities and the communities. It is managed according to several government plans including the Okavango Delta Management Plan (ODMP) and the Ngamiland Integrated Land Use Plan. In addition, the Permanent Okavango River Basin Water Commission (OKACOM) jointly managed through a tripartite agreement between Angola, Botswana and Namibia has been formed to oversee the management and use of the system on a sustainable basis. The site is divided into one Game Reserve, and several Wildlife Management Areas (WMA) and/or Controlled Hunting Areas (CHA). The Moremi Game Reserve, which was proclaimed in 1964 and re-proclaimed in 1974 with additional areas incorporated - only non-consumptive utilization is allowed. The Reserve is managed in terms of the Moremi Game Reserve Management Plan.

CRITERIA UNDER WHICH PROPERTY IS NOMINATED

The dynamic, intact and fully functional Okavango Delta System fulfils criteria vii, ix and x for Natural sites:

Criterion vii - *contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;*

The Okavango Delta ecosystem is a natural feature of outstanding aesthetic importance where several superlative natural phenomena

occur, such as the 'miraculous' annual transformation of the huge, sandy, dry, and brown depression by floods arriving in the winter season creating a vast green oasis, a wetland of deep crystal-clear water surrounded by the parched, dusty, Kalahari desert stretching to the horizon in all directions and large herds of large animals splashing, playing, and drinking the clear waters of the Okavango having survived the dry autumn season or their weeks' long migration across the Kalahari Desert.

Criterion ix - ***be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals;***

The Okavango Delta is an outstanding example of the complex inter-relatedness, inter-dependence, and interplay of climatic, geo-morphological, hydrological, and biological processes. All these processes in combination have resulted in the creation of this vast inland delta, its terrestrial and aquatic ecosystems, and its diverse complement of plant and animal life.

Criterion x - ***contains the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.***

The Okavango Delta has diverse natural habitats including permanent and seasonal rivers and lagoons, permanent swamps with reeds and papyrus, seasonal and occasionally flooded grasslands, riparian forest and woodlands, dry woodlands and island communities. Each of these habitats has a distinct species composition of plants and animals comprising all the major classes of aquatic organisms, reptiles, birds and mammals. The Delta is also refuge to globally significant numbers of rare and endangered large mammals like the Wild Dogs and Cheetahs. Furthermore, it is an Important Bird Area, harbouring 24 species of globally threatened birds. This property is under good conservation management by both the authorities and the local communities.

NAME AND CONTACT INFORMATION OF OFFICIAL LOCAL INSTITUTION

Organisation: Permanent Secretary
Ministry of Environment Wildlife and Tourism
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CHAPTER 1
IDENTIFICATION

1. IDENTIFICATION OF THE PROPERTY

The Okavango Delta is situated in north-western Botswana. The Delta comprises of the lower reaches of the 1 500 km long Okavango River, Southern Africa's third largest, which rises in the southern Angolan Highlands and flows south-eastwards, briefly through Namibia's Caprivi Strip, before entering Botswana. This perennial flooding activity continually maintains and shapes the delta system. This inland Delta is a natural oasis that supports a remarkable assemblage of biodiversity which supports people as well as a complex web of life. Few natural places in the world offer so many goods, assets and services in combination with such aesthetic appeal. Strikingly and importantly, this natural oasis lies in the centre of a flat, semi-arid landscape of Kalahari sands that stretches almost 3 000 km from north to south, and over 1 000 km from east to west (Mendelsohn et al., 2010). It is an extraordinary juxtaposition of a vibrant wetland in an arid landscape, and for this unusual setting the Okavango Delta was called, and is popularly done so now, the Jewel of the Kalahari (Ross, 2003).

Previous page: Elephants bathing in the Okavango Delta

1.a COUNTRY
Republic of Botswana

1.b REGION
Ngamiland District, North-Western Botswana

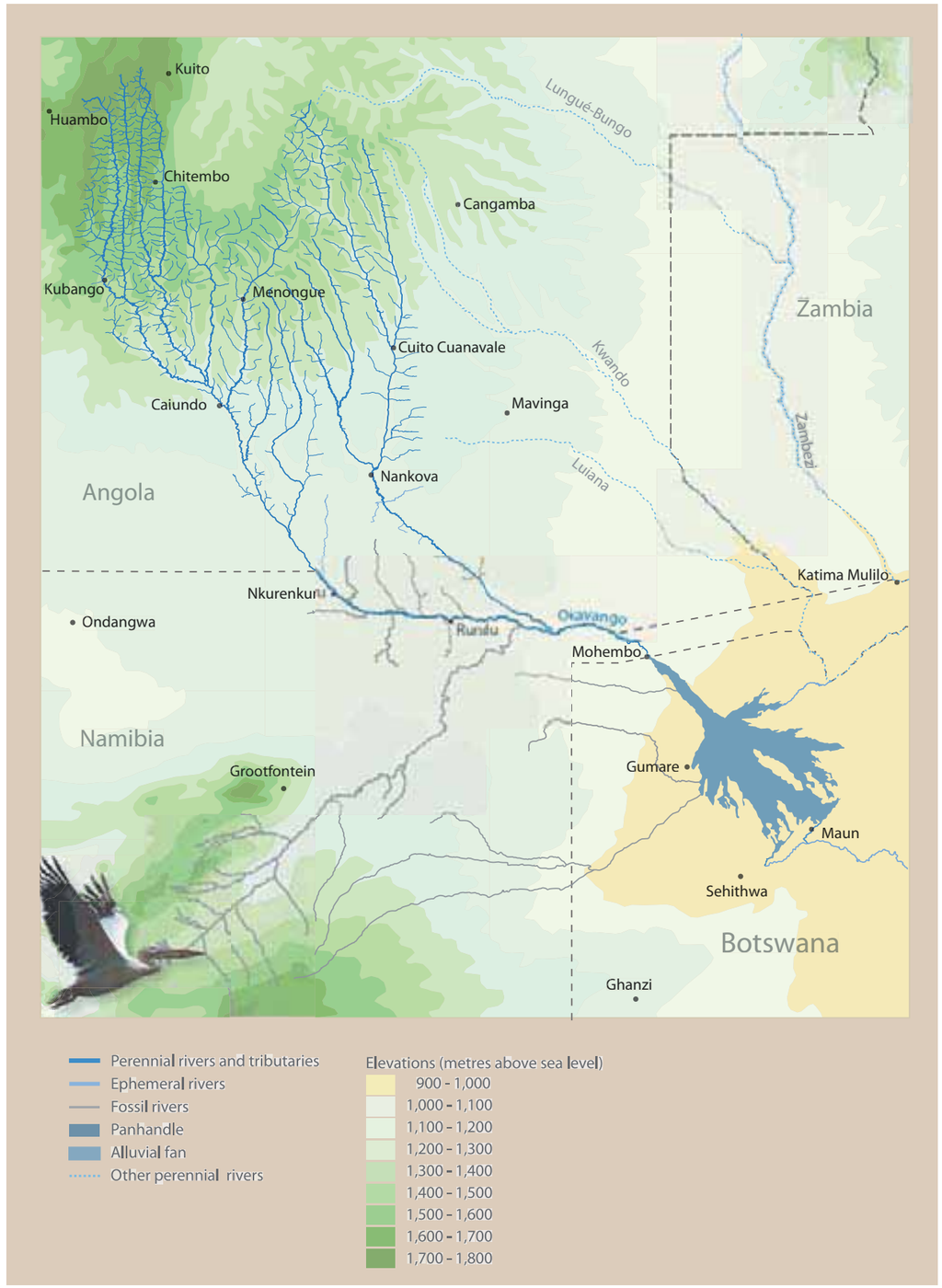
1.c NAME OF PROPERTY
Okavango Delta

1.d GEOGRAPHICAL COORDINATES TO THE NEAREST SECOND
19° 17′ S, 22° 54′ E

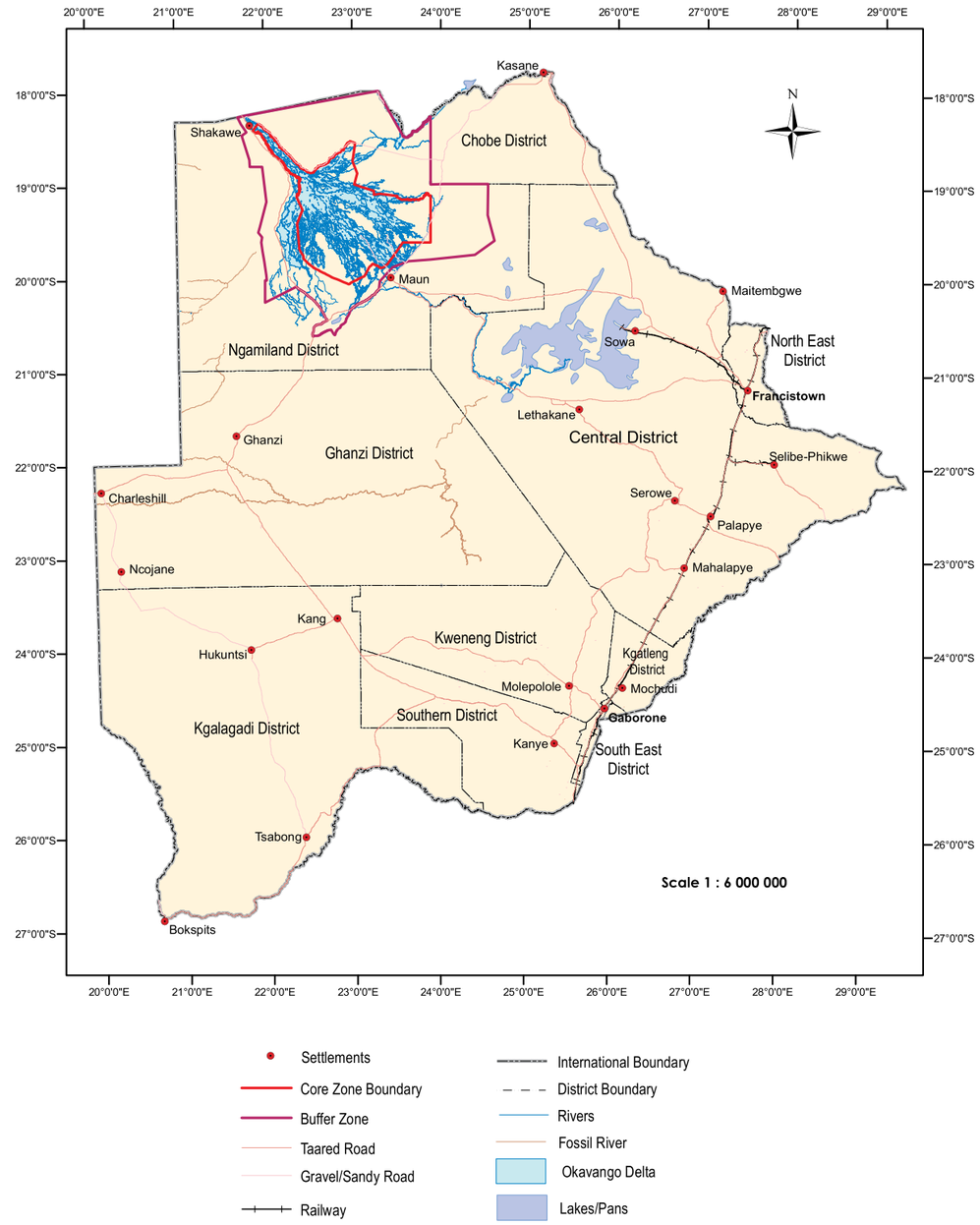
1.e MAP AND PLANS, SHOWING BOUNDARIES OF THE NOMINATED PROPERTY AND BUFFER ZONE

Source data: Botswana National PC Atlas, 2002
Prepared by Department of Surveys and Mapping
© Republic of Botswana, 2012

Map 1.e.1: Location of the Okavango Delta Property in Botswana and Africa



Map 1.e.2: Location and origin of the Okavango Delta Property in the region (Mendelsohn et al., 2010)



Prepared by Department of Surveys and Mapping
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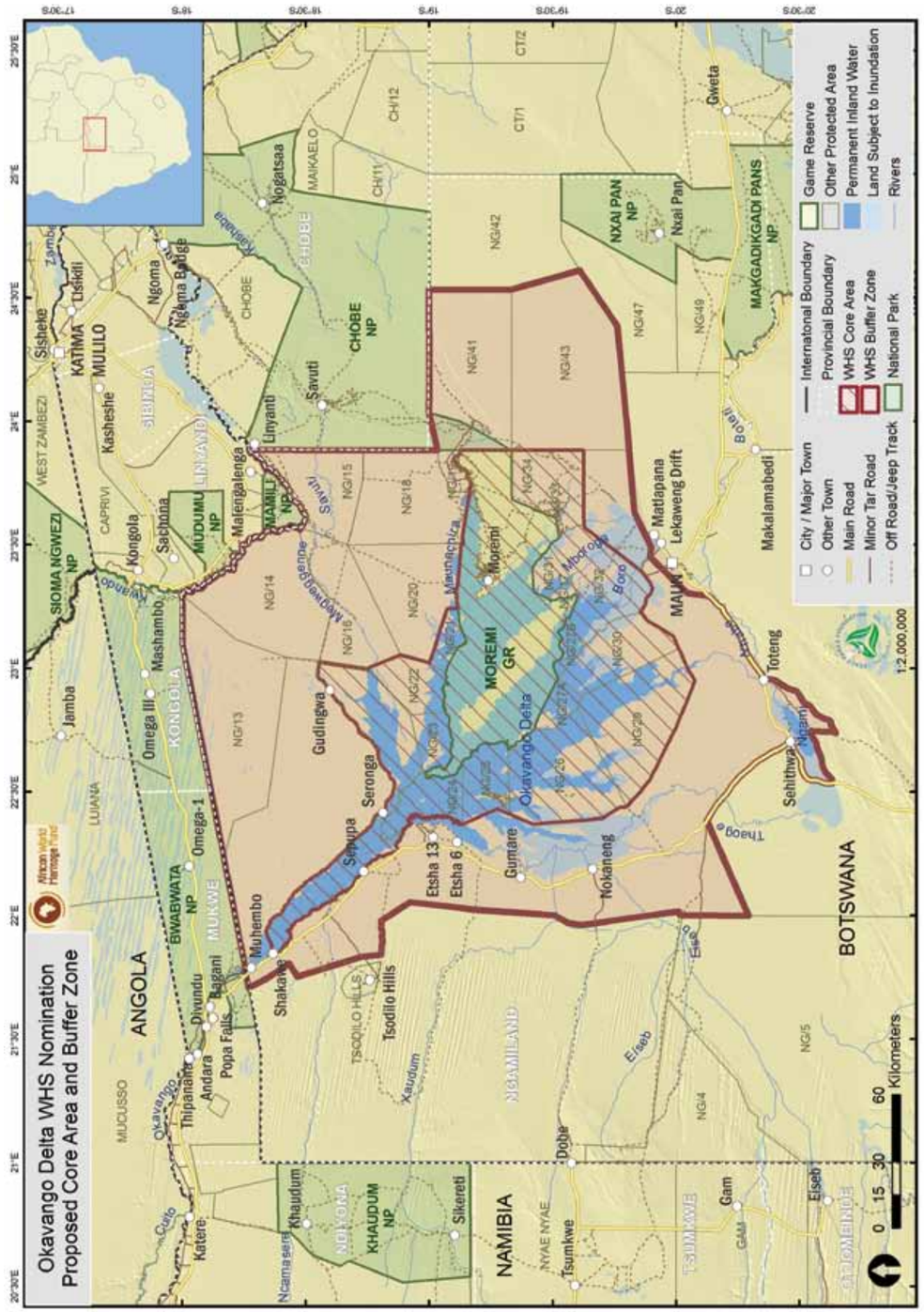
Map 1.e.3: Location of the Okavango Delta Property in Botswana


Okavango Delta WHS Nomination
Proposed Core Area and Buffer Zone
ANGOLA
BOTSWANA
NAMIBIA
CHOBE NP
NXAI PAN NP
MAKGADIKGADI PANS NP
MOREMI GR
SIOMA NGWEZI NP
MUDUMU NP
MAMILI NP
BWABWATA NP
KHAUDUM NP
Okavango Delta
Gweta
Nxai Pan
Maun
Matlapana
Lekaweng Drift
Makalamabedi
Toteng
Sehithwa
Shakawe
Muhembo
Seronga
Gudingwa
Etsha 13
Etsha 6
Gumare
Nokaneng
Tsodilo Hills
Dobe
Eiseb
Gam
Khaudum
Sikereti
Katere
Divundu
Andara
Popa Falls
Thipanana
Omega III
Omega-1
Jamba
Mashambo
Kongola
Sachona
Mohembo
Malengalenga
Linyanti
Savuti
Kasheshe
Sisheke
Lisikili
Ngoma
Ngoma Bridge
Nogatsaa
Moremi
Maun
Toteng
Sehithwa
Gweta
Nxai Pan
Okavango Delta
Tsodilo Hills
Dobe
Eiseb
Gam
Khaudum
Sikereti
Katere
Divundu
Andara
Popa Falls
Thipanana
Omega III
Omega-1
Jamba
Mashambo
Kongola
Sachona
Mohembo
Malengalenga
Linyanti
Savuti
Kasheshe
Sisheke
Lisikili
Ngoma
Ngoma Bridge
Nogatsaa
Seronga
Gudingwa
Etsha 13
Etsha 6
Gumare
Nokaneng
Shakawe

1 : 2 000 000

Area of Core Zone: 1 650 350 ha

Area of Buffer Zone: 3 487 870 ha

Total Area of Property: 5 138 220 ha

Coordinates of Center of Property: -19.283 22.810

Prepared by Department of Surveys and Mapping
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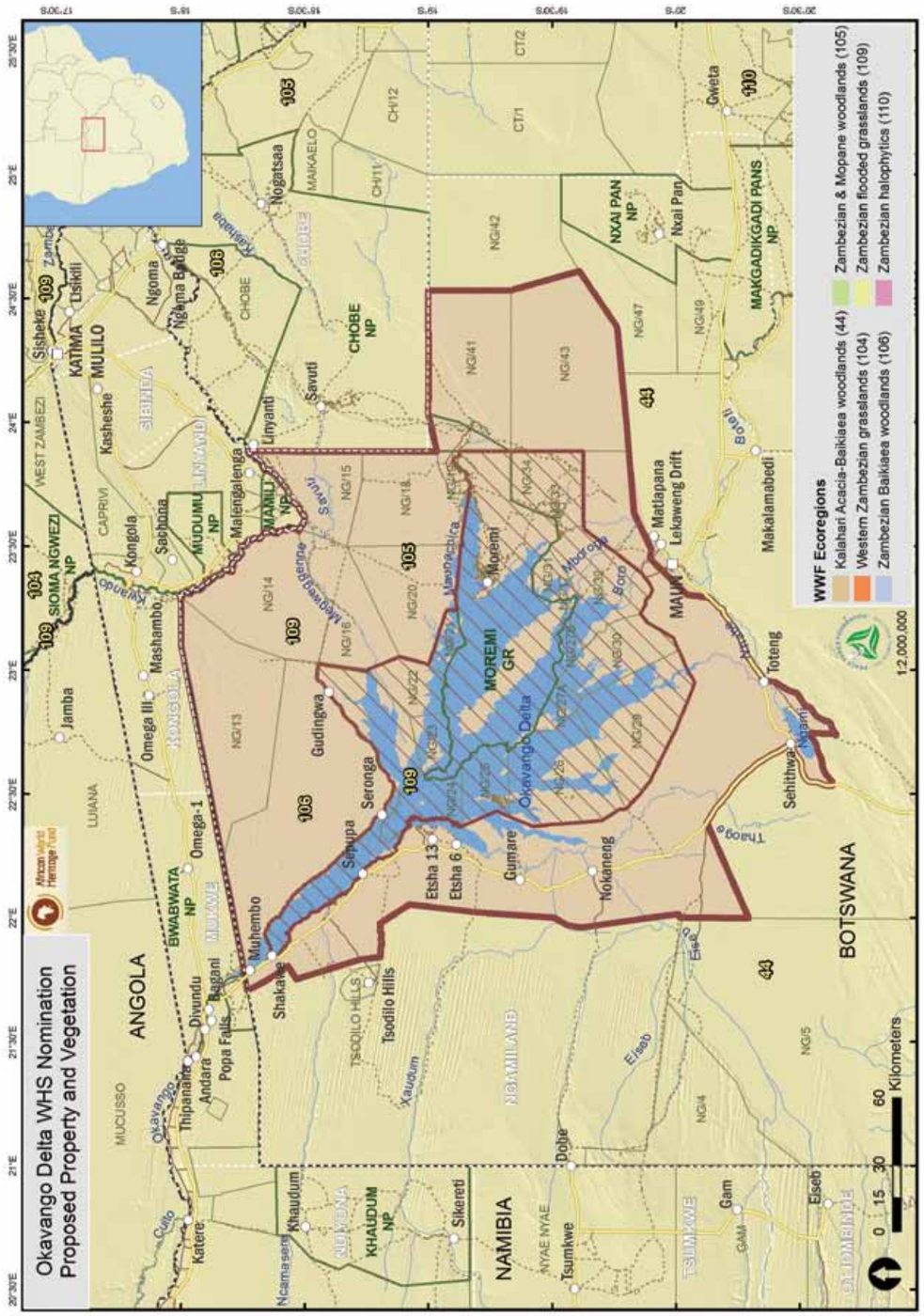
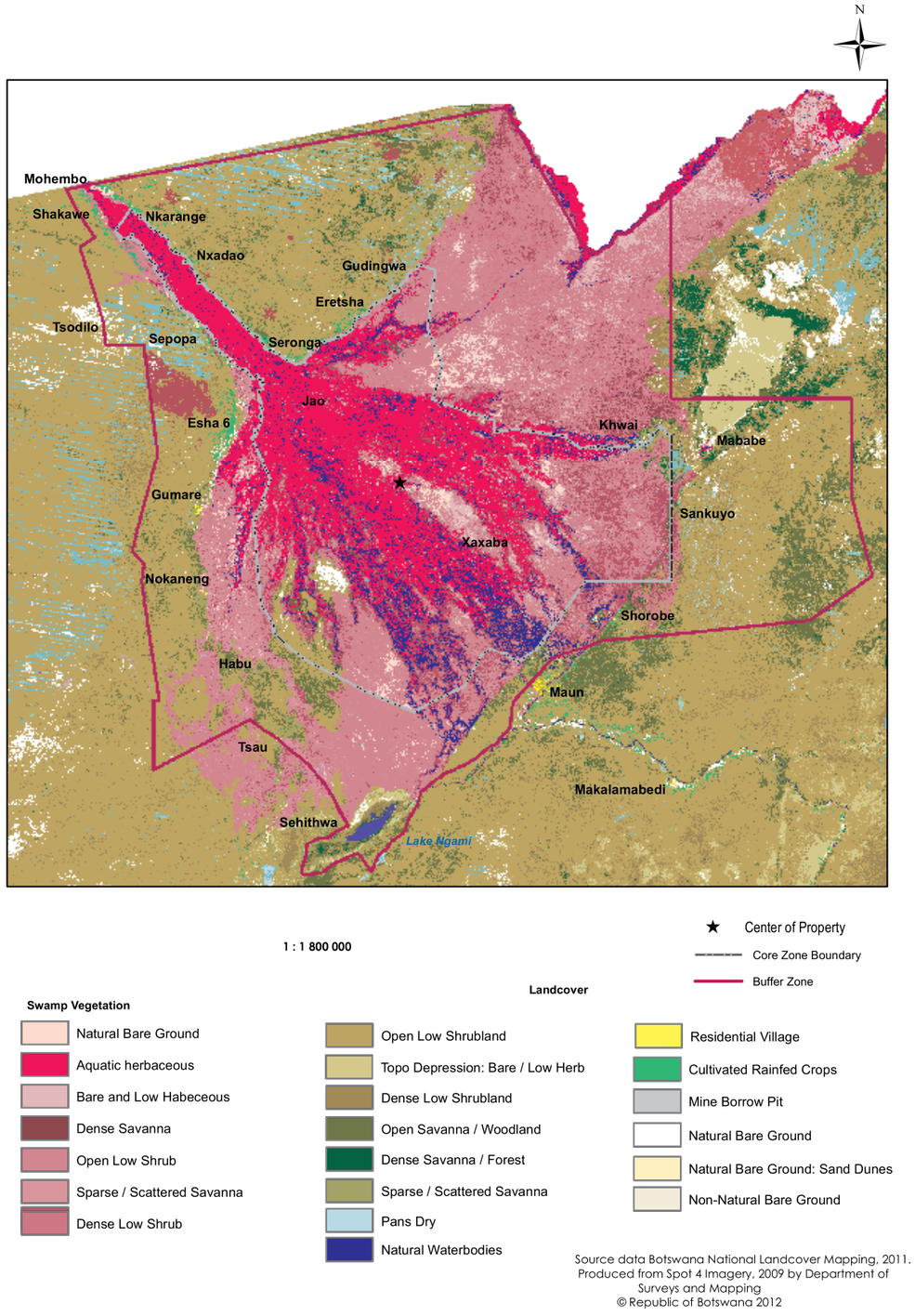
Legend

- Center of Property
- Settlements
- Core Zone Boundary
- Buffer Zone
- Tarred Road
- Gravel/Sandy Road
- International Boundary
- District Boundary
- Okavango Delta

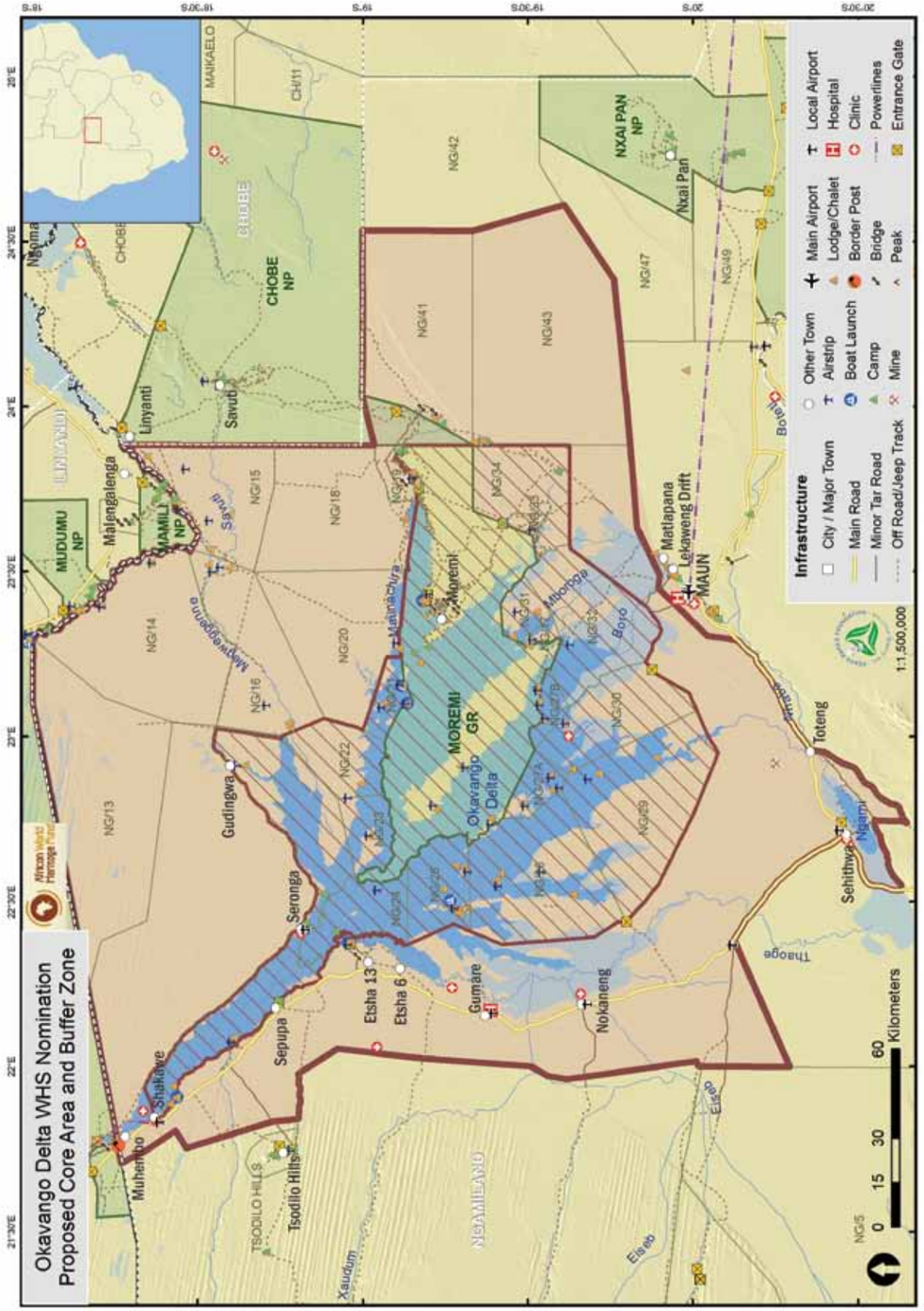
Map 1.e.5: Boundary coordinates of the Okavango Delta Property



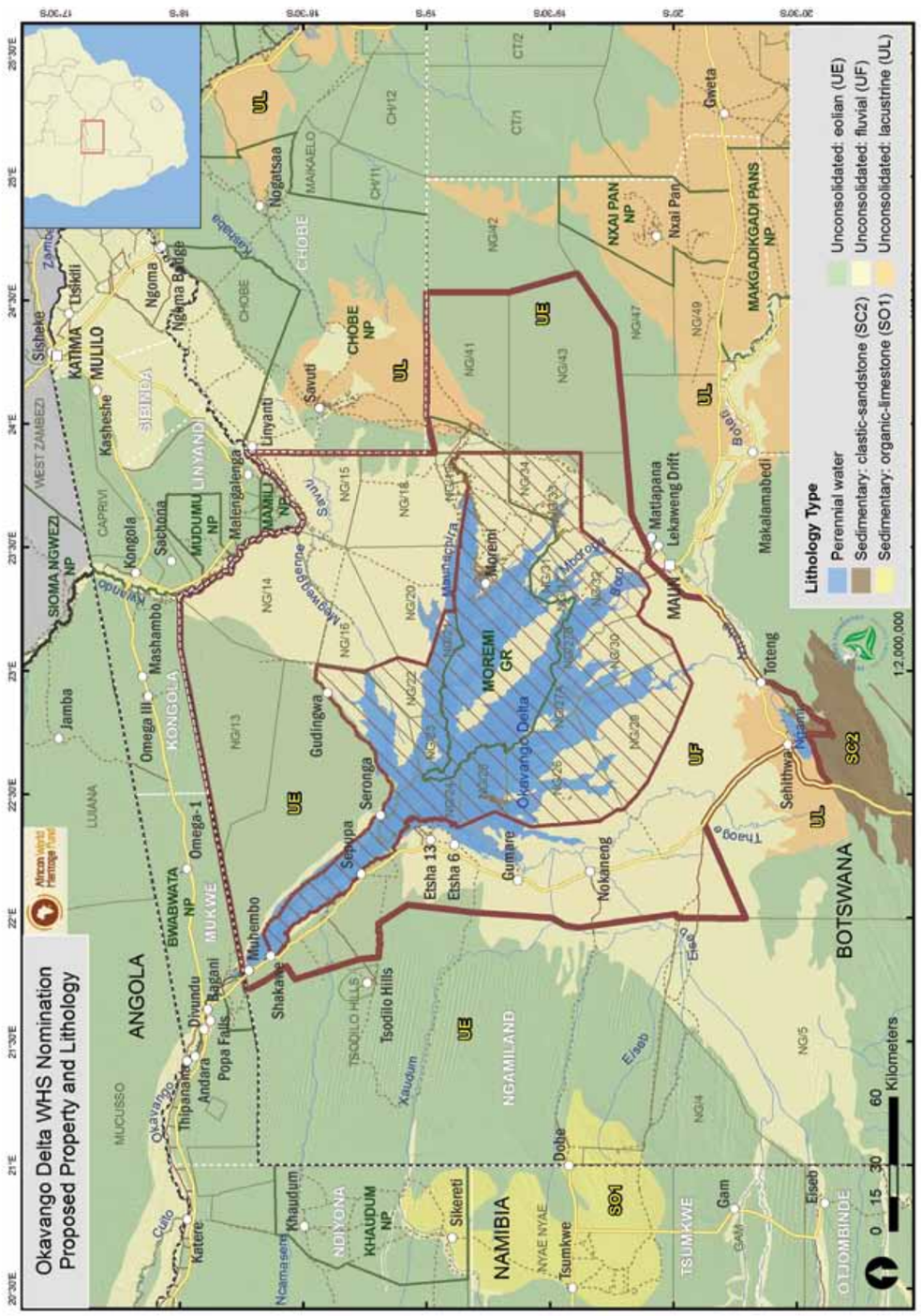
Map 1.e.6: WWF Ecoregions of the Okavango Delta Property



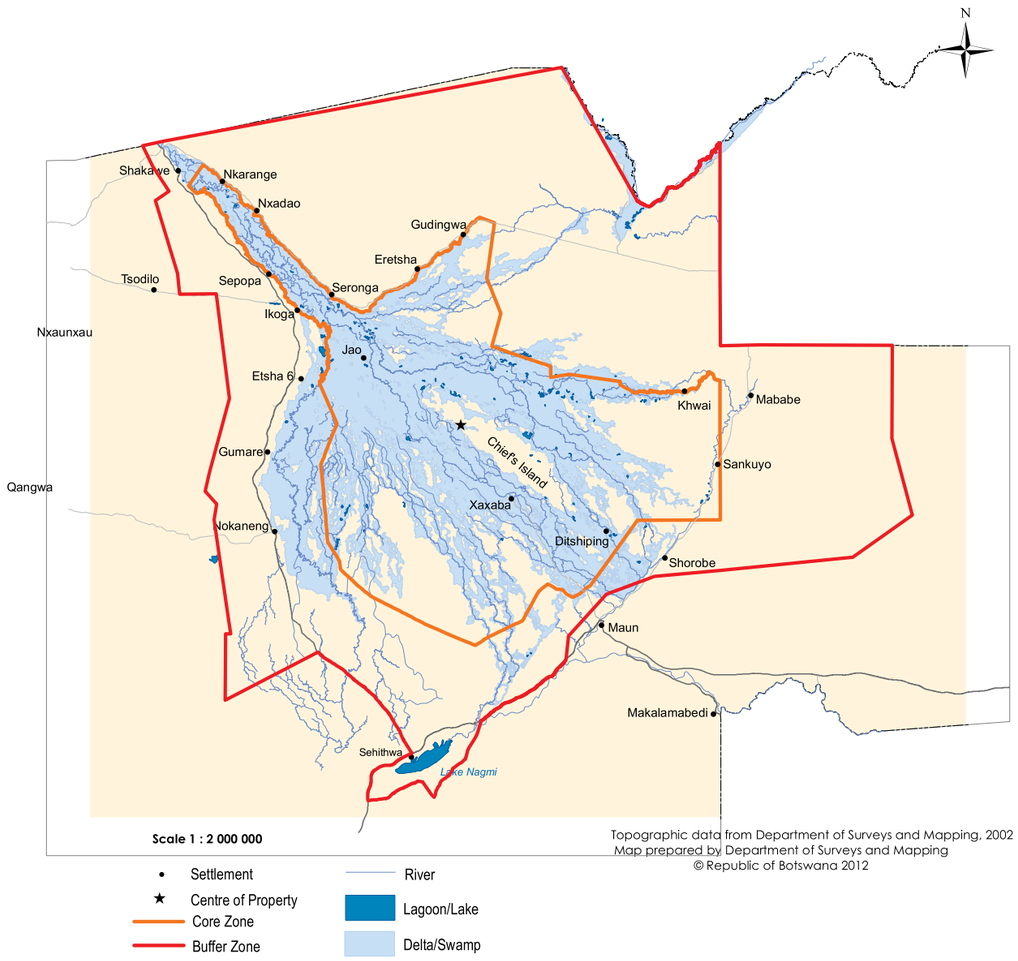
Maps 1.e.7: Landcover of the Okavango Delta Property



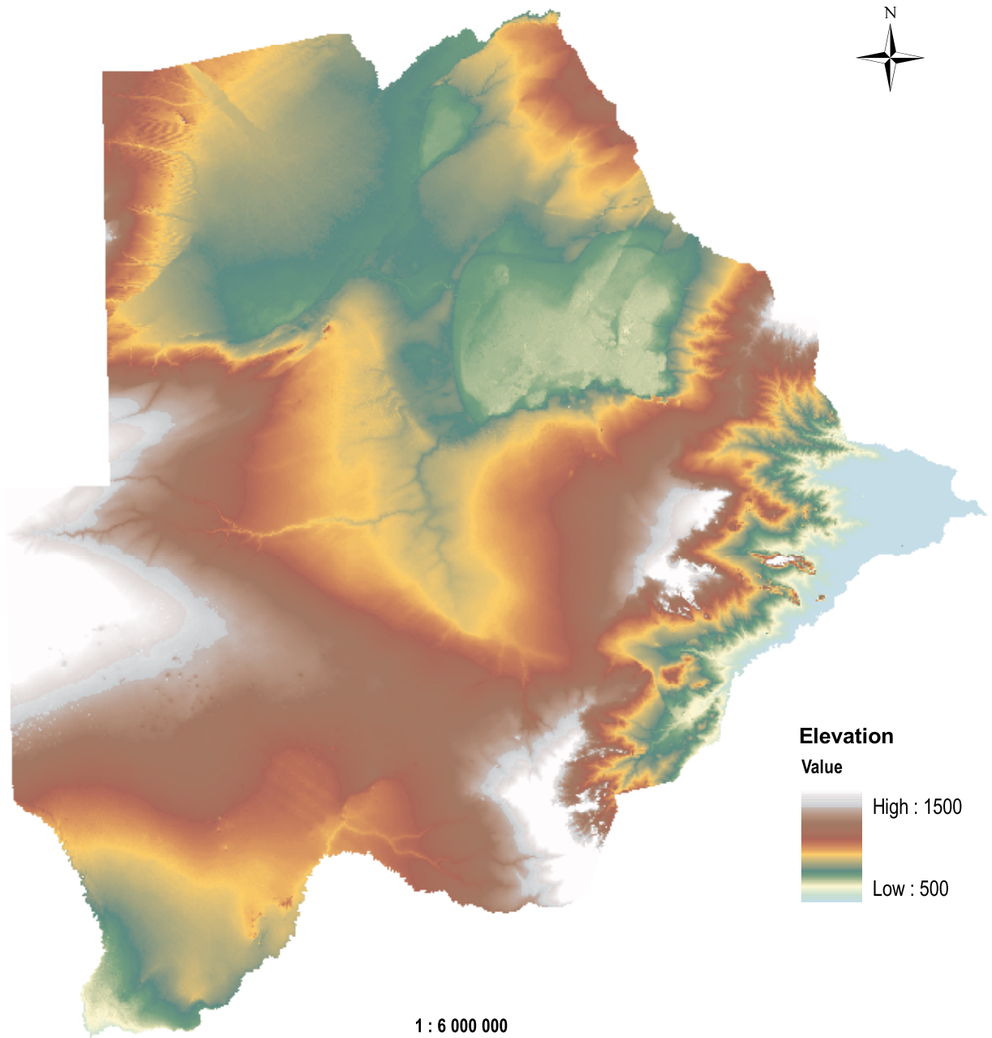
Map 1.e.8: Infrastructure within the Okavango Delta Property



Maps 1.e.9: Lithology types of the Okavango Delta Property



Map 1.e.10: Lakes, rivers and settlements in the Okavango Delta Property



Source Data Botswana National Elevation Data, 2002
Prepared by Department of Surveys and Mapping
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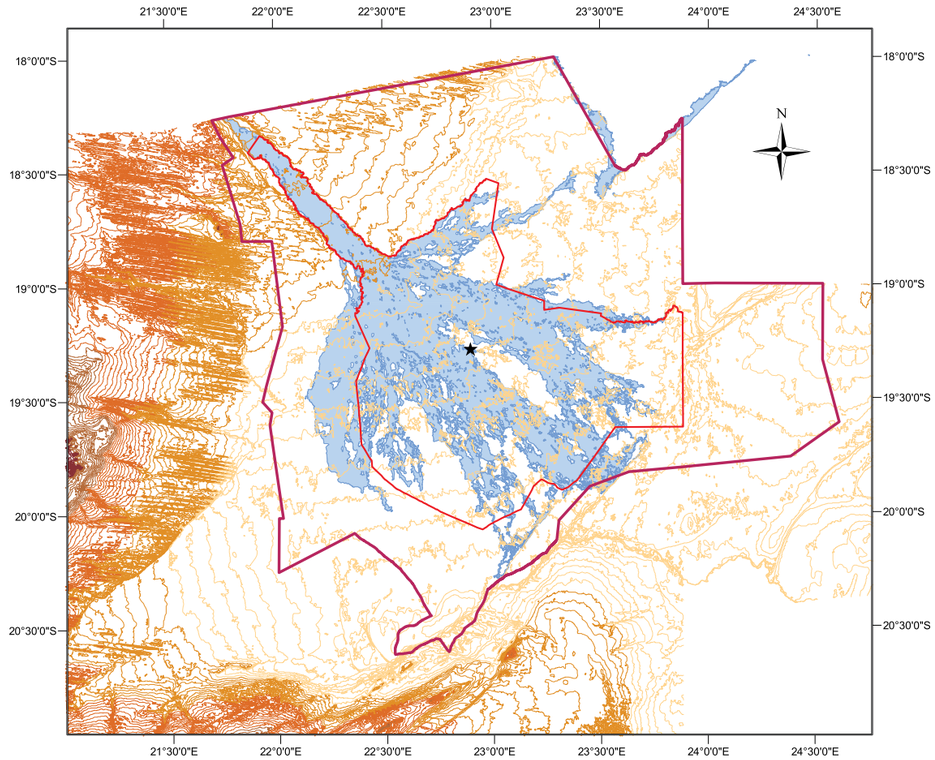
Map 1.e.11: Elevation of Botswana



Soucre data from Botswna National Elevation data, 2002
Prepared by Department of Surveys and Mapping
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1 : 2 500000

0 20 40 80 Kilometers

Center of Property
Core Zone Boundary
Buffer Zone
Okavango Delta

Height in Metres
910.000000 - 970.000000
970.000001 - 1020.000000
1020.000001 - 1080.000000
1080.000001 - 1155.000000
1155.000001 - 1380.000000

Map 1.e.12: Relief of the Okavango Delta Property

1.f AREA OF NOMINATED PROPERTY AND PROPOSED BUFFER ZONE

Core area of nominated property: 1,650,350 ha

Buffer zone: 3,487,870 ha

Total: 5,138,220 ha

CHAPTER 2
DESCRIPTION

2. DESCRIPTION OF PROPERTY

2.a.1 INTRODUCTION

The Okavango Delta was created by seismic activity approximately 40 000 years ago, and is located at the southern distal end of the Okavango River Basin. The Okavango River originates in the Angolan highlands as two rivers, the Cuito and Cubango which join to form the 1 500 km long Kavango River and flows briefly through Namibia's Caprivi Strip before entering Botswana, where it is called the Okavango River. It is a natural area situated in a dry, subtropical and land-locked country in the heart of Southern Africa (Figure 1). This remarkable natural and green oasis lies near the centre and at the lowest point of the extensive subcontinental Kalahari Basin within a vast sea of desert sand. The Kalahari Basin stretches over 3 000 km from north to south and up to 1 500 km east to west.

Previous page: Zebras in the Okavango Delta

Two main watersheds characterize the region, the Okavango, and the Kwando/Linyanti River system to the east which is irregularly connected to the Okavango through the Selinda spillway. The Delta is the common name for an inland alluvial fan, defined as triangular or fan-shaped plain of alluvial sediments deposited where the gradients of rivers suddenly decrease. It comprises approximately 6 000km^2 of permanent swamps with seasonal variation of the extent of the swamp of between 4 000 and 20 000 km^2. Although the size variation is determined by the annual amount of rain falling in the catchment of the Kavango River in Angola, the entire and largest area inundated forms part of the nominated site.

The Okavango Delta developed within the Kalahari Basin that is underlain by the Proterozoic solid basement bedrock that is overlain by the Mesozoic Karoo Supergroup rocks, which occur under 20-300 m of the Kalahari Sands. The solid basement bedrock is aligned into two trends of NW-SE (older) and NE-SW (younger). Renewed movement of the latter trend has caused the Delta to form a down faulted depression which is itself one of the southern-most extensions of

the East African Rift System with active Thamalakane, Kunyere and Gumare Faults. The system is linked to Lake Ngami and the Makgadikgadi Salt Pans through the Nhabe and Boteti Rivers that drains water from the Thamalakane River. Water is drawn from the Angolan Highlands and flows through Namibia and then enters Botswana. The annual inflow ranges between 7 000 and 15 000 million cubic meters of which 97% is lost to evapotranspiration and seepage leaving only 3% to exit past Maun through Thamalakane River.

Because of the shallow gradient of the system, approximately 55 m (Wolski et al., 2005) from the north-west end of the Panhandle to Maun, changes of inflow from its watershed affect river channels rapidly, thus rivers rise and change within a human life-time. During the 1980/90s there was a sequence of years of very low rainfall and low inflows (1995/6 was the lowest on record), and during this period Lake Ngami dried. But during the higher rainfall and inflow of the 2 000 decade, flows along the western distributaries have occurred again, although not quite reaching Lake Ngami. The Matsebi-Xudum distributary has been receiving progressively increasing flows, and this discharge flows into Lake Ngami through the Kunyere River.

The Okavango Delta contains a variety of wet and dry habitats including woodlands, riverine forests, grasslands, floodplains and islands. Most vegetation in flooded areas consists of sedges, grasses and aquatic plants. Woody species are restricted to dryland areas and islands, with the exception of the Water Fig (*Ficus verruculosa*), and include majestic hardwood species such as the African Ebony (*Diospyros mespiliformis*), Knobthorn (*Acacia nigrescens*) and Sausage Trees (*Kigelia africana*).

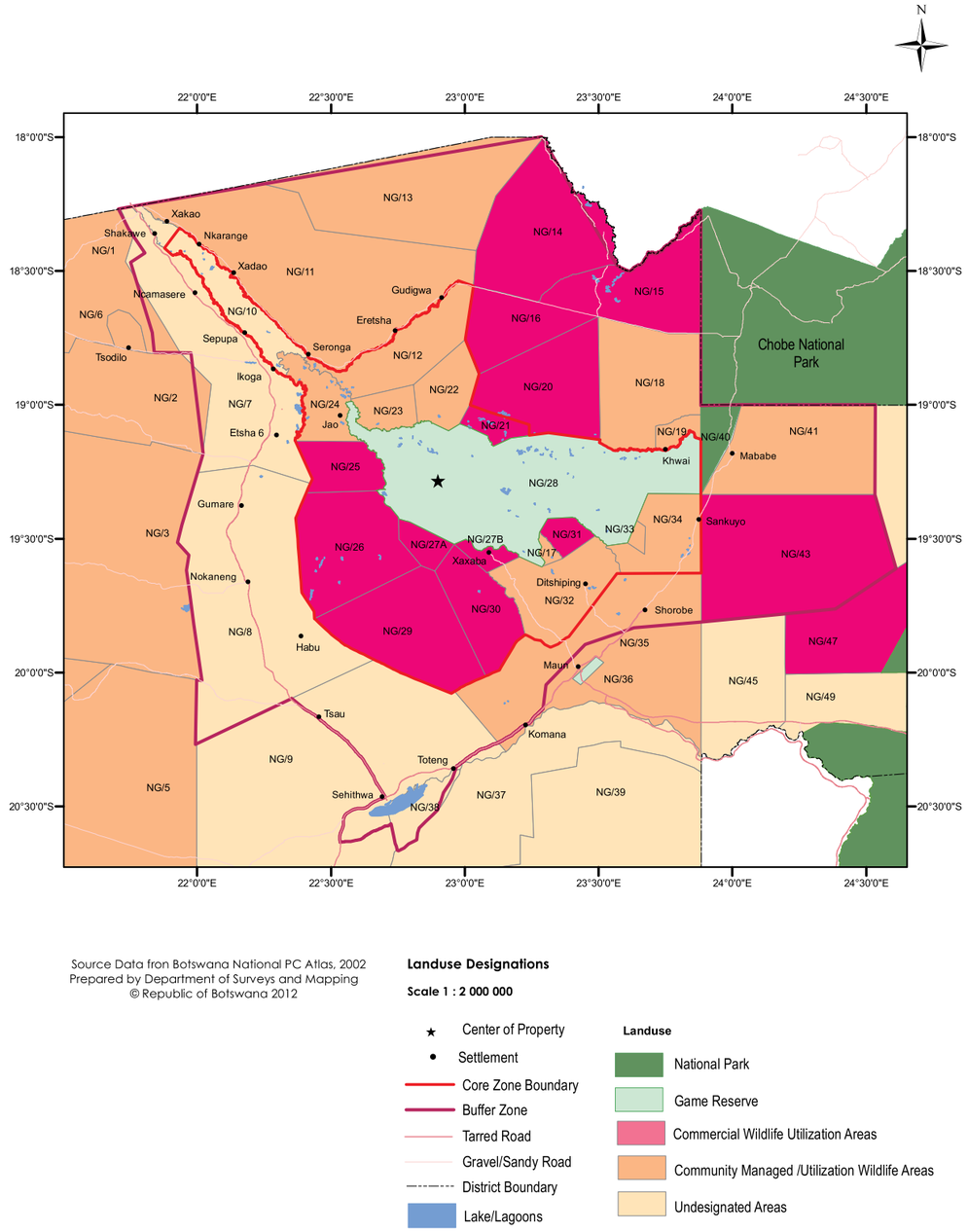
Flooded grasslands and dryland areas away from permanent wetlands form important grazing areas for wildlife in the rainy season due to the existence of green pastures and water-holes, enabling larger animals to move away from permanent water to distant feeding grounds in the surrounding woodlands and savanna. Water level fluctuations in flooded areas are very important for both primary and secondary productivity. Permanent and seasonal flooded grasslands form crucial habitat for many species of mammal and birds.

2.a.2 Okavango Delta ecosystems and landuse

The core zone of the Okavango Delta property encompasses the wetlands, and includes the Moremi Game Reserve, Chief's Island, the upper Panhandle and the major rivers, floodplains, flooded grasslands, islands and sandveld tongues that comprise the not only the most pristine part of the site, but also of sufficient size at 16 400 km^2 to ensure its sustainable ecological functioning now and into the future. The land use within the core zone is similarly suitable to ensure the integrity of the Okavango Delta property, being dedicated to non-consumptive wildlife (photographic) based on tourism. Furthermore, most of the core zone, with the exception of the lower Panhandle, is legislated as livestock free area.

The boundaries of the buffer zone do not only include areas of the Okavango Delta site, but also tracts of the vast dry Kalahari hinterland covered by savanna woodlands. Its extent is large enough to accommodate the dry season movement of large migratory wildlife such as Elephants, Buffaloes and Zebra, and sufficient in size to sustain them. Also incorporates critical wildlife corridors in protected areas in the north (Caprivi and Namibian NPS), North East (Chobe NP), East (Makgadikgadi and Nxai Pan NPs). In terms of land use all of the buffer zone comprises community lands divided for land use purposes into Wildlife Management Areas (WMAs) and controlled Hunting Areas (CHAs) where both consumptive and non-consumptive resource use is permitted, but mostly with a wildlife/conservation focus. The regional capital of Ngamiland, the town of Maun is excluded from the buffer zone, although other smaller villages, outflowing rivers and Lake Ngami and its linkage to Makgadikgadi system is included.

The Ngamiland region is Tribal Land under the control of the Tawana Land Board, that is, land tenure is communally owned. The Board leases a number of concession areas to safari operators for photographic and or limited hunting activities. The area is divided into Controlled Hunting Areas (CHAs). Nine Controlled Hunting Areas are allocated for community management, while a further twelve are under commercial management. The area is divided into the Moremi Game Reserve, Wildlife Management Area (WMA) and/or Controlled Hunting Areas (CHAs) (Figure 2.a.1).



Map 2.a.1: Land use designations in the Okavango Delta Property (Management Area)

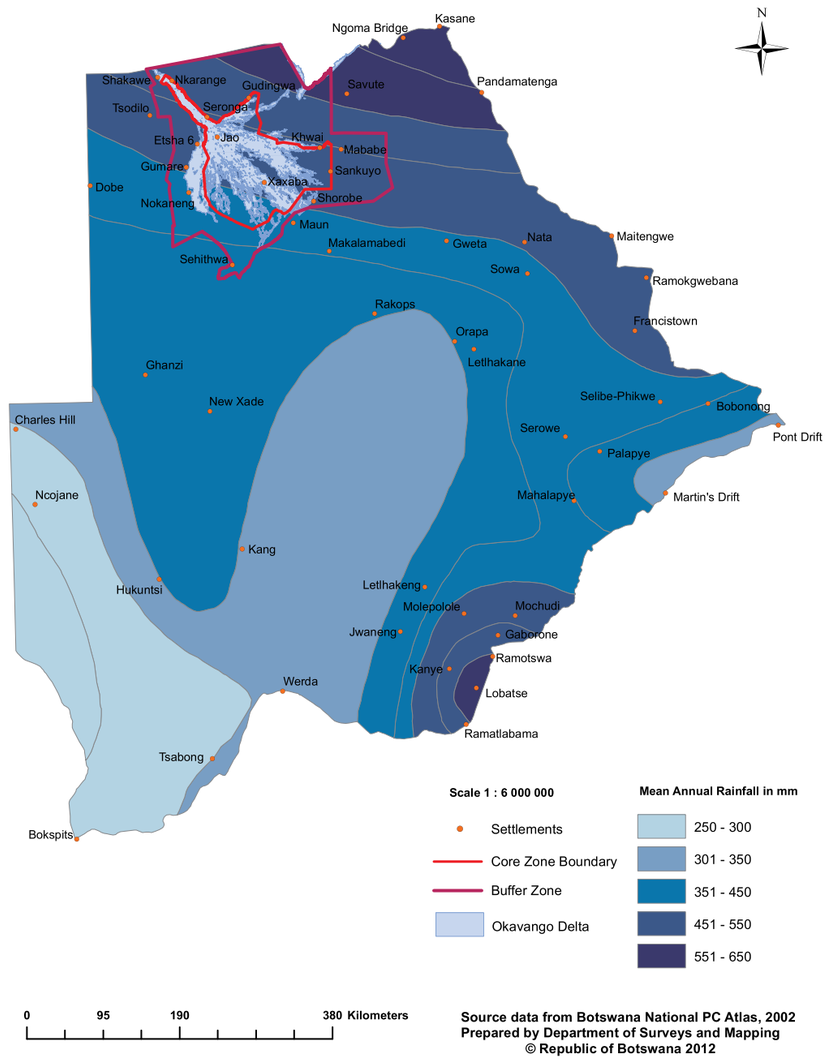
Table 2.a.1: Summary of the Okavango Delta ecosystems

	ECOSYSTEM TYPE	TYPICAL FAUNA	HUMAN LANDSCAPE
Western Delta	Permanent swamp and extensive flooded grasslands 131 plant species dominated by reeds and papyrus.	Distinct aquatic invertebrate and fish species. Abundance of bird and mammal species.	Heavy human and livestock pressure. Encroachment into Ramsar Site by livestock farming and cropping.
Central Delta	Dry (Chief's Island) and flooded grasslands and permanent swamps 108 plant species.	Distinct aquatic invertebrate and fish species. Higher wildlife diversity including Sitatunga, Waterbuck, hippo, Elephant and Impala.	Moremi Game Reserve (including Chief's Island) is protected. Tourism lodges and photographic concessions throughout the zone.
Eastern Delta	Permanent swamps, islands and flooded grasslands. Respond to local rainfall and later to flood input. Reed and papyrus, surrounded by Mopane woodland.	Large diversity of mammals and birds.	Includes important large mammal dry season migration areas. Tourism lodges and photographic concessions throughout the zone.
Delta outflows (Included in the Ramsar Site)	Occasional flooding, distributary channels Nymphaea sp., Nymphoides, Marselia and floodplain grasses	No tiger fish in the zone Mammals are characterised by floodplain grazers such as Tsessebe.	Increased population pressure from molapo farming. Maun is the centre of tourism in the Delta. Southern buffalo fence protects the main part of the Delta from livestock incursion.
Lake Ngami (Part of the Ramsar Site)	Episodic lake Floodplain grasses, Acacia woodland and Ludwigia spp.	High diversity of wetland birds when flooded (326 species) Low fish species diversity, but very high productivity.	Pressure from human settlements and livestock farming. Molapo farming also practiced.

2.a.3 CLIMATE

The Okavango Delta is situated in a semi-arid region with rainfall at Maun ranging from 195 to 940 mm per annum with summer months (November to March) with an average of 455 mm at Maun and 480 mm in the Delta. The mean annual rainfall is 460 mm in the south and 490 mm in the northern part of the Delta, and the evapotranspiration rate is about 200 mm (SMEC, 1987). The rainfall is highly variable with a coefficient of variation of annual rainfall of 35% i.e. being characteristic of an arid environment.

The monthly mean temperature range is from 16-26°C in June (winter) and 28-40°C in October (summer), the highest daily maximum temperature of 34-39°C in October and the lowest of 24-25°C in July. For July the mean minimum temperature during the night is however 8°C (Mendelsohn and el Obeid, 2004). Frosts do occur but are uncommon in winter and thin ice may form occasionally on very shallow waters in the Delta.



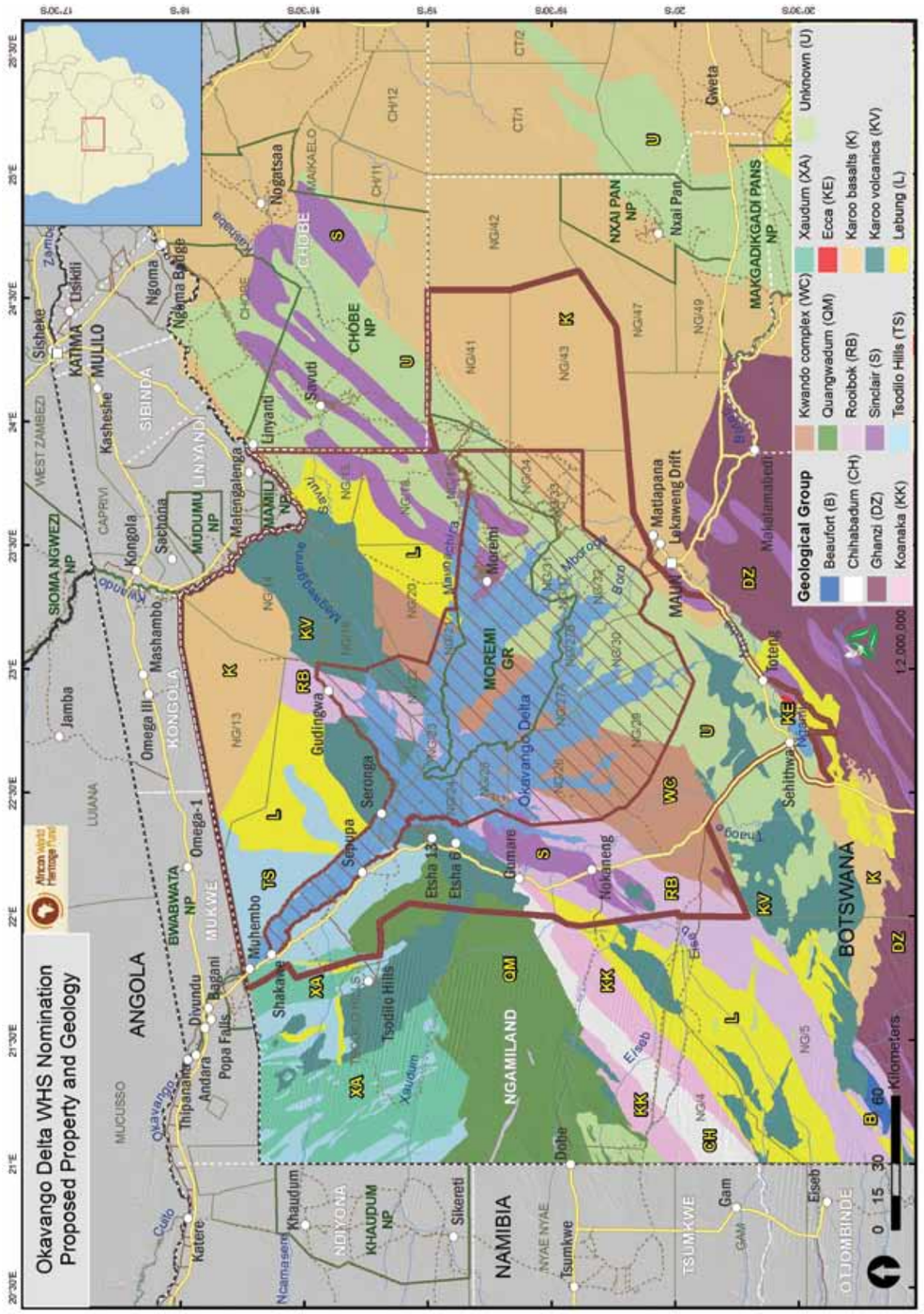
Map 2.a.2: Annual average rainfall in Botswana

2.a.4 Geology and geomorphology

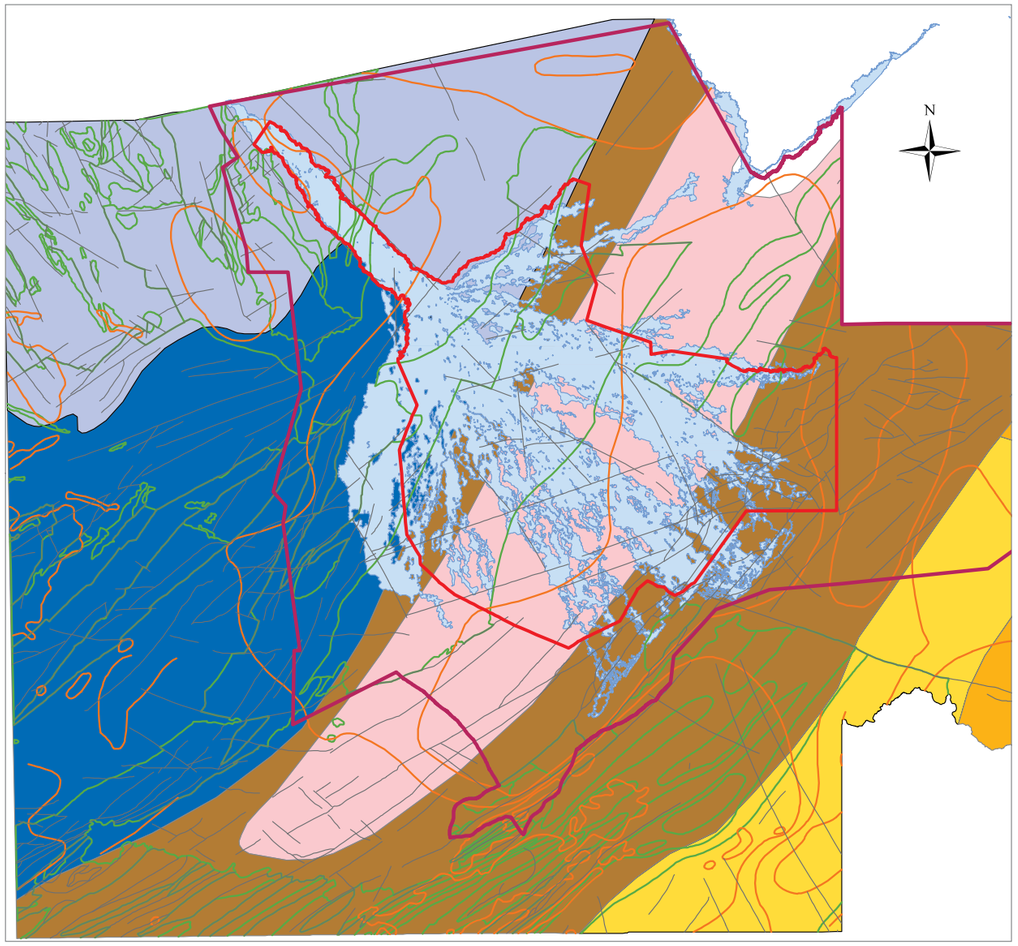
The Okavango Delta is underlain by the Proterozoic solid basement bedrock which is overlain by the Mesozoic Karoo Supergroup of rocks which lie beneath 20-300 m of the Kalahari Sands. The solid basement bedrock is aligned into two trends of NW-SE (older) and NE-SW (younger). Renewed movement of the latter trend has caused the Delta to form in a down faulted depression which is a part of the African Rift Valley System with active Thamalakane, Kunyere and Gumare Faults (see Figure 4 from Figures 7/8 Floods Life Mendlesohn et al., 2010). The system is linked to Lake Ngami and the Makgadikgadi Salt Pans through the Nhabe and Boteti Rivers that drains water from the Thamalakane River.

Faults in the underlying geology that are orientated north-west to south-east confine the flow of the Okavango River south-eastwards towards the Delta area. Inside Botswana the upper Delta flows between two narrow parallel faults, creating a convoluted river meandering between permanent floodplains, approximately 20 km wide and 100 km long, called the 'Panhandle'. Once out of the confines of these faults, the Okavango River slows and spreads outwards, creating a large 'triangular shaped' alluvial and wetland fan, on average 16 000 km^2 in extent, as the slowing waters deposited their sediment load. The perpendicular Gumare, Kunyere and Thamalakane faults bound the alluvial fan of the Okavango Delta. These faults are at the most southerly extension of Africa's Great Rift Valley system.

Ground water resources are not well known. This mainly because of the thick Kalahari beds which cover the bed rock in the region. Most of the water wells and borehole terminate within the superficial formation of the Kalahari beds. The main aquifers are the coarse sands and calcretes of the Kalahari beds in which water is retained within clayed and silty horizons.



Map 2.a.3: Geological group in the Okavango Delta Property



Buffer Zone
Core Zone
Fault
Isopach
Metarmophic
Nossop-Ncojane Basin

Scale 1 : 2 000 000

Kihabe Complex
Kwando Complex
Ghanzi-Chobe Belt

Okwa Belt
Congo Craton
Zimbabwe Craton

Geological data supplied by Geological Department, 1997
Prepared by Department of Surveys and Mapping
© Republic of Botswana, 2012

Map 2.a.4: Pre-Karoo tectonic terrances and major mafic complexes of the Okavango Delta Property

2.a.5 Hydrology

The property includes permanent and seasonal swamps, riverine floodplains, sand islands and an episodic, extensive freshwater lake, Lake Ngami. Water flow distribution is a primary determinant of the Delta's biodiversity. The annual inflow ranges between 7 000 and 15 000 million cubic meters of which 97% is lost to evapo-transpiration and seepage. When inflow is greater water flows via the Thamalakane River into the Boteti River and onto the Makgadikgadi system. This almost pristine wetland supports the lives of over 138 000 people (Mendelsohn et al., 2010), mainly centred in the town of Maun, by providing freshwater, food, building materials, medicinal plants as well as employment through a thriving eco-tourism industry.

Rainwater falling in Angola in November-December arrives at the Panhandle between February-March and moves slowly as a flood-wave across the wetland landscape until it reaches the distal parts of the Delta in July, the dry season in Botswana. The maximum flooding occurs in the dry winter months and the new inflowing water promotes dry season forage and provides water for all forms of life. This dry season flooding is thus a critical hydrological function that sustains animal, plant and aquatic life. During years of heavy rainfall over the Delta, extensive flooding can occur in January and continue until the second flood peak arrives in April-June. The seasonal floodplains are normally water-covered for 3-6 months of the year, but were continuously under water for about 12 months during heavy rainfall in the Delta and high inflows at Mohembo as witnessed in 2 000 and 2010/2011 respectively. The Delta thus has two predictable wet periods and is a typical flood-pulsed system usually with one flooding a year (Ramberg et al., 2006).

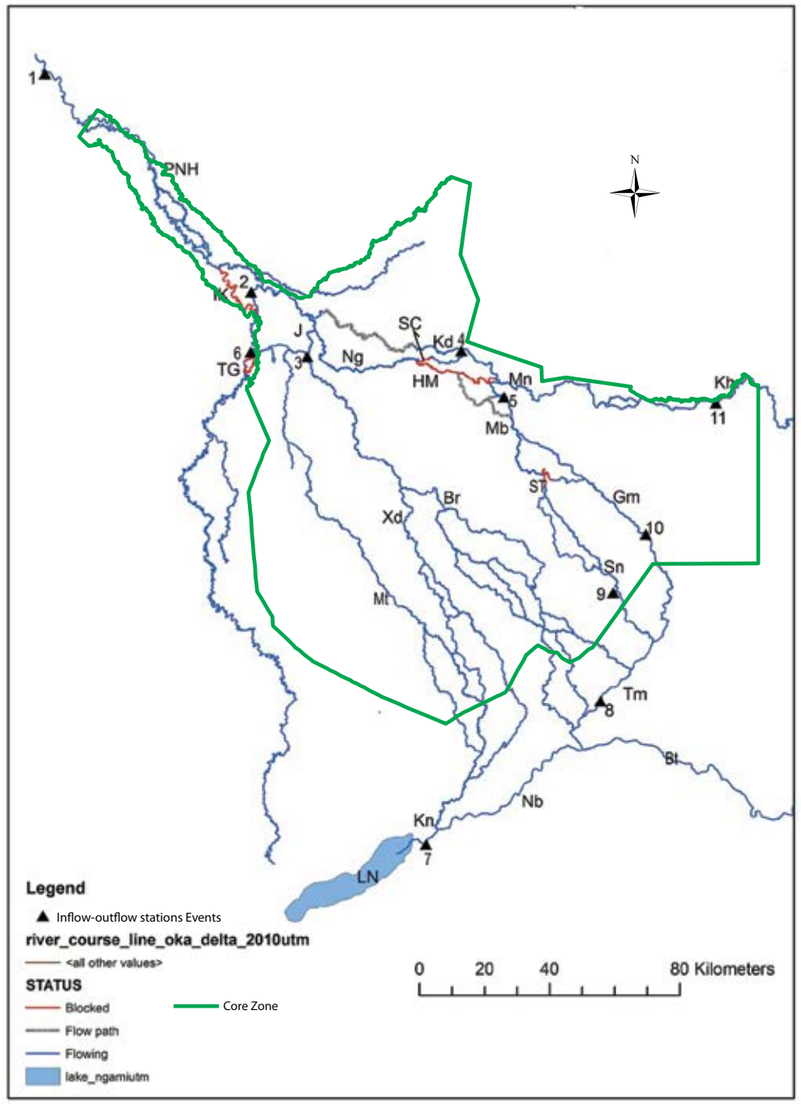
Mean minimum and maximum annual inflows at Mohembo: The highest total annual inflow discharges at Mohembo in a 40 year period was 13107.0 Mm^3 in 1968/69 and the least observed was 5327.4 Mm^3 in 1995/96. The mean annual inflow to the Delta is 9.2 x 10^9 m^3 and rainfall contributes an additional 6x10^9 m^3 (McCarthy and Ellery, 1998). The annual local rainfall over the delta recorded in Maun, Shakawe and Gumare rainfall gauge stations ranges between 250 mm to 550 mm, and above average rainfall of <600 mm could possibly influence the flood levels in the Delta.

Ramsar: The Okavango Delta is protected as a "Ramsar Site". Designated on 4 April 1997, it is the largest "Wetlands of International Importance". The ecosystem supports a large wildlife resource, with high floral diversity of aquatic/wetland plants, grass communities, terrestrial plants including herbs, woodland shrubs and trees. Approximately 72% of the area of the property comprises Wildlife Management Areas (WMAs are designated primarily for wildlife related use) and the remaining 28% is zoned for agriculture and residential development in Ngamiland District Development Plan (DDP, 2001).

There are frequent blockages of the channels in the Delta due to indigenous vegetation and alien invasive Kariba weed, *Salvinia molesta* Mitchell. The blockages and the clearances undertaken from 1930 to 1970 are described in detail (Wilson, 1973) and have been updated in 2003 (Kurugundla, 2003). The gaps in the hydro monitoring have been recognised, identified and implemented in the Okavango Delta Management Plan (ODMP).

The Okavango River enters into the country at Mohembo at the northern end of the Panhandle. At the lower end the river bifurcates into channels which convey the water onto extensive perennial floodplains. In the vicinity of Seronga Village, the delta spreads widely to the south and east into three major distributary systems i.e. the classic 'bird's foot' delta system (McCarthy et al., 1986).

Figure 2.a.1: The Okavango river meanders through the panhandle (Tim and June Liversedge)



1 = Mohembo, 2 = Panhandle, 3 = Selinda Spillway/Magwekgana, 4 = Thaoge, 5 = Matsibe, 6 = Jao, 7 = Boro, 8 = Xudum, 9 = Kunyere, 9a = Nhabe, 10 = Lake Ngami, 11 = Nxotego, 12 Boranyana, 12a = Thamalakane, 13= Boteti, 14 = Nqoga, 15 = Mboroga, 16 = Santantadibe, 17 = Gomoti, 18 = Maunachira, 18a = Gadikwe, 19, Khwai. A = Ikoga blockage, B = Thaoge blockage, C = Lower Nqoga blockage (Hanamuzeyo channel), cc = cross channel, D = Santantadibe blockage KC = Khiandiandavhu channel, MGR = Moremi Game Reserve, SC = Smith channel, Inflow = Mohembo, Flow sharing stations: Cr = Crescent, JB = Jao/Boro, KMJ = Khiandiandavhu/Maunachira Junction, L = Lopis. Outflow Stations: Di = Ditshipi, G = Gomoti, MB = Maun Bridge, MP = Mogapelwa, NG = North Gate, Q = Qaaxhwa,

Figure 2.a.2: Hydrography of the Okavango Delta Property showing various rivers

Main water distributary systems
There are five main water distributary systems:

Panhandle system:
Popa Falls on the Kavango River in Namibia marks the northern end of the Panhandle, which extends downstream to Seronga in Botswana. The length of the Panhandle valley is 100 km and the elevation is from 988 m AMSL at Mohembo to about 975 m AMSL at Seronga. River channels meanders across the floodplain, varying in width from about 50 to 100 m wide and 5 to 6 m deep. The maximum and minimum water levels at Mohembo in the recent high flood event in November 2010 were 4.015 m (May 2011) and 0.58 m (December 2010) respectively, giving a total rise of about 3.4 m.

Okavango → Ikoga/Crescent channel → Thaoge River system:
The Ikoga River and Crescent Channel branch off from the Okavango River and terminates as the Thaoge system. The Ikoga River used to receive larger flows than the Nqoga until about the middle of 19th century, when it blocked completely (Figure 2.a.2). Another cross feeder channel, the Crescent Channel, has a width of less than 10 m (Feeder channel 2 by SMEC, 1987) and twists to the southwest to join the first inflow hydro station, Crescent Island, which supplies water to the lower Thaoge River. The terminal perennial outflow is upstream of Qaaxhwa Lagoon. In 1884 the Thaoge began to suffer from blockages and ceased to run into Lake Ngami (Figure 2.a.2).

Okavango → Jao/Boro/Kudum Rivers:
This is the largest system in the Delta with the Jao/Boro and Xudum Rivers on the west of Chief's Island flowing out to form the Thamalakane River and Lake Ngami respectively. The Jao (Boro) River carries little direct flow from the Okavango but picks up flows from the flooded areas of cross channels and lagoons mainly on its western margin (Figure 2.a.2). A network of channels between latitude 22°49' longitude 19°23' and latitude 22°55' longitude 19°30' flows out to Xo and related flats, which finally converge into a confined channel to the Jao River. The Xudum system originates in the Xo flats and joins the Matsibe River through a network of channels in the upland delta and outflows to Lake Ngami via the Kunyere River in high flood years only (Figure 2.a.2). After years of being dry, water flows reached Lake Ngami in 2002 and flooded 18 to 55 km^2 between 2004 and 2008. Larger floods arrived at the Lake in the 2008/09 and 2009/10, increasing the size to 82 km^2 and then 193 km^2 in 2010. The 2010/11 inflow was the fourth largest on record, with correspondingly large outflows.

Okavango → Nqoga → Maunachira → Mboroga → Santantadibe Rivers:
In this system, the Maunachira shares water flows with the Khwai River in an easterly direction, and with the Mboroga/Santantadibe Rivers on the northeast of Chief's Island. The river Mboroga formerly received a large contribution from the Lower Nqoga (Hanamuzeyo channel) in the 1930s before the latter became blocked (Figure 2.a.2), now receives little water from slow, shallow sheet flows filtered by vegetation. The Mboroga also receives small flows from the Maunachira through Dindiga/Didinga blocked channel. However, a feeder channel was artificially made in the 1980s on the south of the Maunachira by clearing papyrus and this is the major supplier channel to the Mboroga River, which at its terminal end bifurcates into the Gomoti on the northeast and the Santantadibe on the southwest. Both the Gomoti and Santantadibe Rivers are blocked at their origin. The Santantadibe blockage extends for about ca. 7 km in the downstream direction. The Thamalakane River receives water mainly from the Boro River and very rarely through the Santantadibe and Gomoti Rivers. Santantadibe River stopped flowing to Thamalakane in 1978/79 (Mpho, 2004), but has again flowed through in the 2010/11 hydrological year.

Okavango → Nqoga → Maunachira → Khwai River System:
The Maunachira originates at 'Papyrus Filter' in the middle reaches of Nqoga River at Hamoga Island (Smith Channel, SC). After locating the headwaters of Maunachira at less than 100m apart from Nqoga at Hamoga Island, a cross channel was opened by cutting papyrus in November 1973 to facilitate boat movement. This small section is called Smith channel and is cleared more or less on an annual basis by the Department of Water Affairs. With less than 100 metres width all along the 270 km from Mohembo, the river suddenly becomes narrow to about 10 to 15 metres at Nqoga due to the dense growth of papyrus. The flows at this point become diffused through the papyrus culms and shared by three channels namely Lower Nqoga curving southeast (blocked, S19° 04' 01.5" E22° 52' 44.6"), Smith channel leading to Maunachira to east (frequent blockages, S 19° 04' 01.5 E 22° 52' 55.3, Khiandiandavhu to north (blocked, S 19°03' 58.4" E 22°52' 52.2"). The Khiandiandavhu channel finally curves to join Maunachira in the downstream at the co-ordinates, S 190 02'11.4" E 230 00'15.7". The Hamoga hydro station is situated just a few metres upstream of the Lower Nqoga (Figure 2.a.2) take off point and the Hamoga station flows are shared by the Smith and Khiandiandavhu channels. Gadikwe on Maunachira proper and Dxaaba on Mboroga River share the incoming flows of Maunachira River from Hamoga. There is no terminal outflow hydrological discharge station for the Khwai River, which flows up to Mababe village. The terminal hydrological station for the Santantadibe is at Ditshipi Village.

Table 2.a.2: Monitoring hydro stations in the Okavango Delta Property

SYSTEMS	DISCHARGE STATIONS	MANUAL GAUGE	INACCESSIBLE
Okavango → Ikoga/Thaoge River system	17	20	6 – blockage
Okavango → Jao/Boro/Xudum/ Kunyere/Thamalakane/Boteti Rivers	14	32	8 - in high floods
Okavango → Nqoga/Maunachira/ Mboroga/Santantadibe/ Boteti Rivers	19	25	2 – blockage 2 – in high floods
Total	50	77	18

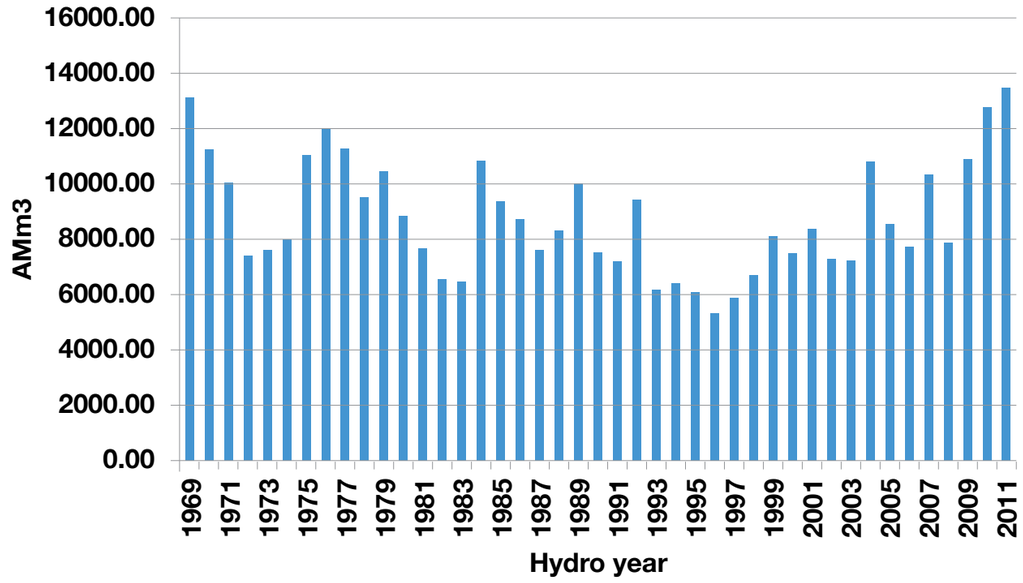


Figure 2.a.3: Total annual inflow at Mohembo from 1969 to 2011

Figure 2.a.4: Blocked Ikoga River and its lagoon (Naidu Kurugundla)

Figure 2.a.5: Papyrus blockage at upper Okavango Delta Property (Peter Hancock)

2.a.6 Flood variation

Having studied the images of the Okavango Delta in the last 30 years, Gumbricht et al. (2004) estimated that the flooded area is likely to extend across 14 000 km² at least every decade, of which 9 000 km² is actual wetland, the rest being islands. The total areas of the Okavango wetland are classified as the Panhandle: 820 km²; Permanent Swamp: 2 500 km²; Seasonal Swamp: 3 300 km² and Occasional Swamp (flooded at least each 10th year) to 7 100 km². Permanently dry areas could account for 4 000 to 10 000 km² but are not included in the classification. By including the dry and wetlands that have been flooded during historical times, from 1 850 to present, the total area of the Okavango Delta thus defined is 28 000 km².

Because of the shallow gradient of the system, approximately 55 m (Wolski et al., 2005), changes of inflow from its watershed affects river channels rapidly, thus rivers rise and change relatively fast. During the 1980/90s there was a sequence of years of very low rainfall and low inflows (1996/6 was the lowest on record), and during this period Lake Ngami dried. But during the higher rainfall and inflow of the 2000 decade, the western rivers have regenerated and with it Lake Ngami which is currently experiencing full historical volumes of inflow.

Ramberg et al. (2006) summarized the dynamic changes in Delta size which appear to have been due to combination of climatic changes and tectonic shifts brought about by fault-line reactivation. Evidence from old floodplains suggests that early alluvial fans may have been fed from the Kwando and other, now ephemeral, rivers to the west, while later fans accumulated from a pre-Okavango system and were deposited along north easterly and south easterly trends in the Makgadikgadi-Okavango Zambezi (MOZ) basin (Ringrose et al., 2002).
A highly variable hydrological regime has been in place over the last 40 000 years, but essentially the major patterns of distributary systems with their main channels, floodplains and islands has been in place for the last 6 300 years. This conformation currently provides the overall geomorphological controls on landscape development today (Anderson et al., 2003).

Sediment Transport:
Three types of sediments are transported by the Okavango River;

Fine sand sediments -
the bulk of this is transported as bed-load (roughly 170 000 tonnes per annum on average) during times of high flows, rather than in suspension. Therefore water is very clear allowing one to see several meters below the surface.

Suspended sediments -
consists of fine silt, clay and organic matter, which is fine enough to be held in suspension at the typical flow velocities encountered in the river channel. These are important because they carry nutrients that maintain the fertility of floodplains.

Solutes -
the concentration of dissolved solids in the water is very low at about 40 mg/l. Nevertheless, it has been estimated that 380 000 tons of solutes reach the Delta each year, and only about 24 000 tons leave via the Delta outflows. The solutes are made up mainly of silica, calcium and magnesium carbonate, sodium and potassium bicarbonate.
The confinement of the flood waters over millennia has led to the accumulation of nutrient resources in and around the Delta. Although inflowing water is relatively nutrient-poor, every annual flood brings with it nutrients necessary to sustain plant life. Dust, containing nutrients, is also blown in by winds and trapped by water, whilst grazing animals on the floodplains and flooded pastured also enrich the water and soils of the Delta with their dung Maintaining the productivity of the Okavango Delta thus requires the protection and conservation of both the amount (volume) of floodwaters and the stored bank of nutrients (Mendelsohn et al., 2010).

Water quality:
The water of the Okavango River Basin is well known for its clarity and this results largely from the geology and soils through which the river flows, the sediment transport characteristics described above, and extensive filtration by aquatic vegetation. It is also subject to low pollution due to loading from urban and agricultural sources. Recent measurements in the Okavango confirm that water quality is generally very good to excellent. There is a gradual increase in conductivity and turbidity going down the river, which falls off in the permanent swamp of the Delta. Generally, dissolved oxygen is stable throughout the length of the mainstream, with a predictable increase after Popa Falls. Chlorophyll – an indicator of the productivity - is generally low in the riverine sections but increases in the permanent swamp. There are some differences in water quality between the Panhandle and the Delta, especially seasonally. Generally pH decreases with flow at all sites, but electrical conductivity increases with flow as rainwater flushes out salts higher up in the basin. The turbidity also shows differences between the sites, increasing in the Panhandle (similar to the main stream above it) as the flow increases, while the turbidity is lower in the Delta due to filtering effects as it passes through the reedbeds. In Xakanaxa and in the Boteti, the turbidity falls with decreasing flow. Dissolved oxygen in the Panhandle tends to decrease with increasing flow due to the oxygen demand of increased organic matter washed into the river during higher flows. Conversely, in the Delta the dissolved oxygen tends to increase with increasing flow.

Flooding and Salinity:
A primary ecological determinant is flooding duration and depth. The majority of sediments or bed load into the Delta is imported during the flooding season and is deposited mainly into the Panhandle. During periods of extreme flood events, the sediments are deposited further downstream. Some depositional areas during low flow conditions may turn into erosion areas during times of high floods. Salinity could also be expected to occur due to high inflow of solutes. However, sand islands in the delta are believed to be augmented by the concentration of salts at depth where both calcrete and amorphous silica are precipitated. At a critical level the woodland vegetation can no longer tolerate the salinity of the groundwater; hence an area depleted of vegetation occurs at the centre of the islands. During a very high flooding cycle, as experienced now, flooding can reach emergency proportions, and in 2010 there have been flood alerts and warning. Because high flooding cycles occur every 25-30 years, people forget historical high water levels and settle on lands that will flood when the current high flood cycle repeats.

2.a.7 Habitats and plant communities of the Okavango Delta

The Okavango Delta has a rich assemblage of plant species (Tables 2.a.3 and 2.a.4 and Appendix 2) with a total of 1068 species of flowering plants and ten species of ferns.

Panhandle: The Panhandle of the Okavango River and the permanent swamps associated with the Nqoga, Thaoge, Boro, Mboroga and Maunachira Rivers are always inundated and are never dry. In the Panhandle, Papyrus (*Cyperus papyrus*) is the dominant community along the river course, while patches of *Phragmites australis* are seen as a next line towards the wetland and along shallower backwater bodies. Vetiveria spp. marks the limits of the seasonal swamps whereas *Aeschynomene fluitans* is common along the margins of main and small channels where flow velocities are low.

Papyrus is giant sedge and the communities form rhizomatous mats, which are compact and heavy, firmly lodged on top of the substrate and are only dislodged with difficulty by higher water flows. Occasionally high flood levels and flow lift the mat above the substrate allowing water to flow unimpeded underneath. The greatest Papyrus expanses are in the upper Panhandle, along the Nqoga River and up to the Hamoga blockage, but cease to be very noticeable beyond the Boro Junction. Further downstream in open rivers, Papyrus attenuates into fringes; culms reduce to 1-2 m before the plant disappears on the seasonal Thaoge and Gomoti. In the downstream swamps, Papyrus is found in circular patches. As markers of perennial waters, their distribution declines southwards and almost disappears in the lower Delta.

Permanently flooded zone:

There are five important communities in perennial swamp: Papyrus in the deeper waters, Miscanthus in the shallow-flooded sites, and between these two the reed *P. australis*, *Typha capensis* and Pycreus communities occur. From Seronga, along the river, there are four types of vegetation associations; *Vossia cuspidata* in flowing water, Papyrus as a continuous fringe, Phragmites patches in semi-aquatic habitat and Miscanthus in shallow waters. Papyrus beds are associated with the fern Cyclosorus interruptus, as well as *Polygonum pulchrum* and Commelina sp. Although able to tolerate a wide range of hydrological regimes, Papyrus is best developed in perennial waters with little variation in minimum and maximum levels so is a good indicator of perennial swamp, but does not occur in all deeper waters due to high flow velocities restricting its vegetative spread.

Seasonal swamp:

The perennial swamp-dominants also extend far into the seasonally inundated areas. P. australis reed beds grow best in slow flowing waters of medium depth, and are prominent at channel sides of Maunachira, certain areas of Mboroga, Thamalakane, and Santantadibe and around lagoon edges away from the papyrus area. Miscanthus is scarce in the Panhandle but large fields start to vie with papyrus on the Nqoga and it becomes dominant on the Maunachira. Beyond the open waters behind Papyrus, a reticulated pattern of the Miscanthus root fibrous system traps deposits of sediments trickling through from the Nqoga and Maunachira river systems. Typha is the least abundant of the taller dominants, but is common around lagoons, pools, channel corners and backwaters and is quite common in the lower reaches of the Boro and the Santantadibe Rivers.

Channel community:

The permanently flooded zone in the Okavango Delta starts at the Botswana-Namibia border point just northwest of Mohembo. The Panhandle of the Okavango River and the permanent swamps associated with the Nqoga, Thaoge, Boro, Mboroga and Maunachira Rivers are always under water and are never dry. In the Panhandle, Papyrus is the dominant community along the river course (although frequently fringed on the river side by *Vossia cuspidata*), while patches of *Phragmites australis* are seen as a next line towards the wetland and along shallower backwater bodies. *Vetiveria nigritana* marks the limits of the seasonal swamps whereas *Aeschynomene fluitans* is common along the margins of main and small channels where flow velocities are low.

The main emergent plants here are perennial grasses *Panicum repens*, *Leersia hexandra* and sedges. The floating-leaved species include *Potamogeton thunbergi*, *Nymphoides indica* and *Caldesia reniformis* and *Trapa natans*. *Ficus verruculosa*, a shrubby tree, is widespread on sites slightly elevated above water level in the lower perennial and regularly-inundated seasonal swamps. In deeper parts of the seasonal swamp *Schoenoplectus inclinatus* and *Cyperus articulatus* are overwhelmingly dominant at most sites often in combination with *Nymphaea nouchali*; Eleocharis spp may also be locally dominant in regularly flooded deeper areas. These are associated with *C. denudatus* and *C. longus* in shallower parts of the catena. Some floodplains commence directly from the rivers or perennial swamps and some are in the seasonal swamps. The wettest types are covered by *Vossia cuspidata*, *Echinochloa stagnina*, *Leersia hexandra* and *Oryza longistaminata*.

Open-water communities:

Open water communities are very varied and occur in both perennial and seasonal swamps. Among the aquatics *Brasenia schreberi* and *Nymphaea nouchali* are the commonest floating-leaved plants and submerged *Najas pectinata*, *Cerotophyllum demersum* and *Lagarosiphon ilicifolius* grow in patches, and where there is some flow, species of the genus Ottelia occur. Floating mats (sudd) occur in which the dominant plant communities are sedges such as *Pycreus nitidus*, *Oxycarium cubense*; these mats may be colonized by an insectivorous plant, *Drosera madagascariensis*. Occasional lumps of peat are dislodged from the bottom and float to the surface due to methane production. These peat sudd islands support Xyris sp. and Utricularia sp. along with various other sedges.

Flooded Grasslands:
Flooded grasslands are subject to occasional inundation by above-average inflows, and also border islands and mainland edges within the swamps. The driest areas have *Cynodon dactylon* and high ground has dense swards of Imperata cylindrica. The sandy–watered floodplains are dominated by *Eragrostis cylindrica*, *Setaria sphacelata* and *Trachypogon spicatus*. Saline soils are indicated by *Sporobolus spicatus* and *Chloris gayana*. The flooded grasslands are among the most productive communities in the Delta, and are extremely important forage areas for wildlife during flood recession and for aquatic biota during periods of inundation.

Islands and mainland edges: In floodplains these are usually marked by tree-lines or by other woody plants. The plant species are ranked predictably according to their preferences for water supply. *Philenoptera violacea* requires little water and is found on the highest elevations of islands in the perennial swamps, and is common on drier seasonal swamp islands. Trees on islands within the perennial swamp are a mixture of *Hyphaene petersiana* palm and *Acacia nigrescens*. *Phoenix reclinata* palm and Syzygium spp. *Ficus verruculosa* and *Vernonia amygdalina* characterise the lower perennial and wetter seasonal swamp island edges. Rhus spp., Combretum spp., Diospyrus spp. shrubs and herbs of the plant families of Amaranthaceae and Acanthaceae are common in the understory. Termite hills are frequently dominated by a small tree *Euclea divinorum* and the climbing shrub *Capparis tomentosa*.

Mainland: The vegetation on the dryer higher lying ground is a characteristic mosaic of grassland and woodland communities comprised of trees, shrubs, and understory herbs. The principal genera are: Acacia spp., Boscia spp., *Colophospermum mopane*, Combretum spp., Philenoptera spp., Terminalia spp. and *Ziziphus mucronata*, *Dichrostachys cinerea*, Grewia spp., Rhus spp., *Ximenia caffra* and Maytenus spp., Common grasses include: Aristida spp., *Cenchrus ciliaris*, Digitaria spp. and Urochloa spp.

Table 2.a.3: Plant species of the Okavango Delta Property by habitat (Smith in SMEC, 1989).

HABITAT TYPE	TOTAL	DICOTYLEDONS	MONOCOTYLEDONS	PTERIDOPHYTES
Aquatic and Semi-Aquatic Plants	208	95	108	5

Table 2.a.4: Number of plant species in various habitats (Smith in SMEC, 1989). Note that some species occur in more than one habitat (Ramberg et al., 2006)

HABITATS	NUMBER OF OBSERVED SPECIES
Perennial swamp	205
Seasonal swamp	240
Flooded grasslands	213
Dry lands	686
Miscellaneous	84

One of the reasons for the high plant species diversity and the exceptionality of this ecosystem lie in the interaction of a periodical natural phenomenon – the annual flood in the dry season and the distinct rainy season in time of low water – with shifts in the flooding pattern over short and long periods. Succession processes at different phases of development are therefore on-going in all plant communities in the Delta. These processes are the main driving forces for the species and habitat diversities in the Okavango Delta.

Figure 2.a.6: The ground orchid *Eulophia latilabris* in the Okavango Delta Property (P. Linder)

2.a.8 Animal species of the Okavango Delta Property

The Okavango Delta supports an outstanding assemblage of animal life (see Appendices) with many species at their southern point of distribution in Botswana. Aquatic fauna includes over 208 species, including 90 species of fish and 22 mollusc species. There are over 130 species of mammals; over 480 bird species, 64 reptiles, 33 amphibians, 94 dragonflies (Odonata), and 115 butterfly species (Ramburg et al., 2006). Whilst there are few endemic species in this property, with no endemic large mammals or birds, but the Delta has an assemblage of large mammal and bird species not duplicated elsewhere in Botswana either in terms of species diversity or abundance. Some of these are on the IUCN Red Data List as Endangered, Vulnerable or Near Threatened (see Table 2.a.5 for a description of species and population sizes).

Mammals:

Estimates of the populations of major mammal species in the property are given in Table 2.a.8.1. Several endangered mammal species occur in the Okavango Delta including three endangered mammal species (IUCN Red Data List, 2011): the African Wild Dog (*Lycaon pictus*), White Rhinoceros (*Ceratotherium simum*), and Black Rhinoceros (*Diceros bicornis*). Cheetah (*Acinonyx jubatus*), Lion (*Panthera leo*), African Elephant (*Loxodonta africana*), and Hippopotamus (*Hippopotamus amphibius*) are listed as Vulnerable. Near threatened species are the Bat (*Miniopterus natalensis*), Leopard (*Panthera pardus*), Sitatunga (*Tragelaphus spekii*) and Ground Pangolin (*Manis temminckii*). Botswana has the largest population of elephants in the world, with a population of 130 000 estimated as occurring in northern Botswana i.e. the Okavango – Chobe region (Chase et al., 2011). Species list including endangered and threatened species in the property can be found in Appendix 3.

Table 2.a.5: Large mammal population estimates for the Okavango Delta Property

SPECIES	ESTIMATED NUMBER	RANGE	% OCCURRENCE	DENSITY/km2
Baboon	973	101 – 1846	51.08	0.057
Buffalo	22799	1429-50612	38.38	1.329
Eland	128	8-377	2.72	0.007
Elephant	31191	23699-38684	20.17	1.818
Giraffe	5058	3739-6376	46.53	0.295
Hippopotamus	2010	986 – 3035	54.62	0.117
Impala	39935	28739 – 51731	73.30	2.327
Kudu	1835	902 – 2768	21.78	0.107
Red Lechwe	36983	19397 – 54569	97.17	2.155
Sable antelope	191	12 – 567	9.55	0.011
Steenbok	96	12 – 180	2.29	0.006
Tsessebe	2904	1440 – 4368	90.50	0.169
Warthog	925	565 – 1286	30.10	0.054
Waterbuck	367	23 – 739	28.72	0.021
Wildebeest	3606	1667 – 5545	23.64	0.210
Zebra	12502	6563 – 18441	25.44	0.729

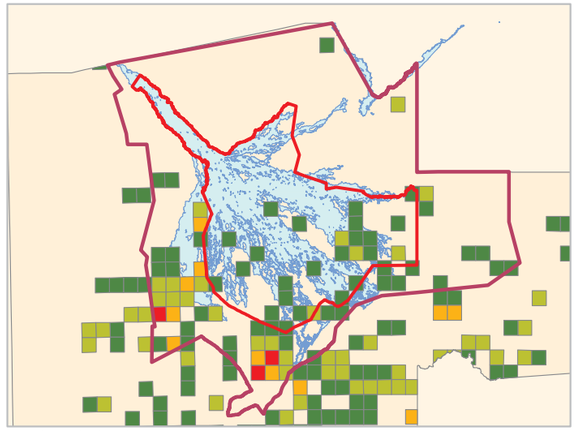
Birds:

Botswana has 590 recorded species of birds (320 non-passerines and 250 passerines) of which 82% (482 species) are considered to occur in the property (Hancock, Muller and Tyler, 2007). There is a low level of endemism in birds in Botswana; however, the near-endemic Slaty Egret (*Egretta vinaceigula*) (which is classified as Vulnerable on the IUCN Red List) has over 85% of its global population confined to the property. The Okavango Delta also has the largest single population of the globally threatened Wattled Crane (*Grus carunculatus*) in the world, numbering 1300 birds. There are an additional 20 globally threatened bird species which occur in significant numbers in the Okavango Delta – including six vulture species, and four other raptors, as well as a variety of water birds. From an avifaunal perspective, the Okavango Delta is also important for 17 bird species that are range-or biome-restricted – birds that are confined to geographically small areas – such as the Coppery-tailed Coucal, Hartlaub's and Black-faced babblers, Brown Firefinch, Arnot's Chat and Burchell's, Sharp-tailed and Meves's starlings. The property also supports over 1% of the global or regional populations of 18 congregatory water birds.

The Okavango Delta is also vitally important as a breeding ground for water birds (Figure 2.a.7). The largest breeding site for the Marabou and Yellow-billed storks in Southern Africa is at Gadikwe Lediba and Gcobega Lediba in Moremi Game Reserve, and the heronry at Lediba la Dinonyane in CHA NG 27 supports one of the most important nesting sites for the African Openbill. There are 40 water bird species that breed regularly at Lake Ngami, part of the Buffer Zone of the property, from whence they disperse all over Africa. Pel's Fishing Owl and the African Fish Eagle are iconic birds of the Okavango Delta and found in relative abundance in the property (Figure 2.a.8).

Figure 2.a.7: Breeding grounds for Carmine bee eaters in the Okavango Delta Property

Figure 2.a.8: African Fish Eagle with Tiger fish catch in Okavango Delta Property (Donovan Drotsky)



Ostrich Distribution

1 : 3 000 000

Core Zone Boundary

Buffer Zone

Ostrich Distribution

5 - 36

37 - 96

97 - 202

203 - 367

Source data from Botswana National PC Atlas, 2002
Prepared by Department of Surveys and Mapping
© Republic Botswana 2012

Figure 2.a.9: Ostrich distribution in the Okavango Delta Property

Fish:

Aquatic biodiversity is of great significance in the Okavango and Upper Zambezi River systems, with an estimated 134 fish species (Skelton, 2001) many of which are particularly important as a food source for local people. There are an estimated 90 species of fish in the Delta. In the IUCN Red List (2011), 2 species of tilapia *Oreochromis andersonii* and *O. macrochir* occurring in the Okavango Delta are listed as Endangered (EN) by the introduction of *Oreochromis niloticus* and the resulting threat of hybridisation. (See UNDP Endangered Species Report of October 2007 in the Appendices). There are no known endemic species in the property. Also no alien species introductions or translocated fish have been found in the Okavango Delta. There is a low density of fish in the Delta compared to other wetland systems, reflected by the low catch per unit effort (CPUE) at 0.4kg/Lundgren gillnet set, - an indication of the low nutrient status of the system. Locally the seasonal floodplains have a much higher density than the permanent swamps and rivers, and occasionally very high densities occur before and during spawning, as well as in drying pools where fish-eating birds aggregate in large numbers.

Reptiles and amphibians:
The African Python (*Python natalensis*) is only protected reptile in Botswana (National List). Although the Nile crocodile (*Crocodylus niloticus*) is globally threatened (IUCN Red List, 2007) and listed in Appendix II of CITES, it has no protected status in Botswana. Research in the Okavango Delta (Crocodile Monitoring Program, Management Plan, 2007) indicates that the crocodile population is declining due to capture of live breeding females and collection of eggs, particularly in the Panhandle. Of the 33 amphibian species found in the Okavango only *Pyxicephalus adspersus* is regarded as Near Threatened, all the rest are in the Least Concern category.

Invertebrates:
A study by Kipping (2003) in 2000-2002 found a total of 94 Odonata species (33 Damselflies (Zygoptera) and 61 Dragonflies (Anisoptera) in the Okavango Delta. Little work has been done on Butterflies (Lepidoptera) since that of Pinhey (1976) who recorded 115 species for the area. It is not known, however, what effect historic aerial spraying for Tsetse Fly control has had on insect species diversity or abundance.

2.b HISTORY AND DEVELOPMENT

A Brief History of Human Settlement:

It is tempting to believe that the Okavango Delta would have had a long history of human settlement; however, the past prevalence of tsetse fly and malaria was a significant limiting factor, and human populations were low and sparsely distributed.

The history of human settlements and people of Ngamiland District is well documented by Tlou (1989) and similar anthropological researchers such as Hitchcock and Terry. They note that the oldest inhabitants of the area were the Basarwa, a diverse group which included the Banoka (people of the river) who actually lived, hunted and fished along the fringes of the Delta. They were joined during the 18th Century by the Bayei and Hambukushu who were forced southwards from the present-day Zambia by the expansion of the Balozi. The Bayei followed their folk hero, Hankuzi, poling their mekoro boats from the Chobe River into the Selinda Spillway linking the Chobe and the Okavango River systems, finally reaching Gabamukuni (just north of the Delta). From there, they continued southwards, reaching Lake Ngami at the site of present-day village of Toteng.

According to the historian Tlou (1989), The Yei and Mbukushu migrations were probably the most significant historical events around the Okavango Delta prior to the Tawana period. These people introduced technological innovations of great importance for the development of fishing, hippopotamus hunting and agriculture. For example, with the introduction of the mokoro or dug-out canoe, the rivers and floodplains, rather than being barriers, became highways of communication. The Okavango environment imposed on these people a decentralised social system. Villages were scattered over the Delta islands, each with its own village headman. People lived by fishing, gathering wild plants and practicing flood-recession farming. Due to the presence of tsetse fly, they had few cattle or other domestic animals.

Figure 2.a.10: Mokoro (dug out canoe)

The most important characteristics of this period before the arrival of the Batawana were the absence of a unitary state, and the prevalence of small-scale communities which co-existed in a fairly peaceful and balanced manner and were relatively autonomous until their incorporation into the Tawana state in the 19th Century. The Batawana seceded from the Bangwato during the early 19th Century, and founded their own state in Ngamiland. This came about because Tawana could not succeed his father, Kgosi Mathiba, since he was the son of a 'minor' wife. Consequently, civil war broke out between his faction and that of Khama (the rightful heir), and Tawana moved south to settle with the Bakwena. Later, they slowly moved northwards and settled at the Kgwebe Hills which was the first Tawana settlement until the 1820s.

When Letsholathebe became king, he managed to unify the people of Ngamiland and rebuild the tribe. He encouraged European traders and missionaries to Ngamiland and thus commenced a lucrative trade in ivory. Batawana hunters acquired rifles and exerted a heavy impact on the elephant population. Bayei canoeists were expert hippo hunters and were relied on to provide hippo teeth. Hunters enjoyed a high status in society. The relatively peaceful existence of the Batawana was disrupted by the Ndebele invasion of 1882/3. The village of Toteng was attacked and burned. This marked a new era, the advance of British Imperialism, during the reign of Moremi II, who had succeeded Letsholathebe, and also that of his successor, Sekgoma Letsholathebe.

Based on the 1991 Botswana's housing and Population census, a total of 124 712 people live in Ngamiland District, Central Statistics Office (CSO, 2002). This number might have doubled in the last 10 years given the development of tourism. This diversity of people settling in Ngamiland over the past 250 years has left its legacy in the form of a diversity of languages and economic activities. The Bayei and Hambukushu are particularly known for their fishing skills; the Herero are renowned pastoral farmers who rarely engage in arable agriculture; Batawana practice both arable and pastoral farming; the San communities are well-known for their hunting and gathering skills. It is against this background that modern-day social and economic activities in Ngamiland should be viewed.

Competition and conflict among the various natural resource users in the Okavango are generally high. Underlying this competition and conflict is the fact that an area like Okavango contains numerous biotic and abiotic elements, all of which have the potential to be valued by one or more different groups. For example, traditional communities see Okavango as their patrimony and their livelihoods are mostly dependent on the utilization of resources found in the wetland. Pastoralists and agro-pastoralists (traditional) communities want control of the area for settlement, grazing and arable agriculture. The Government of Botswana and the private sector interest groups see the area's wildlife resources as a potential source of wealth generation through tourism development. Conservationists regard the Okavango highly on account of its biodiversity and aesthetic values. Each of these social groups thus constructs a different image of the Okavango, and a different set of natural resources, depending on how they perceive and value the different elements of the natural system.

Conservation History:

Between 1885 and 1966, Botswana and indeed the Okavango region were under British Protectorate Administration. During this period, the British Protectorate Administration approached conservation issues in two ways. Firstly, there were statutory laws that governed the use of wildlife resources and only applied to Europeans, and secondly, there was the pressure put by the Protectorate Administration on the tribal chiefs to come up with customary laws for their people to ensure resource conservation. All the laws local chiefs came up with for their people had to conform to the statutory game laws for Europeans. These laws in both cases were allegedly targeted at curbing the unsustainable commercial exploitation of wildlife resources in Botswana. Some of the key statutory laws during the British Protectorate Administration are: the 1886 Proclamation Act, the 1925 Bechuanaland Protectorate Game Proclamation and the 1961 Fauna Conservation Proclamation.

The post-colonial period (1966 to present) offered very little change in terms of wildlife laws in Botswana. However, some of the key laws introduced at the time include the 1967 and 1979 Fauna Conservation Acts. The two Acts especially the Fauna Conservation of 1979 imposed more restriction into hunting activities in the Okavango Delta. Subsequent conservation laws, acts and policies continue to be passed in modern Botswana for example, the Wildlife Conservation Policy of 1986 and the Wildlife Conservation and National Parks Act of 1992. In addition to the laws, management plans have been drawn for the Okavango Delta (e.g. ODMP).

Some of the conservation laws in Botswana have resulted in the establishment of protected areas as a way of achieving biodiversity conservation. For example, the Fauna Wildlife Act of 1961 by the British Protectorate Administration of Botswana led to the establishment of Moremi Game Reserve (MGR) as a protected area in 1963. Moremi Game Reserve encompasses about 4 610 km^2. The Batawana Royal Family (i.e. the leading traditional leadership of the Okavango) working together with the British Protectorate Administration of Botswana is credited for establishing Moremi Game Reserve. Before Independence in Botswana in 1966, the Fauna Conservation Proclamation was the major legal instrument governing wildlife in the Bechuanaland Protectorate; after Independence, this was superseded by the Fauna Conservation Act and the National Parks Act.

Prior to this however, the first game reserve on tribal land had already been announced by the Batawana who had gazetted their own reserve in 1964, the Moremi Wildlife Reserve, between the Khwai and Mogogelo Rivers. The reserve forms a resource rich area of the wetland and it's located in the heart of the Okavango Delta. The initial designated reserve area and subsequent extensions (in 1992 and the inclusion of Chief's Island in 1976) now comprise 20% of the Okavango Delta. In early years this reserve was administered by a society formed for that purpose, the Fauna Preservation Society of Ngamiland, as provided for in its Regulations, and formally established in 1965 (Spinage, 1991). Robert and June Kay, resident in Ngamiland, were actively involved in the formation and running of the Society, together with local tribesmen Isaac Tudor and Jack Ramsden (the latter became the first Warden of Moremi). The area was named Moremi Wildlife Reserve after the then Regent of the Batawana tribe.

In 1976, following an ecological reconnaissance of the area by Southern African ecologist Ken Tinley (Tinley, 1973), the boundaries of the reserve were extended eastwards to connect with the southwest corner of the Chobe National Park, and westwards to include the traditional protected area of Chief's Island, enlarging the area to 3 900 km^2. Finally, in 1979, the Reserve was handed over to central government to be run by the Department of Wildlife and National Parks, becoming the Moremi Game Reserve with a new set of Regulations.

In 1992, the Fauna Conservation Act and National Parks Act were amalgamated into the Wildlife Conservation and National Parks Act, and the boundaries of Moremi were again revised and extended. The Wildlife Conservation Policy of 1986 established Wildlife Management Areas (WMAs) as a primary form of land use in which other land uses are permitted only if these are compatible with wildlife and their utilization (GoB, 1986). As a result, the land in the Okavango Delta was demarcated into WMAs in 1989. WMAs were further sub-divided into Controlled Hunting Areas (CHAs). This resulted in a large portion of the Okavango being protected, either inside Moremi (directly under the control of the Department of Wildlife and National Parks) or in the CHA concessions which are leased to communities and the private sector for wildlife-based tourism. The concept of WMAs and CHAs arose from a need for conservation and controlled utilization of wildlife resources outside national parks and game reserves. A WMA is defined as an area where wildlife utilization is the primary form of land use, but where other types of land use, such as rural settlements, are permitted, provided they do not deplete wildlife populations. CHAs are broadly delineated and allocated according to the location of local communities for various types of wildlife utilization, consumptive and non-consumptive tourism development.

Prior to 1992, Botswana was not party to any international environmental conventions, except CITES which was administered by the Department of Wildlife and National Parks. However, once the National Conservation Strategy Co-ordinating Agency evolved into the Department of Environmental Affairs (DEA), Botswana signed the Ramsar and other conventions (Ramsar in 1996) and DEA took responsibility for these. In 1998, the Government of Botswana acceded to the World Heritage Convention, with the Department of National Museum and Monuments (DNMM) becoming the organ of state responsible for the implementation of the World Heritage Convention. The Tsodilo Hills became Botswana's first (cultural) World Heritage Site in 2001.

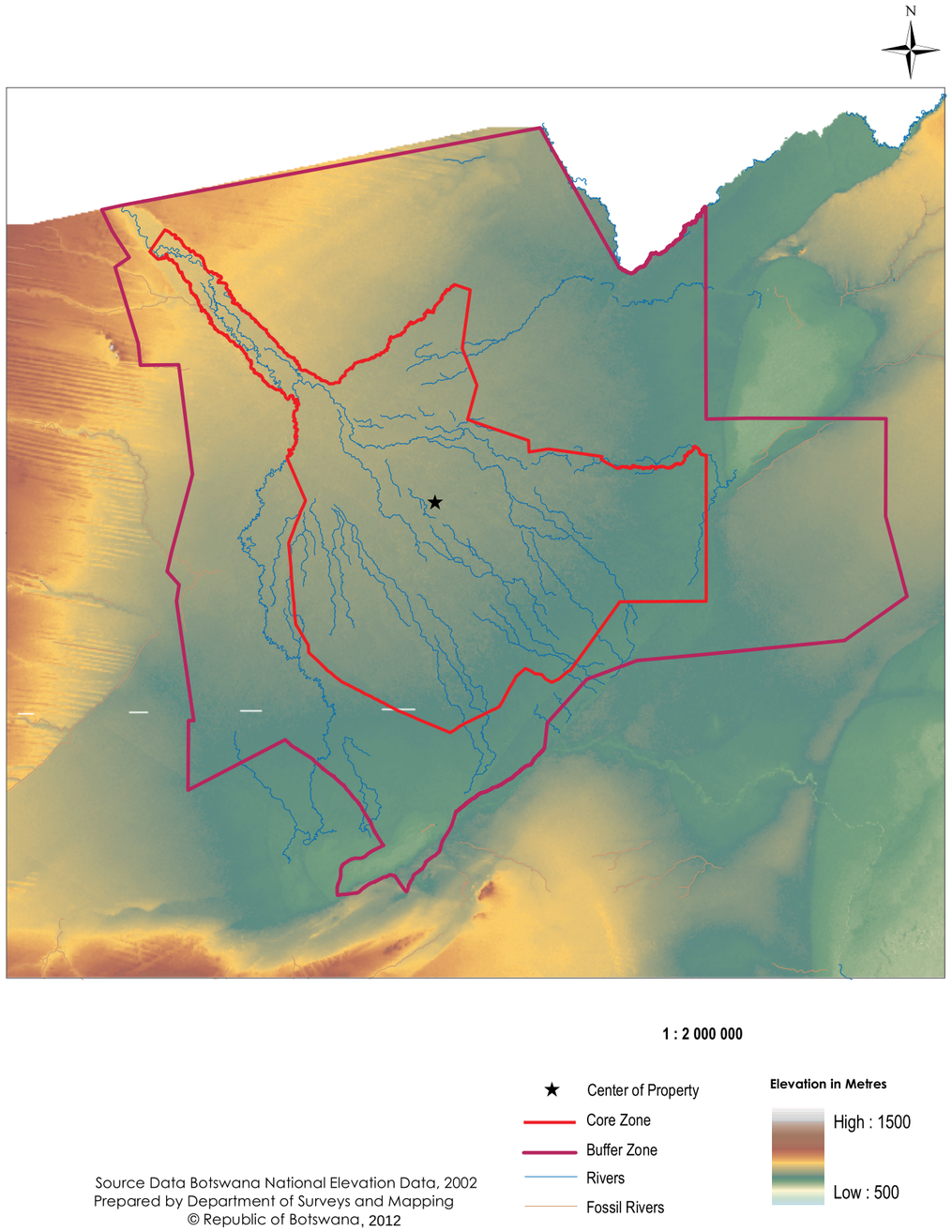
Lions swimming across lagoon in Okavango (Karen S Ross)

CHAPTER 3
JUSTIFICATION

3. JUSTIFICATION FOR INSCRIPTION

In Africa, the Okavango Delta is one of a very few vast, natural, scenically spectacular, inland Delta or Alluvial fan systems where its waters never reach the sea, draining instead into the desert sands of the Kalahari Basin and the extensive Makgadikgadi Salt Pans (northern Kalahari Desert region). Formed by the Earth's geological processes and forces, it bursts into a green oasis wonderland during the harsh, dry, and dusty winter season. Only three large (greater than 20 000 km^2) low gradient Inland Delta systems have developed on the continent of Africa. Although they all share similarities in form and function, the Okavango Delta is the only mega inland delta system south of the equator (McCarthy, 1994). Further, it is the only inland Delta that floods in the dry season, a unique hydrological event that defines this unusual system.

Previous page: Aerial view of Buffalos in the Okavango Delta



Map 3.1: Elevation of the Okavango Delta Property

In 2004 the World Conservation Union (IUCN) produced a strategic paper entitled "The World Heritage List; Future priorities for a credible and complete list of Natural and Mixed sites". In so doing the IUCN identified major gaps in Natural/ Mixed World Heritage site coverage. These included, amongst others, "the flooded grasslands, such as the Okavango". This strategic paper states that such missing habitat types were defined as priorities, and endorsed by organisations such as Conservation International, IUCN/SSC, WWF and Birdlife International. The paper states that any such important habitats described in this strategic paper should receive priority for World Heritage listing.

The Okavango Delta, varying in size between 10 000 and 20 000 km^2 depending on the extent of annual flooding, is one of the least disturbed, almost pristine, natural wetlands on earth, and is part of a "wild" or free-flowing river systems, a state that less than 20% of all of the world's rivers enjoy. Wetlands are amongst the most vital and productive ecosystems on earth and their continued loss throughout the world is a matter of deep international concern.

The waters of the Okavango are a life-line to an outstanding array of Africa's most charismatic large mammals - not only the "Big Five" (Elephant, Buffalo, Rhino, Lion and Leopard), but also rare and endangered species such as Wild Dog and Cheetah (part of Africa's "guild" of large carnivores, of which the property contains all five). The property supports species numbering 130 mammals, 482 birds, 64 reptiles, 33 amphibians, 90 fresh water fish, 155 butterflies, 94 dragon and damsel flies, 22 mollusca, and 1068 plant species, all found in the delta system. Botswana has the largest population of African Elephants in the world, over 130 000 animals, and the Okavango Delta is at the heart of their range, supporting more than 60% of the population of this iconic species. The property is also vital to the conservation of several other globally threatened animal and plant species (UNDP Endangered Species Report, Botswana, 2007).

Figure 3.1: Elephants in the Okavango Delta

Figure 3.2: Rhinos in the Okavango Delta Property

The Okavango Delta system provides vital ecosystem services, and is an important source of fresh-water in an otherwise arid region (the Namib Desert is only 300 km to its west). The Delta supports the livelihoods of approximately 130 000 local people, most of who depend on its resources - not just for water, but also materials for building, and plants and animals for food and medicines. A large percentage of the community also obtains direct employment through a thriving eco-tourism industry and associated services because the area's natural beauty, wildlife spectacles, and biodiversity have created a thriving tourist industry. The livelihood of most people in the region is in some way dependent on the economic benefits from this industry.

Figure 3.3: Tourist activity in the Okavango Delta Property

Figure 3.4: Tourist accommodation facility in the Okavango Delta Property

It is the view of the government and people of Botswana that this critically important natural property is an area of outstanding universal value as a natural sub-Saharan wetland system of superlative natural beauty and tranquillity, which incorporates a spectacular and rich biodiversity of plant and animal life. It is safeguarded by good systems of governance, supported by local communities as well as conservationists and lovers of nature from around the world. It is increasingly an important draw card for a profitable eco-tourism industry that provides access, employment and opportunity to the region, as well as income to Botswana. It is a world-class travel experience for local, regional and international visitors.

Figure 3.5: Women and girls fishing in the upper Okavango Delta Property (Frans Lanting)

3.a CRITERIA UNDER WHICH INSCRIPTION IS PROPOSED

The Okavango Delta System fulfils criteria vii, ix and x for Natural sites;

3.a.1 Criterion vii - contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;

Superlative natural phenomena

The dynamic, intact and fully functional Okavango Delta ecosystem is a natural feature of outstanding aesthetic importance where several superlative natural phenomena occur, such as;

• The 'miraculous' annual transformation of the huge, sandy, dry, and brown depression by floods arriving in the winter season creating a vast green oasis, a wetland of deep crystal-clear water surrounded by the parched, dusty, Kalahari desert stretching to the horizon in all directions.

• Large herds of African Elephant, Buffalo, Red Lechwe, Zebra and other large animals splashing, playing, and drinking the clear waters of the Okavango having survived the dry autumn season or their weeks' long migration across the Kalahari Desert.

• Colonies of colourful nesting birds in papyrus reed beds, or their frenzied feeding on newly hatched fingerlings, surrounded by a mass of blue flowering water lilies.

• The beauty of the mosaic of different coloured aquatic plant communities, some that form extensive areas of swamps, and interspersed by tall tree-covered palm islands with crystal-clear expanses of cool water.

Figure 3.6: Red Lechwe at dawn on the Okavango Delta floodplains (Tim and June Liversedge)

Figure 3.7: Water lilies in the Okavango Delta Property

Due to its rich wildlife diversity, wilderness nature, permanent water resources, flooded grasslands and forests, the Okavango Delta has become one of the key international tourism destinations in Botswana. The rich biodiversity found in the Okavango Delta and the fact that the wetland is faced with an increasing international tourism development has prompted the Botswana Government to adopt a sustainable tourism approach as a tourism development strategy for the Okavango Delta. The sustainable tourism strategy calls for tourism development that promotes environmental sustainability, economic efficiency and social equity. The combination of its outstanding beauty, natural phenomena and wildlife spectacles attracts many visitors to the Okavango wishing to experience this wetland and its wildlife; to fish, enjoy and relax in this superb wilderness to the evocative cry of the African Fish-Eagle.

In a day's mokoro ride along the crystal-clear waterways, one can see the world's largest land mammal, the Elephant, as well as other animals and birds as one glides past beautiful tropical vegetated islands covered with magnificent indigenous fruiting hardwood trees that tower overhead, that have evocative local names such as Matsaudi (*Garcinia livingstonei*), Mokuchumo (*Diospyros mespiliformis*), Moporota (*Kigelia africana*), and Motsentsela (*Berchemia discolor*).

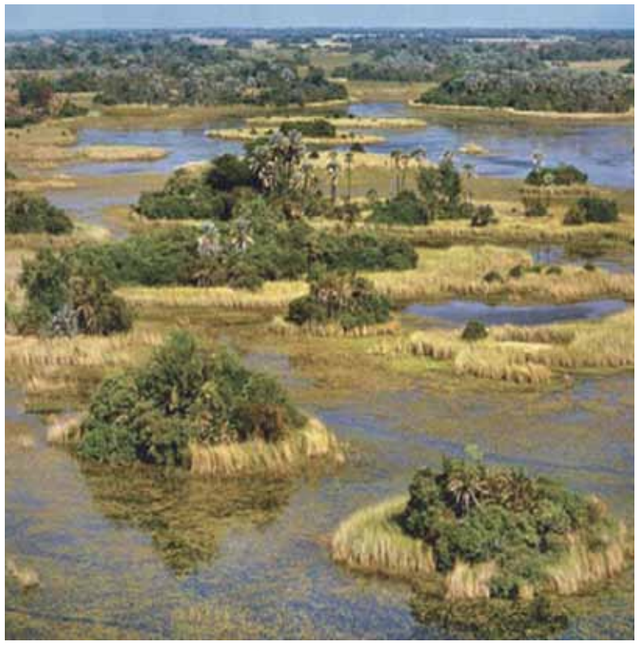


Figure 3.8: Aerial view of the Okavango Delta's permanent swamps and islands (Frans Lanting)

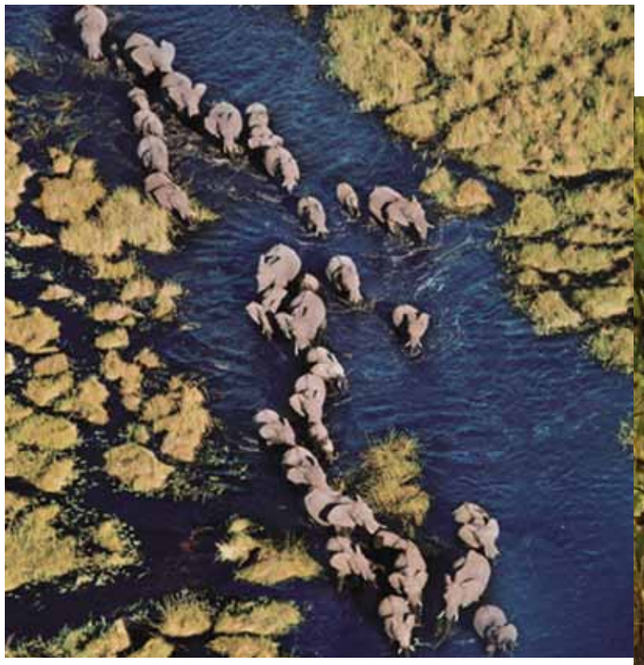


Figure 3.9: Aerial view of Elephants in flooded grasslands, Okavango Delta (Frans Lanting).

3.a.2 Criterion ix - be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals;

"It is the system functioning of the delta that is so special, and what we all marvel at is simply the manifestation of a big, healthy ecosystem working in an unimpaired way." (Mendelsohn et al., 2010).
The Okavango Delta is an outstanding example of the complex inter-relatedness, inter-dependence, and interplay of climatic, geo-morphological, hydrological, and biological processes. All these processes in combination have resulted in the creation of this vast inland delta (wetland), its terrestrial and aquatic ecosystems, and its diverse complement of plant and animal life.

Major important processes are;
The process of flood inundation
The run-off from precipitation falling during the wet summer period (November to January) in the Angolan highlands catchment flows down the various river systems and only reaches the head of the Delta in autumn (March to May) – the dry season. Flows down the Cubango sub-basin are rapid peaking earlier than the flows down the Cuito sub-basin thereby sustaining water input to the head of the Delta from March through to May. Water levels rise rapidly in the Panhandle from May and this process continues progressively southward through firstly the permanent, then seasonal, and occasional swamp systems during the winter months June to September/October. Due to the low gradient of the Delta, the flood waters take several months to flow through the swamps before being lost to either evapotranspiration, seepage into the desert sands, or flow out of the Delta via the Boteti River to the Makgadikgadi Salt Pans to the south-east, or via the Kunyere River to Lake Ngami in the south-west. The climatic and flooding processes are dynamic due to the seasonal variability in the amount of rain falling, the volume and duration of flood water, its time of arrival at the Delta, and the extent of inundation of the floodplain system.

Channel switching processes
Two processes cause channel switching in the Delta.

(i) Located at the southern end of Africa's Rift Valley, seismic activity may result in relatively large parts of the Delta subsiding and or being raised upward. The consequences of this may result in areas being inundated by flood waters and other areas drying out causing a corresponding change in patterns of sediment deposition, direction and destination of nutrient transport, vegetation communities, water availability for animals, creation or loss of grazing and browsing areas, and the breeding sites for birds and aquatic organisms including fish, These hydrological and ecological changes may endure for some time (50 - 150 years) until there is another seismic movement, or some other mechanism causing channel change.

(ii) Plant debris carried by flood water may accumulate at constriction points in channels, blocking off and diverting water flow and sediment deposition patterns. Similar consequences arise as described in (i) above. These channels may then be reopened and or maintained by Hippopotamus in their movement back – and forwards. Thus the process may be short-term or may remain for a longer period of time until either there is a seismic movement or the channel is artificially opened. The Thaoge River on the western edge of the Delta has changed its flow characteristics, probably due to channel aggradation from bed-load sediments.

The second of these processes is better documented than the first (for which we have no direct evidence). Channel avulsion of the main feeding channel (the Okavango mainstream) where it debauches from the Panhandle into the Delta proper has been deduced from historical records and observation to occur on a time scale of about 50-100 years (McCarthy et al., 1986). It also probably occurs on a smaller scale within distributary main channels (for examples the middle Jao system).

Breeding, growth and migration processes
The seasonal flood-pulse and nutrient loads triggers responses in plants and animals in the 'untimely' winter period, such as, an explosion of phyto and zoo – plankton, leaf growth, flowering and seed production in plants, fish migration and the onset of breeding, breeding of birds particularly waterfowl, and the inward movement/migration of large herbivores which are then followed by predators and scavengers. The interplay between wet and dry season forms a pivotal characteristic of the Delta ecosystems, and enhanced biodiversity results from the juxtaposition of this wetland with a semi-arid region.
During the dry season the delta floodplains particularly the Khwai River system in the east of Moremi Game Reserve is the nearest supply of surface water for large populations of large animal species that migrate to this area from the an extensive region (the Kwando-Linyanti, Savuti-Mababe and the Mababe-Sankuyo areas) where water resources dry up. Seasonally high concentrations of these mammal species collect on the river and feed in adjacent grazing and browsing areas. At the onset of the rains these concentrations disperse again into the Mopane woodlands where seasonal rainwater pans fill and supply the water needs of the herds.

Nutrient cycling processes
Nutrient concentrations in the inflowing water are very low. Strong sequestration and internal cycling mechanisms by wetland vegetation maintains the nutrient pool within the biotic components, and thus the low concentrations of nutrients in channel water persist throughout the system. Backwater swamps and floodplains have relatively higher concentrations of nutrients, in part due to the effects of flood-pulsing, resulting in higher biological productivity. Excess nutrients appear to be removed from the system through a complex evapotranspiration-driven groundwater concentration and density fingering mechanism operating under the islands (Bauer et al., 2002; Wolski et al., 2005). This is elaborated on in the section on evapotranspiration and salt/nutrient accumulation under Mega-Processes below.

Floodplain termitaria, colonization and plant succession
Establishment and colonisation by plant species of termitaria on dry floodplains and the growth of islands in some cases have started as termite mounds. During sequences of low inflows and low rainfall, extensive areas of floodplain are dry for several successive years. They are then prime ground for colonization by mound-building termites, which disperse as winged breeding forms (alates) and establish colonies. Each colony constructs a mound, which (providing it is not flooded too early in its development) provides a roosting point for frugivorous and seed-eating birds and a vantage point for primates such as baboons. These visitors deposit seeds of trees or grasses on the termite mound, which may take root and grow, initiating island-building processes (dust trapping, carbonate precipitation, organic matter accumulation).

Mega - processes include;
i. Rifting, and possibly isostatic adjustment; The Okavango Delta system is developed in a graben which appears to be related to the East African Rift (EAR). This graben lies on the south-westerly extension of the EAR, and is filled with sediments primarily of reworked Kalahari sands. The inflowing river system carries on average 250 000 tonnes of bedload sediment per annum, which accumulate within the Panhandle and upper Delta. It is possible that the incremental loading by sediment each year is compensated for by incremental subsidence of the graben floor, with the result that there is not a net aggradation of the Delta's surface above the surrounding landscape.

ii. Peat accumulation beneath *Cyperus papyrus*, Phragmites spp., and other tall emergent species; Anaerobic conditions resulting from perennial inundation in the Panhandle and upper Delta are conducive to peat formation and there is some evidence that this occurs under emergent plant communities such as those dominated by *Cyperus papyrus* and Phragmites spp. This process is significant from the perspective of global carbon budgets, but also it plays an important role in the system controlling relative elevation and thus water distribution in the Delta. This is elaborated on below.

iii. Peat fires, associated subsidence and relief inversion; Channel systems and their associated floodplains may be periodically deprived of water supply through the process of channel avulsion described above. When this occurs, the desiccation of peat and soil organic matter renders it prone to burning; there are subterranean peat fires which have been burning in the central Delta for many years (see for example Gumbricht and McCarthy, 2002). The burning results in a significant loss of soil volume, with the result that these areas subside. Parts of the landscape comprised of mineral sediments, such as channels with aggraded sand beds, do not subside, and consequently appear in the new landscape as raised features. Upon re-flooding (under a subsequent avulsion) the channel beds form islands, while areas affected by subsidence form floodplains. This process is known as relief inversion, and is a major influence on the distribution of water in the Delta.

iv. Evapotranspiration and salt/nutrient accumulation under islands. Salinity could also be expected to occur due to high inflow of solutes. However, sand islands in the delta are believed to be augmented by the concentration of salts at depth where both calcrete and amorphous silica are precipitated. At a critical level the woodland vegetation can no longer tolerate the salinity of the groundwater; hence an area depleted of vegetation occurs at the centre of the islands. In this process, water infiltrates in the floodplains and moves down gradient towards the islands where evapotranspiration by riparian trees concentrates solutes in the soils and island groundwater. Solute concentrations in the groundwater rise, increasing the specific gravity of this solution and also resulting in the precipitation of some salts primarily calcium and magnesium carbonates) within the island subsoil. At some point the density of the island groundwater is sufficiently high that it is denser than the surrounding groundwater, and it migrates downward through the sedimentary pile to the floor of the graben. This mechanism effectively removes solutes such as sodium and chloride (which are potentially toxic at high concentrations); it also appears to take with them nutrients, particularly phosphorus, which are not scavenged by the microbial biota and plant root systems in the island-floodplain ecotone. It is consequently extremely important in maintaining the Delta as a freshwater wetland system, and a fundamental ecological process for this system.

Meso-processes include;
i. Seasonal expansion and contraction of flooded area (seasonal pulsing) in response to intra-annual climate variation;

ii. Pulses in redoximorphic potential of floodplain soils in response to flooding and drying, and consequent pulses of nutrient availability; The Delta is subject to an annual pulse of water flow resulting from the annual rains in the Angolan catchment. The pulse is manifest as a slow extension and then on recession, a contraction of the flooded area in the Delta. This process of flooding and then exposure causes floodplain soils to become anaerobic with inundation and then aerobic on recession. These changes in oxidation potential cause rapid changes in the bio-availability of the different nutrients for plant growth. Upon flooding, there is a progressive chemical reduction of oxygen, nitrate, iron, sulphate, and ultimately carbon. For example this reduction results in the loss of nitrate through a complex sequence of chemical reactions as gaseous NO_x and NH_4 Ionic NO_{3-}, however, is highly mobile in solution and on initial flooding is strongly bio-available to plants for uptake; it is subsequently rapidly lost as described above. Similarly, when the flood pulse recedes, reduced compounds are oxidised and some (such as iron, for example) are rapidly immobilised as insoluble oxides. Such changes in nutrient availability obviously greatly affect primary productivity, depending on the dominant plant species' ability to function under wet or dry (or both) conditions.

Micro-processes include;
i. Establishment and colonisation by plant species of termitaria on dry floodplains

ii. Diurnal cycling of dissolved oxygen, pH and temperature in water in channels and floodplains.

Examples of documentaries film concerning the Okavango Delta property:

- Nature's Great Events "The Great Floods". Afriscreen/BBC (in Appendix).
- Swamp Cats. BBC Natural World (in Appendix).
- Planet Earth. Episode 1 - From Pole to Pole. BBC Bristol (in Appendix).
- Elephants without Borders. Afriscreen/BBC Natural History Unit (in Appendix).
- A Wild dog's Story. BBC Natural History Unit/Afriscreen Films (in Appendix).
- Okavango, Jewel of the Kalahari. BBC/Partridge Films.
- Haunt of the Fishing Owl. Tim and June Liversedge.
- Eye of the Leopard. Dereck and Beverly Joubert.
- The Fascinating World of Birding: Okavango (Episodes 1-3). Ken Oake.
- Eternal Enemies. Richard Goss.
- Rivers of Life. Gerald Hinde.

3.a.3 Criterion x - contains the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

Natural habitats are diverse and include permanent and seasonal rivers and lagoons, permanent swamps with Reeds and Papyrus, seasonal and occasionally flooded grasslands, riparian forest and woodlands, dry woodlands, and island communities. Each of these habitats has a distinct species composition of plants and animals comprising all the major classes of aquatic organisms, reptiles, birds and mammals

These floodplain habitats are species rich with 1061 plants, 89 fish, 64 reptiles, 482 species of birds and 130 species of mammals (Table 3.a.1). The plant species belong to 530 genera and 134 families recorded for the Okavango Delta. However, the inaccessible eastern parts have been less studied, and there could be further species still unrecorded. Lists of animal and plant species and their status recorded for the Okavango Delta are given in the Appendices. The Delta is refuge to globally significant numbers of rare and endangered large mammals, including white and Black Rhinoceros, Wild Dogs, Lions and Cheetahs. Further it is recognized as an Important Bird Area, harbouring 24 species of globally threatened birds, including among others, six species of vulture, Southern Ground-Hornbill, Wattled Crane and the Slaty Egret. Thirty-three species of water birds occur in the Okavango Delta in numbers that exceed 0.5% of their global or regional population.

Table 3.a.1: Number of species in taxonomic groups by habitat (Ramberg et al., 2006)

Taxonomic Group	Total Number of species	Percent habitat overlap	Aquatic/ Perennial swamp	Wetland/ Seasonal swamp	Dryland/ Terrestrial	Sum of species observed in each habitat
Plants	**1061**	**35%**	**205**	**519**	**704**	**1428**
Reptiles	**64**	**0%**	**7**	**5**	**52**	**64**
Birds	**444**	**0%**	**112**	**57**	**275**	**444**
Mammals	**122**	**10%**	**3**	**21**	**110**	**134**

Plant Diversity

The vegetation of the Okavango Delta is derived from 489 plant genera in 120 families, comprising a total of (at present) about 1 100 recorded species (with probably another 600 species occurring only in the surrounding dry parts of the buffer zone). Here we present an analysis only of those plants recorded in the Delta. The vast majority of families are dicotyledons, while the monocotyledon families account for just under half of all species. This gives an average of just over 2 species per genus, 9 per family. Families with 15 or more species are ranked (Table 3.a.2).

Table 3.a.2: The important plant families of the Okavango Delta Property

FAMILY		GENERA	TAXA
POACEAE	(Monocot)	68	194
CYPERACEAE	(Monocot)	20	98
FABACEAE	(Dicot)	40	98
ASTERACEAE	(Dicot)	42	70
ACANTHACEAE	(Dicot)	16	33
EUPHORBIACEAE	(Dicot)	16	31
MALVACEAE	(Dicot)	7	27
LILIACEAE	(Monocot)	15	27
AMARANTHACEAE	(Dicot)	14	22
CONVOLVULACEAE	(Dicot)	6	22
SCROPHULARIACEAE	(Dicot)	14	21
ASCLEPIADACEAE	(Dicot)	14	19
RUBIACEAE	(Dicot)	8	19
LAMIACEAE	(Dicot)	12	17
CUCURBITACEAE	(Dicot)	9	15
TOTALS		301	713

The above 15 families account for two thirds (66%) of all plants (and 62% of their genera). It will be noted that the grasses (Poaceae) are by far the most varied and that the sedges (Cyperaceae) legumes (Fabaceae) and composites (Asteraceae) also have large numbers of species. This primarily reflects the ecotonal nature of large parts of the Delta – as a wetland system, the interface between terrestrial and aquatic communities supports extremely high species densities. The 365 plants not ranked above are contained in 188 genera (or 78 families) - an average of just under 2 species per genus and almost 5 per family.

A number of species have special significance in the Okavango system. *Cyperus papyrus*, the giant sedge, is the dominant species in the channel bank communities of the perennially inundated swamps, and it is this plant's ability to grow apace of channel bed aggradation that drives the critical channel avulsion process responsible for changing water distribution patterns across the face of the alluvial fan. This process helps to maintain the surface of the delta as a freshwater system. *Phragmites australis* and *P. mauritianus*, (common reed) are important bank stabilising plants, and are widely used as building materials. The halophytic grasses *Sporobolus spicatus* and *S. ioclados* are selectively grazed throughout the Delta by wildlife and livestock as they contain high concentrations of vital minerals.

The diverse (commonly up to 27 species of woody plant, although this varies greatly with island size) and spatially varied riparian woodland which characterises island margins is critically important for its role in evapotranspirative pumping of water and concentration of salts, in addition to supporting a large and highly diverse community of frugivores.

There are also a number of species which deserve special conservation status. The orchids Ansellia africana (the only epiphytic orchid in Botswana), *Eulophia angolensis* and *E. latilabris* (terrestrial orchids of the perennial and seasonal swamplands) are all listed on the IUCN RDL as Threatened. The near-endemic orchid (*Habenaria pasmithii*) and the orchid *Zeuxine africana* (extremely rare in southern Africa) are listed as data-deficient. The sedge *Eleocharis cubangensis* is endemic to the Okavango basin (recorded only from Namibia and Botswana) is listed as data-deficient, while *Pycreus okavangensis*, another sedge, is classed as "lower risk", although widespread in northern Botswana.

Large mammals including threatened species of Outstanding Universal Value:

Within the Moremi Game Reserve are some of the highest diversities of animal species in southern Africa, comparable with the rich savannas found elsewhere in Africa (see Appendix 3). The Delta provides habitat for water dependent species such as Hippopotamus, Sitatunga and Red Lechwe which fall under the IUCN Red Data List.

The most striking are the number and diversity of large carnivores, the five large carnivores known scientifically as the 'guild of Africa's large carnivores' which are considered barometers of a healthy ecosystem. These include threatened and endangered carnivores such as the African Wild Dog, Cheetahs and Lions. Leopards are also common, as are Spotted Hyena and Aardwolf and many of smaller carnivores including African Wild Cat, Serval, Civet, Genet, Caracal, Black-foot Cat, Bat-eared Foxes, and nine species of Mongoose. Added to this is a fantastic diversity of herbivores from the largest single population of Elephants on the planet to some of the last migratory Zebra and Wildebeest populations in Africa. Added to this is a remarkable diversity of large African fauna are healthy populations of Southern Giraffe, water adapted antelopes such as Sitatunga and Red Lechwe, and an array of other antelopes such as Greater Kudu, Waterbuck, Reedbuck, Hartebeest, Sable, Roan, Impala, Steenbok and Duikers. It is no surprise that the Okavango Delta is one of the most recognized wildlife refuges in Africa.

Figure 3.10: Wild Dogs in the Okavango Delta (Peter Hancock).

Important bird species of the Okavango Delta

Of the 482 bird species occurring in the Okavango Delta, 24 species are globally threatened and near threatened There is a low level of endemism in birds in Botswana, however, the near-endemic Slaty Egret (*Egretta vinaceigula*) (which is classified as Vulnerable on the IUCN Red List) has over 85% of its global population confined to the property. The Okavango Delta also has the largest single population of the globally threatened Wattled Crane (*Grus carunculatus*) in the world, numbering 1 300 birds. There are an additional 20 globally threatened bird species which occur in significant numbers in the Okavango Delta – including six vulture species, and four other raptors, as well as a variety of water birds.

Flooded grasslands are vitally important to the ecology of the Okavango Delta property, being important feeding grounds for large herbivores, and are hunting grounds for the large predators. During flooding periods in the dry season they are critical breeding grounds for aquatic life, while more terrestrial mammals such as Red Lechwe reside out of the water on termitaria islands. Mendelsohn et al. (2010) have maps (see digital copy of book in Appendix) that describe the extent of the flooded system, especially now in the 2010-2012, high water years, a habitat that is a percentage of the total area of the site.

Figure 3.11: Wattled Crane (*Grus carunculatus*) in the Okavango Delta Property

3.b PROPOSED STATEMENT OF OUTSTANDING UNIVERSAL VALUE

The Okavango Delta is a large low gradient alluvial fan or 'Inland Delta' (half the size of Belgium) with permanent swamps approximately 6 000 km² in size, with an additional 7 000 to 12 000 km² of seasonally flooded grassland. It is Africa's largest endorheic delta, i.e. outflows do not reach the sea, being Africa's third largest alluvial fan. Furthermore it is near pristine being a largely untransformed wetland system. The biota has uniquely adapted their growth and reproductive behaviour, particularly the flooded grassland biota, to be timed with the arrival of flood-water in the dry, winter season of Botswana.

Permanent crystal clear waters and dissolved nutrients transform the otherwise dry Kalahari Desert habitat into a scenic landscape of exceptional and rare beauty, and sustain an ecosystem of remarkable habitat and species diversity, thereby maintaining its ecological resilience and amazing natural phenomena. The annual flood-tide, which pulses through the wetland system every year, revitalizes ecosystems and is a critical life-force during the peak of the Botswana's dry season (June/July).

Geological faults, part of the African Rift Valley System, are currently active and resulted in the capture of the Okavango River that has formed the Delta and its extensive waterways, swamps, flooded grasslands and floodplains. The Okavango Delta's dynamic geomorphological history has a major effect on the hydrology, determining water flow direction, inundation and dehydration of large areas within the Delta system. The water inflow-sediment-vegetation relationships control the dynamics of the flow/flood regimes. The site is an outstanding example of the interplay between climatic, geomorphological, hydrological, and biological processes that drive and shape the system. Subsurface precipitation of calcite and amorphous silica is an important process in creating islands and habitat gradients that support diverse terrestrial and aquatic biota within a wide range of ecological niches. The continuous transformation of geomorphic features such as islands, channels, river banks, flood plains, oxbow lakes and lagoons in turn influences the abiotic and biotic dynamics of the Delta including dry-land, grassland and woodland habitats. These ecological processes provide a scientific benchmark to compare similar and anthropogenically impacted systems elsewhere and give insight into the geological evolution of such wetland systems.
The Delta's diversity of sub-Saharan plants and animals is comparable with the species diversity elsewhere on the continent. However, the Okavango also sustain robust populations of some of the world's most endangered large mammals, such as Cheetah, Wild Dog and Lion, adapted to living in this wetland system. This rich biodiversity also sustains the needs of local communities. Botswana supports the world's largest population of Elephants, numbering around 130 000, for which the Okavango is a core area for this species survival.

The Okavango Delta is a refuge for biodiversity including Africa's mega-fauna, particularly during the dry season. The system maintains a species rich assemblage of plants and animals including populations of a number of globally threatened species. The diversity of plant species is exceptional with an average of 210 species per square kilometre. There are over 480 different bird species in the property, of which 24 are globally threatened. The area is thus internationally recognized as a key site for the conservation of birds and is a UNESCO listed Ramsar Site incorporating three Important Bird Areas (IBAs). Some 29 species of larger mammals as well as 69 species of smaller mammals are present. Some of the mammals are relatively restricted to the area mainly due to their habitat preferences, such as Sitatunga and Red Lechwe antelopes and Southern Reedbuck. In the Okavango Delta several species of mammals are also considered vulnerable or endangered and are protected by National and International protocols.

3.c COMPARATIVE ANALYSIS (INCLUDING STATE OF CONSERVATION OF SIMILAR PROPERTIES)

There are some, but not many, wetlands in the world that can be compared to the Okavango Delta System. The few that can be compared are in South America, Europe, Asia and Africa. Certainly the inland delta systems outside of Africa are entirely different ecological systems supporting their own unique biodiversity, but they are included in the discussion below for the purposes of comparison.

In South America, the Pantanal stands out as one of the world's largest wetland, encompassing some 210 000 km² of Brazil, Paraguay and Bolivia. It consists mainly of the low-altitude floodplain Rio Paraguay and its tributaries, which drop off the Brazilian planalto (Mittermeier et al., 2002). The Pantanal World Heritage property is, however, considerably smaller. Called the Pantanal Conservation Complex, it is a cluster of four protected areas with a total area of 18 000 km² located in western Central Brazil, and is thus comparable in size to the proposed Okavango site. Further similarities are that it was listed under the same criteria: (vii), (ix) and (x), as are proposed for the Okavango Delta property.

A differentiation is that while the Okavango belongs to a group of geologically described Inland Deltas or Alluvial Fans, the Pantanal is an immense alluvial plain. The Okavango system is endorheic, with no outflow to the sea; the Pantanal flows out to the Atlantic Ocean. What partly stands the Okavango apart is the diversity and number of mammals - 150 compared to the 80 recorded in the Pantanal. Furthermore the Okavango's large fauna are fully representative of Africa's sub-Saharan Pleistocene "mega-fauna" such as Elephant, Buffalo, Hippo, Rhino, Lion, Leopard, Cheetah, Wild Dog, Giraffe, Zebra and extremely diverse antelopes (12 species). Furthermore, of these several are globally endangered, such as Wild Dog, Cheetah and Black and White Rhinoceros. A further distinction lies in the developed and degraded upper catchment of the Pantanal which is the locus of intense mining activities, primarily for gold. The catchment of the Okavango by contrast is relatively lightly populated and the main human activities are centred on agriculture and therefore inflowing water is relatively unpolluted.

The Llanos Venezuelanos wetland is also vast and shared with Colombia and Venezuela. However, with over a million inhabitants, the system is quite transformed and threats include fire, cattle ranching, problems with livestock disease outbreaks such as Foot-and-Mouth Disease, and oil drilling (Mittermeier et al., 1999). Currently there are plans for making the Apure River in Venezuela navigable which would further impact this wetland.

In Europe the only comparable wetland is the Danube Delta Biosphere Reserve, shared with Romania and Ukraine, which is a labyrinth of water and land, made up of countless lakes, channels and islands at the end of the 2 860 km long Danube River. Whilst it is Europe's largest Delta and wetland flowing into the Mediterranean Sea, measuring approximately 6 260 km². Both properties have Ramsar designation, and the Danube Delta in the Carpathian region is a Biosphere Reserve and a World Heritage Site, and has Europe's largest herds of free living wild horse. However, it measures some 700 km² (considerably smaller than the Okavango), and it is also more transformed than the Okavango. Whilst of immense importance for its ecosystem function and service, natural resources for people and nature, and with significant biodiversity, as a temperate wetland it cannot, once again, compare with the Okavango's assemblage of African wildlife species and mega-fauna, and its unique hydrological and aquatic ecological processes, as well as the desert location of Botswana's wetland.

The Mesopotamia wetlands of southern Iraq, called marshes, historically comprised a series of shallow, permanent lakes interconnected by seasonal wetlands fed by the flow of the Tigris and Euphrates Rivers, forming a typical deltoid triangle, and their extent used to fluctuate between 10 000 to 20 000 km². The Tigris and Euphrates historically delivered annual pulses of floodwater comprised of spring flood-water from snow melt in the mountains of Turkey, Syria and Iran, which maintained the Mesopotamia marshes. At that time they were the largest marshes in southwest Asia, and twice the size of the Everglades. During the

1980/90s the Marshes have witnessed a significant reduction in their lateral extent (Cattarossi et al., 2010), due to extensive drainage that occurred under the Saddam Hussein Regime. The United Nations Environmental Program (UNEP) reports that about 90% of the marshlands were lost because of drainage and upstream damming. Much of the Hawizeh was dried, reducing the natural extension of the marsh and converting it mainly to a lake-dominated system. Following the removal of the Saddam Hussein Regime in 2003, local people set about breaking the embankments thus increasing the area to about 900 km² of marshlands. The new Government of Iraq has taken steps toward this restoration, including reintroduced water in degraded parts; establishing an environmental monitoring and research program thus ensuring accession to the Ramsar Convention on Wetlands of International Importance in October 2007. But there is renewed uncertainty of the future of the marshes due to water demands and the effects of climate change in periods of unpredictable drought (Maltby, 2010).

In Africa, the Inner Niger Delta, also known as the Macina, is a large area of lakes and floodplains in the semi-arid Sahel of central Mali, just south of the Sahara desert. However, it has been highly transformed by human-use, with the 2010 construction of a large upstream irrigation project which could reduce the deep inundation area by over 40%. Being one of the most densely population areas in the region, the Niger delta is largely unprotected and most large mammals have been eliminated by human population pressures. The Niger River (Lower Niger) in Nigeria forms a delta system in the Atlantic Ocean. There is extensive de-forestation, and the Kainji Dam construction and over 254 active oil fields significantly affect its biodiversity, and the aquatic profile and chemical composition of its waters (Powell, 1997).

The Sudd wetlands of Sudan are probably the largest flooded grassland and permanent swamp system in Africa measuring over 30 000 km² with the peripheral effects of the wetland believed to extend over 150 000 km². However, the area has long been affected by a protracted civil war which resumed again in 1983, resulting in massive uncontrolled hunting which impacted its remarkable antelope assemblage (Fryxell and Sinclair, 1988). The abandoned Jonglei Canal, which is 360 km long and 75 m wide, significantly affects the ecological integrity of the system. For example it is also detrimental to wildlife since it acts as a major barrier to animal movement and also fragments the ecosystem. Uncontrolled hunting, serious lack of management and incursion of cattle continue to threaten its large mammals, with elephant herds now virtually extinct (Stuart et al., 1990).

In conclusion, globally few other wetlands are as aesthetically beautiful, have outstanding natural processes and phenomena, have significant areas of flooded grasslands, or are as well protected and managed and as species rich as the Okavango Delta property. In a world-wide biodiversity comparison of seven globally important wetlands, of which 6 are located in tropical and sub-tropical areas, the Okavango has the highest number of reptiles and bird species, second highest number of plant and mammal species, and third highest number of fish species (Junk et al., 2006). The existing Moremi Game Reserve within the Okavango Delta has some of the highest dry season densities of large mammal species populations in southern Africa, which are comparable with the rich savannas in the East African Rift Valley.

3.d INTEGRITY

The Okavango Delta site is an undisturbed natural ecologically functional area of sufficient size at approximately 16 500 km² to comprehensively accommodate and represent all its features and its natural biophysical processes that maintain and support its communities of plant and animal species. Population sizes are sufficiently large to ensure their viability and genetic heterozygosity. Therefore it is considered that all the interrelated and interdependent elements are present within the site for the maintenance of its biodiversity in the long-term. There are no significant dams or major hydrological infrastructural developments such as canals and water abstraction throughout the system. The only developments that have taken place are limited tourism facilities such as small lodges and camps that must conform to rigorous environmental standards and all developments are privy to EIAs. All roads are not surfaced, yet allow people access to the site. Therefore all the elements that express its outstanding universal value are present.

The Okavango Delta is protected by Botswana laws, including environmental and conservation legislation and a suite of legal instruments. A large Ramsar site was listed in Botswana in 2004, and the proposed World Heritage site and its buffer zone lies within the confine of this Ramsar site. The region is listed in terms of UNESCOs Convention on Wetlands of International Importance.

Under a tri-National Agreement the critically important hydrological components of the system, such as water supply and quality, fall under a tripartite international water agreement between Botswana, Angola and Namibia called OKACOM - the Permanent Okavango River Basin Water Commission. Therefore this Agreement ensures that superlative natural phenomena and the aesthetic beauty of the property will be maintained. The Botswana Government will ensure that in terms of its obligations under the World Heritage Convention. The environmental and nature conservation legislation for Botswana is sufficiently adequate and comprehensive to ensure the protection of the Okavango Delta site.

The Moremi Game Reserve was established in 1964 by the Batawana community, and currently comprises an expanded area of 4 865 km² of the proposed World Heritage Site. The Government later took over the Game Reserve and committed itself to its management, although communities had to move out and were settled in the villages of Khwai, Mababe and Sankuyo. The Government later established adjacent Wildlife Management Areas and Controlled Hunting Areas in an effort to involve local communities in sustainable utilization and conservation of the natural resources of the area. In the Game Reserve only non-consumptive activities take place. The Reserve therefore has remained in a state of wilderness with very little human interference (apart from several airstrips and lodges, and a network of tracks, for game viewing and supplying the camps), providing total protection of the wildlife and natural vegetation.

Wildlife Management Areas (WMAs) and Controlled Hunting Areas (CHAs) that surround Moremi Game Reserve provide additional protection and habitats for migratory species. Furthermore the entire property (buffer and core areas) falls within the jurisdiction and requirements of the ODMP - the Okavango Delta Management Plan, which was adopted in 2003 following the Ramsar listing. This management plan forms part of this Nomination Dossier. The ODMP is currently being implemented by numerous governments, local and tribal institutions, but with the overall authority falling directly under the Ministry of Environment, Wildlife and Tourism. Species lists, their current status and other details are given in the Appendices.

Thus the Okavango Delta site is an outstanding example of climatic, geomorphological, hydrological, biological and biochemical processes which play out every year as an amazing natural phenomenon, and is one of the world's most intact natural wetland ecosystems. The site remains globally outstanding and is, we believe, worthy of inscription as a natural World Heritage Site under three World Heritage criteria (namely, vii, ix and x).

The Okavango Delta site stands out for its ecological integrity as it contains its original biodiversity

complement and has not been significantly transformed. This is not to say that people are not part of the ecosystem and inhabit the buffer zone in particular. On the contrary, communities are a vibrant and traditional part of the area, practicing African rural agricultural systems based largely on traditional knowledge and thereby living sustainably on its resources as they have done for hundreds if not thousands of years. In cultural terms these communities are the guardians of this rare wetland; their use of the land and its resources is managed in trust by the Tawana Land Board and its wards, village headmen and chiefs.

The long term objective of the Okavango Delta Management Plan (ODMP) is "to integrate resource management for the Okavango Delta that will ensure its long-term conservation and that will provide benefits for the present and future well-being of the people, through sustainable use of its natural resources". The existing diverse and complex nature of the Okavango Delta in terms of its natural resources, its wide range of users and uses, its multiple managers (both in and outside government and including communities) and an array of national laws, policies and guidelines as well as regional and international conventions, agreements and protocols are all factors that dictate the need for an integrated management planning process for the Okavango Delta. The Department of Environmental Affairs (DEA) in the Ministry of Environment, Wildlife and Tourism is responsible for overseeing the implementation of the ODMP. As a result, through the ODMP, DEA is mandated by the Botswana Government to ensure that the entire Okavango Delta, including the site, as a natural resource is used sustainably by all the user groups. DEA coordinates all the land use activities and ensures that such uses adhere to the principles of sustainable utilization of the wetland.

The Regional DEA office oversees and coordinates activities related to the use of the Okavango Delta by respective government departments and tourism operators. DEA ensures that all users of the Okavango Delta observe the ODMP in their day-to-day activities. For example, all tourism development projects by the Department of Tourism, Tawana Land Board, and Botswana Tourism Organization as well as by any other private tourism operators require an Environmental Impact Assessment (EIA) before the project commences or is issued with a license. Annual inspections of tourism projects and tourism enterprises in the Okavango Delta are carried out.

CHAPTER 4
CONSERVATION

4 - STATE OF CONSERVATION AND FACTORS AFFECTING THE PROPERTY

4.a PRESENT STATE OF CONSERVATION

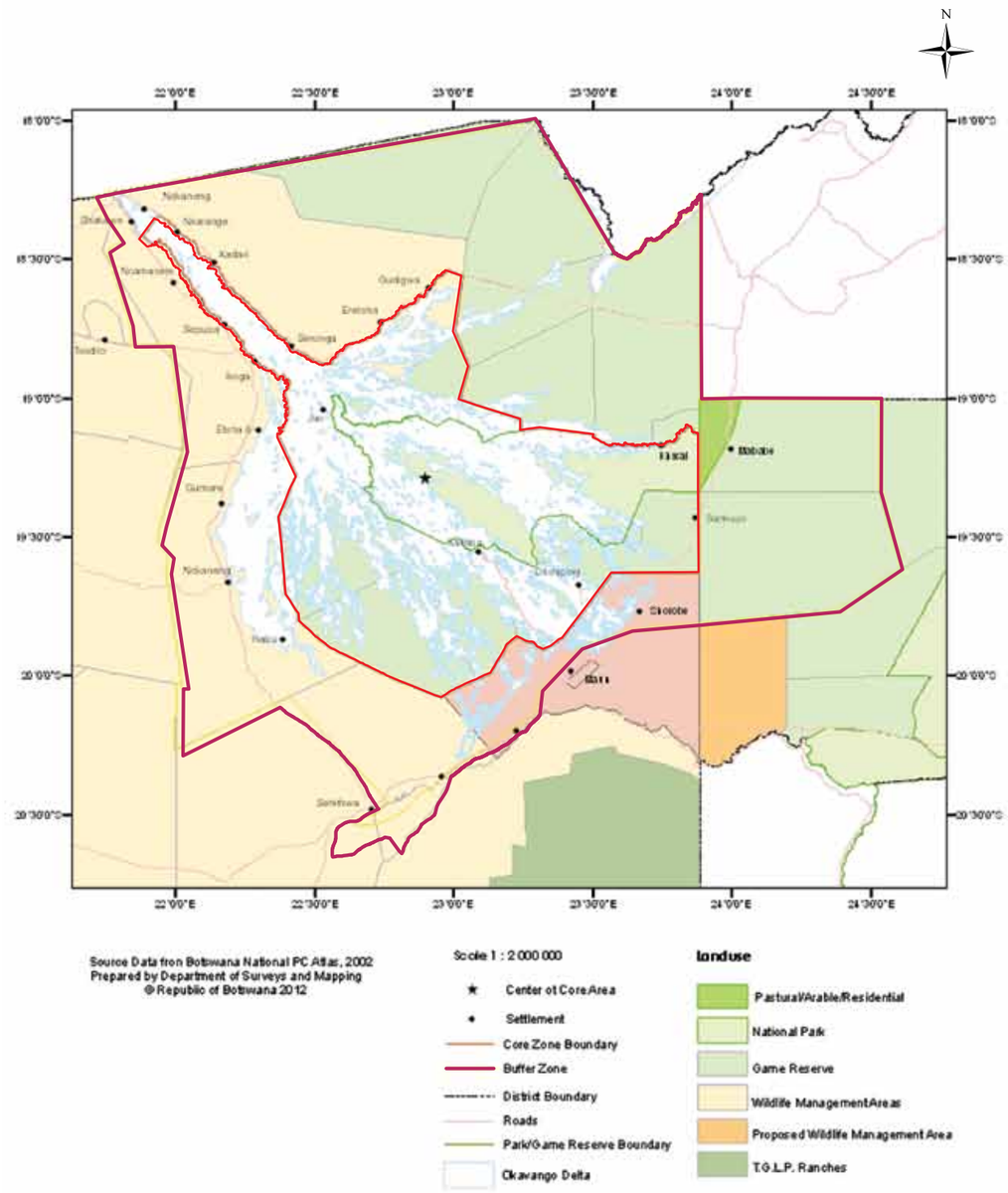
The Okavango Delta site is set in a semi- arid region and subject to large fluctuations in flooded area; the site includes permanent and seasonal swamps, riverine floodplains, flooded grasslands and a seasonal freshwater lake. The flooded grasslands form a critical habitat for many species of bird and wildlife at their Southern limits of distribution in the region. Although the diverse flora and fauna includes rare and endangered species, most populations are robust with sufficient range and resources to survive into the future. These rich and diverse resources give the area very high potential of eco-tourism activities which include recreation, tourism and subsistence farming and fishing, and recreational fishing. However, the entire core zone is wholly utilized for non- consumptive (photographic) tourism, where camp/lodge sites are leased to operators for photographic purposes only.

The Moremi Game Reserve is zoned into a medium density tourism zone, a low density zone and a wilderness zone, in which there is a progressively decreasing amount of human activity. The Game Reserve is a part of the Okavango Delta site and in this area all wildlife is protected. Traditional resource uses e.g. grass and reed cutting takes place on the fringes of the Reserve.

Nine Controlled Hunting Areas are zoned for community management, while a further twelve are zoned for commercial management. The area is divided into one Game Reserve, and several Wildlife Management Areas and/or Controlled Hunting Areas. In the community managed areas limited subsistence hunting takes place, while some small stock and donkeys are kept as well. All commercial and most community areas are managed under resource use leases given out by the Tawana Land Board. Most of the core zone has been declared a stock- free zone under the Diseases of Animals Act of 1977. The Moremi Game Reserve and the Wildlife Management Areas have protection under the Wildlife Conservation and National Parks Act of 1992. The government of Botswana recently concluded the development of an integrated management plan for the Okavango Delta (ODMP), which has a six year planning horizon commencing in November 2006 and aims at the sustainable use and management of the Okavango Delta resources.

In summary, the proposed site is in a largely unaltered condition, with the vegetation and animal groups in a robust state, and with the property under good conservation management by the authorities and the communities.

Previous page: Palm trees in the Okavango Delta Property (Karen S Ross)



Map 4.a.1: Land use designations in the Okavango Delta Property (Wildlife Management Area)

4.a.1 Conservation Status of Wildlife in the Property

Large mammals are most readily counted, and aerial surveys undertaken by DWNP in the past 2 decades do give an indication of numbers, trends and distribution. Tables giving the populations of key animal groups over the past decade are given in the Appendix 3.

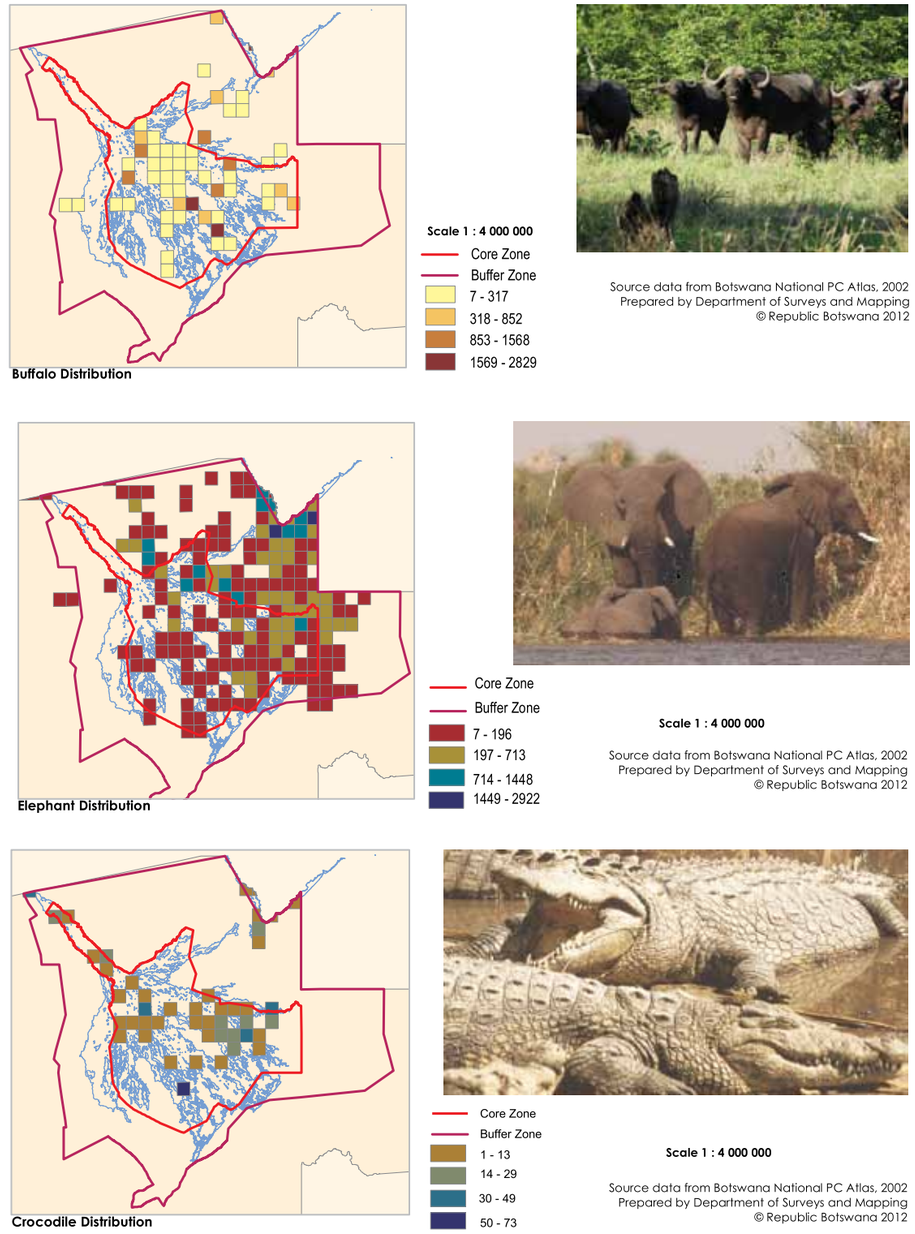


Figure 4.a.1: Distribution of Buffalo, Elephant and Crocodile in the Okavango Delta Property

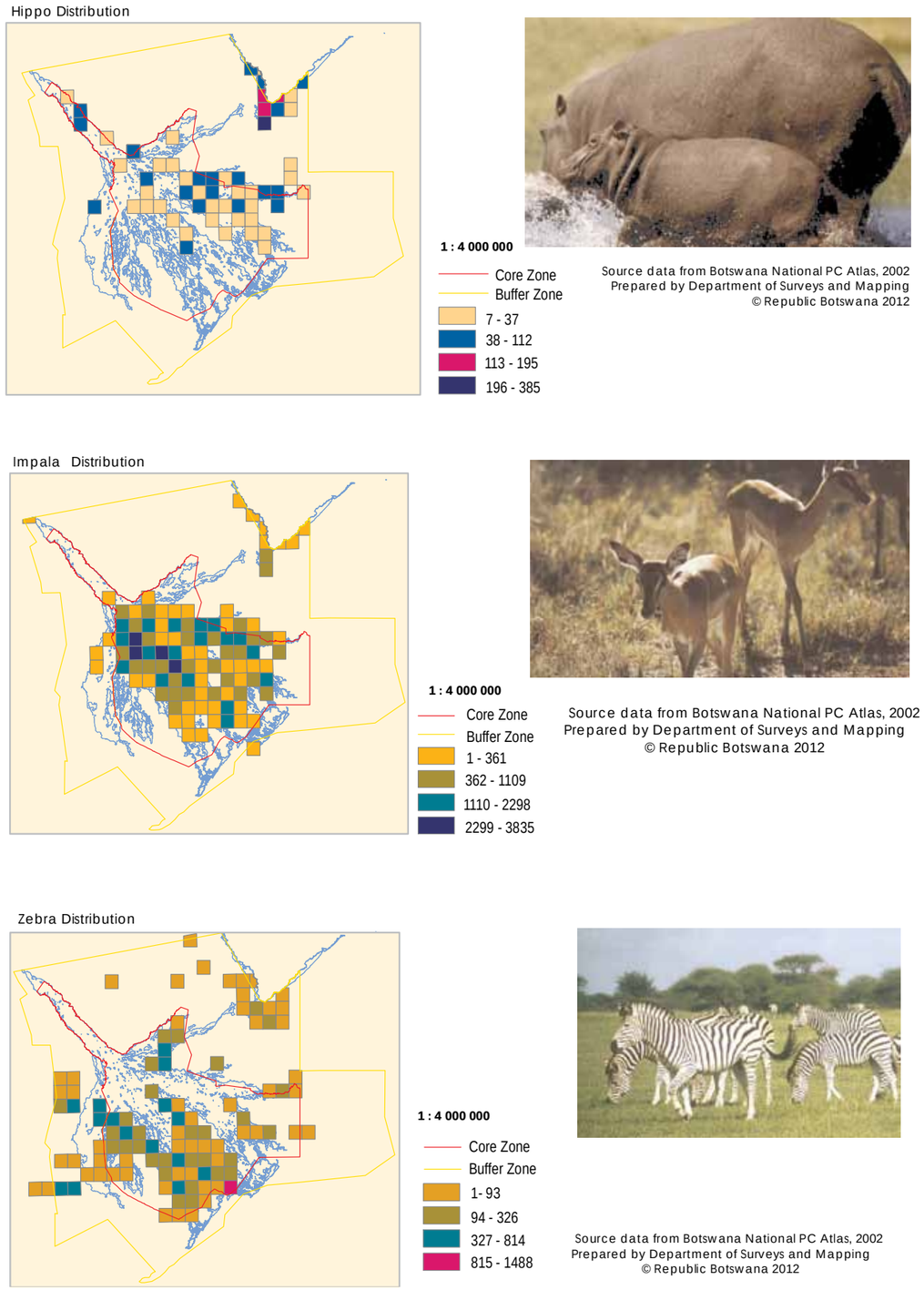


Figure 4.a.2: Distribution of Hippo, Lechwe and Zebra in the Okavango Delta Property

4.a.2 Laws and policies in place to secure conservation status of the Property

The importance of the protection of the Okavango Delta site at a national and international level is recognised by the Government of Botswana which has committed to the conservation and "wise use" of the Delta property under several laws and policies. At the international level the key Conventions are: The Ramsar Convention; The Convention of Biological Diversity (CBD), and the Convention on the International Trade in Endangered Species (CITES).

Table 4.a.1: Conventions ratified by Botswana

INSTRUMENT	YEAR	OBJECTIVE	RELEVANCE
The Convention on Wetlands of International Importance (Ramsar Convention)	Botswana ratified the Convention in 1997	The Convention advocates for the wise use of wetlands and their sustainable utilization for the benefit of mankind in a way compatible with the maintenance of the natural properties of the ecosystem	The Government of Botswana ratified the Ramsar Convention and became a contracting party as of 4th April 1997 and listed the Okavango Delta as a Ramsar site
United Nations Convention on Biological Diversity	Botswana ratified the convention in 1997	The objectives of the convention are to conserve biological diversity, promote the sustainable use of biodiversity components, and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.	The Okavango Delta is rich in biodiversity and genetic resources, the use and conservation of which is within the framework of this convention.
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	Botswana ratified the convention in 1978	The aim of the convention is to prevent extinction of endangered species by controlling international trade in the endangered species and their by-products	CITES deals with the trade in a number of wetland flora and fauna species, including elephants, and therefore is relevant to the management of the Okavango Delta.

INSTRUMENT	YEAR	OBJECTIVE	RELEVANCE
United Nations Convention on Combating Desertification (UNCCD)	Botswana ratified the convention in 1996	The object of this convention is to combat desertification and mitigate the effects of drought in countries experiencing serious drought and/or desertification. It flags effective action at all levels; international cooperation and partnership	The Okavango Delta is located within the Kalahari Desert which is susceptible to droughts and degradation. The convention provides a framework to facilitate action to combat desertification.
United Nations Framework for Convention on Climate Change (UNFCCC)	Botswana ratified the convention in 1993	The convention on climate change sets and overall framework for intergovernmental efforts to tackle the challenge posed by climate change	The Okavango Delta is an ecosystem which is highly susceptible to the impacts of climate change. The Okavango Delta is critical in that it acts as carbon sink through carbon sequestration
United Nations Convention on the Law of Non-navigational use of International Watercourses		It obliges riparian states to take into account the effects of the use or uses of the watercourses between riparian states and encourages harmonization of use	It provides the legal foundation for regulating the shared Okavango River Basin of which the Okavango Delta is a key ecosystem

National Level Laws that affect the Property

A. Environmental Laws:
- National Environment Act of 2005
- Environmental Impact Assessment Act of 2005
- Diseases of Animals Act of 1977
- Monuments and Relics Act of 2001

B. Conservation Laws:
- Wildlife Conservation and National Parks Act of 1992
- Forest Act of 1975
- The Fish Protection Act of 1975
- Tourism Act of 1992
- The Water Act of 1968
- Herbage Preservation Act of 1977
- Agricultural Resources Conservation Act of 1975

National Policies and Plans affecting the Property

The Wildlife Conservation Policy of 1986: This Policy is a blue-print for the re-introduction of community involvement in wildlife conservation through the implementation of Community Based Natural Resource Management Projects (CBNRMP), being designed to promote economic development of rural areas through the implementation of tourism projects. The policy recognizes the potential value of both consumptive and non-consumptive use of Botswana's wildlife resources by the people living in wildlife areas in the buffer zone of the property. The overall aims and objectives of the Wildlife Conservation Policy are;

• To develop a commercial wildlife industry in order to create economic opportunities, jobs and incomes for the rural population and to enable more rural communities to enter the modern wage economy. This is hoped to reduce the number of rural people relying on subsistence hunting and poverty.

• To implement rational and effective conservation and management programs that will ensure that wildlife is utilized on a sustainable basis.

• To obtain good economic return on the land allocated for wildlife utilization.

Through this policy, land in wildlife areas was sub-divided into zones called Controlled Hunting Areas (CHAs). CHAs are administrative land units used by the Department of Wildlife and National Parks (DWNP) to allocate wildlife quotas to local communities for tourism purposes, and communities decide on the type of land use, either for hunting or photographic safaris.

The CBNRM Policy of 2007:
This policy recognizes that due to limited agricultural development, government aims at diversifying the rural economy through natural resource development in order to fight against rural poverty and sustain livelihoods. The Government of Botswana also recognizes that "people who live closest to natural resources generally absorb the greatest costs associated with human/wildlife conflict. Given proper awareness and incentives, they are most likely to successfully benefit from the protected area and conserve the natural resources within their environs. For communities to actively engage in natural resource conservation, the benefits from such resources must exceed the costs of conservation. CBNRM aims to achieve this by offering eligible communities opportunities to earn tangible benefits from sustainable natural resources management (Ministry of Environment, Wildlife and Tourism, 2007:1). Specific objectives of the CBNRM Policy can be summarized as follows:

• To provide guidance on CBNRM implementation on communal and state-owned land, except within such specifically excluded areas as officially gazette protected areas, forest reserves, national parks and game reserves.

• To give communities incentives to engage in conservation activities leading to sustainable development and poverty reduction.

• To establish an institutional, regulatory and participatory framework for the implementation of CBNRM; and

• To promote and ensure a responsible, accountable and transparent decision making process in CBNRM.

Okavango Delta Management Plan (ODMP) of 2008:
The ODMP is included as an Appendix and is thus a part of this Nomination Dossier. The ODMP is the Government of Botswana's initiative through the support of German Development Service (DED), Swedish International Development Agency (SIDA) and Danish Development Agencies (DANIDA) respectively in developing the management plan for the Okavango Delta. The overall objective of the ODMP is to carefully manage the functioning ecosystem of the Delta site in a manner that ensures equitable and sustainable utilisation, which will provide benefits to the local, national as well as international stakeholders.

The overall goal of the ODMP is made up of three Strategic Goals, each with several Strategic Objectives as outlined below.

Strategic Goal 1:
To establish viable institutional arrangements to support integrated resource management in the Okavango Delta.

(i) **Strategic Objective 1.1:** To establish viable management institutions for the sustainable management of the Okavango Delta.

(ii) **Strategic Objective 1.2:** To improve the planning and regulatory framework for sustainable management of the Okavango Delta.

(iii) **Strategic Objective 1.3:** To raise public awareness, enhance knowledge and create a platform for information exchange and learning about the Okavango Delta.

Strategic Goal 2:
To ensure the long-term conservation of the Okavango Delta and the provision of existing ecosystem services;

(i) **Strategic Objective 2.1:** To conserve the ecological character (biotic and abiotic functions) of the Okavango Delta, and the interactions between them;

(ii) **Strategic Objective 2.2:** To maintain or restore the wetland habitats and ecosystems of Okavango Delta.

Strategic Goal 3:
To sustainably use the natural resources of the OD in an equitable way and support the livelihoods of all stakeholders:

(i) **Strategic Objective 3.1:** To sustainably use the natural resources of the OD for the long term benefit of all stakeholders;

(ii) **Strategic objective 3.2:** To develop socio-economic opportunities to improve livelihoods of the OD stakeholders.

The development of ODMP therefore goes a long way in ensuring integration of resource management and long-term conservation as well as provision of benefits of the present and future well-being of the people, through sustainable use of its natural resources in the buffer zone.

Maun Development Plan (1997 - 2021):
Maun has in the last two decades undergone much tourism development and Maun has also grown in terms of human population (CSO, 2002) and infrastructure development to support the tourism industry (Mbaiwa, 2002). In view of the above, a spatial development plan for Maun has been written to encourage modern forms of business activities and service concentration that encourage tourism development. The implications of these planning goals to tourism are that Maun will in the near future develop into a modern city that will promote more tourism development.

Importantly, the buffer zone between the urban edge of Maun and the boundary of the Okavango Delta site is sufficiently wide to ensure there would be no adverse impacts that would affect the Outstanding Universal Values of the property.

Ngamiland Integrated Land Use Plan of 2009:
This is a single unifying document that guides and shapes utilization of land and other resources in Ngamiland, and applies particularly to the buffer zone of the site. This goal is to be achieved in a sustainable and equitable manner, based on existing land tenure, land use potential and land utilization type. The overall goal of the Ngamiland Integrated Land Use Plan is to give direction in land use planning and a map that depicts the land use zones. Key objectives of the plan include the following:
a. To facilitate balanced land use utilization and where appropriate remedy imbalances and solve conflicts. Land utilization in this context relates to ensuring that natural resources are allocated to competing land uses in a manner that acknowledges their socio-economic and environmental significance as well as sustainability of the uses.

b. To promote conservation of natural resources for the benefit of existing and future generations. This objective underlines the need to protect natural resources from excessive human activities and settlement expansion.

c. To rationalize and promote optimal utilization of land.

d. To interact with all relevant Government Ministries and departments where necessary in order to facilitate a smooth implementation of the national projects and policies without causing land use problems.

e. To advise Tawana Land Board, the Department of Land Board Service Management and other relevant key players on land use concerning the allocation of land on the basis of the approved land use zones.

This plan recognises natural resources as a key commodity that has to be used sustainably. Collaboration with stakeholders particularly government ministries and departments as well as local people is meant to reduce land use conflicts thereby achieve sustainability. There is no doubt that Ngamiland is known for its rich biodiversity which has become Botswana's key tourism attraction. If planning for such resources is done with the goal of minimizing resource conflicts and over exploitation of the resources, there is no doubt that wildlife-based tourism in the Okavango Delta site will rise sharply in the planning period provided all other factors remain constant including flooding patterns within the Okavango Delta.

Shakawe and Mohembo Development Plan (2006 - 2030):
The villages of Shakawe and Mohembo, the buffer zone of the site, fall within the physical planning component of the Okavango Delta Management Plan. The Plan has in total ten goals. Key goals are:

a. To create well planned and organised living environments for Shakawe and Mohembo West that is decent, safe, and functional and satisfies various community needs.

b. To provide adequate residential land to meet existing and future housing needs in Shakawe and Mohembo West.

c. To boost and diversify the economic bases of Shakawe and Mohembo West and enhance the opportunities for the creation of employment and investment flows.

d. To provide safe, functional and convenient circulation systems in the development plan areas.

e. To improve infrastructure services in Shakawe and Mohembo West to adequate and affordable standards.

f. To improve sanitation practices in the development plan areas.

g. To provide adequate civic, community and social services in the development plan areas.

h. To protect and preserve the fragile environment and the conservation of natural resources in the development plan areas, in the interest of sustainable development.
i. To protect and preserve fertile arable land from settlement encroachments and the encouragement of good agricultural practices in the development plan areas.

j. To establish unique identities of the villages based on aesthetically pleasing environments.

Like other plans in Ngamiland, the Shakawe and Mohembo West Plan aims at conservation of the natural resources found in the area through sustainable means of allocation and management. The Plan takes into consideration the Okavango River Panhandle Management Plan of 2001 which cover aspects of land use and land management, tourism development and carrying capacities, conservation of natural resources and the protection of the environment, boat engines sizes that can be allowed in the river, community involvements in resources management and tourism development, thus creating a good atmosphere for tourism development.

Table 4.a.2: Regional agreements and protocols

INSTRUMENT	YEAR	OBJECTIVE	RELEVANCE
Permanent Okavango River Basin Agreement	1994	The Permanent Okavango River Basin Commission (OKACOM) is a political agreement which commits the river basin states to work toward joint management of the Okavango River System	Under the OKACOM Agreement, the riparian countries of Angola, Botswana and Namibia are working toward the implementation of an Integrated Management Plan (IMP) for the basin on the basis of an Environmental Assessment (EA). OKACOM is important in that the Okavango Delta is part of a shared river basin, the Okavango River Basin. The ODMP is expected to contribute to the river basin management plan.
Southern African Community (SADC) Shared Watercourse Systems Protocol.	Signed in 1995 and came into effect in 2001.	The protocol calls for equitable utilization of shared water courses and monitoring of the implementation of integrated water resources plans in shard water courses by member states.	The Okavango River Basin, which the Okavango Delta is part of, is a trans boundary river basin and it is important that its management be a joint effort amongst the three riparian states which are all SADC member states.
SADC Protocol on Fisheries.	Signed in 2001 and effected in 2003.	This protocol applies, amongst others, to living aquatic resources and aquatic ecosystems within the SADC states; living aquatic resources of SADC states that extend outside the areas of their jurisdiction; and fishing by nationals of SADC states and activities directly related to fishing.	The Okavango Delta is a Wetland which supports about 71 identified fish species. The fish resources found in the delta provides livelihoods to the local communities within the ODRS. The fishery industry has to comply with the framework of the protocol at regional level (SADC).
SADC Protocol on Development of Tourism.	Signed in 1998 and effected in 2002.	The objectives of the protocol are to use tourism as a vehicle to achieve sustainable social and economic development, and to ensure equitable, balanced and complementary development of the tourism industry region-wide.	The Okavango Delta is one of the iconic tourism products within the SADC region. Within Botswana the Delta is a major tourism destination which supports the economy of the ODRS. The Okavango Delta also forms part of the Kavango-Zambezi Trans frontier Conservation Area. The intention is to offer the area as a regional tourism product, hence the relevance of the provisions of the protocol.
SADC Protocol on Wildlife Conservation an Law enforcement.	2003	Its principal objective is to establish common approaches to the conservation and sustainable use of wildlife resources and to assist with the effective enforcement of laws governing those resources.	Some of its aims are to assist regional capacity for wildlife management' conservation and enforcement of wildlife laws; to promote the conservation of shared wildlife resources through the establishment of trans-frontier conservation areas; to facilitate community-based natural resources management practices for management of wildlife resources. The Okavango Delta is rich in wildlife resources and hosts a significant number of community based organizations who benefit from wildlife resources.

4.b. FACTORS AFFECTING THE PROPERTY

(i) Developmental pressures

Impacts of boating on aquatic and terrestrial species

Boating is a common practice in the Okavango Delta and a variety of powered engine boats are in use. Power boats are used for supplies of resource, leisure for tourists, fishing and as a form of transport. The fast movement of power boats creates waves which disturb nesting birds, mammals and reptiles which live in water. For example, Hippos that used to be in the Xakanaxa lagoon in the core zone have since relocated due to frequent boating activities (Roodt, 1998). The heronries at Xakanaxa and Gadikwe used to be the largest breeding sites in Southern Africa for Marabou and Yellow-billed storks (as well as significant numbers of other species), but have severely dwindled by 2011 (no birds of any species breeding at Xakanaxa and only two pairs of Marabou Storks breeding at Gadikwe) due to disturbance from tourist boats which approach the nesting birds too closely and too frequently (P. Hancock, pers. comm.). African Skimmers breeding on sandbanks along the Panhandle have similarly been negatively affected (Vial, 1995). Power boats have contributed to the noticeable decrease in the breeding population.

In the upper parts of the Okavango Delta property, the Natural Resources People (NRP, 2001) estimates that there are roughly 111 power boats owned by the different tour operators. According to NRP, noise pollution and the action of waves from boats has disturbed, and led to a drastic decline in waterfowl populations. Power boat engine of house boats produces a wake and vibrations that disturb fish nests and African Skimmer nests. In response, the authorities have introduced "no wake zones" at key sites along the Okavango River, such as African Skimmer breeding sites, where boats are required to slow down thereby eliminating boat induced wakes.

Water contamination and pollution

Tourism growth is normally coupled with increasing local populations which has placed pressure on the environment with respect to liquid waste management. McCarthy et al. (1994) argue that the water table in the Okavango Delta is usually less than one meter below the surface during flood seasons and, as such, discharge of effluent into the ground makes contamination of the ground water unavoidable. The average per capita waste water generated from each camp/lodge is 200 litres per person per day. Close to 80% of the camps/lodges use septic tank and-soak away waste water treatment system. This system has been found to lead to contamination and pollution of the Okavango Delta's low nutrient water. McCarthy et al. (1994) warn that the discharge of waste and sewage effluent into the ground has the potential to pollute the borehole water supply used in many of the tourism camps and lodges in the Okavango Delta. Much of the sewage generated from the lodges and camps in the Okavango Delta property is directly discharged into the soils while solid waste, particularly litter, is often burnt in dug pits.

In areas with high concentrations of tourist activities and appealing natural attractions, waste disposal is a serious problem and improper disposal can be a major despoiler of the natural environment, rivers, scenic areas, and roadsides. Solid waste and littering can degrade the physical appearance of the water and shoreline and cause the death of aquatic and coastal animals. Improper disposal of liquid and solid waste generated by the tourism industry is a problem in developing countries that lack the capacity to treat waste materials properly. Disposal of such untreated waste has, in turn, contributed to reducing availability of the above-mentioned resources at the local level. Apart from the contamination of freshwater from pollution by untreated sewage, tourist activities can also lead to land contamination from solid waste and the contamination of fresh waters from pollution generated by lodges.

Furthermore, potential threats exist to water quality from upstream agricultural developments in Namibia and Angola. Run-off from large-scale agricultural developments where fertilizers are used could result in eutrophication and/or contamination of the Okavango's waters which are typically pure with very low dissolved solids. Similarly, leaching of agricultural chemicals, especially pesticides, could result in serious pollution downstream in the Okavango Delta property.

Human pressure including agriculture

The Bayei brought the "mokoro" (dug-out canoe) to the Delta, which has become symbolic of travel in the Delta for different activities such as fishing, photography and leisure purposes.

Figure 4.b.1: Fisherman on a mokoro in the Panhandle of the Okavango Delta Property (Tim and June Liversedge)

Local communities in the buffer zone of the site derive part of their livelihood from fishing, which is a complementary activity to a myriad of livelihood strategies ranging from crop production, livestock rearing, basket making, beer brewing, and harvesting of wood, reeds and medicinal plants. Dry land farming is practiced mainly at subsistence level. Reeds, papyrus and palms are used for building homes, making mats and baskets - the latter being for local consumption as well as for sale to tourists.

The Hambukushu are the original makers of the baskets that have made Botswana famous for the craft. Plant products for food include fruit of trees but also several water plants like water lilies and bulrushes. The people have considerable knowledge of the flora and fauna in the Delta region, especially plants that are used for medicinal purposes. However, such resource use needs to be sustainable, and there is a potential for over-use in the buffer zone.

Tsetse Fly control in Botswana

The former presence of tsetse flies in the northern Botswana and the Okavango Delta once caused human and animal trypanosomiasis, which resulted in a long government campaign to eradicate the fly vector. In 1973 - 1991 regular sequential aerial spraying of endosulphan was done, followed by the use of a cocktail of endosulphan and synthetic pyrethroids. Due to the toxic effects of endosulphan on non-target species, particularly fish, sequential aerial spraying was stopped in the early 1990s in favour of the odour baited targets which were used from 1991 - 2000. The odour baited targets were successful in suppressing tsetse fly populations but could not achieve eradication. Moreover they were continuously damaged by elephants and baboons, resulting in high maintenance costs. Consequently, trypanosomiasis had affected over 300 cattle around the Okavango Delta by 1999. In the year 2000, the African Heads of States Meeting of the then Organization of African Unity resolved that the eradication of tsetse fly should be a collective responsibility of all countries. Thus a Pan African Tsetse and Trypanosomiasis Eradication Campaign (PATTEC) was formulated with the mission of eradicating tsetse and trypanosomiasis within the shortest possible time.

With the advent of better environmental awareness and international conventions, and the increasing need to manage and maintain biodiversity, aerial spraying for the eradication of tsetse was preceded by an EIA and accompanied by environmental monitoring of terrestrial invertebrates, aquatic micro-invertebrates, fish, eco-toxicology, birds, tourism and socio-economic matters of concern. The environmental monitoring of the impact of deltamethrin on non-targets organisms involved three main phases. Phase I Pre-Spraying Monitoring, Phase II Post-Spray monitoring and Phase III Recovery Monitoring. Spraying of deltamethrin reduced the total abundance of both aquatic and terrestrial invertebrates in the short-term, but overall their numbers recovered after spraying.

Following the implementation of PATTEC, the Botswana government successfully eradicated tsetse flies from the Okavango Delta and the Kwando-Linyanti areas using sequential spraying of deltamethrin, a pyrethroid of low toxicity to mammals and birds. A total area of about 17 000 km^2 was sprayed. Due to this successful elimination of the Tsetse fly, aerial spraying currently does not take place in the Okavango Delta site or elsewhere in Botswana.

Water extraction

In spite of natural variations of water inflow and its effect on new and old river systems, the Okavango Delta has fortunately remained remarkably unaffected by any significant man-induced impediments. This is not to say, however, that serious environmental threats have not risen to threaten the conservation value of the Delta in the past. During the development of the Orapa diamond mine in the 1970s, numerous small bunds and the dredging of about 8 km of the Boro River, which is the only river to exit the Okavango Delta system through Maun, took place. Many communities saw their water systems, flooding areas and breeding grounds for fish and animals diminish. So much so that when the Southern Okavango Integrated Water Development Plan (SMEC/SOIWPD 1988) was to be implemented in 1987 to dredge 36 km of the Boro River, the communities joined forces with the rising protest of conservationists in Botswana, amidst a rising tide of international concern. It was largely due to community objections, voiced at the famous "Kgotla" of January 12th, 1991, that the project was halted, 3 days before work was due to start.

The Botswana Government then invited the IUCN to undertake a review of the SOWIDP project, popularly known as the "Boro dredging project", an investigation by a team of thirteen experts, including anthropologists, hydrological modellers, ecologists and other experts. After two years the review was completed (IUCN/SOWIDP, 1992), and found that the project was flawed on socio-economic, hydrological and ecological grounds, thus the project was abandoned. This indicates both potential threats to the Delta, and the power of the local tribal communities as guardians of their heritage. The Okavango Delta system is also vulnerable to the actions of upstream riparian neighbours, Namibia and Angola, and for this reason World Heritage status would be an important factor in assisting the

community guardians, the Government of Botswana and civil society in protecting this outstanding ecosystem.

Towards the end of the dry 1990s decade, Namibia announced their intention of connecting their Eastern National Water Carrier to the Kavango River to "provide water to Windhoek and the surrounding areas". Fortunately the good rains of 1999, local and international concerns (Rothert, 2001; Conservation International, 2002) led to the project being temporarily shelved. An application for this project has recently been revived to undertake a feasibility study.

To address these water issues in Southern Africa including the Okavango River Basin, members of the Southern African Development Community (SADC) have responded with a protocol on shared river basins known as the SADC Protocol on Shared Watercourses of 1995, revised in 2001. The Protocol addresses issues relating to the utilization of water resources of international character. Furthermore, countries of Botswana, Angola and Namibia agreed to form the Okavango River Basin Commission (OKACOM). OKACOM aims to ensure that the natural resources in the Okavango River Basin are used sustainably.

Threats from mineral exploitation

The Ministry of Energy, Mineral and Water Resources has issued several mineral prospecting licenses to exploration companies for concession areas within the buffer zone of the site. No licenses have been issued within the core zones of the property. Should an application to mine within the buffer zone arise, and Environmental Impact Study (EIA) will be required as part of Botswana's EIA Act, which would address concerns relating to the World Heritage property. Also the matter would be referred to the World Heritage Centre (WHC) for their advice.

(ii) Environmental pressures

Invasive alien vegetation

Salvinia molesta is a floating water fern native to south-eastern Brazil which has become invasive in Botswana when it was transported from the Kwando/Linyanti to the Okavango Delta, either by animals or man in the 1980s. The weed was first discovered in the Moremi Game Reserve in July 1986 (Forno and Smith, 1999), and it gradually infested several areas of the Delta and its current status indicates that it has started moving out of the Moremi Game Reserve. The negative impacts of Salvinia in the Okavango Delta include: blockage of streams and channels, choking back water bodies such as ponds and lagoons, elimination of indigenous vegetation, impairing the access of wildlife to drinking water, disrupting the navigation and recreational activities such as fishing and tourism thereby affecting the socio-economic conditions of the area. Salvinia infested water is known to have less O_2, high turbidity and high nutrient accumulations, thus impacting aquatic life, and by causing fish mortality, and thus impacting livelihoods.

Mitigation:

Salvinia molesta is being brought under control by a host-specific bio-control agent, the weevil *Cyrtobagous salviniae*. Biological control has now proved to be effective against *S. molesta* in Botswana and is now the preferred strategy of control. Systematic monitoring sites of 3-5 km distance encompassing riverine wetlands, pools and lagoons were demarcated in the infested areas in 1999 and 2000 (Kurugundla, 2003). Adult *C. salviniae* with its larvae and pupae stages were collected in the areas of high density weevil populations and seeded in the sites of infestations of less biocontrol. By 2003 the Salvinia infestations in several areas of Moremi Game Reserve were brought under control.

Figure 4.b.2: Biocontrol weevil in a Hippo pool in the Okavango Delta Property

Human-Elephant conflict

There is a potential for increased human-elephant conflict which is an on-going matter managed by the Department of Wildlife and National Parks.

Livestock diseases

The core area of the Delta site is virtually livestock free, except for the Panhandle area, due partly to the historical occurrence of Tsetse fly and the associated disease, sleeping sickness or Nagana, as well as the potential threat of the spread of Foot and Mouth from wildlife to cattle. Livestock development has impacted negatively on the area in the past through the extensive construction of Veterinary Cordon Fences which have obstructed wildlife movements in places, and increased poaching due to new access roads along the fence lines. However, in the early 1980's the Southern Buffalo Fence was constructed to control the movement of buffalo, carriers of FMD, to separate livestock and wildlife by keeping cattle out of the core zone of Okavango Delta. This fence has been, and still is, useful in keeping cattle outside of the core zone of the Delta property, and currently marks the lower boundary of the core zone of the site.

Other agricultural threats related to agricultural activities;

• Molapo fields located in channels in the buffer zone of the site might block the water-flow and cause local degradation from loss of habitat and biodiversity.

• Clearing of riparian vegetation for arable lands in the buffer zone of the site leads to degradation loss of riverine trees and biodiversity.

• The use of agro-chemicals in arable farming in the buffer zone pollutes water channels and can be hazardous to aquatic plants and animals.

• In order to protect the Okavango Delta buffer zone area from these threats, the Botswana government has introduced the following measures:

• The government Livestock Management and Infrastructure Development (LIMID) programme helps farmers to drill and purchase boreholes in the sandveld away from the Delta property.

• Several Veterinary Cordon fences were constructed following the outbreak of Contagious Bovine Pleuro Pneumonia (CBPP) in 1995 as a way of minimizing interaction between wildlife and livestock.

• Farmers are allocated ploughing fields away from the delta.

(iii) Natural disasters and risk preparedness

Earthquakes

Okavango Delta system lies within the terminus of the East African Rift Valley where there is active faulting. This is likely to result in occasional shifting of channels that could greatly affect the hydrology of the whole system causing changes in vegetation communities and sediment flow and nutrient distribution. The semi-arid climatic characteristic of the area is highly unreliable resulting in episodic droughts hence affecting the ecology of the area. Although muffled by deep sand, tectonic movements may cause significant changes in the distribution of flow across the Delta (as described above). However, most tremors have been small, although one in Maun in 1952 measured 6.7 on the Richter scale.

Climate change

The potential effects of climate change on the Delta have been a research focus for ORI for several years. Modelling efforts initially focussed on the Delta itself, and assessed potential changes resulting from both possible climate change and anthropogenic change in the catchment. In broad terms, the variation in the outputs from the many Global Circulation Models (GCMs) is much wider than the observed variation in climate. Because of this, the approach has been to use a large suite of GCMs and to look for convergence in predictions of change. In our current understanding, it seems likely that there will be some increase in evaporative losses of water in Delta, due to (relatively certain) increases in regional temperature. Changes in rainfall pattern are much less certain, and seem likely to remain similar (in terms of variability, at least) to the existing record.

Modelling vegetation change based on Delta inflows simulated by 3 widely differing GCMs suggests that if reduced inflows occur as a result of drying in the catchment, grassland and savannah woodland will replace some portions of the Delta currently classed as seasonally flooded grassland (Murray-Hudson, 2009). Likewise, increased inflows from increased precipitation and runoff in the catchment are likely to result in expansion of regularly seasonally flooded and perennially flooded communities at the expense of seasonally flooded grassland. However, these modelled outputs were based on relatively coarse scaled simulations of catchment hydrology. Present modelling initiatives are looking at the possibilities for statistical downscaling of GCM outputs for both the Delta and the upstream catchment (Wolski et al., submitted). Through faculty on sabbatical, ORI has established close links to the Climate System Analysis Group (CSAG) at the University of Cape Town, where a major initiative is the Coordinated Regional Downscaling Project (CORDEX) (http://www.csag.uct.ac.za/cordex/). In addition, ORI is the host institution for SACCNET, the Southern Africa Climate Change Network (www.saccnet.org).

Fires

Most fires in the Okavango Delta property are reportedly started by people, mainly during May before the annual floods and in September before the summer rains and first associated lightning (Mbaiwa, 2002; Tacheba, 2010). Reasons for starting fire are related to;

• Attracting wildlife to fresh pastures to offer tourists greater chances of seeing wildlife,

• Improving the quality of grazing for livestock and wildlife in the buffer zone of the site,

• Gaining access to fishing grounds,

• Improving the quality of thatching grass, reeds and papyrus and

• Clearing land for cultivation in the buffer zone of the site.

(iv) Visitor/tourism pressures

The Okavango delta property is a showpiece for Botswana's tourism and is known worldwide as a tourist attraction not to be missed, coupled with the nearby Chobe National Park. There are several policies and development plans that control the development of tourisms adverse impacts on the

Okavango Delta site. These are;

• The Tourism Policy of 1990 (under review).

• The Wildlife Conservation Policy of 1986 (under review).

• The Community Based Natural Resource Management Policy of 2007.

• National Ecotourism Strategy of 2002.

• Ngamiland Tourism Development Plan 2007 and the Ngamiland Land Use Plan.

The Tourism Policy of 1990

It is the key policy in the control, monitoring and promotion of tourism in the Okavango Delta site. The policy describes tourism as the new "engine of growth" of which the main aim is to diversify the country's economy from reliance on diamond mining through the promotion of tourism (GoB, 1990). The policy has consistently promoted the ideal of "low volume/high cost" which keeps the impact of visitor use to a minimum.

Some of the specific objectives of the policy include the following:

• To increase foreign exchange earnings and government revenue.

• To generate employment, mainly in rural areas.

• To raise incomes in rural areas in order to reduce urban drift.

• To promote rural development and stimulate the provision of the services in remote areas of the country.

The Tourism Policy also emphasizes the need for increased local participation in the tourism industry. It acknowledges the need for diversification of the tourism product to lessen concentration in the attractions in the northern part of the country such as the Okavango Delta and the Chobe National Park. The Tourism Policy is currently under review. It is assumed that the review will expand tourism development in the Okavango Delta site. The future impacts of the reviewed Tourism Policy in the Okavango Delta are that tourism activities, infrastructure development and tourist numbers will possibly increase. As a result, increase pressure on natural resources will need to be managed so as not to result in any negative environmental impacts. Another scenario is that if flooding levels, in particular parts of the Okavango Delta, changed (e.g. decrease) either through the natural processes or through upstream abstraction (e.g. Namibia or Angola), there would be a likelihood that tourism development in the wetland would be affected. For example, during high flooding patterns, roads became impassable and self-drive tourists were unable to drive out to game view. As a result income at Moremi Game Reserve would decline.

The Botswana National Ecotourism Strategy of 2002

The NES ensures that all elements of tourism development planning and management facilitate, promote and reward adherence to the key 'principles' of ecotourism by all parties involved in the tourism industry. There are five main principles which have come to guide ecotourism development in Botswana, these include;

• Minimising (or avoiding) negative social, cultural and environmental impacts.

• Maximising the involvement in, and the equitable distribution of economic benefits to, host communities and citizen entrepreneurs.

• Maximising revenues for re-investment in conservation.

• Educating both visitors and local people as to the importance of conserving natural and cultural resources.

• Delivering a quality experience for tourists (without which tourists will not continue to visit, and so the benefits to conservation and development will not be sustained).

The NES promotes community-based tourism development in Botswana using any nature based product that can be sold in the tourism market. The Okavango Delta is endowed with a variety of natural resources. As a result, if the various communities in the Okavango Delta are to benefit from tourism development in their local environment as the NES envisages, the increased pressure on the use of natural resources from the wetland would need to be closely monitored to ensure sustainability.

Ngamiland Tourism Development Plan of 2007

The plan strives for the development of a world class nature-based tourism destination that is economically sustainable and optimises benefits to local communities and the nation within agreed limits of acceptability. In its development of tourism in the Okavango Delta site, the plan is guided by the following ideals;

• Develop and promote Maun as the gateway to the Okavango Delta.

• Develop a tourism gateway business centre at Maun Airport.

• Broaden the permissible configuration of tourist lodges in the Okavango Delta. It also promotes a range of different configurations of accommodation facilities permissible with a defined tourism development node or nodes. The number of permissible tourist facilities is dependent upon the defined, mapped tourism resources within the concession area.

• Close part of Moremi Game Reserve to self-drive tourists. The concept of closing part of Moremi Game Reserve to self-drive tourists is to create opportunities for the provision of less sophisticated tourism products that may be provided by emerging, local tourism operators. These products include safari operating through the provision of safari vehicles and guides, game guides, non-permanent fly camps at certain locations and hospitality products at north and south gates to Moremi Game Reserve.

• Establish a development zone on the eastern side of Moremi Game Reserve that provides an appropriate range of experiences and facilities appropriate for the self-drive tourist market that provide optimal benefits to local host communities.

• Establish a new national tourism asset in the form of Tsodilo National Park based on the San art and culture.

• Establish a new tour route on the periphery of the Okavango Delta aimed at the overseas coach market-the Three Countries Triangular Tour Route.

The above tourism development ideals indicate government intentions to develop tourism to its maximum in the Okavango Delta. If the Plan is to be effectively and successfully implemented, it will increase tourism activities in the Okavango Delta property.

The Botswana Ecotourism Certification System

It is designed to encourage and support responsible environmental, social and cultural behaviour by tourism businesses in the property and make sure they provide a quality eco-friendly product to consumers. Information on this certification system can be found in the Appendix.

Tourism Trends

Tourism to wildlife rich areas in Botswana make a major contribution to the country's GDP, especially the arrival of foreign tourists. Tourist arrivals have increased significantly from 619582 in 1994 to about 2,200,000 visitors in 2010 (Figure 4.b.3).

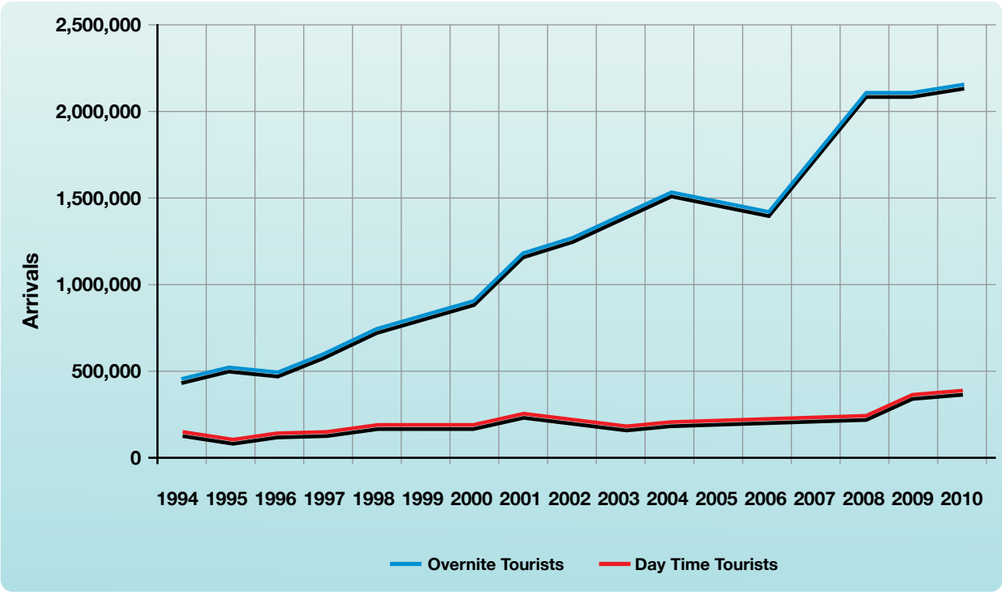


Figure 4.b.3: Tourist trends in Botswana, 1994 – 2010 (DoT, 2011).

Approximately 2 million tourists visited Botswana in 2011 (Daily New Jan 23 2012 # 013page 19). The Okavango Delta (Figure 11) which is the second largest tourist destination in Botswana after the Kasane/Chobe region. Tourism revenue to Botswana in 2011 was 3.1 billion Pula, nearly 3% of Botswana's GDP, and directly and indirectly accounting for the employment of 50 000 people.

Size of Accommodation Facilities

In the last decade, there has been an increase in the number of tourism lodges and camps due to an increase in tourists' volumes to the Okavango Delta area. The Department of Tourism (2010) further notes that in 2010 when compared with other regions, the Okavango region had the highest number of accommodation facilities (116 facilities with 1125 rooms and 2 129 beds). Accommodation facilities are located in different parts of the property. Map 5.h.1 in the Appendices shows the location of the different tourists lodges/camps or accommodation facilities within the property. Recreation and tourism activities within the property include both consumptive and non-consumptive use. Consumptive activities include safari hunting within some Controlled Hunting Areas (CHAs) some of which are located in the buffer zone of the property. Sport hunting is done on the peripheral parts of the property, in the buffer zone area. Non-consumptive tourism activities include: game drives, 'tag and release' fishing, boating, mekoro rides, walking safaris, helicopter game viewing, bird watching, and related photographic tourism activities and take place in parts of both the core zone and the buffer zone of the site.

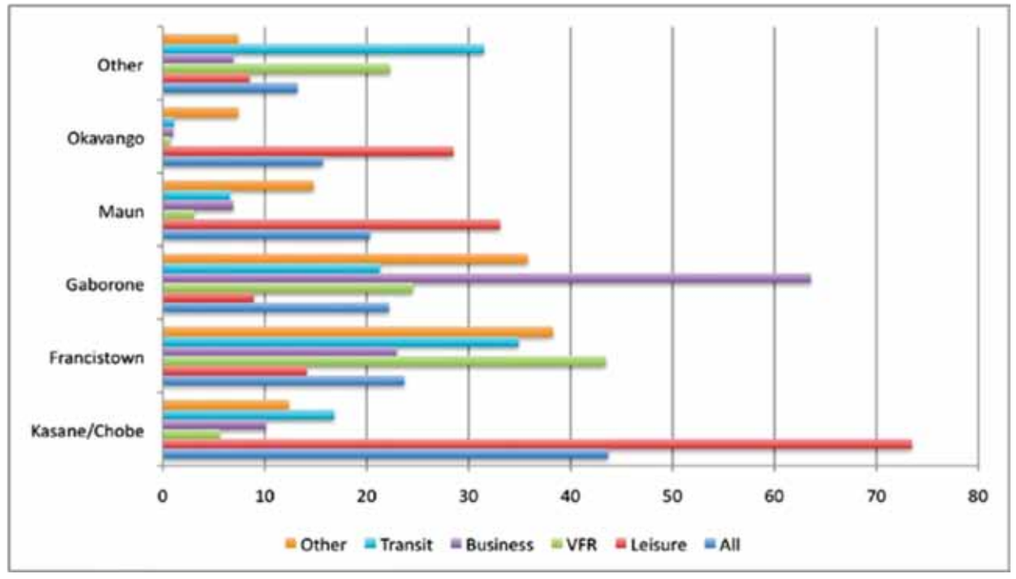


Figure 4.b.4: Places visited for at least one night by tourists in 2010

Disturbance of plant and animal species by tourism activities and their impacts

The increased participation in tourism activities has exerted pressures on the beauty of the natural feature and the aesthetic values of the property. Noticeable impacts include the creation of illegal roads and tracks, forest fires, pollution and disturbance of plant and animal species.

The increase in visitor numbers and motor vehicles entering the Okavango Delta site has resulted in the creation of illegal tracks/ungazetted roads. The creation of illegal roads affects vegetation and reduces the scenic beauty of the Okavango Delta`s sensitive areas such as the Xakanaxa in the Moremi Game reserve. For example, there is a total of 178 tourist vehicles that use the Xakanaxa area every day in the tourist peak season (Roodt, 1998), resulting in congestion and impacting negatively on the wilderness experience of visitors. This number might have increased since there has been a rapid increase in tourism visitors. The rate of increase of the tourist vehicle is still researchable and this will determine the necessary mitigation actions.

Another example is the increase in tourism activities between Xakanaxa and Third Bridge (a distance of some 25 km) which has resulted in over 600 km of tracks (Meyer, 2004). Furthermore, Mbaiwa (2005) highlighted that in Moremi Game Reserves (about 4 685 km^2), there are over 1 200 km of illegal roads which are used mostly during game-viewing driving. This destroys the vegetation of the area and therefore aesthetic beauty of the Okavango Delta that tourism requires. Tourist vehicles, boats and charter planes are all sources of noise pollution. The authorities are aware of these concerns and noise pollution will also need to be addressed at some stage.

There are indications that the total number of aquatic birds breeding in the delta has declined in recent decades, particularly at two of the major heronries which are presently almost defunct due to human disturbance, especially by tourists venturing too close to the breeding birds (Mendelsohn et al., 2010). As noted, the African Skimmer is another species that requires high levels of protection as it nests on sandy islands and disturbance by boats has led to nest abandonment and predation. Numbers of breeding skimmers has also declined largely due to human disturbances.

(v) Number of inhabitants within the property and the buffer zone

Within the buffer zone of the Okavango Delta property, preliminary results of Botswana's 2011 Housing and Population Census indicate that there are 137 593 people who live in the area (CSO, 2011). Over 95% of these people directly or indirectly depend on the natural resources found in the wetland to sustain their livelihoods (NWDC, 2003). Livelihood activities include collection of various plant products for different uses, fishing and flood recession farming (Kgathi et al., 2004).

CHAPTER 5
MANAGEMENT

5 - PROTECTION AND MANAGEMENT OF THE PROPERTY

The Okavango Delta site is managed according to several government plans including the Okavango Delta Management Plan (ODMP) and the recently completed Ngamiland Integrated Land Use Plan. Both of these plans are provided in the Appendix.

The Okavango Delta Management Plan (ODMP), which was adopted in 2008, has a six year planning horizon and sets out strategic goals, objectives, and operational guidelines which ensure the sustainability of the Okavango system. In addition to the OMDP, the Permanent Okavango River Basin Water Commission (OKACOM) jointly managed through a tripartite agreement between Botswana, Namibia and Angola was established to oversee the management and use of the system on a sustainable basis and thus contributes towards its conservation.

Within Moremi Game Reserve, which was proclaimed in 1964 and re-proclaimed in 1974 with additional areas incorporated - only non-consumptive utilization is allowed. The Reserve is managed in terms of the Moremi Game Reserve Management Plan (Appendix). In the Wildlife Management Areas wildlife utilization (both consumptive and non-consumptive) is the primary form of land use. Appropriate land use and management plans have been or are being prepared for these areas.

Land use in the property, like elsewhere in the country, is regulated and zoned for specific uses by the Tawana Land Board. The land use allocation for the Okavango Delta site is that of conservation tourism. All major developments are subject to Environmental Impact Assessments.

Previous page: Tourists on a mokoro at dusk in the Okavango Delta Property (Karen S Ross)

5.a OWNERSHIP

The Department of Lands holds and administers the land on behalf of the government. State Land allocation is on a fixed period state grant (FPSG) and certificate of rights (COR) basis. State land is granted on a lease basis, the period of lease varying according to the land use, with industrial and commercial land being leased for a period of 50 years, while residential land use is leased for 99 years. Most of the land comprising the buffer zone of the site is communal land with the exception of CHAs NG 41 and NG 42, which are State Land (see Map 4.a.1).

Almost the entire area of the property is communally owned. Such Tribal Land is held in trust for communities by the Tawana Land Board (TLB), which performs land management functions in accordance with the provisions of the Tribal Land Act of 1968. Rights to land are either granted communally or to individuals. Land under tribal ownership is never sold and as such land transactions are only for the sake of improvements or development. Allocations on tribal land in the nominated area are made by TLB on customary law grant or common law grant basis in accordance with the Ngamiland Land Use Plan. Residential plots are issued for a lease period of 99 years. Common law grants on the other hand, can be made to citizens and non-citizens alike, for commercial, tourism and industrial developments on a 50 year lease.

Tawana Land Board leases a number of concession areas in the Okavango Delta property to safari operators for camp and lodge sites for tourism purposes. There are nine Controlled Hunting Areas zoned for community management and a further twelve for commercial management. The Moremi Game reserve is unique in that it was founded by the local people, and is a protected area managed by DWNP.

Traditional resource use (e.g. grasses and reed cutting) takes place on the fringes of the reserve. Wildlife Management Areas surround the CHAs and are subdivided for commercial and community management, that is, they are either zoned for non-consumptive utilization (the areas immediately bordering the reserve) or as multi-purpose areas in which both non-consumptive utilization and consumptive utilization (trophy hunting, citizen hunting, subsistence hunting, capture, culling and cropping) are allowed, but these only take place in the buffer zone of the property. In the community managed areas, limited subsistence cropping takes place, while some small stock and donkeys are also kept.

In the core zone of the Okavango Delta property, of which Moremi Game Reserve is a part, only non-consumptive wildlife use for tourism related activities is permitted.

5.b PROTECTIVE DESIGNATION

The Okavango Delta system is a national asset and enjoys multi-layered protection through Botswana's national vision, laws, policies, plans and strategies; regional protocols and its ratified international conventions. The Botswana Government aspires to maintain the Okavango Delta property in its natural state while maintaining its cultural assets, thus existing protection measures have preserved the integrity of the Okavango Delta and, what is considered to be, its outstanding universal value. The nominated property incorporates the main Delta and wetland system, as well as the Panhandle of the Okavango River, and the Moremi Game Reserve. The buffer zone incorporates a large part of the designated Ramsar area.

The Management Authority of the nomination site is the Ministry of Environment, Wildlife and Tourism (MEWT). This ministry comprises all government departments relevant for the management of the site. The Minister of Environment, Wildlife and Tourism has proclaimed the property in the Botswana Government Gazette as a national monument in terms of Botswana's Monuments and Relics Act of 2001.

This control of land use in the area provides the protection necessary for the area's natural resources. The Okavango Delta is also a Ramsar site and the implementation of its management plan ensures sustainable use of resources in the area and provides strategic goals and objectives needed for effective management.

5.c MEANS OF IMPLEMENTING PROTECTIVE MEASURES

The nomination property has both Development and Tourism Management Plans. Current legal instruments for protecting and conserving the area include; the Wildlife Conservation and National Parks Act of 1992, and the Monuments and Relics Act of 2001 (administered by the Department of National Museum and Monuments (DNMM) which protects monuments and heritage sites). The mandate of the Ministry of Environment Wildlife and Tourism is to protect the whole site through the implementation of the Diseases of Animals Act of 1977, Tourism Act of 1992, Water Act of 1968, Forest Act of 1976, and the Fish Protection Act of 1975. Given below are listed the government's instruments used for protecting and conserving the Okavango Delta Ramsar Site.

The Government of Botswana has approved a National World Heritage Commission (Division) that would be within DNMM and established as a national office with the responsibility of ensuring compliance with the World Heritage Convention. Highest authority would be that of Deputy Director.

National legislation in place to protect the property

a. **Environment Assessment Act of 2011:** The Act provides for environmentally sound policies, programmes and projects. It also provides an opportunity for the views and concerns of affected stakeholders to be taken into account before the implementation of planned policies, programmes and projects.

b. **Monuments and Relicts Act of 2001:** Provides for better preservation and protection of ancient monuments, ancient workings, relics and other objects of aesthetics, archaeological, historical or scientific value or interest and for other matters connected therewith.

c. **Wildlife Conservation and National Parks Act of 1992:** The Act provides for the conservation and management of the wildlife of Botswana. The relevance of the Act lies in the presence of the Moremi Game Reserve and a number of Wildlife Management Areas in the Okavango Delta Ramsar Site.

d. **Forestry Act of 1976:** The Act provides for the regulation and protection of forests and forest products in Botswana. Its significance pivots around issues of vegetation resources which form part of the Okavango Delta biological diversity.

e. **The Fish Protection Act of 1975:** This act provides for the effective regulation, control, protection and improvement of fish and fishing in Botswana. This Act is of extreme relevance to the Okavango Delta property because fish are a source of livelihood in the site.

f. **Tourism Act of 1992:** The Act makes provisions for the regulation of the tourism industry with regard to promoting its development and wellbeing. The Okavango Delta is a tourist destination and tourism activities need to be regulated in order to sustainably utilize the very resource that attracts tourists.

g. **The Water Act of 1968:** It defines the ownership of any rights to the use of water. It also governs the granting of water rights and servitudes.

h. **Herbage Preservation Act of 1977:** It is the legal framework administering the management of fire in Botswana and caters for a complex and well-structured set of rules for a potential integrated fire management system in Botswana.

i. **Agricultural Resources Conservation Act of 1975:** The general aim of this act is to control and conserve agricultural resources in Botswana. Agricultural resources are broadly defined to include animals, birds, plants, water, soils, vegetation and vegetation products, fish and insects.

j. **National Environment Act 2005**.

k. **Disease of Animals Act 1977**.

Policies

a. **The Draft National Wetlands Policy and Strategy of 2000:** The goal of the policy is to provide for the conservation of Botswana's wetlands, the Okavango Delta being the largest, in order to sustain the ecological and socio-economic functions as well as providing benefits for the present and future wellbeing of the people.

b. **National Policy on Natural Resources Conservation and Development of 1990:** This policy focuses on key environmental issues and solution packages and takes the form of a National Conservation Strategy. It led to the establishment of the National Conservation Coordinating Agency now the Department of Environmental Affairs. It fully captures the importance of conservation and development vis-à-vis the natural resources of the country.

c. **National Biodiversity Strategy and Action Plan of 2004:** The goal of the strategy and action plan is long term health of Botswana's ecosystem and its species, and to encourage sustainable and wise use of resources through the provision of a framework of specific activities designed to improve the way biodiversity is perceived, utilized and conserved.

d. **Tourism Policy of 1990:** The policy provides guidelines for planning, developing and managing tourism in Botswana. It is designed to ensure that tourism activities are carried out in an ecologically sustainable basis. It also provides local communities with direct and indirect benefits from tourism activities.

e. **Wildlife Conservation Policy of 1986:** The policy provides strategies for the development of a viable and commercial wildlife sector through practice of sustainable resource utilization and conservation in Wildlife Management Areas and in the process address issues of community livelihoods through citizen participation in the wildlife industry. The draft revised Wildlife Conservation Policy of 2011 has the theme "Promoting partnerships in Wildlife Management".

f. **National Water Conservation Policy and Strategy Framework of 2002:** The water policy has amongst its objectives the protection, conservation and efficient use, management of water resources, the protection and restoration of the environment.

g. **National Settlement Policy of 1998:** The settlement policy provides for the creation of settlements and the re-settlement of people as part of the developmental process. It provides for compensation in instances where a community or people are moved out of a development area.

h. **National Policy on Rural Development of 1997:** The revised National Policy on Rural Development is a framework policy to link and facilitate coordination of the various sectoral policies and to engender a common vision and unity in pursuit of rural development.

Policies and Development Plans in place to protect the Property

1. The Draft National Wetlands Policy and Strategy of 2000.
2. National Policy on Natural Resources Conservation and Development of 1990.
3. National Biodiversity Strategy and Action Plan of 2004.
4. Tourism Policy of 1990.
5. Wildlife Conservation Policy of 1986. (Currently being revised and soon to be finalized).
6. National Water Conservation Policy and Strategy Framework of 2002.
7. National Settlement Policy of 1998.
8. The Revised National Policy on Rural Development.
9. Vision 2016 – A long Term Vision for Botswana of 1996.

Regional and International Protocols and Agreements

1. The Permanent Okavango River Basin Agreement of 1994.
2. SADC Shared Watercourse System Protocol of 1975.
3. SADC Protocol on Fisheries.
4. SADC Protocol on Development of Tourism of 1998.
5. SADC Protocol on Wildlife Conservation and Law Enforcement of 2003.
6. The Convention on Wetlands of International Importance.
7. The United Nations Convention on Biological Diversity.
8. The Convention on International Trade in Endangered Species of Wild Fauna and Flora.
9. The Convention on Combating Desertification.
10. United Nations Framework Convention on Climate Change.

National Development and Master Plans

1. The National Development Plan 10 (2009 – 2016).
2. Ngamiland District Development Plan 7.
3. Botswana Tourism Master Plan.
4. National Water Master Plan of 1991.
5. Ngamiland District Settlement Strategy (2003 – 2027).
6. The Ngamiland Integrated Land Use Plan of 2009.
7. The Okavango Delta Management Plan of 2006.

Regulatory/Institutional Protection

National Vision

a. Vision 2016 – A long Term Vision for Botswana: The national vision is the blue print for the planning process in Botswana. Issues of environmental, natural resource development and utilization, population growth, poverty reduction and sustainable growth feature prominently in Vision 2016. The vision has recognized the urgent need for the Okavango Delta Environment Master Plan. This was in realization of the complex and fragile nature of the Okavango Delta ecosystem.

Regional Protocols

a. **The Permanent Okavango River Basin Agreement of 1994:** Under the OKACOM agreement, the riparian countries of Angola, Botswana and Namibia cooperate and work towards the implementation of interventions contained in the Integrated Management Plan (IMP). The plan calls for an Environmental Assessment to be undertaken for proposed developments.

b. **The SADC Shared Water Courses Systems Protocol of 1995:** SADC member states that included Botswana, signed the revised protocol on shared water courses systems. This was in recognition of the importance of a coordinated approach to the utilization and preservation of water in international river systems. The protocol calls for equitable utilization of shared water resources, monitoring of the implementation of water resources developments by member states.

c. **SADC Protocol on Fisheries of 2001:** This protocol applies amongst others to resources of aquatic ecosystems within SADC states. The protocol recognizes the UN Convention on the Law of the SEA (UNCLOS) and takes into account the FAO Code of Conduct for responsible fishing, including inland fishing.

d. **SADC Protocol on the Development of Tourism of 1998:** The Objective of this protocol is to use tourism as a vehicle to achieve sustainable social and economic development and to ensure equitable, balanced and complementary development of the tourism industry region-wide. Since tourism has been identified as a viable land use in the Okavango Delta ecosystem, provisions of this protocol are very important.

e. **SADC Protocol on Wildlife Conservation and Law Enforcement of 2003:** It is principal objective is to establish common approaches to the conservation and sustainable use of wildlife resources and to assist with the effective enforcement of laws governing those resources.

Regional and international protocols and agreements to give additional protection

a. The Convention Concerning the Protection of the World Cultural and Natural Heritage, 1972.
The government of Botswana ratified the Convention on World Heritage in 1998 and inscribed the Tsodilo Hills as its first World Heritage Site in 2001.

b. **The Convention on Wetlands of International Importance (Ramsar Convention of 1971):** The government of Botswana ratified the Ramsar Convention and became a contracting party in April 1997 and listed the Okavango Delta as a Ramsar

Site. Botswana complies with the principles of the Convention which advocates for the wise use of wetlands and their sustainable utilization for the benefit of humankind in a way compatible with the maintenance of the natural properties of the ecosystem.

c. **Convention on Biological Diversity, 1992:** Botswana ratified this Convention in 1997. Objectives of this convention are to conserve biological diversity, promote the sustainable use of biodiversity components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.

d. **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973:** Botswana ratified this convention in 1978. CITES deals with the trade in endangered species which include several wetland plants and animal species (e.g. elephant) and therefore it is relevant to the management of the Okavango Delta site. It takes seriously the risks posed by the inadvertent or deliberate release of alien species into the wild.

e. **Convention on Combating Desertification (UNCCD), 1994:** Botswana ratified this convention in 1996. The objective if this convention is to combat desertification and mitigate the effects of drought in countries experiencing droughts particularly in Africa. It flags effective action at all levels, international cooperation and partnership and integrated approach consistent with Agenda 21. The Okavango Delta is situated within the Kalahari Desert which is highly prone to drought hence the relevance of the convention to the Okavango Delta Site.

f. **Framework for the Convention on Climate Change (UNFCCC),1992:** Botswana acceded to this convention in 1993. The Convention on Climate Change sets as an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. The Okavango Delta is an ecosystem which is susceptible to impacts of climate change.

Management Authority for Okavango Delta World Heritage Site

The Ministry of Environment, Wildlife and Tourism (MEWT) is the custodian of the World Heritage Convention of 1972 in Botswana. Currently Botswana has only one World Heritage Site - Tsodilo Hills inscribed in 2001. The Tsodilo Hills World Heritage Site is small when compared to the Okavango Delta with very few resource users and stakeholders. The Department of National Museum and Monuments (DNMM) is the Management Authority for this site. Given the complexity of the Okavango Delta site with a variety of legislative requirements and plans, resources, resource managers and users, it is inappropriate for DNMM to undertake the responsibility of a Management Authority for the Okavango Delta. The Management Authority is best placed within the Ministry of Environment, Wildlife and Tourism and the Permanent Secretary (PS) is therefore the Management Authority. This ensures that both accountability and operational implementation is undertaken as follows:

a. The PS MEWT is the Accounting Officer for the Ministry and the most senior civil servant reporting to the Minister (the political head of the Ministry). The PS MEWT is supported by three Deputy Permanent Secretaries who have been apportioned supervisory roles for the different departments within the Ministry. The PS provides accountability and decisive actions with regard to the protection and management of the site.

b. MEWT is the predominant user and manager within the government of Botswana of the resources of the proposed Okavango Delta World Heritage Site. The Ministry is comprised of seven Departments, they are: National Museum and Monuments; Wildlife and National Parks; Forestry and Range Resources; Tourism; Meteorological Services; Environmental Affairs; Waste Management and Pollution Control. These technical departments are administratively supported by Department of Corporate Services in the Ministry. Furthermore the Ministry supervises one parastatal organization, Botswana Tourism Organization. All these departments are headed by a Director except for BTO which is headed by a Chief Executive Officer (CEO). Because of the importance of biodiversity to tourism, the principal managers are located within the ministry. It is therefore appropriate that the Management Authority for the Okavango Delta site is the PS MEWT. The Department of Wildlife and National Parks, Tourism, Department of Environmental Affairs and Department of National Museum and Monuments have been actively involved in the preparation of this nomination dossier.

c. Furthermore other ministries play a major role in the management of critical resources found within the site such as Ministry of Minerals, Energy and Water Resources (MEWR) through Department of Water Affairs (management of water resources which is the main driver of the Okavango Delta ecosystem) and International Waters Unit because of the trans boundary nature of the Okavango River Basin; Ministry of Lands and Housing – land use planning and management; finally Ministry of Local Government through North West District Council – the political body within the district and Tribal Administration – tribal leadership. There is a cooperative and cordial working relationship between MEWR and MEWT primarily within the auspices of the Permanent Okavango River Basin Water Commission (OKACOM), which is driven by MEWR in accordance with the tri-nation OKACOM agreement. This is demonstrated by the representation of MEWT within all structures of OKACOM.

The representation of MEWT within OKACOM is at the highest level, that of Commissioner and also at technical levels of Okavango Basin Steering Committee and Biodiversity Task Force. Predominant land use disposition within the site has long been recognized by the Ministry of Lands which is responsible for land use planning and management as the most economically, socially and environmentally optimum in accordance with the Ngamiland Integrated Land Use Plan. The current land use of conservation-tourism within the core area will therefore be sustained into the future. There are established protocols for involving these structures within government and the Management authority.

d. The property also falls within the Kavango-Zambezi Trans-frontier Conservation Area (KAZA) which also includes conservation areas in Angola Namibia, Zambia and Zimbabwe. On December 7th, 2006 the relevant Ministers from the participating countries signed a Memorandum of Understanding (MOU) for the establishment of the KAZA Trans-frontier Conservation Area (TFCA), thereby agreeing to manage the combined natural resources of the area for mutual benefit. The Okavango Delta system is a key component of the KAZA TFCA, and much of the Okavango River Basin falls within its area. The Southern African Development Community (SADC) has formally endorsed KAZA, and this project has also been made known to the KAZA secretariat and has its endorsement.

e. The coordination role of DEA is critical for the day-to-day management of the site through the support of existing multi-sectoral structures in the district such as District Development Committee (DDC), District Land Use Planning Unit (DLUPU) and the Okavango Wetlands Management Committee (OWMC) in accordance with the Okavango Delta Management Plan (ODMP). As alluded above DEA falls within MEWT and therefore it is accountable to the PS. DEA has strong links with DNMM at district level with respect to implementation of the UNESCO World Heritage Convention. DNMM is the focal point for the Convention in Botswana and is charged with managing heritage resources through the Monuments and Relics Act of 2001. Therefore DNMM will be responsible for preparation of regular and routine reports on behalf of the PS and the Minister.

f. DEA has a regional office in Maun. The office is coordinated by a Regional Coordinator and staffed with four (4) personnel holding Bachelors and Masters Degrees in Environmental Science and Natural Resource management. The Regional DEA office oversees and coordinates activities related to the use of the Okavango Delta by respective government departments and tourism operators. DEA ensures that all users of the Okavango Delta observe the ODMP, which is a framework for management for Okavango Delta resources in their day-to-day activities. DEA is also the custodian of the Environmental Impact Assessment (EIA) Act 2005 and ensures that all development projects are subjected to the EIA process before the project is approved.

Coordinated annual inspections of tourism projects and tourism enterprises in the Okavango Delta are carried out to ensure compliance with conditions of establishment.

g. DEA is a critical partner in the implementation of the Botswana National Action Plan and the Strategic Action Plan within the OKACOM process.

The University of Botswana Okavango Research Institute (ORI) is located 15 km NE of Maun. It is mandated to carry out research on the biophysical and socio-ecological functioning of the Okavango Delta. ORI has close links with local authorities and central government and also the private sector and civic society in Ngamiland District. It hosts the Okavango Delta Information System (ODIS), a web-based-online database for the implementation of the ODMP. They have also recently initiated the Okavango Basin Information System (OBIS). This is designed to host and make accessible data from a basin-wide research initiative investigating livelihoods and environmental sustainability. ORI provides a range of technical backstopping services to local and central government, foremost of which is its hydrological modelling for flood prognosis. The Ministry of Environment Wildlife and Tourism has signed a Memorandum of Understanding with the University of Botswana to further institutionalize this support.

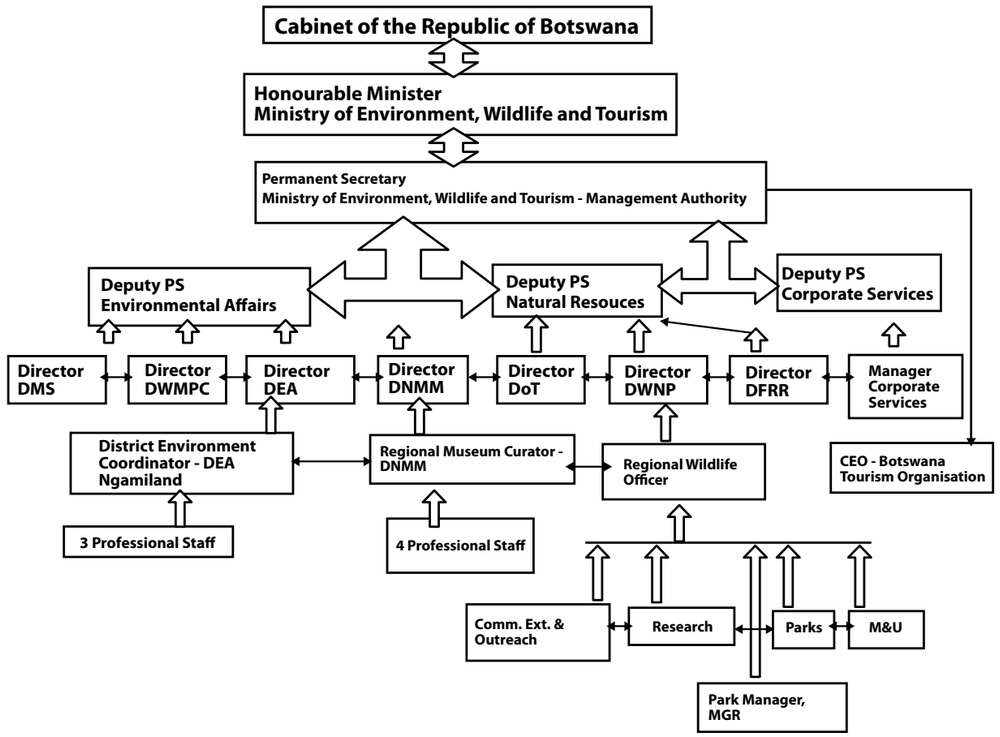


Figure 5.c.1: Proposed management structure of the Okavango Delta Property

5.d EXISTING PLANS RELATED TO REGION IN WHICH PROPOSED PROPERTY IS LOCATED

a. **The National Development Plan 10 (2009 - 2016):** This plan calls for the appropriate use of natural resources and the consideration of environmental costs in planning and development. Sustainability is seen as a strategic concept that links population, the economy and natural resources together in the context of socio-economic development.

b. **Ngamiland District Development Plan 7:** One of the key planning issues is environmental conservation. The associated development goal is to retain the ecological and environmental integrity of the district through improved conservation measures.

c. **Botswana Tourism Master Plan:** The master plan serves as a basic guideline for the development of tourism, enabling decision-makers to agree on the principles for the direction of tourism development.

d. **National Water Master Plan of 1991:** Water is an economic, social and environmental resource that provides the inter-sectoral linkages. The Government of Botswana has therefore adopted an integrated approach to water resources management and development.

e. **Ngamiland District Settlement Strategy (2003 – 2027):** One of the goals of the strategy is to protect and preserve the environment generally in the district and sustainably utilize its natural resources. It is one of the Okavango Delta Management Plan deliverables.

f. **Ngamiland Integrated Land Use Plan of 2009:** It is the basis for environmental management and biodiversity use in Ngamiland. Its main aim was to zone land in Ngamiland for various land use activities taking into account the use for which particular land areas are best suited in terms of soil suitability, physical environment sensitivity, resource availability and community aspirations. It is also one of the ODMP deliverables and was upgraded by the Tawana Land Board.

g. **The Okavango Delta Management Plan (ODMP) of 2006:** It is hailed as a good example of how the planning process should be done in the Okavango Delta Site. It was developed using a combination of wetlands planning approaches like the ecosystem approach and the Ramsar Planning guidelines. It encourages integrated planning to resource management. The ODMP contains important recommendations for protecting the property.

5.e PROPERTY MANAGEMENT PLAN OR OTHER MANAGEMENT SYSTEMS

The diverse and complex nature of the Okavango Delta in terms of its natural resources, its wide range of uses, its multiple managers (both in and outside government including communities) and an array of national laws, policies and guidelines as well as regional and international conventions, agreements and protocols are all factors that dictate the need, and determine the context, for an integrated management planning process for the Okavango Delta. An Integrated Management Plan, the Okavango Delta Management Plan (ODMP) has been developed for the site. The plan provides a framework for sustainable use through which all sector plans and programs operate. The plan sets out strategic goals, objectives, and operational objectives which when realized contribute to the sustainability of the Okavango system. The ODMP emphasizes the sustainable utilization of resources and as such encourages the management and use of the system to be on a sustainable basis for all concerned.

Water developments should not be entirely discounted, however the OKACOM agreement between the three riparian States calls for sustainable management of the Okavango River Basin. The use levels or developments that may be undertaken would be guided by wise-use principles and the spirit and objectives of the tripartite agreement. Should the nomination site be listed this agreement would need to be amended to ensure that the outstanding universal values contained within this new World Heritage Site would not be compromised by any future development in the Okavango's catchment area.

The vision of ODMP is stated as 'a carefully managed, well-functioning ecosystem that equitably and sustainably provides benefits for local, national and international stakeholders'. The goal of ODMP is to 'integrate resource management for the Okavango Delta that will ensure its long-term conservation and that will provide benefits for the present and future well-being of the people through sustainable use of its natural resources'.

The implementation of the ODMP has strategic and political support as stated by the Minister of Environment, Wildlife and Tourism Honourable Onkokame Kitso Mokaila in the preface section of the final ODMP document thus ' …it stands to reason that the ODMP should and will be implemented as intended and that future review processes will indicate notable and positive impact on the bio-physical and socio-economic health of various aspects of the Okavango Delta Ramsar Site, as well as improved institutional coordination and strengthening at all levels of operation. The level of expectation and commitment on the ODMP so far displayed gives some level of assurance for action' (ODMP, 2006).

5.f SOURCES AND LEVEL OF FINANCE

The Okavango Delta as an ecosystem is managed by a number of organizations and institutions within government and outside Government. The funding for the various interventions geared towards the management of the resources of the site is mainly from Government financial mechanisms. The implementation of the National Development Plan and District Development Plan are primarily financed by government. In addition specific project level interventions that address issues affecting the sites are also funded by International Development Partners, Private Sector and International Funding Agencies. As a trans-boundary resource there are also funding opportunities within the Permanent Okavango River Basin Water Commission (OKACOM). However, there is a shortage of resources for the management of the site, and contributions from international cooperating partners and donors for conservation work within the property.

The funding for the various interventions geared towards the management of the resources of the site is mainly from government financial mechanisms. The implementation of the National Development Plan and District Development Plan are primarily financed by government. From the Annual National budget we have Ministerial allocations. The Ministries further allocates funds to their different departments who do further allocations to their district offices. The Ministry of Environment, Wildlife and Tourism gets an annual budget of 890 Million Pula ($ 108 million). This is further divided according to the departments and to the district offices. The District Environmental Office in Maun is allocated One Million Pula annually.

Other district offices from the Ministerial departments are allocated approximately seven million Pula annually ($ 875 000), a portion of which goes to the management of the critical resources found within the site. Specific project level interventions that address issues affecting the site are also funded by international Development Partners, Private Sector and International Funding Agencies. As a Trans boundary resource there are also funding opportunities within the Permanent Okavango River Basin Water Commission (OKACOM). Royalties amounting to six million Pula ($ 750 000) annually are collected from the tourism establishments in the district by Botswana Tourism Organization on behalf of the Ministry. It is earmarked that the money will go into the National Environment Fund.

5.g SOURCES OF EXPERTISE AND TRAINING IN CONSERVATION AND MANAGEMENT

The multi-resource endowment of the site and the fact that various aspects of the management of the site cuts across a number of government ministries and departments means that the expertise lies at those institutions. For example water resources, wildlife, environment, heritage management is the responsibility of Departments of Water Affairs (DWA), Wildlife and National Parks, Environmental Affairs, National Museum and Monuments respectively. Although there are elements of capacity and skills deficit the institutions in general have the required

expertise to manage the site. For example the Department of Wildlife and National Parks has qualified and experienced staff that undertake wildlife census, monitoring and management, and DWA is currently implementing a water quality monitoring programme, the Department of Environmental Affairs (DEA) has overall expertise in integrated resource management and planning while the Department of National Museum and Monuments has expertise in heritage management given its qualified and experienced staff. Moreover, all these Departments are housed within the Ministry of Environmental, Wildlife and Tourism (the management authority for the property), with the exception of Department of Water Affairs (DWA).

Scientific support is provided by the Okavango Research Institute of the University of Botswana. The centre was established by the government specifically to undertake research in the delta that will inform Government about its proper management. The centre has a number of PhD level scientists with a range of mostly ecological expertise and the centre provides capacity development and degree training programmes.

The Okavango Delta Wetlands Management Committee is a body given authority to ensure that the Okavango Delta is managed professionally with relevant expertise. The committee comprises representatives from the following institutions with relevant practical training and skills to manage resources in the Okavango Delta Ramsar Site in a sustainable manner;

• The Tawana Land Board which coordinates all development programmes in the district.
• The Department of Environmental Affairs has expertise in environmental management.
• The District Administrative Office has expertise in planning for development.

• The District Authority, the North West District Council, has a Tourism Office with expertise promoting tourism in local community developments. The Environmental Health Office has expertise in the management of solid and liquid waste.

• The District Wildlife Office has expertise in the sustainable use of wildlife resources, and its research division provides data and information on wildlife trends. The Fisheries Division has a function of ensuring that there is sustainable use of the fish resource in the site.

• Department of Water Affairs has expertise in the hydrology of the Okavango system and the control of aquatic weeds.

• Veterinary Services: This department has expertise on the sustainable use of livestock in the buffer zone of the site.

• Department of Forestry and Range Resources has expertise on range land resources within the buffer zone.

• Meteorological Services has staff that records and analyses climate data.

• Agricultural Research Department undertakes research on crop production and animal husbandry in the buffer zone of the site.

• Botswana Wildlife Training Institute: The institute provides in-service training on sustainable wildlife utilization and management primarily to employees of the Department of Wildlife and National Parks. This institute also provides specialized courses such as those for professional guides and professional hunters.

• Non-Governmental Organizations such as Birdlife Botswana and the Kalahari Conservation Society support government efforts through public awareness and community outreach. Birdlife Botswana conducts biodiversity monitoring in the Okavango Delta, using birds as an indicator for biodiversity status.

5.h VISITOR FACILITIES AND STATISTICS

The Department of Tourism is established with a mandate to regulate tourism enterprises, set out procedures with respect to applications, undertake inspections and conduct appeals. The department

has an office in Maun which regulates tourism activities in the area. There are a total of 261 licensed facilities (i.e. camps, lodges, hotels, mobile operators, and travel agencies) and tourism activities (game viewing, bird watching, mekoro trails, recreational fishing, hunting and mobile safaris) in the Ngamiland. The licensed tourism activities that take place in the nomination site are: See Map 5.h.1, for a full map of Visitor Facilities in the Okavango Delta property.

•Accommodation in towns and villages: 33 establishments.

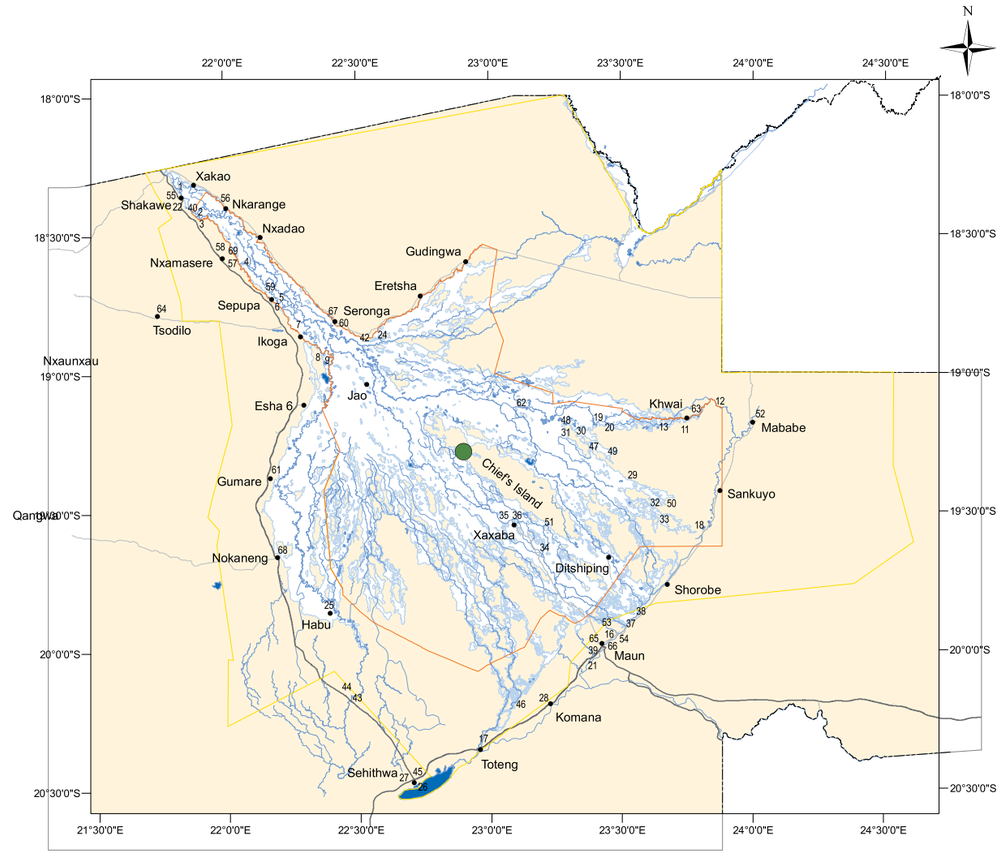
•Camps and lodges in the property: 100 establishments.

• Mobile camping safari companies: 86 operators.

• Transfer agents (hotel shuttles, taxis etc): 8 operators.

• Operators for mekoro (dugout canoes) trails: 9 operators.

• Accommodation on houseboats: 7 houseboats



List of Some Tourist Facilities

Scale 1 : 2 000 000

- Center of Property
- Settlement
- Core Zone
- Buffer Zone
- Tarred Road
- Gravel/Sandy Road
- Rivers

1. Shakawe Clinic
2. Shakawe Fishing Lodge
3. Shakawe Camping Site
4. Ncamasere Lodge
5. Swamp Stop Camp
6. Sepopa Clinic
7. Ikoga Clinic
8. Guma Airstrip
9. Guma Lagoon Camp
10. Khwai River Lodge
11. MGR3 Camp
12. MGR2 Camp
13. MGR5 Camp
14. Rileys Hotel
15. Sedie Hotel
16. Dolar Lodge
17. Toteng Clinic
19. Kazikini Camp Site
20. Xakanaka Camp Site
21. Xakanaka Airfield
22. Statunga Camp Site
23. Honey Barclays Bank
24. Drotskys Cabins
25. Xau Mokoro Station
26. Habu Clinic
27. Sehitwa Post Office
28. Sehitwa Clinic
29. Komana Clinic
30. Hatab Mobile Camp Site
31. Hatab 12 Camp Site
32. Mboma Boat Station
33. Santawanl Airstrip
34. Santawani Lodge
35. Ivory Camp Sites
36. Gunn Camp Site
37. Airstrip
38. Matapana Boat Station
39. Thamalakane River Lodge
40. Botshelo Guest House
41. Okavango Crocodile Farm
42. Mbiroba Camp
43. Umvuvu Lodge
44. Tsau Clinic
45. Tsau Airstrip
46. Sehitwa Post Office
47. Phatshwa Mobile Clinic
48. Hatab 6 Camp
49. Mboma Boat Station
50. Hatab 13 Camp
51. Sankuyo Bush Camp
52. Boga 2 Camp
53. Airstrip
54. Maun International Airport
55. Letsholathebe Hospital
56. Shakawe Airstrip
57. Ngarange Airstrip
58. Ncamasere Boat Station
59. Ncamasere Airstrip
60. Sepupa Airstrip
61. Seronga Airstrip
62. Gumare Airstrip
63. Camp Okavango
64. Khwai Airstrip
65. Tsodilo Airstrip
66. Bank
67. Bank
68. Clinic
69. Nokaneng Clinic
70. Xau Mokoro Station

Source Data from Okavango Tourst Map, 2010
Prepared by Department of Surveys and Mapping
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Map 5.h.1: Tourist Facilities in the Okavango Delta Property

5.i POLICIES AND PROGRAMS RELATED TO THE PRESENTATION AND PROMOTION OF THE PROPERTY

The government of Botswana developed a Tourism Master Plan in 2000 which serves as a basic guideline for development and promotion of tourism, enabling decision makers to agree on the principles for the direction of tourism development for the decade. The office of the Department of Tourism in Maun is responsible for the implementation of the tourism promotion, policies and programs working in close collaboration with the Botswana Tourism Organisation (BTO) to market tourism in the Okavango Delta property. BTO produces two glossy magazines - Discover Botswana and Bajanala, to promote tourism in the country.

A number of institutions that have a mandate to manage the resources of the site have different public education and awareness programmes to promote the conservation and wise use of the site resources. For example, different communication and awareness tools are currently being used to promote awareness of the site such as radio, print media, publicity materials (posters and brochures). Educational programmes for schools and public meetings for the general public in various settlements are on-going.

Most of the safari companies, over one hundred, have their own web pages which are effective in promoting the property throughout the global web. Furthermore, there are numerous trade fairs, such as the 'iNdaba' in South Africa, the World Travel Market in London, and various 'Pitsos' in Botswana, that assist companies and the government in promoting and marketing the property. The government press and Botswana Television (BTV) are also available to promote events and news regarding the nomination site, and related tourist and conservation related activities in the property and elsewhere in Botswana.

All applications to film or make documentaries are received by the Ministry of Environment, Wildlife and Tourism (MEWT). The MEWT actively promotes the filming of wildlife, protected areas and cultural events, to both the film and tourism industries. Since the 1970's many accounts and photographic 'coffee table" books and publications have been produced which feature the Okavango Delta. In addition, a considerable number of books and papers on scientific research have been published in both national and international journals (see Bibliography). These publications have therefore promoted the Okavango Delta site amongst the scientific community as well as others.

Examples of documentaries film concerning the Okavango Delta property:

• Nature's Great Events "The Great Floods". Afriscreen/ BBC (in Appendix).

• Swamp Cats. BBC Natural World (in Appendix).

• Planet Earth. Episode 1 - From Pole to Pole. BBC Bristol (in Appendix).

• Elephants without Borders. Afriscreen/BBC Natural History Unit (in Appendix).

• A Wild Dog's Story. BBC Natural History Unit/ Afriscreen Films (in Appendix).

• Okavango, Jewel of the Kalahari. BBC/Partridge Films.

• Haunt of the Fishing Owl. Tim and June Liversedge.

• Eye of the Leopard. Dereck and Beverly Joubert.

• The Fascinating World of Birding: Okavango (Episodes 1-3). Ken Oake.

• Eternal Enemies. Richard Goss.

• Rivers of Life. Gerald Hinde.

5.j STAFFING LEVELS

The present establishment of the Department of Environmental Affairs in Maun responsible for the overall coordination and implementation of the Management Plan has four professional staff and 8 support staff. The professional staff has expertise in environmental impact assessment, environmental planning and management, coordination and integrated resources management, rural development and participatory planning.

The implementation of the management plan is the responsibility of various sector institutions which have expertise relevant to their mandate, refer to section 5g above. For example institution like DWNP has park management staffs that are responsible for day-to-day management of protected areas within the site.

DEPARTMENT OF WILDLIFE (DWNP) STAFF LIST FOR MOREMI GAME RESERVE AND MAUN

In Moremi there are four stations namely; Maqwee, Khwai, Third Bridge and Xakanaxa.

Table 5.j.1: Four stations in Moremi Game Reserve

	KHWAI	XAKANAKA	THIRD BRIDGE	MAUN	MAQWEE
Professionals	8	5	3	124	8
Technicians	0	1	0	56	0
Receptionists	0	0	0	2	0
Total	8	6	3	182	8

STAFF TRAINING

The Department of Wildlife and National Parks comprises of both Professional and Technical staff with various qualifications. The professional staff has academic qualifications to certain levels such as Certificate, Diploma and Degree in Wildlife Management, Environmental Science and majoring in Biology, Sociology and Ecology as well as Veterinary Medicine. Technical staff undergoes training in various disciplines such roads and building construction, maintenance, borehole drilling, vehicle and heavy plant mechanics, and driver training courses.

Other courses include administrative courses such as Human Resources Management, Leadership training and Functional Management courses. These are management oriented training courses, which are repeated at regular intervals throughout the year.

CHAPTER 6
MONITORING

6.a KEY INDICATORS MEASURING STATE OF CONSERVATION

Environmental monitoring is a necessary supporting activity for sustainable development. However due to limited resources, long-term monitoring in the Delta has been mainly limited to hydrological and meteorological data collection at two localities being at Shakawe in the north and at Maun in the south east. This monitoring is undertaken by the Department of Water Affairs (DWA) and Department of Meteorological Services. During the late 1960s and 1970s, DWA was engaged in monitoring an extensive network of hydrological stations throughout the delta, established during a study by FAO/UNDP. During the 1990s in response to perceived desiccation of the system and the need to reduce resource commitments the number of locations being monitored was reduced considerably. Other monitoring activities have included somewhat occasional aerial wildlife censuses by the DWNP, and shorter-term, project-based monitoring related to human or animal health (Tsetse Fly control, Foot and Mouth Disease, Malaria, Bilharzia Monitoring of human health issues is done from clinic and hospital records by the Ministry of Health.

Previous page: Thaoge Channel in the Okavango Delta Property y (Karen S Ross)

The Okavango Research Institute (ORI) of the University of Botswana (UB) has been monitoring various environmental parameters for the past 14 years on a limited scale. These parameters include surface and groundwater levels, water chemistry (TDS, DO, pH, temperature), and fish catch per unit effort, at Nxaraga in the central Delta. Such activities were initiated in response to the perception that anthropogenic change in the basin is an inevitable result of human development. In order to be able to manage the system in a sustainable way, information on both socio-ecological baselines and trends in socio-ecological parameters is required. The ORI ad hoc monitoring programme goes a little way towards addressing these requirements, but is far from sufficient to inform adaptive management in the Delta or the basin, because the spatial spread required to capture and separate trends from internal dynamics is very large. Effective monitoring for the system requires an extensive spatially distributed network which is logistically difficult and demanding on resources given the size of the system. Current plans to approach this problem centre on developing partnerships with government and private sector (tourism operators in the Delta).

ORI is also engaged in research projects that have an element of monitoring – such monitoring is limited to the life of the project – for example ORI monitors the abundance of the schistosomiasis host snails in the Thamalakane River in order to estimate population size of the vector under the Eco Health project. Birdlife Botswana complements the monitoring undertaken by ORI by monitoring avifauna as a key indicator of biodiversity status, using the State - Pressure-Response model advocated by the Convention on Biological Diversity (CBD).

The Okavango Research Institute (ORI) has recently established a Monitoring Section within its Research Services section. The long-term mandate of this section is to monitor the environmental status of the Okavango Delta, in particular to support the implementation of the Okavango Delta Management Plan (ODMP). The ODMP Research Strategy (Ashton et al., 2005) identified as examples of aspects to be monitored the extent of different vegetation types in response to changing hydrology, location and extent of fires, distribution and movement of key herbivore and carnivore species, threatened bird species, fish catches, extent of flood recession agriculture, use of traditional and motor boats in identified sensitive areas, keystone plant species like *Cyperus papyrus* as indicators of changes in water quality, and patterns of change in riparian and island fringe vegetation. To this list must be added the fundamental variables of major nutrient content of the inflow to the Delta.

In the present circumstances, there is a small recurrent budget for monitoring activities provided by the University. ORI is actively pursuing other sources of funding to expand and improve the present programme of monitoring. The Department of Environmental Affairs (DEA), mandated with implementing the ODMP, is clearly a primary beneficiary of these data, which currently include stage and discharge, water quality, fish Catch Per Unit Effort (CPUE ground-based) and flood and fire extent (remote sensing) as outlined above. At present these data are simply collected and captured at ORI; basic analysis is being carried out to generate baselines and identify trends.

ORI is engaged with DEA in developing a Memorandum of Understanding (MoU) to provide that framework and schedule for monitoring as well as to increase the Unit's resources and activities. Given the extent of the Delta and the potential environmental threats, ORI foresees the need to secure multiple funding sources to ensure that the requirements for monitoring are adequately met. A practical monitoring system must incorporate basic hydrological and water quality variables at 3 - 4 points along each of the major distributary systems, the inflow (Mohembo) and all of the outflows, a representative spread of climatic data (>10) stations spread inside and along the peripheries of the Delta, the extent and health of the major herbivore habitats, population sizes and demographics of the major wildlife (including avian) species, extent, timing and locations of bush and peat fires, distribution, density and socio-economic health of human populations (including level of natural resource use). All of these monitoring activities should be corroborated wherever possible using remote sensing applications. Clearly such a programme will require considerable commitment of resources from the managers and users of the system.

Table 6.a.1: Current monitoring activities

SUBJECT	SOURCE OF INFORMATION/ MONITORING AGENCY	COMMENTS
Seismic activity	University of the Witwatersrand, Johannesburg, and others; hosted by ORI.	
Meteorology	D Met Services (MEWT) DWA ORI in association with (in future) the private sector.	Met Services has long-term data recording stations in Maun and Shakawe. ORI has automatic met stations at Nxaraga and Sexaxa. DWA had stations installed in various parts of the Delta, but these have been discontinued.
Water: Quantity	DWA, ORI	DWA monitors discharge at Mohembo and Maun on a daily basis. ORI measures stage at Nxaraga on a daily basis.
Water: Quality	DWA, ORI	ORI carries out 2-weekly sampling at Nxaraga field camp. DWA has initiated a consultancy to establish a water quality monitoring programme. ORI/BiOkavango initiated monitoring including macro-invertebrates, but this programme is falling away due to lack of funding.
Flood Extent	ORI	ORI monitors monthly flood extent based on MODIS satellite imagery for the Delta.
Fire Extent	ORI	ORI monitors monthly burned area based on MODIS satellite imagery for the Delta.
Macro-invertebrates	ORI-BiOkavango	A short project-based monitoring programme.
Fish Catch per Unit Effort	ORI	Regular CPUE sampling is done by ORI at Nxaraga; ad-hoc CPUE is done elsewhere. CPUE monitoring was part of the BiOkavango diversity monitoring program, on the Panhandle, but this is now finished.

SUBJECT	SOURCE OF INFORMATION/ MONITORING AGENCY	COMMENTS
Large mammal populations	DWNP, ORI	DWNP tries to carry out annual censuses of wildlife to help with setting hunting quotas. These have been sporadic because of logistical problems. ORI has recently been involved in ad hoc censuses of specific parts of the Delta to answer range management questions.
Avifauna	Birdlife Botswana	Birdlife Botswana carries out regular monitoring of globally threatened species, and uses the State-Pressure-Response model for monitoring birds as a proxy for biodiversity..
Socio-economic indices	Various government agencies, Central Statistics Office as a collating and disseminating centre. CBNRM Forum	Population and major socio-economic parameters monitored through 10-yearly censuses. Other parameters such as health on more frequent basis, determined by characteristics of diseases. Employment. Human-wildlife conflicts Resource user perceptions.
Tourism	Department of Tourism, Botswana Tourism Organisation ORI and other researchers	Numbers, occupancy. Intermittent independent WTP-type surveys, no regular visitor satisfaction surveys.

Table 6.a.2: Indicators and periodicity

INDICATOR	PERIODICITY	LOCATION OF RECORDS
Water Balance	Monthly	
Inflows at Mohembo	Daily	DWA, ORI
Outflows: Maun,	Daily	DWA, ORI
Outflows Toteng	Weekly	DWA, ORI
Temperature, RH (Shakawe, Maun)	Daily	Dept. Met Services
Water level Nxaraga	Daily	ORI
Material and Nutrient Balances	Monthly	
Main channel dissolved sediment load	Monthly	DWA water quality monitoring
Water quality at inflow	Daily	DWA
Water quality at Nxaraga	Monthly	ORI
Habitat Distribution		
Flooding extent	Daily	ORI
Flooding duration	Monthly	ORI
NDVI	Daily	ORI
Extent of burning	Monthly	Under development (ORI)
Fauna	Monthly	
Wildlife populations	Quasi-Annual	DWNP
Wildlife populations	Ad-hoc	Individual private researchers
Bird populations	Annual	Birdlife Botswana
Tourism		
Visitor Numbers	Annual	Departments of Tourism and Immigration
Breakdown of types of tourists	Annual	Department Tourism
Socio-economic status		Central Statistics Office (CSO)
Annual household income	Annual	CSO
Proportion in employment	Annual	CSO
Proportion in arable agriculture	Annual	CSO
Proportion in livestock	Annual	CSO
Human-wildlife conflict rate of incidence	Annual	DWNP
Proportion of household involved in tourism		CSO
Health – HIV infection rate Malaria infection rate Tuberculosis IR Schistosomiasis IR	Annual	MoH

6.b ADMINISTRATIVE ARRANGEMENTS FOR MONITORING

The Department of Environmental Affairs (DEA) in the Ministry of Environment, Wildlife and Tourism (MEWT) is the primary motivator for monitoring efforts, as the agency responsible for the implementation of the ODMP. Arrangements for implementation of technical aspects of monitoring, including public access to these data, are the subject of specific agreements between DEA and various other government and non-government agencies. In this context, ORI plays a significant role, because it has the technical capacity to carry out much of the monitoring necessary to guide sustainable management. DEA and ORI are currently engaged in reviving a MoU (which had been shelved during the enforced cut-back on Government spending following the global recession of 2009). Under this agreement, DEA was to provide "seed funding" to ORI to assist with the establishment of a Monitoring Unit. In the interim, ORI has proceeded with this establishment, albeit in a limited way to begin with;

Department of Environmental Affairs
P O Box 35
Maun, Botswana
TEL: +267 6801237
FAX: +267 6862503

Department of Wildlife and National Parks
P O Box 11
Maun, Botswana
TEL: +267 6860368
FAX: +267 6860053/6864939

University of Botswana
Okavango Research Institute
P/Bag 285
Maun, Botswana
TEL: +267 6817200/6861833
FAX: +267 686 1835 Website: www.ori.ub.bw

6.c RESULTS OF PREVIOUS REPORTING EXERCISES

Previous reporting has been done for hydrology and wildlife populations by DWA and DWNP.

Since the site is already a Ramsar Site there have been a number of reports submitted to the Convention Secretariat on the status of the site and management effectiveness. To date there has been at least three National Reports submitted to the Ramsar Secretariat. In addition as the main storehouse of biodiversity the status of the resources of the site features a lot on the national reports to the Convention on Biological Diversity (CBD), to this end Botswana has recently submitted the Fourth National Report to the CBD.

The Okavango Delta holds the largest single population of elephants in the country and the world as a whole therefore Botswana has been regularly reporting to the Convention on International Trade in Endangered Species (CITES). Climate change has the potential to affect the status of the site. There are studies and reports on the likely impacts of climate change on the site. In addition Botswana has also submitted the Second National Communication report to the United Nations Framework Convention on Climate Change (UNFCCC). Several Multi-lateral Environmental Agreements (MEAs) applicable to the Delta have also being reporting on various Secretariats on the status of the resources of the site.

Long-term hydrological monitoring data have been used extensively in modelling exercises for prediction of flood extent and assessment of hydrological and ecological changes resulting from climate and anthropogenic change in the catchment. Early warnings for extensive flooding resulting from large inflows and local rain in 2010 were accurate and to a large extent helped prevent economic losses. Similar warnings have been issued by ORI for the flood of 2011.

Wildlife census data are used on an annual basis to adjust (if necessary) the quotas issued for consumptive use, and also to help detect unwanted trends in various "sensitive" species. However, the margins of error of the estimates generated may be too broad to be appropriate for detecting such change, particularly in the case of herd species; consequently basing management actions on the results of a single year's census results is not advisable. Likewise, aerial census is not particularly effective for estimating populations of cryptic species like the 'guild' of the five major predators, Lions, leopards, Cheetahs, Wild Dogs and Hyenas.

IN PLACE-MONITORING OF WILDLIFE SPECIES IN THE PROPERTY BY THE DEPARTMENT OF WILDLIFE AND NATIONAL PARKS (DWNP)

The property includes Wildlife Management Areas and Moremi Game Reserve. Monitoring of the state of the property includes resource inventory of wild animals that occur in the area through the use of a fixed-wing aircraft to carry out aerial surveys. During the survey, a suitably equipped Cessna 206 aircraft is used. Accurate navigation along transects is maintained using Global Positioning Systems fitted in the aircraft. A constant height of 300ft above ground level (a.g.l.) is maintained with the use of radar altimeters. The method of stratified systematic transect sampling (Griffiths, 1978) is employed for the survey.

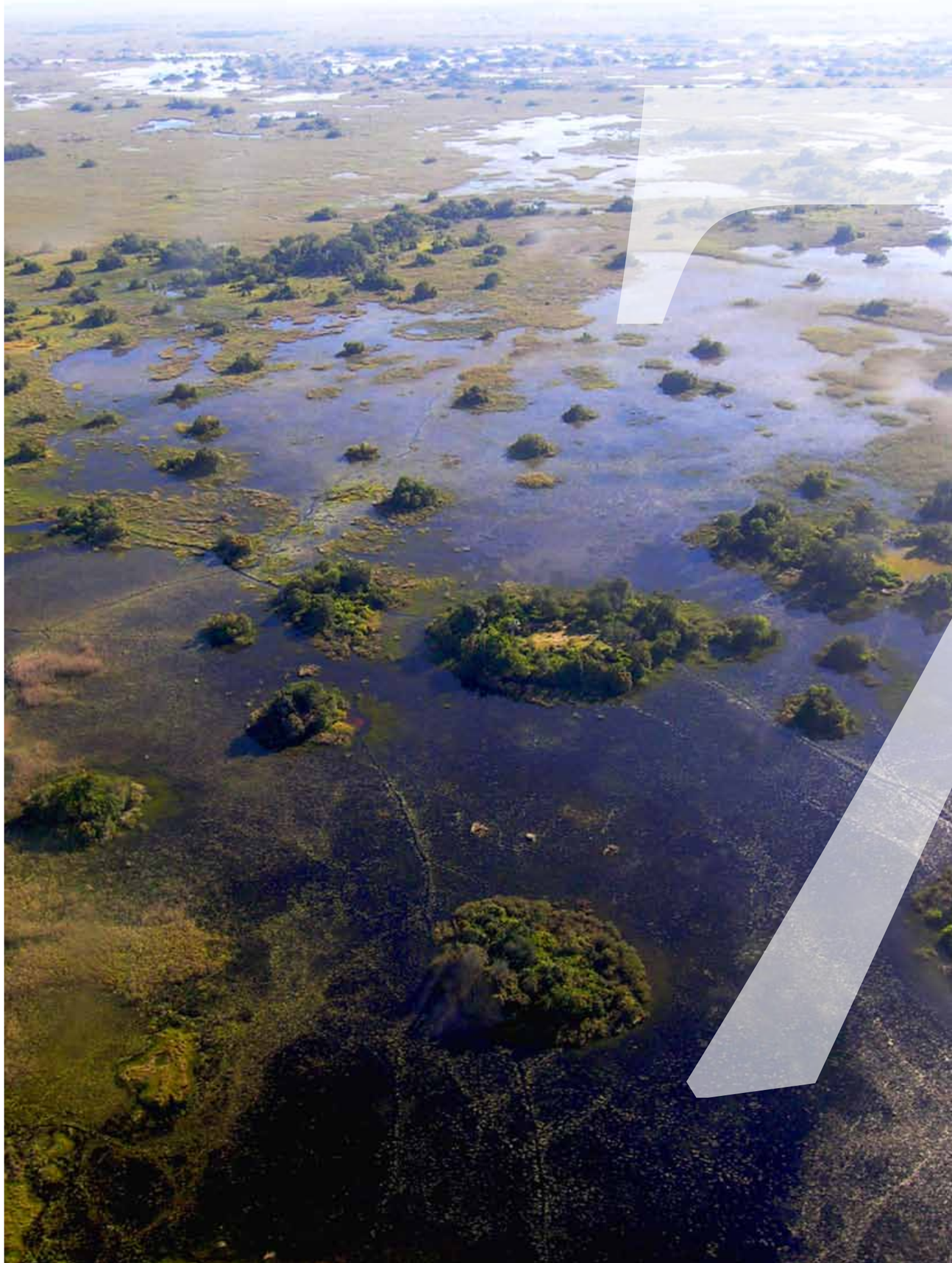
During the survey, the aircraft is flown at a nominal speed of 90 knots along transects. A recorder seated in the front next to the pilot records sightings made by observers in the pair of seats in the next row. The position of each sighting is then recorded from the GPS. Population estimate results of the aerial surveys which were carried out by the Department of Wildlife and National Parks between 2001 and 2006 (table 1-5) for the core delta which constitutes the property. Data from these surveys is contained in Appendix 2.

Gaps in Monitoring

Vegetation: This is a critical gap which is currently being addressed by the Okavango Research Institute (ORI). The vegetation of the Delta directly reflects the health of the hydrology, and can be used to monitor drying/wetting trends. This is considered essential information for managing wildlife populations, and indirectly, tourism. ORI is currently engaged in research to facilitate monitoring of floodplain vegetation.

Small mammals: Very little is known about the small mammal ecology of the Okavango. Boom-and bust type population cycles have been observed in rodents; historically these have been associated with outbreaks of bubonic plague. Clearly the biomass of small mammals has major implications for the populations of small predators and raptors.

Geographical spread of monitoring: Monitoring activities are currently relatively limited to a few stations. Very little is known about how the climate and environment "inside" the Delta differs from that on the peripheries. Therefore more monitoring stations to cover a more extensive area of the property will be a future priority.



CHAPTER 7
DOCUMENTATION

The following items are included in the Appendices;

7.a PHOTOGRAPHS, SLIDES, AUDIO AND IMAGE INVENTORY

A photo library DVD with about 60 photos is provided in the back of the cover of this document, which shows the SUPERLATIVE NATURAL BEAUTY of the Okavango Delta property, and includes people, as well as land use activities such as tourism, mekoro use, and fishing. Images also capture landscapes showing natural habitats, fauna and flora and ecosystem processes such as flooding.

- All photographers have agreed to relinquish copyright to World Heritage Center for materials submitted.
- A full description of photos, location and photographer are provided with the photos on the image inventory DVD.
- Six additional DVD's are provided on recent wildlife documentaries filmed in the site.

ID No.	Format	Caption	Date of Photograph	Photographer & Copyright owner	Contact detail of copyright owner	Non-exclusive cessation of rights
OD1	jpg	African Fish Eagle 2	04/05/2010	Donovan Drotsky	dydrotsky@yahoo.com 72122970	Yes
OD2	jpg	Africa Fish Eagle	10/06/2010	Same as above	Same as above	Yes
OD3	jpg	Breeding grounds for Carmine bee eaters in the Okavango Delta Property	12/02/2011	Gertrude M. Matswiri	P/Bag 017 Maun Tel: +267 6861852 Fax: +2676861832 Email: gertymatswiri@gmail.com or getrudematswiri@yahoo.com	Yes
OD4	jpg	Cattle Egrets	19/03/2008	Joyce Bestelink	simonjoyce@info.bw P O Box 250 Maun Tel: 6862623	Yes
OD5	jpg	Lappet-faced and W-b Vultures	01/12/2008	Same as above	Same as above	Yes
OD6	jpg	Lekukara Pelican	22/11/2007	Department of Wildlife and National Parks	Box 131, Gaborone, Botswana	Yes
OD7	jpg	Lilac-breasted Roller	15/3/2009	Joyce Bestelink	simonjoyce@info.bw P O Box 250 Maun Tel: 6862623	Yes
OD8	jpg	Okavango White backed Night Heron	Unknown	Donovan Drotsky	dydrotsky@yahoo.com 72122970	Yes
OD9	jpg	Okavango Saddle billed Stork	Unknown	Karen S. Ross	Tel: + 1 646 595 7443 Email: karenross@mweb.co.za; deltaskimmer@gmail.com	Yes
OD10	jpg	Ostrich	25/11/2007	Department of Wildlife and National Parks	Box 131, Gaborone, Botswana	Yes
OD11	jpg	Pel's Fishing Owl	22/10/2010	Donovan Drotsky	dydrotsky@yahoo.com 72122970	Yes
OD12	jpg	Slaty Eating Fish	17/10/2005	Grant Atkinson	Atkinson.grant@gmail.com	Yes
OD13	jpg	Wattled Crane	24/11/2007	Department of Wildlife and National Parks	Box 131, Gaborone, Botswana	Yes
OD14	jpg	Basket 1	28/03/2011	National Museum, Monuments and Art Gallery	P Bag 00114,Gaborone, Botswana	Yes
OD15	jpg	Basket 2	08/04/2005	Same as above	Same as above	Yes
OD16	jpg	Women and girls fishing in the upper Okavango Delta property.	Unknown	Frans Lanting	207 McPherson Street, Suite D,Santa Cruz, CA 95060 USA +1 831-429-1331	Yes
OD17	jpg	Okavango Bream	Unknown	Department of Wildlife and National Parks	Box 131, Gaborone, Botswana	Yes
OD18	jpg	Okavango Bream	Unknown	Same as above	Same as above	Yes
OD19	jpg	Fish Harvesting in the Okavango Delta	Unknown	Same as above	Same as above	Yes
OD20	jpg	Mokoro with Fish	01/05/2011	K.Oake	gamestudios@ngami.net	Yes
OD21	jpg	African Elephant	09/07/2008	Pete Hancock	P O Box 20463 Maun, Botswana Tel: + 267 74654464 Email: birdlifemaun@gmail.com	Yes
OD22	jpg	African Elephants	11/09/2010	Same as above	Same as above	Yes
OD23	jpg	Antelope (Impala)	30/07/2009	Department of Wildlife and National Parks	Box 131, Gaborone, Botswana	Yes
OD24	jpg	Antelope (Kudu)	22/11/2007	Same as above	Same as above	Yes
OD25	jpg	Buffalo	22/11/2007	Ian Johnson / Department of Wildlife and National Parks	Same as above	Yes
OD26	jpg	Aerial view of Buffaloes	05/12/2007	Same as above	Same as above	Yes
OD27	jpg	Cheetah	28/07/2009	Department of Wildlife and National Parks	Same as above	Yes
OD28	jpg	Elephant 1	19/02/2012	Ryuichi Ishida	ronxvii@gmail.com	Yes

OD29	jpg	Female Sitatunga running	04/04/2007	Chris Harvey	13 West End, Launton, OXON OX26 5 DT, UK. email:chrisharvey@talktalk.net	Yes
OD30	jpg	Giraffe	16/08/2012	Ryuichi Ishida	ronxvii@gmail.com	Yes
OD31	jpg	Impala	16/01/2010	Pete Hancock	P O Box 20463 Maun, Botswana Tel: + 267 74654464 Email: birdlifemaun@gmail.com	Yes
OD32	jpg	Lechwe during dawn	07/04/2010	Tim & June Liversedge	Liversedge@info.bw Tel: +267 6862340/72320090	Yes
OD33	jpg	Leopard	16/02/2010	Department of Wildlife and National Parks	Box 131, Gaborone, Botswana	Yes
OD34	jpg	Lion 1	16/08/2012	Ryuichi Ishida	ronxvii@gmail.com	Yes
OD35	jpg	Lion 2	23/11/2007	Department of Wildlife and National Parks	Box 131, Gaborone, Botswana	Yes
OD36	jpg	Lions swimming across lagoon in Okavango	17/07/2006	Karen. S Ross	Tel: + 1 646 595 7443 Email: karenross@mweb.co.za; deltaskimmer@gmail.com	Yes
OD37	jpg	Red Lechwe 3	08/09/2007	Joyce Bestelink	simonjoyce@info.bw Tel: +267 6862623	Yes
OD38	jpg	Rhinos	22/11/2007	Ian Johnson / Department of Wildlife and National Parks	Box 131, Gaborone, Botswana	Yes
OD39	jpg	Roan Antelope	27/11/2011	Pete Hancock	P O Box 20463 Maun, Botswana Tel: + 267 74654464 Email: birdlifemaun@gmail.com	Yes
OD40	jpg	Sitatunga	09/03/2008	Donovan Drotsky	dydrotsky@yahoo.com +267 72122970	Yes
OD41	jpg	Wild dogs	28/11/2011	Pete Hancock	P O Box 20463 Maun, Botswana Tel: + 267 74654464 Email: birdlifemaun@gmail.com	Yes
OD42	jpg	Zebra 1	16/08/2012	Ryuichi Ishida	ronxvii@gmail.com	Yes
OD43	jpg	Zebra 2	19/11/2007	Department of Wildlife and National Parks	Box 131, Gaborone, Botswana	Yes
OD44	jpg	Zebra crossing Okavango Delta	04/04/2007	Chris Harvey	13 West End, Launton, OXON OX26 5 DT, UK. email:chrisharvey@talktalk.net	Yes
OD45	jpg	Aerial view of Okavango	19/03/2009	Pete Hancock	P O Box 20463 Maun, Botswana Tel: + 267 74654464 Email: birdlifemaun@gmail.com	Yes
OD46	jpg	Aerial View of elephant in flooded grasslands	Unknown	Frans Lanting	207 McPherson Street, Suite D,Santa Cruz, CA 95060 USA +1 831-429-1331	Yes
OD47	jpg	Channel 2	13/02/2011	Gertrude M. Matswiri	P/Bag 017 Maun Tel: +267 6861852 Fax: +2676861832 Email: gertymatswiri@gmail.com or getrudematswiri@yahoo.com	Yes
OD48	jpg	Channel 3	15/08/2012	Same as above	Same as above	Yes
OD49	jpg	Channel 4	15/08/2012	Same as above	Same as above	Yes
OD50	jpg	Wooded Islands and Channels in the Okavango Delta	15/08/2012	Karen. S Ross	Tel: + 1 646 595 7443 Email: karenross@mweb.co.za; deltaskimmer@gmail.com	Yes
OD51	jpg	Channel 6	01/01/2004	Gertrude M. Matswiri	P/Bag 017 Maun Tel: +267 6861852 Fax: +2676861832 Email: gertymatswiri@gmail.com or getrudematswiri@yahoo.com	Yes
OD52	jpg	Wildlife Trails in the permanent swamps of the Okavango Delta	15/08/2012	Dana Allan	Wilderness Safaris. Photo from Mendelsohn etc Floods of Life	Yes

OD53	jpg	Island in the permanent swamps of the Okavango Delta	15/08/2012	Mike Holding	Afriscreen, P O Box H A 40 HAK, Maun	Yes
OD54	jpg	Channel 9	Unknown	Naidoo Kurugundla	Water Affairs, Maun	Yes
OD55	jpg	Aerial view of the Okavango Delta	19/08/2012	Frans Lanting	207 McPherson Street, Suite D,Santa Cruz, CA 95060 USA +1 831-429-1331	Yes
OD56	jpg	Aerial View of Okavango Delta annual Floods	12/04/2007	Karen S. Ross	Tel: + 1 646 595 7443 Email: karenross@mweb.co.za; deltaskimmer@gmail.com	Yes
OD57	jpg	Delta Scenic	20/08/2001	Tim & June Liversedge	Liversedge@info.bw Tel: +267 6862340/72320090	Yes
OD58	jpg	Meandering Okavango river	07/04/2010	Same as above	Same as above	Yes
OD59	jpg	Mokoro 1	15/06/2011	Yusuke Hirano	jasmine@f4.dion.ne.jp	Yes
OD60	jpg	Okavango Aerial 2	19/09/2012	Joyce Bestelink	simonjoyce@info.bw P O Box 250 Maun Tel: +267 6862623	Yes
OD61	jpg	Okavango Aerial 3	19/09/2012	Same as above	Same as above	Yes
OD62	jpg	Okavango Aerial	19/03/2009	Pete Hancock	P O Box 20463 Maun, Botswana Tel: + 267 74654464 Email: birdlifemaun@gmail.com	Yes
OD63	jpg	Tourists on a mokoro at dusk in the Okavango Delta property	12/04/2007	Karen S. Ross	Tel: + 1 646 595 7443 Email: karenross@mweb.co.za; deltaskimmer@gmail.com	Yes
OD64	jpg	Okavango Delta	19/05/2011	Pete Hancock	P O Box 20463 Maun, Botswana Tel: + 267 74654464 Email: birdlifemaun@gmail.com	Yes
OD65	jpg	Okavango panorama	19/09/2012	Joyce Bestelink	simonjoyce@info.bw P O Box 250 Maun Tel: +267 6862623	Yes
OD66	jpg	Okavango riparian	06/01/2010	Pete Hancock	P O Box 20463 Maun, Botswana Tel: + 267 74654464 Email: birdlifemaun@gmail.com	Yes
OD67	jpg	Thaoge Channel in the Okavango Delta property	17/07/2006	Karen S. Ross	Tel: + 1 646 595 7443 Email: karenross@mweb.co.za; deltaskimmer@gmail.com	Yes
OD68	jpg	Papyrus blockage	19/05/2011	Pete Hancock	P O Box 20463 Maun, Botswana Tel: + 267 74654464 Email: birdlifemaun@gmail.com	Yes
OD69	jpg	Pom Pom channel	19/05/2011	Same as above	Same as above	Yes
OD70	jpg	Sunrise over the Okavango	12/07/2008	Same as above	Same as above	Yes
OD71	jpg	Tourist accommodation in the Okavango Delta	11/09/2012	Department of Wildlife and National Parks	Box 131, Gaborone, Botswana	Yes
OD72	jpg	Tourist facility in the Okavango Delta	11/09/2012	Same as above	Same as above	Yes
OD73	jpg	Aerial view of Okavango Delta	Unknown	Pete Hancock	P O Box 20463 Maun, Botswana Tel: + 267 74654464 Email: birdlifemaun@gmail.com	Yes
OD74	jpg	Acacia erioloba	07/09/2012	Same as above	Same as above	Yes
OD75	jpg	Eulophia latilabris - Rare Okavango ground orchid	19/08/2012	P. Linder	Okavango Research Centre, Maun, Botswana	Yes
OD76	jpg	Mophane trees, Moremi Game Reserve	16/06/2007	Karen S. Ross	Tel: + 1 646 595 7443 Email: karenross@mweb.co.za; deltaskimmer@gmail.com	Yes
OD77	jpg	Palm Trees in the Okavango Delta property	12/02/2011	Karen S. Ross	Tel: + 1 646 595 7443 Email: karenross@mweb.co.za; deltaskimmer@gmail.com	Yes

OD78	jpg	Palm trees in the Okavango Panhandle	12/02/2011	Gertrude M. Matswiri	P/Bag 017 Maun Tel: +267 6861852 Fax: +2676861832 Email: gertymatswiri@gmail.com or getrudematswiri@yahoo.com	Yes
OD79	jpg	Plant in the Okavango Panhandle 1	12/02/2011	Same as above	Same as above	Yes
OD80	jpg	Plant in the Okavango Panhandle 2	12/02/2011	Same as above	Same as above	Yes
OD81	jpg	Water lilies	24/01/2010	Joyce Bestelink	simonjoyce@info.bw P O Box 250 Maun, Botswana Tel: 6862623	Yes
OD82	jpg	Water lily	15/06/2011	Yusuke Hirano	jasmine@f4.dion.ne.jp	Yes
OD83	jpg	Nile Crocodile	08/07/2011	Pete Hancock	P O Box 20463 Maun, Botswana Tel: + 267 74654464 Email: birdlifemaun@gmail.com	Yes
OD84	jpg	Okavango Xakanaxa Long reed frog	19/07/2006	Karen S. Ross	Tel: + 1 646 595 7443 Email: karenross@mweb.co.za; deltaskimmer@gmail.com	Yes
OD85	jpg	Southern African Python	04/07/2008	Pete Hancock	P O Box 20463 Maun, Botswana Tel: + 267 74654464 Email: birdlifemaun@gmail.com	Yes
OD86	jpg	Southern African Python	Unknown	Joyce Bestelink	simonjoyce@info.bw P O Box 250 Maun Tel: +267 6862623	Yes
OD87	jpg	Cheetah2	Unknown	Pete Hancock	P O Box 20463 Maun, Botswana Tel: + 267 74654464 Email: birdlifemaun@gmail.com	Yes
OD88	jpg	Gloriosa superba	Unknown	Same as above	Same as above	Yes
OD89	jpg	Mokoro trail	Unknown	Same as above	Same as above	Yes
OD90	jpg	Red Lechwe 4	Unknown	Same as above	Same as above	Yes
OD91	jpg	Wild Dog	Unknown	Same as above	Same as above	Yes
OD92	jpg	Water pond	Unknown	Ryuichi Ishida	ronxvii@gmail.com	Yes
OD93	jpg	Channel12	Unknown	Gertrude M. Matswiri	P/Bag 017 Maun Tel: +267 6861852 Fax: +2676861832 Email: gertymatswiri@gmail.com or getrudematswiri@yahoo.com	Yes
OD94	jpg	Channel13	Unknown	Same as above	Same as above	Yes
OD95	jpg	Channel14	Unknown	Same as above	Same as above	Yes
OD96	jpg	Channel15	Unknown	Same as above	Same as above	Yes
OD97	jpg	Lechwe3	Unknown	Same as above	Same as above	Yes
OD98	jpg	Mokoro at Sunset	Unknown	Same as above	Same as above	Yes
OD99	jpg	Buffalo and Yellow-billed Oxpecker	Unknown	Jane Macdonald	P O Box 2063, Maun, Botswana E mail: jmacdonald@gmail.com	Yes
OD100	jpg	Elephant4	Unknown	Department of Wildlife and National Parks	Box 131, Gaborone, Botswana	Yes
OD101	jpg	Fish eagle 3	Unknown	Same as above	Same as above	Yes
OD102	jpg	Fresh bream	Unknown	Same as above	Same as above	Yes
OD103	jpg	Giraffe 2	Unknown	Same as above	Same as above	Yes
OD104	jpg	Hippo Yawn 2	Unknown	Same as above	Same as above	Yes
OD105	jpg	Hippo1	Unknown	Same as above	Same as above	Yes
OD106	jpg	Hyena	Unknown	Same as above	Same as above	Yes
OD107	jpg	Lion3	Unknown	Same as above	Same as above	Yes
OD108	jpg	saddlebilled stork	Unknown	Same as above	Same as above	Yes

7.b TEXTS RELATING TO PROTECTIVE DESIGNATION, COPIES OF PROPERTY MANAGEMENT PLANS OR DOCUMENTED MANAGEMENT SYSTEMS AND EXTRACTS OF OTHER PLANS RELEVANT TO THE PROPERTY

THE APPENDICES

- Appendix 1: The Atlas: GIS maps of the Property
- Appendix 2: Tables of species in the Okavango Delta Property
- Appendix 3: Aerial survey data of species
- Appendix 4: Summary of consultations
- Appendix 5: Botswana ecotourism certification system
- Appendix 6: The Okavango Delta Management Plan (ODMP) – soft and hard copies
- Appendix 7: Moremi Game Reserve Management Plan – soft and hard copies
- Appendix 8: Photo Gallery of the Okavango Delta Property
- Appendix 9: Documentaries of the Okavango Delta on DVD

7.c FORM AND DATES OF MOST RECENT INVENTORY RECORDS (on CD)

- Okavango; Floods of Life: Mendelsohn et al., 2010 (digital copy).
- UNDP/Gob; Endangered Species Management and Policy Report (2007) (digital copies).

7.d ADDRESS WHERE THESE INVENTORIES AND RECORDS ARE HELD

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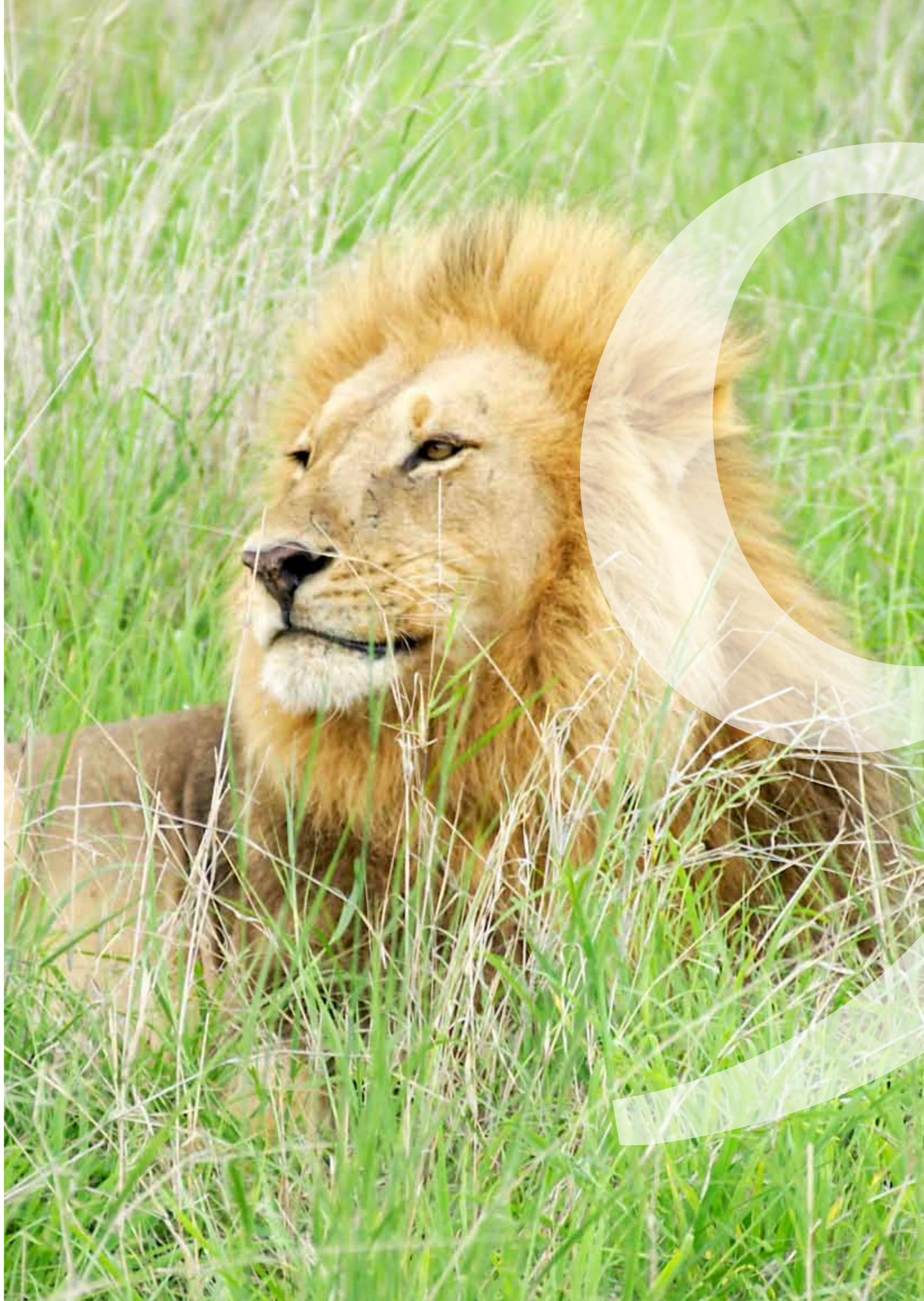
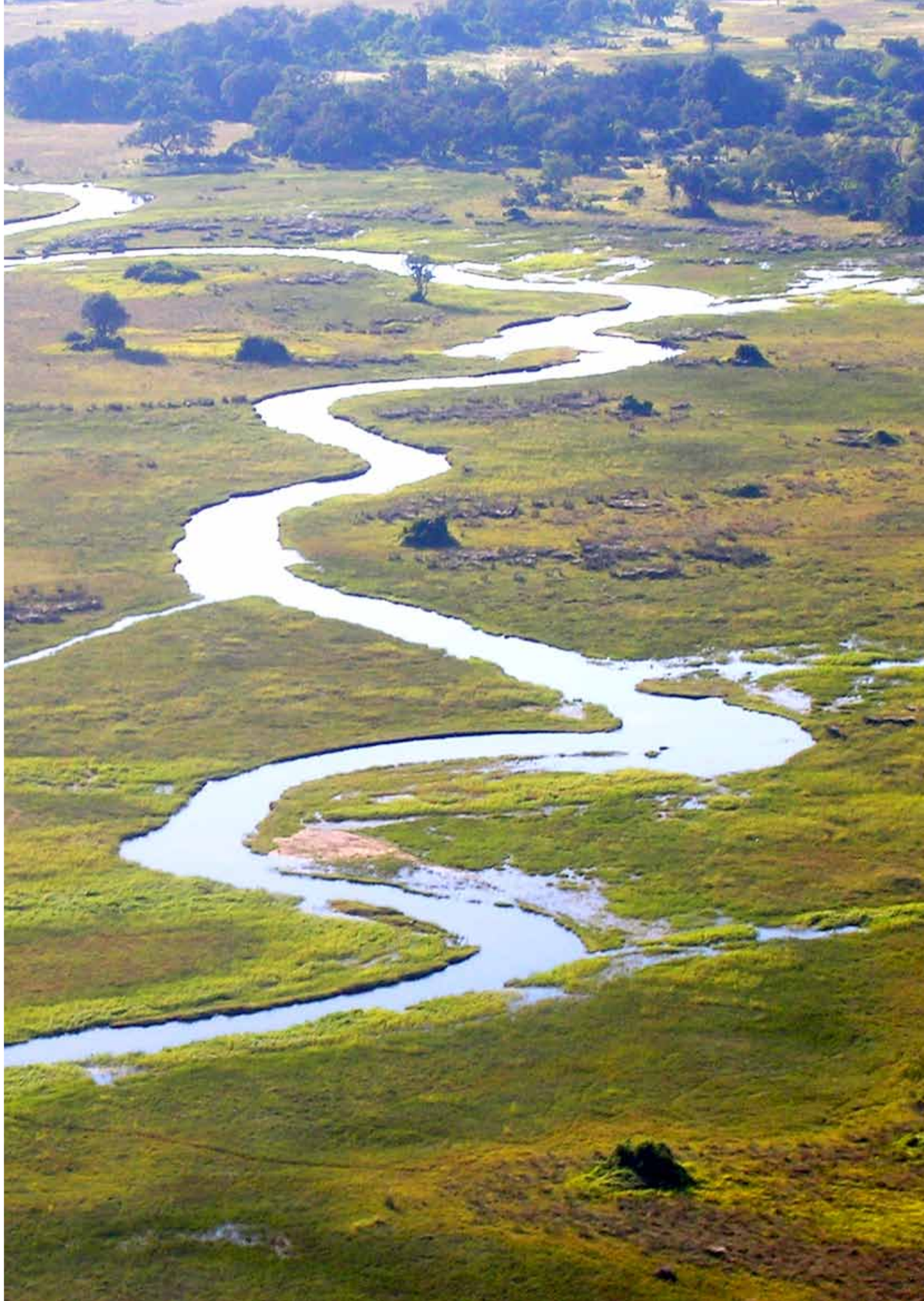


CHAPTER 9
SIGNATURE

9 - OFFICIAL SIGNATURE ON BEHALF OF THE STATE PARTY

The Honourable Tshekedi Khama
MINISTER OF ENVIRONMENT, WILDLIFE AND TOURISM



Appendices

for

Okavango Delta Nomination Dossier

REPUBLIC OF BOTSWANA

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OKAVANGO DELTA NOMINATION DOSSIER

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In addition, the following large-scale maps describing the property are attached in 'The Atlas' Appendix 1, in both hard and digital format.

Map 1: Tourist facilities in the Okavango Property
Map 2: Landcover of the Okavango Delta Property
Map 3: Boundary coordinates of the Okavango Delta Property
Map 4: Lakes, rivers and settlements in the Okavango Delta Property
Map 5: Land use designations in the Okavango Delta Property (Wildlife Management Area)

The above maps can be accessed at;

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Private Bag 0037
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Tel: +267 3953251
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b. Peace Parks Foundation
P. O. Box 12743
Die Boord, Stellenbosch 7613
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Fax: +27 (21) 866800345

APPENDIX 2: TABLES OF SPECIES IN THE OKAVANGO DELTA PROPERTY

Appendix 2.1: Inventory of Birds in the Okavango Delta property (Hancock et al., 2007)

Species	Number and status	Habitats	Comments
Common Ostrich Struthio camelus	Resident – rare in core area but more common in buffer.	Open grassland and woodland	Numbers decreased dramatically over last 20 years particularly in Sehithwa area
Black-necked Grebe Podiceps nigricollis	Sparse in World Heritage Site	Shallow saline pans	Fairly regular on Maun Sewage ponds.
Little Grebe Tachybaptus ruficollis	Very common resident	Lagoons, floodplains, rivers	Exceeds 0,5% of the regional population at Lake Ngami alone when water is present (Hancock et al., 2005). World Heritage Site has >1% of population.
Great White Pelican Pelecanus onocrotalus	Approx. 5,000 to 6,000. Seasonally common resident	Large expanses of shallow water (including floodplains) and lagoons. Follows drying floodplains and lagoons.	Lake Ngami, when it had water during 2004, supported 5,200 Great White Pelicans, out of an estimated Southern African population of 7,500 (Hancock et al., 2005).
Pink-backed Pelican Pelecanus rufescens	Sparse resident	Lagoons, floodplains	The World Heritage Site has one of only three known breeding sites in Botswana (Tyler and Hancock, 2006).
White-breasted Cormorant Phalacrocorax lucidus	Regular vagrant	Lagoons, rivers	Scarce in the core area; usually seen in the buffer zone at Lake Ngami
Reed Cormorant Phalacrocorax africanus	Common resident	Lagoons, floodplains, rivers	Over 3,000 present at Lake Ngami alone during 2004 (Hancock et al., 2005) – the World Heritage Site supports >0,5% of the regional population.

African Darter Anhinga rufa	Common resident	Lagoons, floodplains, rivers	Several important breeding sites exist in the World Heritage Site (Tyler and Hancock, 2006). Exceeds 1% threshold (Tyler, 2001).
Grey Heron Ardea cinerea	Common resident	Edges of lagoons, pans	
Black-headed Heron Ardea melanocephala	Sparse resident	Grassland and open savannah	Locally common at times at Lake Ngami; scarce elsewhere in the core area.
Goliath Heron Ardea goliath	Common resident	Lagoons	Significant numbers occur, exceeding 1% threshold.
Purple Heron Ardea purpurea	Common resident	Lagoons, reedbeds	Breeds at heronry in Xakanaxa lediba (Tyler and Hancock, 2006). Significant numbers found in core of World Heritage Site.
Great Egret Egretta alba	Very common resident	Shallow waters of lagoons, floodplains	Phragmites reedbeds important for roosting and breeding by this species. Several such sites documented (Tyler and Hancock). Exceeds 1% threshold (Tyler, 2001).
Little Egret Egretta garzetta	Very common resident	Edges of lagoons, floodplains, rivers	Phragmites reedbeds important for this colonially roosting and breeding species. Several such sites documented (Tyler and Hancock). Lake Ngami alone supported >1% of regional population during 2004 (Hancock et al., 2005).
Yellow-billed Egret Egretta intermedia	Common resident	Edges of lagoons, floodplains, rivers	Numbers exceed the 0,5% threshold. Phragmites reedbeds important for this colonially roosting and breeding species. Several such sites documented (Tyler and Hancock, 2006)

Black Heron Egretta ardesiaca	Common resident	Shallow waters of lagoon edges, floodplains	Phragmites reedbeds important for this colonially roosting and breeding species - a few sites documented in the core of the World Heritage Site (Tyler and Hancock, 2006). Exceeds 1% threshold.
Slaty Egret Egretta vinaceigula	4,000. Uncommon resident. Globally threatened	Shallow floodplains with short emergent vegetation. Follows floodwaters.	Phragmites reedbeds important for this colonially roosting and breeding species. Several such sites documented (Hancock et al, 2006). World Heritage Site has 75 – 80% of the world population of this species.
Cattle Egret Bubulcus ibis	Very common resident	Grassland and savannah, as well as channel edges	Phragmites reedbeds important for roosting/ breeding, although it also nests in trees – several such sites documented (Tyler and Hancock, 2006). Delta supports >0,5% of population.
Squacco Heron Ardeola ralloides	Very common resident	Reed and sedges on margins of lagoons, channels	Phragmites reedbeds important for roosting/ breeding – a few such sites documented (Tyler and Hancock, 2006). Delta supports >0,5% of population.
Green-backed Heron Butorides striata	Very common resident	Rivers, channels, also lagoons with fringing vegetation	
Rufous-bellied Heron Ardeola rufiventris	Common resident	Marshes, swamps, lagoons and floodplains with reeds	Breeds in reeds and Phoenix reclinata. A few important breeding sites known in the World Heritage Site (Tyler and Hancock, 2006). Exceeds 1% threshold.

Black-crowned Night-Heron Nycticorax nycticorax	Common resident	Bushes and trees overhanging Rivers, channels and lagoons. Also reedbeds.	Over 0,5% of regional population counted at Lake Ngami alone during 2004 (Hancock et al., 2005). Exceeds 1% threshold in World Heritage Site.
White-backed Night Heron Gorsachius leuconotus	Uncommon resident	Rivers with overhanging bushes and trees.	Most records are from the Okavango Panhandle in the core area. The World Heritage Site is important for this species.
Little Bittern Ixobrychus minutes	Sparse to fairly common resident and migrant	Rivers and lagoons with fringing reedbeds and tall aquatic vegetation.	Numbers exceed the 0,5% level.
Dwarf Bittern Ixobrychus sturmii	Sparse to common migrant depending on rainfall	Seasonally flooded depressions in woodland.	
Eurasian Bittern Botaurus stellaris	Very rare vagrant	Reedbeds and tall aquatic vegetation.	Few recent authenticated sight records.
Hamerkop Scopus umbretta	Very common resident	Rivers, channels, floodplains	
White Stork Ciconia ciconia	Common migrant	Open grassland and floodplains (wet or dry), savannah	
Black Stork Ciconia nigra	Rare vagrant	Rivers and channels	
Abdim's Stork Ciconia abdimii	Very common migrant	Short grassland on floodplains, plains, open savannah	
Woolly-necked Stork Ciconia episcopus	Sparse migrant	Grassland near water, floodplains, savannah.	World heritage Site supports >0,5% of regional population.
African Openbill Anastomus lamelligerus	Common resident	Floodplains and drying channels. Follows floodwaters.	Several important breeding sites known in the core area (Tyler and Hancock, 2006), which supports >0,5% of population.
Saddle-billed Stork Ephippiorhynchus senegalensis	Approx. 1,000 (Hancock, 2003b). Common resident, population stable	Lagoons, floodplains, channels.	Over 100 nests known in the World Heritage Site (Hancock, 2003b). Exceeds 1% level.

Marabou Stork Leptoptilos crumeniferus	Very common resident	Open savannah, shallow waterbodies	Over 1% of regional population recorded at Lake Ngami alone during 2004 (Hancock et al., 2005). Most important Southern African breeding sites documented are in the core area.
Yellow-billed Stork Mycteria ibis	Common resident	Shallow waters of lagoons, floodplains	Most important Southern African breeding sites documented are in the core area.
African Sacred Ibis Threskiornis aethiopicus	Common resident	Lagoons, flooded grassland	Exceeds 0,5% threshold (Tyler, 2001).
Glossy Ibis Plegadis falcinellus	Common resident	Wet grassland, edges of lakes, lagoons	Over 0,5% of regional population occurred at Lake Ngami alone during 2004 (Hancock et al., 2005).
Hadeda Ibis Bostrychia hagedash	Sparsely distributed resident	Tall riparian trees, riverine forest and adjacent grassland	
African Spoonbill Platalea alba	Common resident	Shallow waters of lagoons, floodplains	Numbers exceed 1% threshold.
Greater Flamingo Phoenicopterus ruber	Occasional visitor	Shallow waterbodies such as lakes and pans	Over 0,5% of regional population counted at Lake Ngami alone during 2004 (Hancock et al., 2005).
Lesser Flamingo Phoenicopterus minor	Occasional visitor. Globally threatened.	Shallow waterbodies such as lakes and pans	
White-faced Duck Dendrocygna viduata	Very common resident	Shallow water and vegetated or muddy edges of lagoons and lakes, floodplains.	
Fulvous Duck Dendrocygna bicolour	Sparse resident	Vegetated lagoons and floodplains	The World Heritage Site supports >0,5% of regional population (Tyler, 2001).
White-backed Duck Thalassornis leuconotus	Sparse resident and visitor in good rainfall years	Lagoons, lakes and channels with floating and emergent vegetation.	
Egyptian Goose Alopochen aegyptiaca	Very common resident	Floodplains, edges of lagoons and lakes.	
Yellow-billed Duck Anas undulata	Sparse resident	Lagoons, floodplains, pans and pools	

Cape Teal Anas capensis	Rare resident – regular at Maun Sewage ponds, irregular visitor elsewhere	Saline waters of pans	Breeds in the World Heritage Site buffer zone.
Hottentot Teal Anas hottentota	Common	Lagoons, lakes and flooded grassland usually with emergent vegetation	In 1979, 7,000 were estimated at Lake Ngami by Douthwaite (1979), well in excess of the 1% threshold.
Red-billed Teal Anas erythrorhyncha	Very common to abundant resident	Lagoons, lakes and flooded grassland usually with submerged vegetation	Lake Ngami alone, when it has water, supports well in excess of the 1% threshold for this species (Hancock et al., 2005).
Northern Pintail Anas acuta	Rare vagrant		Single bird shot at Lake Ngami in June, 1980.
Garganey Anas querquedula	Rare vagrant		Seen at Lake Ngami
Cape Shoveler Anas smithii	Sparse resident	Saline waters of pans	
Southern Pochard Netta erythrophthalma	Uncommon resident and regular visitor in good rainfall years	Lagoons, lakes and channels with deep water	Thamalakane River supports more than 1% of regional population of this species when water is present (Tyler, 2001).
African Pygmy-Goose Nettapus auritus	Very common resident	Lagoons with floating aquatic vegetation	The World Heritage Site is important for this species as its numbers exceed the 1% threshold.
Comb Duck Sarkidiornis melanotos	Common resident	Floodplains, seasonally flooded grasslands and savanna	In 2004, Lake Ngami alone supported > 0,5% of the population of this species (Hancock et al., 2005). This species exceeds 1% threshold in the World Heritage Site.
South African Shelduck	Vagrant in good rainfall years		Found at Lake Ngami and on the Thamalakane River
Spur-winged Goose Plectropterus gambensis	Very common resident	Floodplains and edges of lakes, lagoons	Exceeds 1% of regional population.
Secretarybird Sagittarius serpentarius	Uncommon resident	Grassland plains and open savanna	This species is globally threatened.
Hooded Vulture Necrosyrtes monachus	Common resident	Woodland and tree savannah	This species is globally threatened.
Cape Vulture Gyps coprotheres	Sparse. Globally threatened. Declining throughout range.	Savanna	Young birds are vagrant to the World Heritage Site.

White-backed Vulture Gyps africanus	Very common resident.	Woodland and tree savannah	Globally threatened. The Linyanti riparian is a very important breeding area for this species.
Lappet-faced Vulture Aegypius tracheliotos	Fairly common resident. Globally threatened.	Woodland and tree savannah	One nest found in NG 31 (Chitabe) during September 2008.
White-headed Vulture Aegypius occipitalis	Sparse resident. Globally Vulnerable.	Woodland and savannah	
Black Kite Milvus migrans	Very common Palaearctic migrant	Woodland and savannah	
Yellow-billed Kite Milvus migrans	Very common intra-African migrant	Woodland and savannah	Breeds in the World Heritage Site
Black-shouldered Kite Elanus caeruleus	Common resident	Open tree and bush savannah	Subject to marked population booms in years of good rodent numbers
African Cuckoo Hawk Aviceda cuculoides	Very rare resident	Mature broadleafed woodland	World Heritage Site is western limit of its range.
Bat Hawk Macheiramphus alcinus	Uncommon resident	Large trees in riparian forest	Breeds in the World Heritage Site.
European Honey-Buzzard Pernis apivorus	Rare visitor		
Tawny Eagle Aquila rapax	Common resident	Woodland and tree savannah	
Steppe Eagle Aquila nipalensis	Uncommon migrant	Edges of woodland and tree savannah	
Lesser Spotted Eagle Aquila pomarina	Uncommon migrant	Broadleafed woodland and savannah	
Wahlberg's Eagle Aquila wahlbergi	Common migrant	Woodland and tree savannah	
Booted Eagle Aquila pennatus	Sparse migrant	Woodland and tree savannah	
African Hawk-Eagle Aquila spilogaster	Common resident	Woodland and tree savannah	
Ayres's Hawk-Eagle Aquila ayresii	Scarce migrant and possible rare resident	Mature dense woodland, including riparian woodland	
Long-crested Eagle Lophaetus occipitalis	Rare resident	Edges of woodland, particularly those bordering floodplains	This is a 'bird of concern' in Botswana, and more information is required on its status.
Martial Eagle Polemaetus bellicosus	Uncommon resident	Open woodland and savannah	Globally threatened species.
Brown Snake-Eagle Circaetus cinereus	Common resident	Woodland	

Black-chested Snake-Eagle Circaetus pectoralis	Common resident	Open savanna, grassland plains, floodplains	
Western Banded Snake-Eagle Circaetus cinerascens	Sparse resident	Riverine forest and woodland on edge of swamps	World Heritage Site is extreme southern limit of range.
Bateleur Terathopius ecaudatus	Very common resident	Woodland and savannah	Globally threatened species. Significant populations occur at Khwai and Linyanti.
Palm-nut Vulture Gypohierax angolensis	Very rare vagrant		No authenticated recent records
African Fish-Eagle Haliaeetus vocifer	Very common resident	Rivers and lagoons with fringing large trees	
Steppe Buzzard Buteo vulpinus	Common migrant	Tree and bush savannah	
Augur Buzzard Buteo augur	Very rare vagrant	Tree and bush savanna	
Lizard Buzzard Kaupifalco monogrammicus	Sparse resident	Broadleafed woodland and tree savannah.	
Ovambo Sparrowhawk Accipiter ovampensis	Rare resident	Acacia and mixed woodland on Kalahari sand	
Little Sparrowhawk Accipiter minullus	Common resident	Broadleafed and Acacia woodland	
Black Sparrowhawk Accipiter melanoleucus	Very rare visitor	Riparian forest and dense woodland	
Shikra Accipiter badius	Common resident	Woodland	
African Goshawk Accipiter tachiro	Sparse resident	Riparian forest and mature woodland in river valleys	The World Heritage Site is extreme southern and western limit of range
Gabar Goshawk Melierax gabar	Common resident	Woodland	
Southern Pale Chanting Goshawk Melierax canorus	Common resident	Semi-desert tree and bush savannah	
Dark Chanting Goshawk Melierax metabates	Common resident	Broadleafed woodland and savannah with tall mature trees	
African Marsh-Harrier Circus ranivorus	Very common resident	Floodplains and reedbeds	
Western Marsh-Harrier Circus aeruginosus	Rare Palaearctic summer visitor	Floodplains	
Montagu's Harrier Circus pygargus	Uncommon migrant	Open grasslands and floodplains	

Pallid Harrier Circus macrourus	Rare migrant. Globally near threatened	Open grassland	Seen with much less frequency than Montagu's Harrier
African Harrier-Hawk Polyboroides typus	Common resident	Dense woodland including edges of riparian forest	
Osprey Pandion haliaetus	Sparse migrant	Rivers and channels	
Peregrine Falcon Falco peregrinus	Rare visitor	Woodland and savannah	
Lanner Falcon Falco biarmicus	Common resident	Tree and bush savannah	
Eurasian Hobby Falco subbuteo	Common and regular migrant	Open areas at edges of woodland and savannah	
African Hobby Falco cuvierii	Rare vagrant in the World Heritage Site	Woodland and tree savannah	
Red-necked Falcon Falco chicquera	Common resident	Tree savannah, especially palms	Hyphaene palms integral to this birds habitat and distribution
Red-footed Falcon Falco vespertinus	Regular migrant	Open tree and bush savannah	Globally threatened
Amur Falcon Falco amurensis	Regular migrant	Open tree and bush savannah	
Rock Kestrel Falco rupicolis	Sparse resident	Woodlands and savannah with hills	
Greater Kestrel Falco rupicoloides	Sparse resident	Grassland plains, open tree and bush savannah	
Lesser Kestrel Falco naumanni	Sparse migrant. Globally threatened	Grassland plains, open tree and bush savannah	
Dickinson's Kestrel Falco dickinsoni	Common resident	Woodland and tree savannah, also including palms	Range/biome restricted species
Coqui Francolin Peliperdix coqui	Rare resident	Wooded grassland and bush savannah	
Crested Francolin Dendroperdix sephaena	Common resident	Thickets and dense vegetation in woodland and savannah	
Red-billed Spurfowl Pternistis adspersus	Very common resident	Bushes and thickets in woodlands and savannah and on floodplains	
Swainson's Spurfowl Pternistis swainsonii	Very common resident	Tree and bush savannah with good grass cover	
Common Quail Coturnix coturnix	Rare visitor to the World Heritage Site	Open savannah with fairly long grass	
Harlequin Quail Coturnix delegorguei	Common migrant	Rank grass at edges of floodplains	

Helmeted Guineafowl Numida meleagris	Very common resident	Tree and bush savannah	
Kurrichane Buttonquail Turnix sylvaticus	Common resident	Grassland, open tree and bush savannah	
Wattled Crane Bugeranus carunculatus	1,200 – 1,450. Sparse resident, population stable in the World Heritage Site. Globally threatened.	Seasonal floodplains	World Heritage Site supports >15% of global population and has largest single population remaining in the world (Hancock, 2003a; Motsumi and Hancock, 2004).
Grey Crowned Crane Balearica regulorum	Rare visitor	Floodplains	Globally threatened species.
African Rail Rallus caerulescens	Uncommon resident and visitor in good rainfall years	Swamps, marshes and reedbeds	
Corn Crake Crex crex	Rare migrant. Globally threatened.	Swamps, marshes, reedbeds and floodplains	
African Crake Crecopsis egregia	Common migrant in good rainfall years	Marshes, seasonally inundated grassland and floodplains	
Black Crake Amaurornis flavirostris	Very common resident	Dense Miscanthus and Phragmites beds	
Spotted Crake Porzana porzana	Vagrant in the Ramsar site	Flooded grassland and seasonal pans	
Baillon's Crake Porzana pusilla	Vagrant	Reedbeds on margins of lakes, inundated grassland	
Striped Crake Aenigmatolimnas marginalis	Regular and easily overlooked migrant in good rainfall years	Flooded grassland and seasonal pans	More common during years of above-average rainfall when it breeds in ephemeral pans.
Red-chested Flufftail Sarothrura rufa	Sparse resident	Seasonally inundated grassland	
Buff-spotted Flufftail Sarothrura elegans	Rare vagrant	Riparian forests and thickets	One record only, from Matlapaneng, Maun
African Purple Swamphen Porphyrio madagascariensis	Common resident	Swamps with rushes, reeds and other tall aquatic vegetation	
Allen's Gallinule Porphyrio alleni	Common breeding visitor	Lagoons, floodplains	The World Heritage Site supports a significant population of this species.
Common Moorhen Gallinula chloropus	Common resident	Vegetated margins of lakes, lagoons, floodplains	Lake Ngami, during 2004, supported >0,5% of the regional population (Hancock et al., 2005).

Lesser Moorhen Gallinula angulata	Common breeding visitor	Seasonal pans and flooded depressions	Numbers exceed the 1% threshold.
Red-knobbed Coot Fulica cristata	Common resident	Lagoons, open channels	Subject to massive seasonal fluctuations but usually uncommon in the core area.
Kori Bustard Ardeotis kori	Common resident	Grassland and open savannah; also grassland along dry channels	This is a 'bird of concern' in Botswana, and more information is required on its status.
Denham's Bustard Neotis denhami	Rare visitor	Grassland and open savannahs with short grass	
Red-crested Korhaan Lophotis ruficrista	Very common resident	Tree and bush savannah on Kalahari sand	
Black-bellied Bustard Lissotis melanogaster	Sparse resident	Long grass in open woodland	
Northern Black Korhaan Afrotis afraoides	Possible rare resident in the buffer zone	Grassland plains and open savannah	Possibly occurs in the grasslands in the western part of the buffer zone of the WHS
African Jacana Actophilornis africanus	Very common resident	Lagoons, lakes, floodplains with floating vegetation.	
Lesser Jacana Microparra capensis	Common resident	Lagoons, broad channels and floodplains with floating vegetation	World Heritage Site is important for this species – numbers exceed the 1% threshold.
Greater Painted-snipe Rostratula benghalensis	Common to abundant in good years - visitor and resident	Seasonal pans and flooded grassland	
Common Ringed Plover Charadrius hiaticula	Sparse migrant	Shores of pans, lakes and flooded depressions	
White-fronted Plover Charadrius marginatus	Rare visitor to the WHS	Sandy shores of pans, lagoons, sandbanks in Okavango River	
Chestnut-banded Plover Charadrius pallidus	Rare visitor to the WHS	Sandy shores of shallow inland waters	
Kittlitz's Plover Charadrius pecuarius	Common resident	Shores of pans and lagoons, dry floodplains	
Three-banded Plover Charadrius tricollaris	Common resident	Shores of lakes, channels, lagoons	
Caspian Plover Charadrius asiaticus	Sparse migrant	Flat, open, short grass and open plains	Lake Ngami during 2004, supported >0,5% of the population (Hancock et al., 2005).

Grey Plover Pluvialis squatarola	Uncommon migrant	Shores of lakes, pans	
Crowned Lapwing Vanellus coronatus	Very common resident	Open short grassland, plains and floodplains	
Blacksmith Lapwing Vanellus armatus	Very common to abundant resident	Floodplains, edges of channels, lagoons	WH Site supports >0,5% of regional population.
White-crowned Lapwing Vanellus albiceps	Very sparse resident	Sandbanks, shores of rivers and lakes	
African Wattled Lapwing Vanellus senegallus	Uncommon resident	Floodplains, open grasslands	
Long-toed Lapwing Vanellus crassirostris	Common resident	Lagoons and channels with floating vegetation	Numbers exceed 1% threshold.
Ruddy Turnstone Arenaria interpres	Rare migrant	Shores of lakes and pans	
Terek Sandpiper Xenus cinereus	Rare migrant	Shallow waters of lake and channel edges	
Common Sandpiper Actitis hypoleucos	Very common migrant	Shores of lakes, lagoons and channels	
Green Sandpiper Tringa ochropus	Rare migrant	Quiet shaded waters on river and channel margins	
Wood Sandpiper Tringa glareola	Very common migrant	Shores of lakes, rivers and channels	
Spotted Redshank Tringa erythropus	Uncertain		Two records only.
Common Redshank Tringa tetanus	Rare migrant	Shores of lakes, lagoons and pans	
Marsh Sandpiper Tringa stagnatilis	Regular migrant	Edges of lakes, pans and river channels	
Common Greenshank Tringa nebularia	Common migrant	Edges of lakes, pans and river channels	
Greater Yellowlegs Tringa melanoleuca	Rare vagrant	Shores of lakes, lagoons and pans	
Curlew Sandpiper Calidris ferruginea	Common migrant	Open shores of lakes and pans	
Little Stint Calidris minuta	Common migrant	Shores of lakes, lagoons and pans	
Pectoral Sandpiper Calidris melanotos	Rare migrant		A rare visitor to the World Heritage Site.
Sanderling Calidris alba	Sparse migrant	Shores of lakes, lagoons and pans	
Ruff Philomachus pugnax	Common migrant	Shores of lakes, rivers, lagoons and pans	
Great Snipe Gallinago media	Rare vagrant	Shores of lakes, lagoons and pans	

African Snipe Gallinago nigripennis	Common resident and visitor	Marshes, flooded grassland and shores of lakes	
Black-tailed Godwit Limosa limosa	Uncommon migrant.	Shores of lakes, lagoons and pans	Globally threatened species.
Bar-tailed Godwit Limosa lapponica	Rare migrant in the WHS	Shores of lakes, lagoons and pans	
Eurasian Curlew Numenius arquata	Rare migrant	Shores of lakes, lagoons and pans	
Common Whimbrel Numenius phaeopus	Rare migrant	Shores of lakes, lagoons and pans	
Pied Avocet Recurvirostra avosetta	Uncommon nomad	Shallow water on edges of lakes	
Black-winged Stilt Himantopus himantopus	Common resident and visitor	Shallow water on edges of lakes, lagoons and broad river channels	Lake Ngami supported >0,5% of the population of this species during 2004 (Hancock et al., 2005). This species exceeds 1% threshold in the WHS.
Spotted Thick-knee Burhinus capensis	Common resident	Short grassland in savannah	
Water Thick-knee Burhinus vermiculatus	Common resident	Banks and beaches of rivers, lagoons and lakes	
Temminck's Courser Cursorius temminckii	Spase resident	Short grass in open areas	Favours recently burnt ground
Burchell's Courser Cursorius rufus	Rare vagrant	Short grass in open areas	
Double-banded Courser Rhinoptilus africanus	Sparse resident	Bare or short-grassed pans, open grassland plains	
Bronze-winged Courser Rhinoptilus chalcopterus	Sparse resident and visitor	Woodland and savannah	
Collared Pratincole Glareola pratincole	Common migrant	Open areas and short grass near water	World Heritage Site supports >0,5% of regional population (Penry and Tarboton, 1990).
Black-winged Pratincole Glareola nordmanni	Irregular migrant - globally near threatened	Flat open grassland and plains	Lake Ngami regularly has >1% of the global population – 10,000 recorded in 1990 by Penry and Tarboton (1990).
Lesser Black-backed Gull Larus fuscus	Rare vagrant	Rivers, lakes, flooded pans	
Grey-headed Gull Larus cirrocephalus	Common resident	Rivers, lakes, flooded pans	

Gull-billed Tern Sterna nilotica	Rare vagrant	Flooded lakes and pans	
Caspian Tern Sterna caspia	Rare visitor to the World Heritage Site	Flooded lakes and pans	
Whiskered Tern Chlidonias hybrid	Common breeding visitor	Lakes, lagoons and broad river channels	Lake Ngami alone supports >0,5% of regional population (Hancock et al., 2005), and the WHS has > 1% of the population.
White-winged Tern Chlidonias leucopterus	Common migrant	Lakes, lagoons and broad river channels	
African Skimmer Rhynchops flavirostris	Uncommon resident/ partial migrant. Globally threatened	Large rivers and channels	Breeds on sandbanks. Okavango Delta supports >1% of global population (Tyler, 2001).
Namaqua Sandgrouse Pterocles namaqua	Rare and irregular visitor to the WHS	Semi-desert scrub, bare rocky ground	
Burchell's Sandgrouse Pterocles burchelli	Common resident	Grassland in savannah, grassy plains	Range/biome restricted species
Yellow-throated Sandgrouse Pterocles gutturalis	Very rare visitor to the WHS	Floodplains and short grassland near swamps	Numbers of this species have declined dramatically over the last 20 years
Double-banded Sandgrouse Pterocles bicinctus	Common resident	Tree and bush savannah and edges of woodland	
Speckled Pigeon Columba guinea	Resident – numbers increasing dramatically in Maun	Hilly areas	Range expanding due to construction of buildings suitable for nesting
Red-eyed Dove Streptopelia semitorquata	Common resident	Tall trees along rivers	
African Mourning Dove Streptopelia decipiens	Common resident	Tall riverine trees	
Cape Turtle-Dove Streptopelia capicola	Very common resident	Woodland and savannah	
European Turtle-Dove Streptopelia turtur	Very rare vagrant	Woodland and savannah	
Laughing Dove Streptopelia senegalensis	Very common resident	Open woodland and savannah	
Namaqua Dove Oena capensis	Very common resident	Acacia tree and bush savannah	
Emerald-spotted Wood-Dove Turtur chalcospilos	Very common resident	Thicket and dense cover in any woodland	
African Green-Pigeon Treron calvus	Common resident	Riparian woodland	

Meyer's Parrot Poicephalus meyeri	Common resident	Deciduous woodland and tree savannah	
Grey Go-away-bird Corythaixoides concolor	Very common resident	Open Acacia tree and bush savannah	
Ross's Turaco Musophaga rossae	Rare	Riparian woodland	
Common Cuckoo Cuculus canorus	Sparse migrant	Broadleafed and mixed Acacia woodland	
African Cuckoo Cuculus gularis	Uncommon migrant	All types of woodland	
Red-chested Cuckoo Cuculus solitarius	Scarce in World Heritage Site	Tree and bush savannah	
Black Cuckoo Cuculus clamosus	Common migrant	Broadleafed and mixed Acacia woodlands	
Great Spotted Cuckoo Clamator glandarius	Uncommon migrant	Acacia woodland and tree and bush savannah	
Jacobin Cuckoo Clamator jacobinus	Common migrant	Broadleafed and mixed Acacia woodlands	
Levaillant's Cuckoo Clamator levaillantii	Common migrant	Broadleafed and mixed Acacia woodlands	
Thick-billed Cuckoo Pachycoccyx audeberti	Rare migrant	Broadleafed and mixed Acacia woodlands	
Klaas's Cuckoo Chrysococcyx klaas	Sparse migrant	Tree and bush savannah with dense thickets	
Diderick Cuckoo Chrysococcyx caprius	Common migrant	Acacia tree and bush savannah	
African Emerald Cuckoo Chrysococcyx cupreus	Very rare visitor in years of good rains	Broadleafed woodlands and forest	
Black Coucal Centropus grillii	Uncommon migrant	Tall, rank grass on floodplains	
Coppery-tailed Coucal Centropus cupreicaudus	Common resident	Marshes and swamps with tall rank vegetation, including Papyrus and reeds	Range/biome restricted species
Senegal Coucal Centropus senegalensis	Common resident	Long grass and thickets in tree savannah	
White-browed Coucal Centropus superciliosus	Fairly common resident	Rank growth, thicket and dense vegetation near water	
Barn Owl Tyto alba	Common resident	All types of woodland	
African Wood-Owl Strix woodfordii	Localised resident restricted to the Panhandle	Riparian forest	Occurs regularly at Shakawe and Linyanti in the core area, but nowhere else
Marsh Owl Asio capensis	Common resident and visitor	Rank, moist grassland	Numerous around Lake Ngami.

African Scops-Owl Otus senegalensis	Very common resident	Tall mature broadleafed and Acacia woodland	
Southern White-faced Scops-Owl Ptilopsis granti	Fairly common resident	Acacia tree and bush savannah	
Pearl-spotted Owlet Glaucidium perlatum	Very common resident	Open areas of woodland	
African Barred Owlet Glaucidium capense	Common resident	Riparian forest and tall, mature woodland, usually near water	
Spotted Eagle-Owl Bubo africanus	Sparse resident	Woodlands and savannah	
Verreaux's Eagle-Owl Bubo lacteus	Fairly common resident	Riparian forest and large trees along watercourses	
Pel's Fishing-Owl Scotopelia peli	Uncommon resident in restricted habitat	Riparian forest and large trees along perennial waterways	Species needs careful monitoring – declines noted in recent years possibly due to drying up of the Delta. WHS is of great importance for this species.
European Nightjar Caprimulgus europaeus	Rare migrant	Open areas of tree and bush savannah	
Fiery-necked Nightjar Caprimulgus pectoralis	Common resident	Mature broadleafed woodland	
Rufous-cheeked Nightjar Caprimulgus rufigena	Common migrant	Woodland with open areas and clearings	
Swamp Nightjar Caprimulgus natalensis	Sparse resident	Floodplains and edges of marshes and swamps	
Square-tailed Nightjar Caprimulgus fossii	Common resident	Open woodland and savannah	
Pennant-winged Nightjar Macrodipteryx vexillarius	Rare migrant in years of good rainfall	Mature broadleafed woodland	
Common Swift Apus apus	Common migrant	Forages over open areas such as floodplains and pans	
African Black Swift Apus barbatus	Vagrant and possibly overlooked	Forages mainly near hills and river valleys	
White-rumped Swift Apus caffer	Possible rare visitor		No recently authenticated records for the core area
Horus Swift Apus horus	Possible vagrant	Found along major rivers and adjacent habitats	No authenticated records for the core area
Little Swift Apus affinis	Uncommon visitor	Forages over major rivers and adjacent habitats	Sometimes occurs in large numbers over the Thamalakane River
Alpine Swift Tachymarptis melba	Uncommon migrant	Found over floodplains and woodland	

African Palm-Swift Cypsiurus parvus	Very common resident	Hyphaene Palmveld	Hyphaene Palms integral to this bird's survival
Bohm's Spinetail Neafrapus boehmi	Rare vagrant	Open woodland and floodplains	
Red-faced Mousebird Urocolius indicus	Common resident	Variety of savannah and woodland types	
Narina Trogon Apaloderma narina	Rare resident in the Panhandle and vagrant elsewhere	Riparian forest, dense broadleafed woodland	
Pied Kingfisher Ceryle rudis	Very common resident	Rivers, lagoons, floodplains, channels	
Giant Kingfisher Megaceryle maximus	Fairly common resident	Perennial, tree-lined rivers	
Malachite Kingfisher Alcedo cristate	Common resident	Reeds, grasses or sedges along channels and lagoons	
African Pygmy-Kingfisher Nettapus auritus	Sparse migrant	Mature woodland and riparian forest	
Woodland Kingfisher Halcyon senegalensis	Common migrant	Riparian forest, broadleafed and mixed woodlands	
Brown-hooded Kingfisher Halcyon albiventris	Sparse resident	Riparian forest and dense growth along drainage lines	
Grey-headed Kingfisher Halcyon leucocephala	Fairly common migrant	Mature woodlands usually near water	
Striped Kingfisher Halcyon chelicuti	Common resident	Broadleafed woodland	
European Bee-eater Merops apiaster	Common migrant	Woodland and tree savannah	
Blue-cheeked Bee-eater Merops persicus	Common migrant	Marshes and floodplains with fringing woodland	
Southern Carmine Bee-eater Merops nubicoides	Very common migrant	Rivers, channels and floodplains	Important breeding sites along Okavango panhandle at Shakawe, and at Xakanaxa and Linyanti.
White-fronted Bee-eater Merops bullockoides	Common resident	Rivers, channels and floodplains	Important breeding sites along Okavango panhandle at Shakawe
Little Bee-eater Merops pusillus	Very common resident	Edges of woodland	
Swallow-tailed Bee-eater Merops hirundineus	Common resident	Variety of woodland including Mophane woodland	

European Roller Coracias garrulous	Sparse migrant.	Woodland and savannah	Globally threatened.
Lilac-breasted Roller Coracias caudatus	Very common resident	Woodland and savannah	
Racket-tailed Roller Coracias spatulatus	Vagrant to the World Heritage Site	Mature Baikiaea woodland and Miombo	World Heritage Site is at southwestern limit of its range. This is a range/ biome restricted species.
Purple Roller Coracias naevius	Common resident	Tree savannah, particularly Acacia	
Broad-billed Roller Eurystomus glaucurus	Common migrant	Riparian forest and tall, mature woodland	
African Hoopoe Upupa Africana	Very common resident	Woodland, tree and bush savannah	
Green Wood-Hoopoe Phoeniculus purpureus	Very common resident	Mixed deciduous and Acacia woodlands	
Common Scimitarbill Rhinopomastus cyanomelas	Common resident	Acacia tree and bush savannah	
African Grey Hornbill Tockus nasutus	Very common resident	Any woodland	
Red-billed Hornbill Tockus erythrorhynchus	Very common resident	Broadleafed woodland, particularly Mophane	
Southern Yellow-billed Hornbill Tockus leucomelas	Very common resident	Savannah and woodland of all types	
Bradfield's Hornbill Tockus bradfieldi	Common resident	Broadleafed woodlands, including Mophane	Range/biome restricted species
Southern Ground-Hornbill Bucorvus leadbeateri	Common resident. Population probably stable.	Woodlands and dry floodplains	Globally threatened species.
Black-collared Barbet Lybius torquatus	Very common resident	Riparian forest, mature woodland, savannah	
Acacia Pied Barbet Tricholaema leucomelas	Very common resident	Acacia woodland and savannah	
Yellow-fronted Tinkerbird Pogoniulus chrysoconus	Common resident	Broadleafed woodland and riparian forest	
Crested Barbet Trachyphonus vaillantii	Very common resident	Dense vegetation and thicket in woodland, savannah and riverine areas	
Greater Honeyguide Indicator indicator	Common resident	Deciduous woodland, riparian, edges of forest	
Lesser Honeyguide Indicator minor	Common resident	Riparian forest and deciduous woodland along rivers	

Brown-backed Honeybird Prodotiscus regulus	Sparse resident	Tree savannah and deciduous woodland	
Green-backed Honeybird Prodotiscus zambesiae	Rare visitor		Recently recorded reliably from the Panhandle
Bennett's Woodpecker Campethera bennettii	Common resident	Mature woodland and Acacia tree savannah	
Golden-tailed Woodpecker Campethera abingoni	Common resident	Variety of woodland types	
Cardinal Woodpecker Dendropicos fuscescens	Very common resident	Variety of woodland types	
Bearded Woodpecker Dendropicos namaquus	Common resident	Well-developed woodland with tall trees	
African Broadbill Smithornis capensis	Rare, only 1 record from 1988	Riverine forest	
Monotonous Lark Mirafra passerine	Irregular to abundant migrant in years of good rainfall.	Open savannah with patchy grass cover	
Rufous-naped Lark Mirafra Africana	Common resident	Grassland and dry floodplains in savannah	
Eastern Clapper Lark Mirafra fasciolata	Rare resident at very limit of distribution	Open bush savannah and grass plains	
Flappet Lark Mirafra rufocinnamomea	Sparse resident	Open areas and edges of woodland	
Fawn-coloured Lark Calendulauda africanoides	Common resident	Open bush savannah	
Sabota Lark Calendulauda sabota	Common resident	Acacia savannah and mixed woodland	
Dusky Lark Pinarocorys nigricans	Fairy common migrant	Open short grass in tree and bush savannah	
Red-capped Lark Calandrella cinerea	Common resident and visitor	Sparsely grassed areas on pans and floodplains	
Pink-billed Lark Spizocorys conirostris	Uncertain	Short open grasslands	
Chestnut-backed Sparrowlark Eremopterix leucotis	Common resident	Flat open grass areas and bare ground with clumps of grass	
Grey-backed Sparrowlark Eremopterix verticalis	Common resident	Flat open grass areas and bare ground with clumps of grass	
Barn Swallow Hirundo rustica	Common migrant. Numbers declining.	Variety of habitats but usually near water	Roosts in Phragmites reedbeds.
White-throated Swallow Hirundo albigularis	Sparse migrant	Grassland and open savannah usually near water	

Wire-tailed Swallow Hirundo smithii	Common resident	Permanent water and adjacent woodland	
Pearl-breasted Swallow Hirundo dimidiata	Uncommon visitor	Broadleafed and riverine woodland	
Red-breasted Swallow Hirundo semirufa	Common migrant	Open areas of tree and bush savannah	
Mosque Swallow Hirundo senegalensis	Very rare visitor	Tall mature woodland in river valleys	
Greater Striped Swallow Hirundo cucullata	Very rare migrant	Open areas in savannah	
Lesser Striped Swallow Hirundo abyssinica	Common migrant	Woodland, tree and bush savannah	
South African Cliff-Swallow Hirundo spilodera	Sparse migrant	Variety of habitats while on passage	
Rock Martin Hirundo fuligula	Sparse and isolated resident	Hilly areas	
Common House-Martin Delichon urbicum	Fairly common migrant	Variety of habitats, but regularly over water	
Grey-rumped Swallow Pseudhirundo griseopyga	Common resident and partial migrant	Grass plains, floodplains and open woodland	
Sand Martin Riparia riparia	Sparse migrant	Floodplains, river channels – usually near water	
Brown-throated Martin Riparia paludicola	Common resident	Floodplains, river channels, lagoons – near water	
Banded Martin Riparia cincta	Common resident and migrant	Open grassland and floodplains	
Black Cuckooshrike Campephaga flava	Common resident and partial migrant	Broadleafed and mixed woodland, edges of riparian forest	
White-breasted Cuckooshrike Coracina pectoralis	Rare resident	Mature broadleafed woodland	
Fork-tailed Drongo Dicrurus adsimilis	Very common to abundant resident	Any type of woodland	
Eurasian Golden Oriole Oriolus oriolus	Sparse migrant	Woodland and tree savannah	
African Golden Oriole Oriolus auratus	Common migrant	Mature Baikiaea and Mophane woodlands, and riverine forest	
Black-headed Oriole Oriolus larvatus	Common resident	Mature broadleafed woodland usually close to water	

Pied Crow Corvus albus	Common resident increasing in settled areas	Tree and bush savannah, human settlements	
Ashy Tit Parus cinerascens	Sparse resident	Acacia savannah	
Southern Black Tit Parus niger	Very common resident	Woodland, Acacia along drainage lines	
Cinnamon-breasted Tit	Status uncertain		Possible rare resident along Namibian border in buffer zone
Cape Penduline-Tit Anthoscopus minutus	Common resident	Bush savannah with Terminalia and Acacia	
Grey Penduline-Tit Anthoscopus caroli	Sparse resident	Broadleafed woodland, riverine Acacia – often along drainage lines	
Arrow-marked Babbler Turdoides jardineii	Very common resident	Dense vegetation and thickets in savannah. Also riverine forest	
Black-faced Babbler Turdoides melanops	Uncommon range restricted resident	Thicket and understory of woodland	Range/biome restricted species, found between Gumare and Nokaneng in the buffer zone
Hartlaub's Babbler Turdoides hartlaubii	Very common resident	Thickets and dense vegetation on floodplains. Riparian forest.	Range/biome restricted species.
Southern Pied Babbler Turdoides bicolour	Common resident	Tree and bush savannah, particularly Acacia	
African Red-eyed Bulbul Pycnonotus nigricans	Common resident	Dry tree and bush savannah	
Dark-capped Bulbul Pycnonotus tricolour	Abundant resident	Moist woodland, riverine bush	
Terrestrial Brownbul Phyllastrephus terrestris	Common resident	Ground and mid-stratum of riparian vegetation	
Yellow-bellied Greenbul Chlorocichla flaviventris	Sparse resident	Tall evergreen riparian forest	
Kurrichane Thrush Turdus libonyanus	Common resident	Broadleafed and mixed Acacia woodland	Range/biome restricted species
Groundscraper Thrush Psophocichla litsitsirupa	Common resident	Woodland with short grass groundcover	
Capped Wheatear Oenanthe pileate	Very common migrant	Open bare ground or short grass plains	
Familiar Chat Cercomela familiaris	Sparse resident	Rocky or stony ground in hilly regions	
Arnot's Chat Myrmecocichla arnoti	Common resident	Mature broadleafed woodland such as Mophane	Range/biome restricted species

Ant-eating Chat Myrmecocichla formicivora	Common resident	Open grassy areas in tree and bush savannah	
African Stonechat Saxicola torquatus	Common resident	Rank grass and sedges along rivers, lagoons, floodplains	
Whinchat Saxicola rubetra	Rare migrant		
White-browed Robin-Chat Cossypha heuglini	Very common resident	Dense undergrowth in riparian forest	
Thrush Nightingale Luscinia luscinia	Sparse migrant	Riverine bush and thicket	
Collared Palm-Thrush Cichladusa arquata	Sparse resident	Riparian with Hyphaene Palms	Has extended range westwards from Kasane into Okavango World Heritage Site.
White-browed Scrub-Robin Cercotrichas leucophrys	Very common resident	Savannah with tall bushes, thickets and long grass	
Kalahari Scrub-Robin Cercotrichas paena	Regular resident in the west of the buffer area of the WHS	Open savannah with scattered bushes and trees and sparse ground cover	Range/biome restricted species
Bearded Scrub-Robin Cercotrichas quadrivirgata	Very sparse resident	Thickets and tangled growth along rivers and forest edges	Recorded from Shakawe
Garden Warbler Sylvia borin	Sparse migrant	Broadleafed woodland, riverine vegetation	
Common Whitethroat Sylvia communis	Rare migrant	Deciduous thickets, particularly Acacia and riverine	
Chestnut-vented Tit-babbler Parisoma subcaeruleum	Common resident	Tree and bush savannah	
Icterine Warbler Hippolais icterina	Uncommon migrant	Acacia trees and bushes	
Olive-tree Warbler Hippolais olivetorum	Sparse migrant	Acacia thicket, especially A. mellifera	
River Warbler Locustrella fluviatilis	Rare Palaearctic migrant		
Great Reed-Warbler Acrocephalus arundinaceus	Sparse migrant	Reedbeds and rank vegetation near water	
Eurasian Reed-Warbler Acrocephalus scirpaceus	Status uncertain		
African Reed-Warbler Acrocephalus baeticatus	Common resident	Reedbeds and tall rank vegetation near water	

Marsh Warbler Acrocephalus palustris	Sparse migrant	Dense vegetation, but does not require wet habitat	
Sedge Warbler Acrocephalus schoenobaenus	Sparse migrant	Reedbeds and rank growth along rivers and channels	
Lesser Swamp-Warbler Acrocephalus gracilirostris	Common resident	Tall reeds, rushes and sedges, including Papyrus	
Greater Swamp-Warbler Acrocephalus rufescens	Common resident	Papyrus and other tall aquatic vegetation	In Botswana, virtually confined to the World Heritage Site
Little Rush-Warbler Bradypterus baboecala	Common resident	Marshes, swamps and tall aquatic vegetation	
Willow Warbler Phylloscopus trochilus	Common migrant	All types of woodland	
Yellow-breasted Apalis Apalis flavida	Common resident	Riparian forest edges and deciduous woodland	
Long-billed Crombec Sylvietta rufescens	Very common resident	Lower stratum of nay woodland type	
Yellow-bellied Eremomela Eremomela icteropygialis	Common resident	Acacia and mixed woodland	
Green-capped Eremomela Eremomela scotops	Sparse resident	Miombo and Baikiaea woodland	
Burnt-necked Eremomela Eremomela usticollis	Common resident	Acacia tree and bush savannah	
Grey-backed Camaroptera Camaroptera brevicaudata	Very common resident	Thickets and tangled vegetation in woodland and savannah	
Barred Wren-Warbler Calamonastes fasciolatus	Common resident	Acacia and mixed deciduous woodland	Range/biome restricted species
Stierling's Wren-Warbler Calamonastes stierlingi	Rare resident in the WHS	Miombo and Baikiaea woodland	Range/biome restricted species
Zitting Cisticola Cisticola juncidis	Common resident	Open, moist grassland	
Desert Cisticola Cisticola aridulus	Fairly common resident	Open short grassland and plains in semi-desert	
Pale-crowned Cisticola Cisticola cinnamomeus	Sparse		
Tinkling Cisticola Cisticola rufilatus	Uncommon resident	Semi-desert bush and scrub savannah	
Rattling Cisticola Cisticola chiniana	Common resident	Savannah with well-established bushes and isolated thickets	
Luapula Cisticola Cisticola luapula	Common resident	Tall grasses, sedges and reeds on floodplains	

Chirping Cisticola Cisticola pipiens	Common resident	Miscanthus, Papyrus and tall aquatic vegetation	In Botswana, virtually confined to the WHS. Range/biome restricted species
Neddicky Cisticola fulvicapilla	Rare resident	Tall grass and scattered bushes in Miombo and Baikiaea woodland	
Tawny-flanked Prinia Prinia subflava	Common to very common resident	Long grass, sedges and reeds along rivers	
Black-chested Prinia Prinia flavicans	Common resident	Rank grass and low bushes of savannah	
Spotted Flycatcher Muscicapa striata	Common migrant	Edges of woodland and savannah	
Ashy Flycatcher Muscicapa caerulescens	Common resident	Riparian forest and adjacent tall woodland	
Grey Tit-Flycatcher Myloparus plumbeus	Rare resident	Dense cover of woodland and riverine forest	
Southern Black Flycatcher Melaenornis pammelaina	Uncommon resident	Riparian Acacia, well-developed Mophane woodland and mixed broadleafed woodland	
Marico Flycatcher Bradornis mariquensis	Very common resident	Thorn tree and bush savannah	
Pale Flycatcher Bradornis pallidus	Sparse resident	Well-established broadleafed woodland	
Chat Flycatcher Bradornis infuscatus	Sparse resident, occurs around Gumare.		
Chinspot Batis Batis molitor	Very common resident	Any woodland and savannah	
Pririt Batis Batis pririt	Sparse resident in the western parts of the buffer zone	Any woodland and savannah, but inhabits drier areas than the Chinspot Batis.	
African Paradise-Flycatcher Terpsiphone viridis	Common migrant	Riparian forest and riverine Acacia	
African Pied Wagtail Motacilla aguimp	Rare resident	Shores of Okavango River	
Cape Wagtail Motacilla capensis	Common resident	Shores of rivers and lagoons	
Yellow Wagtail Motacilla flava	Common migrant	Short grass near water	
African Pipit Anthus cinnamomeus	Common resident	Open, short, moist grassland	
Wood Pipit Anthus nyassae	Probably a sparse visitor	Open woodland	

Plain-backed Pipit Anthus leucophrys	Common resident	Short grass on or near floodplains	
Buffy Pipit Anthus vaalensis	Common resident	Flat open areas of short grass	
Tree Pipit Anthus trivialis	Very sparse migrant	Broadleafed woodland	
Mountain Pipit Anthus hoeschi	Possibly a common passage migrant		
Rosy-throated Longclaw Macronyx ameliae	Common resident	Moist grassland	
Lesser Grey Shrike Lanius minor	Common migrant	Open areas in savannah	
Common Fiscal Lanius collaris (subcoronatus)	Rare vagrant	Acacia thicket	
Red-backed Shrike Lanius collurio	Common migrant. Numbers declining.	Tree and bush savannah	
Magpie Shrike Corvinella melanoleuca	Very common resident	Acacia savannah	
Swamp Boubou Laniarius bicolour	Very common resident	Dense riverine vegetation, islands	In Botswana, virtually confined to the WHS.
Crimson-breasted Shrike Laniarius atrococcineus	Very common resident	Thicket or tangled growth in savannah	
Black-backed Puffback Dryoscopus cubla	Very common resident	Canopy of deciduous woodland and riverine forest	
Brubru Nilaus afer	Very common resident	Acacia and broadleafed woodland	
Brown-crowned Tchagra Tchagra australis	Very common resident	Acacia and broadleafed woodland	
Black-crowned Tchagra Tchagra senegalus	Common resident	Broadleafed woodland and savanna including Miombo and Terminalia	
Orange-breasted Bush-Shrike Telophorus sulfureopectus	Common resident	Dense growth and thicket of riparian vegetation	
Grey-headed Bush-Shrike Malaconotus blanchoti	Sparse resident	Riverine forest and thicket	Occurs in the Linyanti area of the buffer zone. Very rare in the Okavango Delta core area.
White-crested Helmet-Shrike Prionops plumatus	Common resident	Mainly broadleafed woodland including Mophane	
Retz's Helmet-Shrike Prionops retzii	Common resident	Broadleafed woodland including Mophane	
Southern White-crowned Shrike Eurocephalus anguitimens	Common resident	Tree and bush savannah	

Wattled Starling Creatophora cinerea	Common nomad	Semi-arid woodland and tree savannah	
Violet-backed Starling Cinnyricinclus leucogaster	Common migrant	Broadleafed woodland and riparian forest	
Burchell's Starling Lamprotornis australis	Very common resident	Mixed woodlands, including Acacia, with mature tees	Roosts communally in Phragmites reedbeds – an important component of its habitat. Range restricted species.
Meves's Starling Lamprotornis mevesii	Very common resident	Tall trees such as Mophane and riparian Acacia	Range restricted species.
Cape Glossy Starling Lamprotornis nitens	Very common resident	Tree and bush savanah of all types	
Greater Blue-eared Starling Lamprotornis chalybaeus	Very common resident	Broadleafed woodland, riparian forest and riverine Acacia	
Sharp-tailed Starling Lamprotornis acuticaudus	Rare resident	Found in northwestern woodlands along the Namibian border.	Biome/range-restricted species.
Yellow-billed Oxpecker Buphagus africanus	Very common resident	Deciduous woodland and tree savannah	
Red-billed Oxpecker Buphagus erythrorhynchus	Very common resident	Broadleafed and Acacia woodland and savannah	
Marico Sunbird Cinnyris mariquensis	Very common resident	Acacia and mixed deciduous woodland	
Purple-banded Sunbird Cinnyris bifasciatus			One record from Panhandle in 2002.
White-bellied Sunbird Cinnyris talatala	Very common resident	Any woodland and savannah, and riverine vegetation	Range/biome restricted species
Scarlet-chested Sunbird Chalcomitra senegalensis	Common resident	Deciduous tree and bush savannah and Acacia	
Amethyst Sunbird Chalcomitra amethystine	Sparse to common resident	Clearings in woodland and edges of riverine forest	
Collared Sunbird Hedydipna collaris	Common resident	Riparian forest and lush riverine bush	
African Yellow White-eye Zosterops senegalensis	Common resident	Riparian forest and riverine woodland	
Red-billed Buffalo-Weaver Bubalornis niger	Very common resident	Mixed woodland and Acacia savannah	
White-browed Sparrow-Weaver Plocepasser mahali	Very common resident	Tree and bush savannah, particularly Acacia	

House Sparrow Passer domesticus	Sparse resident	Human habitation	
Great Sparrow Passer motitensis	Sparse resident	Tree and bush savannah, mainly Acacia	
Southern Grey-headed Sparrow Passer diffusus	Very common resident	Woodland, tree and bush savannah	
Yellow-throated Petronia Petronia superciliaris	Common resident	Broadleafed woodland, particularly Miombo, Baikiaea and Mophane	
Scaly-feathered Finch Sporopipes squamifrons	Very common resident	Acacia bush and scrub savannah	
Thick-billed Weaver Amblyospiza albifrons	Sparse resident	Tall reedbeds in lagoons, floodplains and channels	In Botswana, virtually confined to the World Heritage Site
Spectacled Weaver Ploceus ocularis	Uncommon resident	Edges of riparian forest, riverine bush with tangled vegetation	
Village Weaver Ploceus cucullatus	Uncommon resident	Reedbeds on the margins of rivers and lagoons with adjacent riparian forest	Occasional reports from Shakawe on the Panhandle
Chestnut Weaver Ploceus rubiginosus	Rare and irruptive breeding visitor in years of good rains	Canopy of Acacia woodland	The World Heritage Site is at the eastern limit of its distribution
Southern Masked-Weaver Ploceus velatus	Very common resident	Wide variety of habitats – any tree and bush savannah	
Lesser Masked-Weaver Ploceus intermedius	Fairly common resident	Tree and bush savannah, edges of deciduous woodland, riparian Acacia	
Golden Weaver Ploceus xanthops	Common resident	Rank vegetation near water, including forest and bush	In Botswana, virtually confined to the World Heritage Site
Southern Brown-throated Weaver Ploceus xanthopterus	Fairly common resident	Rank vegetation near water, including forest and bush	In Botswana, virtually confined to the World Heritage Site.
Red-headed Weaver Anaplectes melanotis	Common resident	Variety of woodland and savannah habitats	
Cuckoo Finch Anomalospiza imberbis	Uncommon		Probably regular in Panhandle and Kwando River system.
Red-billed Quelea Quelea quelea	Very common resident	Open grassland, tree and bush savannah	
Red-headed Quelea Quelea erythrops	Very sparse vagrant		Occurs in the Kwando-Linyanti system.
Southern Red Bishop Euplectes orix	Common resident	Reedbeds and tall rank grasses on the edges of rivers	

Yellow-crowned Bishop Euplectes afer	Regular visitor - in years of good rains it can be abundant	Open grassland, tree and bush savannah, floodplains	
Fan-tailed Widowbird Euplectes axillaris	Common resident	Reedbeds, floodplains, seasonally inundated grassland	In Botswana, virtually confined to the World Heritage Site.
Green-winged Pytilia Pytilia melba	Very common resident	Thicket in tree and bush savannah	
Jameson's Firefinch Lagonosticta rhodopareia	Common resident	Rank grass, bushes and thickets in tree and bush savannah	
Red-billed Firefinch Lagonosticta senegala	Common resident	Rank grass, bushes and thickets in tree and bush savannah	
Brown Firefinch Lagonosticta nitidula	Common resident	Edges of riparian forest and dense riverine vegetation	In Botswana, virtually confined to the World Heritage Site. Range/ biome restricted species
Blue Waxbill Uraeginthus angolensis	Very common resident	Tree and bush savannah, especially Acacia	
Violet-eared Waxbill Granatina granatina	Common resident	Acacia tree and bush savannah, typically in dry areas	
Common Waxbill Estrilda astrild	Common resident	Rank grass along rivers, channels, lagoons	
Black-faced Waxbill Estrilda erythronotos	Common resident	Tree and bush savannah, especially Acacia	
African Quailfinch Ortygospiza atricollis	Fairly common resident	Short grassland in moist conditions	
Orange-breasted Waxbill Sporaeginthus subflavus	Rare resident	Reeds and tall vegetation along rivers and lagoons	
Cut-throat Finch Amadina fasciata	Common resident	Open ground in tree and bush savannah	
Red-headed Finch Amadina erythrocephala	Fairly common resident	Semi-desert grassland, open areas in tree and bush savannah	
Pin-tailed Whydah Vidua macroura	Common resident	Moist open conditions in tree and bush savannah	
Shaft-tailed Whydah Vidua regia	Common resident	Dry tree and bush savannah with Acacia	
Long-tailed Paradise-Whydah Vidua paradisaea	Common resident	Tree and bush savannah	
Dusky Indigobird Vidua funereal	Sparse resident	Tall grass, usually near water	
Village Indigobird Vidua chalybeate	Fairly common resident	Riverine Acacia, open deciduous woodland	

Yellow-fronted Canary Crithagra mozambicus	Common resident	Mature broadleafed woodlands and savannah	
Black-throated Canary Crithagra atrogularis	Common resident	Tree and bush savannah, edges of woodland and riverine bush	
Yellow Canary Crithagra flaviventris	Sparse resident	Dry tree and bush savannah, mainly Acacia and Terminalia	
Golden-breasted Bunting Emberiza flaviventris	Common resident	Any woodland, tree and bush savannah	
Cinnamon-breasted Bunting Emberiza tahapisi	Rare resident	Woodland and tree savannah	Rock outcrops, stony hillsides when breeding.
Lark-like Bunting Emberiza impetuani	Very sparse nomad	Dry, open tree and bush savannah	

Reptiles: Based on the distribution records of Auerbach (1987) a checklist of amphibians and reptiles of the Delta was drawn up for the Ecological Zoning (SMEC, 1989). This list has 95 spe-cies/subspecies of amphibians and reptiles, of which 28 are frogs, 7 tortoises and terrapins, 22 lizards, 4 amphisbaenians, 33 snakes and 1 crocodile. There are a further 14 species which also may occur in the Delta. The Pelomedusidae (terrapins) show an interesting diversity in the Delta area, four of the five Botswana species are recorded from here.

- *Limnophis bicolor bangweolicus* (Eastern Striped Swamp Snake) is an Angola/Zambian species recorded from Maun and Xugana Lediba.
- *Crotaphopeltis barotseensis* (Barotse Water Snake) is confined in Botswana to the Delta and its preferred habitat appears to be papyrus swamp (Sepupa, Xugana Lediba and Magwegqana).
- *Rhamphiophis oxyrhynchus rostratus* (Eastern Rufous Beaked Snake) - four of the five Botswana records are from the Delta.
- Although *Philothamus angolensis* has a wide distribution in Africa, it is confined, in Botswana, to the Okavango and Kasane areas.

Fish: At the present state of knowledge there are 76 species of fish in the Okavango system within Botswana. The vast majority of Okavango fishes fall into 13 families. Merron and Bruton (1988) rec-ognise 5 major divisions of the Okavango Delta ecosystem which apply to the fish fauna.

Appendix 2.2 Bird species checklist for Moremi Game Reserve (Core Zone of the Property)

	Accuracy	Status	Notes
Family: Struthionidae			
Struthio camelus	2	LC	
Family: Podicipedidae			
Podiceps nigricollis	2	LC	
Tachybaptus ruficollis	2	LC	
Family: Pelicanidae			
Pelecanus onocrotalus	2	LC	
Pelecanus rufescens	2	LC	
Family: Phalacrocoracidae			
Phalacrocorax carbo	2	LC	
Phalacrocorax africanus	3	LC	
Family: Anhingidae			
Anhinga melanogaster	2	LC	
Family: Ardeidae			
Ardea cinerea	2	LC	
Ardea melanocephala	2	LC	
Ardea goliath	3	LC	
Ardea purpurea	3	LC	
Egretta alba	3	LC	
Egretta garzetta	2	LC	
Egretta intermedia	3	LC	
Egretta ardesiaca	2	LC	
Egretta vinaceigula	3	VU	Resident, aquatic habitats, Okavango pop. est. 10 000
Bubulcus ibis	3	LC	
Ardeola rufiventris	2	LC	
Butorides striatus	2	LC	
Butorides rufiventris	2	LC	
Nycticorax nycticorax	2	LC	
Gorsachius leuconotus	2	LC	Resident, large pop. in Okavango Vulnerable to degradation of aquatic habitats.
Ixobrychus minutus	2	LC	
Ixobrychus sturmii	2	LC	
Botaurus stellaris	2	LC	
Family: Scopidae			
Scopus umbretta	3	LC	
Family: Ciconiidae			
Ciconia ciconia	2	LC	
Ciconia nigra	2	LC	
Ciconia abdimii	2	LC	
Ciconia episcopus	2	LC	
Anastomus lamelligerus	2	LC	
Ephippiorhynchus senegalensis	3	LC	
Leptoptilos crumeniferus	3	LC	
Mycteria ibis	3	LC	
Family: Plataleidae			
Threskiornis aethiopicus	2	LC	
Plegadis falcinellus	2	LC	
Bostrychia hagedash	3	LC	
Platalea alba	3	LC	
Family: Phoenicopteridae			
Phoenicopterus ruber	2	LC	
Phoenicopterus minor	2	NT	Regional migrant, affected by human impacts. MPNP important breeding site
Family: Anatidae			
Dendrocygna viduata	3	LC	
Dendrocygna bicolor	2	LC	
Thalassornis leuconotus	2	LC	
Alopochen aegyptiacus	2	LC	
Anas undulata	2	LC	
Anas capensis	2	LC	
Anas hottentota	2	LC	
Anas erythrorhyncha	2	LC	
Netta erythrophthalma	2	LC	
Nettapus auritus	3	LC	
Sarkidiornis melanotos	3	LC	
Plectropterus gambensis	3	LC	
Oxyura maccoa	2	NT	Nomadic, permanent wetlands in open areas. Few records in Botswana.
Family: Sagittariidae			
Sagittarius serpentarius	2	LC	
Family: Accipitridae			
Necrosyrtes monachus	3	LC	
Gyps africanus	3	NT	Resident, scavenger, major threats are poisoning, power line collision and electrocution
Aegypius tracheliotus	2	VU	Resident, scavenger, threatened by habitat loss, poisoning, traditional med-icine trade

Trigonoceps occipitalis	2	VU	Resident, scavenger, declining popula-tion, sn. African pop. est. < 1,000
Milvus migrans	2	LC	
Milvus aegyptius	2	LC	
Elanus caeruleus	2	LC	
Aviceda cuculoides	2	LC	
Macheiramphus alcinus	2	LC	
Aquila rapax	2	LC	
Aquila nipalensis	3	LC	
Aquila pomarina	3	LC	
Aquila wahlbergi	3	LC	
Hieraaetus pennatus	2	LC	
Hieraaetus spilogaster	2	LC	
Hieraaetus ayresii	2	LC	
Lophaetus occipitalis	2	LC	Resident, forest edges and woodland. Some indication that Botswana range is expanding.
Polemaetus bellicosus	2	LC	Resident. Occurs in woodland, savanna. Major pop. declines outside of protected areas.
Circaetus cinereus	2	LC	
Circeatus pectoralis	2	LC	
Circeatus cinerascens	2	LC	
Terathopius ecaudatus	3	LC	
Haliaeetus vocifer	3	LC	
Buteo buteo	2	LC	
Accipiter ovampensis	2	LC	
Accipiter minullus	2	LC	
Accipiter melanoleucus	2	LC	
Accipiter badius	2	LC	
Micronisus gabar	2	LC	
Melierax canorus	2	LC	
Melierax metabates	2	LC	
Circus ranivorus	3	LC	
Circus pygargus	2	LC	
Circus macrourus	2	NT	Non-br. summer visitor, occurs in grass-lands, sn. African pop. est. 500. Vulner-able to poisoning.
Polyboroides typus	2	LC	
Family: Pandionidae			
Pandion haliaetus	2	LC	
Family: Falconidae			
Falco biarmicus	2	LC	

Falco subbuteo	2	LC	
Falco chicquera	2	LC	
Falco vespertinus	2	NT	Non-br. summer visitor, roosts in huge flocks. Pop. has declined, mainly in Euro., Asian br. areas.
Falco tinnunculus	2	LC	
Falco rupicoloides	2	LC	
Falco naumanni	2	VU	Non-br. summer visitor, nomadic. Large population declines, vulnerable to insec-ticide misuse
Falco dickinsoni	2	LC	
Family: Phasianidae			
Francolinus coqui	2	LC	
Francolinus sephaena	2	LC	
Francolinus levaillantoides	2	LC	
Francolinus adspersus	2	LC	
Francolinus swainsonii	2	LC	
Coturnix coturnix	2	LC	
Coturnix delegorguei	2	LC	
Family: Numididae			
Numida meleagris	3	LC	
Family: Turnicidae			
Turnix sylvatica	2	LC	
Family: Gruidae			
Bugeranus carunculatus	2	VU	Resident or nomadic, affected by habi-tat destruction/degradation, Botswana pop. est. 1,200
Family: Rallidae			
Rallus caerulescens	2	LC	
Crex egregia	2	LC	
Amaurornis flavirostris	3	LC	
Porzana pusilla	2	LC	
Aenigmatolimnas marginalis	2	LC	
Sarothrura rufa	3	LC	
Porphyrio porphyrio	2	LC	
Porphyrula alleni	2	LC	
Gallinula chloropus	2	LC	
Gallinula angulata	2	LC	
Fulica cristata	2	LC	
Family: Otididae			
Ardeotis kori	2	LC	Nomadic, mainly in dry savanna. Threatened by habitat loss, poisoning and hunting.

Neotis denhami	2	NT	Resident or migrant, does not breed in Botswana. Threats incl. habitat loss, hunting, poisoning.
Eupodotis ruficrista	2	LC	
Eupodotis melanogaster	2	LC	
Afrotis afroides	2	SA,LC	
Family: Jacanidae			
Actophilornis africanus	3	LC	
Microparra capensis	2	LC	
Family: Rostratulidae			
Rostratula benghalensis	2	LC	
Family: Charadriidae			
Charadrius hiaticula	2	LC	
Charadrius marginatus	2	LC	
Charadrius pecuarius	2	LC	
Charadrius tricollaris	2	LC	
Charadrius asiaticus	2	LC	
Pluvialis squatarola	2	LC	
Vanellus coronatus	3	LC	
Vanellus armatus	3	LC	
Vanellus albiceps	2	LC	
Vanellus senegallus	2	LC	
Vanellus crassirostris	2	LC	
Family: Scolopacidae			
Arenaria interpres	2	LC	
Actitis hypoleucos	2	LC	
Tringa ochropus	2	LC	
Tringa glareola	2	LC	
Tringa stagnatilis	2	LC	
Tringa nebularia	2	LC	
Calidris ferruginea	2	LC	
Calidris minuta	2	LC	
Calidris alba	2	LC	
Philomachus pugnax	2	LC	
Gallinago nigripennis	2	LC	
Limosa limosa	2	NT	Rare non-br. summer visitor, occurs in lakes and marshes
Numenius arquata	2	LC	
Family: Recurvirostridae			
Recurvirostra avosetta	2	LC	
Himantopus himantopus	3	LC	
Family: Burhinidae			
Burhinus capensis	2	LC	

Burhinus vermiculatus	2	LC	
Family: Glareolidae			
Cursorius temminckii	2	LC	
Smutsornis africanus	2	LC	
Rhinoptilus chalcopterus	2	LC	
Glareola practincola	2	LC	
Glareola nordmanni	2	NT	Non-br. summer visitor, occurs in seasonally wet grasslands/pans. Declines mainly in br. range.
Family: Laridae			
Larus cirrocephalus	2	LC	
Childonias hybridus	2	LC	
Childonias leucopterus	2	LC	
Family: Rynchopidae			
Rynchops flavirostris	2	NT	Partial intra-Afr. migrant, breeds on bare sandbanks. Okavango pop. est. 800 – 1, 200.
Family: Pteroclidae			
Pterocles namaqua	2	LC	
Pterocles burchelli	2	LC	
Pterocles gutturalis	2	LC	
Pterocles bicinctus	2	LC	
Family: Columbidae			
Columba livia	2	LC	
Streptopelia semitorquata	3	LC	
Streptopelia decipiens	3	LC	
Streptopelia capicola	3	LC	
Streptopelia senegalensis	2	LC	
Oena capensis	3	LC	
Turtur chalcospilos	3	LC	
Treron calva	2	LC	
Family: Psittacidae			
Poicephalus suahelicus	2	LC	
Poicephalus meyeri	3	LC	
Family: Musophagidae			
Corythaixoides concolor	3	LC	
Family: Cuculidae			
Cuculus canorus	2	LC	
Cuculus gularis	2	LC	
Cuculus solitarius	2	LC	
Cuculus clamosus	2	LC	
Clamator glandarius	2	LC	
Clamator levaillantii	3	LC	

Clamator jacobinus	3	LC	
Chrysococcyx klaas	2	LC	
Chrysococcyx caprius	3	LC	
Centropus bengalensis	2	LC	
Centropus cupreicaudus	3	LC	
Centropus senegalensis	3	LC	
Centropus burchellii	2	LC	
Family: Tytonidae			
Tyto alba	3	LC	
Family: Strigidae			
Strix woodfordii	2	LC	
Asio capensis	2	LC	
Otus senegalensis	3	LC	
Otus leucotis	2	LC	
Glaucidium perlatum	3	LC	
Glaucidium capense	3	LC	
Bubo africanus	2	LC	
Bubo lacteus	2	LC	
Scotopelia peli	3	LC	Resident, highest sn African pop. concentration in Okavango. Vulnerable to water pollution, etc.
Family: Caprimulgidae			
Caprimulgus pectoralis	2	LC	
Caprimulgus rufigena	2	LC	
Caprimulgus natalensis	2	LC	
Caprimulgus fossii	2	LC	
Family: Apodidae			
Apus apus	2	LC	
Apus affinis	2	LC	
Apus melba	2	LC	
Cypsiurus parvus	3	LC	
Family: Coliidae			
Urocolius indicus	2	LC	
Family: Trogonidae			
Apaloderma narina	2	LC	
Family: Halcyonidae			
Ceryle rudis	3	LC	
Megaceryle maxima	2	LC	
Alcedo cristata	2	LC	
Ispidina picta	2	LC	
Halcyon senegalensis	3	LC	
Halcyon albiventris	2	LC	
Halcyon leucocephala	3	LC	

Halcyon chelicuti	3	LC	
Family: Meropidae			
Merops apiaster	3	LC	
Merops persicus	3	LC	
Merops nubicoides	3	LC	
Merops bullockoides	2	LC	
Merops pusillus	3	LC	
Merops hirundineus	3	LC	
Family: Coraciidae			
Coracias garrulus	2	NT	Non-br. summer visitor, declines mainly in Euro, Asian br. range.
Coracias caudata	2	LC	
Coracias spatulata	2	LC	
Coracias naevia	2	LC	
Eurystomus glaucurus	3	LC	
Family: Upupidae			
Upupa epops	2	LC	
Family: Phoeniculidae			
Phoeniculus purpureus	3	LC	
Rhinopomastus cyanomelas	2	LC	
Family: Bucerotidae			
Tockus nasutus	3	LC	
Tockus erythrorhynchus	3	LC	
Tockus leucomelas	2	LC	
Tockus bradfieldi	2	LC	
Bucorvus leadbeateri	2	LC	Resident, grasslands, savannas and woodlands. Major pop declines due to habitat loss.
Family: Capitonidae			
Lybius torquatus	3	LC	
Tricholaema leucomelas	2	LC	
Pogoniulus chrysoconus	2	LC	
Trachyphonus vaillantii	3	LC	
Family: Indicatoridae			
Indicator indicator	3	LC	
Indicator minor	2	LC	
Prodotiscus regulus	2	LC	
Family: Picidae			
Campethera bennettii	3	LC	
Campethera abingoni	3	LC	
Dendropicos fuscescens	3	LC	
Thripias namaquus	2	LC	
Family: Eurylaimidae			

Smithornis capensis			
Family: Alaudidae			
Mirafra passerina	2	LC	
Mirafra africana	2	LC	
Mirafra rufocinnamomea	2	LC	
Mirafra africanoides	2	LC	
Mirafra sabota	2	LC	
Pinarocorys nigricans	2	LC	
Calandrella cinerea	2	LC	
Eremopterix leucotis	2	LC	
Eremopterix verticalis	2	LC	
Family: Hirundinidae			
Hirundo rustica	3	LC	
Hirundo albigularis	2	LC	
Hirundo smithii	2	LC	
Hirundo dimidiata	2	LC	
Hirundo semirufa	2	LC	
Hirundo senegalensis	2	LC	
Hirundo cucullata	2	LC	
Hirundo abyssinica	2	LC	
Hirundo spilodera	2	LC	
Hirundo fuligula	2	LC	
Delichon urbica	2	LC	
Pseudhirundo griseopyga	2	LC	
Riparia riparia	2	LC	
Riparia paludicola	3	LC	
Riparia cincta	2	LC	
Family: Campephagidae			
Campephaga flava	3	LC	
Coracina pectoralis	2	LC	
Family: Dicruridae			
Dicrurus adsimilis	3	LC	
Family: Oriolidae			
Oriolus oriolus	2	LC	
Oriolus auratus	3	LC	
Oriolus larvatus	3	LC	
Family: Corvidae			
Corvus capensis	2	LC	
Corvus albus	2	LC	
Family: Paridae			
Parus cinerascens	2	LC	
Parus niger	3	LC	
Family: Remizidae			

Anthoscopus minutus	2	LC	
Anthoscopus caroli	2	LC	
Family: Timaliidae			
Turdoides jardeneii	2	LC	
Turdoides hartlaubii	3	LC	
Turdoides bicolor	2	SA,LC	
Family: Pycnonotidae			
Pycnonotus nigricans	2	LC	
Pycnonotus barbatus	2	LC	
Phyllastrephus terrestris	2	LC	
Chlorocichla flaviventris	2	LC	
Family: Turdidae			
Turdus libonyana	2	LC	
Turdus litsitsirupa	2	LC	
Oenanthe pileata	2	LC	
Thamnolaea arnoti	2	LC	
Myrmecocichla formicivora	2	SA,LC	
Saxicola torquata	2	LC	
Cossypha heuglini	3	LC	
Erythropygia leucophrys	2	LC	
Erythropygia paena	2	LC	
Family: Sylviidae			
Sylvia borin	2	LC	
Sylvia communis	2	LC	
Parisoma subcaeruleum	2	LC	
Hippolais icterina	2	LC	
Acrocephalus arundinaceus	2	LC	
Acrocephalus baeticatus	2	LC	
Acrocephalus palustris	2	LC	
Acrocephalus schoenobaenus	2	LC	
Acrocephalus gracilirostris	2	LC	
Acrocephalus rufescens	2	LC	
Bradypterus baboecala	3	LC	
Phylloscopus trochilus	3	LC	
Apalis flavida	2	LC	
Sylvietta rufescens	3	LC	
Eremomela icteropygialis	2	LC	
Eremomela scotops	2	LC	
Eremomela usticollis	2	LC	
Camaroptera brachyura	2	LC	
Calamonastes fasciolatus	2	LC	
Cisticola juncidis	3	LC	
Cisticola aridula	2	LC	

Cisticola rufilata	2	LC	
Cisticola chiniana	3	LC	
Cisticola galactotes	2	LC	
Cisticola pipiens	3	LC	
Cisticola fulvicapilla	2	LC	
Prinia subflava	3	LC	
Prinia flavicans	2	LC	
Family: Muscicapidae			
Muscicapa striata	3	LC	
Muscicapa caerulescens	3	LC	
Myioparus plumbeus	2	LC	
Melaenornis pammelaina	2	LC	
Melaenornis mariquensis	2	LC	
Melaenornis pallidus	2	LC	
Batis molitor	3	LC	
Batis pririt	2	LC	
Terpsiphone viridis	3	LC	
Family: Motacillidae			
Motacilla aguimp	2	LC	
Motacilla capensis	3	LC	
Motacilla flava	2	LC	
Anthus cinamomeus	2	LC	
Anthus leucophrys	2	LC	
Anthus vaalensis	2	LC	
Macronyx ameliae	2	LC	Resident, moist grasslands and swamp edges. Threatened on account of small range.
Family: Laniidae			
Lanius minor	2	LC	
Lanius collaris	2	LC	
Lanius collurio	2	LC	
Corvinella melanoleuca	2	LC	
Eurocephalus anguitimens	2	LC	
Family: Malaconotidae			
Laniarius bicolor	2	LC	
Laniarius artococcineus	2	LC	
Dryoscopus cubla	3	LC	
Nilaus afer	3	LC	
Tchagra australis	2	LC	
Tchagra senegala	2	LC	
Telophorus sulfureopectus	2	LC	
Malaconotus blanchoti	2	LC	
Family: Prionopidae			

Prionops plumatus	2	LC	
Prionops retzii	2	LC	
Family: Sturnidae			
Creatophora cinerea	2	LC	
Cinnyricinclus leucogaster	3	LC	
Lamprotornis australis	3	LC	
Lamprotornis mevesii	3	LC	
Lamprotornis nitens	2	LC	
Lamprotornis chalybaeus	3	LC	
Family: Buphagidae			
Buphagus africanus	2	LC	
Buphagus erythrorhynchus	3	LC	
Family: Nectariniidae			
Nectarinia mariquensis	2	LC	
Nectarinia talatala	2	LC	
Nectarinia senegalensis	2	LC	
Nectarinia amethystina	2	LC	
Anthreptes collaris	2	LC	
Family: Zosteropidae			
Zosterops senegalensis	3	LC	
Family: Ploceidae			
Bubalornis niger	3	LC	
Plocepasser mahali	2	LC	
Passer domesticus	2	LC	
Passer motitensis	2	LC	
Passer diffusus	3	LC	
Petronia superciliaris	3	LC	
Sporopipes squamifrons	2	LC	
Amblyospiza albifrons	2	LC	
Ploceus ocularis	2	LC	
Ploceus cucullatus	2	LC	
Ploceus rubiginosus	2	LC	
Ploceus velatus	2	LC	
Ploceus intermedius	2	LC	
Ploceus xanthops	3	LC	
Ploceus xanthopterus	2	LC	
Anaplectes rubriceps	2	LC	
Quelea quelea	2	LC	
Euplectes orix	2	LC	
Euplectes afer	2	LC	
Euplectes axillaris	3	LC	
Family: Estrilididae			
Pytilia melba	2	LC	

Lagonosticta rhodopareia	3	LC	
Lagonosticta senegala	2	LC	
Lagonosticta nitidula	2	LC	
Uraeginthus angolensis	3	LC	
Uraeginthus granatinus	2	LC	
Estrilda astrild	3	LC	
Estrilda erythronotos	2	LC	
Ortygospiza atricollis	2	LC	
Ortypospiza locustella	2	LC	
Sporaeginthus subflavus	2	LC	
Amadina fasciata	2	LC	
Amadina erythrocephala	2	LC	
Family: Viduidae			
Vidua macroura	3	LC	
Vidua regia	2	LC	
Vidua paradisaea	2	LC	
Vidua purpurascens	2	LC	
Vidua chalybeata	2	LC	
Family: Fringillidae			
Serinus mozambicus	2	LC	
Serinus atrogularis	2	LC	
Serinus flaviventris	2	LC	
Emberiza flaviventris	3	LC	
Emberiza tahapisi	2	LC	
Emberiza impetuani	2	LC	

APPENDIX 2.3: Red Data status of bird of the Okavango Delta - 2009. (Tyler and Bish-op, updated)

Globally threatened birds	
Egyptian Vulture	Slaty Egret
Cape Vulture	Wattled Crane
Lappet-faced Vulture	Basra Reed-warbler
White-headed Vulture	Corn Crake
Lesser Kestrel	Grey Crowned Crane
Southern Ground-Hornbill	
Globally Near Threatened	
Pallid Harrier	Black-winged Pratincole
Lesser Flamingo	White-backed Vulture
African Skimmer	Great Snipe
European Roller	Red-footed Falcon
Black-tailed Godwit	Eurasian Curlew
Bateleur	Martial Eagle
Restricted Range and Biome Restricted Assemblages	
Dickinson's Kestrel	Burchell's Sandgrouse
Coppery-tailed Coucal	Racket-tailed Roller
Bradfield's Hornbill	Black-faced Babbler
Hartlaub's Babbler	Kurrichane Thrush
Arnot's Chat	Kalahari Scrub Robin
Barred Wren-Warbler	Chirping Cisticola
Burchell's Starling	Meves's Starling
Sharp-tailed Starling	White-bellied Sunbird
Brown Firefinch	
1% or more of population	
Great White Pelican	African Darter
Goliath Heron	Great Egret
Little Egret	Black Heron
Squacco Heron	Rufous-bellied Heron
Black-crowned Night-Heron	African Openbill
Saddle-billed Stork	Marabou Stork
African Spoonbill	White-backed Duck
African Pygmy-Goose	Lesser Moorhen
Lesser Jacana	Collared Pratincole
0,5% or more of population	
Yellow-billed Egret	Cattle Egret
Little Bittern	Woolly-necked Stork
African Sacred Ibis	Fulvous Duck
Red-billed Teal	Spur-winged Goose
Long-toed Lapwing	
Other important populations	
White-backed Night-Heron	Allen's Gallinule

APPENDIX 2.4: Frogs of the Okavango Delta Property

GENUS	SPECIES	RED DATA STATUS
Breviceps	adspersus	Least Concern
Amietophrynus	gutturalis	Least Concern
Amietophrynus	lemairii	Least Concern
Amietophrynus	maculatus	Least Concern
Amietophrynus	poweri	Least Concern
Poyntonophrynus	kavangensis	Least Concern
Hemisus	guineensis	Least Concern
Hemisus	marmoratus	Least Concern
Hyperolius	benguellensis	Least Concern
Hyperolius	nasutus	Least Concern
Hyperolius	parallelus	Least Concern
Kassina	senegalensis	Least Concern
Phrynomantis	bifasciatus	Least Concern
Phrynobatrachus	mababiensis	Least Concern
Phrynobatrachus	natalensis	Least Concern
Phrynobatrachus	parvulus	Least Concern
Hildebrandtia	ornata	Least Concern
Ptychadena	anchietae	Least Concern
Ptychadena	guibei	Least Concern
Ptychadena	mascareniensis	Least Concern
Ptychadena	mossambica	Least Concern
Ptychadena	oxyrhynchus	Least Concern
Ptychadena	subpunctata	Least Concern
Ptychadena	taenioscelis	Least Concern
Xenopus	laevis	Least Concern
Xenopus	muelleri	Least Concern
Xenopus	petersii	Least Concern
Cacosternum	boettgeri	Least Concern
Pyxicephalus	adspersus	Near Threatened
Tomopterna	cryptotis	Least Concern
Tomopterna	krugerensis	Least Concern
Tomopterna	tandyi	Least Concern
Chiromantis	xerampelina	Least Concern

APPENDIX 2.5: Plant inventory from the Okavango Delta Property

Family	Species	No. of species
ACANTHACEAE	*Asystasia gangetica*	1
	Barleria lancifolia	1
	Barleria mackenii	1
	Barleria senensis	1
	Blepharis diversispina	1
	Blepharis leendertziae	1
	Blepharis maderaspatensis	1
	Dicliptera spinulosa	1
	Hygrophila pilosa	1
	Hygrophila pobeguinii	1
	Hygrophila prunelloides	1
	Hygrophila sp.	1
	Hypoestes forskaolii	1
	Justicia anselliana	1
	Justicia betonica	1
	Justicia dinteri	1
	Justicia exigua	1
	Justicia glabra	1
	Justicia heterocarpa	1
	Justicia kirkiana	1
	Megalochlamys marlothii	1
	Monechma debile	1
	Monechma divaricatum	1
	Nelsonia canescens	1
	Peristrophe paniculata	1
	Ruellia otaviensis	1
	Ruellia patula	1
	Ruspolia decurrens	1
	Ruspolia seticalyx	1
	Thunbergia aurea	1
ACANTHACEAE Total		30
AIZOACEAE	*Trianthema salsoloides*	1
	Zaleya pentandra	1
AIZOACEAE Total		2
ALISMATACEAE	*Caldesia reniformis*	1
	Limnophyton angolense	1
	Wiesneria schweinfurthii	1
ALISMATACEAE Total		3
AMARANTHACEAE	*Achyranthes aspera*	1
	Aerva javanica	1

	Aerva lanata	1
	Aerva leucura	1
	Alternanthera pungens	1
	Alternanthera sessilis	1
	Amaranthus praetermissus	1
	Amaranthus standleyanus	1
	Amaranthus thunbergii	1
	Celosia trigyna	1
	Cyathula orthacantha	1
	Gomphrena celosioides	1
	Guilleminea densa	1
	Hermbstaedtia scabra	1
	Kyphocarpa angustifolia	1
	Pupalia lappacea	1
AMARANTHACEAE Total		16
AMARYLLIDACEAE	*Ammocharis tinneana*	1
	Crinum carolo-schmidtii	1
	Crinum crassicaule	1
	Pancratium tenuifolium	1
	Scadoxus multiflorus	1
AMARYLLIDACEAE Total		5
ANACARDIACEAE	*Rhus tenuinervis*	1
	Sclerocarya birrea	1
ANACARDIACEAE Total		2
ANTHERICACEAE	*Chlorophytum longifolium*	1
ANTHERICACEAE Total		1
APIACEAE	*Hydrocotyle verticillata*	1
APIACEAE Total		1
APOCYNACEAE	*Carissa edulis*	1
	Cynanchum schistoglossum	1
	Gomphocarpus fruticosus	1
	Gomphocarpus tomentosus	1
	Marsdenia macrantha	1
	Marsdenia sylvestris	1
	Pergularia daemia	1
	Pergularia sp.	1
	Periglossum mossambicense	1
	Sarcostemma viminale	1
	Tacazzea apiculata	1
APOCYNACEAE Total		11
ASPARAGACEAE	*Asparagus nelsii*	1
	Asparagus nodulosus	1
	Asparagus racemosus	1

	Protasparagus exuvialis	1
ASPARAGACEAE Total		4
ASPHODELACEAE	*Aloe greatheadii*	1
	Aloe zebrina	1
	Trachyandra laxa	1
ASPHODELACEAE Total		3
ASTERACEAE	*Acanthospermum hispidum*	1
	Adenostemma caffrum	1
	Baccharoides anthelmintica	1
	Bidens pilosa	1
	Bidens schimperi	1
	Blainvillea gayana	1
	Conyza aegyptiaca	1
	Conyza albida	1
	Crassocephalum x picridifolium	1
	Dicoma schinzii	1
	Dicoma tomentosa	1
	Distephanus divaricatus	1
	Eclipta prostrata	1
	Ethulia conyzoides	1
	Galinsoga parviflora	1
	Helichrysum stenopterum	1
	Hirpicium gorterioides	1
	Laggera crispata	1
	Laggera decurrens	1
	Launaea rarifolia	1
	Litogyne gariepina	1
	Melanthera scandens	1
	Melanthera triternata	1
	Mikania sagittifera	1
	Nicolasia costata	1
	Nidorella resedifolia	1
	Nolletia ciliaris	1
	Pechuel-Loeschea leubnitziae	1
	Pegolettia senegalensis	1
	Philyrophyllum schinzii	1
	Pseudoconyza viscosa	1
	Schkuhria pinnata	1
	Senecio abruptus	1
	Senecio leptocephalus	1
	Senecio strictifolius	1
	Sonchus asper	1
	Sonchus oleraceus	1

	Sphaeranthus flexuosus	1
	Sphaeranthus peduncularis	1
	Vernonia amygdalina	1
	Vernonia fastigiata	1
	Vernonia glabra	1
	Xanthium strumarium	1
ASTERACEAE Total		43
AZOLLACEAE	*Azolla pinnata*	1
AZOLLACEAE Total		1
BALANITACEAE	*Balanites aegyptiaca*	1
BALANITACEAE Total		1
BARTRAMIACEAE	*Philonotis dregeana*	1
	Philonotis falcata	1
	Philonotis hastata	1
BARTRAMIACEAE Total		3
BIGNONIACEAE	*Kigelia africana*	1
	Markhamia zanzibarica	1
	Rhigozum brevispinosum	1
BIGNONIACEAE Total		3
BOMBACACEAE	*Adansonia digitata*	1
BOMBACACEAE Total		1
BORAGINACEAE	*Cordia sinensis*	1
	Ehretia amoena	1
	Ehretia obtusifolia	1
	Heliotropium ovalifolium	1
	Heliotropium strigosum	1
	Heliotropium zeylanicum	1
BORAGINACEAE Total		6
BRASSICACEAE	*Coronopus integrifolius*	1
BRASSICACEAE Total		1
BURSERACEAE	*Commiphora africana*	1
	Commiphora glandulosa	1
BURSERACEAE Total		2
CABOMBACEAE	*Brasenia schreberi*	1
CABOMBACEAE Total		1
CAMPANULACEAE	*Wahlenbergia banksiana*	1
	Wahlenbergia napiformis	1
CAMPANULACEAE Total		2
CAPPARACEAE	*Boscia albitrunca*	1
	Boscia matabelensis	1
	Boscia mossambicensis	1
	Capparis tomentosa	1
	Cleome hirta	1

	Cleome rubella	1
CAPPARACEAE Total		6
CARYOPHYLLACEAE	*Pollichia campestris*	1
	Polycarpaea corymbosa	1
CARYOPHYLLACEAE Total		2
CELASTRACEAE	*Gymnosporia senegalensis*	1
CELASTRACEAE Total		1
CERATOPHYLLACEAE	*Ceratophyllum demersum*	1
	Ceratophyllum sp.	1
CERATOPHYLLACEAE Total		2
CHENOPODIACEAE	*Chenopodium album*	1
	Chenopodium ambrosioides	1
	Chenopodium olukondae	1
	Chenopodium opulifolium	1
CHENOPODIACEAE Total		4
CLUSIACEAE	*Garcinia livingstonei*	1
CLUSIACEAE Total		1
COLCHICACEAE	*Camptorrhiza strumosa*	1
	Gloriosa superba	1
COLCHICACEAE Total		2
COMBRETACEAE	*Combretum albopunctatum*	1
	Combretum apiculatum	1
	Combretum collinum	1
	Combretum hereroense	1
	Combretum imberbe	1
	Combretum mossambicense	1
	Combretum psidioides	1
	Combretum sp.	1
	Combretum zeyheri	1
	Terminalia prunioides	1
	Terminalia sericea	1
COMBRETACEAE Total		11
COMMELINACEAE	*Commelina africana*	1
	Commelina benghalensis	1
	Commelina diffusa	1
	Commelina erecta	1
	Commelina forskaolii	1
	Commelina subulata	1
	Commelina zambesica	1
	Cyanotis foecunda	1
	Floscopa glomerata	1
COMMELINACEAE Total		9
CONVOLVULACEAE	*Astripomoea lachnosperma*	1

	Evolvulus alsinoides	1
	Ipomoea dichroa	1
	Ipomoea eriocarpa	1
	Ipomoea magnusiana	1
	Ipomoea obscura	1
	Ipomoea pes-tigridis	1
	Ipomoea plebeia	1
	Ipomoea rubens	1
	Ipomoea sinensis	1
	Xenostegia tridentata	1
CONVOLVULACEAE Total		11
CRASSULACEAE	*Kalanchoe brachyloba*	1
	Kalanchoe lanceolata	1
CRASSULACEAE Total		2
CUCURBITACEAE	*Acanthosicyos naudinianus*	1
	Coccinia sessilifolia	1
	Corallocarpus bainesii	1
	Corallocarpus triangularis	1
	Cucumis anguria	1
	Kedrostis crassirostrata	1
	Kedrostis foetidissima	1
	Lagenaria siceraria	1
	Lagenaria sphaerica	1
	Momordica balsamina	1
	Oreosyce africana	1
	Zehneria marlothii	1
CUCURBITACEAE Total		12
CYPERACEAE	*Bolboschoenus glaucus*	1
	Bulbostylis burchellii	1
	Bulbostylis contexta	1
	Bulbostylis hispidula	1
	Bulbostylis trabeculata	1
	Carex cognata	1
	Cladium mariscus	1
	Courtoisia sp.	1
	Courtoisina cyperoides	1
	Cyperus articulatus	1
	Cyperus compressus	1
	Cyperus cyperoides	1
	Cyperus denudatus	1
	Cyperus difformis	1
	Cyperus digitatus	1
	Cyperus dives	1

	Cyperus dubius	1
	Cyperus esculentus	1
	Cyperus fulgens	1
	Cyperus laevigatus	1
	Cyperus longus	1
	Cyperus maculatus	1
	Cyperus margaritaceus	1
	Cyperus mwinilungensis	1
	Cyperus papyrus	1
	Cyperus pectinatus	1
	Cyperus rotundus	1
	Cyperus sp.	1
	Cyperus sphaerospermus	1
	Cyperus squarrosus	1
	Cyperus tenuispica	1
	Cyperus turrillii	1
	Cyperus zollingeri	1
	Eleocharis acutangula	1
	Eleocharis atropurpurea	1
	Eleocharis caduca	1
	Eleocharis dulcis	1
	Eleocharis naumanniana	1
	Eleocharis retroflexa	1
	Eleocharis sp.	1
	Eleocharis variegata	1
	Fimbristylis complanata	1
	Fimbristylis dichotoma	1
	Fimbristylis squarrosa	1
	Fuirena ciliaris	1
	Fuirena leptostachya	1
	Fuirena pubescens	1
	Fuirena stricta	1
	Fuirena umbellata	1
	Kyllinga alba	1
	Kyllinga erecta	1
	Kyllinga intricata	1
	Lipocarpha abietina	1
	Lipocarpha chinensis	1
	Lipocarpha hemisphaerica	1
	Mariscus hamulosus	1
	Oxycaryum cubense	1
	Pycreus aethiops	1
	Pycreus chrysanthus	1

	Pycreus flavescens	1
	Pycreus macranthus	1
	Pycreus macrostachyos	1
	Pycreus mundii	1
	Pycreus nitidus	1
	Pycreus pelophilus	1
	Pycreus polystachyos	1
	Pycreus unioloides	1
	Rhynchospora brownii	1
	Rhynchospora candida	1
	Rhynchospora corymbosa	1
	Rhynchospora holoschoenoides	1
	Rhynchospora perrieri	1
	Schoenoplectus brachyceras	1
	Schoenoplectus corymbosus	1
	Schoenoplectus erectus	1
	Schoenoplectus lateriflorus	1
	Schoenoplectus muricinux	1
	Schoenoplectus senegalensis	1
	Schoenoplectus sp.	1
	Scleria distans	1
	Scleria dregeana	1
	Scleria lacustris	1
	Scleria melanomphala	1
	Scleria sp.	1
	Scleria unguiculata	1
	Websteria confervoides	1
CYPERACEAE Total		86
DRACAENACEAE	*Sansevieria aethiopica*	1
DRACAENACEAE Total		1
DROSERACEAE	*Aldrovanda vesiculosa*	1
	Drosera madagascariensis	1
DROSERACEAE Total		2
EBENACEAE	*Diospyros mespiliformis*	1
	Euclea divinorum	1
	Euclea sp.	1
	Euclea undulata	1
EBENACEAE Total		4
ELATINACEAE	*Bergia pentheriana*	1
	Bergia polyantha	1
	Bergia sp.	1
	Elatine ambigua	1
ELATINACEAE Total		4

ERIOCAULACEAE	*Eriocaulon setaceum*	1
	Eriocaulon welwitschii	1
ERIOCAULACEAE Total		2
ERIOSPERMACEAE	*Eriospermum bakerianum*	1
ERIOSPERMACEAE Total		1
ERPODIACEAE	*Erpodium beccarii*	1
ERPODIACEAE Total		1
EUPHORBIACEAE	*Acalypha indica*	1
	Acalypha villicaulis	1
	Antidesma venosum	1
	Cephalocroton mollis	1
	Croton gratissimus	1
	Croton megalobotrys	1
	Euphorbia crotonoides	1
	Euphorbia inaequilatera	1
	Euphorbia indica	1
	Euphorbia mossambicensis	1
	Euphorbia prostrata	1
	Flueggea virosa	1
	Phyllanthus burchellii	1
	Phyllanthus fraternus	1
	Phyllanthus parvulus	1
	Phyllanthus pentandrus	1
	Phyllanthus reticulatus	1
	Pterococcus africanus	1
	Tragia okanyua	1
EUPHORBIACEAE Total		19
FABACEAE	*Abrus precatorius*	1
	Acacia erioloba	1
	Acacia fleckii	1
	Acacia galpinii	1
	Acacia hebeclada	1
	Acacia karroo	1
	Acacia luederitzii	1
	Acacia nigrescens	1
	Acacia sieberiana	1
	Acacia sp.	1
	Acacia tortilis	1
	Aeschynomene fluitans	1
	Aeschynomene indica	1
	Albizia harveyi	1
	Bolusia sp.	1
	Chamaecrista absus	1

	Chamaecrista biensis	1
	Chamaecrista capensis	1
	Chamaecrista falcinella	1
	Colophospermum mopane	1
	Crotalaria barkae	1
	Crotalaria laburnifolia	1
	Crotalaria platysepala	1
	Crotalaria sp.	1
	Crotalaria spartioides	1
	Crotalaria steudneri	1
	Dichrostachys cinerea	1
	Elephantorrhiza goetzei	1
	Indigastrum parviflorum	1
	Indigofera astragalina	1
	Indigofera bainesii	1
	Indigofera charlieriana	1
	Indigofera colutea	1
	Indigofera daleoides	1
	Indigofera filipes	1
	Indigofera flavicans	1
	Indigofera praticola	1
	Indigofera sp.	1
	Indigofera tinctoria	1
	Lessertia benguellensis	1
	Lonchocarpus nelsii	1
	Neonotonia wightii	1
	Neorautanenia amboensis	1
	Neptunia oleracea	1
	Philenoptera nelsii	1
	Philenoptera violacea	1
	Piliostigma thonningii	1
	Requienia sphaerosperma	1
	Rhynchosia minima	1
	Rhynchosia sp.	1
	Rhynchosia totta	1
	Sesbania bispinosa	1
	Sesbania cinerascens	1
	Sesbania rostrata	1
	Tephrosia lupinifolia	1
	Tephrosia purpurea	1
	Vigna luteola	1
	Vigna oblongifolia	1
	Vigna unguiculata	1

	Zornia glochidiata	1
FABACEAE Total		60
FABRONIACEAE	*Fabronia pilifera*	1
FABRONIACEAE Total		1
GENTIANACEAE	*Enicostema axillare*	1
	Sebaea junodii	1
GENTIANACEAE Total		2
GERANIACEAE	*Monsonia angustifolia*	1
GERANIACEAE Total		1
GISEKIACEAE	*Gisekia africana*	1
	Gisekia pharnacioides	1
GISEKIACEAE Total		2
HALORAGACEAE	*Laurembergia repens*	1
	Laurembergia sp.	1
	Myriophyllum spicatum	1
HALORAGACEAE Total		3
HYACINTHACEAE	*Albuca abyssinica*	1
	Albuca sp.	1
	Dipcadi glaucum	1
	Dipcadi longifolium	1
	Dipcadi sp.	1
	Drimia indica	1
	Drimia sanguinea	1
	Drimia uniflora	1
	Ledebouria marginata	1
HYACINTHACEAE Total		9
HYDROCHARITACEAE	*Lagarosiphon cordofanus*	1
	Lagarosiphon ilicifolius	1
	Ottelia kunenensis	1
	Ottelia muricata	1
	Ottelia ulvifolia	1
	Vallisneria aethiopica	1
	Vallisneria spiralis	1
HYDROCHARITACEAE Total		7
IRIDACEAE	*Lapeirousia schimperi*	1
IRIDACEAE Total		1
KIRKIACEAE	*Kirkia acuminata*	1
KIRKIACEAE Total		1
LAMIACEAE	*Acrotome inflata*	1
	Clerodendrum ternatum	1
	Hemizygia bracteosa	1
	Hemizygia petrensis	1
	Hoslundia opposita	1

	Hyptis pectinata	1
	Leonotis nepetifolia	1
	Leucas martinicensis	1
	Neohyptis paniculata	1
	Ocimum americanum	1
	Plectranthus tetragonus	1
	Pycnostachys coerulea	1
	Rotheca uncinata	1
LAMIACEAE Total		13
LAURACEAE	*Cassytha filiformis*	1
LAURACEAE Total		1
LEMNACEAE	*Lemna aequinoctialis*	1
	Lemna gibba	1
	Wolffiella welwitschii	1
LEMNACEAE Total		3
LENTIBULARIACEAE	*Utricularia benjaminiana*	1
	Utricularia foliosa	1
	Utricularia gibba	1
	Utricularia inflexa	1
	Utricularia reflexa	1
	Utricularia scandens	1
	Utricularia sp.	1
	Utricularia stellaris	1
LENTIBULARIACEAE Total		8
LORANTHACEAE	*Plicosepalus kalachariensis*	1
	Tapinanthus oleifolius	1
LORANTHACEAE Total		2
LYTHRACEAE	*Ammannia auriculata*	1
	Nesaea crassicaulis	1
	Nesaea ondongana	1
	Nesaea radicans	1
	Rotala dinteri	1
	Rotala filiformis	1
	Rotala myriophylloides	1
	Rotala sp.	1
LYTHRACEAE Total		8
MALPIGHIACEAE	*Sphedamnocarpus pruriens*	1
MALPIGHIACEAE Total		1
MALVACEAE	*Abutilon angulatum*	1
	Abutilon austro-africanum	1
	Abutilon engleranum	1
	Abutilon englerianum	1
	Abutilon ramosum	1

	Gossypium herbaceum	1
	Hibiscus calyphyllus	1
	Hibiscus cannabinus	1
	Hibiscus diversifolius	1
	Hibiscus dongolensis	1
	Hibiscus schinzii	1
	Hibiscus sidiformis	1
	Hibiscus sp.	1
	Kosteletzkya buettneri	1
	Pavonia burchellii	1
	Pavonia senegalensis	1
	Sida cordifolia	1
	Wissadula rostrata	1
MALVACEAE Total		18
MARSILEACEAE	*Marsilea coromandelina*	1
	Marsilea minuta	1
	Marsilea nubica	1
	Marsilea sp.	1
	Marsilea villifolia	1
MARSILEACEAE Total		5
MELASTOMATACEAE	*Antherotoma debilis*	1
MELASTOMATACEAE Total		1
MENISPERMACEAE	*Cissampelos mucronata*	1
	Cocculus hirsutus	1
MENISPERMACEAE Total		2
MENYANTHACEAE	*Nymphoides indica*	1
	Nymphoides rautanenii	1
	Nymphoides thunbergiana	1
MENYANTHACEAE Total		3
MOLLUGINACEAE	*Glinus bainesii*	1
	Glinus oppositifolius	1
	Limeum fenestratum	1
	Mollugo cerviana	1
	Mollugo nudicaulis	1
MOLLUGINACEAE Total		5
MORACEAE	*Ficus capreifolia*	1
	Ficus pygmaea	1
	Ficus verruculosa	1
MORACEAE Total		3
MYRICACEAE	*Morella serrata*	1
	Myrica serrata	1
MYRICACEAE Total		2
MYRTACEAE	*Syzygium intermedium*	1

MYRTACEAE Total		1
NAJADACEAE	*Najas horrida*	1
NAJADACEAE Total		1
NYCTAGINACEAE	*Boerhavia coccinea*	1
	Boerhavia diffusa	1
	Commicarpus pilosus	1
	Commicarpus plumbagineus	1
NYCTAGINACEAE Total		4
NYMPHAEACEAE	*Nymphaea lotus*	1
	Nymphaea nouchali	1
NYMPHAEACEAE Total		2
OCHNACEAE	*Ochna pulchra*	1
OCHNACEAE Total		1
OLACACEAE	*Ximenia americana*	1
OLACACEAE Total		1
OLEACEAE	*Jasminum fluminense*	1
	Jasminum stenolobum	1
OLEACEAE Total		2
ONAGRACEAE	*Ludwigia abyssinica*	1
	Ludwigia adscendens	1
	Ludwigia leptocarpa	1
	Ludwigia octovalvis	1
	Ludwigia sp.	1
	Ludwigia stenorraphe	1
ONAGRACEAE Total		6
ORCHIDACEAE	*Eulophia horsfallii*	1
	Eulophia kyimbilae	1
	Eulophia latilabris	1
	Habenaria filicornis	1
	Habenaria ichneumonea	1
ORCHIDACEAE Total		5
OROBANCHACEAE	*Alectra orobanchoides*	1
	Buchnera randii	1
	Buchnera simplex	1
	Cycnium tubulosum	1
	Rhamphicarpa fistulosa	1
	Sopubia mannii	1
	Striga asiatica	1
OROBANCHACEAE Total		7
OXALIDACEAE	*Oxalis corniculata*	1
OXALIDACEAE Total		1
PAPAVERACEAE	*Argemone ochroleuca*	1
PAPAVERACEAE Total		1

PARKERIACEAE	*Ceratopteris thalictroides*	1
PARKERIACEAE Total		1
PEDALIACEAE	*Dicerocaryum eriocarpum*	1
	Harpagophytum procumbens	1
	Sesamum alatum	1
	Sesamum triphyllum	1
PEDALIACEAE Total		4
PLUMBAGINACEAE	*Plumbago zeylanica*	1
PLUMBAGINACEAE Total		1
POACEAE	*Acrachne racemosa*	1
	Andropogon eucomus	1
	Andropogon gayanus	1
	Andropogon huillensis	1
	Andropogon laxatus	1
	Anthephora pubescens	1
	Aristida adscensionis	1
	Aristida junciformis	1
	Aristida meridionalis	1
	Aristida pilgeri	1
	Aristida scabrivalvis	1
	Aristida sp.	1
	Aristida spectabilis	1
	Aristida stipitata	1
	Aristida stipoides	1
	Bothriochloa bladhii	1
	Brachiaria arrecta	1
	Brachiaria deflexa	1
	Brachiaria dura	1
	Brachiaria grossa	1
	Brachiaria humidicola	1
	Brachiaria nigropedata	1
	Brachiaria sp.	1
	Brachiaria xantholeuca	1
	Cenchrus ciliaris	1
	Chloris gayana	1
	Chloris virgata	1
	Chrysopogon nigritanus	1
	Cortaderia jubata	1
	Cymbopogon caesius	1
	Cymbopogon excavatus	1
	Cynodon dactylon	1
	Dactyloctenium aegyptium	1
	Dactyloctenium giganteum	1

	Diandrochloa namaquensis	1
	Dichanthium annulatum	1
	Digitaria debilis	1
	Digitaria eriantha	1
	Digitaria eylesii	1
	Digitaria milanjiana	1
	Digitaria sanguinalis	1
	Digitaria seriata	1
	Digitaria velutina	1
	Echinochloa colona	1
	Echinochloa haploclada	1
	Echinochloa holubii	1
	Echinochloa jubata	1
	Echinochloa pyramidalis	1
	Echinochloa stagnina	1
	Elymandra grallata	1
	Elytrophorus globularis	1
	Enneapogon cenchroides	1
	Enneapogon desvauxii	1
	Enteropogon macrostachyus	1
	Enteropogon rupestris	1
	Entolasia imbricata	1
	Eragrostis aspera	1
	Eragrostis barrelieri	1
	Eragrostis cilianensis	1
	Eragrostis cylindriflora	1
	Eragrostis echinochloidea	1
	Eragrostis heteromera	1
	Eragrostis inamoena	1
	Eragrostis lappula	1
	Eragrostis membranacea	1
	Eragrostis pallens	1
	Eragrostis pilosa	1
	Eragrostis rigidior	1
	Eragrostis rotifer	1
	Eragrostis sarmentosa	1
	Eragrostis sp.	1
	Eragrostis superba	1
	Eragrostis trichophora	1
	Eragrostis viscosa	1
	Eriochrysis pallida	1
	Eulalia aurea	1
	Hemarthria altissima	1

	Heteropogon contortus	1
	Hyparrhenia dichroa	1
	Hyparrhenia rufa	1
	Hyperthelia dissoluta	1
	Imperata cylindrica	1
	Leersia friesii	1
	Leersia hexandra	1
	Leptocarydion vulpiastrum	1
	Leptochloa fusca	1
	Melinis repens	1
	Microchloa indica	1
	Microchloa kunthii	1
	Miscanthus junceus	1
	Odyssea paucinervis	1
	Oplismenus burmannii	1
	Oplismenus undulatifolius	1
	Oryza longistaminata	1
	Oryza sp.	1
	Oryzidium barnardii	1
	Panicum coloratum	1
	Panicum dregeanum	1
	Panicum fluviicola	1
	Panicum funaense	1
	Panicum heterostachyum	1
	Panicum hymeniochilum	1
	Panicum kalaharense	1
	Panicum maximum	1
	Panicum parvifolium	1
	Panicum repens	1
	Panicum repentellum	1
	Panicum sp.	1
	Panicum trichonode	1
	Paspalidium obtusifolium	1
	Paspalidium sp.	1
	Paspalum scrobiculatum	1
	Pennisetum glaucocladum	1
	Pennisetum setaceum	1
	Perotis patens	1
	Phragmites australis	1
	Phragmites mauritianus	1
	Pogonarthria fleckii	1
	Pogonarthria squarrosa	1
	Sacciolepis africana	1

	Sacciolepis sp.	1
	Sacciolepis typhura	1
	Schizachyrium jeffreysii	1
	Schizachyrium sp.	1
	Schmidtia kalahariensis	1
	Schmidtia pappophoroides	1
	Setaria pumila	1
	Setaria sagittifolia	1
	Setaria sp.	1
	Setaria sphacelata	1
	Setaria verticillata	1
	Sorghastrum friesii	1
	Sorghum bicolor	1
	Sporobolus cordofanus	1
	Sporobolus festivus	1
	Sporobolus fimbriatus	1
	Sporobolus ioclados	1
	Sporobolus macranthelus	1
	Sporobolus pyramidalis	1
	Sporobolus salsus	1
	Sporobolus spicatus	1
	Stipagrostis uniplumis	1
	Trachypogon spicatus	1
	Tragus berteronianus	1
	Tragus racemosus	1
	Tricholaena monachne	1
	Triraphis schinzii	1
	Urochloa brachyura	1
	Urochloa mosambicensis	1
	Urochloa oligotricha	1
	Urochloa trichopus	1
	Vossia cuspidata	1
	Willkommia sarmentosa	1
POACEAE Total		153
POLYGALACEAE	*Polygala albida*	1
	Polygala capillaris	1
	Polygala petitiana	1
	Polygala schinziana	1
POLYGALACEAE Total		4
POLYGONACEAE	*Oxygonum delagoense*	1
	Persicaria decipiens	1
	Persicaria limbata	1
	Persicaria meisneriana	1

POLYGONACEAE Total		4
PONTEDERIACEAE	*Eichhornia natans*	1
	Heteranthera callifolia	1
PONTEDERIACEAE Total		2
PORTULACACEAE	*Portulaca hereroensis*	1
	Portulaca oleracea	1
	Talinum arnotii	1
	Talinum tenuissimum	1
PORTULACACEAE Total		4
POTAMOGETONACEAE	*Potamogeton octandrus*	1
	Potamogeton pusillus	1
	Potamogeton schweinfurthii	1
	Potamogeton thunbergii	1
POTAMOGETONACEAE Total		4
POTTIACEAE	*Didymodon ceratodonteus*	1
	Pseudocrossidium porphyreoneurum	1
POTTIACEAE Total		2
RANUNCULACEAE	*Clematis brachiata*	1
	Ranunculus rionii	1
RANUNCULACEAE Total		2
RHAMNACEAE	*Berchemia discolor*	1
	Ziziphus mucronata	1
RHAMNACEAE Total		2
RICCIACEAE	*Riccia okahandjana*	1
	Ricciocarpos natans	1
RICCIACEAE Total		2
ROSACEAE	*Rubus apetalus*	1
ROSACEAE Total		1
RUBIACEAE	*Kohautia caespitosa*	1
	Kohautia virgata	1
	Oldenlandia angolensis	1
	Oldenlandia capensis	1
	Oldenlandia corymbosa	1
	Oldenlandia lancifolia	1
	Oldenlandia sp.	1
	Pavetta harborii	1
	Pavetta zeyheri	1
	Pentodon pentandrus	1
	Richardia scabra	1
	Spermacoce quadrisulcata	1
	Spermacoce senensis	1
	Tricalysia junodii	1
	Vangueria infausta	1

RUBIACEAE Total		15
SAPINDACEAE	*Cardiospermum corundum*	1
SAPINDACEAE Total		1
SCROPHULARIACEAE	*Aptosimum decumbens*	1
	Craterostigma plantagineum	1
	Diclis petiolaris	1
	Jamesbrittenia elegantissima	1
	Limnophila ceratophylloides	1
	Limnophila indica	1
	Limosella grandiflora	1
	Torenia thouarsii	1
SCROPHULARIACEAE Total		8
SOLANACEAE	*Solanum leucophaeum*	1
	Solanum nigrum	1
	Solanum nodiflorum	1
	Solanum panduriforme	1
	Solanum sp.	1
SOLANACEAE Total		5
SPHENOCLEACEAE	*Sphenoclea zeylanica*	1
SPHENOCLEACEAE Total		1
STERCULIACEAE	*Hermannia eenii*	1
	Hermannia glanduligera	1
	Hermannia guerkeana	1
	Hermannia modesta	1
	Hermannia sp.	1
	Hermannia tomentosa	1
	Melhania acuminate	1
	Melhania didyma	1
	Melhania forbesii	1
	Waltheria indica	1
STERCULIACEAE Total		10
THELYPTERIDACEAE	*Cyclosorus interruptus*	1
	Thelypteris confluens	1
THELYPTERIDACEAE Total		2
TILIACEAE	*Corchorus tridens*	1
	Corchorus trilocularis	1
	Grewia bicolor	1
	Grewia flavescens	1
	Grewia retinervis	1
	Grewia schinzii	1
	Grewia subspathulata	1
	Triumfetta annua	1
	Triumfetta pentandra	1

TILIACEAE Total		9
TRAPACEAE	*Trapa natans*	1
	Trapa sp.	1
TRAPACEAE Total		2
TYPHACEAE	*Typha capensis*	1
TYPHACEAE Total		1
VAHLIACEAE	*Vahlia capensis*	1
	Vahlia capensis (L.f.) Thunb. subsp. vulgaris Bridson intermediate between var. vulgaris & var. linearis	1
VAHLIACEAE Total		2
VELLOZIACEAE	*Xerophyta humilis*	1
VELLOZIACEAE Total		1
VERBENACEAE	*Lantana angolensis*	1
VERBENACEAE Total		1
VITACEAE	*Cyphostemma cirrhosum*	1
	Cyphostemma congestum	1
	Cyphostemma currorii	1
VITACEAE Total		3
XYRIDACEAE	*Xyris anceps*	1
	Xyris capensis	1
XYRIDACEAE Total		2
ZYGOPHYLLACEAE	*Tribulus terrestris*	1
ZYGOPHYLLACEAE Total		1

APPENDIX 2.6: Plant species of Moremi Game Reserve (core zone of Property)

Family	Species	No. of species
ACANTHACEAE	*Asystasia gangetica*	1
	Barleria lancifolia	1
	Barleria mackenii	1
	Barleria senensis	1
	Blepharis diversispina	1
	Blepharis leendertziae	1
	Blepharis maderaspatensis	1
	Dicliptera spinulosa	1
	Hygrophila pilosa	1
	Hygrophila pobeguinii	1
	Hygrophila prunelloides	1
	Hygrophila sp.	1
	Hypoestes forskaolii	1
	Justicia anselliana	1
	Justicia betonica	1
	Justicia dinteri	1
	Justicia exigua	1
	Justicia glabra	1
	Justicia heterocarpa	1
	Justicia kirkiana	1
	Megalochlamys marlothii	1
	Monechma debile	1
	Monechma divaricatum	1
	Nelsonia canescens	1
	Peristrophe paniculata	1
	Ruellia otaviensis	1
	Ruellia patula	1
	Ruspolia decurrens	1
	Ruspolia seticalyx	1
	Thunbergia aurea	1
ACANTHACEAE Total		30
AIZOACEAE	*Trianthema salsoloides*	1
	Zaleya pentandra	1
AIZOACEAE Total		2
ALISMATACEAE	*Caldesia reniformis*	1
	Limnophyton angolense	1
	Wiesneria schweinfurthii	1
ALISMATACEAE Total		3
AMARANTHACEAE	*Achyranthes aspera*	1
	Aerva javanica	1
	Aerva lanata	1
	Aerva leucura	1
	Alternanthera pungens	1
	Alternanthera sessilis	1
	Amaranthus praetermissus	1
	Amaranthus standleyanus	1
	Amaranthus thunbergii	1
	Celosia trigyna	1
	Cyathula orthacantha	1
	Gomphrena celosioides	1
	Guilleminea densa	1
	Hermbstaedtia scabra	1
	Kyphocarpa angustifolia	1
	Pupalia lappacea	1
AMARANTHACEAE Total		16
AMARYLLIDACEAE	*Ammocharis tinneana*	1
	Crinum carolo-schmidtii	1
	Crinum crassicaule	1
	Pancratium tenuifolium	1
	Scadoxus multiflorus	1
AMARYLLIDACEAE Total		5
ANACARDIACEAE	*Rhus tenuinervis*	1
	Sclerocarya birrea	1
ANACARDIACEAE Total		2
ANTHERICACEAE	*Chlorophytum longifolium*	1
ANTHERICACEAE Total		1
APIACEAE	*Hydrocotyle verticillata*	1
APIACEAE Total		1
APOCYNACEAE	*Carissa edulis*	1
	Cynanchum schistoglossum	1
	Gomphocarpus fruticosus	1
	Gomphocarpus tomentosus	1
	Marsdenia macrantha	1
	Marsdenia sylvestris	1
	Pergularia daemia	1
	Pergularia sp.	1
	Periglossum mossambicense	1
	Sarcostemma viminale	1
	Tacazzea apiculata	1
APOCYNACEAE Total		11
ASPARAGACEAE	*Asparagus nelsii*	1
	Asparagus nodulosus	1
	Asparagus racemosus	1

	Protasparagus exuvialis	1
ASPARAGACEAE Total		4
ASPHODELACEAE	*Aloe greatheadii*	1
	Aloe zebrina	1
	Trachyandra laxa	1
ASPHODELACEAE Total		3
ASTERACEAE	*Acanthospermum hispidum*	1
	Adenostemma caffrum	1
	Baccharoides anthelmintica	1
	Bidens pilosa	1
	Bidens schimperi	1
	Blainvillea gayana	1
	Conyza aegyptiaca	1
	Conyza albida	1
	Crassocephalum x picridifolium	1
	Dicoma schinzii	1
	Dicoma tomentosa	1
	Distephanus divaricatus	1
	Eclipta prostrata	1
	Ethulia conyzoides	1
	Galinsoga parviflora	1
	Helichrysum stenopterum	1
	Hirpicium gorterioides	1
	Laggera crispata	1
	Laggera decurrens	1
	Launaea rarifolia	1
	Litogyne gariepina	1
	Melanthera scandens	1
	Melanthera triternata	1
	Mikania sagittifera	1
	Nicolasia costata	1
	Nidorella resedifolia	1
	Nolletia ciliaris	1
	Pechuel-Loeschea leubnitziae	1
	Pegolettia senegalensis	1
	Philyrophyllum schinzii	1
	Pseudoconyza viscosa	1
	Schkuhria pinnata	1
	Senecio abruptus	1
	Senecio leptocephalus	1
	Senecio strictifolius	1
	Sonchus asper	1
	Sonchus oleraceus	1

	Sphaeranthus flexuosus	1
	Sphaeranthus peduncularis	1
	Vernonia amygdalina	1
	Vernonia fastigiata	1
	Vernonia glabra	1
	Xanthium strumarium	1
ASTERACEAE Total		43
AZOLLACEAE	*Azolla pinnata*	1
AZOLLACEAE Total		1
BALANITACEAE	*Balanites aegyptiaca*	1
BALANITACEAE Total		1
BARTRAMIACEAE	*Philonotis dregeana*	1
	Philonotis falcata	1
	Philonotis hastata	1
BARTRAMIACEAE Total		3
BIGNONIACEAE	*Kigelia africana*	1
	Markhamia zanzibarica	1
	Rhigozum brevispinosum	1
BIGNONIACEAE Total		3
BOMBACACEAE	*Adansonia digitata*	1
BOMBACACEAE Total		1
BORAGINACEAE	*Cordia sinensis*	1
	Ehretia amoena	1
	Ehretia obtusifolia	1
	Heliotropium ovalifolium	1
	Heliotropium strigosum	1
	Heliotropium zeylanicum	1
BORAGINACEAE Total		6
BRASSICACEAE	*Coronopus integrifolius*	1
BRASSICACEAE Total		1
BURSERACEAE	*Commiphora africana*	1
	Commiphora glandulosa	1
BURSERACEAE Total		2
CABOMBACEAE	*Brasenia schreberi*	1
CABOMBACEAE Total		1
CAMPANULACEAE	*Wahlenbergia banksiana*	1
	Wahlenbergia napiformis	1
CAMPANULACEAE Total		2
CAPPARACEAE	*Boscia albitrunca*	1
	Boscia matabelensis	1
	Boscia mossambicensis	1
	Capparis tomentosa	1
	Cleome hirta	1

	Cleome rubella	1
CAPPARACEAE Total		6
CARYOPHYLLACEAE	*Pollichia campestris*	1
	Polycarpaea corymbosa	1
CARYOPHYLLACEAE Total		2
CELASTRACEAE	*Gymnosporia senegalensis*	1
CELASTRACEAE Total		1
CERATOPHYLLACEAE	*Ceratophyllum demersum*	1
	Ceratophyllum sp.	1
CERATOPHYLLACEAE Total		2
CHENOPODIACEAE	*Chenopodium album*	1
	Chenopodium ambrosioides	1
	Chenopodium olukondae	1
	Chenopodium opulifolium	1
CHENOPODIACEAE Total		4
CLUSIACEAE	*Garcinia livingstonei*	1
CLUSIACEAE Total		1
COLCHICACEAE	*Camptorrhiza strumosa*	1
	Gloriosa superba	1
COLCHICACEAE Total		2
COMBRETACEAE	*Combretum albopunctatum*	1
	Combretum apiculatum	1
	Combretum collinum	1
	Combretum hereroense	1
	Combretum imberbe	1
	Combretum mossambicense	1
	Combretum psidioides	1
	Combretum sp.	1
	Combretum zeyheri	1
	Terminalia prunioides	1
	Terminalia sericea	1
COMBRETACEAE Total		11
COMMELINACEAE	*Commelina africana*	1
	Commelina benghalensis	1
	Commelina diffusa	1
	Commelina erecta	1
	Commelina forskaolii	1
	Commelina subulata	1
	Commelina zambesica	1
	Cyanotis foecunda	1
	Floscopa glomerata	1
COMMELINACEAE Total		9
CONVOLVULACEAE	*Astripomoea lachnosperma*	1

	Evolvulus alsinoides	1
	Ipomoea dichroa	1
	Ipomoea eriocarpa	1
	Ipomoea magnusiana	1
	Ipomoea obscura	1
	Ipomoea pes-tigridis	1
	Ipomoea plebeia	1
	Ipomoea rubens	1
	Ipomoea sinensis	1
	Xenostegia tridentata	1
CONVOLVULACEAE Total		11
CRASSULACEAE	*Kalanchoe brachyloba*	1
	Kalanchoe lanceolata	1
CRASSULACEAE Total		2
CUCURBITACEAE	*Acanthosicyos naudinianus*	1
	Coccinia sessilifolia	1
	Corallocarpus bainesii	1
	Corallocarpus triangularis	1
	Cucumis anguria	1
	Kedrostis crassirostrata	1
	Kedrostis foetidissima	1
	Lagenaria siceraria	1
	Lagenaria sphaerica	1
	Momordica balsamina	1
	Oreosyce africana	1
	Zehneria marlothii	1
CUCURBITACEAE Total		12
CYPERACEAE	*Bolboschoenus glaucus*	1
	Bulbostylis burchellii	1
	Bulbostylis contexta	1
	Bulbostylis hispidula	1
	Bulbostylis trabeculata	1
	Carex cognata	1
	Cladium mariscus	1
	Courtoisia sp.	1
	Courtoisina cyperoides	1
	Cyperus articulatus	1
	Cyperus compressus	1
	Cyperus cyperoides	1
	Cyperus denudatus	1
	Cyperus difformis	1
	Cyperus digitatus	1
	Cyperus dives	1

	Cyperus dubius	1
	Cyperus esculentus	1
	Cyperus fulgens	1
	Cyperus laevigatus	1
	Cyperus longus	1
	Cyperus maculatus	1
	Cyperus margaritaceus	1
	Cyperus mwinilungensis	1
	Cyperus papyrus	1
	Cyperus pectinatus	1
	Cyperus rotundas	1
	Cyperus sp.	1
	Cyperus sphaerospermus	1
	Cyperus squarrosus	1
	Cyperus tenuispica	1
	Cyperus turrillii	1
	Cyperus zollingeri	1
	Eleocharis acutangula	1
	Eleocharis atropurpurea	1
	Eleocharis caduca	1
	Eleocharis delis	1
	Eleocharis naumanniana	1
	Eleocharis retroflexa	1
	Eleocharis sp.	1
	Eleocharis variegata	1
	Fimbristylis complanata	1
	Fimbristylis dichotoma	1
	Fimbristylis squarrosa	1
	Fuirena ciliaris	1
	Fuirena leptostachya	1
	Fuirena pubescens	1
	Fuirena stricta	1
	Fuirena umbellata	1
	Kyllinga alba	1
	Kyllinga erecta	1
	Kyllinga intricata	1
	Lipocarpha abietina	1
	Lipocarpha chinensis	1
	Lipocarpha hemisphaerica	1
	Mariscus hamulosus	1
	Oxycaryum cubense	1
	Pycreus aethiops	1
	Pycreus chrysanthus	1

	Pycreus flavescens	1
	Pycreus macranthus	1
	Pycreus macrostachyos	1
	Pycreus mundii	1
	Pycreus nitidus	1
	Pycreus pelophilus	1
	Pycreus polystachyos	1
	Pycreus unioloides	1
	Rhynchospora brownii	1
	Rhynchospora candida	1
	Rhynchospora corymbosa	1
	Rhynchospora holoschoenoides	1
	Rhynchospora perrieri	1
	Schoenoplectus brachyceras	1
	Schoenoplectus corymbosus	1
	Schoenoplectus erectus	1
	Schoenoplectus lateriflorus	1
	Schoenoplectus muricinux	1
	Schoenoplectus senegalensis	1
	Schoenoplectus sp.	1
	Scleria distans	1
	Scleria dregeana	1
	Scleria lacustris	1
	Scleria melanomphala	1
	Scleria sp.	1
	Scleria unguiculata	1
	Websteria confervoides	1
CYPERACEAE Total		86
DRACAENACEAE	*Sansevieria aethiopica*	1
DRACAENACEAE Total		1
DROSERACEAE	*Aldrovanda vesiculosa*	1
	Drosera madagascariensis	1
DROSERACEAE Total		2
EBENACEAE	*Diospyros mespiliformis*	1
	Euclea divinorum	1
	Euclea sp.	1
	Euclea undulata	1
EBENACEAE Total		4
ELATINACEAE	*Bergia pentheriana*	1
	Bergia polyantha	1
	Bergia sp.	1
	Elatine ambigua	1
ELATINACEAE Total		4

ERIOCAULACEAE	*Eriocaulon setaceum*	1
	Eriocaulon welwitschii	1
ERIOCAULACEAE Total		2
ERIOSPERMACEAE	*Eriospermum bakerianum*	1
ERIOSPERMACEAE Total		1
ERPODIACEAE	*Erpodium beccarii*	1
ERPODIACEAE Total		1
EUPHORBIACEAE	*Acalypha indica*	1
	Acalypha villicaulis	1
	Antidesma venosum	1
	Cephalocroton mollis	1
	Croton gratissimus	1
	Croton megalobotrys	1
	Euphorbia crotonoides	1
	Euphorbia inaequilatera	1
	Euphorbia indica	1
	Euphorbia mossambicensis	1
	Euphorbia prostrata	1
	Flueggea virosa	1
	Phyllanthus burchellii	1
	Phyllanthus fraternus	1
	Phyllanthus parvulus	1
	Phyllanthus pentandrus	1
	Phyllanthus reticulatus	1
	Pterococcus africanus	1
	Tragia okanyua	1
EUPHORBIACEAE Total		19
FABACEAE	*Abrus precatorius*	1
	Acacia erioloba	1
	Acacia fleckii	1
	Acacia galpinii	1
	Acacia hebeclada	1
	Acacia karroo	1
	Acacia luederitzii	1
	Acacia nigrescens	1
	Acacia sieberiana	1
	Acacia sp.	1
	Acacia tortilis	1
	Aeschynomene fluitans	1
	Aeschynomene indica	1
	Albizia harveyi	1
	Bolusia sp.	1
	Chamaecrista absus	1

	Chamaecrista biensis	1
	Chamaecrista capensis	1
	Chamaecrista falcinella	1
	Colophospermum mopane	1
	Crotalaria barkae	1
	Crotalaria laburnifolia	1
	Crotalaria platysepala	1
	Crotalaria sp.	1
	Crotalaria spartioides	1
	Crotalaria steudneri	1
	Dichrostachys cinerea	1
	Elephantorrhiza goetzei	1
	Indigastrum parviflorum	1
	Indigofera astragalina	1
	Indigofera bainesii	1
	Indigofera charlieriana	1
	Indigofera colutea	1
	Indigofera daleoides	1
	Indigofera filipes	1
	Indigofera flavicans	1
	Indigofera praticola	1
	Indigofera sp.	1
	Indigofera tinctoria	1
	Lessertia benguellensis	1
	Lonchocarpus nelsii	1
	Neonotonia wightii	1
	Neorautanenia amboensis	1
	Neptunia oleracea	1
	Philenoptera nelsii	1
	Philenoptera violacea	1
	Piliostigma thonningii	1
	Requienia sphaerosperma	1
	Rhynchosia minima	1
	Rhynchosia sp.	1
	Rhynchosia totta	1
	Sesbania bispinosa	1
	Sesbania cinerascens	1
	Sesbania rostrata	1
	Tephrosia lupinifolia	1
	Tephrosia purpurea	1
	Vigna luteola	1
	Vigna oblongifolia	1
	Vigna unguiculata	1

	Zornia glochidiata	1
FABACEAE Total		60
FABRONIACEAE	*Fabronia pilifera*	1
FABRONIACEAE Total		1
GENTIANACEAE	*Enicostema axillare*	1
	Sebaea junodii	1
GENTIANACEAE Total		2
GERANIACEAE	*Monsonia angustifolia*	1
GERANIACEAE Total		1
GISEKIACEAE	*Gisekia africana*	1
	Gisekia pharnacioides	1
GISEKIACEAE Total		2
HALORAGACEAE	*Laurembergia repens*	1
	Laurembergia sp.	1
	Myriophyllum spicatum	1
HALORAGACEAE Total		3
HYACINTHACEAE	*Albuca abyssinica*	1
	Albuca sp.	1
	Dipcadi glaucum	1
	Dipcadi longifolium	1
	Dipcadi sp.	1
	Drimia indica	1
	Drimia sanguinea	1
	Drimia uniflora	1
	Ledebouria marginata	1
HYACINTHACEAE Total		9
HYDROCHARITACEAE	*Lagarosiphon cordofanus*	1
	Lagarosiphon ilicifolius	1
	Ottelia kunenensis	1
	Ottelia muricata	1
	Ottelia ulvifolia	1
	Vallisneria aethiopica	1
	Vallisneria spiralis	1
HYDROCHARITACEAE Total		7
IRIDACEAE	*Lapeirousia schimperi*	1
IRIDACEAE Total		1
KIRKIACEAE	*Kirkia acuminata*	1
KIRKIACEAE Total		1
LAMIACEAE	*Acrotome inflata*	1
	Clerodendrum ternatum	1
	Hemizygia bracteosa	1
	Hemizygia petrensis	1
	Hoslundia opposita	1

	Hyptis pectinata	1
	Leonotis nepetifolia	1
	Leucas martinicensis	1
	Neohyptis paniculata	1
	Ocimum americanum	1
	Plectranthus tetragonus	1
	Pycnostachys coerulea	1
	Rotheca uncinata	1
LAMIACEAE Total		13
LAURACEAE	*Cassytha filiformis*	1
LAURACEAE Total		1
LEMNACEAE	*Lemna aequinoctialis*	1
	Lemna gibba	1
	Wolffiella welwitschii	1
LEMNACEAE Total		3
LENTIBULARIACEAE	*Utricularia benjaminiana*	1
	Utricularia foliosa	1
	Utricularia gibba	1
	Utricularia inflexa	1
	Utricularia reflexa	1
	Utricularia scandens	1
	Utricularia sp.	1
	Utricularia stellaris	1
LENTIBULARIACEAE Total		8
LORANTHACEAE	*Plicosepalus kalachariensis*	1
	Tapinanthus oleifolius	1
LORANTHACEAE Total		2
LYTHRACEAE	*Ammannia auriculata*	1
	Nesaea crassicaulis	1
	Nesaea ondongana	1
	Nesaea radicans	1
	Rotala dinteri	1
	Rotala filiformis	1
	Rotala myriophylloides	1
	Rotala sp.	1
LYTHRACEAE Total		8
MALPIGHIACEAE	*Sphedamnocarpus pruriens*	1
MALPIGHIACEAE Total		1
MALVACEAE	*Abutilon angulatum*	1
	Abutilon austro-africanum	1
	Abutilon engleranum	1
	Abutilon englerianum	1
	Abutilon ramosum	1

	Gossypium herbaceum	1
	Hibiscus calyphyllus	1
	Hibiscus cannabinus	1
	Hibiscus diversifolius	1
	Hibiscus dongolensis	1
	Hibiscus schinzii	1
	Hibiscus sidiformis	1
	Hibiscus sp.	1
	Kosteletzkya buettneri	1
	Pavonia burchellii	1
	Pavonia senegalensis	1
	Sida cordifolia	1
	Wissadula rostrata	1
MALVACEAE Total		18
MARSILEACEAE	*Marsilea coromandelina*	1
	Marsilea minuta	1
	Marsilea nubica	1
	Marsilea sp.	1
	Marsilea villifolia	1
MARSILEACEAE Total		5
MELASTOMATACEAE	*Antherotoma debilis*	1
MELASTOMATACEAE Total		1
MENISPERMACEAE	*Cissampelos mucronata*	1
	Cocculus hirsutus	1
MENISPERMACEAE Total		2
MENYANTHACEAE	*Nymphoides indica*	1
	Nymphoides rautanenii	1
	Nymphoides thunbergiana	1
MENYANTHACEAE Total		3
MOLLUGINACEAE	*Glinus bainesii*	1
	Glinus oppositifolius	1
	Limeum fenestratum	1
	Mollugo cerviana	1
	Mollugo nudicaulis	1
MOLLUGINACEAE Total		5
MORACEAE	*Ficus capreifolia*	1
	Ficus pygmaea	1
	Ficus verruculosa	1
MORACEAE Total		3
MYRICACEAE	*Morella serrata*	1
	Myrica serrata	1
MYRICACEAE Total		2
MYRTACEAE	*Syzygium intermedium*	1

MYRTACEAE Total		1
NAJADACEAE	*Najas horrida*	1
NAJADACEAE Total		1
NYCTAGINACEAE	*Boerhavia coccinea*	1
	Boerhavia diffusa	1
	Commicarpus pilosus	1
	Commicarpus plumbagineus	1
NYCTAGINACEAE Total		4
NYMPHAEACEAE	*Nymphaea lotus*	1
	Nymphaea nouchali	1
NYMPHAEACEAE Total		2
OCHNACEAE	*Ochna pulchra*	1
OCHNACEAE Total		1
OLACACEAE	*Ximenia americana*	1
OLACACEAE Total		1
OLEACEAE	*Jasminum fluminense*	1
	Jasminum stenolobum	1
OLEACEAE Total		2
ONAGRACEAE	*Ludwigia abyssinica*	1
	Ludwigia adscendens	1
	Ludwigia leptocarpa	1
	Ludwigia octovalvis	1
	Ludwigia sp.	1
	Ludwigia stenorraphe	1
ONAGRACEAE Total		6
ORCHIDACEAE	*Eulophia horsfallii*	1
	Eulophia kyimbilae	1
	Eulophia latilabris	1
	Habenaria filicornis	1
	Habenaria ichneumonea	1
ORCHIDACEAE Total		5
OROBANCHACEAE	*Alectra orobanchoides*	1
	Buchnera randii	1
	Buchnera simplex	1
	Cycnium tubulosum	1
	Rhamphicarpa fistulosa	1
	Sopubia mannii	1
	Striga asiatica	1
OROBANCHACEAE Total		7
OXALIDACEAE	*Oxalis corniculata*	1
OXALIDACEAE Total		1
PAPAVERACEAE	*Argemone ochroleuca*	1
PAPAVERACEAE Total		1

PARKERIACEAE	*Ceratopteris thalictroides*	1
PARKERIACEAE Total		1
PEDALIACEAE	*Dicerocaryum eriocarpum*	1
	Harpagophytum procumbens	1
	Sesamum alatum	1
	Sesamum triphyllum	1
PEDALIACEAE Total		4
PLUMBAGINACEAE	*Plumbago zeylanica*	1
PLUMBAGINACEAE Total		1
POACEAE	*Acrachne racemosa*	1
	Andropogon eucomus	1
	Andropogon gayanus	1
	Andropogon huillensis	1
	Andropogon laxatus	1
	Anthephora pubescens	1
	Aristida adscensionis	1
	Aristida junciformis	1
	Aristida meridionalis	1
	Aristida pilgeri	1
	Aristida scabrivalvis	1
	Aristida sp.	1
	Aristida spectabilis	1
	Aristida stipitata	1
	Aristida stipoides	1
	Bothriochloa bladhii	1
	Brachiaria arrecta	1
	Brachiaria deflexa	1
	Brachiaria dura	1
	Brachiaria grossa	1
	Brachiaria humidicola	1
	Brachiaria nigropedata	1
	Brachiaria sp.	1
	Brachiaria xantholeuca	1
	Cenchrus ciliaris	1
	Chloris gayana	1
	Chloris virgata	1
	Chrysopogon nigritanus	1
	Cortaderia jubata	1
	Cymbopogon caesius	1
	Cymbopogon excavatus	1
	Cynodon dactylon	1
	Dactyloctenium aegyptium	1
	Dactyloctenium giganteum	1

	Diandrochloa namaquensis	1
	Dichanthium annulatum	1
	Digitaria debilis	1
	Digitaria eriantha	1
	Digitaria eylesii	1
	Digitaria milanjiana	1
	Digitaria sanguinalis	1
	Digitaria seriata	1
	Digitaria velutina	1
	Echinochloa colona	1
	Echinochloa haploclada	1
	Echinochloa holubii	1
	Echinochloa jubata	1
	Echinochloa pyramidalis	1
	Echinochloa stagnina	1
	Elymandra grallata	1
	Scleria sp.	1
	Scleria unguiculata	1
	Websteria confervoides	1
CYPERACEAE Total		86
DRACAENACEAE	*Sansevieria aethiopica*	1
DRACAENACEAE Total		1
DROSERACEAE	*Aldrovanda vesiculosa*	1
	Drosera madagascariensis	1
DROSERACEAE Total		2
EBENACEAE	*Diospyros mespiliformis*	1
	Euclea divinorum	1
	Euclea sp.	1
	Euclea undulata	1
EBENACEAE Total		4
ELATINACEAE	*Bergia pentheriana*	1
	Bergia polyantha	1
	Bergia sp.	1
	Elatine ambigua	1
ELATINACEAE Total		4
ERIOCAULACEAE	*Eriocaulon setaceum*	1
	Eriocaulon welwitschii	1
ERIOCAULACEAE Total		2
ERIOSPERMACEAE	*Eriospermum bakerianum*	1
ERIOSPERMACEAE Total		1
ERPODIACEAE	*Erpodium beccarii*	1
ERPODIACEAE Total		1
EUPHORBIACEAE	*Acalypha indica*	1

	Acalypha villicaulis	1
	Antidesma venosum	1
	Cephalocroton mollis	1
	Croton gratissimus	1
	Croton megalobotrys	1
	Euphorbia crotonoides	1
	Euphorbia inaequilatera	1
	Euphorbia indica	1
	Euphorbia mossambicensis	1
	Euphorbia prostrata	1
	Flueggea virosa	1
	Phyllanthus burchellii	1
	Phyllanthus fraternus	1
	Phyllanthus parvulus	1
	Phyllanthus pentandrus	1
	Phyllanthus reticulatus	1
	Pterococcus africanus	1
	Tragia okanyua	1
EUPHORBIACEAE Total		19
FABACEAE	*Abrus precatorius*	1
	Acacia erioloba	1
	Acacia fleckii	1
	Acacia galpinii	1
	Acacia hebeclada	1
	Acacia karroo	1
	Acacia luederitzii	1
	Acacia nigrescens	1
	Acacia sieberiana	1
	Acacia sp.	1
	Acacia tortilis	1
	Aeschynomene fluitans	1
	Aeschynomene indica	1
	Albizia harveyi	1
	Bolusia sp.	1
	Chamaecrista absus	1
	Chamaecrista biensis	1
	Chamaecrista capensis	1
	Chamaecrista falcinella	1
	Colophospermum mopane	1
	Crotalaria barkae	1
	Crotalaria laburnifolia	1
	Crotalaria platysepala	1
	Crotalaria sp.	1

	Crotalaria spartioides	1
	Crotalaria steudneri	1
	Dichrostachys cinerea	1
	Elephantorrhiza goetzei	1
	Indigastrum parviflorum	1
	Indigofera astragalina	1
	Indigofera bainesii	1
	Indigofera charlieriana	1
	Indigofera colutea	1
	Indigofera daleoides	1
	Indigofera filipes	1
	Indigofera flavicans	1
	Indigofera praticola	1
	Indigofera sp.	1
	Indigofera tinctoria	1
	Lessertia benguellensis	1
	Lonchocarpus nelsii	1
	Neonotonia wightii	1
	Neorautanenia amboensis	1
	Neptunia oleracea	1
	Philenoptera nelsii	1
	Philenoptera violacea	1
	Piliostigma thonningii	1
	Requienia sphaerosperma	1
	Rhynchosia minima	1
	Rhynchosia sp.	1
	Rhynchosia totta	1
	Sesbania bispinosa	1
	Sesbania cinerascens	1
	Sesbania rostrata	1
	Tephrosia lupinifolia	1
	Tephrosia purpurea	1
	Vigna luteola	1
	Vigna oblongifolia	1
	Vigna unguiculata	1
	Zornia glochidiata	1
FABACEAE Total		60
FABRONIACEAE	*Fabronia pilifera*	1
FABRONIACEAE Total		1
GENTIANACEAE	*Enicostema axillare*	1
	Sebaea junodii	1
GENTIANACEAE Total		2
GERANIACEAE	*Monsonia angustifolia*	1

GERANIACEAE Total		1
GISEKIACEAE	*Gisekia africana*	1
	Gisekia pharnacioides	1
GISEKIACEAE Total		2
HALORAGACEAE	*Laurembergia repens*	1
	Laurembergia sp.	1
	Myriophyllum spicatum	1
HALORAGACEAE Total		3
HYACINTHACEAE	*Albuca abyssinica*	1
	Albuca sp.	1
	Dipcadi glaucum	1
	Dipcadi longifolium	1
	Dipcadi sp.	1
	Drimia indica	1
	Drimia sanguinea	1
	Drimia uniflora	1
	Ledebouria marginata	1
HYACINTHACEAE Total		9
HYDROCHARITACEAE	*Lagarosiphon cordofanus*	1
	Lagarosiphon ilicifolius	1
	Ottelia kunenensis	1
	Ottelia muricata	1
	Ottelia ulvifolia	1
	Vallisneria aethiopica	1
	Vallisneria spiralis	1
HYDROCHARITACEAE Total		7
IRIDACEAE	*Lapeirousia schimperi*	1
IRIDACEAE Total		1
KIRKIACEAE	*Kirkia acuminata*	1
KIRKIACEAE Total		1
LAMIACEAE	*Acrotome inflata*	1
	Clerodendrum ternatum	1
	Hemizygia bracteosa	1
	Hemizygia petrensis	1
	Hoslundia opposita	1
	Hyptis pectinata	1
	Leonotis nepetifolia	1
	Leucas martinicensis	1
	Neohyptis paniculata	1
	Ocimum americanum	1
	Plectranthus tetragonus	1
	Pycnostachys coerulea	1
	Rotheca uncinata	1

LAMIACEAE Total		13
LAURACEAE	*Cassytha filiformis*	1
LAURACEAE Total		1
LEMNACEAE	*Lemna aequinoctialis*	1
	Lemna gibba	1
	Wolffiella welwitschii	1
LEMNACEAE Total		3
LENTIBULARIACEAE	*Utricularia benjaminiana*	1
	Utricularia foliosa	1
	Utricularia gibba	1
	Utricularia inflexa	1
	Utricularia reflexa	1
	Utricularia scandens	1
	Utricularia sp.	1
	Utricularia stellaris	1
LENTIBULARIACEAE Total		8
LORANTHACEAE	*Plicosepalus kalachariensis*	1
	Tapinanthus oleifolius	1
LORANTHACEAE Total		2
LYTHRACEAE	*Ammannia auriculata*	1
	Nesaea crassicaulis	1
	Nesaea ondongana	1
	Nesaea radicans	1
	Rotala dinteri	1
	Rotala filiformis	1
	Rotala myriophylloides	1
	Rotala sp.	1
LYTHRACEAE Total		8
MALPIGHIACEAE	*Sphedamnocarpus pruriens*	1
MALPIGHIACEAE Total		1
MALVACEAE	*Abutilon angulatum*	1
	Abutilon austro-africanum	1
	Abutilon engleranum	1
	Abutilon englerianum	1
	Abutilon ramosum	1
	Gossypium herbaceum	1
	Hibiscus calyphyllus	1
	Hibiscus cannabinus	1
	Hibiscus diversifolius	1
	Hibiscus dongolensis	1
	Hibiscus schinzii	1
	Hibiscus sidiformis	1
	Hibiscus sp.	1

	Kosteletzkya buettneri	1
	Pavonia burchellii	1
	Pavonia senegalensis	1
	Sida cordifolia	1
	Wissadula rostrata	1
MALVACEAE Total		18
MARSILEACEAE	*Marsilea coromandelina*	1
	Marsilea minuta	1
	Marsilea nubica	1
	Marsilea sp.	1
	Marsilea villifolia	1
MARSILEACEAE Total		5
MELASTOMATACEAE	*Antherotoma debilis*	1
MELASTOMATACEAE Total		1
MENISPERMACEAE	*Cissampelos mucronata*	1
	Cocculus hirsutus	1
MENISPERMACEAE Total		2
MENYANTHACEAE	*Nymphoides indica*	1
	Nymphoides rautanenii	1
	Nymphoides thunbergiana	1
MENYANTHACEAE Total		3
MOLLUGINACEAE	*Glinus bainesii*	1
	Glinus oppositifolius	1
	Limeum fenestratum	1
	Mollugo cerviana	1
	Mollugo nudicaulis	1
MOLLUGINACEAE Total		5
MORACEAE	*Ficus capreifolia*	1
	Ficus pygmaea	1
	Ficus verruculosa	1
MORACEAE Total		3
MYRICACEAE	*Morella serrata*	1
	Myrica serrata	1
MYRICACEAE Total		2
MYRTACEAE	*Syzygium intermedium*	1
MYRTACEAE Total		1
NAJADACEAE	*Najas horrida*	1
NAJADACEAE Total		1
NYCTAGINACEAE	*Boerhavia coccinea*	1
	Boerhavia diffusa	1
	Commicarpus pilosus	1
	Commicarpus plumbagineus	1
NYCTAGINACEAE Total		4

NYMPHAEACEAE	*Nymphaea lotus*	1
	Nymphaea nouchali	1
NYMPHAEACEAE Total		2
OCHNACEAE	*Ochna pulchra*	1
OCHNACEAE Total		1
OLACACEAE	*Ximenia americana*	1
OLACACEAE Total		1
OLEACEAE	*Jasminum fluminense*	1
	Jasminum stenolobum	1
OLEACEAE Total		2
ONAGRACEAE	*Ludwigia abyssinica*	1
	Ludwigia adscendens	1
	Ludwigia leptocarpa	1
	Ludwigia octovalvis	1
	Ludwigia sp.	1
	Ludwigia stenorraphe	1
ONAGRACEAE Total		6
ORCHIDACEAE	*Eulophia horsfallii*	1
	Eulophia kyimbilae	1
	Eulophia latilabris	1
	Habenaria filicornis	1
	Habenaria ichneumonea	1
ORCHIDACEAE Total		5
OROBANCHACEAE	*Alectra orobanchoides*	1
	Buchnera randii	1
	Buchnera simplex	1
	Cycnium tubulosum	1
	Rhamphicarpa fistulosa	1
	Sopubia mannii	1
	Striga asiatica	1
OROBANCHACEAE Total		7
OXALIDACEAE	*Oxalis corniculata*	1
OXALIDACEAE Total		1
PAPAVERACEAE	*Argemone ochroleuca*	1
PAPAVERACEAE Total		1
PARKERIACEAE	*Ceratopteris thalictroides*	1
PARKERIACEAE Total		1
PEDALIACEAE	*Dicerocaryum eriocarpum*	1
	Harpagophytum procumbens	1
	Sesamum alatum	1
	Sesamum triphyllum	1
PEDALIACEAE Total		4
PLUMBAGINACEAE	*Plumbago zeylanica*	1

PLUMBAGINACEAE Total		1
POACEAE	*Acrachne racemosa*	1
	Andropogon eucomus	1
	Andropogon gayanus	1
	Andropogon huillensis	1
	Andropogon laxatus	1
	Anthephora pubescens	1
	Aristida adscensionis	1
	Aristida junciformis	1
	Aristida meridionalis	1
	Aristida pilgeri	1
	Aristida scabrivalvis	1
	Aristida sp.	1
	Aristida spectabilis	1
	Aristida stipitata	1
	Aristida stipoides	1
	Bothriochloa bladhii	1
	Brachiaria arrecta	1
	Brachiaria deflexa	1
	Brachiaria dura	1
	Brachiaria grossa	1
	Brachiaria humidicola	1
	Brachiaria nigropedata	1
	Brachiaria sp.	1
	Brachiaria xantholeuca	1
	Cenchrus ciliaris	1
	Chloris gayana	1
	Chloris virgata	1
	Chrysopogon nigritanus	1
	Cortaderia jubata	1
	Cymbopogon caesius	1
	Cymbopogon excavatus	1
	Cynodon dactylon	1
	Dactyloctenium aegyptium	1
	Dactyloctenium giganteum	1
	Diandrochloa namaquensis	1
	Dichanthium annulatum	1
	Digitaria debilis	1
	Digitaria eriantha	1
	Digitaria eylesii	1
	Digitaria milanjiana	1
	Digitaria sanguinalis	1
	Digitaria seriata	1

	Digitaria velutina	1
	Echinochloa colona	1
	Echinochloa haploclada	1
	Echinochloa holubii	1
	Echinochloa jubata	1
	Echinochloa pyramidalis	1
	Echinochloa stagnina	1
	Elymandra grallata	1

APPENDIX 2.7:Tables of Protected or Listed Species in Botswana

Please refer to the Report "United Nations Development Program Endangered Species Management Policy". October 2007. Government of Botswana /UNDP/KGMG/EWT.

Due to the size of this document is burnt to CD # 1 as a digital copy, together with digital pdf copies of the maps relating to the property, and a copy of the reference book "Okavango, Floods of Life" by Mendelsohn et al 2010.

For additional information on the Okavango Delta Property, also refer to the following documents:

a. IUCN - Global Status according to the IUCN Red Data List of 2007, including the criteria upon which this listing is based
b. CITES Status in terms of threats through trade according to the CITES database for Botswana (http://www.cites.org/eng/resources/species.html, 1 October 07)
c. GoB Status under Schedule 6 and Schedule 7 Part I of the Wildlife and National Parks Act of 1992.

APPENDIX 3: AERIAL SURVEY DATA OF SPECIES

Below are population estimate results of the aerial surveys which were carried out by the Department of Wildlife and National Parks between 2001 and 2006 (Table3.1- 3.4) for the property.

Table 3.1: 2001 Dry season Aerial Survey results for Block 27D DELTA

BLOCK AREA: 17 118 km²					sampling intensity: 7.01 %				
136139 units of biomass in area @ 7.95 Livestock Units/km²									
ESTIMATES:									
SPECIES	EST.NO.	95%CL %EST	95% RANGE		NO.	DENS/ km	BIOMAS LU/km	%BIO MASS	S.E.
ELEPHANT	18175	32	12273	24078	1274	1.062	2.91	36.58	2891
ZEBRA	8745	49	4476	13015	613	0.511	0.28	3.49	2091
ELEPHANT F	11342	49	5763	16921	795	0.663	0.00	0.00	2732
HIPPO	1427	70	428	2426	100	0.083	0.15	1.89	489
WARTHOG	1227	47	654	1800	86	0.072	0.01	0.16	281
ELEPHANT M	2397	33	1612	3181	168	0.140	0.00	0.00	384
GIRAFFE	5207	29	3693	6722	365	0.304	0.45	5.61	742
ELAND	29	196	2	84	2	0.002	0.00	0.02	27
KUDU	1255	43	718	1792	88	0.073	0.03	0.38	263
SITATUNGA	285	51	140	431	20	0.017	0.00	0.05	71
GEMSBOK	71	200	5	214	5	0.004	0.00	0.02	70
ROAN	185	180	13	519	13	0.011	0.01	0.08	163
SABLE	57	156	4	146	4	0.003	0.00	0.02	44
WATERBUCK	542	108	38	1125	38	0.032	0.01	0.16	285
LECHWE	49690	50	24904	74476	3483	2.903	0.73	9.23	12138
REEDBUCK	128	83	21	235	9	0.008	0.00	0.02	52
TSESEBE	2825	38	1754	3895	198	0.165	0.06	0.72	524
WILDEBEEST	6292	62	2368	10215	441	0.368	0.17	2.18	1921
IMPALA	19103	29	13607	24599	1339	1.116	0.20	2.50	2691
KLIPSPRING	29	139	2	68	2	0.002	0.00	0.00	19
STEENBOK	114	131	8	264	8	0.007	0.00	0.00	73
BUFFALO	41373	100	2900	82716	2900	2.417	2.42	30.39	20247
BABOON	4094	69	1250	6939	287	0.239	0.00	0.00	1393
JACKAL	14	197	1	42	1	0.001	0.00	0.00	14
LION	29	135	2	67	2	0.002	0.00	0.00	19
OSTRICH	1027	135	72	2411	72	0.060	0.01	0.18	678
CROCODILE	114	59	47	182	8	0.007	0.00	0.00	33

Table 3.2: 2002 Dry season Aerial Survey results for Block 27D DELTA

27D DELTA									
BLOCK AREA: 17 828 km²					sampling intensity: 6.48 %				
167972 units of biomass in area @ 9.42 Livestock Units/km²									
ESTIMATES:									
SPECIES	EST.NO.	95%CL %EST	95% RANGE		NO.	DENS/ km	BIOMAS LU/km	%BIO MASS	S.E.
ELEPHANT	28550	30	19922	- 37178	1849	1.601	4.39	46.57	4225
ZEBRA	16753	44	9458	- 024048	1085	0.940	0.51	5.43	3573
ELEPHANT F	23084	35	14970	- 31198	1495	1.295	0.00	0.00	3974
HIPPO	2223	59	913	- 3534	144	0.125	0.23	2.39	642
WARTHOG	1698	51	827	- 2570	110	0.095	0.02	0.18	427
ELEPHANT M	1899	40	1135	- 2664	123	0.107	0.00	0.00	374
GIRAFFE	5358	34	3542	- 7174	347	0.301	0.44	4.68	889
KUDU	1405	50	709	- 2102	91	0.079	0.03	0.34	341
SITATUNGA	124	85	19	- 228	8	0.007	0.00	0.02	51
GEMSBOK	15	201	1	- 47	1	0.001	0.00	0.00	15
ROAN	77	163	5	- 203	5	0.00	0.00	0.03	61
SABLE	93	196	6	- 274	6	0.005	0.00	0.03	89
WATERBUCK	247	130	16	- 0567	16	0.014	0.01	0.06	157
LECHWE	60929	41	35651	- 86208	3946	3.418	0.86	9.18	12379
REEDBUCK	649	66	218	- 1079	42	0.036	0.01	0.06	211
TSESEBE	5126	53	2410	-7843	332	0.288	0.10	1.06	1330
WILDEBEEST	8446	61	3288	- 13604	547	0.474	0.22	2.37	2526
IMPALA	13773	38	8570	- 18976	892	0.773	0.14	1.46	2548
STEENBOK	108	80	22	- 194	7	0.006	0.00	0.00	42
BUFFALO	31252	72	8729	- 53776	2024	1.753	1.75	18.61	11030
BABOON	2887	57	123	- 4542	187	0.162	0.00	0.00	810
WILD DOG	31	196	2	- 91	2	0.002	0.00	0.00	30
SPT HYAENA	15	197	1	- 46	1	0.001	0.00	0.00	15
LION	139	137	9	- 329	9	0.008	0.00	0.00	93
OSTRICH	849	85	132	- 1567	55	0.048	0.01	0.12	351
CROCODILE	664	41	390	- 938	43	0.037	0.00	0.00	134

Table 3.3: 2003 Dry season Aerial Survey results for-Block 27D DELTA

27D DELTA									
BLOCK AREA: 17 063 km²					sampling intensity: 7.41 %				
114083 units of biomass in area @ 6.69 Livestock Units/km²									
ESTIMATES:									
SPECIES	EST.NO.	95%CL %EST	95% RANGE		NO.	DENS/ km	BIOMAS LU/km	%BIO MASS	S.E.
ELEPHANT	19079	24	14426	- 23732	1414	1.118	3.06	45.82	2279
ZEBRA	12211	51	5944	- 18478	905	0.716	0.39	5.82	3069
ELEPHANT F	14586	30	10204	- 18967	1081	0.855	0.00	0.00	2146
HIPPO	1201	70	356	- 2046	89	0.070	0.13	1.90	414
WARTHOG	918	47	486	- 1349	68	0.054	0.01	0.14	211
ELEPHANT M	2645	27	1920	- 3370	196	0.155	0.00	0.00	355
GIRAFFE	4372	35	2826	- 5917	324	0.256	0.38	5.62	757
KUDU	1066	58	452	- 1680	79	0.062	0.03	0.38	301
SITATUNGA	67	98	5	- 134	5	0.004	0.00	0.01	32
GEMSBOK	67	161	5	-176	5	0.004	0.00	0.03	53
ROAN	27	197	2	- 80	2	0.002	0.00	0.01	26
SABLE	81	100	6	- 162	6	0.005	0.00	0.04	40
WATERBUCK	553	70	167	- 939	41	0.032	0.01	0.20	189
LECHWE	45511	35	29591	- 61431	3373	2.667	0.67	10.09	7796
REEDBUCK	67	114	5	- 144	5	0.004	0.00	0.01	38
TSESEBE	3657	47	1955	- 5358	271	0.214	0.07	1.12	833
WILDEBEEST	3076	106	228	- 6323	228	0.180	0.08	1.27	1590
IMPALA	24773	36	15758	- 33787	1836	1.452	0.26	3.87	4414
BUFFALO	15233	99	1129	- 30304	1129	0.893	0.89	13.35	7381
BABOON	2145	69	665	- 3626	159	0.126	0.00	0.00	725
JACKAL	13	196	1	- 40	1	0.001	0.00	0.00	13
SPT HYAENA	27	137	2	- 64	2	0.002	0.00	0.00	18
LION	54	153	4	- 137	4	0.003	0.00	0.00	41
OSTRICH	810	76	191	- 1428	60	0.047	0.01	0.17	303
CROCODILE	297	68	94	- 500	22	0.017	0.00	0.00	100

Table 3.4: 2004 Dry season Aerial Survey results for Block 27D DELTA

27D DELTA									
BLOCK AREA: 17 063 km²					sampling intensity: 8.18%				
130701 units of biomass in area @ 7.66 Livestock Units/km²									
ESTIMATES:									
SPECIES	EST.NO.	95%CL %EST	95% RANGE		NO.	DENS/ km	BIOMAS LU/km	%BIO MASS	S.E.
ELEPHANT	27917	27	20328	- 35506	2285	1.636	4.48	58.52	3716
ZEBRA	15761	64	5743	- 25778	1290	0.924	0.50	6.56	4906
ELEPHANT F	24875	30	17344	- 32406	2036	1.458	0.00	0.00	3688
RHINO (W)	24	194	2	- 72	2	0.001	0.00	0.00	23
HIPPO	2751	821	531	- 4972	225	0.161	0.29	3.80	1087
WARTHOG	440	61	171	- 709	36	0.026	0.00	0.06	132
ELEPHANT M	2163	36	1380	- 2945	177	0.127	0.00	0.00	383
GIRAFFE	4496	23	3456	- 5536	368	0.263	0.37	5.05	509
ELAND	61	139	5	- 146	5	0.004	0.00	0.04	42
KUDU	953	59	391	- 1515	78	0.056	0.02	0.30	275
SITATUNGA	12	193	1	- 36	1	0.001	0.00	0.00	12
ROAN	73	164	6	- 193	6	0.004	0.00	0.03	59
WATERBUCK	281	80	57	- 505	23	0.016	0.01	0.09	110
LECHWE	33158	43	18800	- 47517	2714	1.943	0.49	6.42	7032
TSESEBE	2077	59	855	- 3299	170	0.122	0.04	0.55	599
WILDEBEEST	2248	89	242	- 4254	184	0.132	0.06	0.81	982
IMPALA	18888	35	12348	- 25428	1546	1.107	0.20	2.57	3203
STEENBOK	110	91	10	- 210	9	0.006	0.00	0.00	49
BUFFALO	8748	64	3133	- 14362	716	0.513	0.51	6.69	2750
BABOON	2187	74	567	- 3807	179	0.128	0.00	0.00	793
JACKAL	12	196	1	- 36	1	0.001	0.00	0.00	12
LION	208	130	17	- 479	17	0.012	0.00	0.00	133
OSTRICH	208	78	46	- 370	17	0.012	0.00	0.04	79
CROCODILE	293	76	70	- 516	24	0.017	0.00	0.00	109

APPENDIX 4: SUMMARY OF CONSULTATIONS

4.a SUMMARY OF STAKEHOLDERS CONSULTATIONS

From the beginning of the project in 2009, a series of consultations have been made with stakeholders from government departments, Non -Governmental Organizations, researchers, and the public in general, and most importantly with local communities living around the Okavango Delta site. These were done from the earliest stages when the Department of Na-tional Museum and Monuments activated the World heritage Nomination programme, includ-ing the revision of the 1999 National Tentative List, and working towards the proposal to list the Okavango Delta as a UNESCO Natural World Heritage site. What follows therefore is a summary of consultations made with different stakeholders including local communities.

Table 4.a.1: List of stakeholders consulted

STAKEHOLDER	VENUE	DATES
World Heritage Listing (WHL) Stakeholders workshop	Gaborone	27-28 July 2009
WHL Tentative Stakeholders Meeting – Technical Committee	Gaborone	24th August 2009
WHL tentative Stakeholders Meeting – Technical Committee	Gaborone	2nd March 2010
Regional WHL Stakeholders	Maun	11th March 2010
ORI GIS Centre	Maun	12th March 2010
UNESCO WHC Delegation	Shakawe	13-14 March 2010
Okavango Delta Site Working Group	Maun	20th May 2010
OKACOM Secretariat	Maun OKACOM Office	21st May 2010
Batawana Tribal Authority	Tribal Administration– Maun	21st May 2010
Hon. Bagalatia Arone, MP	Constituency	June 2010
NWDC Plan Management Committee	Maun	7th June 2010
Hon. Kgosi Tawana Moremi, MP	National Museum	11th June 2010
Hon. Ramsden, MP	Minister's Office	11th June 2010
Hospitality And Tourism Association of Botswana (HATAB)	BTO Training Office – Maun	24th June 2010
NWDC Full Council Meeting	Council Chamber – Maun	24th June 2010
Okavango Basin Steering Committee	Gaborone	25th June 2010
NWDC Full Council Special Meeting	Council Chamber - Maun	30th July 2010
ODMP Stakeholders	Shakawe Community	23rd August 2010
African World Heritage Fund Director	National Museum	23rd August 2010
ODMP Stakeholders	Maun	1st September 2010
National World Heritage Committee	National Museum	3rd February 2011
16th OKACOM Open Dialogue	Gaborone - GICC	22nd February 2011
Hon. T.G Habano, MP	Office 40 Parliamentary Annexure	5th April 2011
Members of Ntlo Ya Dikgosi	Ntlo Ya Dikgosi Chamber	25th October 2011
Community consultation feedback to Northwest District councillors	Northwest District Council -Maun	29th March 2012
Regional conference for stakeholders (NGO's)	Maun Lodge -Maun	16th May 2012
Shakawe Region Development Support Society	National Museum - Gaborone	12th June 2012

4.b SUMMARY OF COMMUNITY CONSULTATIONS

Community consultations were done after consultations with traditional leaders, Dikgosi (Chiefs) and the political leadership in the district, including Members of Parliament and Vil-lage Councilors. The traditional leadership and political leaders (some village Councilors) were also present during the community consultations. Out of the 31 Villages consulted al-most all agreed to the proposed listing, only two did not and one had mixed feelings. Thse concerns raised by the communities were not so much related to the listing proposed, but ra-ther related to other issues such as lack of development, poverty, tight restrictions to re-sources in comparison to neighboring countries of Namibia and Angola, as well as unem-ployment.

Table 4.b.1: List of communities consulted

VILLAGE	NO OF PEOPLE	DATE	NAME OF LEADER	DECISION
1.GUDIGWA	64	17/10/2011	I. Ndado - Chief's Representative	YES
BEETSHA	34	17/10/2011	Kgosi Baruta Moriri	YES
ERETSHA	53	18/10/2011	Kgosi Dimo Seletse	YES
GUNOTSOGA	44	18/10/2011	Kgosi Gadigane Saoxho	YES
SERONGA	60	19/10/2011	Kgosi Ndozi	YES
NGARANGE	59	19/10/2011	Kgosi T. Tsheko	YES
SEKONDOMBORO	42	20/10/2011	Kgosi Mokoya Mathambo	YES
MOGOTLHO	53	21/10.2011	Kgosi Mosheti	YES
SEHITHWA	51	07/11/2011	Kgosi Dithapo	YES
BODIBENG	86	08/11/2011	Mr. Mbaeva – Chief's Represent.	YES
BOTHATOGO	48	08/11/2011	Kgosi Gakebone Leduledi	YES
SHOROBE	38	17/11/2011	Kgosi Tlotlang Dingalo	YES
BORO	86	18/11/2011	Kgosi Motswagole Mokgwathi	NO
KHWAI	41	16/11/2011	Kgosi Amos Merafe	YES
MABABE	37	16/11/2011	Kgosi Montle Kebuelemang	YES
SANKUYO	52	17/11/2011	Kgosana Galesotle Ketwaeletse	YES
XAKAO	58	17/10/2011	Kgosi Kashongu Xhumu	YES
KAUXWI	95	18/10/2011	Kgosi Siyakambowe	YES
SHAKAWE	136	18/10/2011	Kgosi Komana Mokwe	YES
TSODILO	52	19/10/2011	Kgosi Samoxha Mareko	YES
NOKANENG	83	07/11/2011	Kgosi Ozoe	NO
ETSHA 13	47	10/10/2011	Kgosi James Sevako	YES
MOHEMBO	80	18/10/2011	Kgosi Matlhatlheo	YES
SAMOCHIMA	61	19/10/2011	Kgosi Thari Sepapara	YES
SEPOPA	81	20/10/2011	Kgosi Nyame	YES
HABU	32	07/11/2011	Kgosi L.S Kapomboro	YES
TUBU	30	08/11/2011	Kgosi Motshediemang	YES
IKOGA	56	09/11/2011	Kgosi Mombeko	YES
MAUN	63	15/11/2011	Kgosi Ledimo and Letsholathebe	Undecided
XAXABA	42	28/08/2012		YES
DITSHIPING	24	30//08/ 2012		YES

APPENDIX 5: BOTSWANA ECOTOURISM CERTIFICATION SYSTEM

The Botswana Ecotourism Certification System is designed to encourage and support respon-sible environmental, social and cultural behaviour by tourism businesses and make sure they provide a quality eco-friendly product to consumers. It comprises a set of voluntary quality performance standards, which are designed to meet or exceed basic environmentally respon-sible standards or legislation. The Botswana Ecotourism Certification System covers more than 240 standards encompassing the following: environmental management, cultural re-sources protection and community development, socio-economic responsibilities and funda-mental ecotourism criteria.

Two sets of standards have been developed. (1) All fixed tourism sites (accommodation facil-ities) will be assessed using the Accommodation standards. (2) All Mobile activities includ-ing ecotourism will be assessed using the Ecotourism standards.

The system uses a three-tiered structure (levels) designed to incorporate the broadest cross-section of tourism operations while still distinguishing an urban facility, from a true ecotour-ism product in a pristine natural environment. The three-tiered structure promotes progress and is designed to encourage operators to improve their performance towards achievement of the next higher level. Of the three levels, the simplest to obtain is Green followed by Green+ and finally the Ecotourism level.

Green: - This is the basic entry level and reflects all of the mandatory criteria that are neces-sary for all facilities to be considered for certification. The standards for this level deal pri-marily with the environmental management systems of the facility.

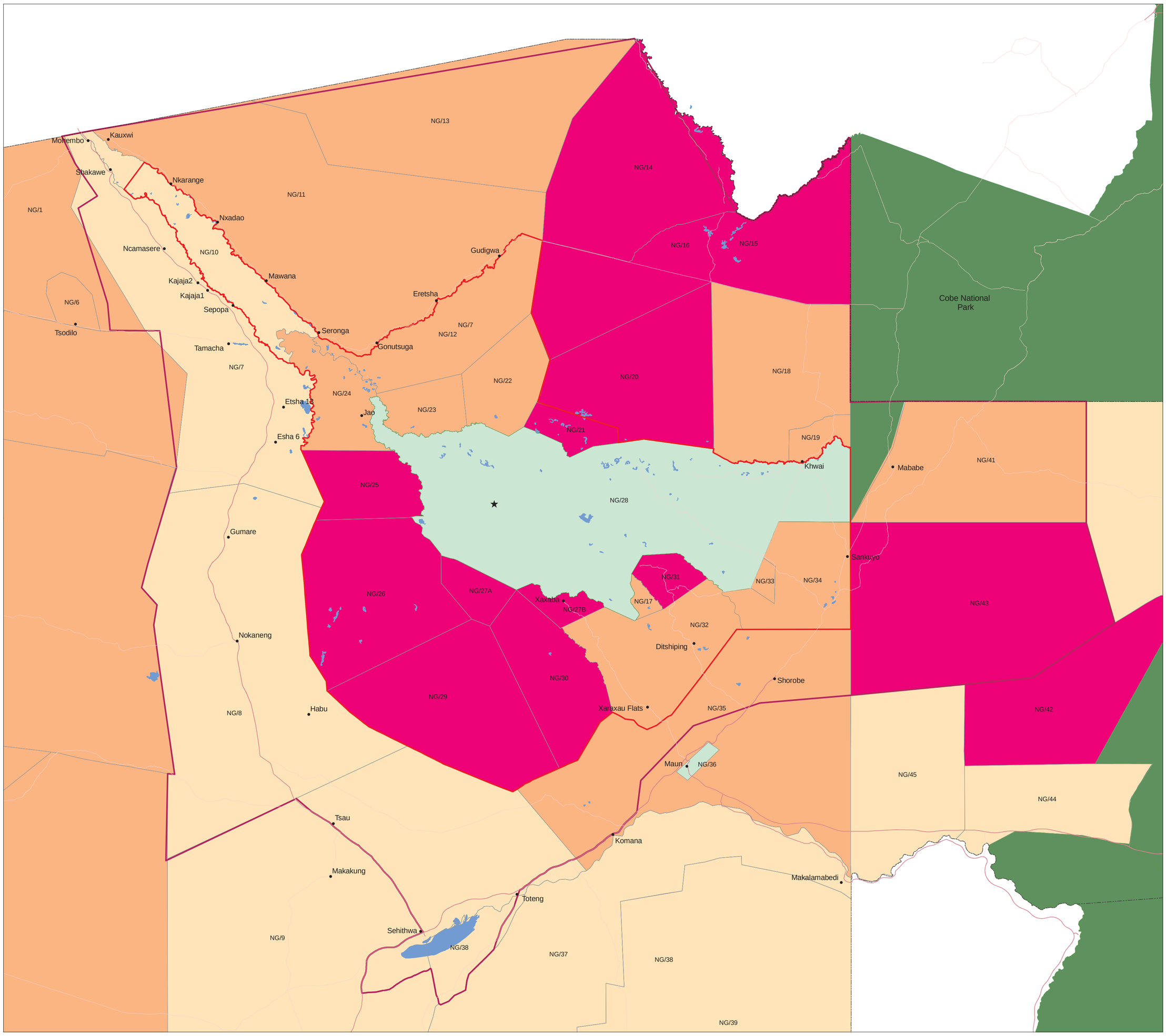
Green

Green +: - This level has additional requirements and is of a higher standard than the Green level.

Green+

Ecotourism: This level upholds the principles of ecotourism, as stated in the Botswana Na-tional Ecotourism Strategy and defines those facilities that have met all the principles of eco-tourism. The level reflects the operator's commitment to and involvement with local commu-nities in tourism development, nature conservation, environmental management and interpre-tation of the surrounding environment to the guests

Okavango Delta: Landuse Designations



Scale 1 : 700 000

0 25 50 100 Kilometers

Source Data fron Botswana National PC Atlas, 2002
Prepared by Department of Surveys and Mapping
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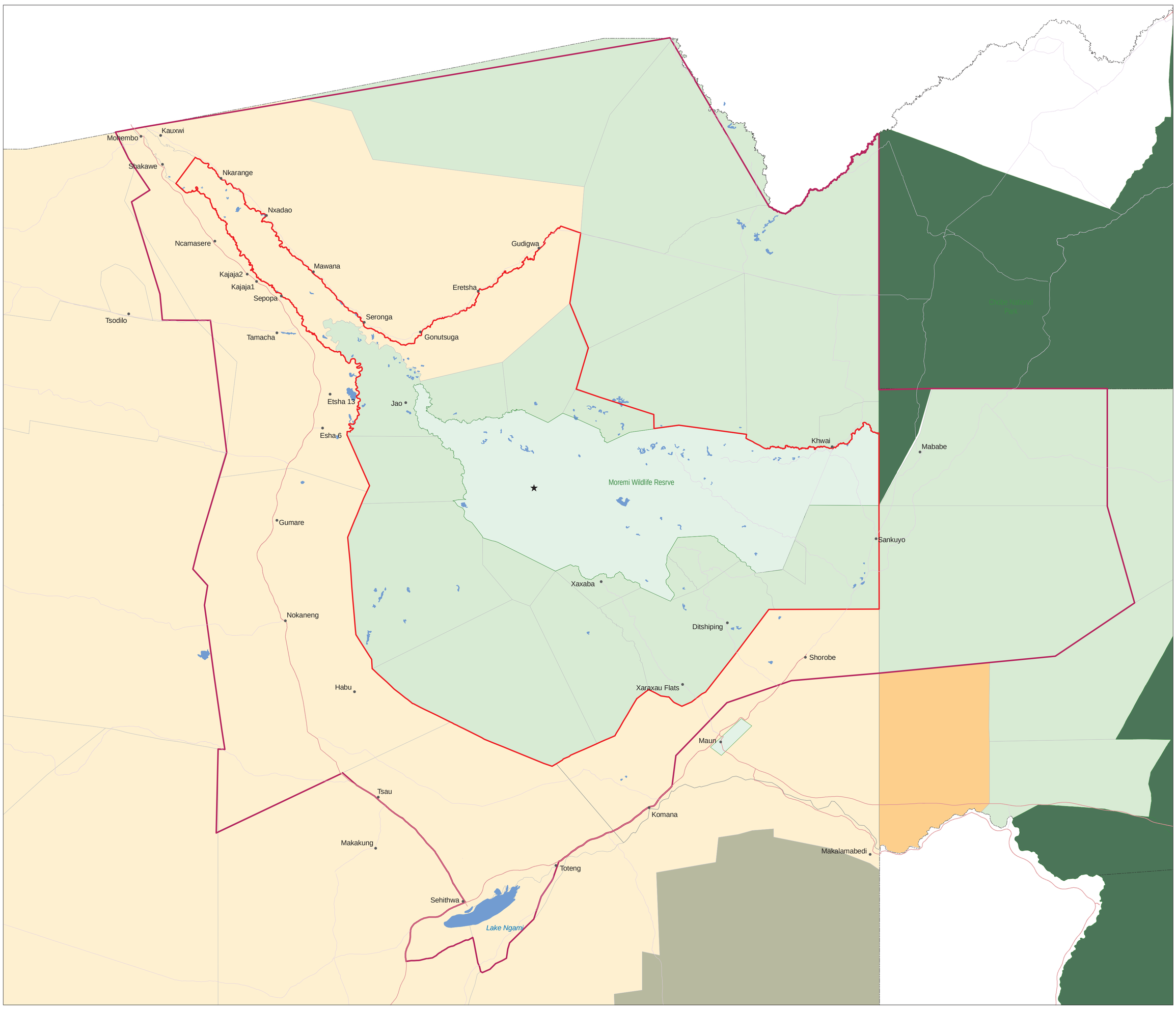
Landuse Designations

- ★ Center of Property
- • Settlement
- Core Zone Boundary
- Buffer Zone
- Tarred Road
- Gravel/Sandy Road
- District Boundary
- Lake/Lagoons

Landuse

- National Park
- Game Reserve
- Commercial Wildlife Utilization Areas
- Community Managed /Utilization Wildlife Areas
- Undesignated Areas

Okavango Delta: Landuse Designations



1 : 700 000

0 30 60 120 Kilometers

Source Data fron Botswana National PC Atlas, 2002
Prepared by Department of Surveys and Mapping
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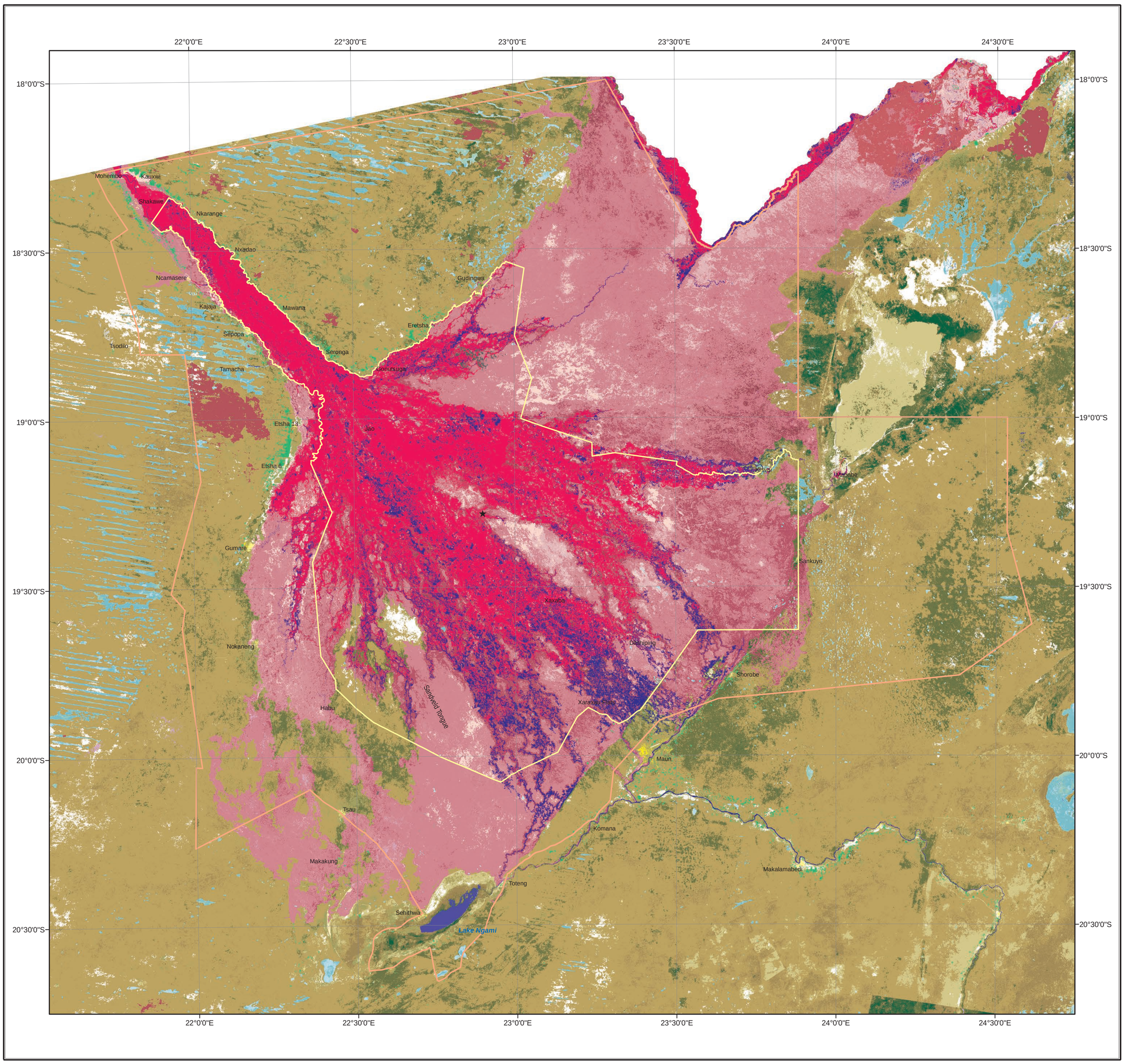
Scale 1 : 700 000

Landuse

- Center of Property
- Settlements
- Core Zone Boundary
- Buffer Zone
- District Boundary
- Tarred Road
- Gravel/Sandy Road
- National Park
- Game Reserve
- Wildlife Management Areas
- Pastural/Arable/Residential Areas
- Proposed Wildlife Management Area
- T.G.L.P. Ranches

Okavango Delta: Landcover



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★ Center of Property

Core Zone Boundary

Buffer Zone

Source data Botswana National Landcover Mapping, 2011.
Produced from Spot 4 Imagery, 2009 by Department of Surveys and Mapping
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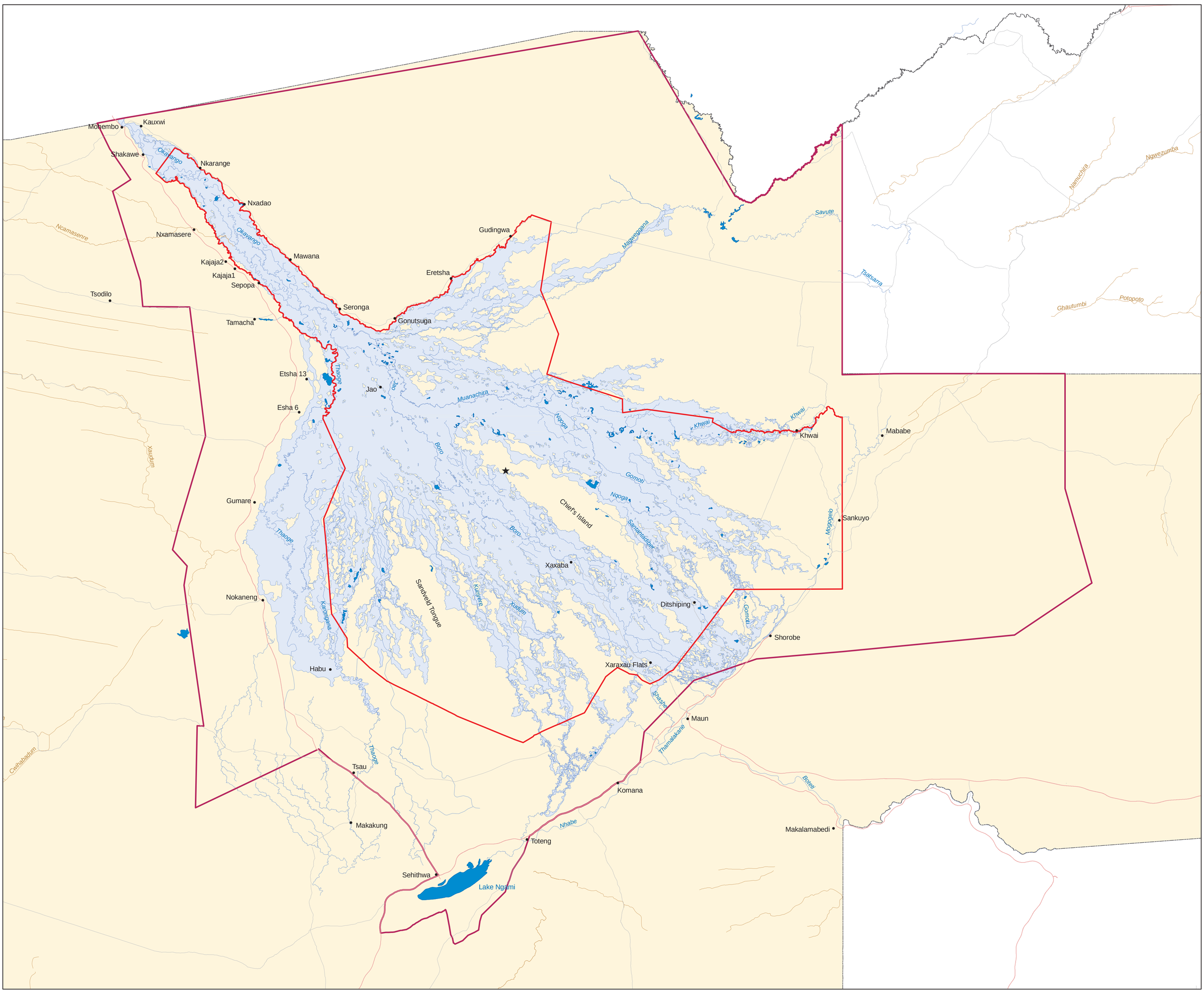
Swamp Vegetation

- Natural Bare Ground
- Aquatic herbaceous
- Bare and Low Habeceous
- Dense Savanna
- Open Low Shrub
- Sparse / Scattered Savanna
- Dense Low Shrub

Landcover

- Open Low Shrubland
- Topo Depression: Bare / Low Herb
- Dense Low Shrubland
- Open Savanna / Woodland
- Dense Savanna / Forest
- Sparse / Scattered Savanna
- Pans Dry
- Natural Waterbodies
- Residential Village
- Cultivated Rainfed Crops
- Mine Borrow Pit
- Natural Bare Ground
- Natural Bare Ground: Sand Dunes
- Non-Natural Bare Ground

Okavango Delta: Rivers, Lakes, Settlements



1 : 700 000

0 30 60 120 Kilometers

Settlements
Center of Property
Core_Zone
Buffer_Zone
Rivers
Fossil Rivers
Tarred Road
Gravel/Sandy Road
District Boundary
Lakes/Lagoons
Okavango Delta

Source data: Botswana National PC Atlas, 2002
Prepared by Department of Surveys and Mapping
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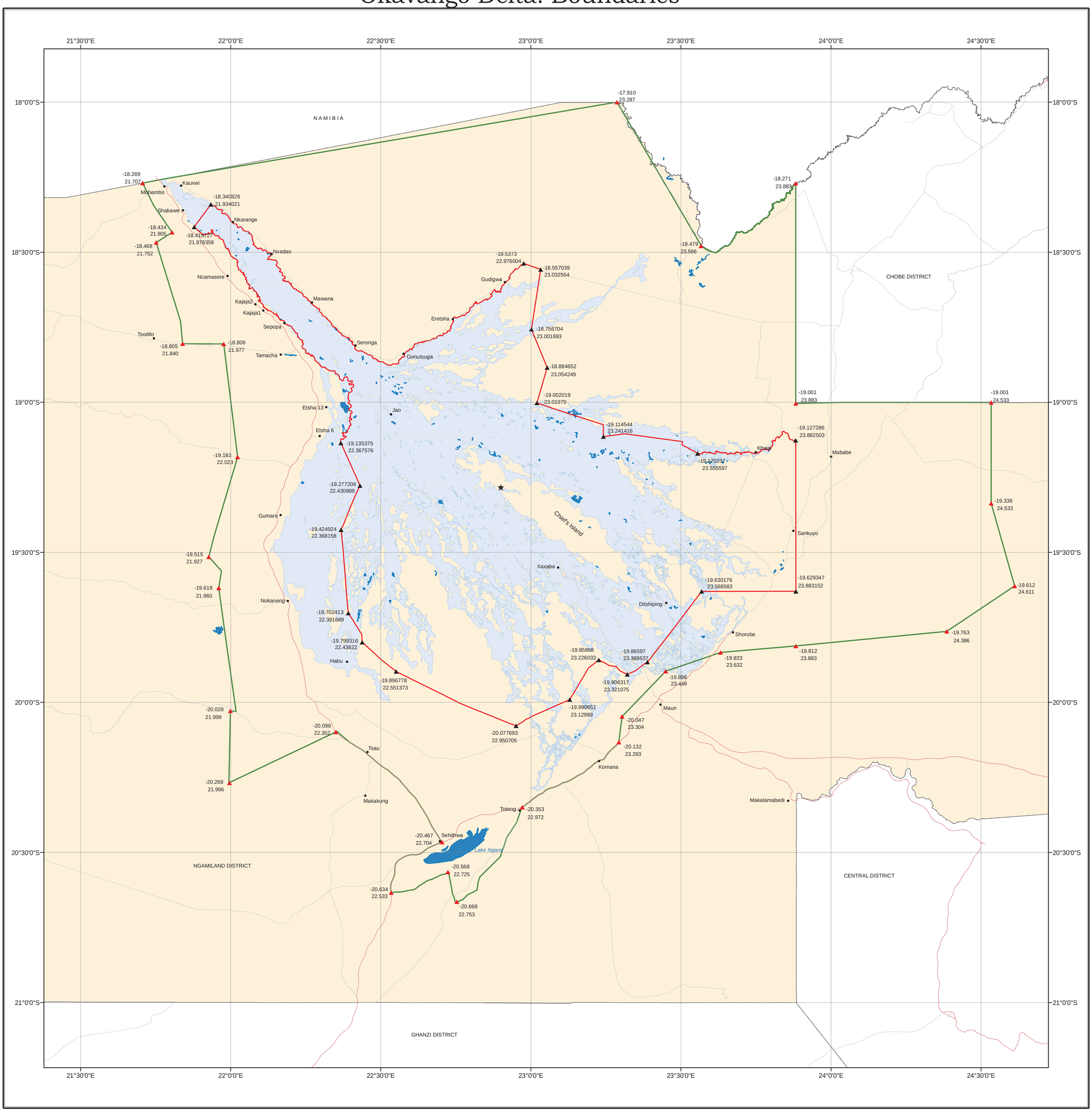
Okavango Delta: Boundaries



1 : 750 000

0 25 50 100 Kilometers

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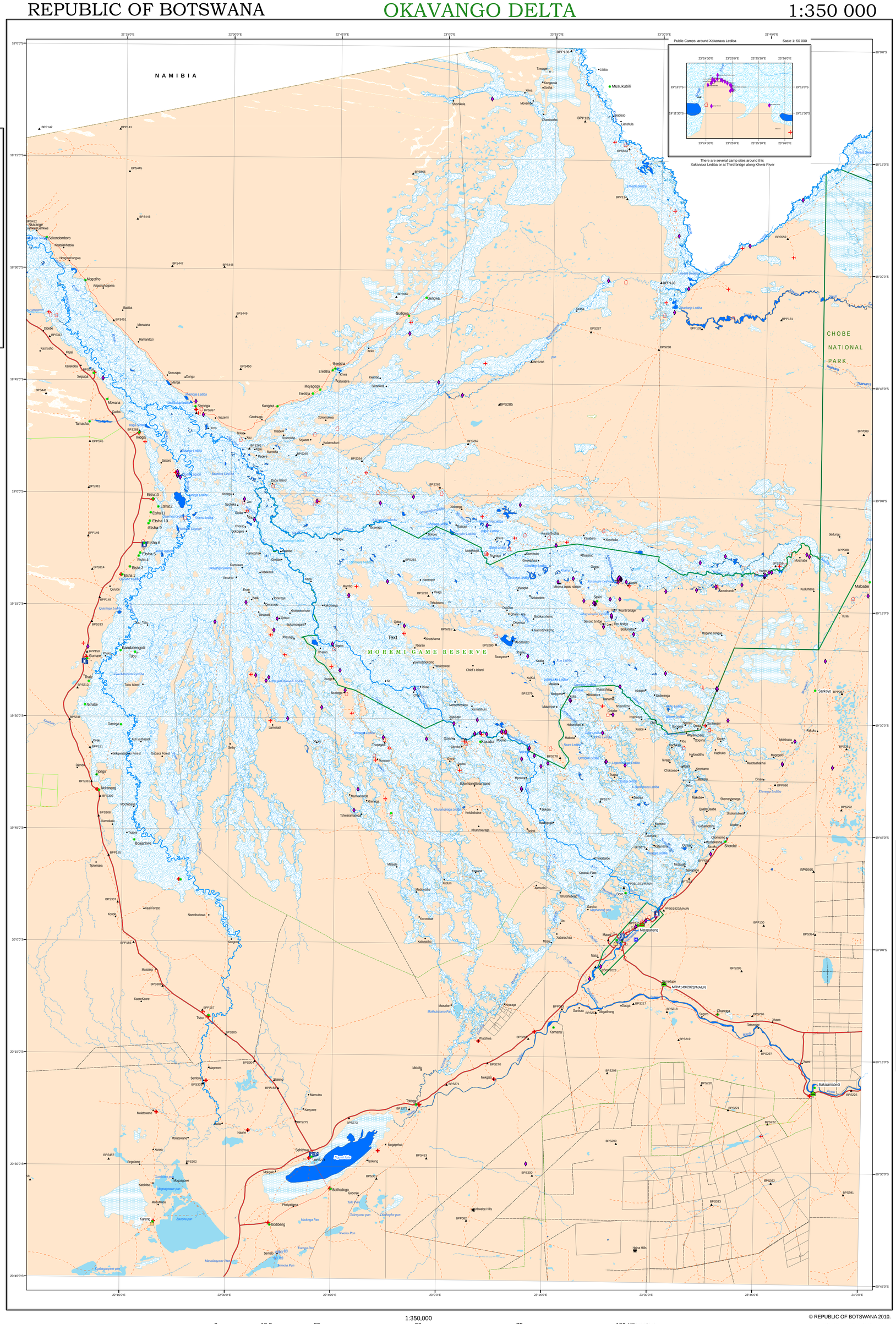
Legend

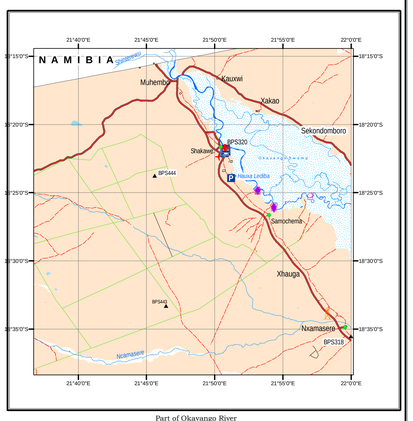
- ★ Center of Property
- • Settlements
- Core Zone Boundary
- Buffer Zone
- District Boundary
- Tarred Road
- Gravel/Sandy Road
- Lakes/Lagoons
- OkavangoDelta

REPUBLIC OF BOTSWANA

OKAVANGO DELTA

1:350 000





Part of Okavango River
The river drives its water
from the highlands of Angola
spreading into the delta.

Tsodilo Mesum in Ngamiland:
Reach in craft and artistry

Tsodilo hill is located 53 km
southwest of Shakawe.The hills contain
oldest historical collections
of rock art .

Mapula Lodge is located inside the
private concession which is NG/12
consists of 10 luxury chalets on raised
docks to view a wide variety of game
in the islands.

Well serviced self catering chalets
found in the moremi Game Reserve.

Mokoro boat (dugout canoes) are
used for viewing variety
of wildlife and birding on the islands.

Elephant are the largest land mammals
found in Moremi Game Reserve.

Gcwihaba Hill

These caverns were first known
to the Qung San and were shown
to Martinus Drostsky,a Ghanzi
farmer in 1934.Subsequently he
publicised them.The caves formed
as a result of natural processes that
operated and created fascinating
geological formations some 3 to 2
million years ago.

SHEET HISTORY
First edition published 1987
First digital map, revised with digital Orthophotos 2001/2002..
Aerial Photography by Swedesurvey AB, 2001/2002.
Field completion by the Department of Surveys and Mapping 2009.

Year of Aerial Photography 2002

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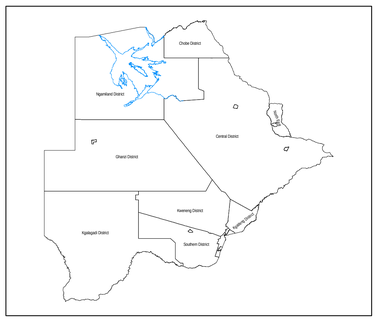


The Okavango Delta is situated in the
North West of Botswana at a size of 12000 km square.
It is one of the largest wetland in Africa.the unique beauty
of the Okavango with its vast wild life resources has
resulted in the development of a thriving and rapidly
growing tourist industry.

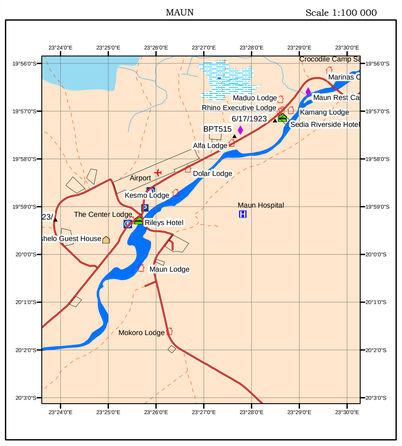
Legend

- Village
- Settlement
- Trigonometry station
- Landing strip
- Bank/Atm
- Camping
- Cemetery
- Clinic/Health centre
- Boat station
- Bridge
- Borehole
- Perennial river
- Seasonal river
- Stream
- Fence
- Quarantine Camp
- National Boundary
- Pan
- Dam/Laggon
- Swamp
- Swamp Habaceous
- Hospital
- Hostel
- Hotel
- Lodge
- Police
- Post Office
- Service station
- Hills
- View Point
- Main gate
- Tarred Road
- Gravel Road
- Track
- Cutline
- Veterinary Cordence Fence
- Park Reserve
- Area Liable to Flood
- Dry Fossill River
- Bakground/Island

GPS COORDS:

NAME	LAT	LONG
Mmapula Lodge Camp	18.868S	22.694E
Savuti Camp	18.563S	24.061E
Linyanti Camp	18.296S	23.908E
Zarafa Camp	18 35.364S	23 31.840E
Savuti Safari Lodge	18.817S	24.057E
Selinda Camp	18 .517S	23 .517E
Maun Loge	-20.00 14S	23 .429E
Reliys Hotel	-19 .974S	16.427E

MAUN Scale 1:100 000



Projection:	Transverse Mercator	Scale Factor:	0.9992
False Easting:	1 000 000	Latitude Of Origin:	0°
False Northing:	5 000 000	Datum:	GRS80
Central Meridian:	24°	Spheroid:	GRS80

Mean magnetic declination
19°31' West of True North 2006.05.
Mean annual change 1.5' Westwards.

TRAVEL TIPS IN OKAVANGO DELTA

Visitors to the delta know that you will be entering the wetlands accessible only by four by four weel drive.

For more information contact
Department of Wildlife and National Park
Gaborone Office:
Tel:267 397 1405

Maun Office
Tel: 267 686 0368

Kasane Office
Tel: 267 625 0486

1:350,000

0 12.5 25 50 75 100 Kilometers

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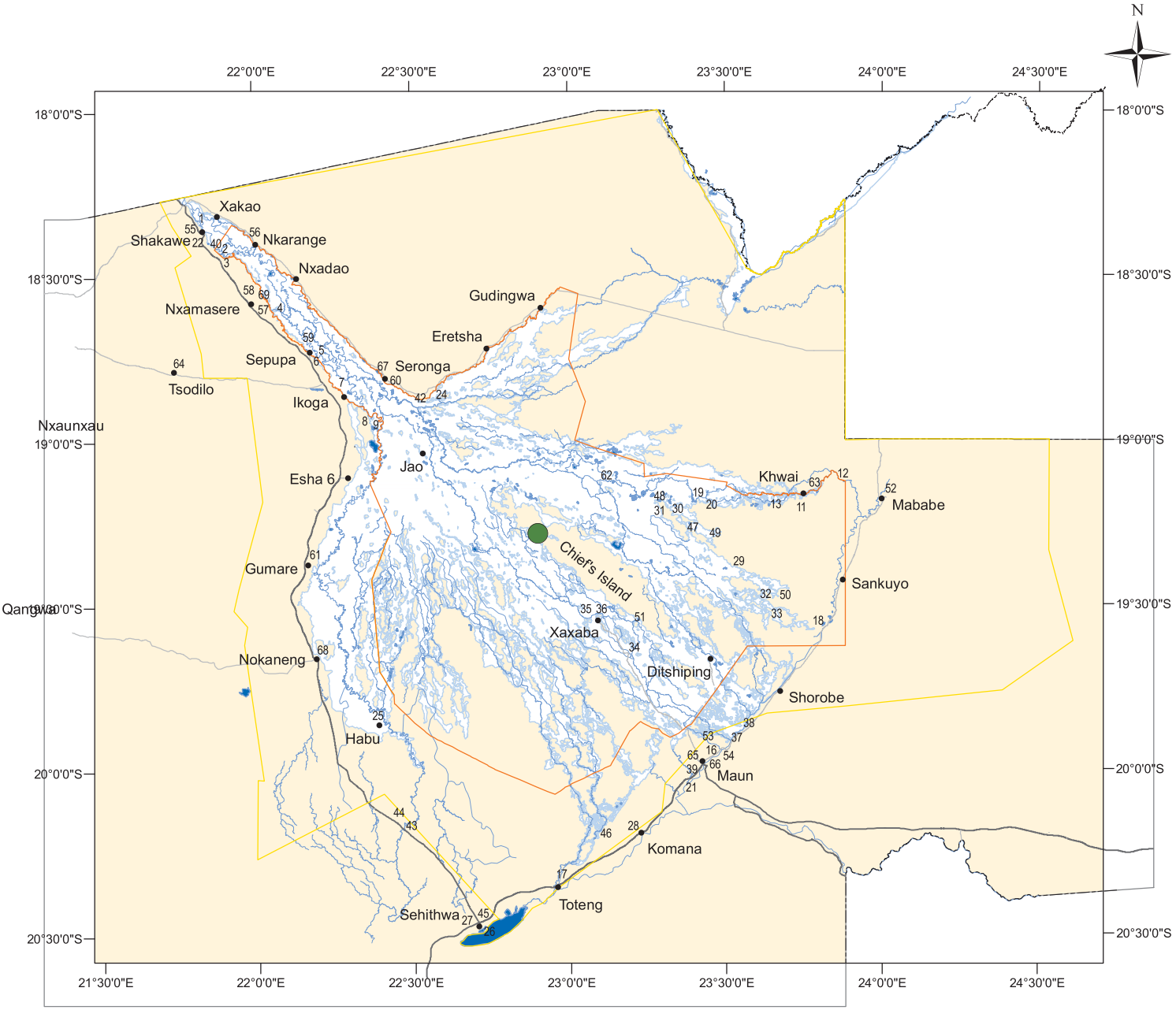

Scale 1 : 2 000 000

- Center of Property
- Settlement
- Core Zone
- Buffer Zone
- Tarred Road
- Gravel/Sandy Road
- Rivers

List of Some Tourist Facilities

1. Shakawe Clinic
2. Shakawe Fishing Lodge
3. Shakawe Camping Site
4. Ncamasere Lodge
5. Swamp Stop Camp
6. Sepopa Clinic
7. Ikoga Clinic
8. Guma Airstrip
9. Guma Lagoon Camp
10. Khwai River Lodge
11. MGR3 Camp
12. MGR2 Camp
13. MGR5 Camp
14. Rileys Hotel
15. Sedie Hotel
16. Dolar Lodge
17. Toteng Clinic
19. Kazikini Camp Site
20. Xakanaka Camp Site
21. Xakanaka Airfield
22. Statunga Camp Site
23. Honey Barclays Bank
24. Drotskys Cabins
25. Xau Mokoro Station
26. Habu Clinic
27. Sehitwa Post Office
28. Sehitwa Clinic
29. Komana Clinic
30. Hatab Mobile Camp Site
31. Hatab 12 Camp Site
32. Mboma Boat Station
33. Santawanl Airstrip
34. Santawani Lodge
35. Ivory Camp Sites
36. Gunn Camp Site
37. Airstrip
38. Matapana Boat Station
39. Thamalakane River Lodge
40. Botshelo Guest House
41. Okavango Crocodile Farm
42. Mbiroba Camp
43. Umvuvu Lodge
44. Tsau Clinic
45. Tsau Airstrip
46. Sehitwa Post Office
47. Phatshwa Mobile Clinic
48. Hatab 6 Camp
49. Mboma Boat Station
50. Hatab 13 Camp
51. Sankuyo Bush Camp
52. Boga 2 Camp
53. Airstrip
54. Maun International Airport
55. Letsholathebe Hospital
56. Shakawe Airstrip
57. Ngarange Airstrip
58. Ncamasere Boat Station
59. Ncamasere Airstrip
60. Sepupa Airstrip
61. Seronga Airstrip
62. Gumare Airstrip
63. Camp Okavango
64. Khwai Airstrip
65. Tsodilo Airstrip
66. Bank
67. Bank
68. Clinic
69. Nokaneng Clinic
70. Xau Mokoro Station

Source Data from Okavango Tourst Map, 2010
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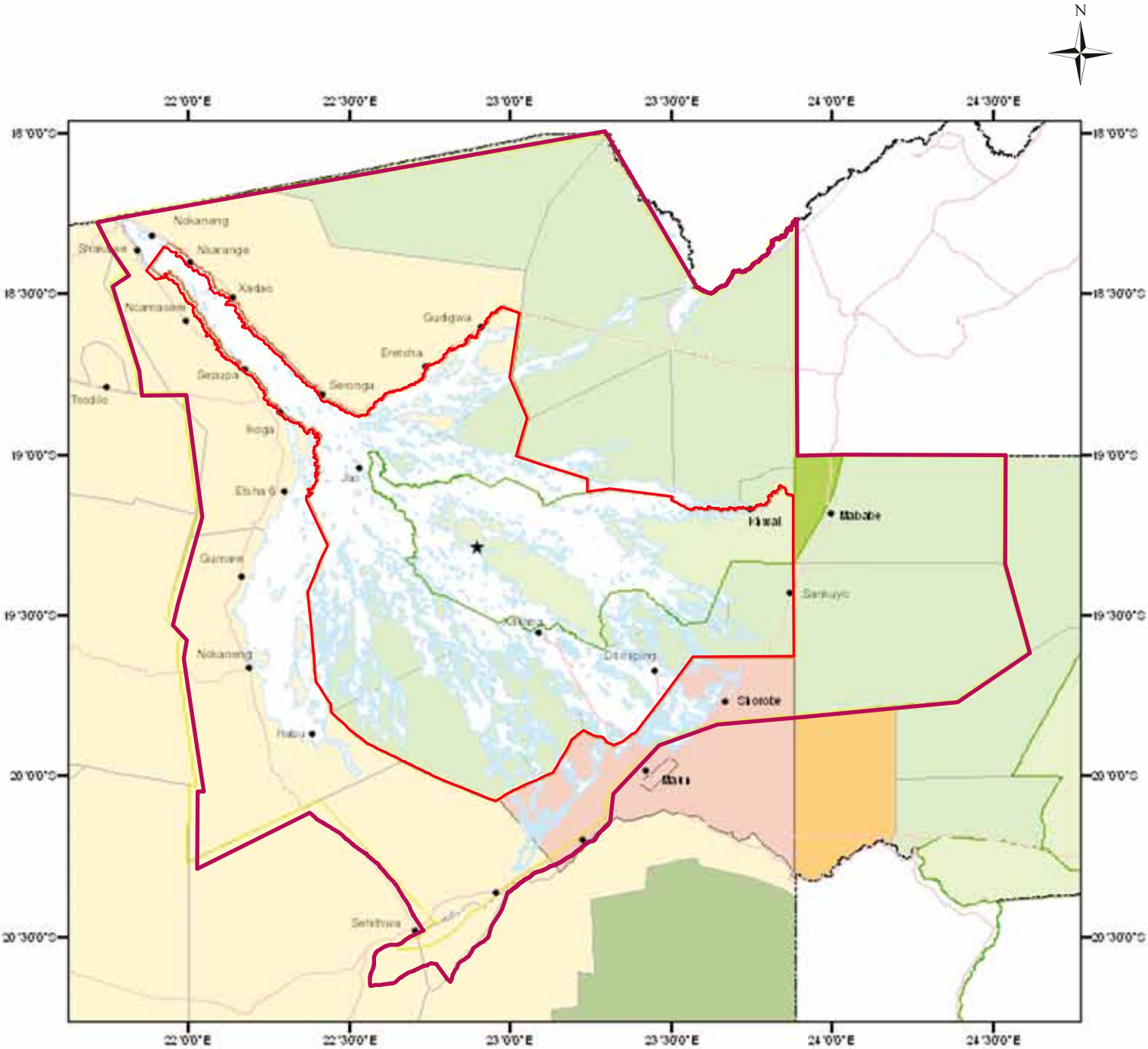

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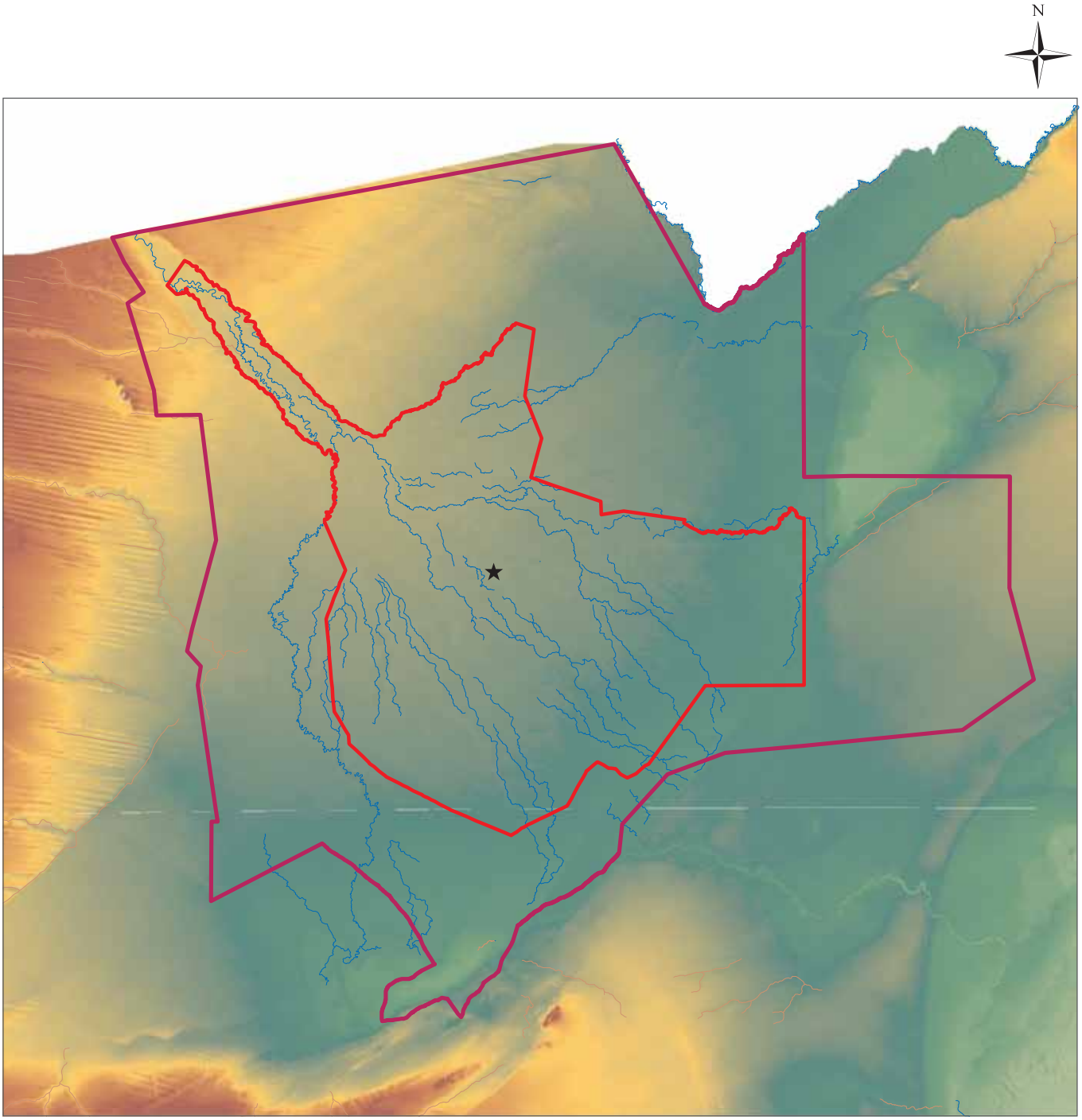
Scale 1 : 2 000 000

- ★ Center of Core Area
- • Settlement
- Core Zone Boundary
- Buffer Zone
- District Boundary
- Roads
- Park/Game Reserve Boundary
- Okavango Delta

Landuse

- Pastural/Arable/Residential
- National Park
- Game Reserve
- Wildlife Management Areas
- Proposed Wildlife Management Area
- T.G.L.P. Ranches



1 : 2 000 000

★ Center of Property

Core Zone

Buffer Zone

Rivers

Fossil Rivers

Elevation in Metres

High : 1500

Low : 500

Source Data Botswana National Elevation Data, 2002
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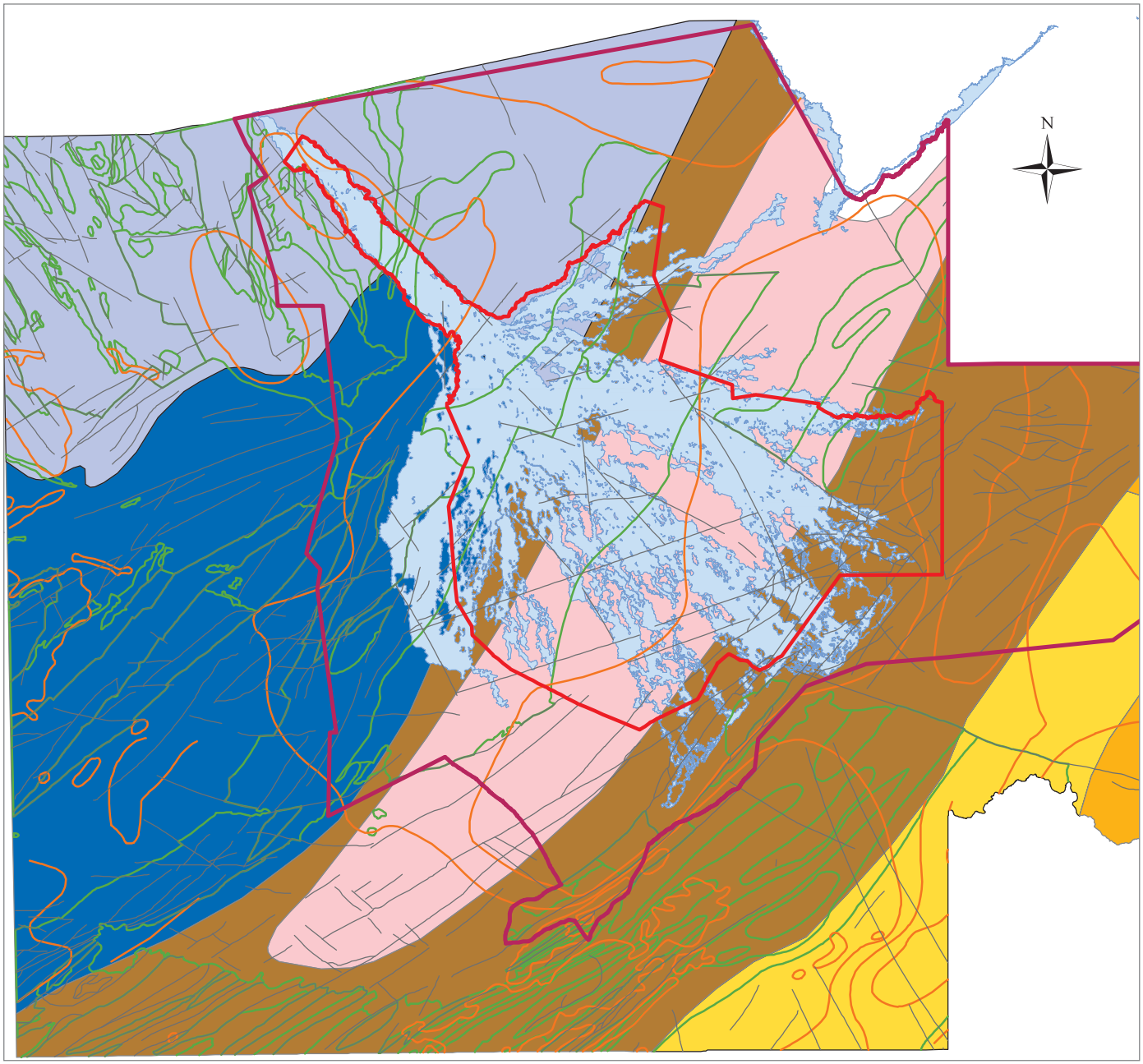

Buffer Zone
Core Zone
Fault
Isopach
Metarmophic
Nossop-Ncojane Basin

Scale 1 : 2 000 000

Kihabe Complex
Kwando Complex
Ghanzi-Chobe Belt

Okwa Belt
Congo Craton
Zimbabwe Craton

Geological data supplied by Geological Department, 1997
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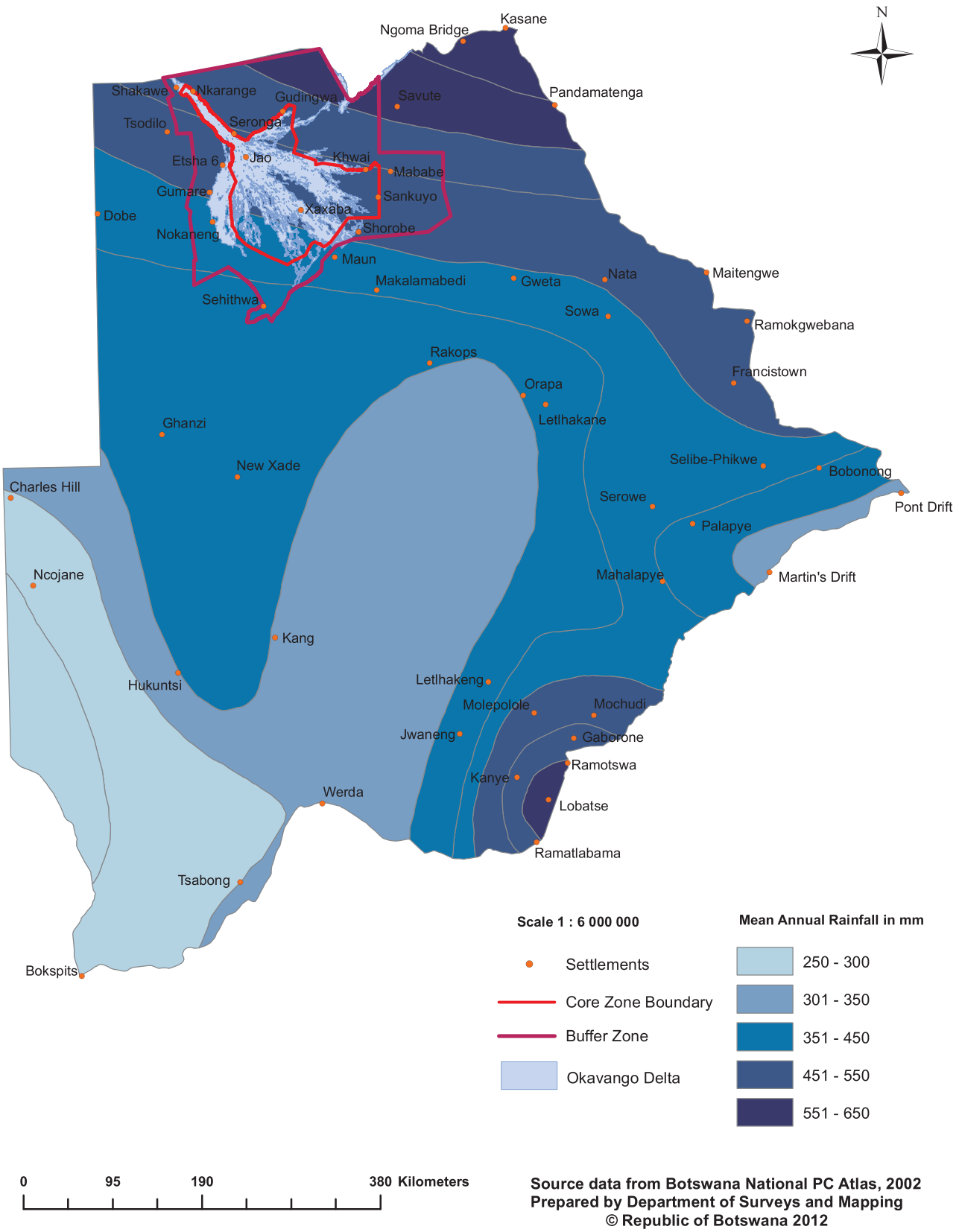

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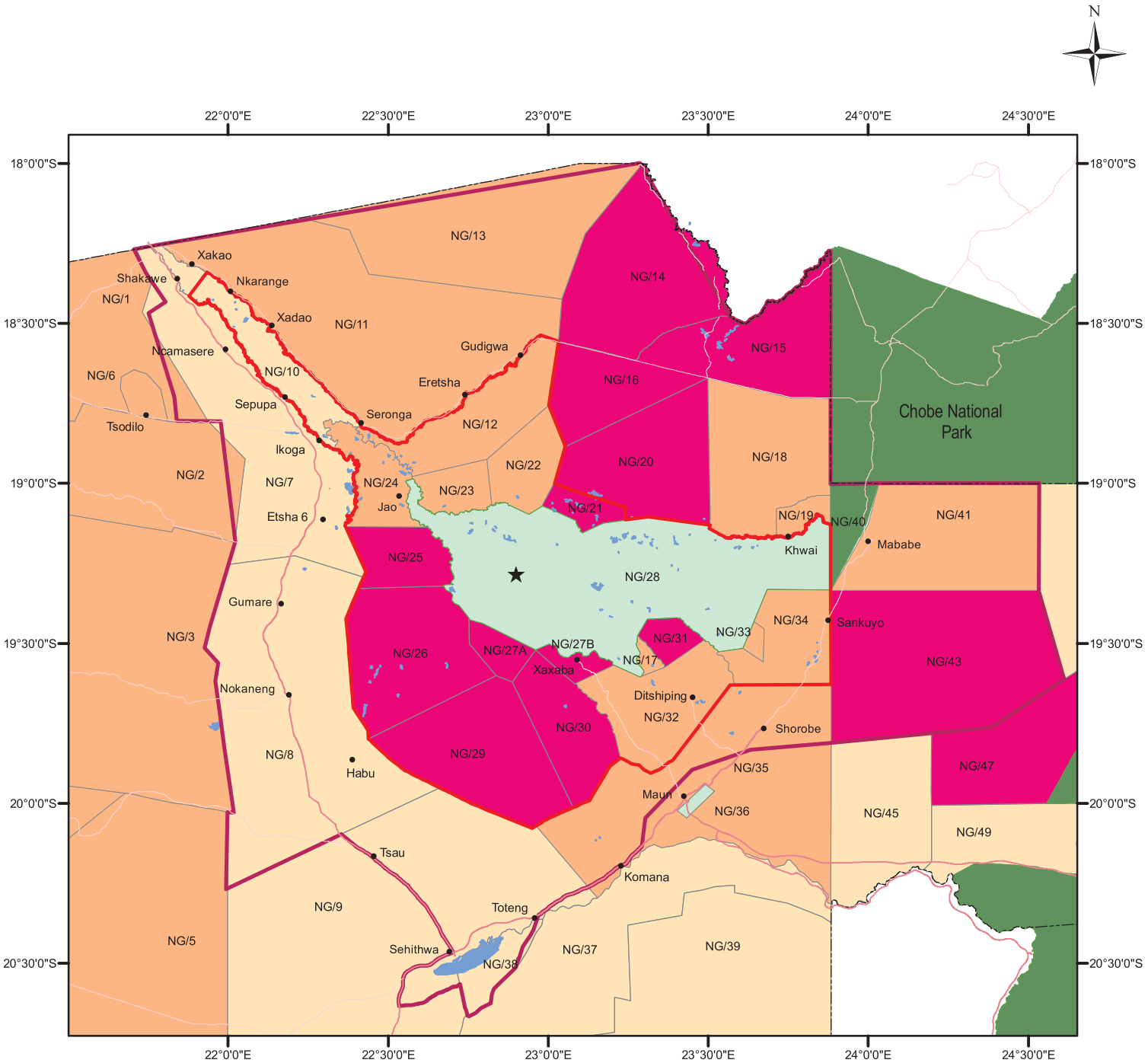

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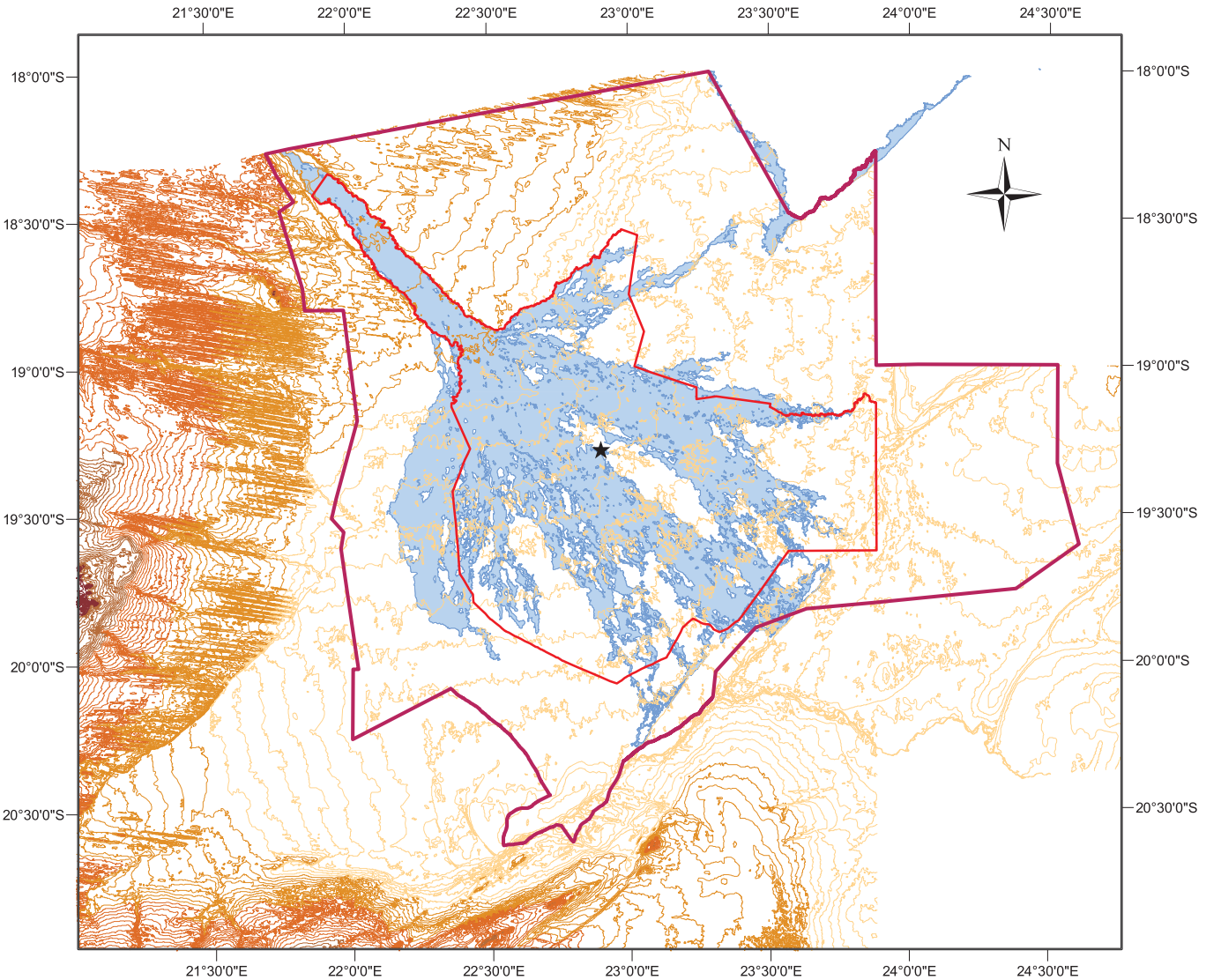
Landuse Designations

Scale 1 : 2 000 000

- ★ Center of Property
- • Settlement
- Core Zone Boundary
- Buffer Zone
- Tarred Road
- Gravel/Sandy Road
- District Boundary
- Lake/Lagoons

Landuse

- National Park
- Game Reserve
- Commercial Wildlife Utilization Areas
- Community Managed /Utilization Wildlife Areas
- Undesignated Areas



Soucre data from Botswna National Elevation data, 2002
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1 : 2 500000

0 20 40 80 Kilometers

★ Center of Property

Core Zone Boundary

Buffer Zone

Okavango Delta

Height in Metres

910.000000 - 970.000000

970.000001 - 1020.000000

1020.000001 - 1080.000000

1080.000001 - 1155.000000

1155.000001 - 1380.000000

JOHN MENDELSOHN is a freelance researcher and writer based in Namibia. Matters concerned with biology, the socio-economics of rural livelihoods, birds, land and information are his principal academic passions. He has a PhD in Zoology from the University of Natal, South Africa, and was born and partially raised in Kenya.

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LARS RAMBERG is Professor in Limnology at HOORC, and was the Centre's founding director. He holds a PhD in Limnology from Uppsala University, Sweden, and his research focuses mainly on the interplay between terrestrial and aquatic ecosystems, functional relations between land use and water use and their effects on ecology and ultimate human responses.

MIKE MURRAY-HUDSON grew up in Botswana. His undergraduate degree in Geology and Zoology gave an early indication of his broad interests. After about 20 years of varied environmental work, he obtained a PhD from the University of Florida in systems ecology. He is now at HOORC working on the effects of hydrological change on the Delta's ecosystems.

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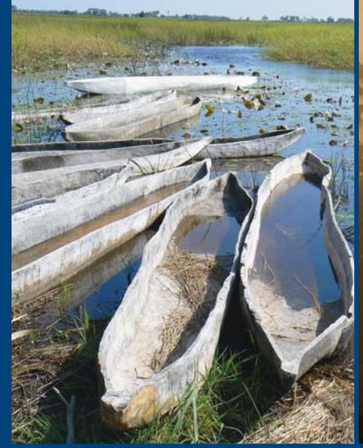
KETLHATLOGILE MOSEPOLE is a Senior Research Scholar at HOORC and a PhD candidate in Fisheries Biology and Management at the University of Bergen, having previously obtained an MPhil in Fisheries Biology and Management. Fisheries management; fish ecology and biology; aquatic ecosystem functioning; and natural resource management are his main research interests.



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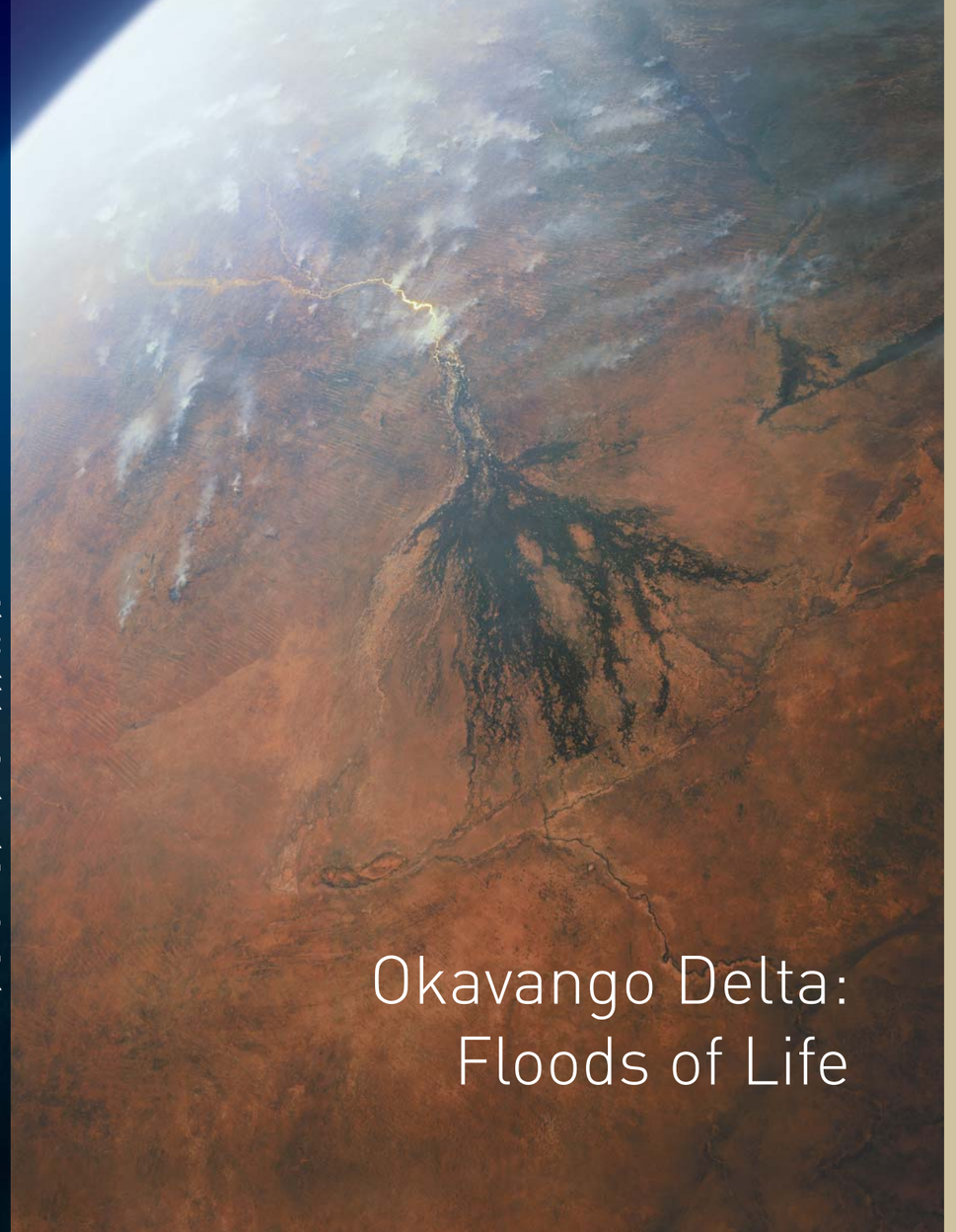
Okavango Delta: Floods of Life

John Mendelsohn • Cornelis vanderPost • Lars Ramberg • Mike Murray-Hudson • Piotr Wolski • Ketsa Mosepele

RAISON



Okavango Delta: Floods of Life

Okavango Delta: Floods of Life describes the origins, functioning, life and people of this remarkable wetland. In combination, no other body of water in Africa is so large, well protected, pristine, economically valuable, and well-known internationally. This blend of values could be unique worldwide.

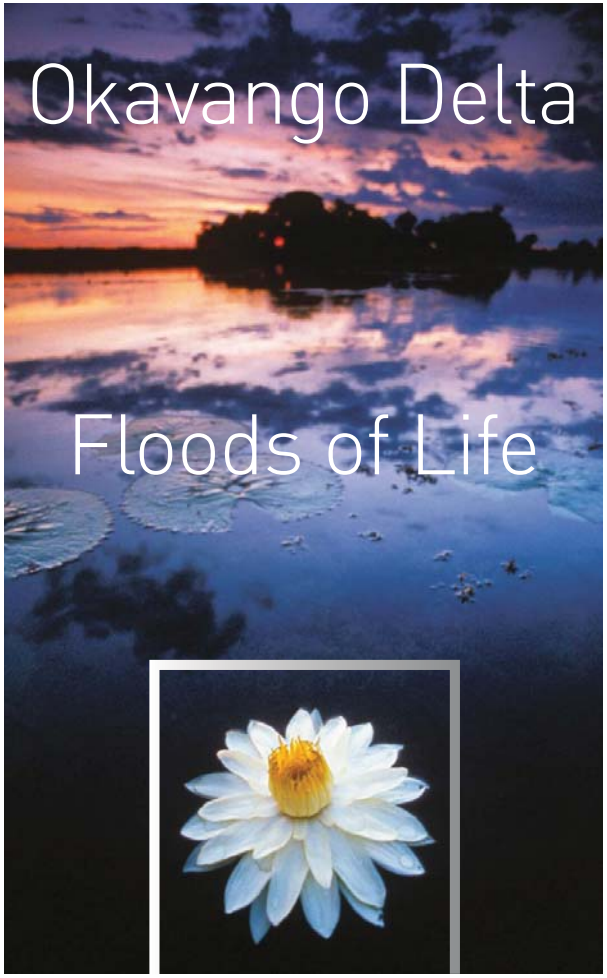
The Delta brings to mind wildlife and water. But there is much more: it is an interface between wetland and dryland and a rich reservoir of nutrients. It runs on internal processes that shift water from one area to another and keep the water fresh. Pulses of water retreat and then inundate the following season to permit the recycling of nutrients and life to spring from sediments. Each square metre of sediment may contain fifty thousand crustacean eggs, for example, and countless other constituents of life. This is a patchwork of diversity of habitat and life forms; economic opportunities that enable people to move from subsistence to lifestyles that provide cash and food security; and good governance.

Permanent swamps at the head of the Delta filter out most sediments, clays and nutrients from the incoming water. Peat beneath these swamps stores large volumes of nutrients, while fish seek refuge in permanent waters when the flood waters are low.

The Delta's wealth of life is replenished each year downstream in the seasonal swamps when catalytic flood waters from Angola stir the dormant nutrients and eggs into regular production. Drier, occasional floodplains are the centres of biological diversity and provide settings for episodic booms of biological production.

Spike McCarthy, who has contributed much to our knowledge of the Delta, wrote: 'It is almost as if the Okavango is a single organism, with the different communities serving the function of specific organs, and working together to ensure the well-being of the whole – a kind of super-organism. The Okavango has been around a long time and is pretty robust, but it too has its jugular.'

There is a need to understand the jugular and to debate the future, considering the competing challenges and opportunities that depend on this pristine wetland. *Okavango Delta: Floods of Life* provides information and ideas to improve that debate in the hope that this wetland remains one of planet earth's great assets.


Okavango Delta
Floods of Life

Okavango Delta: Floods of Life

John Mendelsohn, Cornelis vanderPost,
Lars Ramberg, Mike Murray-Hudson, Piotr Wolski &
Keta Mosepele

International Union for the Conservation of Nature

European Union

UNIVERSITY OF BOTSWANA
Harry Oppenheimer
Okavango Research Centre

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Project management: William Darwall (IUCN), Cornelis vanderPost (HOORC) and John Mendelsohn (RAISON)

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Cover image taken from NASA space shuttle mission STS043 on the 8th of August 1991

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Other important assistance was given by Rene and Marije Allemekinders, Jon Barnes, Brad Besterlink and Andy Crawford, Hans Beuster, Caspar Bonyongo, Lin Cassidy, Masego Dhliwayo, Louis du Preez, Birgitta Farrington, Richard Fynn, Clinton Hay, Don Kgathi, Martie MacFarlane, Lapo and Innocent Magole, Coleen Mannheimer, Wellington Masamba, Joseph Mbaiwa, Tico McNutt, Martin and Stephie Mendelsohn, Lesego Mmualefe, Monica Morrison, Sekgowa Motsumi, Chaminda Rajapakse, Vince Schacks, Roger Swart, Eliot Taylor and Ben van der Waal.

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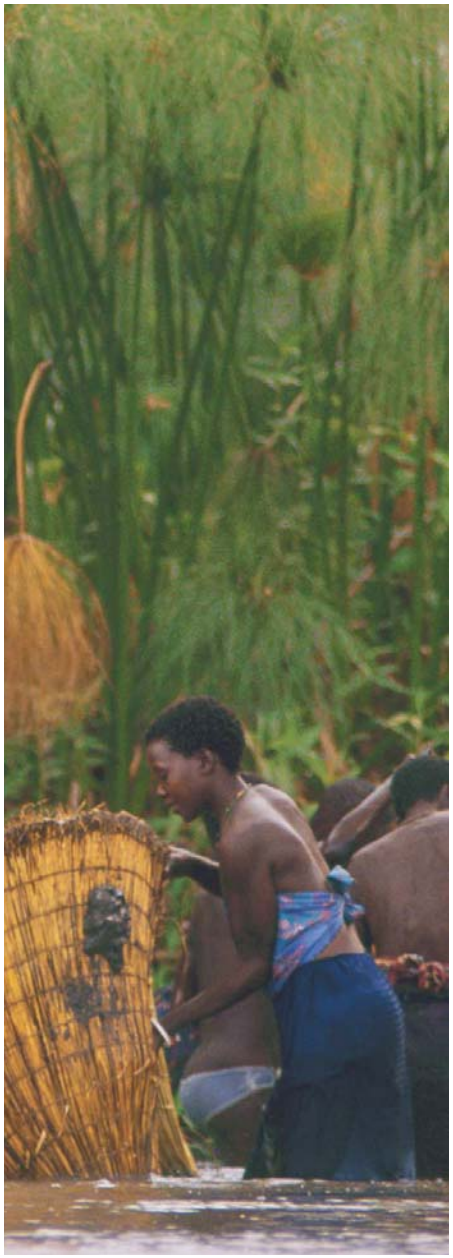
Okavango Delta: Floods of Life was produced under the auspices of an agreement between IUCN and HOORC, and the *Biokavango* project of the Botswana government, the Global Environment Facility (GEF) and United Nations Development Program (UNDP); the UK DEFRA Darwin project *Monitoring and Simulating threats of aquatic biodiversity in the Okavango Delta* undertaken at the University College of London; and the Southern African Institute for Aquatic Biodiversity (SAIAB).

Recommendations to produce this book stem from a long-standing wish of staff at HOORC to have such a volume published and the IUCN project which produced the report *The Status and Distribution of Freshwater Biodiversity in Southern Africa*, published in 2009.

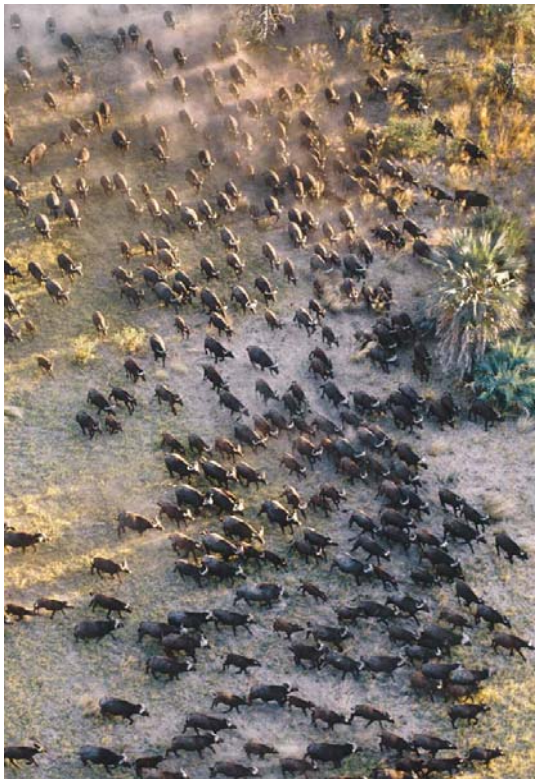


1 Introducing the Okavango Delta

The Delta of the Okavango River means different things to different people: a wonderland to some, a wetland or wildlife paradise to others, and for many it provides for wealth and welfare.

Few natural places in the world offer so many goods, assets and services in combination with such aesthetic appeal. And all of this happens in an incongruous setting lying in the centre of a flat, semi-arid landscape of sand that stretches almost three thousand kilometres from north to south, and over one thousand kilometres from west to east. Much of it is called the Kalahari Desert, and for its setting the Delta has been aptly named the jewel of the Kalahari, which is the title of another book that portrays the beauty and intricacy of the Delta.[1]

Several other books, and many magazine articles and documentary films have been devoted to its magic, their pages and footage filled with striking images of spectacular animals, plants and scenes. These images on film and paper have carried the fame of this natural asset out into the world. Each year, the Delta attracts tens of thousands of tourists from many countries on several continents.



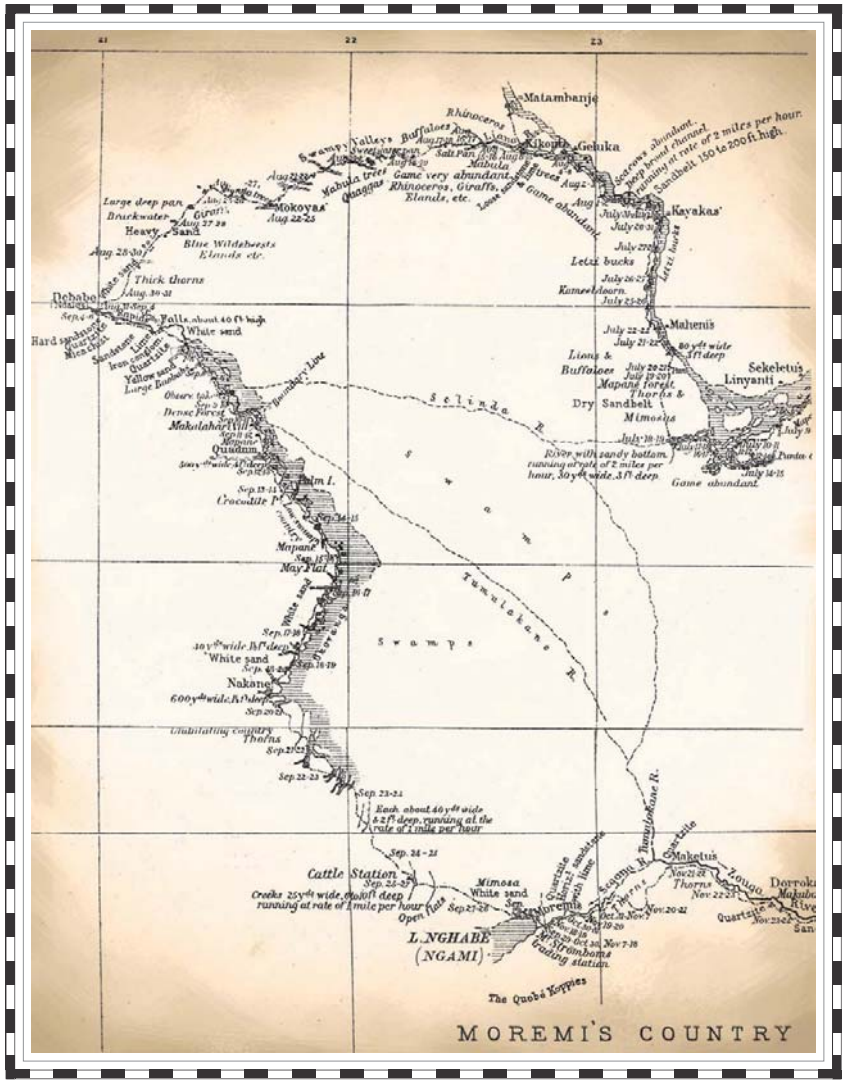
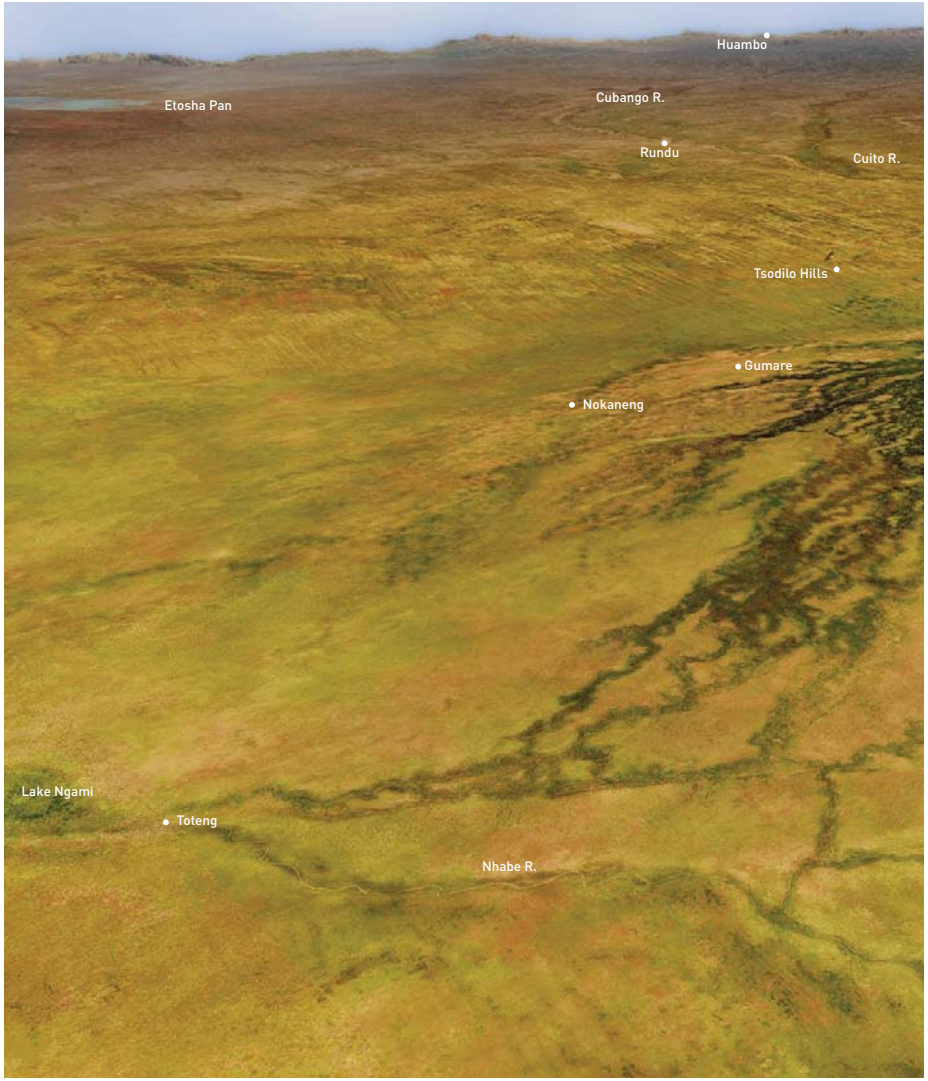


Figure 1 | *David Livingstone and his co-explorers, William Cotton Oswell and Mungo Murray, were probably the first westerners to record their visits to the Okavango-Ngamiland region when they reached Lake Ngami in 1849.[2] Their 'discovery' was immediately followed by visits by many other explorers, hunters and traders, including those by Charles John Andersson and Thomas Baines. The earliest maps only documented features on the edges of the Delta, such as the Boteti and Thamalakane Rivers, Thaoge Channel and Khwebe Hills, and the Linyanti and Zambezi Rivers to the north. Although Livingstone had been told by local people that the country was 'full of rivers', it took explorers and cartographers several decades to comprehend the details of what lay inside the Delta. The map shown here was published in 1897 after a journey of exploration by Aurel Schultz and August Hammer. Theirs was the first map to show the Okavango River (given as* Okovanga*), and they inferred the rough courses of rivers through the Delta, naming them the Selinda and Tumulakane.*

While its margins became known to many visitors, the nature and extent of the Delta largely remained a mystery until 1905. This is when the explorer Siegfried Passarge published his Das Okawango-sumpfland und seine Bewöhner *(The Okavango swamps and its inhabitants). The book included the first map showing the approximate shape of the Delta and its network of waterways.*



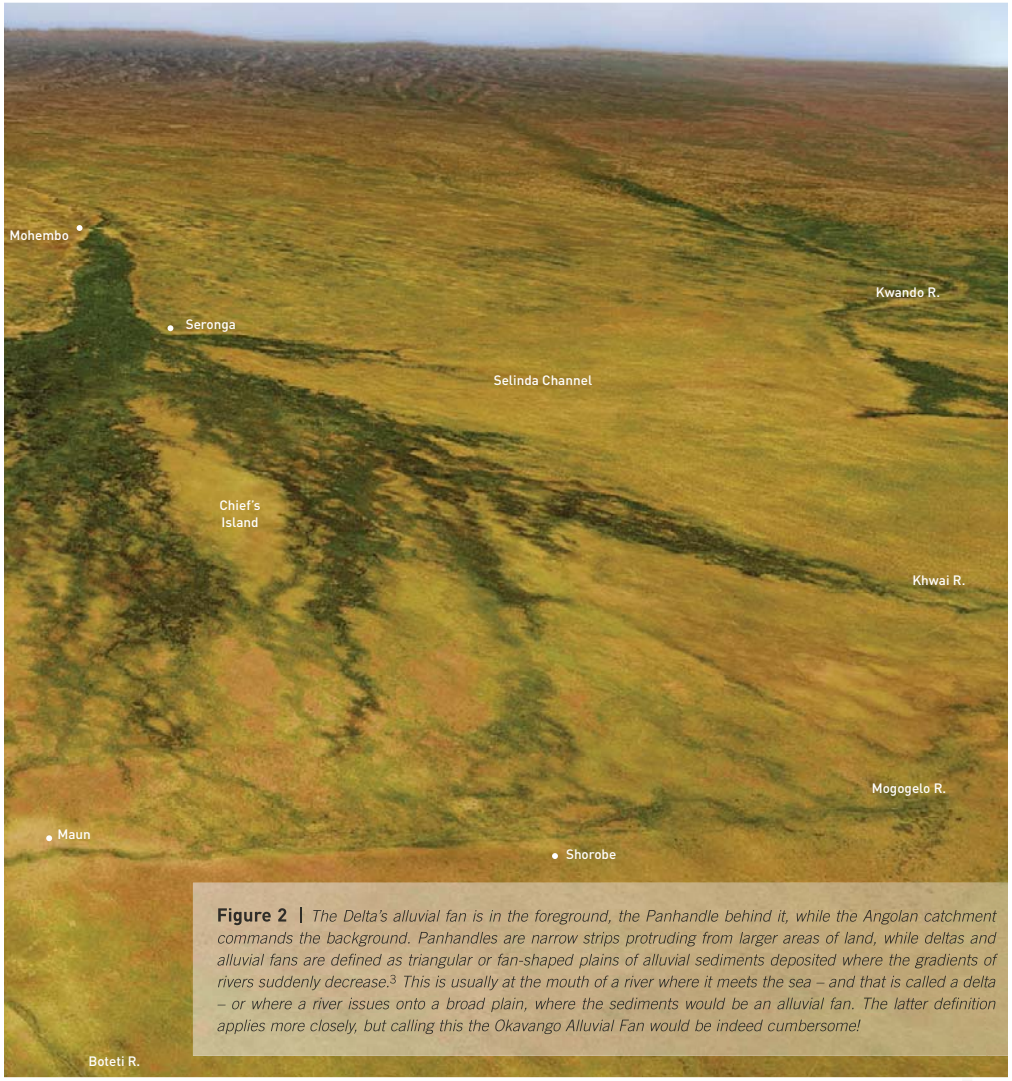


Figure 2 | *The Delta's alluvial fan is in the foreground, the Panhandle behind it, while the Angolan catchment commands the background. Panhandles are narrow strips protruding from larger areas of land, while deltas and alluvial fans are defined as triangular or fan-shaped plains of alluvial sediments deposited where the gradients of rivers suddenly decrease.*[3] *This is usually at the mouth of a river where it meets the sea – and that is called a delta – or where a river issues onto a broad plain, where the sediments would be an alluvial fan. The latter definition applies more closely, but calling this the Okavango Alluvial Fan would be indeed cumbersome!*

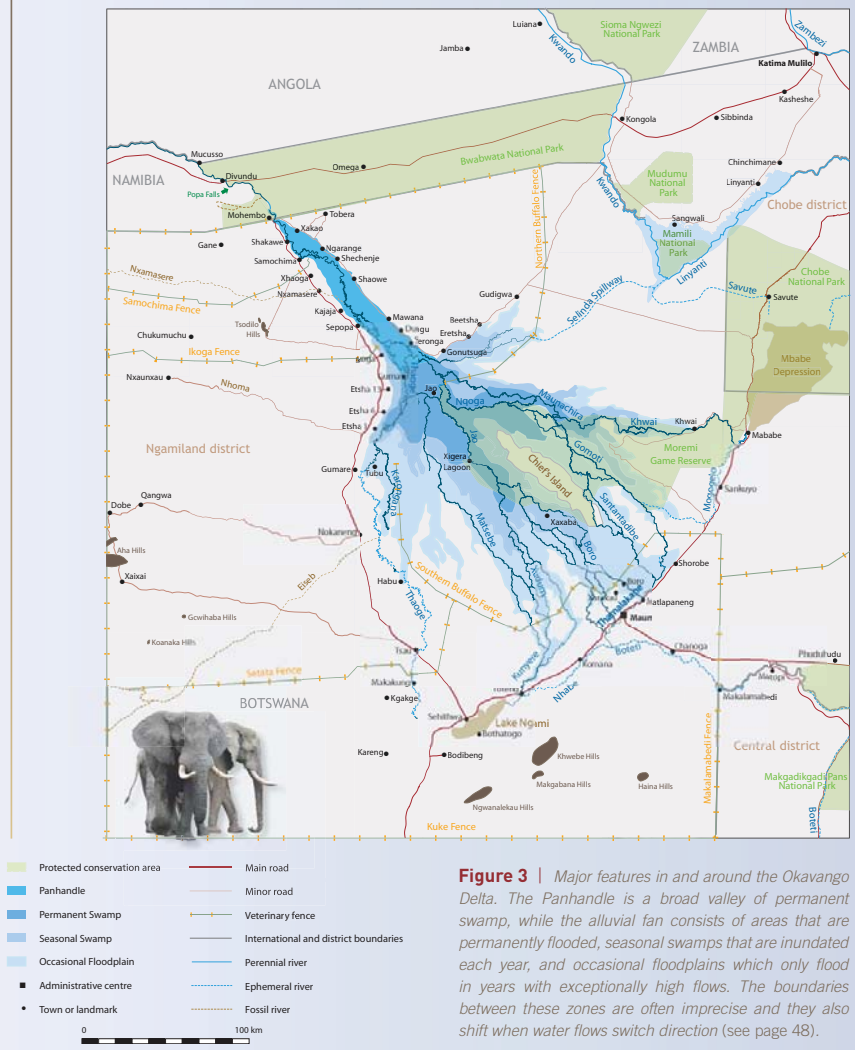


Figure 3 | *Major features in and around the Okavango Delta. The Panhandle is a broad valley of permanent swamp, while the alluvial fan consists of areas that are permanently flooded, seasonal swamps that are inundated each year, and occasional floodplains which only flood in years with exceptionally high flows. The boundaries between these zones are often imprecise and they also shift when water flows switch direction* (see page 48).

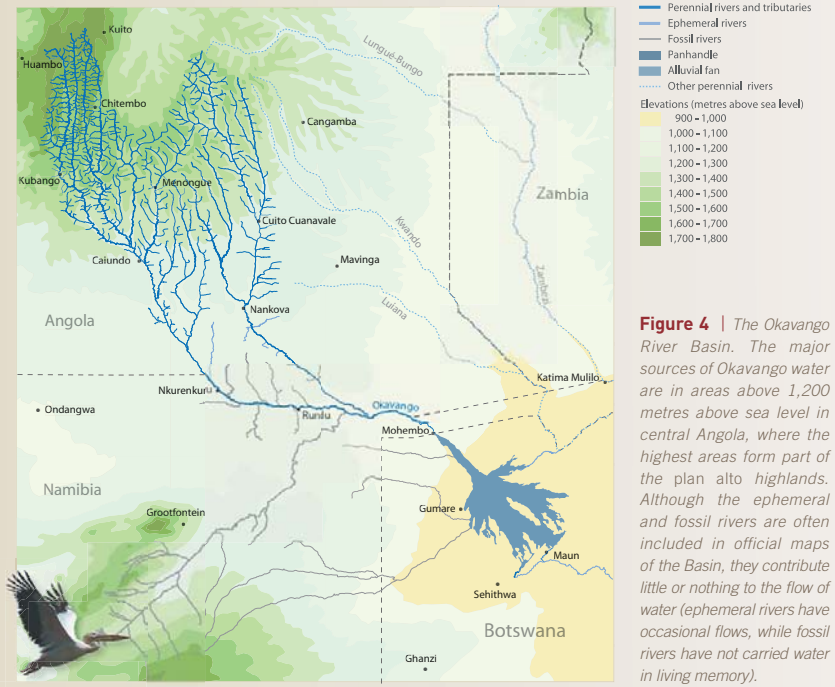
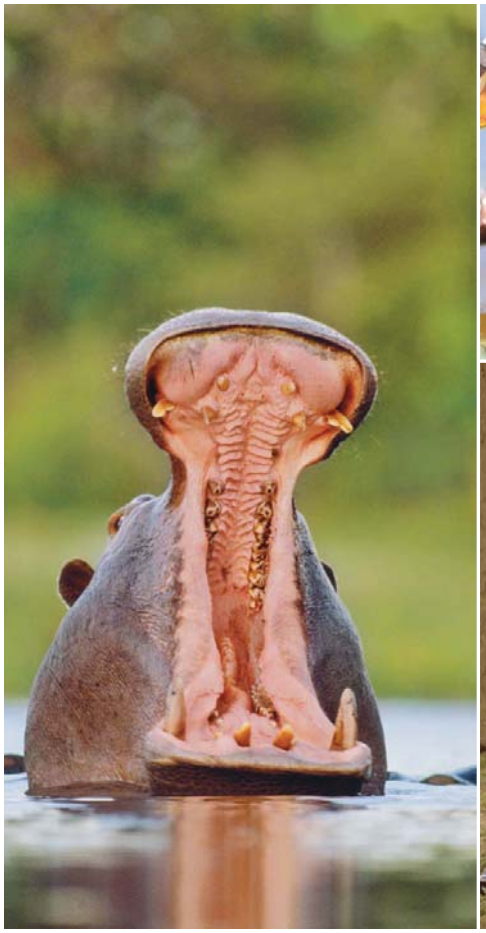


Figure 4 | *The Okavango River Basin. The major sources of Okavango water are in areas above 1,200 metres above sea level in central Angola, where the highest areas form part of the plan alto highlands. Although the ephemeral and fossil rivers are often included in official maps of the Basin, they contribute little or nothing to the flow of water (ephemeral rivers have occasional flows, while fossil rivers have not carried water in living memory).*

Compared to other freshwater environments, the Delta is thus well known as a spectacle rich in wildlife, especially in the minds of devotees to wild places and nature. But much less is generally known about the origins of the Delta, its functioning, the major processes that give it bountiful life, what threats it may face in the years ahead, and what can be done to meet challenges that may compromise its future. And limited information about its workings is available to people who may influence that future, for example those who determine how water in the Delta's catchment is used or abused.

Okavango Delta: Floods of Life is a celebration of the Delta's living wealth, but it specifically aims to do three things.

The first is to explore how the Delta functions. Much of our search is synthesised from the findings of hundreds of scientists who have given years of study to the Delta. The book describes the catchment areas in Angola and the passage of the Okavango River through Namibia. This is where the quality, volume and timing of water flow entering the Delta is determined. Once water reaches the Delta, various processes govern the distribution of flows across the alluvial fan. Some processes are physical, dependant on slope, sedimentation, faults and channels fixed long ago in the sands of the Kalahari. Yet others are driven by biological agents, principally by such divergent organisms as papyrus, termites and hippos. The effects of all these processes also change, and so the spread of water varies from one season to the



The Delta immediately evokes water and wildlife. But there is so much more: a meeting between wetland and dryland, a rich reservoir of nutrients, engineering processes that move water from one place to another and keep the water fresh; a patchwork of diversity of habitat and life forms; three countries, each with separate perspectives and influences on the Okavango River and its Delta; high economic values that move people of the Delta from subsistence lifestyles to ones enmeshed in cash-based services; one of the world's most pristine river systems; and tangible proof of good governance.

next, and across longer scales of time that range from tens to thousands of years. In short, the flow of water is extremely variable and unpredictable.

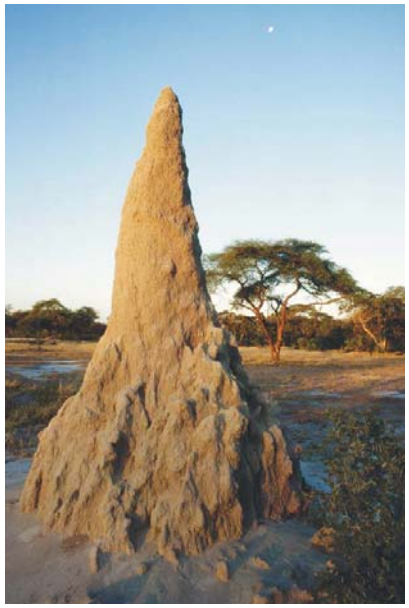
Pulses of water coming down from the catchment are critical to the functioning of the Delta. But the rich production of plants and animals is only possible when – and where – the waters mix with layers of nutrients to mobilise these molecular constituents of food and form. Without abundant nutrients, the waters of the Delta would be sterile, and so it is this dynamic mix of water and nutrients, ever shifting from one place to another, that holds the key to the wealth of biological production and diversity.

A second aim of this book is to emphasize the values of the Delta that stem from the rich life found here. This wealth has been recognized by the international Ramsar Convention, which has distinguished the Delta as a wetland of 'significant value for Botswana and … for humanity as a whole … because of its international significance in terms of ecology, botany, zoology, limnology or hydrology'.[4]

Not only is the Delta an oasis of water, but also one of high biological diversity with more than 400 species of birds, about 1,300 plants, 71 fish and tens of thousands of invertebrate species, for example. What is significant about these organisms? Where else in the world are they found? On what habitats do they depend, and what factors determine their abundance? What assets, resources, products and services are provided by the Delta's biota, and what or whom do they benefit?

What needs to be done to secure the future of the Delta? To address this question is the third purpose of *Okavango Delta: Floods of Life*. Although this Kalahari wetland is isolated from other expanses of freshwater, it is by no means immune to various external threats. There are also local challenges brought about by economic activities that take place in and around the Delta. Most of these relate to the way in which the people of the Delta live and regard its resources.

A range of approaches and activities need to be employed if the Delta is to continue to serve its people, the citizens of Botswana and the international community. Reliable information is needed to assess the nature and degree of threat posed by the many challenges. Since many of the threats are constantly changing and ever increasing, it is important to monitor the health of the Delta so that detrimental impacts can be identified as early as possible.



The elevated mounds of termites later become wooded islands which are crucial in adding to the diversity of habitats in the Delta and maintaining its fresh water.

Such technical assessments and measurements are necessary, but alone they are not sufficient. The challenges facing the Delta derive ultimately and proximally from economic interests, which are usually cloaked in the languages of politics and business. The choice for conservation thus needs to be backed by political will.

All who have an interest in the Okavango Delta need a common purpose and tongue if they are to preserve this valuable oasis of water, wildlife, wealth and welfare. We hope that this book will contribute to the development of this common language and understanding.

Across a fire-scarred Panhandle to the woodlands that line its western edge, and to the Tsodilo Hills in the distance.

2 Shaping the Delta

Whereas the great majority of rivers in the world flow to the sea, the Okavango River ends in its Delta, right in the middle of the southern African continental landmass.

The Delta is close to the lowest point and centre of the Kalahari Basin (Figure 5). Most of the basement rocks beneath the Kalahari and the Delta were formed long ago from sediments that were forced and folded upwards from the floor of an ancient ocean about 700–550 million years ago. Extreme pressure and heat turned the marine sediments into metamorphic rocks of the so-called Damara Group. Overlying the Damara Group rocks are more recent fluvial, aeolian and volcanic rocks of the Karoo Group deposited from 300–180 million years ago. All these basement rocks are now hidden beneath the surface, except as isolated landmarks, such as the Khwebe Hills south of Toteng and the Tsodilo Hills west of Sepopa (*see* Figure 3, *page 14*).

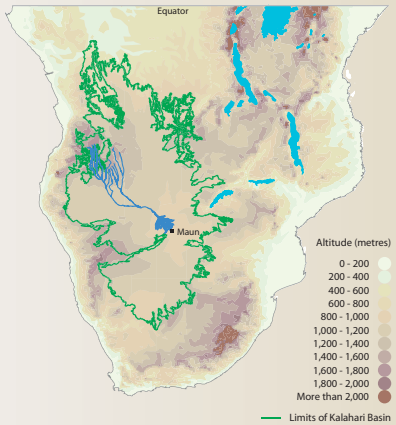


Figure 5 | *The Kalahari Basin is a vast sea of sand extending 3,000 kilometres from the northern Cape, across most of Botswana, through much of Angola and up to the Democratic Republic of Congo. From west to east, the Basin extends 1,500 kilometres at its widest.*

Two sets of faults in the basement have a marked impact on the flow and distribution of surface rivers and the shape of the Delta. Most of the first group are far to the north, where a series of parallel faults direct the flows of the Okavango, Cuito, Kwando and Zambezi rivers south-eastwards (*see* Figure 4, *page 15*). Extensions of these faults probably fix the orientation of the Panhandle, as well as the south-easterly flow of the Kwando River before it kinks into the Linyanti Swamps.

The second set of faults lies perpendicular to the first, and these control the position and shape of the Delta. The faults were formed by tectonic activity along a south-western extension of the East African Rift Valley. About two million years ago, faulting in this extension probably created two sub-basins in northern Botswana. One of these lies beneath the Delta, while the other sub-basin is found below the Makgadikgadi Pans. It is probably that rifting and collapse of the underlying basement that caused this broad trough, which encompasses the Delta and Makgadikgadi to be the lowest in the whole Kalahari Basin.

Other faulting along this extension of the Rift Valley is visible on the surface as the Gumare, Kunyere, Thamalakane, Linyanti and Chobe faults. The Gumare fault divides the Panhandle from the alluvial fan. The Kunyere and Thamalakane faults block water in the Delta from flowing further south-eastwards (Figure 7), forcing it to slow and therefore to spread. These two faults are fundamental in confining the Delta's alluvial fan.

The ridges that form the margins of the Panhandle rise about 20 metres above the swamp (Figure 6), and are sometimes thought to have been formed by faulting. However, it appears likely that the broad valley that confines the Panhandle was caused by erosion as the Okavango cut through, and deeper into the surrounding Kalahari Sands.

The Kwando/Linyanti has been shaped in the same way as the Delta, its flow to the south-east being halted by the Linyanti fault. As a result, the Kwando forms a mini-delta. Flows seep away progressively through the Linyanti Swamps to the

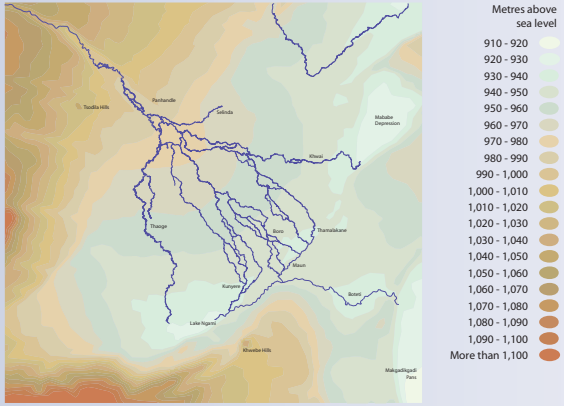


Figure 6 | *Although slopes down and across the Delta are very even, the deposition of sediments bought in by the Okavango River has led to the formation of a fan with a near-perfect conical shape, as shown in this map of elevations above sea level.*

BELOW: Popa Falls marks the real head of the Delta. As water tumbles over the Falls which are a nick-point in the Okavango River, its speed of flow slows and it is there that the river widens into the Panhandle and begins to deposit sandy sediments.

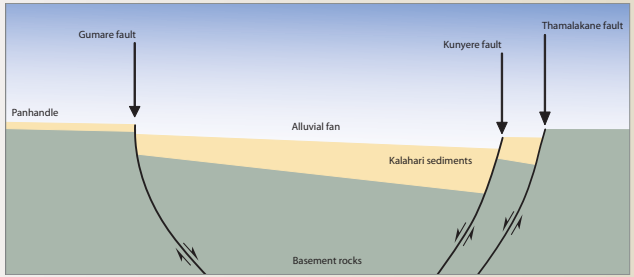
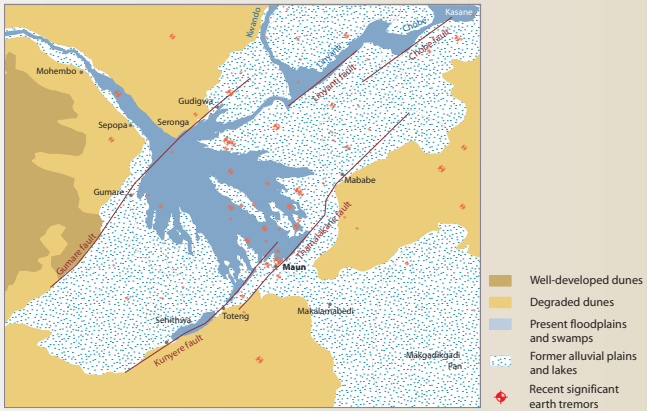
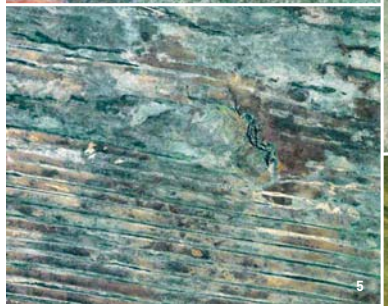
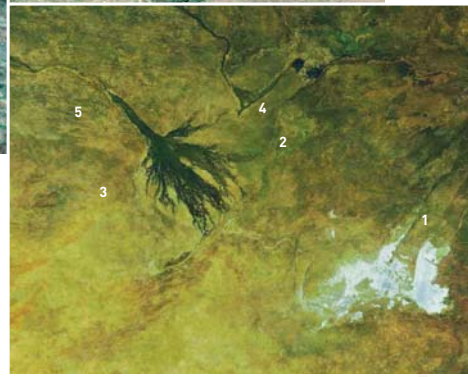


Figure 7 | *Cross-section through the Delta from north-west to south-east, showing the layers of rock and sediments, and the three faults that confine the alluvial fan.[1] Elevations along the Panhandle are extremely gentle, the river dropping only about 5 metres over a distance of about 150 kilometres. Over the next 150 kilometres or so from the Gumare to the Thamalakane Fault at the edge of the alluvial fan, elevations drop about 40 metres.*

Figure 8 | *The surface geology in and around the Delta includes well-developed sand dunes which formed during very arid conditions, as well as massive areas of alluvial sediments deposited during much wetter times by the Okavango, Kwando and Zambezi rivers. Recent earthquakes have ranged in magnitude from 2 (the smallest dots) to 6.7 on the Richter scale.[2]*







Some features around the Delta:[3]

1. The salt works in Sua Pan, which is part of the great Makgadikgadi Pans.
2. Mababe Depression; the colours reflect scars from fires at different times.
3. The sharp interface between the sand dunes and alluvial deposits of the Delta when it was much larger.
4. The Kwando River where it forms a mini-delta with the Linyanti Fault.
5. Tsodilo Hills; note how the linear dunes have packed up against the hills on the east.

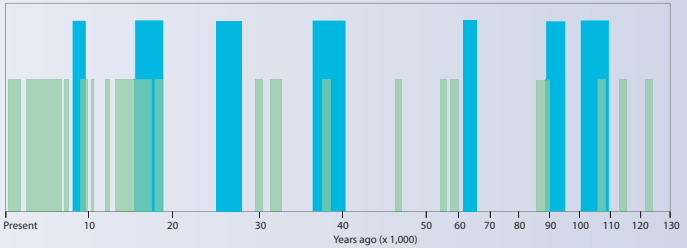
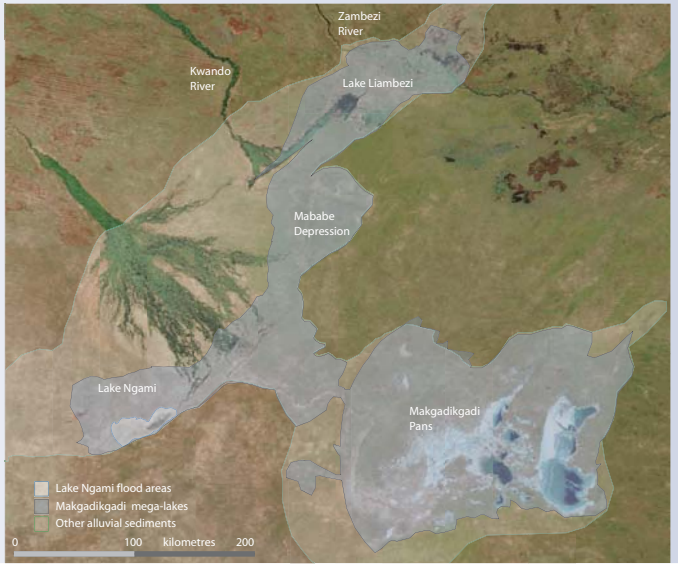


Figure 9 | Top: *Periods (blue bars) during the last 130,000 years ago when mega-lakes extended over Makgadikgadi and the low-lying areas around Lake Ngami, the Mababe Depression and across the eastern Caprivi, and phases (green bars) when Lake Ngami and its immediate surrounds were flooded. The extent of the mega-lakes (which covered some 66,000 square kilometres) and flooded areas around Lake Ngami (covering about 2,600 square kilometres) are shown in the map below. The map also depicts the extent of alluvial sediments deposited during other wet periods and when the flows of the Okavango, Kwando and Zambezi Rivers probably followed different courses.*[4]



north-east and sometimes reach Lake Liambezi. Further east, the Chobe fault controls the position of the Chobe River, which is a backwater of the Zambezi River.

The whole Kalahari Basin now has a remarkably flat surface, which drops gradually from its margins towards the centre. Its flat surface is a consequence of the Basin being filled steadily with sediments over the past 65 million years. Several hundred metres of layered sediments are to be found in places. For example, the Delta lies on top of 100 to 270 metres of deposits.[5] The sediments laid down during the first 63 million years were mainly alluvial, carried into the Basin by large rivers that left their deposits in massive lakes and deltas. The remnants of these now lie deep below the present surface, which, by contrast, was largely shaped by aeolian deposits of wind-blown sand during much more arid conditions over most of the last two million years.

But even during these drier two million years, other rivers bigger than the Okavango have flowed into northern Botswana, leaving behind alluvial sediments over an expanse of about 120,000 square kilometres around the Delta and Makgadikgadi Pan **(Figure 9)**. That area is about ten times bigger than the present Delta. For example, the Zambezi possibly ran here as recently as 50,000 years ago, before being captured by a river that had cut its way back from the east coast.[6] An older course of the Kwando also probably flowed into what is now the Delta.[7]

The Okavango Delta and northern Botswana have therefore looked very different from what we see today. At times dominated by aridity, these areas may have been very similar to the Namib Desert in appearance, while in wetter periods huge expanses of water in lakes, pans and perhaps other deltas have characterized the landscape.

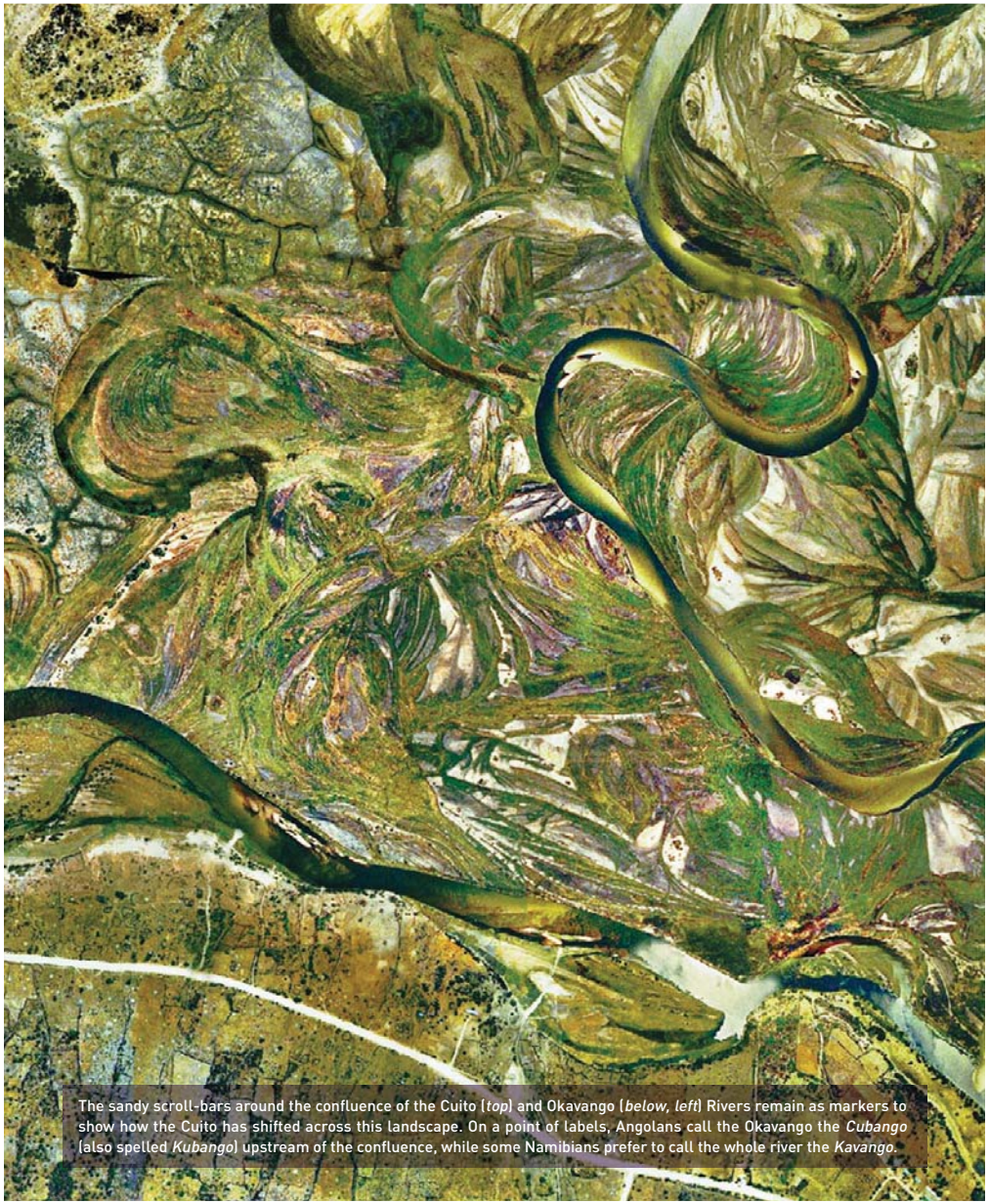
How old is the Delta? This is difficult to answer, given the variety of rivers, courses and volumes of water that have flowed into northern Botswana over millennia. However, if we define the Delta as the fan of water now confined by the Kunyere and Thamalakane faults, it is perhaps relatively young, since those barriers seem to have developed no more than 120,000 years ago. We presume this because extensive older alluvial sediments have been identified to the south and east of the present faults, suggesting that water then flowed beyond the present limits of the alluvial fan.[8]

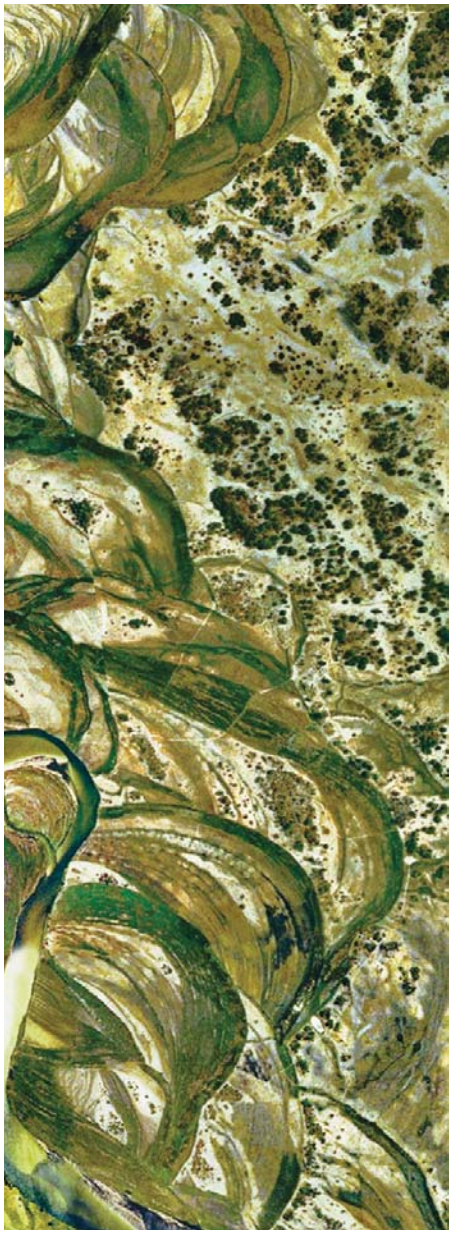
In the same way that climates change, tiny tectonic movements may cause subtle changes in elevation which result in significant changes in the distribution of flows across the Delta (*see page 51*). Most of the dozens of tremors in the area have been small **(Figure 8)** but one at Maun in 1952 measured 6.7 on the Richter scale.

The repeated flooding and drying of the Delta and its adjacent areas over hundreds, even thousands of years may be considered a matter of academic interest. However, that history and the confinement of flows has led to the accumulation of nutrient resources in and around the Delta. Each flood brought with it more of these chemical constituents of life. Nutrients blown in by wind were trapped in the water, and faecal matter from animals attracted to the water and its associated floodplain pastures likewise enriched the Delta. The key point is that the rich nutrient supplies took a very long time to accumulate here, unlike the fresh supplies of water which arrive to re-flood the Delta year after year. Maintaining the productivity of the Delta thus requires the protection of both the supply of water and the age-old base of nutrients.

KEY POINTS

1. The Delta lies near the lowest part of the vast Kalahari Basin which stretches over 3,000 kilometres from north to south and up to 1,500 kilometres east to west.
2. The Basin is largely filled with aeolian and alluvial sediments that lie on basement rock formations.
3. Faults lying north-west to south-east in the basement rocks control the flow of the Okavango River south-eastwards towards the Delta.
4. Other perpendicular faults – the Gumare, Kunyere and Thamalakane faults – confine the alluvial fan of the Delta.
5. Climates and the extent of the Delta and other bodies of water in northern Botswana have changed radically. There have also been dry periods when the Delta was probably covered by sand dunes.
6. As a result of flooding, nutrients have accumulated progressively over a long time in the Delta's sediments and those of adjacent areas flooded by much larger lakes.





The sandy scroll-bars around the confluence of the Cuito (*top*) and Okavango (*below, left*) Rivers remain as markers to show how the Cuito has shifted across this landscape. On a point of labels, Angolans call the Okavango the *Cubango* (also spelled *Kubango*) upstream of the confluence, while some Namibians prefer to call the whole river the *Kavango*.

3 Okavango River: flow of a lifeline

For most people, the word Okavango brings the Delta to mind, a place given prominence by the public media and tourism, and renowned for its rich wildlife.

However, there is another part to the Okavango that should enjoy equal fame. This is the Okavango River's catchment, much of which consists of tens of thousands of square kilometres of the most pristine wilderness in an area once appropriately known in Angola as *terras do fim do mundo* – the land at the end of the earth. Moreover, the wealth of the Delta depends largely on the health of the catchment. The future of the Okavango Delta is thus rooted in the future of the Okavango River!

The whole Okavango River Basin is divided into three zones: the northern catchment from which water actively drains, the middle-reaches through which the Okavango River flows without collecting significant runoff, and then the Delta (Figure 10). The northern area lies entirely in Angola and receives much higher rainfall than the middle zone, which is in southern Angola and Namibia. In addition to the differences in rainfall, there are also substantial changes in the use of land, demography and recent history across the whole Basin. All these aspects have direct or indirect bearings on the Delta.

The northern catchment spans an area of about 400 kilometres from east to west and 500 kilometres from north to south, and is divided into two sub-catchments. The western, or Cubango sub-catchment is relatively hilly and characterised by outcrops of granites, ferasol soils and Kalahari sands, while the eastern, Cuito sub-catchment consists almost entirely of Kalahari sands that blanket a flat landscape. Respectively, the two sub-catchments contribute about 55% and 45% of all the water that flows to the Delta, but their flow regimes are quite different (Figure 11). Those flows coming off the western, higher areas are more rapid and aggressive, water running downstream soon after rain has fallen. Sharper increases in inflow to the Delta are therefore mainly of water coming from the Cubango and its major tributaries: the Cutato, Cuchi, Cacuchi, Cuebe and Cueio Rivers.

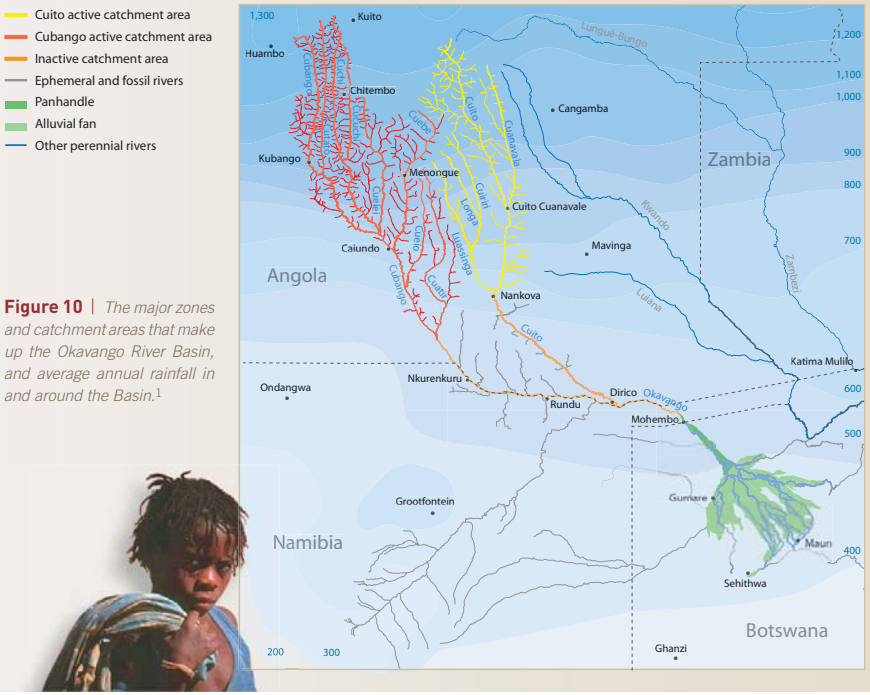


Figure 10 | *The major zones and catchment areas that make up the Okavango River Basin, and average annual rainfall in and around the Basin.*[1]

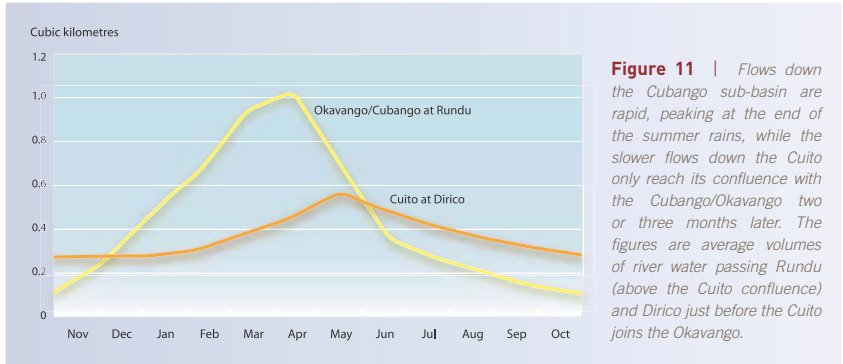
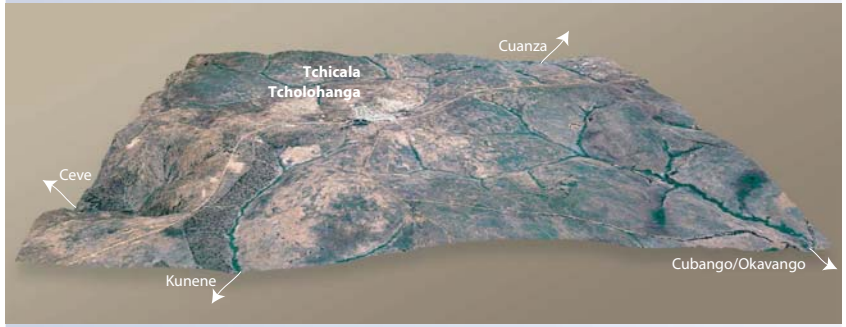
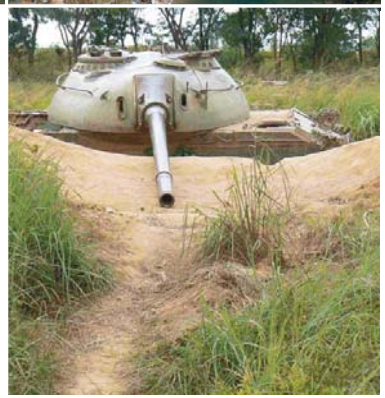


Figure 11 | *Flows down the Cubango sub-basin are rapid, peaking at the end of the summer rains, while the slower flows down the Cuito only reach its confluence with the Cubango/Okavango two or three months later. The figures are average volumes of river water passing Rundu (above the Cuito confluence) and Dirico just before the Cuito joins the Okavango.*



The Okavango River starts its journey to Delta just outside the small town of Tchicala Tcholohanga on the *plan alto* (highlands) of Huambo Province, Angola. Remarkably, the small hill where the town was built is also the source of three other major rivers. These, and the Okavango flow in quite separate directions: the Kunene River to the south-west and its eventual mouth in the Atlantic Ocean, the Ceve north-west to its mouth at Port Amboim on the Atlantic, the Okavango south-east to the Delta, and the Cutato (a major tributary of the Cuanza) north-east and then westwards to the Atlantic just south of Luanda. The river basins associated with the four tiny tributaries fanning out from small hill at Tchicala Tcholohanga thus cover hundreds of thousands of square kilometers of Angola, Namibia and Botswana.

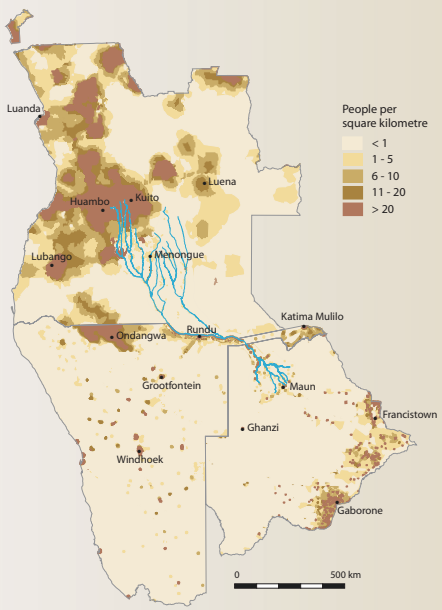


Images of Angola: Many rivers are flanked by wide grassy floodplains (*top left*), while their meanders are often so broad that the crystal-clear waters flow sideways as much as they do downstream (*bottom left*). Hundreds of kilometers of valley marshlands are dominated by papyrus which filters out nutrients, clays and sandy sediments (*top right*). Maize, cassava, bananas and various vegetables are grown in *onaka* fields along tiny tributaries (*2nd from top right*), while rivers provide the only water for most villagers to wash their clothes (*3rd from top right*). Remnants of the civil war, which ended in 2002, are scattered across the catchment (*bottom right*).

Images of Namibia: The well-wooded islands at Andara have not been cleared because they are the traditional burial grounds of Hambukushu chiefs (*top left*), but most riverine vegetation has been cleared for crops elsewhere (*middle left*). The Okavango flows along a narrow, steep-sided valley in some stretches, while elsewhere it meanders across broad floodplains (bottom left). Most tourist lodges (*top right*) are near Rundu or within 50 kilometres of Mohembo. Goats and cattle are much more abundant than in the Angolan catchment (*middle right*). The Namibian government intends to expand the current 2,200 hectares of irrigation to a potential area of 15,600 hectares.[2]

By contrast, flows from the Cuito sub-catchment provide a more sustained input of water to the Delta, since much of the water entering the Cuito and its major tributaries – the Longa, Cuanavale and Luassinga Rivers – is slow seepage from the surrounding Kalahari sands. Moreover, the Cuito and its tributaries meander across broad valleys that have only the slightest gradient. For example, the Cuito River drops just 85 metres over a straight-line distance of about 270 kilometres from Cuito Cuanavale to Dirico. And the flow of water is further slowed as it percolates through the broad floodplains of grasses, reeds and sedges that line the main channels of these rivers.

Figure 12 | *The density of people throughout the Basin and in Angola, Namibia and Botswana.*[3]



River water in both sub-basins is generally crystal clear. Very few suspended particles and dissolved substances – including nutrients – are carried in the water. Much of the purity is due to the substrate of Kalahari sand, which consists mainly of grains of quartz. Little can be dissolved from the inert quartz and the sands have been leached by relatively abundant rain over millions of years. Very few clay particles are therefore available to be washed into the river water. The paucity of suspended clay in the flow off the catchment is fundamental in maintaining the permeability of the Delta's substrate and its fresh water (*see page 55*).[4]

But there is another, less obvious reason for the clear, nutrient-deficient waters. This is the effect of the same vegetation that slows the speed of water. Many of the nutrients and suspended clay particles that do get into the water are filtered out by the plants. The floodplains are especially broad in the Cuito sub-catchment, but lots of the valleys in the Cubango sub-catchment are likewise congested with dense beds of reeds, as shown in the photographs on *page 30*.

Rainfall averages over 1,300 millimetres per year in parts of the catchment furthest to the north-west. From there it steadily declines as the river moves southward, until it averages 450 millimetres in the lowest reaches of the Delta (Figure 10). Almost all the rain falls during the summer months between October and April, with the highest falls in December and January in most areas. However, in the most northerly areas, rain often falls in two peaks, one in November-December and the other in February-March. As a result, there are often two peak periods of flow into the Delta (*see page 41*).

Average rainfall in the middle reaches ranges between 500 and 600 millimetres per year. This zone also consists of Kalahari sand into which rain readily percolates and so there is almost no run-off, even after very heavy thunderstorms. The Okavango River thus functions as a conduit in the middle reaches, channeling water from its upstream Angolan sources to Botswana and the Delta.

The river is very much a lifeline for many people living along this channel in the middle reaches. It

Dense, fairly tall Brachystegia or miombo woodlands cover gentle hills of red Kalahari sand in the upper catchment of the Cuito River and its major tributaries. Very few people live in this broad expanse of Angola.

waters their livestock and vegetable gardens and provides fish, reeds for houses and pastures for cattle. No other permanent surface water is available in the area, and so the value of the river for local residents is particularly high. This dependency on waters of the Okavango is quite different from conditions in the upper catchment where abundant rain means that people are less reliant on water from the thousands of tiny streams that feed the Okavango. Evaporation rates are also lowest in the upper catchment, and rain is therefore more effective in supplying the moisture needs of crops and pastures than downstream. Indeed, aridity further south is as much a consequence of very high rates of evaporation as it is of low rainfall. For example, evaporation per year in the middle reaches and around the Delta is about three to four times higher than average annual rainfall.

While most households in both the upper catchment and the middle reaches practise some kind of agriculture, a great many families do not depend on agriculture as a main source of income. Instead, additional incomes from wages, small businesses, pensions and remittances provide for most cash and food needs. The apparent paradox of rural, farming households relying on non-farming income is a consequence of two fundamental features throughout much of the Okavango River Basin.

The first is that conditions are poorly suited to agriculture: soils have low fertility; rainfall varies too much to produce good yields from such rain-fed crops as maize, cassava (manioc), sorghum and pearl millet; and pastures can not support large numbers of livestock.

Livestock diseases and crop pests also limit production, and so most families battle to harvest enough to meet their need for staples, let alone surpluses that might be sold to provide for their cash needs.[5]

Secondly, the scope for commercial production is limited by much of the Okavango River Basin being far from markets where occasional produce might be sold. Most people in all three countries are concentrated elsewhere in Angola, Namibia and Botswana, either in places better suited to farming or, increasingly, in towns and cities (Figure 12), and *see page 71* in Chapter 7. For example, less than 3% of the total Angolan population is in the Basin, while equivalent proportions for Namibia and Botswana are also small, respectively 7% and 5%.

Nevertheless, the highest densities in the northern parts of the Basin are indeed a consequence of the relatively good farming conditions there, at least compared to areas further south. Densities elsewhere in the Basin are generally low and there are large areas where there are no, or just a handful of people. Menongue, Rundu and Maun are the only major urban areas in the whole Basin. Rundu and Maun each have populations of over 50,000, while Menongue probably has between 30,000 and 40,000 people. All other towns and villages are very small, most having between several hundred and a few thousand inhabitants.

The comparatively high population densities on the southern banks of the Okavango River in Namibia are a consequence of unusual circumstances. Perhaps more than half of this population was born in Angola or was born in Namibia of immigrants from Angola who moved south to escape the Angolan civil war, particularly during the 1980s and mid 1990s. Many Angolans were also attracted by the relatively better economic opportunities and social services in Namibia.

A consequence of the comparatively small proportions of the Angolan, Namibian and Botswana populations is that each government pays less attention to services and development in the Okavango Basin than elsewhere. The centres of government in each country – Luanda, Windhoek and Gaborone – are also all remote from the Basin and its needs. With the notable exception of tourism to the Delta (*see page 81*), enterprises and resources that generate significant revenue are also far from the Basin: for example, services in Luanda, offshore oil, and diamonds in the Lunda provinces in Angola; and coastal fish and diamonds in Namibia,

Most homes are clustered in villages or small towns in the Angolan headwaters (*opposite page top*) and downstream around the Delta (*above*), whereas households are generally spread as solitary homes along the river valley in the middle reaches (*opposite page bottom*).

services in Windhoek and Walvis Bay, and tourism in western Namibia. As for Botswana, services are concentrated in and around Gaborone, while exports of diamonds and beef are mainly from the central and southern regions.[6]

These factors – small populations, remoteness and other economic interests – mean that the Basin enjoys less interest than it should. For Angola, much of the catchment remains inaccessible as the *terras do fim do mundo*. Plans for hydroelectric and large-scale irrigation schemes have often been suggested, but none has materialized. There are no dams of any significance on any of the Okavango's tributaries in Angola.

There are also no dams in Namibia. Despite the Okavango's poor soils and isolation from markets, the Namibian government's main interest in the river is for irrigation. This use is often justified with the assumption that Okavango water can be used to create Namibia's breadbasket. Although there have been dozens of agricultural development projects in recent decades, farming remains unproductive and irrigation projects only function with substantial subsidies of public funds. There have also been plans to pipe Okavango water

Fires often burn over south-eastern Angola, as shown so clearly in the photograph on the cover. Tall savanna woodlands are being reduced to shrubland in many areas, both by frequent, intense fires and by uncontrolled logging.

to the central regions of the country and to use the water for hydropower, but these have not been implemented. In summary, the Namibia government mainly sees the river water as a passing resource to be harvested before it is lost at Mohembo.[7]

Although some areas were proclaimed as hunting reserves by the Portuguese administration, no land within the Angolan catchment is now managed for environmental conservation. One small conservancy and the Bwabwata National Park, which includes a stretch of about 20 kilometres of the Okavango River, are the only conservation areas in Namibia. In Botswana, by contrast, most land in and around the Delta is under conservation management, either in the Moremi Game Reserve or as wildlife management areas (*see page 79*). Likewise, there is almost no tourism in Angola, significantly more in Namibia, and then a substantial tourism industry in Botswana (*see page 81*).

Almost all land in the Basin is formally owned by the state, and except for national parks, government and private farms, formal urban areas and concessions areas, most land is settled and used as communal land. Access to this land is largely controlled by traditional authorities in Angola and Namibia where neither the state nor traditional authorities place effective limits on the use of commonage resources. In Botswana, access to land is controlled by land boards, and the use of commonage resources is controlled to some extent in designated wildlife management areas. Nevertheless, it is generally in everyone's interests to exploit commonages maximally throughout the Basin (*see page 79*). Wealthy residents who have lucrative off-farm incomes graze as many animals as they can manage, often

at the expense of poorer folk who subsist entirely on farming. A lack of control over commonages also leads to excessive clearing of virgin land (some of which is never used for cropping), run-away fires, and logging.

Recent history has treated residents of the Basin in the three countries quite differently. Angola recently emerged from a long period of strife that began with its war of independence from 1961 to 1975 which was then followed by a civil war from 1976 to 2002. And before those 41 years of turmoil, Angolans suffered from centuries of forced labour and slave trading. Namibia has had an easier, calmer past, although it too endured several decades of armed struggle for liberation from South African administration, which ended with independence in 1990. Botswana has had the most tranquil history, being the first to gain its independence in 1966 and having never had a war. Its government has been stable, and has enjoyed a reputation for service delivery and respect for human rights.

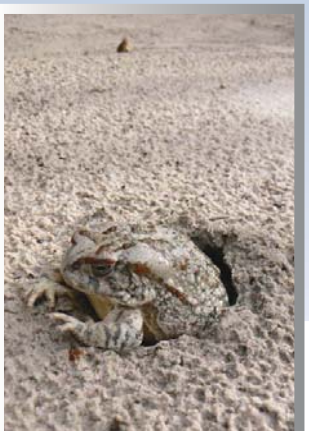
People in the upper catchment have thus endured the most violence, the highest levels of insecurity and the poorest public services. Moving downstream, history has been kinder in Namibia, and even gentler in Botswana. Together with these differences, the value of water increases downstream from Angola to Namibia and Botswana as the Okavango River enters environments that are progressively drier. Likewise, the value of tourism and wildlife also increases downstream because each of the three countries has done more to promote tourism than its upstream neighbour. The Okavango River is most attractive as an oasis downstream, and nutrient resources that support wildlife are most plentiful in the Delta. The downstream Delta is the part of the Basin managed most effectively for conservation, but it is at the mercy of activities in the upstream Basin where incentives for environmental management have yet to develop. Creating incentives to manage the whole Basin wisely is one of the greatest challenges for people who value the Delta.

KEY POINTS

1. At the terminus of the Okavango River Basin, the Delta depends on the healthy flow of water from its catchment in Angola and the safe passage of water through Namibia. What is called the Okavango is therefore much more than the Delta.
2. About half of the Delta's inflow comes from the Cubango sub-catchment and the other half from the Cuito and its tributaries in Angola. Flows down the Cubango are quite rapid, whereas slower run-offs down the Cuito reach the Delta later.
3. Water flow is slowed and filtered by large expanses of reeds and floodplain grasslands that line the major tributaries and rivers in Angola.
4. Although rural households farm with crops and livestock, off-farm incomes from wages, business earnings, remittances and pensions usually provide for most of their livelihood needs.
5. Small proportions of all people in Angola, Namibia and Botswana live in the Okavango River Basin, and each country's greatest economic and political interests lie outside the Basin.
6. Although agricultural and hydro-power developments are often proposed in the Angolan catchment, much of it remains undeveloped and prisitine. Namibia often sees the Okavango's waters as a transient resource to be harvested before entering the Delta.
7. Waters of the Okavango gain increasing value as they flow downstream. History has treated residents of the Basin more kindly downstream, where the waters have greatest value for tourism and wildlife.

4 The functioning Delta

Some people compare the Delta to an organism. Water enters the Delta through its mouth and oesophagus, the Panhandle. Further down, arterial channels distribute water across the alluvial fan.



Island plants work as kidneys to remove salts. Sediments accumulate as plaque in the channels, later creating blockages equivalent to clots in the arteries. When water is forced to bypass the blockages, new channels are formed which feed water to places that have not recently been flooded. And like body fat reserves, nutrient resources have accumulated in these places over very long periods.[1]

This chapter explores three of these metaphorical systems in some detail. The first is the blood system, to develop an understanding of how water is distributed across the Delta, and how the spread of water varies in time and space. Second, are the processes that remove salts and keep the waters of the Delta fresh. Third, are the fat or nutrient reserves, to see where they come from, how they are stored and how they are mobilised to produce the wealth of life that characterises the Delta.

The flow of water

Flows into the Delta through the Panhandle are usually smallest between September and November when they are about five times lower than the highest volumes of water coming in between March and April (Figure 13). In many years there is also a small, early surge in December or January which is then followed several weeks later by the main seasonal peak. The first pulse comes very largely from the Cubango sub-catchment (*see page 28*) because its flows are rapid and it often receives early rains before a short dry spell in mid-summer, while the later inflows come from both the Cubango and Cuito sub-catchments. Those from the sluggish Cuito contribute progressively more water as the year wears on, especially during winter and autumn. But overall, the two sub-catchments provide roughly equal proportions of all water flowing into the Delta (see Figure 11, *page 29*).[2]

The gauging station at Mohembo where Botswana measures the volume of water entering the Delta.

Seasonal changes in water levels, reaching up to two metres, are greatest in the Panhandle because the spread of water is confined by dense reeds and the elevated margins either side of the Panhandle. From there, fluctuations progressively decline downstream as the water spreads out across the alluvial fans. However, levels along the Kunyere and Thamalakane faults also change substantially during the year because of the damming effects of the faults (*see page 20*).

Having entered Botswana, water takes one to two months to meander through the main 190 kilometre-long channel of the Panhandle from Mohembo to Seronga. And from the head of the alluvial fan at Seronga, the water then takes another two to three months before reaching the lowest, most distal reaches of the Delta along the Thamalakane, lower Kunyere and Khwai Rivers. Flows in the Thamalakane River at Maun are thus highest in July, August and September (Figure 14). The distance along the shortest path of flow from the top of the alluvial fan to the Thamalakane is 210 kilometres.

Water flow is most obvious along the many channels throughout the Delta. These are widest in the Panhandle and in the apex of the alluvial fan, whereas the channels narrow progressively downstream into the fan. They also become increasingly liable to closure and being diverted in new directions, as we shall see below. Flows in the channels are relatively rapid: usually at speeds of 120 to 300 centimetres per second in the Panhandle, 40 to 80 centimetres in the major channels of the alluvial fan, but only 10 to 20 centimetres per second in the small, distal channels.

While water is most conspicuous in the channels, there is also considerable leakage from the channels into the surrounding back swamps and

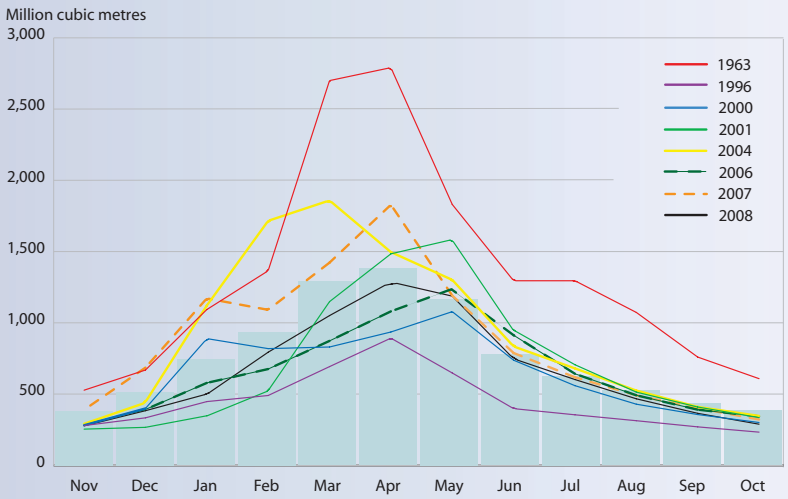


Figure 13 | *Average monthly flows of water measured at the head of the Delta at Mohembo* (blue columns), *and examples of flows each month for a number of years. Note how peak flows are early in some years and later in others, and how flows in the dry season are much more consistent than those during periods of high flow. The highest recorded inflow was in 1963 while the lowest was in 1996.*[3]

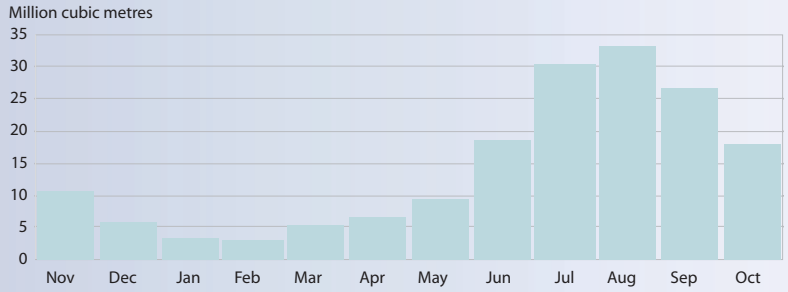


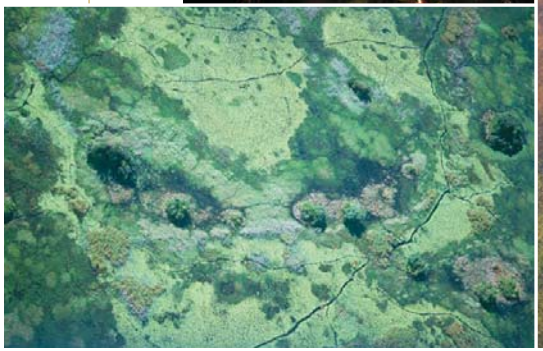
Figure 14 | *Average monthly flows at Maun, showing how levels in the Thamalakane are highest several months after the peak intakes at Mohembo. These are averages, and in many dry years no water reaches the Thamalakane. Note that the y-axis scale covers a tiny range compared to the scale for Mohembo above.*

floodplains. Some of this is through long tunnels maintained by hippos under the papyrus that lead between the channels and isolated lagoons or lakes. But most leakage is through the permeable margins of the channels from where water slowly percolates out through the extensive beds of papyrus, reeds and sedges. Here the flows are extremely sluggish – at less than 1 centimetre per second – as a result of the hindering effects of plants and shallow gradients, which become ever gentler away from the main channels.

Much of the water that filters into back-swamps remains there until it eventually evaporates, is transpired into the atmosphere by plants or seeps away into the ground. The rates of infiltration can be high, amounting to between 10 and 40 centimetres of water per day as a result of the predominance of permeable Kalahari Sand.[4] As we will see, this percolation is a critical first step towards maintaining the Delta as a fresh-water system.

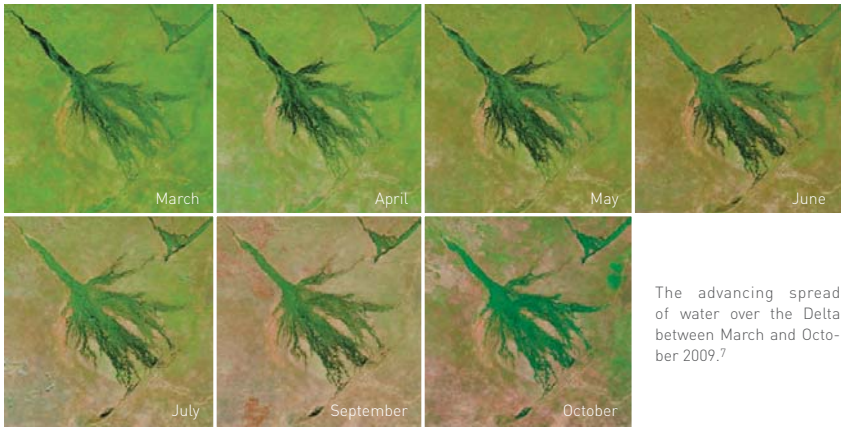
Annual variation in water flow and the extent of flooding

Flows into the Delta have been monitored since 1934. From these records, average intakes amount to 9.3 million cubic metres per year, which is equivalent to 9.3 cubic kilometres of water. The lowest intake of 6 cubic kilometres was in 1996 while the highest of 16.4 cubic kilometers was recorded in 1963 (Figure 13 and 15).[5] This variation is entirely due to year-to-year changes in rainfall in the Angolan catchment.



Hippo tunnels under the papyrus beds aid the distribution of water across the Delta, as do the many surface paths worn by hippos, elephants and other large mammals.

Many lakes or *madiba* (singular *lediba* in Setswana) lie along belts of ancient meandering channels that were subsequently blocked or diverted. The lakes are thus remnants of deep channels, and remain as open water because they are too deep for the growth of reeds, papyrus and other emergent vegetation.[6]



The advancing spread of water over the Delta between March and October 2009.[7]

Two features stand out in Figure 15. One is the high degree of year-to-year change, much of which appears erratic and unpredictable. Years of high flow may be followed with equal likelihood by further good intakes or by very poor flows. The second obvious pattern is the cycles. While these are made clear by the running average line, it is not that easy to determine their length or periodicity by eye. However, statistical analyses of these figures from Mohembo – as well as from rainfall at Maun and in western Zambia, water flows along the Zambezi River, and signatures of climate in stalagmites, pollen and tree rings – indicate that rainfall and river flows follow two cycles: one lasting from 16–18 years and another 60–80 years.[8] It seems that a new period of higher rainfall and greater inflow started during the mid-1990s, but whether this will continue over the next two or three decades remains to be seen.

Volumes of inflow largely determine the extent of flooding or inundation, so the spread of water is limited in years with low inflows, while the biggest and lasting flooding occurs when flows are highest. Examples from the interpretation of satellite images in Figure 16 show how the extent of flooding varies. Data obtained from those kinds of analyses and extrapolations from water inflows indicate that at the height of flooding an average of about 9,000 square kilometres is inundated. However, in 1996, which was the driest year on record, a maximum of about 5,300 square kilometres was under water, while about 15,500 square kilometres was flooded in 1963.[9] These are the extents of flooding at its maximum each year. Areas of inundation range between about 5,000 and 6,000 square kilometres during low water months before the annual pulse of inflow.'

In addition to inflow, the expanse of flooding in any one year is influenced by two other factors. One is the extent of inundation in the previous year, since flood waters spread further on top of existing sheets of water or if the soil is already relatively saturated. Rainfall over the Delta also affects flooding, both by adding to surface inflow from the catchment and by wetting the soil so that less new floodwater infiltrates the sands. Separating out these three influences on the extent of inundation shows that rainfall accounts for 21% of the variation in flooding each year, the extent of previous inundation explains another 1%, while inflows account for the major share of variation: 49%.[10]

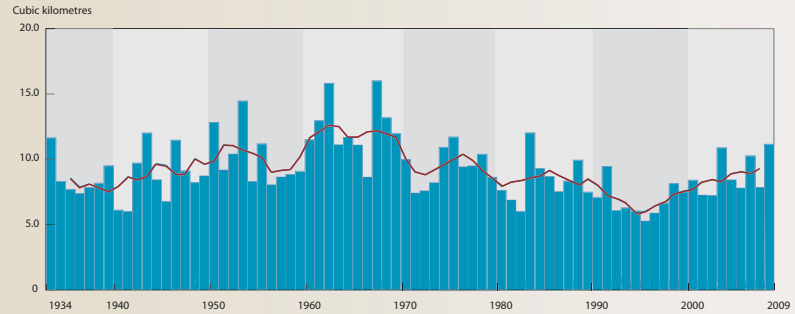


Figure 15 | *The total volume of water entering the Delta each year at Mohembo. The line is a 5-year moving average to help highlight trends and cycles. Note: the flow given for each year is actually the total flow between November of the previous year and October of the given year; in other words from the beginning to the end of each season of inflow.*

Figure 16 | *The maximum extent of flooding each year from 2003 to 2008. Most of the annual variation in the extent of flooding is in the southern and western areas. The eastern areas are flooded more permanently and regularly, by contrast.*[11]

Rainfall in the northern parts of the Delta averages about 550 millimetres per year, whereas Maun and Sehitwa in the south receive about 450 millimetres. Most of this falls during afternoon thunderstorms between November and March (Figure 17). Since this is several months before the annual floodwaters spread across the area, animals and plants in the Delta enjoy an unusually long season of at least some wetness. By contrast, rain-fed wetlands elsewhere in southern Africa only have water for a few months. Biological production in those wetlands is thus limited to much shorter periods than in the Delta.

Rain is of particular importance as the main source of water for the growth of dryland vegetation scattered in and around Delta. Thus, the growth of grass and many other plants depends on precipitation. Numerous pans and pools in these areas are only ever filled by rain, and they often hold the only available fresh water for many miles around. The length of time the pools hold water depends largely on the amount and frequency of rainfall. Those that fill after sporadic heavy falls during spring usually dry up quickly if further rain does not fall, since evaporation rates are also highest in early summer (Figure 17).

Of all the water entering the Delta, an average of only 2% ever leaves as surface flow. Much of this is down the Boteti River, but significant losses can occur along the Kunyere River into Lake Ngami and Khwai River into the southern areas of the Mababe Depression. These outflows only happen during good years when flood waters reach that far south. Similarly, only about 0.2% of water ever sinks into the deeper groundwater. Of the remaining 98%, about 74% evaporates directly from surface waters, with the highest rates of evaporation being in spring and early summer (Figure 17). The other 24% is also lost to the atmosphere, but only after first percolating into shallow ground waters and then later being transpired by island plants, as discussed below.[12] It is the predominance of permeable Kalahari Sand that allows so much water to percolate and be available for the growth and transpiration of island vegetation.

Most of the water flow down the Panhandle is along a single, main channel. Upon reaching the alluvial fan, the channel splits into four main distributaries, from east to west, the Selinda, Nqoga, Jao and Thaoge channels. These channels then split into further distributaries downstream (Figure 18). However, flows are not divided equally between the four main channels, and

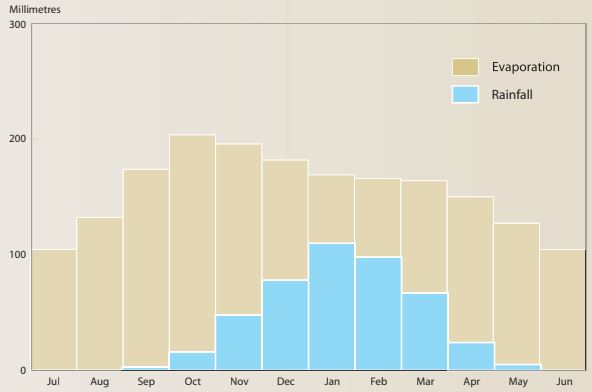


Figure 17 | *Average monthly rainfall and evaporation at Maun. While rainfall varies greatly, evaporation rates are rather similar from year to year. The overall aridity of the environment around the Delta is more an effect of high evaporation than low rainfall. Thus, total evaporation at Maun – at 1,884 millimeters per year, on average – is almost four times the average rainfall of 448 millimetres.*

Most of the Delta's rainfall buckets down during dramatic afternoon thunderstorms.

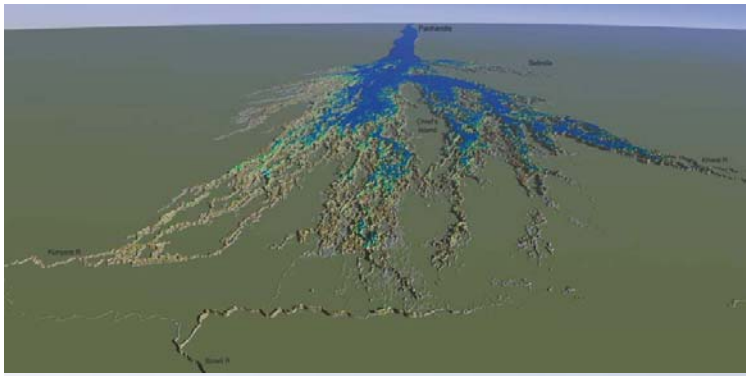


Figure 18 | *A model of flooding frequency based on an analysis of satellite images taken between 1989 and 2007.[13] Places that were inundated most often are higher and bluer than those that seldom received water.*

therefore do not radiate out equally across the alluvial fan. In recent decades, most water has flowed to the south-east into the Nqoga, Mboroga, Manuchira and Khwai areas north of Chief's Island, and also into the central Jao and upper Boro. By contrast, flows north-eastward to the Selinda channel and south into the Thaoge and Karongana areas have usually been weak, and have only occurred in years with exceptional floods.

There are two reasons for the unequal distribution of water from the head of the fan. One is the result of blockages, especially along the Thaoge (Figure 19, and see the account below of how these obstacles redistribute water). Another factor is the current location of the main Panhandle channel close to the eastern ridge that separates the permanent swamps from the higher adjoining woodlands. As a result, water percolating eastwards out of the main channel soon dams up because it can't spread beyond the ridge. However, there are no immediate barriers on the other side where large volumes of water can filter out of the main channel to make their way slowly west and then south. What this means is that flows to the west and south first have to permeate through extensive reed beds before reaching the southern extremities of the Delta. By contrast, flows to the south-east and east are more channeled and regular, and therefore sustain large areas of permanent swamp north and south of Chief's Island.

The changing distribution of water

The broad zones shown in Figure 19 reflect flooding conditions seen in recent decades. While these conditions change seasonally, the changes are usually rather predictable as flows from Angola rise and fall. But events and processes occurring within the Delta also alter the distribution of water, but they do so in ways and directions that are largely unpredictable! These unexpected changes result in wetting and drying that are markedly different from those experienced normally. Expanses of swamp may suddenly dry up when water diverts elsewhere, for example, and new floodplains may develop in places that have been arid for decades.

Most distributional changes are due to blockages of channels which forces water to take new directions. Sites where major blockages are known are shown in Figure 19, but those on the

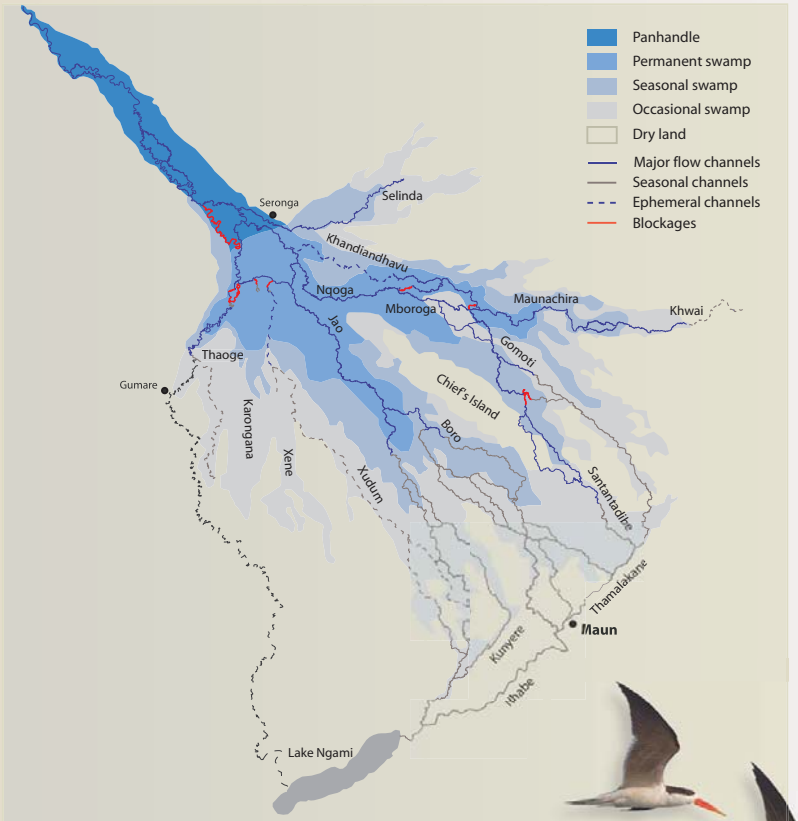


Figure 19 | *The main channels and flood zones of the Delta. As the name implies, the Permanent Swamps hardly vary in size from year to year and usually cover about 3,000 square kilometres. Annual changes in the extent of flooding are thus largely in the Seasonal Swamps and Occasional Floodplains. Boundaries between these two zones are usually hard to define, and they also change during wet and dry phases. For instance, the Seasonal Swamps become much more extensive during repeated years of high inflow.[14] Vegetation growth and types are closely related to levels and frequencies of inundation, and so the categories of plant communities described in Chapter 5 are closely linked to these zones.*

Thaoge provide the most impressive example of what happens once a channel stops flowing. Up until 130 years ago, much of the water entering the alluvial fan flowed down the Thaoge and its distributaries, thus regularly flooding what are now the dry grasslands of the western half of the Delta. Flows down the Thaoge also reached and filled Lake Ngami. Indeed, Charles Andersson boated up the Thaoge from Lake Ngami for 13 days in August 1854, travelling an average speed of eight kilometres per day.[15]

Then in about 1883 and 1884, the Thaoge became progressively blocked by accumulations of floating vegetation – or sudd – and encroaching vegetation, especially papyrus. And despite numerous attempts to open and canalise the channel it still remains largely dormant.

Probably as a result of flows along the Thaoge being halted, flooding to the east then increased, raising water levels in the Maunachira, Mboroga and Santantadibe. However, the northern reaches of the Mboroga became blocked in the 1970s, which then led to reduced flows into the Santantadibe and Gomoti, but also greater inputs to the Khandiandhavu, Maunachira and Khwai distributary areas.

At least some of Lake Ngami's former glory has now been restored through a new feeder. In about 1996, flows into the Xudum and Xene began and have continued to increase until the large inflow from Angola in 2004 eventually pushed water down the Kunyere River and into the Lake (Figure 20).[16] Just what caused increased flows into the Xudum and Xene is

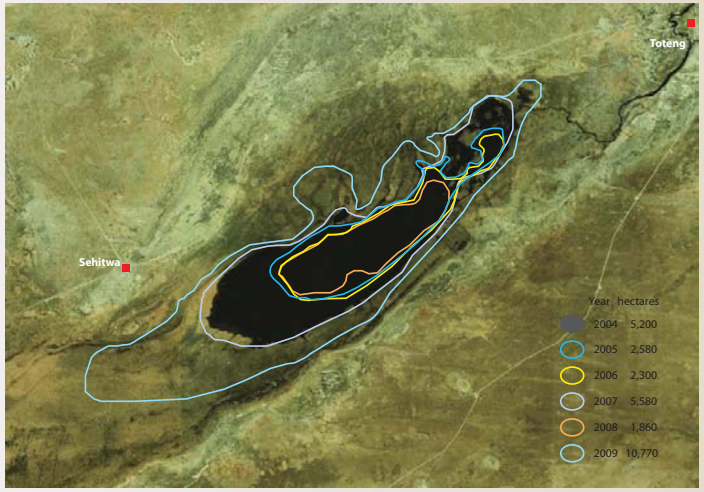


Figure 20 | *The black expanse is water in an image of Lake Ngami taken in September 2004, which was the first year that the lake had had water since 1989. Levels of the lake were lower in 2005, 2006 and 2008, rather higher in 2007 and then much higher in 2009, as shown by the lines marking the expanse of water in each year.*[17]

unknown, but many people speculated that it was due to a small tectonic event. This is quite likely in such a flat landscape, where a shift of a few centimeters up or down could cause flows to speed up or slow down considerably. Nevertheless, firm evidence has yet to be found for tectonic movements causing recent distributional changes anywhere in the Delta.

The best explanation for changes in flow directions starts with, and rests on the fact that almost all the solid, sandy sediments carried in from Angola remain in, and close to the beds of channels. Here, the solid, mostly quartz grains are gently rolled along as far as the speed of water permits. However, speeds slow as increasing proportions of water leak out of the channels, and this causes more and more sediment to be deposited and the channel beds to rise in a process called aggradation (see Figure 21). Dense margins of papyrus stabilize the position of the rising channels, thus preventing them from shifting to lower adjacent ground. And as the water slows even further, papyrus growth impinges on the channels and floating sudd and debris increasingly get stuck in the channels.

As blockages become more and more impermeable, water in the channel is dammed and starts to rise. At some point, it breaks through the walls of the channel upstream of the obstructions, and makes its way along newfound courses into the surrounding, lower-lying floodplains. This is known as channel avulsion. It is widely held that these new courses often follow the paths worn through the swamp vegetation by hippos. However, fire almost certainly plays a major role in charting new directions of flow by burning away elevated levees of dry papyrus. Large channels may thus be diverted into new waterways which go off in quite different directions.[18]

Other factors thought to cause flows to change direction include the subsidence of the ground, perhaps as a result of tectonic shifts, and simple damming due to the build-up of floating sudd and encroachment of aquatic plants without the aggrading effects of sediments.

Changes in the distribution of water often cause annoyance, especially when water no longer reaches places that have enjoyed consistent flooding and flows. Those affected, for example villages that lose fishing grounds or lodges that no longer have access to channels, observe the losses as permanent and sometimes blame other people who use the Delta.

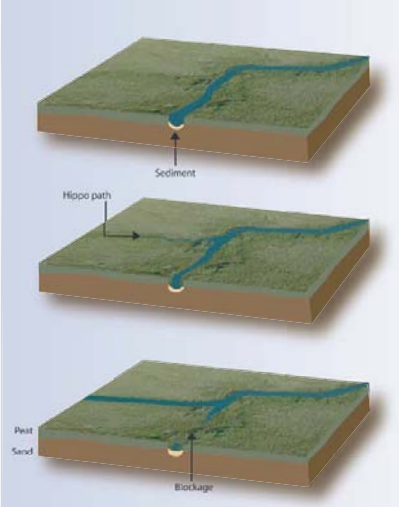
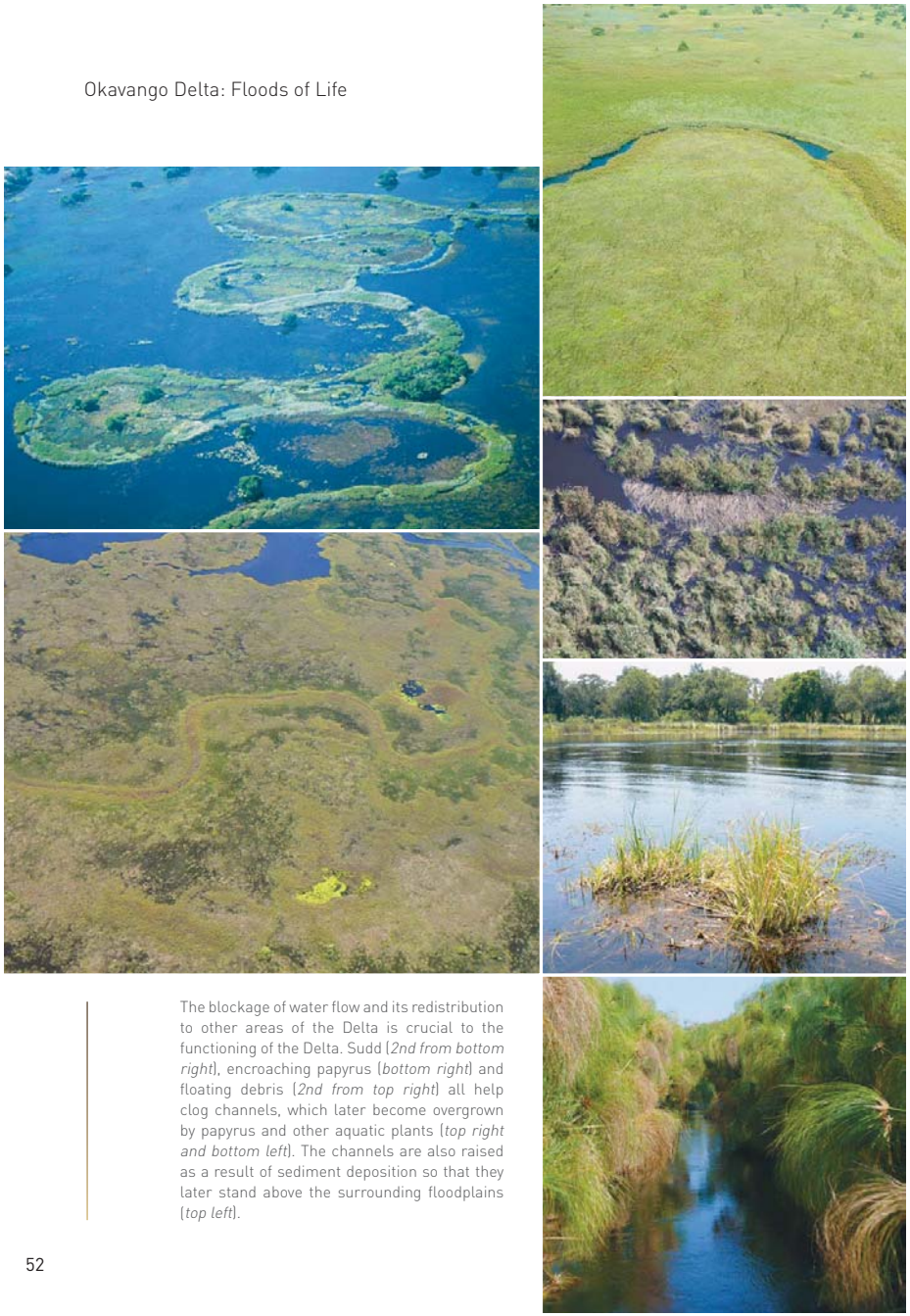


Figure 21 | *Snapshots during the development of a blockage along a channel and the subsequent diversion of its flow along a newly formed channel. Note the rising levels of sediment and the narrowing of the main channel, and the development of the blockage as the speed of flow decreases.*

However, such changes are normal and temporary in the longer term.[19] The changes are also inevitable in this flat, aggrading landscape and they contribute to the greater productivity of the Delta. Indeed, significant features of the Delta are consequences of the distributional changes:

- Habitat diversity is increased
- Habitats change rapidly
- As a result of drying, nutrients trapped in aquatic plants are released for use by other organisms
- When inundated, nutrients lying dormant in sediments are mobilised into new cycles of production (*see page 62*)
- Once flooded, mounds built by termites become islands on which transpiration by trees helps to concentrate salts and thus maintain the fresh waters of the Delta



The blockage of water flow and its redistribution to other areas of the Delta is crucial to the functioning of the Delta. Sudd (*2nd from bottom right*), encroaching papyrus (*bottom right*) and floating debris (*2nd from top right*) all help clog channels, which later become overgrown by papyrus and other aquatic plants (*top right and bottom left*). The channels are also raised as a result of sediment deposition so that they later stand above the surrounding floodplains (*top left*).

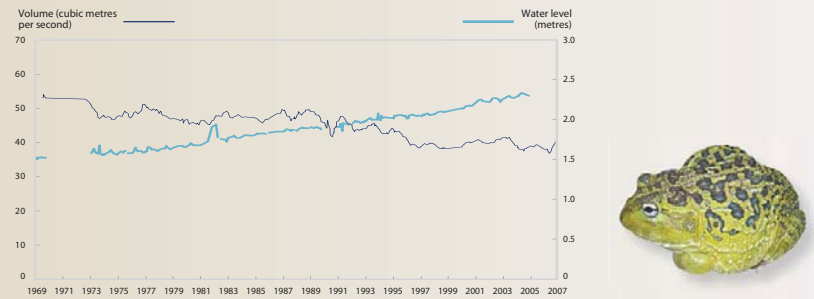


Figure 22 | *The gradual build-up of the Nqoga channel at Gaenga between 1969 and 2007. Rates of sand accumulation can be substantial, perhaps as much as five centimetres per year, or half a metre in 10 years. Water levels then rise* (right axis) *causing the volumes of water discharge to decrease* (left axis).[20]

The quality of water

Anyone visiting the Delta or using its water must be astonished at its clarity and purity, qualities that stem from the nature of water coming off the catchment (*see page 32*). Here, few particles or nutrients are available to be washed into the Okavango River and, in any case, dense barriers of aquatic plants trap much of any material that does get into the river. To put the purity in context, the conductivity of water entering Botswana is 15–20 times lower (i.e. better) than would be classified as *Ideal* water for drinking, and about 40 times better than water of *Acceptable* quality, as established by standards of the Botswana government.

Conductivity is a measure of the quantities of salts and other solids dissolved in water. Of course, there are other dimensions to water quality, such as its colour, odour, turbidity and acidity but, again, all the monitoring work done so far indicates that the inflowing water is exceptionally clear of dissolved and suspended materials. Average pHs of between 5.9 and 7.6, or near neutral, are measured throughout the Delta. Slight acidity or alkalinity is sometimes detected locally and is usually the result of the decomposition of organic matter or of concentrations of algal growth, respectively.

These comments refer to concentrations of chemicals and particles, and not to the quantities of material swept into the Delta. These are indeed substantial when the tiny concentrations in the huge volumes of water are added up. In fact, an estimated 170,000 tonnes of bed load (mainly minute grains of quartz sand), 30,000 tonnes of suspended material (largely clay and organic matter) and some 381,000 tonnes of salts are carried down the Okavango River each year.[21] What happens to all these tonnes?

Because water speeds are so slow in its meandering channels, about 90% of the sandy bed load settles in the Panhandle, while most of the remaining 10% is deposited close to the head of the alluvial fan. Much of the lighter matter in suspension also remains in the permanent swamps of the Panhandle and at the top of the alluvial fan. That entrapment and the fact that so few clayey particles come down the Okavango River is crucial in retaining the permeability of Delta's substrate.[22] Lots of surface water can therefore sink into the groundwater which then allows for the concentration of salts beneath islands, as described below. For example, rates of infiltration in one seasonal floodplain ranged between 45 and 54 millimetres of water per day, which was 9 to 10 times higher than the amounts of water lost by evaporation.[23]

Most dissolved salts eventually permeate through the sandy substrate and into the groundwater. This happens after they have been distributed by surface waters, and their concentrations increase progressively as a

Water almost everywhere in the Delta is so clear and clean of salts, nutrients and floating particles that it surpasses the quality of bottled water.

result of surface evaporation. Concentrations in samples steadily increase by an average factor of 10 between the head of the Panhandle and the distal reaches of the alluvial fan in the south-east. But in terms of conductivity, even the highest concentrations found at the bottom of the Delta are similar to those found in most bottled water.

Quantities of nutrients in the inflowing water are likewise very low. Most nitrogen, phosphorous, sodium and potassium, for example, is quickly absorbed by papyrus and phragmites reeds growing in the Panhandle and along the main channels at the base of the alluvial fan. Very small amounts of these elements therefore make their way to the seasonal and occasional floodplains. Here, most biological production is fed by nutrients that accumulated in their sediments over long periods (*see page 62*).

While the waters of the Okavango are usually clean and clear, local conditions of impurity sometimes develop. For example, high concentrations of salts may develop as a result of evaporation in pools that are isolated from the main Delta flows. Water percolating through the papyrus beds in the Panhandle is sometimes so depleted of oxygen as a result of aerobic respiration by bacteria, that substantial numbers of fish die (*see page 102*). And with the growing number of people living in and around the Delta, the chances of local pollution escalate, particularly in places where people are concentrated, such as at Maun and along the Panhandle (*see page 115*).

Maintaining water quality: permeable substrates, islands and sinking salt

Makgadikgadi and Etosha are open expanses of salty sediments. Why did yet another pan not form here, perhaps called the Okavango Pan? Three separate processes – all of which have to do with the removal of salts – explain the anomaly of the freshwater Delta in this arid region. The combination of these processes in one place is probably unique in the world.[24]

The first process involves the very high rates of water infiltration made possible by the limited intake of clay from the catchment and the permeability of the Delta substrate. The large volumes of water that disappear into the ground therefore carry and remove salts from the surface water.

The second process stems from the abundance of islands within the Delta on which trees and other woody plants grow. In all, there are about 150,000 islands covering a combined area of some 4,500 square kilometres. Most are tiny, consisting of just a few square metres, but others extend over hundreds of hectares; an estimated 43,000 islands are larger than 50 by 50 metres.[25] These numbers and areas provide places to grow for very many trees which draw water out of the ground and then transpire it through their leaves. As the water is pumped up through the roots, water levels beneath the islands drop, causing a substantial gradient (of 1:100 to 1:200) between groundwater levels below the surrounding floodplains and those under the islands (Figure 23). The water – accompanied by its salts – thus flows laterally and continually from

Xigera lagoon is the most prominent and last major site of sand deposition as water flows down through the alluvial fan. The sand settles and forms a mini delta because the speed of flow immediately drops when the water enters the lagoon.

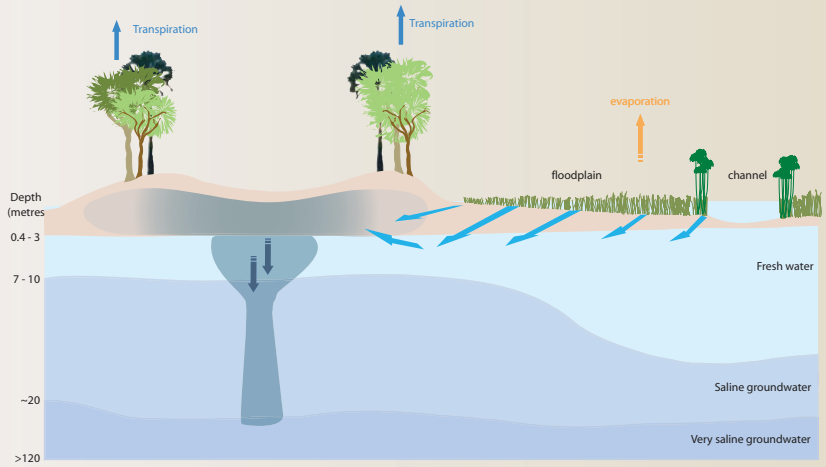
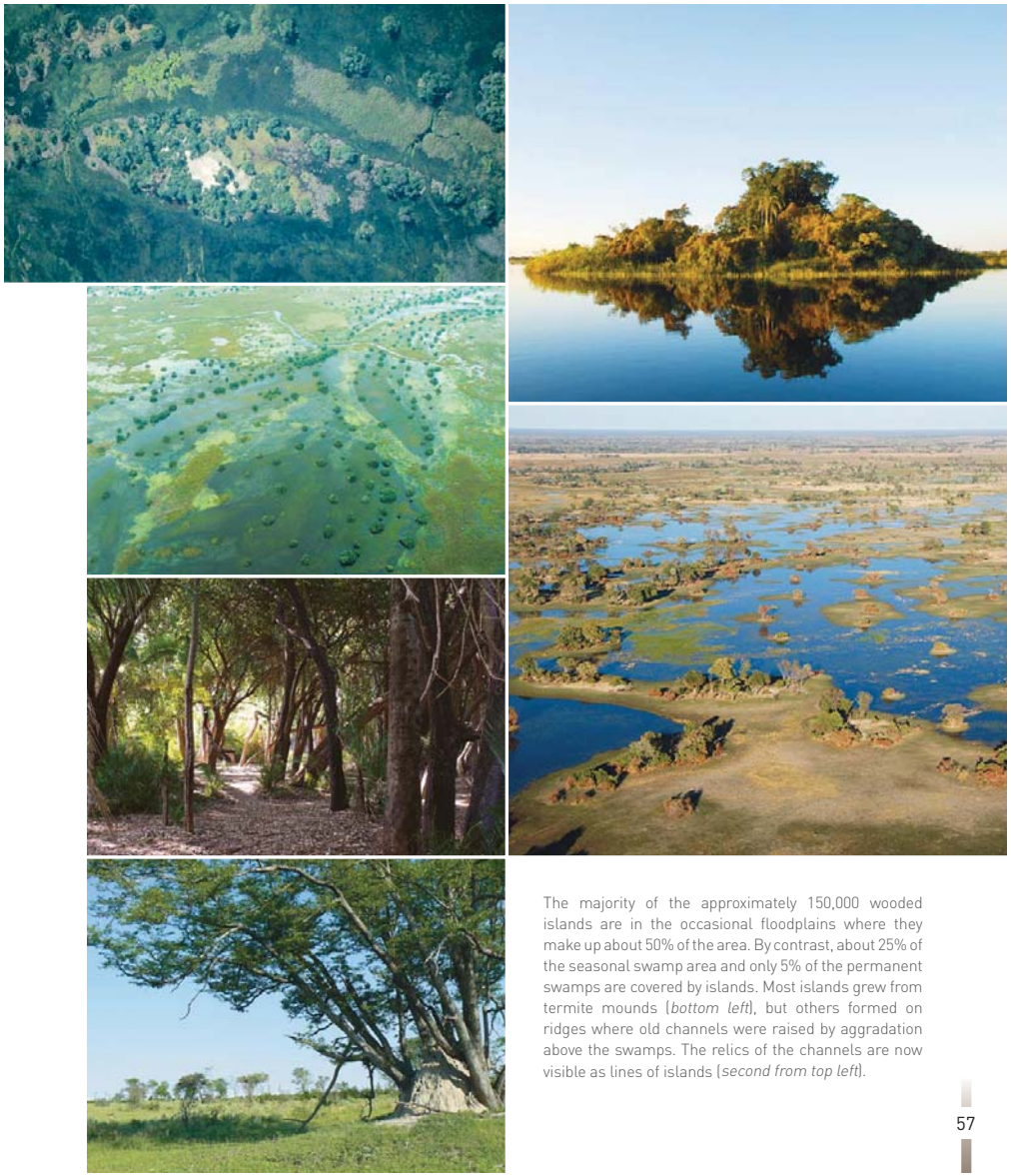


Figure 23 | *A horizontal cross-section through an island and its surrounding floodplain. Note the higher margins of the islands formed from deposits of calcium and magnesium carbonate and the accumulation of organic debris beneath the trees and shrubs. Few plants can tolerate the very salty soils in the island centres. It may take 200 years for an island to grow from a small copse of trees and shrubs into one looking like an atoll with a barren centre.*[26]

beneath the floodplains to below the islands. In essence, this second process moves salts from the floodplains and concentrates them below island vegetation.

The rates of concentration are considerable. For example, chlorine in water below the islands is 500–1,000 times more concentrated than floodplain surface water. According to their chemical properties, different salts and elements react differently once they are concentrated. Magnesium and calcium are precipitated into solid calcrete carbonates, while precipitates of silica and potassium form clayey soils that are between 3 and 10 metres deep below the islands. Dissolved organic carbon and sodium bicarbonate remains in solution in the island groundwater, but as their concentrations increase, sodium bicarbonate crusts may form on the surface and the island centres become too saline for most plants. As a result, most trees only grow on their margins, leaving the central areas of islands to grasses and a few palm trees that tolerate the salty soils.

Most islands are thought to originate as termite mounds on which copses of trees grow when the mounds are later flooded. The islands then expand and continue growing as more and more clayey deposits and calcretes are added to their volume. Organic matter, such as leaves, that accumulates beneath the trees further contributes to their growth. While some islands remain small and rounded, reflecting their origins as termite mounds, others have grown and merged with other islands into large, irregularly shaped areas.



The majority of the approximately 150,000 wooded islands are in the occasional floodplains where they make up about 50% of the area. By contrast, about 25% of the seasonal swamp area and only 5% of the permanent swamps are covered by islands. Most islands grew from termite mounds (*bottom left*), but others formed on ridges where old channels were raised by aggradation above the swamps. The relics of the channels are now visible as lines of islands (*second from top left*).

The third and final process in removing salts from the Delta also occurs below the islands. Once particularly high concentrations are reached, the saline groundwater becomes denser, and therefore heavier, than the water which lies further down. 'Density fingering' then occurs as the hyper-saline water sinks down to much deeper levels.[27] This is the final fate of dissolved salts that originated hundreds of kilometres away in Angola.

Of the estimated 381,000 tonnes of dissolved material entering the Delta each year, 56% eventually turns into precipitates that expand the islands while another 38% will later sink away as very saline water. The small remaining fraction of 6% is carried off down the Boteti River during its sporadic flows.

Nutrients

There are many aspects of the Delta that are odd. This is an oasis in a semi-desert of sand, and it is a body of water that remains fresh even though 98% of the water evaporates. Another peculiarity is that living organisms are abundant despite the fact that few nutrients enter the Delta. A measure of this wealth is provided by the number of large mammals. Based on the carrying capacity of soil and rainfall conditions at different places elsewhere in Africa, northern Botswana should be able to sustain about 1,200 kilogrammes of large mammals per square kilometre. In reality, however, the biomass of large mammals in the Delta is almost 10 times higher.[28]

Clearly, there is more to support so many animals than meets the eye. But without special equipment, eyeing the abundant nutrients that feed so many animals and plants is difficult. In addition, research on nutrients has been rather limited; while we have a pretty clear idea of the water budget, the food budget of the Delta has not been well documented.

Three nutrients are essential to all plants and animals: carbon for building bodies, nitrogen for proteins and phosphorous for the molecule ATP (adenosine tri-phosphate; also called the 'universal energy currency of life') which stores energy produced during respiration. Although other nutrients are required for metabolism and growth, it is these three elements that are needed in the most significant quantities. They are thus more routinely monitored than other nutrients, and these measures provide indications of the overall nutrient status of the Delta.[29] Since carbon is usually less constraining on production than nitrogen and phosphorous, it is these two nutrients, and particularly phosphorous, that often limit the growth and reproduction of plants and animals everywhere.

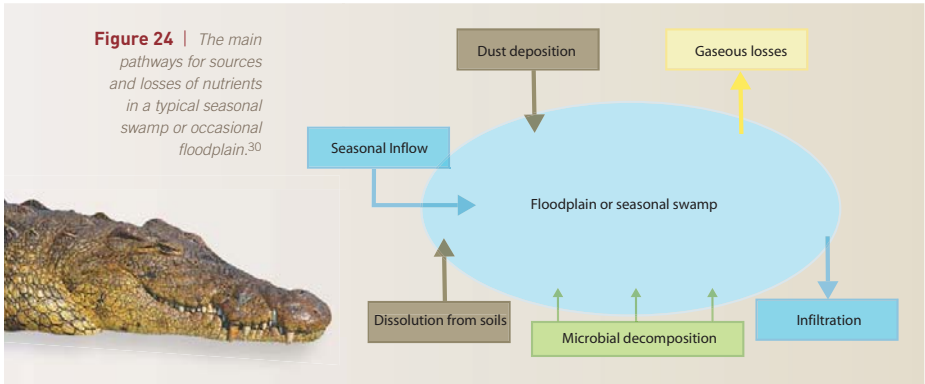


Figure 24 | *The main pathways for sources and losses of nutrients in a typical seasonal swamp or occasional floodplain.*[30]

Nutrients are cycled and recycled between sediments beneath the floodplains, living swamp vegetation, peat and surrounding woodlands.

Sources and losses of nutrients

Although nutrients are limiting, how so much nitrogen, phosphorous and carbon came to be in the Delta has yet to be fully explained. However, there appear to be five main sources (Figure 24). The first is the Okavango River. While nutrient concentrations in its waters are tiny, they add up to significant amounts when the volumes of water that have come to settle on the sediments over hundreds and thousands of years are considered. The concentrations of nitrogen and phosphorous measured at Mohembo are typically in the order of 1–2 and 0.0–0.1 milligrams per litre, respectively. There are no significant seasonal changes in the concentrations.

Aerosols are a second source. The Delta happens to be located in a zone where anti-cyclonic conditions often prevail, and air laden with dust then subsides. This happens particularly during the dry winter months that coincide with flooding. As a result, an estimated 250,000 tonnes of dust (or 570 grams per hectare) are deposited each year on the Delta.[31] Significant quantities of nutrients come with the dust, and these may contribute up to 40% of all nitrogen and 60% of phosphorous added to the Delta.[32] The aerosol nutrients settle both on water surfaces, where they may dissolve and immediately become available to biological processes, and on dry land, where they dissolve later when flooding occurs. It is almost impossible to separate out those that settle on dry land from a third supply, which is that comprised of nutrients that dissolve out of soil particles. However, this third source is probably of minor significance because inert grains of quartz comprise much of the sandy soil.

Fourthly, nutrients are made available by microbes, such as diazotrophic bacteria living on the roots of floodplain

Nutrients are added to the Delta's water in the form of faeces produced from food obtained in the surrounding dry woodlands.

Peat fires are not often seen but they play a crucial role in releasing nutrients that are bound up in the organic debris of which peat is largely comprised.

vegetation. They convert gaseous atmospheric nitrogen into ammonia and other forms which can be used by living organisms. Blue-green algae likewise fix nitrogen in water, and bacteria associated with the roots of the common rice grass *Oryza breviligulata* probably also fix nitrogen. Mycorrhizae of fungi found in and among roots convert ions of phosphorous into forms that can be used by plants.[33]

Finally, nutrients are imported in the faecal matter of animals that visit the Delta. This happens most often and typically by animals that drink regularly after long bouts of foraging in the surrounding woodlands and dryland pastures. Obvious examples are elephants, cattle and impala, of which there are very large numbers (*see page 106*) that dump considerable volumes of faeces and nutrients into the Delta on a daily basis. But conversely, smaller amounts of nutrients are lost when animals that have fed on aquatic food leave and defeacate elsewhere.

One of the reasons that phosphorus is so limiting is that much of it is held in insoluble compounds bound to such elements as iron, aluminum, calcium and manganese, and also to clay. Other insoluble phosphorus lies trapped in the decayed remains of microbes, animals and plants.

The relative importance of each of the nutrient sources varies across the Delta, both in time and space. For example, inflowing nutrients contribute most to production along channel margins, especially in the Panhandle. In the back-swamps, more nutrients are supplied by aerosol sources and by the limited breaking down (and thus recycling) of organic molecules bound into peat. On seasonally flooded plains, soil nutrients are the prime source once the floodwaters arrive, but deposits from dust become increasingly important as the season wears on. Production in occasional swamps probably depends largely upon nutrients lying dormant in the sediments, having accumulated there over long periods from various origins: aerosols, mineralized plant matter and faeces, for instance.

The overall abundance of nutrients means that the Delta is a sink, with more nutrients having accumulated here than have left. The losses may, nonetheless, be significant, particularly through fire which can accelerate the rate at which nitrogen is lost to the atmosphere as a gas, and through the leaching of phosphorus into deep sediments. Considerable quantities of organic carbon and phosphorous also disappear in the flow of water from floodplains to beneath islands where the nutrients remain trapped in the very saline groundwater and clays.

Dung beetles help to release nutrients originally locked into plant matter for new cycles of animal and plant production.

Nutrient cycles and uses

Most nutrient losses are, however, temporary in the sense that nutrients become locked into reservoirs where they are unavailable to new rounds of biological production. There are two principal reservoirs in the Delta: living plants, and dead peat and detritus. Nutrients locked into plants are recycled when floodwaters dry up and the plants die. This happens seasonally in areas that are inundated each year, but also in permanent swamps where large nutrient stocks are held in the expanses of papyrus, phragmites reeds and other aquatic plants. These only die off when channels change course to switch the flow of water to other places. Once the swamps dry, their degradation is often hastened by fires that burn the desiccated plants (*see page 84*). On a smaller scale, nutrients embedded in plants also are released by grazers, especially the very abundant lechwe and buffalo (*see page 106*). Dung beetles and other insects that consume manure are the first to use these nutrients, which then get cycled into other organisms that eat, parasitise or decompose the insects.

Peat in the permanent swamps holds even greater volumes of nutrients than the green vegetation above, since peat consists of dense masses of decomposed roots, rhizomes, charcoal and other organic and inorganic detritus.[34] However, nitrogen and phosphorus in peat is largely present in the form of organic compounds which cannot be readily used for growth and reproduction. Further recycling is thus needed before they are available as ammonium, nitrates and phosphates. While some of this is achieved by aerobic actinomycetes bacteria and fungi that also break down cellulose into carbon, most of the nutrient pool is only released once peat is dried or burnt.

Thus, great quantities of potential food remain inert in various forms in the Delta. The most impressive and final release of nutrients into blooms of production occurs when water reaches the seasonal and occasional floodplains.[35] The soils of the floodplains contain huge numbers of spores of anaerobic bacteria that spring to life when the waters arrive. By decomposing detritus, the living activated bacteria produce and release carbon and soluble nitrogen and phosphorous into the floodwaters.

Diatoms and other phytoplankton blossom, aquatic plants grow rapidly, and eggs that have lain dormant in the sediments hatch and develop into dense swarms of zooplankton (*see page 100*). Fish migrate into the temporary waters, spawning to produce large numbers of fish fry which feast on the zooplankton. In turn, these and the fingerlings feed countless frogs, birds and predatory fish. As the flood continues and later abates, the frogs and birds breed quickly to produce new generations, surviving young fish swim back to populate the main channels and waters of the permanent swamps, while nutrients parcelled in the bodies of insects, herbivores and other animals are redistributed elsewhere to add life to the Delta.

To conclude

It is mainly in the seasonal swamps and occasional floodplains – where the aquatic and terrestrial worlds meet – that the Delta comes to life, and its wealth is produced. The annual pulse of water mobilises nutrients which, in turn, are largely provided by the terrestrial environment. The pulsing happens regularly in the seasonal swamps and episodically in the occasional floodplains in a great number of places over a wide area. An ever-changing patchwork of different levels of nutrients, at different stages of biological succession is thus created. And all of this is aided by the extended period of water availability due to rain and flood waters being received at different times.

Wetting is thus important, but so is drying. Without desiccation, most nutrients would not be released from living plants and peat. Changes to the distribution of water make much of the drying possible and, likewise, the switching of channels allows water to inundate new ground. Most biological production occurs in places that have lain dry for some years after periods of repeated flooding in the past. The most productive sites have long histories of flooding because each flood added more nutrients that were washed in, trapped from aerosols or dropped by animals attracted to the water. When the water dries and aquatic plants die back, the nutrients lie embedded in soils and detritus, waiting – as it were – again to be mobilised into production when catalyzing water next arrives.

The wetting, drying and consumption of the Delta's larders. After the arrival of flood waters, mats of algae and emergent aquatic plants cover Lake Ngami (*left top and middle*) and water among trees near the Gomoti River (*right top*); masses of birds feeding on fish trapped in a shrinking pool, isolated as the seasonal swamps dry up (*right bottom*); and the receding waters that lead to the death of plants and recycling of nutrients (*left bottom*).

Concentrations of greenery close to channels are due to those plants having better access to nutrients in the channels than those growing in the more sterile backwaters.

Central to the abundance of life in the Delta is this shifting kaleidoscope of water and land, with water enabling plants and animals to use larders of nutrients to grow and reproduce. Each year, floodwaters bring life but then recede so that nutrients are returned to the soil, ready for further bouts of production in the years ahead.

Because the distribution of water changes so frequently, many plants and animals have evolved opportunistic strategies. Those that are able to shift to new supplies of water do so, making the move as quickly as possible. Those that can't move, lie in wait for years, perhaps decades. And they lie waiting in a variety of forms: as eggs, seeds, spores, pupae or as aestivating, slumbering adults.

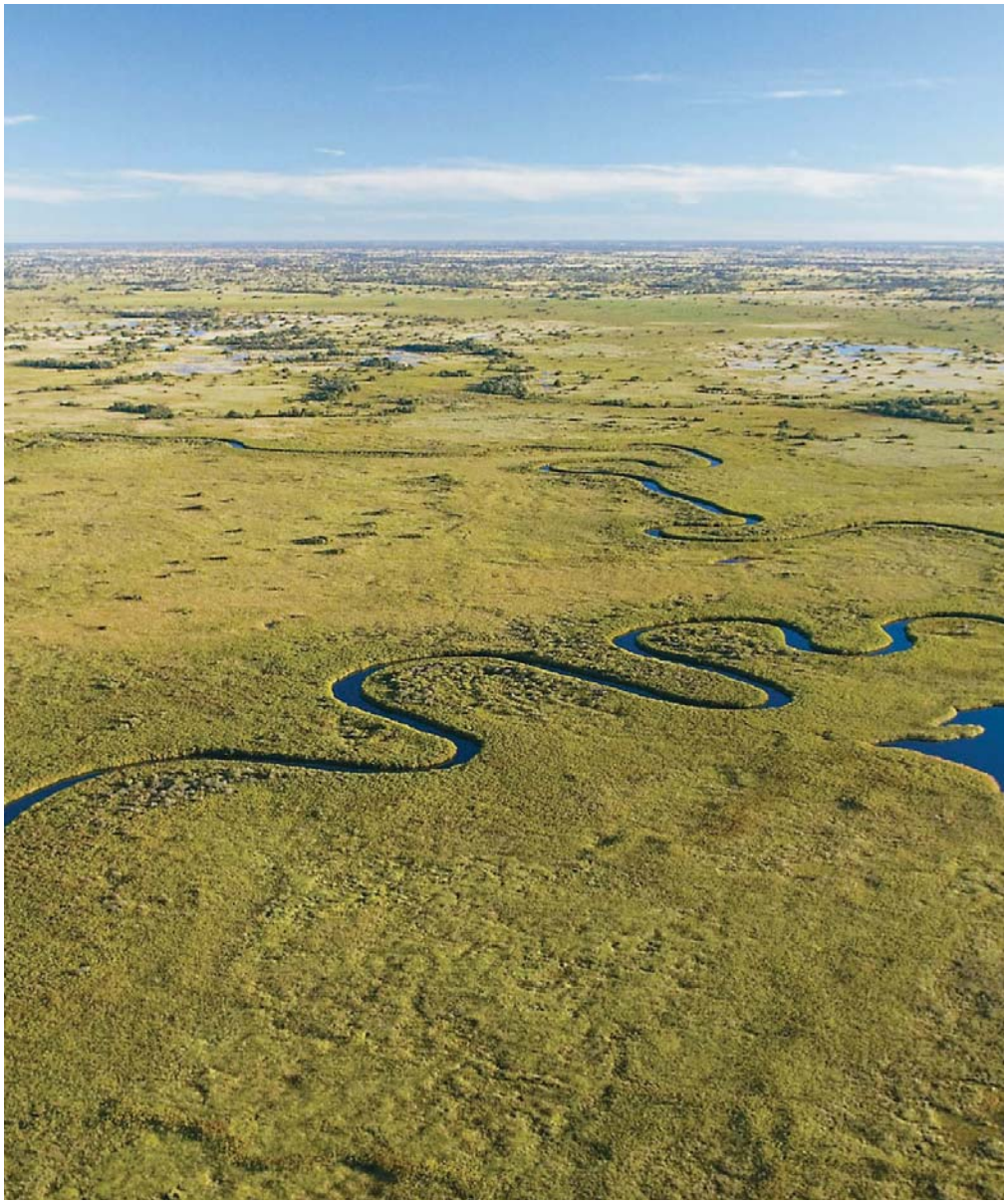
One of the best places to see and learn about episodic production is at Lake Ngami. As an outlier on the most distal margins of the Delta, the lake has often been dry. But there have also been long periods of inundation which led to the accumulation of huge nutrient reserves in its sediments. These are now augmented by the manure of cattle herds that graze around the lake, and wildlife doubtless did the same before the area was populated by stock farmers. Cattle now also graze the aquatic grasses in and around the lake, thus returning nutrients to the soil that would otherwise be trapped in vegetation. The lake waters are thus highly productive as a result of these processes that accumulate and recycle nutrients. When flooded, Lake Ngami attracts more birds than any other wetland in Botswana. For example, 5,200 white pelicans, 20,000 red-billed teal and 3,000 little egrets were counted there in 2004,[36] and the Lake supported a vibrant fisheries industry during the 1970s. The Mababe Depression is certain to be equally productive when its waters again return.

Several processes must be conserved if the Delta is to remain as productive as it now. The first is the necessity of seasonal pulses of water flow to maintain the wetting and drying that mobilize and release stocks of nutrients. Secondly, the distribution of water has to keep changing, which means that the agents that cause the redistribution of flow (papyrus growth, fine sediment accumulation and hippos) have to keep working. Third, processes that make this this an oasis of freshwater need to be sustained, for example by ensuring that inflows of suspended clays do not increase and escalating elephant populations (*see page 87*) do not decimate the riparian trees that transpire large volumes of water from islands.

These kinds of cautions come from an understanding of processes that mould the organism we call the Okavango Delta. Other cautions will be offered later in the pages ahead, and understandings of different processes will emerge as a result of further research in the years ahead. People charged with caring for the health of the Delta must be good physicians, basing their diagnoses and treatments on the best knowledge.

KEY POINTS

1. Annual pulses of water entering the Delta reach peak levels in March and April when inflows are about five times greater than the lowest discharges in October and November. The March/April pulses then take several months to flow down the Panhandle and spread across the alluvial fan.
2. Flooding thus occurs in the dry winter months after the summer rains, and life in the Delta enjoys much longer periods of water supply than other freshwater wetlands in southern Africa.
3. Inflows and the extent of flooding change substantially from year to year – and also between longer wet and dry cycles – as a result of varying rainfall in the Angolan catchment of the Okavango River.
4. The biggest floods cover about three times more of the alluvial fan than the smallest floods. The expanse of flooding is not only influenced by inflow, but also by rainfall and the levels of inundation during the previous year.
5. The confinement and deposition of sand in the channels leads to their beds rising, the water flow slowing, vegetation encroaching along their margins, and to their eventual blockage. As a result, areas of swamp dry up as the dammed water cuts new channels, often to areas that have not flooded in recent years.
6. Of the little clay carried down the Okavango River, much is trapped in the permanent swamps. This allows the Delta's substrate of Kalahari Sand to remain permeable. The water's percolation through the sands and its transpiration by island vegetation results in the concentration of salts beneath islands. Eventually the accumulated salts sink to substantial depths below the Delta. It is these processes that keep the Delta's water fresh.
7. The Delta is a rich sink of nutrients that accumulated here over long periods from river water sources, aerosol deposits, fixation by microbes and faecal deposits of large mammals.
8. Most nutrients are however trapped in peat and living swamp vegetation. They are only *released by drying* when water is redistributed (through channel blockages and switching) and the dry organic debris is decomposed or burnt.
9. However, the nutrients are only *mobilised by wetting* into new cycles of biological production when floodwaters reach the seasonal swamps and occasional floodplains.
10. Much of the wealth of life in the Delta is therefore generated by wetting and drying caused by the repeated pulsing and redistribution of floodwaters.
11 It is vital that conservation measures maintain the processes that enable some areas to be flooded and others to be dried.



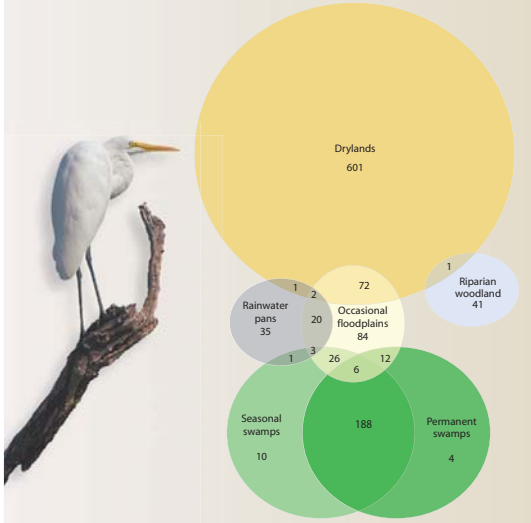
5

Plants: producers, filters and distributors

The variety of vegetation in the Delta gives it beauty, sustenance and diversity, and also controls many aspects of how this wetland works.

Water and nutrients are the primary resources that fashion the Delta. Both are inorganic, crucial to plant life and come directly or indirectly from areas outside the Delta, as described in the last chapter. Plants also require sunlight and carbon dioxide, which likewise come from remote sources. However, these two requirements are rather evenly available in any given area. The growth, abundance and structure of plants are therefore largely controlled by local variations in water and nutrient supplies. This is true throughout the world, and so it is for the Delta, as the following pages will show.

Figure 25 | *The number of plant species found in each of their preferred habitats. Plants typically found in two habitats are counted in the zones of overlap between habitats. A high proportion of plants prefer the Drylands, Riverine Woodlands, Occasional Floodplains and Rainwater Pans as habitats, while a very high percentage of aquatic species occur in both the Permanent and Seasonal Swamps. Nine more species that are not shown here all occur in Rainwater Pans, Seasonal Swamps and Permanent Swamps.*[1]



However, there is a difference! This is the important role plants perform in fashioning the living Delta, for example in causing channels to switch direction, sieving out mud and clay, and pumping water up into the atmosphere. These are local effects, which are as important as the external influences of floodwaters, nitrogen, phosphorous and other nutrients. Understanding and conserving the roles performed by plants is thus vital to the overall health and future of the Delta.

Much of this chapter focuses on higher, flowering or vascular plants which are dominated by grasses, sedges, forbs, shrubs and trees.[2] About 1,300 species have been identified so far, with the grasses (Poaceae) and sedges (Cyperaceae) being the largest groups, followed by the asters and daisies (Asteraceae) and leguminous bean and pea pulses (Fabaceae).[3]

Just over 75% of all species are herbaceous plants, while the remaining plants are woody trees, shrubs and dwarf shrubs. Eighteen species are parasites and 12 are carnivores (*see page 74*). In addition to the higher plants, there are also non-vascular plants such as mosses, algae and diatoms, blue-green algae (cyanobacteria) and dinoflagellates in this aquatic environment. Much less is known about them, and they are relatively sparse as a result of the nutrient-poor water. However, some information is available on diatoms (*see page 82*).

Do these 1,300 species constitute a particularly diverse assemblage of plants? In terms of Botswana, the answer is yes, because about ten times more species are found here than anywhere else in the country.[4] Of six major freshwater wetlands in the world, the Delta has the second highest diversity of plants, surpassed only by the Brazilian Pantanal, but greater than the Florida Everglades, Indian Sundarban, Cambodian Tonle Sap and the Australian Kakadu wetlands.[5]

Patterns of diversity

Much of the high diversity in the Delta results from wetland and dryland species growing side by side. Perhaps surprisingly, about 60% of all the plants are dryland species that grow on islands and on tongues of dry Kalahari sand that

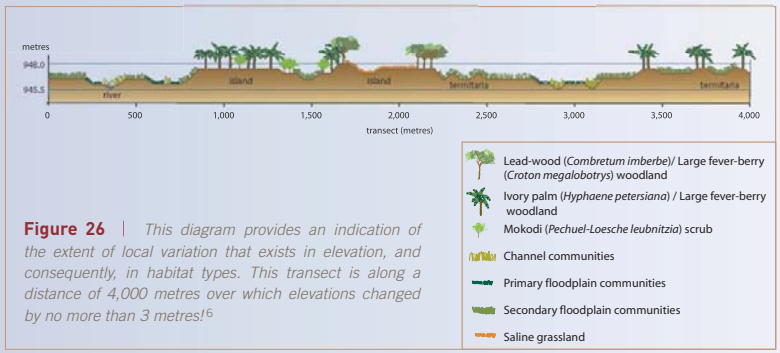


Figure 26 | *This diagram provides an indication of the extent of local variation that exists in elevation, and consequently, in habitat types. This transect is along a distance of 4,000 metres over which elevations changed by no more than 3 metres!*[6]

jut into the Delta (Figure 25). However, many of these dryland species are absent from the adjacent, more arid savannas because they require higher levels of soil and air moisture, or only grow in areas where groundwater is shallow. They are thus very much associated with the broader wetland conditions offered in and close to the Delta. Prominent examples of these are jackal-berry (*Diospyros mespiliformis*), knob-thorn (*Acacia nigrescens*) and lead-wood (*Combretum imberbe*).

Most plants thus grow in the habitats that are never or seldom flooded. By contrast, large areas of the Permanent Swamps are dominated by one or two species, particularly papyrus (*Cyperus papyrus*) and phragmites (*Phragmites australis* and *P. mauritianus*) reeds.

While the truly aquatic species are limited to areas of permanent or frequent flooding, many species grow in a wide variety of conditions of inundation. In fact, as many as 35% of all the Delta's plants grow in more than one habitat along a gradient ranging between swamp and dryland.[7] Some of the plants adopt different growth forms depending on water levels. For instance, the floating heart water lily (*Nymphoides indica*) has floating leaves when the water is high, but grows as a terrestrial plant when the floodplains dry. Its leaves then form compact rosettes. An important point is that the substantial – and frequent – variation in flooding has led to the evolution of physiological and morphological plasticity.

Islands support the highest density of species, especially along their margins where a concentrated mix of species hugs the interface between dryland and wetland. One study found between 20 and 83 species in different sample plots, each of which measured only 7 by 10 metres.[8]

The number of species found in any broad area reflects the diversity of habitats. Far from being a uniform wetland, the Delta is very much a patchwork of habitats, as many photographs in this book show. And so it is the mix of habitats that gives the Delta such biotic diversity. In addition, the variety of habitats contributes to the abundance of life because adaptable species can move from one habitat to another, growing and breeding as each habitat becomes productive when wetted, and then retreating elsewhere as the habitat dries. Much of the mix of habitats is due to tiny variations in elevation (Figure 26). Thus, a depression may be inundated for much of the year, while another area just 50 metres away may have standing water for only two months because it is 50 centimetres higher. And between these two, there might be a more elevated area that remains consistently dry.

Overall, the diversity and patchiness of habitats progressively increases from the Panhandle towards the Occasional Floodplains, reflecting both the increasing variation in flooding frequency and the greater number

of islands in the more ephemeral areas (*see page 57*). These patterns of variety and the dynamic nature of habitats have several implications for the Delta's conservation. One is that looking after the Delta's biological wealth cannot be concentrated on small areas or particular habitats. Second, the variety of habitats stems from switching and seasonal pulses of water, and so anything that reduces the variation of flooding would lead to a loss of diversity. And third, plant communities may often be in a state of flux, called succession by botanists, as the supply of water waxes and wanes according to levels of inflow and distribution of water. Conservation measures should thus not aim to preserve a particular condition, other than to allow conditions to change naturally! Mechanisms that cause variability need to be preserved.

Reaching out across the water towards sedges and water lilies is this attractive legume *Aeschynomene fluitans*, probably one of many plants in the Delta that fixes nitrogen.

Processes of change that divide the Delta into its assorted habitats operate over a range of time scales, from decades upwards to tens of thousands of years (*see page 25*). Plant species in the Delta have thus had to track and adapt to frequent changes in habitat conditions. Consequently, we might expect many of the Delta's plants to be so specially evolved to local conditions that they are now endemic, and thus occur nowhere else. Adding weight to this expectation is the Delta's perceived isolation as a wetland, which should lead to its plants being genetically separated from those in other wetlands.

However, all the Delta's plants are found elsewhere in southern and central Africa, especially in wetlands to the north in Zambia.[9] Similar distributional patterns are found for animals, most of which also occur in wetlands associated with the Zambezi River.[10] These broader distributions reflect two features of the Delta and its biota. The first is that the Delta is not as isolated as we think. In the past it was part of much larger wetlands that were connected to those of the Zambezi (*see page 24*)[11], and the Selinda Spillway still provides intermittent connections between the Delta and the Linyanti Swamps. And from the Linyanti, there is continuous swamp all the way up the Kwando River (which is more an extremely long marsh than a river) to the wetlands from which both it and the Zambezi River drain.

Secondly, aquatic species in the tropics and sub-tropics have evolved to be highly mobile because freshwater wetlands are often ephemeral. This is true at time scales of seasons, decades or centuries, depending on the reliability of water sources that fill the wetlands. Species that depend on wetlands thus need to develop ways of moving to patches of water as they become available, and leaving when they dry up. Plants use a number of strategies to spread themselves, for example, by having seeds that float, seeds carried by animals in their guts or as attached burrs, seeds that germinate after varying periods of desiccation, and seeds and bulbs that survive long dry periods. In addition, some plants have rhizomes and stolons that creep along under the ground, while aquatic species have flowers above water to enable pollination between plants over wide areas.

Habitats

The distribution of major habitats in and around the Delta is shown in **Figure 27**. This map presents a neat demarcation of labelled categories, and it is broadly valid in reflecting where different habitats predominate. However, demarcations on the ground are far from simple because there are also many sub-groups characterised by more subtle assemblages of species. Moreover, quite different habitats are often found cheek by jowl because of the local variation in topography and inundation **(Figure 26)**. And habitats change when water flows shift from one area of the Delta to another. For example, the swamplands that predominated in the western Delta turned into dry grasslands when the Thaoge River dried up over a hundred years ago (*see page 50*).

Studies by several plant ecologists have all shown that hydrology is the key factor that determines how vegetation is structured into habitats **(Figure 28)**.[12] Three aspects of hydrology stand out: the frequency of flooding, its duration and the depth of water. These are of course often correlated, so that places that are frequently flooded also have the deepest water for the longest periods. Nutrient availability is also important, but less is known about the role of nutrient conditions because these are harder to measure and evaluate. Other significant impacts are from soil salinity (*see page 78*), fire (*page 84*) and foraging by herbivores (*page 87*).

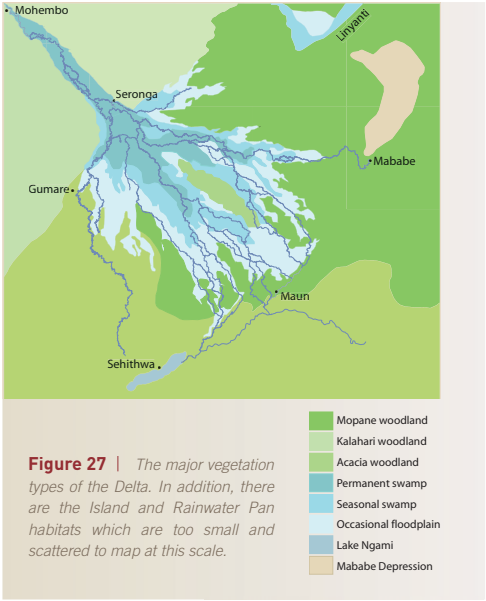


Figure 27 | *The major vegetation types of the Delta. In addition, there are the Island and Rainwater Pan habitats which are too small and scattered to map at this scale.*

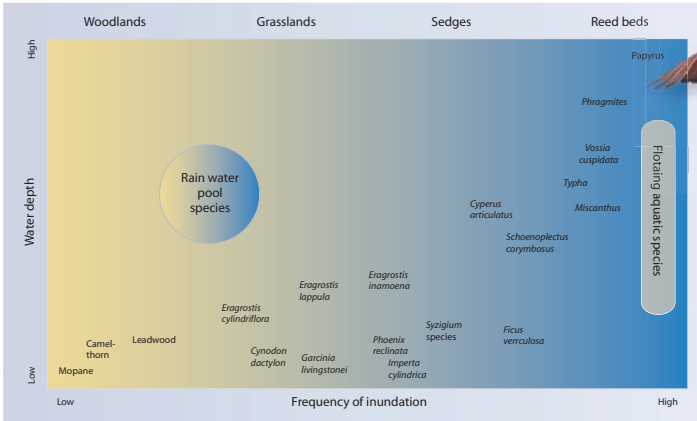


Figure 28 | *The broad relationship between flooding and habitat types, and the approximate preferences of various common or conspicuous species within the realm of flooding frequency (x-axis) and depth (y-axis).*

1. Permanent Swamps

While water levels may drop temporarily to ground level in the Permanent Swamps, they do not drop below its surface. This is a key factor for plants in this habitat, since all are true aquatic species. Four plants are especially abundant and domineering along the margins of the channels and in their immediate back-swamps: papyrus, the two phragmites reeds (*Phragmites australis* and *P. mauritianus*) and the swamp grass (*Miscanthus junceus*). Their growth and abundance is largely determined by water depth, flow rates and their ability to capture nutrients from the passing water. Thus, tall papyrus and phragmites reeds dominate the deeper waters of the Panhandle and upper alluvial fan, while swamp grass is abundant in the shallower lower reaches in the alluvial fan. The plants cannot encroach into channels as long as water flows remain strong, and growth is also limited by their ability to take up soluble nutrients from the water.

Few plants grow in the lagoons or lakes because of their depth, but their perimeters have communities similar to those of the shallow back-swamps. Once dislodged from the bottoms of the lakes by decomposition and methane production, blocks of peat may rise to the surface as floating sudd mats which are then colonised by plants such as *Pycreus nitidus*, *Websteria confervoides*, *Cyperus pectinatus* and *Oxycaryum cubensis*.

The four species lose their dominance away from the main channels and back-swamps where the water is shallower and nutrients from inflows of the Okavango River are less available. These more open waters are occupied by a greater variety of plants, most of which grow as emergent, floating and submerged species. Examples are the bulrush (*Typha capensis*); the sedges *Pycreus nitidus*, *Cyperus pectinatus* and *C. articulatus*; blue water lily or tswii (*Nymphaea nouchali*); the floating heart lily (*Nymphoides indica*); *Brasenia schreberi*; *Ottelia* species; and *Potamogeton* species.

Although some plants are rooted in sandy substrates, others grow on layers of peat that are widespread in the Permanent Swamps. The peat consists largely of decomposing organic plant matter but may also contain considerable proportions of clay. This is particularly true in the Panhandle where much of the suspended clay load is filtered out of the inflowing Okavango River water. Indeed, inorganic sediments may comprise 60-85% of the peat in the Panhandle, compared to less than 15% in peat further downstream in the alluvial fan. The densest layers of peat form beneath phragmites reeds.

No other species characterises the Permanent Swamps as much as papyrus, especially where it is so dominating that it may comprise up to 90% of all plant biomass. This is perhaps the main ecosystem engineer of the Delta because papyrus forms large areas of peat, helps filter out much of the incoming clay, uses much of the inflowing nutrient resource, and is largely responsible for causing major changes in the distribution of water and habitats (*see page 51*).

The Permanent Swamps are the most stable areas of the Delta. Although rates of plant biomass production are higher than elsewhere (Figure 29), almost all the production is through the few dominant perennial papyrus and reed species which take up and retain most nutrients. Few nutrients are thus available in the Permanent Swamps to other organisms which are also constrained by a lack of oxygen in the peat and water. However, the swamps are important refuges for fish before the annual floods. They then leave the swamps for the temporary

The swamp grass (*Miscanthus junceus*), here surrounding the chick and nest of a saddle-billed stork, usually occurs where seasonal changes of water levels are less than 30 centimetres. It thus replaces papyrus and phragmites in the shallower areas of the Permanent Swamps.

Figure 29 | *A measure of average plant production over 16 years, which shows that most biomass is produced in the extensive papyrus and reed beds of the Permanent Swamps.*[13]

In addition to their upright stalks, phragmites reeds have stems called stolons that grow below the ground where they are protected from burning. The stolons sprout after fire, enabling this vigorous species to recolonise burnt areas rapidly. These elephants have uprooted the reeds in their quest for the soft, nutritious stolons and newly grown stems.

Utricularia gibba, one of 12 carnivorous plants in the Delta. These carnivores overcome shortages of nutrients by obtaining them from animals which are trapped and then digested in the small bladders shown immediately above. Species of the genus *Utricularia* have attractive flowers and are most abundant. But the Delta is also home to *Aldrovanda vesiculosa*, which is rare throughout the world.

Papyrus (*above*) is not rooted in the sandy substrate of the Delta, but instead grows and reproduces on layers of peat. This is why it floats so easily on gradually rising water levels. The wide spacing between its stems allows water to percolate through to the back-swamps. The slowing of water flow in blocked channels enhances the growth of papyrus, which then soon invades and further clogs the waterways. But strong flows of water can also break off chunks of papyrus which float off as sudd. If the sudd becomes lodged elsewhere, new communities of papyrus form downstream. Such propagation is very important, since papyrus only reproduces vegetatively. Papyrus also sprouts new growth after fire, as long as their rhizome roots have remained permanently submerged.

The Permanent Swamps typically consist of rather uniform expanses of reeds and papyrus broken only by meandering channels and lakes or lagoons of various sizes. The channels and lakes are often connected by tunnels maintained by hippos (*see page 42*).

floodplain grasslands during the floods to capitalise on the terrestrial nutrients that are mobilised there. And when the flood waters recede, the fish swim back upstream to the Permanent Swamps. Sandbanks along channels in the permanent Panhandle are the most important nesting grounds for crocodiles and African skimmers (*see page 96*).

2. Seasonal Swamps

Whereas the majority of plants stand tall in the deep waters of the Permanent Swamps, most of those in the shallower Seasonal Swamps are shorter. And unlike the evergreens in the Permanent Swamps, many die back when the water dries, to sprout new stems and leaves only when they are next inundated. The key characteristic of this habitat is that flooding is sufficiently regular and deep to support the growth of all life forms of aquatics, especially submerged species. But it is really the sedges that characterise the Seasonal Swamps, setting them apart from the reeds of the Permanent Swamps, the grasses of the Occasional Floodplains, and the woody trees and shrubs of the Drylands **(Figure 28)**.

The arrival of seasonal floodwaters sets in motion a burst of production, which starts when the first microbes are rehydrated. They begin decomposing organic debris, while germinating plants and the regrowth of those that died back in the dry season soon follow. A surprising contest for nutrients that have lain dormant in the terrestrial sediments also begins. As the first bacteria and fungi are revitalized by the water, they start to decompose wetted detritus, rapidly depleting the oxygen in the water to do so. Anaerobic conditions develop, forcing the microbes to use different molecules to metabolise energy, in a chemical process known as reduction.[14] Life is hard without oxygen, and the tough community of different microbes function slowly because using molecules other than oxygen for respiration is a protracted, inefficient process.

The molecules reduced by the microbes for their respiration are also those that plants require as nutrients. Moreover, some molecules become volatile as a result of reduction and then evaporate into the atmosphere. To counter the shortage of nutrients, plants pump oxygen down to their roots, creating micro-atmospheres of oxygenated rhizospheres around their root hairs. The oxygen is for the use of other microbes which congregate around the rhizospheres and use it to oxidise molecular nutrients into forms that the plants can indeed use.

The Seasonal Swamps support a diverse assemblage of short-lived sedges, grasses and aquatics. The mix of species in one any one place depends strongly on the frequency, depth and duration of flooding, so that grasses predominate in areas that seldom receive water, while taller sedges, swamp grass and aquatics are more abundant in the wettest areas.

While the flooding lasts, the competition for nutrients is fierce and rates of production are rapid, since all plants and animals need to maximise their production within the limited and unpredictable period of inundation. The gist of the competition is for nutrients which can only be obtained from inert detritus when the seasonal floodwaters arrive. While decomposition of the detritus leads to a loss of oxygen, the mass of resulting bacteria and fungi feeds swarms of zooplankton, fish and other animals (*see page 100*). When the waters recede, much of the plant biomass produced during the flooding returns as desiccated detritus to the soil, where it will lie until the Angolan water next arrives in the Seasonal Swamps.

The Seasonal Swamps provide such rich grazing that the high abundance of herbivores in the Delta is probably attributed more to this habitat than to any other. What is especially important is the availability of this grazing during the long, dry winter months when forage in the surrounding Drylands is depleted. Succulent shoots produced by growing grass and from the rhizomes of sedges attract buffalo and zebra within weeks of the floodwaters arriving. They forage in shallow water, while impala graze the fringes of green grass along the shores, and red lechwe feed in the deepest areas. As the waters recede at the end of the flood season, tubers and rhizomes provide food for many baboons and warthogs, and termites proliferate, actively harvesting dead reeds and grass. Attracted by the nutritious termites, dozens of predators arrive to feast their fill.

3. Occasional floodplains

It is often hard to distinguish the Occasional Floodplains from the Seasonal Swamps, and many ecologists prefer not to draw a firm line between the two habitats. Indeed, the boundaries between them (Figure 27) are somewhat arbitrary, and also shift in response to longer term changes in flooding frequency. And although the Occasional Floodplains are dry for much of the time, their soils were nevertheless largely formed by alluvial sedimentation.

Grasses with scattered bushes and copses of trees dominate the vegetation of the Occasional Floodplains which are flooded so infrequently that many people would not regard them as floodplains. The most characteristic and common grasses are *Aristida stipoides*, *Chloris virgata*, *Sporobolus ioclados*, *Wilkommia sarmentosa*, *Cynodon dactylon*, *Bothriochloa bladhii*, *B. insculpta* and *Schizachyrium jeffreysii*.

About 220 species of grasses and 120 sedges occur around the Delta. Many of them have small, but intricate flowers, clockwise from top left: *Schmidtia pappophoroides*, *Enneapogon cenchroides*, *Cyperus zollingeri*, *Melinis kallimorpha*, *Kyllingiella microcephala*, *Pennisetum macrourum* and *Dactyloctenium giganteum*.

However, the Occasional Floodplains have a high proportion of plants that occur in no other habitats (Figure 25). Here, regular, annual production depends on rains that fall locally. These features set the Occasional Floodplains apart from the Seasonal Swamps which receive regular pulses of floodwater and share many species with the Permanent Swamps. The Seasonal Swamps also have many more sedges than the grassy Occasional Floodplains.

Since rainfall is usually limited, rates of growth and production in the Occasional Floodplains are generally mediocre (Figure 29). However, during years of flooding, large reserves of nutrients that have accumulated here

over many years are mobilised by the water, and production then booms. Large flocks of birds, swarms of insects, herds of mammals and schools of fish are attracted to these productive events. Not only do the animals thrive on this bonanza, but these uncommon episodes of surplus and bounty enable many organisms to reproduce rapidly and prolifically. It is very likely that much of the Delta's biological wealth is indeed produced on the Occasional Floodplains.

4. Islands

The role of island plants in helping to maintain the Delta as a freshwater system by pumping water into the atmosphere was described in Chapter 4 (*see page 55*). The islands also contribute a great deal to the Delta's overall biological diversity, since the estimated 150,000 islands support the most diverse assemblage of species. This is a product of the close combination of terrestrial and fringing aquatic communities and the considerable changes in soil chemistry between the margins and centres of islands. As a result, quite different plants occupy different soil zones.

Changes in soil chemistry across islands are the result of water transpiration by plants, particularly the riparian trees. By drawing up and transpiring water from beneath the ground, a gradient is formed of increasingly concentrated groundwater from the edges to the centres of islands. Calcium and magnesium precipitate out as carbonates on the fringes where the deposits build the slight ridges to be seen around the edges of islands. These precipitates and the gradual accumulation of organic debris cause the islands to grow in size. Sodium, by contrast, precipitates in the middle of the islands where it often forms a salt crust. This crust of sodium carbonate is poisonous to most plants, so the island centres are mostly barren except for a few salt-tolerant species, such as the grass *Sporobolus spicatus* and the ivory palm (*Hyphaene petersiana*).

The fringes of freshwater-loving riparian woodland vary in width from one island to the next. Some are only a few trees and shrubs wide while others extend up to 200 metres in breadth. The commonest and biggest trees in

The biological diversity of island vegetation is valuable in a broad sense, but island plants also provide a suite of resources that support many of the animals in the Delta. For example, grazing and browse is available for herbivores and fruit for frugivores, while many birds use the islands for nesting and roosting. And of course, islands form oases for the myriad of insects, spiders, reptiles and other animals that simply prefer to stay dry.

The variety of species found on an island is broadly related to its size. Thus, the smallest islands are covered by a handful of trees and shrubs, while on the larger, older islands concentric rings of different riparian communities surround zones of grassland growing on saline soils.

riparian woodlands are knob-thorns, lead-woods, jackal-berries, sycamore figs (*Ficus sycomorus*), water-berries (*Syzygium cordatum*), wild date palms (*Phoenix reclinata*), large fever-berries (*Croton megalobotrys*), mangosteens (*Garcinia livingstonei*), rain trees (*Philenoptera violacea*), sausage trees (*Kigelia africana*) and marulas (*Sclerocarya birrea*). Beneath and around the trees are diverse communities of grasses and many broad-leafed shade herbs.

5. Rainwater Pans

Although they cover a tiny area of the Delta, Rainwater Pans are disproportionately important because they contain rich accumulations of nutrients and are often centres of biological production. And since they are usually filled by summer rain before the later spread of Delta floodwaters, the Pans provide water to herbivores that have moved into the Drylands to graze fresh pastures that sprout after summer showers. The waters and bottoms of the Pans are also much more clayey than other areas of the Delta. Their most characteristic species are *Echinochloa crus-galli*, *Lemna aequinoctialis*, *Portulaca oleracea*, *Tragus berteronianus* and *Chloris gayana*.[15] About one-third of the plants found in the Pans also occur in the Occasional Floodplains (Figure 25), which is indicative of the ephemeral nature of both habitats where so many species lie dormant until they are activated by water.

The number and size of Rainwater Pans depend on rainfall, as does the length of time that they offer water to wildlife. Their special value lies in the fact that the Pans often supply water in places that are far from sources of Delta water.

6. Dryland woodlands

The three types of woodlands surrounding the Delta are associated with different soils (Figure 27). Thus, the broad-leafed deciduous Kalahari Woodlands to the north are on aeolian sands, the Acacia Woodlands to the west and south grow on deep alluvial sands, while Mopane Woodlands to the east are rooted in alluvial sediments that are more clayey and shallow.[16] The alluvial soils of the Mopane and Acacia Woodlands were formed during much wetter periods when the floodplains of the Delta were several times their present size and the Makgadikgadi mega-lakes extended over huge areas of Botswana (*see page 25*).

The composition and structure of the woodlands is rather homogenous in many areas where just a handful of tree species dominate the landscape. However, there is also much local variety, particularly where soils have been changed by water flows and sedimentation. For example, the Kalahari Woodlands (characterised by red syringa (*Burkea africana*), Zambezi teak (*Baikiaea plurijuga*), and Angolan teak (*Pterocarpus angolensis*) are interspersed with inter-dune valleys where acacias predominate on soils that are more clayey. Similar mixes are to be found in Mopane Woodland where uniform stands of mopane occupy higher ground while mixed communities of camel-thorns, jackal-berries, lead-woods and rain trees grow along old, low-lying drainage lines. Large patches of shrubland savanna dominated by shrubs (mainly species of *Grewia*, *Rhus*, *Maytenus*, *Ximenia*, *Croton* and sickle-bush [*Dichrostachys cinerea*]) mixed with occasional trees (*Acacia*, *Combretum*, and Shepherd's Bush [*Boscia albitrunca*]) occur where soils are sandier than most of those in the Acacia woodlands.

The Acacia Woodlands are characterised by camel-thorns, which have deep roots to tap the groundwater, while mopane have extensive shallow root systems to take advantage of even the smallest local rainfall event. The clayey soils preferred by mopane also hold more water than the sandier soils in which camel-thorns grow.

Mopane Woodlands are relatively tall and dense close to wetlands, while on drier areas they are more open with most trees of uniform height. There are also large areas of shrubland known locally as *gumane* where the mopane shrubs appear stunted, perhaps by fire, frost, browsing by elephants or some feature of the soil.

The woodlands provide valuable pastures and browse, especially highly nutritious seed pods, for herbivores associated with the Delta. Without the woodlands there would be few impala and kudu, for example, and it is probably the large areas of mopane wood- and shrubland that allow the huge elephant populations to exist (*see page 106*). Pastures in the Acacia and Mopane Woodlands are substantially more productive because the nutrient content of their alluvial sands and clays is higher than that of the wind-blown sands of the broad-leafed Kalahari Woodlands.

7. Lake Ngami and the Mababe Depression

Sediments very rich in nutrients have accumulated in these low-lying extensions or overflows of the Delta as a result of their repeated flooding and drying over hundreds of thousands of years (*see page 25*). Both have been dry for most of the time in recent decades, and neither has filled anything

Thousands of hectares of Lake Ngami were covered by very dense stands of *Datura ferox* early in 2009 (*left*). An extensive community of umbrella-thorn trees had grown up in a zone around Lake Ngami that was last flooded in the late 1970s. Flowers dropped by the trees produced carpets of yellow when the exceptional flood waters arrived in the second half of 2009 (*right*).

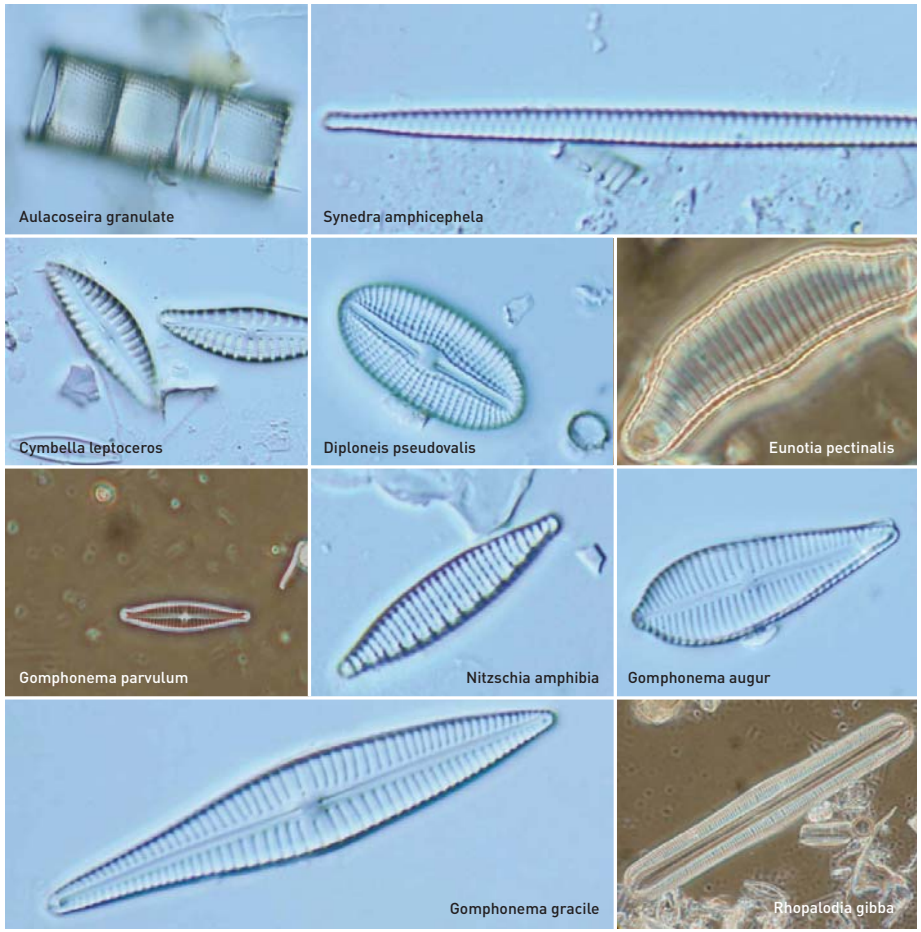
like as much as in the past.[17] As elsewhere, the structure and composition of plant communities in Lake Ngami and the Mababe Depression are strongly influenced by inundation. Those in the lowest, frequently flooded areas consist of grasslands when dry, and a variety of sedges, reeds and floating plants when wet. Algae are particularly abundant because of the rich supply of nutrients in the sediments. However, other than the hardy couch grass (*Cynodon dactylon*), little grass cover remains in the bed of Lake Ngami because of very high grazing pressures by cattle. The removal of native species has enabled substantial stands of invasive pioneer plants, such as *Datura ferox* and *D. stramonium*, the burweed (*Xanthium strumanium*) and *Sesbania* species to take hold. Cattle are absent from Mababe so that the grasslands, dominated by nutritious buffalo grass (*Cenchrus ciliaris*) and couch grass remain in good condition here.

The higher zones around both depressions are wooded, with umbrella-thorn (*Acacia tortilis*), camel-thorn (*Acacia erioloba*), buffalo thorn (*Zizyphus mucronata*) and lead-wood being conspicuous and abundant.

DIATOMS

Early studies focused on documenting what species occur in the Delta, and over 180 species of diatoms have been identified so far.[18] More recent research has sought to understand the preferred ecological conditions of different species and to evaluate the potential for using diatoms as indicators of water quality and the overall health of the Delta. These latest studies found that the Delta's diatoms are characteristic of species that prefer water with low alkalinity, that most species also occur elsewhere in the world and Africa, and that different communities of diatoms inhabit different areas of the Delta. Factors that appeared to influence the distribution and abundance of diatoms included water chemistry – such as levels of calcium, silica and alkalinity – and the duration of flooding. A few rare species of diatoms were found, but more work needs to be done to determine if they are endemic to the Delta or not. [19]

None of the species shown on the facing page have English or other common names, and they are very small, ranging from less than 0.01 to 0.3 of a millimetre. The plants in these images have thus been enlarged about 1,000 times.



Diatoms are tiny algae found in most aquatic environments. Each plant consists of a single cell, the walls of which are composed of silica sculpted in intricate structures that are unique to each species. As photosynthetic algae, diatoms are primary producers and add oxygen to the Delta's waters. They also play important roles in cycling chemicals, particularly silica, and in contributing to the diversity and ecological resilience of the Delta. An average litre of water in the Delta may contain from tens to thousands of individual diatoms, most of which would be attached to underwater stems.

Fire, herbivores and people

The Buffalo Fence separates areas of the Delta used for wildlife management from those where cattle and other livestock are held (*see page 78*). It is a small, simple wire fence but its position is easily visible from space because of differences in vegetation on either side of the barrier (see, for example, the book cover and the image on *page 44*). More specifically, the differences are in the density of trees and shrubs, so the darker areas on the images have more woody plants whereas grasses are more abundant in the paler areas. Most people agree that these differences are a consequence of different grazing pressures by livestock and/or wildlife. But just how this results in more or less grass, or greater or lesser woody plant cover, is debateable. The debate revolves around several possible consequences of grazing.

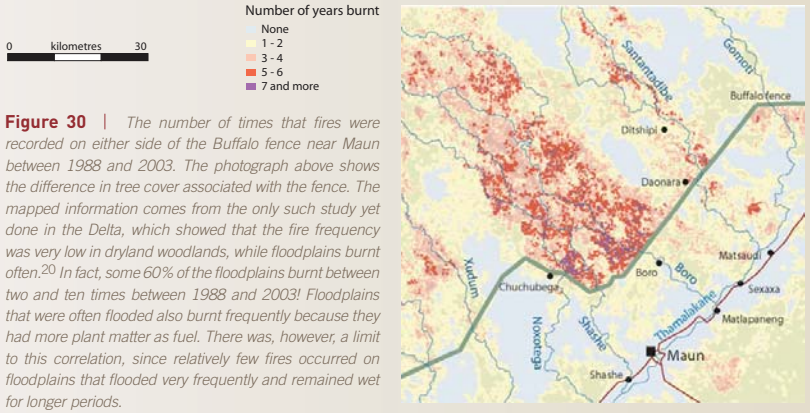


Figure 30 | *The number of times that fires were recorded on either side of the Buffalo fence near Maun between 1988 and 2003. The photograph above shows the difference in tree cover associated with the fence. The mapped information comes from the only such study yet done in the Delta, which showed that the fire frequency was very low in dryland woodlands, while floodplains burnt often.[20] In fact, some 60% of the floodplains burnt between two and ten times between 1988 and 2003! Floodplains that were often flooded also burnt frequently because they had more plant matter as fuel. There was, however, a limit to this correlation, since relatively few fires occurred on floodplains that flooded very frequently and remained wet for longer periods.*

The great majority of Delta fires are started by people, mainly during May before the annual floods and in September before the summer rains and first associated lightening.[21] Some are accidental while other fires set on purpose often run away out of control. A host of reasons have been offered for the setting of fires: to attract wildlife to fresh pastures for hunting and to offer tourists greater chances of seeing wildlife, to improve the quality of grazing for livestock and wildlife, to gain access to fishing grounds, to improve the quality of thatching grass, reeds and papyrus, and to clear land for cultivation.

A variety of plants are used by residents of the Delta. For example, the rhizomes of blue water lilies (locally called *tswii*) are eaten, while the leaves of *Neptunia oleracea*, *Hibiscus cannabinus* and *Alternanthera sessilis* are cooked as spinach. The last species is also used to make soap and can be used to treat digestive problems. Marula berries are a popular food. The fruit of water-berries are edible, can be used to treat diabetes and make alcoholic beverages. Sap from the ivory or real fan palm (*mokolwane*) is fermented into wine. The bark of large fever-berries is used to poison fish. *Indigofera tinctoria* and bird plum (*Berchemia discolor*) are used to dye baskets. Phragmites is widely used for thatching roofs and making palisade walls. *Mokoro* canoes are hollowed out of the trunks of rain trees and jackal-berries.

Most people appreciate elephants very much, but their rapidly growing numbers (*see page 106*) are cause for concern because woodlands in and around the Delta are increasingly being decimated. Mopane Woodlands suffer the greatest damage since elephants relish their leaves and bark. Trees that have been killed or pushed over provide fuel that intensifies fires.

First, high stocking rates and over-grazing may *limit* the abundance of woody species when herbivores physically damage young woody plants by trampling or browsing them. In addition, grazing may stimulate perennial grasses to grow so vigorously that this, too, constrains the growth of young shrubs and trees. Densely stocked areas then have less shrub and tree cover. Second, the removal of grass by grazers can *encourage* the growth of woody shrubs and trees because more water and nutrients are available to them. High stocking rates then leads to the opposite effect: greater bush density.

A third consequence of high grazing pressures is that they reduce the availability of dry grass fuel for fires which curtails the intensity and spread of burning. Woody shrubs and young trees are therefore not killed or burnt back, while those in ungrazed areas are burnt down each time a hot fire passes over them.

This third effect is perhaps apparent on either side of the Buffalo Fence close to Maun **(Figure 30)**. To the south and east of the fence where cattle are abundant, fires are infrequent (and probably less intense) and there is a dense, bush-encroached cover of young mopane. The same trees are virtually absent a few metres across the fence where hot fires are frequent and grazing pressures are low. Another explanation, which does not invoke burning, is that the woodiness south of the fence is due to a combination of livestock grazing intensity (the second idea described above) and a lack of browsing by elephants.

The association between an absence of fire and bush encroachment is troublesome because grass production decreases as bush densities increase. Pastures for both cattle and wildlife are thus lost. The problem is also hard to reverse, since the chances of having fires hot enough to remove woody plants diminish as bush densities

The waters of the Delta are adorned with attractive flowers, clockwise from top left: *Nymphoides indica*, *Cycnium tubulosum*, *Nymphaea lotus*, *Nymphaea nouchali*, *Utricularia foliosa*, *Ottelia ulvifolia* and *Lagarosiphon ilicifolius*.

increase and fewer grasses establish themselves. Fire is also a problem in the Kalahari Woodlands (*see page 80*) where frequent, intense fires gradually convert the tall savannas into shrubland. Mature trees are killed by the fires as a result of the progressive burning of their stems and bark.The trees are seldom replaced because there are too few fire-free years for young trees to grow tall enough to escape the effects of hot fires. In essence, there are just too many hot fires which rage through the Kalahari woodlands almost every year.

Fires are a problem too, when resources such as thatching grass, reeds, timber and even homes are lost.[22] Burnt landscapes also have no aesthetic appeal for tourists. Furthermore, urgent concerns are often raised about the impact of frequent, hot fires in changing the composition of plant communities, and causing losses of wildlife, water birds and fish production. Good evidence for the nature and severity of these impacts is lacking, however.[23]

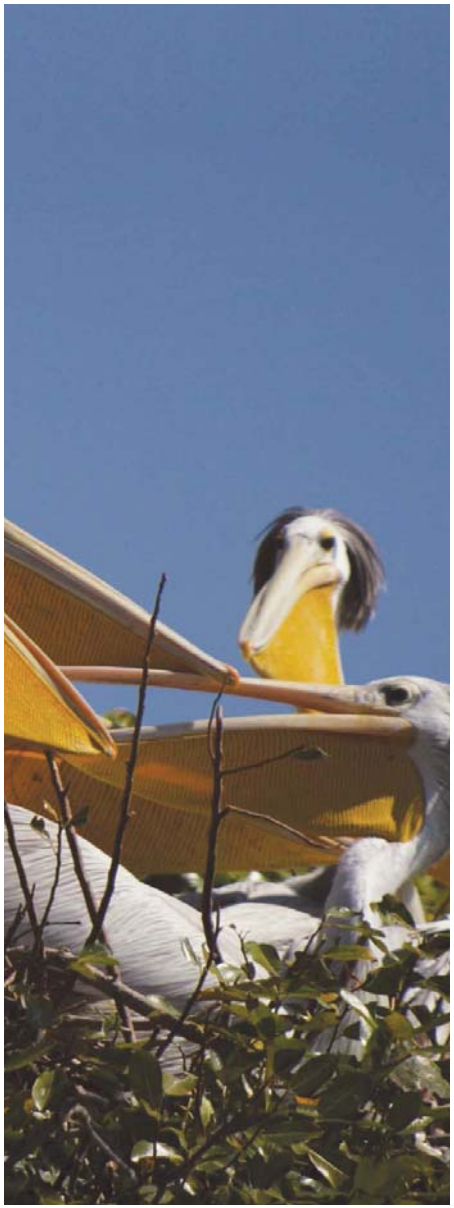
One study compared plant and animal production between two adjacent Seasonal Swamp areas, one of which had just had a very intense fire.[24] All the organic debris and peat was removed by the fire. No grasses and sedges grew in the first season when floodwaters returned to the burned floodplain, but its production of algae was substantial. By contrast, production on the unburned floodplain was dominated by bacteria that decomposed plant litter. Populations of zooplankton (*see page 100*) were similar on the two floodplains, but the number of fish fry on the burned area was 15 times lower than on the unburned floodplain.

The reason for this dramatic difference was not clear, and the results need to be confirmed. But it is clear that by removing the grass-sedge-litter matrix, hot fires change the habitat structure and decomposition of organic debris. Their impacts on the functioning of floodplains may therefore be considerable, and this needs more investigation. Research is also needed to study what is widely agreed to be two major benefits of fire in the Delta. The first is the role of fire in releasing nutrients that have accumulated in peat and other organic debris (*see page 59*). Without fires, much of the biological value of nutrients that have built up in the Delta would probably not be available. Secondly, fires appear to play a major role in causing changes to the distribution of water (*see page 51*), thereby adding to the Delta's diversity and allowing some areas to be wetted and others to dry (and therefore, paradoxically, to be burnt).

While fires are perhaps more frequent than before (because most are set by people), it is also obvious that burning is a natural process. Communities of plants, animals and people have endured the costs and enjoyed the benefits of fires in the Delta for time immemorial. There are also costs if fires are too infrequent, for example when the hot, killing infernos consume large masses of plant material that have accumulated over years. The challenge now is to learn more about the effects of frequent, hot fires and to understand how the devastation of burns (as particular events) measures in relation to burning (as a process).

KEY POINTS

1. Plants are important 'engineers' in causing channels to switch direction, sieving out mud and clay, and pumping water into the atmosphere which helps maintain the freshwater of the Delta.
2. About 1,300 species of flowering plants have been identified in the Delta. Most are grasses, sedges, asters and daisies, and bean and pea pulses.
3. Most plant species occur in habitats that are never or seldom flooded, whereas areas that are permanently flooded are dominated by a handful of species, particularly papyrus and phragmites reeds.
4. The number of species found in any broad area reflects the diversity of habitats, of which there are many in the Delta. It is thus the mix of habitats that gives the Delta such biotic diversity.
5. Most of the Delta's plants are found elsewhere in southern and central Africa, especially in wetlands to the north in the upper Zambezi River Basin.
6. The frequent fires have a variety of effects. On the one hand, plant resources, wildlife, fish production, and nutrients may be lost. But fires also release nutrients held in peat and other organic debris, and cause changes to the distribution of water which add to the Delta's diversity.
7. Conservation should not aim to protect particular habitats or conditions, but rather preserve processes that allow for change and plant diversity.



6 Animals: shifting consumers

More tourists are drawn to the Delta by its animals than by any of the wetland's other spectacular features.

Likewise, this wealth of wildlife also largely attracts and focuses the attention of international conservation groups on the environmental value of the Delta. And for local people, wildlife and fish are important as sources of food and revenue that pay salaries and royalties, and that boost the economy of Botswana. So when it comes to the question of what commands attention, what elicits sympathy, or what generates altruistic donations, wildlife wins hands down. Plants may well provide the habitats and food on which animals depend for their very existence, but they are simply not as sexy as hippos, lions, fish eagles, reed frogs or even damselflies.

Other chapters attempt to provide reasonably comprehensive overviews of various topics: the Delta's history (*Chapter 2*), sources of water (*Chapter 3*), functioning (*Chapter 4*), people (*Chapter 7*) and challenges (*Chapter 8*). Here we take a different approach by focusing on a few select groups of animals, each of which tells a different story about life in the Delta. For example, information on tiny crustaceans, which few people ever see (but may swallow unwittingly!) shows how different species respond to flooding and the roles they play in cycling energy from one level of a food web to another. Birds, more mobile than most creatures, provide glimpses of the challenges animals face in tracking sources of food when floodwaters mobilise nutrients into new cycles of biological production. Dragonflies and damselflies illustrate how life cycles are adapted to different flooding patterns, and show how species in the Delta relate to those in neighbouring areas of southern and central Africa.

These and other perspectives provided in this chapter paint cameos of the varied and fascinating strategies adopted by animals that inhabit this wetland. But before continuing, it is useful to recap on some of the fundamental aspects that define the 'playing field' on which the lives of the animals are played out.

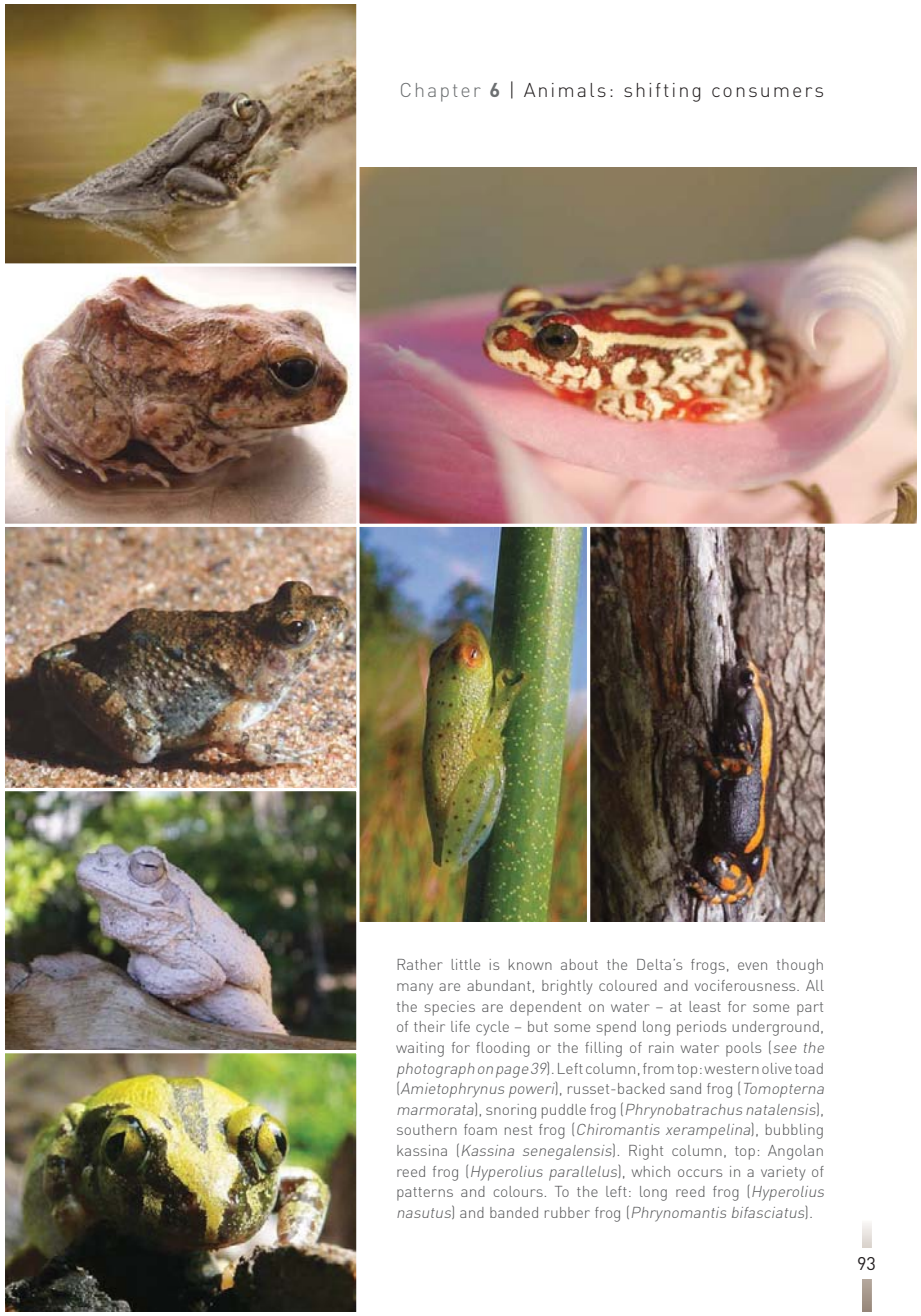
The first fundamental is the great diversity of habitats, which broadly range from drylands (of different kinds) to wetlands (again, of different kinds), to very local levels where a patch of bush grows right next to a pool of water. As with plants (*see page 68*), most animal species occur in the drylands, as the figures in the following table indicate:[1]

	Reptiles	Birds	Mammals
Total number of species	64	444	122
Perennial swamp	7	112	3
Seasonal swamp	5	57	21
Dryland	52	275	110

Over long evolutionary periods, this diversity provides opportunities for specialization so that different species are adapted to different environments. On a day-to-day time scale, the habitats allow animals to enjoy a broad canvas of resources. A young elephant can, for example, indulge on phragmites stolons (*see page 73*) in the morning and mopane bark (*see page 87*) in the afternoon.

Secondly, the landscape is ever shifting over large areas of the Delta, particularly in the alluvial fan's seasonal swamps and occasional floodplains (*see page 44*). As waters come and go, so do food supplies, secure nesting sites, or safe resting places. Opportunism is key to exploiting these changes, and animals need ways of rapidly moving to choice areas, and of escaping those that offer diminished resources or looming danger. They must also be able to locate – and to choose – patches that can offer up the best prospects and rewards, and they need mechanisms to determine the most opportune times to make their movements.

Third, the diversity of species and the astounding numerical abundance of animals in the Delta are very much a consequence of its nutrient wealth. But other factors serve to make this Africa's last Eden.[2] One is the variety and close mix of habitats, as noted above. Another important feature is the availability of a perennial supply of water. Without it, only animals especially adapted to conserving water could exist here. Moreover, life in the Delta is particularly attractive because



Rather little is known about the Delta's frogs, even though many are abundant, brightly coloured and vociferousness. All the species are dependent on water – at least for some part of their life cycle – but some spend long periods underground, waiting for flooding or the filling of rain water pools (*see the photograph on page 39*). Left column, from top: western olive toad (*Amietophrynus poweri*), russet-backed sand frog (*Tomopterna marmorata*), snoring puddle frog (*Phrynobatrachus natalensis*), southern foam nest frog (*Chiromantis xerampelina*), bubbling kassina (*Kassina senegalensis*). Right column, top: Angolan reed frog (*Hyperolius parallelus*), which occurs in a variety of patterns and colours. To the left: long reed frog (*Hyperolius nasutus*) and banded rubber frog (*Phrynomantis bifasciatus*).

animals have access to water for extended periods, with the summer rains being complemented by the spread of floodwaters during the winter months. In this Eden, wise humans have played a role by preserving the environment and its wildlife. Without their foresight, the Okavango Delta might now be known for its rice paddies or as a former place of glory, with the water drained to far-away mines and cities.

The wildlife of the Delta is therefore not to be taken for granted.[3] Neither should its pools of nutrients, the pulsed flows of water through Namibia from Angola, and the benefits of good management.

Dragonflies and damselflies

In the tradition of bird-watchers, a growing number of people have taken to watching these colourful insects. Hovering and darting, they settle, the dragons with their ostentatiously outstretched wings, and the damsels with theirs demurely folded. Perhaps because of their conspicuous beauty and the efforts of specialists,[4] more is known about this group (called Odonata) of insects than about any other in the Delta. So far, 99 dragonfly species (which, hereafter, includes damselflies) have been found in the Delta. The highest numbers in the world of ten of these species occur in the Delta, endowing it with special value for the conservation of these populations.

The assemblage of species found in any one area is related to patterns of water availability and flooding. For example, dragonflies around temporary pools are typical of the species found at ephemeral rainwater pools in the dry Kalahari. Not surprisingly, their life cycles are rapid, with adults emerging only 30 days after the eggs have been laid. Species of the permanent swamps, by contrast, require water throughout the year.

The highest number of species occurs where permanent and temporary waters are close together. Assemblages of dragonfly species also change when patterns of inundation alter. For example, only species typical of temporary pools were found on the Thamalakane River when it received intermittent flows during the early 2000s, but these were replaced by more 'perennial' species when the river received water year after year after 2005.

The protracted presence of water from rainfall and flooding allows some species to breed twice in one year. For example, the damselfly *Pseudagrion deningi* is very common between December and March, and then a second generation emerges in late July. Since dragonflies are less abundant in the cooler winter months, reduced competition from other species may be one advantage enjoyed by the second generation.

Of course, the main reason for so many dragonflies being here is the presence of a wetland, although not many people will know that this is because their larvae are aquatic predators. Most of the species found in the Delta also occur in other permanent waters nearby, the closest of these being the perennial wetlands of the Zambezi River and Kwando River catchment. This broad swathe of swamps, rivers, lakes and floodplains in eastern Angola and Zambia (which includes Lake Bangweulu in northern Zambia) is a hotspot of biological diversity and endemism for dragonflies and several other groups, including antelope, flowering plants and fish.[5] The biological resemblances between the Delta and these northern wetlands reflect their similarities as perennial wetlands and historical linkages between them when water flowed more freely between the Okavango, Kwando and Zambezi (*see page 25*).

Crocodiles

These are usually retiring animals, slipping away into the water whenever people approach. Since not much hunting goes on in the Delta, one might assume the population of these giant reptiles to be in good health.

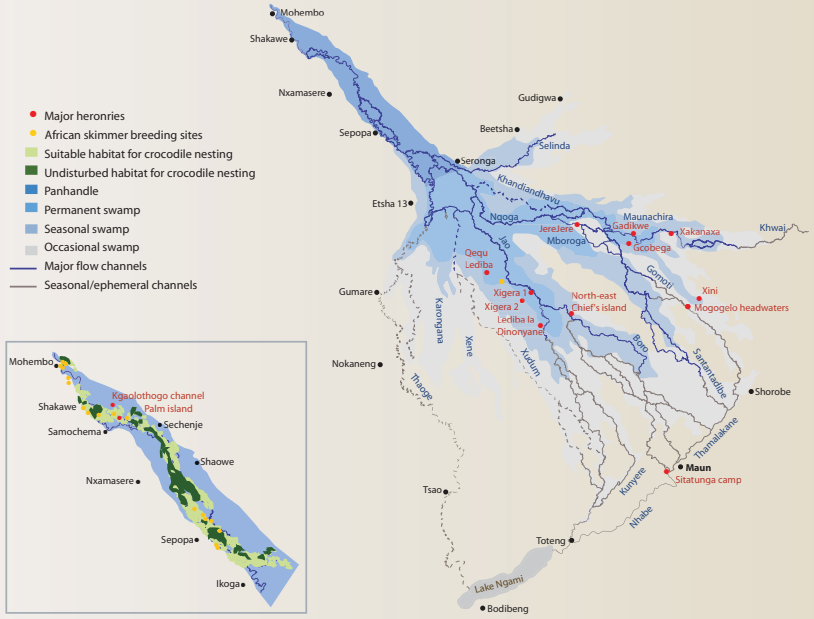
However, their reproduction suffers from considerable disturbance caused by people removing eggs or destroying their nests. In addition, nest sites are altered by burning, trampling by cattle and wakes from motor boats washing over nest sites on sandy beaches. Water monitor lizards often dig up nests to eat the eggs, as well. As a result of all these hazards, only 2% of all eggs laid hatch into young crocodiles.[6]

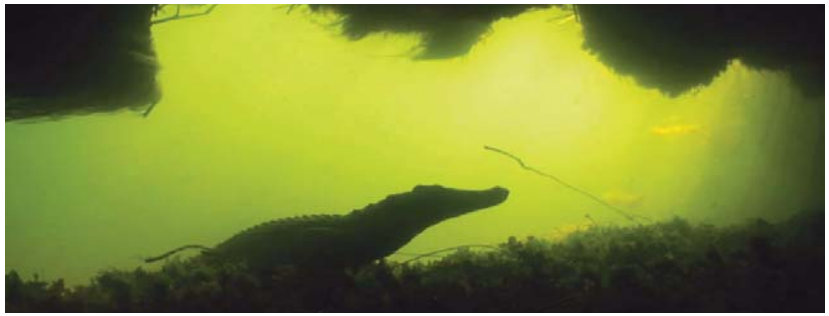
Dragonflies and damselflies are obvious, abundant and colourful animals of the Delta. For most of the time we see them flying about, seemingly without special regard for the wetlands. But the chief reason for there being so many is that they have to breed in water. In fact, much of their life cycle is spent in water as fierce larvae that eat other animals. Left column, from top to bottom: *Sympetrum fonscolombii*, *Pseudagrion rufostigma*, *Pseudagrion deningi*, *Pinheyagrion angolicum* and right top *Trithemis hecate*, bottom, left to right: *Ischnura senegalensis* and *Trithemis aequalis*.

Such disturbances would be less of a problem if patches of flat sand suitable for nesting were more widely available. However, few good nesting areas are available, and these are only along certain stretches of channels in the Panhandle (Figure 31). Unfortunately, these areas are generally populated by cattle and people (*see page 115*, and Figure 37) and only 43% of areas suited to crocodile nesting is relatively free of human disturbance.

The great majority of crocodiles live in the Panhandle and upper reaches of the Permanent Swamps. Counts over several years indicate that there are about 2,600 crocodiles in the Panhandle, of which close to one quarter are adults. Their food varies according to size, and so the youngest, smallest animals feed on insects and small fish, while the biggest crocodiles take proportionately larger prey. Overall, however, fish form much of their diet in the Delta. In addition to the presence of suitable nesting grounds, the greater abundance of adult fish in the permanent swamps and Panhandle (*see page 101*) further explains the concentration of crocodiles in these areas.

Figure 31 | *Areas of nesting habitat suitable for crocodiles, and remaining areas where they can nest with little disturbance. The map also shows places where African skimmers breed, and the major breeding colonies for water birds in the Delta. The Panhandle has been enlarged to show more detail of the nesting areas.*





Crocodiles lay clutches of 40 to 80 eggs in nests excavated in flat sandy areas next to large channels. The nests are guarded by females until the hatchlings emerge after about 90 days of incubation. Interestingly, the temperature of the nest determines the sex of young, so that males are produced under warm conditions and females when nests are cooler.

Birds

For much of the time, populations of birds subsist in the Delta, each individual ticking over from day to day. Daily routines start with a period of warming in the rays of the rising sun. Then follows a bout of feeding before a long period of mid-day rest. Another stint of foraging may follow the siesta, before the bird settles down for the night in a secure roost.

But then there are times when the Delta hums with two kinds of productive activity. One is breeding, which boosts the pool of genes, and the other is voracious feeding, which boosts body reserves. Birds of course feed every day, but these are the times when food is super-abundant. Moreover, the feeding events are episodic and they occur in widely separated places. The most important, or at least well known of these spells are:

- emergences of fat-laden termite alates (winged adults), on which vast numbers of birds of many species gorge themselves;
- concentrations of zooplankton and fish fry in seasonal swamps and occasional floodplains which attract flocks of wading egrets, herons and storks; and
- concentrations of large fish trapped in drying pools to which pelicans, storks, fish eagles and other piscivores are drawn (*see the photograph on page 63*).

How do birds track and find such ephemeral sources of food? This is one of the 'big' questions of biology. The ability to do so makes the difference between idling and recharging body reserves which enable birds to launch themselves into the other form of (re)production.

While great feeding orgies are often unpredictable, most of the spectacular reproductive events occur annually in well-established breeding colonies. The biggest colonies are shown in Figure 31. There are 14 major heronries in the Delta, where spoonbills, pink-backed pelicans, sacred ibises, yellow-billed, openbill and marabou storks, African darters, reed cormorants and several other species can be found breeding. Hundreds of pairs may breed simultaneously, but the total at each colony also varies from year to year. Unfortunately, there are indications that the total number of aquatic birds breeding in the Delta has declined in recent decades. Human disturbance, especially by tourists venturing too close to the breeding birds, is considered to be the main reason for this loss.[7]

These colonies deserve the highest levels of protection, as do the nesting sites of African skimmers and bee-eaters in the Panhandle. The skimmers nest on sandy islands along the main channels, while carmine and white-fronted bee-eaters breed in colonies in vertical sand banks where the main channel has eroded into layers of Kalahari sand. Numbers of breeding skimmers have also declined, largely as a result of the same kinds of disturbance suffered by nesting crocodiles.

An example of how much concentrated food can be available. Up to 5,200 white pelicans have been counted at Lake Ngami, alongside many other fish-eating species.[8] Each of the pelicans would consume just less than a kilogram of fish each day, which means that 5,200 of them would harvest about 5 tonnes of fish daily. White pelicans nesting at the Nata River delta in the Makgadikgadi Pans make return journeys over 600–700 kilometres every day to collect fish trapped in pools in the Delta. They leave the Pans in the morning and return with belly-cans of fish in the afternoon which they disgorge to feed their chicks.

The Delta has very special conservation value for slaty egrets (*left*) and wattled cranes (*right*). The approximately 1,200–1,450 cranes in the Delta constitute the largest single population of this globally threatened species, while an estimated 75-80% of all slaty egrets in the world live in the Delta. This species, too, is classified as globally threatened. In addition, more than 1% of the global populations of 25 other bird species occurs at this Ramsar site (*see page 121*), while another 12 species have more than 0.5% of their populations here. The Okavango Delta Ramsar Site extends across three of Botswana's important bird areas (IBAs) which are the Okavango Delta, Lake Ngami and the Linyanti Swamps/Chobe River.

Of over 450 species of birds recorded in the Delta, about 112 are aquatic birds that feed by diving, wading or swimming, or feed in the vicinity of water. Many of them feed largely on fish which means that they are piscivorous species. This is a selection of fish-eaters. *Top, left to right*: African fish eagle, yellow-billed stork; *middle, left to right*: saddle-billed stork, giant kingfisher, goliath heron; *Bottom, left to right:* Pel's fishing owl, pied kingfisher and green-backed heron.

Zooplankton

This is the collective name for a variety of tiny animals that float or swim, while phytoplankton is the equivalent name for small floating plants, many of which are algae and diatoms (*see page 83*). The majority of zooplankton in the Delta's waters are crustaceans that belong to groups called Cladocera and Copepoda. Most of them are filter-feeders, sieving out bacteria, small phytoplankton and other minute organisms. Much of what is known about zooplankton in the Delta – and described below – concerns cladocerans, however.[9]

A study of cladoceran diversity found there to be relatively few species in the open waters of channels and lagoons, where their densities were also low. Somewhat more species, some of them in moderate densities, were recorded in the permanent swamps, but the real centre of cladoceran diversity and abundance was in the seasonal swamps.

Three of the cladoceran species that are common in the seasonal swamps in the Delta: *Bosmina longirostris* (*top*), *Chydorus sphaericus* (*bottom left*) and *Ceriodaphnia reticulata* (*bottom right*). These names are much longer than the animals themselves, most of which measure less than a millimetre in length or breadth. Cladocerans are commonly called water fleas.

Of course, these animals are not present when the seasonal swamps are dry, but the first eggs hatch soon after the floodwaters arrive. Up to 50,000 cladoceran eggs per square metre have been recorded, all of them lying dormant in the dry sediments. Each egg is enclosed in a thick-shelled ephippium or casing which offers protection during the months – or even years – the egg might lie waiting for water.

Different species in the seasonal swamps hatch at different times, timing their emergence and development to capitalise on the wave of food made available by flooding. Much of the food for cladocerans is provided by vast quantities of phytoplankton, algae and bacteria which decompose particles of plant matter that have lain there since the last flooding.

Moreover, the wealth of production is usually made possible by abundant phosphorous being released into the water, with much of this phosphorous probably coming out of dried mammal droppings. (Accumulations of dried droppings can be as high as 500–700 kilograms per hectare!) In essence, all these constituents of life – the cladoceran eggs, bacterial and algal spores, and then also the plant detritus and phosphorous – remain dormant on the surface or in the sediments until the floodwaters arrive.

Although different species hatch at different times, most of them congregate in the shallowest waters on the edges of the seasonal swamp. This is where nutrient releases are greatest, their food most abundant, and where the cladocerans are best protected from predators, such as fish. Some remarkable densities of cladocerans have been recorded, as many as 100,000 individuals being counted in one litre of water, and in such concentrations that their crustacean odour was distinctly recognisable in the air above the water. Under these conditions, fish, various predatory insects and birds enjoy a veritable feast that does much to replenish their stocks of energy and genes.

Fish

Productive booms in the seasonal swamps (and the occasional floodplains when they get water) do not escape the attention of the Delta's fish, especially those that will benefit from an abundance of zooplankton and lush vegetation.

During dry periods when most water is confined to the Panhandle and permanent swamps, adult fish are likewise limited to standing water in channels, lagoons and reed beds. But as the pulse of inflowing water passes, the fish follow, migrating downstream into areas that are to be temporarily inundated. There, many of the fish spawn as quickly as possible so that the young fry have time to make the most of the seasonal or short-lived food that becomes available in the swamps.[10]

The adults of at least 19 species also remain in these temporary waters to regain body reserves, and to grow larger so that they are more competitive and attractive as mates.

Fish eggs generally hatch within a few days, and the young larval fry then begin the business of feeding and growing as quickly as possible. Most of the fry eat zooplankton and plant matter, since these are the most abundant kinds of food. Indeed, many begin by feeding on cladocerans and copepods when they are small, and later switch to being herbivores when they grow larger.

Under reasonably normal conditions, seasonal swamps hold water for four to six months, during which time sedges and other aquatic plants offer the young fish protection as they grow and grow. For example, species of tilapia can reach lengths of 10–12 centimetres during these few months, each additional centimetre of size reducing their chances of falling prey to predators, such as piscivorous birds (*see page 99*) or African pike.

As a result, growth and survival rates of young fish are directly related to the extent and duration of flooding. Prolonged flooding also provides adults with more opportunities of spawning in the first place, and of growing larger themselves. Thus, in years with little or no flooding, the Delta's fish populations remain static, whereas the highest levels of recruitment occur when flooding is most extensive. The same effects of flooding on fish populations have been found in many other freshwater wetlands.[11]

About 20 fish species in the Delta care for their eggs and fry, such as the red-breasted tilapia (*Tilapia rendalli*) with its young (*top*). This has particular value where predators are abundant and oxygen levels are low, such as in the seasonal floodplains where microbes deplete the water of oxygen (*see page 75*). The aerial foam nests of African Pike (*Hepsetus odoe*) are thus guarded by the parents while the nests provide an oxygen-rich environment for the embryos (*above*). African pike are the predators of the alluvial fan, whereas tiger-fish (*Hydrocynus vittatus*) predominate in the Panhandle. The pike are ambush predators, relying on dense vegetation for cover while waiting for prey, while tiger-fish chase down their prey in open water.

The nests of three-spot tilapia (*Oreochromis andersonii*) have diameters of 70–190 centimetres, and depths of up to 50 centimetres. Males construct the nests after which the females select the best nests and the largest and most colourful males for breeding. The eggs are laid in the nests where they are fertilised by the males and then picked up by the females who hold and protect them in their mouths for up to three weeks.

The famous barbel or catfish run in the Panhandle usually occurs between August and September when many smaller fish return to the permanent beds of papyrus and phragmites after breeding in the seasonal swamps. Packs of sharp-tooth (*Clarias gariepinus*) and silver catfish (*Schilbe intermedius*) move along the main channels, hunting down the smaller fish concentrated along the margins of the channels. These frenzied runs of feeding catfish are followed by tiger-fish, large bream, aquatic birds and other predators which snap up morsels and prey that escape the catfish.

The annual wave of floodwaters which arrives in the lower Panhandle each March and April flushes out water that has been standing in the reed beds for months. This relatively stagnant water contains very little oxygen because it has been used by bacteria that decompose peat (*see page 54*). Great numbers of fish are killed when this water is pushed into lagoons, such as the one at Guma, because there is too little oxygen for them to respire.

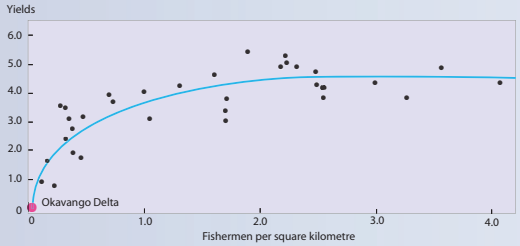


Figure 32 | *Fishing effort (as reflected by the density of fishermen on the x-axis) is generally dependant on yield (y-axis, kilograms per hectare per year), as shown by this analysis for 31 African lakes. Each lake is represented by a dot. Yields and efforts are smallest in the Delta, largely because fish populations are low as a result of the nutrient-deficient waters* (see page 53).[13]

Fishing and fishermen

Most of the 71 fish species in the Delta are too small and uncommon to be exploited, but there are a number of fish that are large and tasty, and that provide a good contest for recreational anglers. The most highly-prized for consumption are tilapia, the three-spot, red-breast and the green-head tilapia (*Oreochromis macrochir*), and they are targeted by commercial fishers who sell their catches to customers in and around the Delta. Anglers are usually after tiger-fish, which have a reputation for offering a sporting fight, as well as the large nembwe (*Serranochromis robustus*).

The number of recreational anglers is not known. Neither is the number of fish nor the weight of fish that they remove, although most people agree that these are not substantial. Commercial fishing operations are concentrated in the northern areas of the Panhandle, where syndicates of fishermen have cold-storage facilities at Samochima, Mohembo West and Ngarange. There are now about 40-50 commercial fishermen in the area, operating mainly from motor boats and using nets.

A much greater number of people fish for subsistence purposes. Most of them are women and young girls who use baskets (*see page 8*), or young boys with hooks and line, or men with spears and barrage traps. The total number of families who fish is estimated to be about 3,000, and most of them live alongside the Panhandle, particularly around the Etsha villages.[12] While fish usually supplement other, more staple foods, such as that obtained from cash purchases and farming, fishing can be a valuable safety-net, especially for very poor families. Interestingly, many more families turned to fishing during 1996 when all the cattle in Ngamiland were killed as a result of an outbreak of lung sickness (*see page 119*).

The question of whether the Delta is over-fished or under-fished is often debated, sometimes hotly so. Accusations often include claims that there are too few fish to go round or that the Delta is being over-fished. For example, commercial fishermen complain of being excluded from tourism concession areas because there are too few fish in areas in which they normally operate. In turn, tourism operators counter by objecting to fishing by commercial and subsistence fishers in their concessions, because they claim that the local fishermen will deplete stocks available for angling tourists.

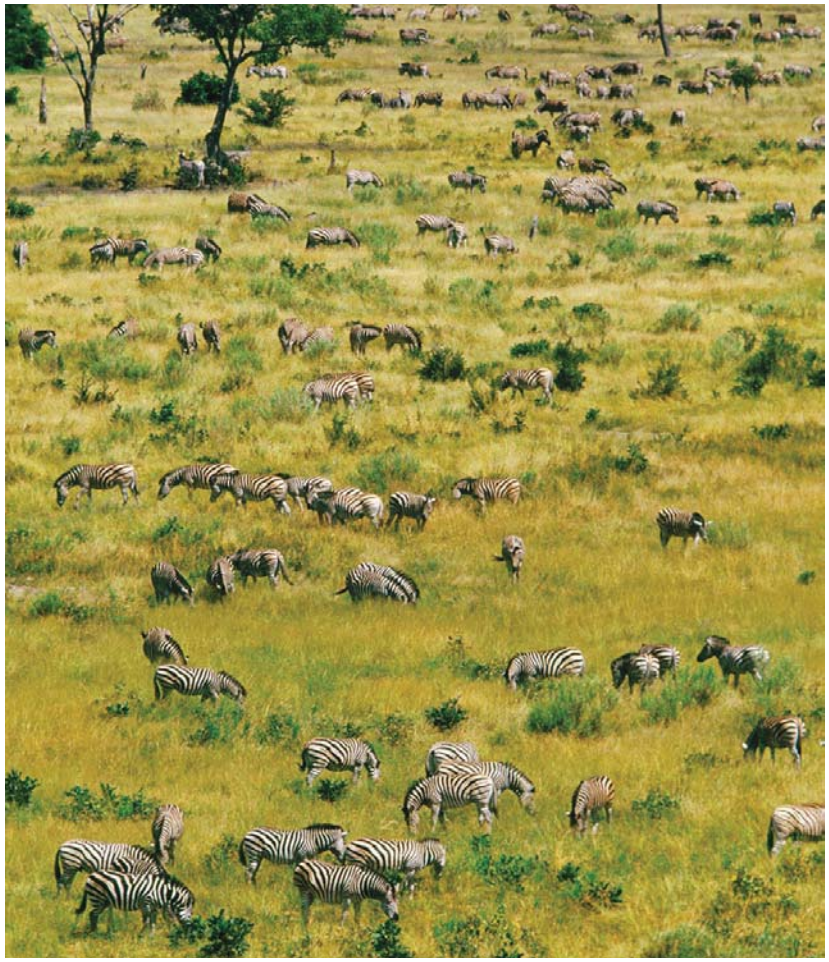
Such debate actually revolves more around rights to resources and land (*see page 122*) than the abundance of fish. Nevertheless, fishing off-take has dropped significantly over the past 20 years, from about 3,000 tons per year to less than 1,000 tons.[14] This is perhaps because more people have access to cash incomes and/or because public funds were previously used to subsidise equipment for commercial fishermen and the purchase of their catches.

Over-exploitation certainly occurs locally, for instance in confined lagoons isolated from the easy interchange of fish populations with other waterways in the Delta. However, most research suggests that the Delta's fish are in good health, largely because so few people actually catch fish (Figure 32) and because there are large areas where there is no fishing. These are places where fishing is prohibited or that are too far from human settlements.

Large mammals

Everyone would agree that the Delta is full of large mammals, but why, and how many are there? The first question was discussed in Chapter 4 (*see page 58*) where it was reported that the Delta holds about 10 times more large mammals than would be expected in an area of similar annual rainfall if the underlying soils were also Kalahari sands. And so the key feature that sets the Delta apart in providing sustenance to so many mammals is its nutrient base. Not only do the nutrient rich soils enable forage to grow rapidly and in abundant quantities, but much of the forage is also much more nutritious in quality than it would be on poorer sandy soils.

Answering the second question about how many mammals live here is harder. First, what area are we talking about: the permanent and seasonal swamps (which cover about 6,900 square kilometres) or the occasional floodplains as well (which add another 6,500 square kilometres). Or do we include the larger are of nutrient rich sediments that is now usually dry but which received water flows over tens of thousands of years (*see page 24*)? Another confounding problem is that many mammals move around, spending some months in the heart of the Delta and others far away in the Kalahari sands or around the Makgadikgadi Pans, for example.



Browsing mammals, such as kudu and giraffe (*opposite*), are much more sedentary than grazers, such as buffalo, wildebeest and Burchell's zebra (*above*). Trees tend to produce similar amounts of foliage each year, whereas the abundance of grass varies greatly in relation to rainfall. Grazers thus need to move to places where good rains have fallen. Unfortunately, these movements are often blocked by veterinary fences (*see page 120*).

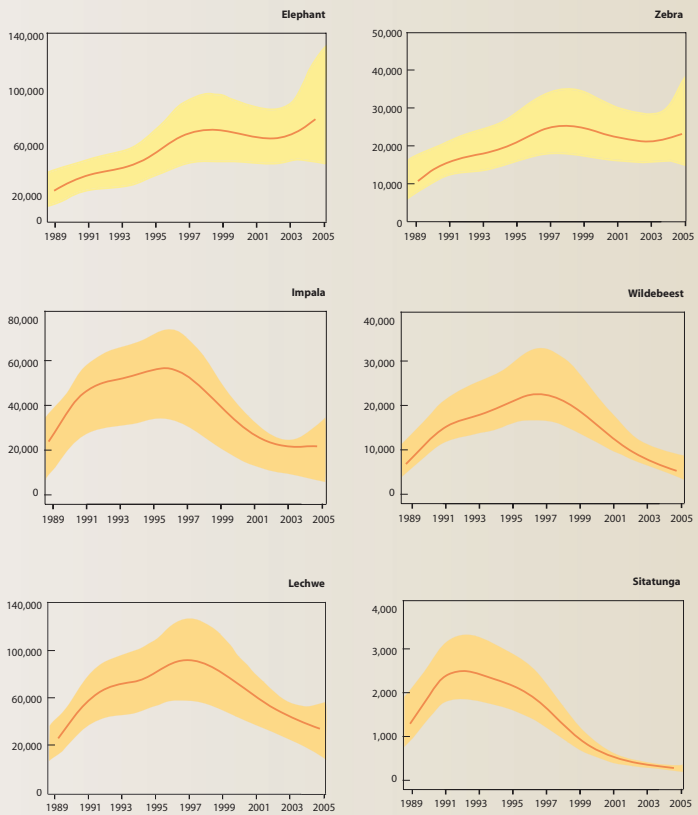
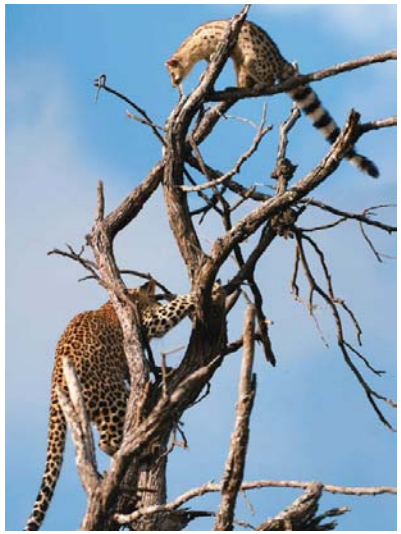


Figure 33 | *Population estimates for large mammals obtained from aerial counts between 1989 and 2005. The thin red lines show the population estimates for each year, while the coloured bands above and below the lines are the 95% confidence limits for the estimates.*



Two spotted predators testing their nerves: a leopard below and large spotted genet above.

Moreover, numbers of large mammals have been changing, and substantially so. For example, data from aerial surveys done by the Department of Wildlife and National Parks over an area of 20,000 square kilometres (which includes all of the proper wetlands of the Delta) indicates that populations of Burchells' zebra and elephant increased several times over a period of 16 years (Figure 33). By contrast, numbers of red lechwe, sitatunga, blue wildebeest and impala rose significantly during the 1990s and then declined by similar orders of magnitude. Rather similar changes were recorded giraffe and waterbuck, while numbers of sable, tsessebe, roan and eland declined more steadily over the same period.

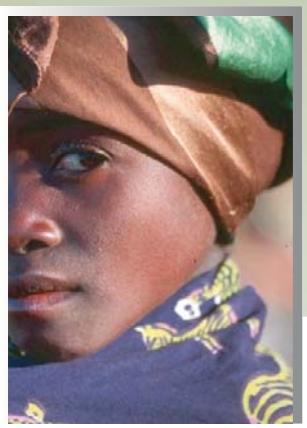
And that begs another question: what causes the population changes? Clear answers are not available, and they may differ from species to species. However, one plausible explanation draws on the consequences of longer term high and low inflows from Angola and the ensuing flooding cycles (*see page 44*). As a result of the higher flows in most years after the late 1990s, larger areas of the Delta have been flooded with deep water for longer periods. This may have limited the extent of floodplain grasslands, thus reducing the availability of nutritious forage for some grazers.[15] This is one hypothesis, and clearly much more investigation is needed to understand factors that influence the population dynamics of these charismatic icons of the Delta.

KEY POINTS

1. The highest diversity of animals is in the drylands that surround the Delta, whereas the permanent and seasonal swamps are the preferred habitats for relatively few species.
2. Populations of fish (and many other animals) are directly dependant on the extent and duration of seasonal flooding because most recruitment occurs in the nutrient-rich seasonal swamps and occasional floodplains.
3. The Delta's populations of crocodiles, African skimmers and carmine and white-fronted bee-eaters breed mainly in the Panhandle where they often suffer from human disturbance.
4. Populations of several large mammals and also of aquatic birds breeding in heronries have declined in recent years, but the numbers of Burchell's zebra and elephant have increased, by contrast.
5. Most of the 99 species of dragonflies recorded in the Delta also occur in wetlands in the headwaters of the Kwando and Zambezi rivers, which is a centre of endemism for various groups of animals and plants.
6. Vast numbers of zooplankton hatch and 'ride waves' of production as floodwaters extend into and over seasonal swamps. In turn, adult fish migrate from permanent waters into the seasonal swamps to spawn where their fry feast on the zooplankton and other abundant food.
7. Per unit area, there are far fewer fishermen in the Delta than in other African wetlands because fishing yields are much lower than elsewhere.
8. Fish populations are relatively low because the nutrient base of the Delta's waters is small. By contrast, large herbivorous mammals are very abundant as a result of sediments and forage being rich in nutrients.

7 People: predators and protectors

Humankind is both the enemy and guardian of the Delta. Certain people use it, while others abuse the wetland; some people remain on the land, while others move away.



Concerns about increasing pressures being placed on the Delta's natural resources contributed to the reasons for writing this book. Some threats come from far afield, such as climate change and potential developments upstream of the Delta (*see page 130*), but others are due to local processes. And because the Delta matters most to the people who live there, much of the obligation to care for the wetlands falls on local shoulders.

The health of the Delta is thus very much a matter for local people, on whom we now focus. As the chapter will show, this is a sparsely populated area compared to most places in the world. It is also one where people are in rapid transition from traditional lifestyles to others associated with modern economics and commodities. And, with many people being recent immigrants from elsewhere in Botswana and other countries, the population is diverse in character and origin.

The majority of people live on the outskirts of the Delta rather than within the wetlands themselves. For this reason and the fact that most demographic information is aggregated for Ngamiland, many of the statistics presented are for this district.

The people of the Delta have been highly mobile in various ways, and the lives of many continue to change. Making judgments about what is good and what is undesirable is extremely difficult. Charting a course that seems best for today may not hold for tomorrow, and what suits one group of people may be troublesome to others.

Historical perspectives

Associations between people and the Delta started long before it came to the attention of the wider outside world during the second half of the 19th century (*see page 10*). But rather little is known of those earlier times, which are largely shrouded in legend. For example, Tsodilo Hills, which are adorned with over 4,000 rock paintings, are claimed by several peoples, including the Hambukushu, Bugakhwe and Xanikhwe, Ju/'hoansi as their ancestral 'home'.[1]

From archaeological records it is clear that northern Botswana has been inhabited for the past 100,000 years at least, and probably for much longer before that. Evidence of occupation has been found at many sites around the Delta (Figure 34), and we can assume that all areas between these sites were also occupied at various stages.

It is also certain that the Delta's resources, such as fish, game and water, were vital to those who lived nearby, and that people who lived further away would likewise have made excursions to gather food from the wetland.

The Delta and its immediate surroundings have therefore been a home and pantry for much longer than we often imagine. Those who first lived here were hunter-gatherers, and today's so-called Bushmen, San or Basarwa are perhaps their descendants. The populations of the earliest inhabitants would have been small, and they would have moved widely and frequently in pursuit of sustenance provided by wild plants and animals.

Rock paintings at Tsonxhwaa Hill, just south-east of Savute camp. How different was the reasoning of people who painted these images from those who took the photographs in this book? The sets of images were captured in different media (paint, film or digital code) but all conceivably reflect the esteem in which the subjects were held.

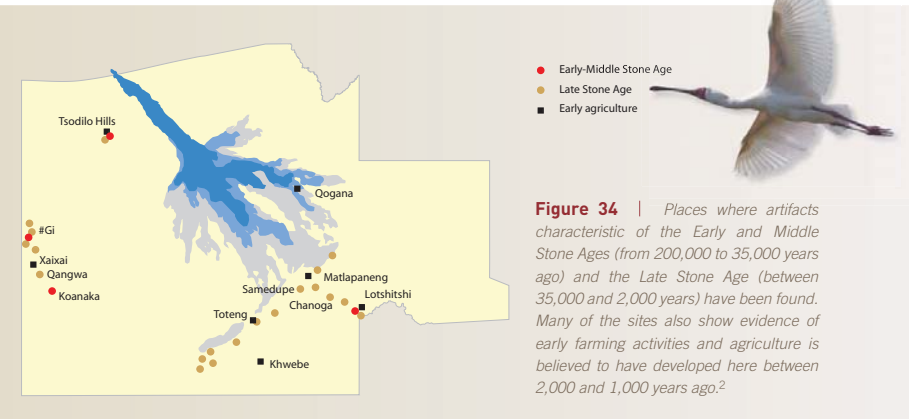


Figure 34 | *Places where artifacts characteristic of the Early and Middle Stone Ages (from 200,000 to 35,000 years ago) and the Late Stone Age (between 35,000 and 2,000 years) have been found. Many of the sites also show evidence of early farming activities and agriculture is believed to have developed here between 2,000 and 1,000 years ago.*[2]

Permanent settlements were established only when livestock and crop farming was introduced by Bantu people. Directly or indirectly, these first farmers were probably the forefathers of the BaKgalagadi, Wayeyi and Hambukushu, Dxeriku, Herero and Tawana, even though some groups appear to have settled around the Delta more recently.[3]

Indeed, the history of most people associated with the Delta is characterised by frequent migration towards newly found natural resources or economic opportunities, or to escape livestock and human disease, conflict, drought or flooding.

For example, the Tawana people initially came on hunting forays to Ngamiland, where they established their first settlements in about 1800. Over the next 100 years, they moved their capital eight times between places such as Kgwebe, Toteng, Nokaneng and Tsao. The last move was in 1915 to Maun.[4] The rinderpest epidemic in 1896 wiped out all the cattle in Ngamiland, while outbreaks of sleeping sickness (transmitted by tsetse flies) led to several settlements in the Delta being abandoned in the 1940s and 1950s.

Conflict frequently played a role. Raids by the Matabele in the second-half of the 19th century forced residents of many settlements to flee. Most Herero people escaped to Ngamiland to avoid extermination during the 1904-1906 German-Herero war in Namibia. And more recently, Hambukushu people were relocated to the Etsha settlements in 1969 and 1970 to evade conflict in Angola.

Exoduses to escape hardships are better documented than movements prompted by the lure of new resources or opportunities, which are more gradual and less dramatic. As we shall see, mobility in pursuit of better livelihoods remains a feature as large numbers of people forsake their rural homes for urban ones.

The first attempt at a systematic appraisal of population size was by Siegfried Passarge in 1898. By counting huts and villages, and estimating how many villages lay beyond his route, he arrived at an estimate of 5,000 inhabitants in Tsau, the then Tawana capital, and between 20,000 and 25,000 in the whole region around Lake Ngami.

And families now often have diverse sources of income. This is another characteristic with a long history that stems from the need to be flexible and resourceful in a land where rainfall and flooding was variable, diseases common, and natural resources spread over large areas, for instance.[5] Family members therefore often had different roles. Their activities during the dry season also differed from those after rain had fallen, or from one year to the next, depending on flooding, access to resources, labour and capital.[6]

The number and spread of people

Official census figures were gathered in the first half of the 20th century by requesting everyone to assemble and be counted at villages of their headmen. This was the basis for estimates of 21,550 people in 1904, and also for figures in 1911, 1921 and 1936, some of which seem rather high or low (Figure 35). Subsequent counts were more reliable, and we can be confident of the population totals that have risen so steeply between 1964 (42,572 people) and the latest estimate of 138,654 people in 2006.

Whilst migrations led to some population increases, most of the district's recent population growth was due to better survival rates, particularly as a result of health

Figure 35 | *The population of Ngamiland has grown rapidly, particularly after the widespread introduction of health services during the 1960s and 1970s. Between 1981 and 1991, the number of people grew by 3.3% each year. This rate dropped to 2.8% between 1991 and 2001, and is now estimated to be 2.1%.[7] This is good news, but only means that the* rate at which more natural resources are consumed each year *is perhaps not as high as it was. Indeed, demands on natural resources continue to rise even if populations remain constant because so many people seek western, consumerist livelihoods, a trend made clear by the rapid growth of Maun's population.*

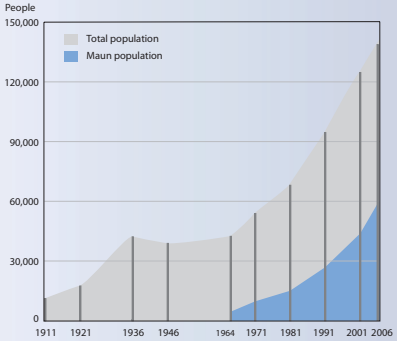


Figure 36 | *Declining birth rates in Ngamiland are reflected by the smaller proportions of young children in 2001 compared to 1991. The age pyramids also show that the swelling population of Maun consists largely of people of working and job-seeking ages.*

Some idea of the enterprise and bustling activity in the booming town of Maun is provided by these images. Maun was officially a village before gaining formal status as a town in April 2009, when it had about 60,000 residents. Its population has been doubling every 11 years.

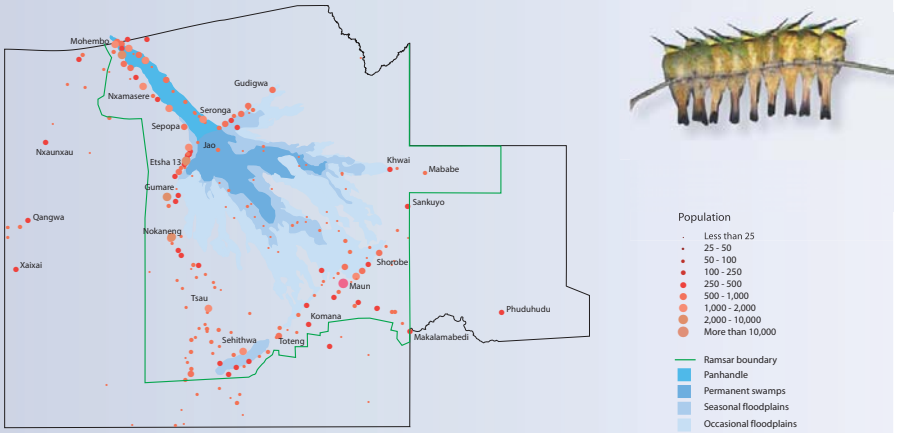


Figure 37 | *The great majority of people live along the western and southern margins of the Delta where most large villages and settlements are located* (top). *The map of Ngamiland's human footprint below provides an idea of the magnitude of the man-made pressures that are being brought to bear on resources. The measures are based on estimates of population density, the amounts of land transformed for settlements or by clearing for cultivation, and locations of roads which reflect human access to natural resources.*[8]

services reducing disease and mortality among children. Prior to the establishment of clinics and hospitals the people of Ngamiland were often the victims of malaria, gastro-intestinal infections, sleeping sickness, tuberculosis, venereal diseases, bilharzia and other maladies.

Populations throughout the world have grown, not because more children were born, but because more have survived. In fact, birth rates in Botswana have dropped significantly in recent decades. In 1981, the average number of children born to a woman in Botswana was 6.6, but this had halved to 3.2 children in 2006.[9] The decline in birth rate can largely be attributed to women attaining progressively higher levels of education, and therefore spending more of their lives in employment than at being mothers.

While declining birth rates have caused the overall expansion of the population to slow in recent years, mortality and illness from HIV/AIDS has probably had a substantial impact on growth. Infection rates in Botswana have been amongst the highest in the world for a long time, and about one-quarter of people aged 15-49 in Ngamiland were infected in 2004.[10]

Although infection rates may not have dropped, the situation has since improved because increasing numbers of people have access to anti-retroviral drugs and therefore survive. Before the drugs became widely available, life expectancy dropped from an average of 65 years in 1990–1995 to just 40 years in 2000–2005. Botswana was the first African country to provide antiretroviral drugs to everyone in need.[11]

No one lives permanently in most areas of the inner Delta and the remote areas of western and northern Ngamiland. Of the settlements that do exist, most are very small (Figure 37), with a high proportion of the population clustered in a handful of larger villages and in the district capital of Maun. From census data gathered in 2001, the largest villages, each with more than 1,000 residents, were (from largest to smallest): Gumare, Shakawe, Etsha 6, Etsha 13, Seronga, Nokaneng, Sepopa, Sehithwa, Nxamasere, Mohembo West, Tsao, Matlapana and Xakao. In total, these 13 larger villages together with the town of Maun were home to about 84,800 people, or 58 % of Ngamiland's population. Since 1981, Maun's rate of growth has exceeded 6% per year, with the population doubling every 11 years. Other settlements, such as Shakawe and Gumare, have also grown rapidly.[12]

As a result of migrations over a long period of time, a large variety of people labelled as belonging to different ethnic and language groups live in Ngamiland. The most populous groups are the Tawana (also called BaTawana, most of whom live in Maun and various large villages), Wayeyi (mostly in smaller settlements along the southern and western margins of the alluvial fan, Hambukushu (mainly in settlements and villages along the western Panhandle) and Herero (largely in the south-west of the alluvial fan in such places as Sehithwa and Tsau). Other, smaller groups are Tcanikhoe (also spelled Xanekhwe or //Anikhwe), Bugakhwe (alternatively Bukakhwe), Deti (or Teti), Hura (or Ura), Ju/'hoansi, Gomahing, BaKgalagadi, BaKhurutsi, Masubia, Makalaka, Dxeriku, and various Europeans and Asians.

Some of the rapidly changing circumstances of peoples' livelihoods are illustrated in the table on the next page, which compares the results of the 1991 census with those of 2001. For example, whereas the majority of homes (78%) were traditional structures with thatched roofs (*built with labour*) in 1991, almost half had corrugated iron roofs (*built with cash*) in 2001. Two out of five people were employed in agriculture or the harvesting of natural resources in 1991, compared to about one in six people in 2001. Over three quarters of households had access to piped water in 2001, compared to about half in 1991. Other measures that have changed a good deal over the last few decades, and continue to change, are improved levels of education (with more people going to school and/or completing higher levels of education), greater access to health care, and higher levels of possession of imported manufactured goods, such as vehicles, telephones, radios and other domestic appliances.

Farming

Two types of agriculture predominate in Ngamiland: livestock and crop farming, and both are largely practised using traditional methods which depend on family labour and local natural resources such as water, soil nutrients, pastures and browse.[13] Much of this farming is 'subsistence' in nature, providing local residents with food for domestic consumption and, in the case of cattle, capital security. Approaches are thus quite different from those used in commercial farming operations where most inputs, for example fertilisers,

	1991	2001
Homes with piped water or using communal taps	52%	77%
Households using river water	17%	9%
Homes with corrugated iron roofs	18%	46%
Homes with thatched roofs	78%	49%
People employed in public administration	7%	19%
People employed in wholesale and retail enterprises	9%	15%
People employed in farming and harvesting natural resources	40%	15%

The Okavango Ramsar site has about 194,000 cattle and 99,000 goats.[14]

Flood recession farming is mainly practised along the western edges of the alluvial fan between the Etsha villages and Tsao, and also in the south-east between Shorobe and the upper reaches of the Boteti River.

farm managers, livestock feed, pesticides, electricity and water for irrigation, are specially purchased or hired.

Livestock are generally based at cattle-posts or the homes of their owners (especially goats) from where they graze outwards on a daily basis. Cattle and goats are the most abundant stock, with smaller numbers of sheep and donkeys. Most stock are held on communal or tribal land, and the great majority of animals are kept south of the buffalo veterinary fence. Less than half of all rural families have cattle and goats. For example, 37% of households in Ngamiland owned cattle in 2001, while 43% owned goats. Livestock ownership is thus very unequal, and the biggest herds or flocks also belong to relatively few owners. Goats are slaughtered infrequently for household consumption or sold when their owners need additional cash. With the exception of Herero farmers who frequently market cattle for commercial gain,[15] most people keep cattle as security assets and for occasional ceremonial use, for example when a family member marries or dies.

Fields are divided into those planted with rain-fed or dryland crops, and those used for flood-recession or *molapo* cultivation. By the year 2000, some 48,900 hectares had been cleared for crops in Ngamiland, of which 75% were dryland fields and 25% were fields in floodplain areas.[16] However, only about 10,000 hectares are used in any given year, the remainder being abandoned or left fallow.

Each *molapo* field (plural *melapo*) averages about two hectares, and is cleared on ground that slopes down into channels or broader floodplains. Maize, sorghum and vegetables, such as beans and pumpkins, are planted most often, usually in late winter and spring as temperatures begin to warm. The crops are planted in strips parallel to water lying in the channels or floodplains to benefit from floodwater moisture remaining in the soil. Although early rains in October and November provide supplementary water, the success of *molapo* farming is primarily determined by flooding – both the previous season's flooding and that of the coming season. Either too much or too little flooding is detrimental to *molapo* crops.

Yields from *melapo* are generally higher than those from dry lands, which can only be planted after the first good rain fall. Dryland crops also frequently suffer from shortages of water as a result of both limited and episodic falls of rain, and the low capacity for water retention in soils that are mainly sandy. Average yields for dryland crops are 162 kilograms of maize, 121 kilograms of sorghum and 144 kilograms of millet per hectare. These yields amount to less than US$100 per hectare if they are translated into values that would be paid for packaged cereals.

Although their methods and commodities differ, livestock and crop farming share several features.

The first is that these activities largely supplement the livelihoods of most rural families who live off a range of different incomes. Farming is just one source of income, and it is often small compared to cash earnings, remittances and social benefits. For instance, it was estimated in 2003 that at least 50%, and perhaps as much as 76%, of all rural income in Ngamiland was not

generated by farming activities. Another set of figures showed farming to be the most important livelihood activity for less than one in four rural households.[17] Agriculture is therefore not the mainstay livelihood for most people in Ngamiland, and its importance will continue to diminish as people increasingly seek cash-based incomes in towns.

Secondly, these farming strategies are typical of a 'low input, low output' system. For example, farmers seldom invest in, or take measures that many outside observers would assume as necessary for better production. Few farmers thus add fertilizers, compost or manure to improve soil fertility, and weeds are not removed as often as they might be. As a result, crop yields are low. So too, are off-take rates of livestock that are often allowed to graze freely, when herding might provide better forage for the animals.

The major reason for low inputs is due to a third feature of farming in Ngamiland. This is the significant risk of failure or loss, which means that extra investment or effort often doesn't pay off. For example, pests and diseases plague both crops and livestock. Rinderpest wiped out most cattle in 1896, and lung sickness (Contagious Bovine Pleuropneumonia [CBPP]) effectively did the same in 1995 and 1996.[18] Earlier on, over a quarter (28%) of all cattle starved to death during the dry years that lasted between 1982 and 1988. Outbreaks of tripanosomiasis and foot-and-mouth disease occur from time to time. Crops are attacked by various parasites, stripped by locusts and red-billed quelea birds, and suffer from shortages of rain or floodwater. For example, Botswana declared droughts in 27 of the 33 years between 1964 and 1997.[19] Wildlife exerts further tolls on farming, for example by damaging crops and killing livestock. Indeed, the increasing incidence of such conflicts may undermine goodwill towards wildlife and the conservation of the Delta.

A fourth similarity is that it is usually impossible for most farmers to earn reasonable amounts of money because of low levels of production, and because market opportunities for surpluses are limited. This was not a problem before cash became essential, but nowadays everyone needs cash for necessities such as decent clothing, medicines, cell phones and efficient transport. And it is this need for money that now drives so many people to forsake farming for urban livelihoods where they have reasonable chances of earning incomes from employment or enterprises.

Finally, both livestock and crop farming enjoy very substantial subsidies from government. For example, crop farmers can get support to obtain draught animal power, animal-drawn farm implements, fencing materials, water tanks, fertilisers, threshing machines, mini-silos, chaff cutters, scotch carts, and canoes and paddles. Grants are also available for stock farmers to obtain poultry and guinea fowl, sheep and goats, equipment for boreholes and wells, fodder, fodder barns, dip tanks, kraals, crushes and loading ramps.[20] In addition, extension and veterinary officers provide farmers with free advice, veterinary medication and soil testing services. Very poor families can receive food baskets.

Rural life in Ngamiland would be even tougher without all these subsidies. Traditional farming clearly provides some food and security, but does little to provide most residents with the necessities of modern life. However, it is also true that farming is valuable to poor families that have few or no other sources of income. For example, a recent assessment of poverty found that about 28% of all households were below the poverty datum line.[21] What proportions of these were in rural and urban areas is not known. A challenge for the future is to evaluate whether the best options for alleviating poverty really lie in farming or other economic livelihoods. Likewise, we need to consider whether farming (and what kind of agriculture) or other enterprises are apt to make the best use of land in and around the Delta.

Land uses

All land in Ngamiland is either state-owned or communal, which is often also called tribal land (Figure 38). Government departments directly manage state land while the Tawana Land Board is responsible for the administration and allocation of communal land. The state land consists of the Moremi Game

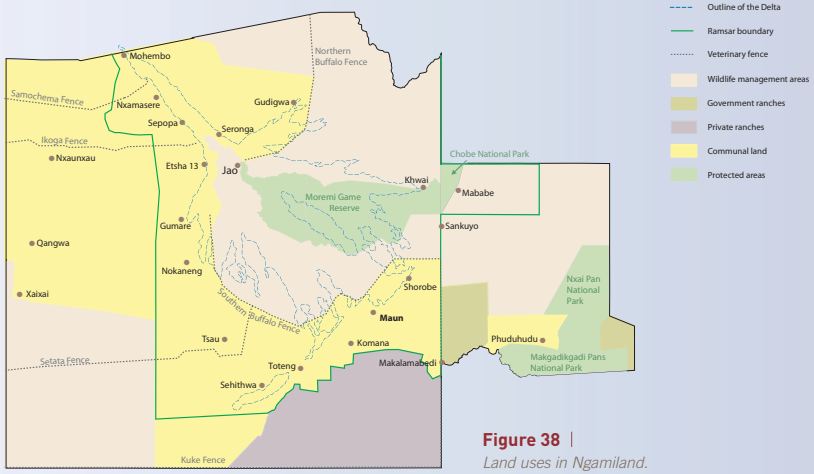


Figure 38 |
Land uses in Ngamiland.

Veterinary cordon fences were erected to limit the spread of disease between wildlife and livestock and to control infections between domestic animals when outbreaks occur. For instance, foot-and-mouth disease is easily transmitted from buffalo to cattle, and an epidemic of this disease could jeopardise the whole of Botswana's export beef industry.

However, veterinary (and other) fences are detrimental environmentally. This is particularly true in arid landscapes where animals need to roam over large areas to obtain water and forage because rainfall is erratic in space and time. As a result of the southern Buffalo fence, regular wildlife migrations from the Delta westwards towards Namibia and southwards to Lake Ngami have been stopped. Dramatic declines in numbers of wildlife in the Kalahari are probably due to their migrations being cut off, especially by the Kuke fence **(Figure 38)**. In addition, fences create biological islands where animals are prevented from inter-breeding with populations elsewhere. Genetic diversity is therefore reduced, while in-breeding may have unwelcome effects.

Reserve (covering 4,871 square kilometres), the 344 square kilometres of Chobe National Park that fall within Ngamiland, several large cattle ranches (used for experimental breeding, artificial insemination and quarantining) and the town of Maun.

In terms of the Tribal Grazing Land Policy (TGLP) of 1975, a large area of designated communal or tribal land was divided into commercial ranches. Most of the ranches each cover between 4,000 and 7,000 hectares. While the ranches were allocated as leaseholds to individual farmers, they have effectively become private property.

Land uses in the remaining communal areas are divided between those where emphasis is placed on crop and livestock farming and those where the primary use of land is for wildlife and tourism. The latter are called Wildlife Management Areas (WMAs), and each is known by a unique number, such as NG/21 or NG/33. Their boundaries and broad purposes were introduced in 1992 as part of a community-based natural resource management (CBNRM) programme. The goals of CBNRM are to provide local communities with benefits from wildlife and simultaneously to maintain large areas in and around the Delta for tourism and conservation. Many of the WMAs also provide buffers between farming areas and protected wildlife zones.

Of 29 WMAs in Ngamiland, rights for the use of 15 are currently leased to private entrepreneurs who use the areas for tourism and/or trophy hunting. Another 13 WMAs are allocated to communities, which usually enter into joint-venture agreements with tourism and/or hunting enterprises.[22] A variety of benefits accrue through the joint ventures. For example, local residents gain incomes from employment by the enterprises, which also pay royalties to community management trusts for tourism and hunting rights. Other benefits include support to local social services, such as schools and clinics, and the distribution to local residents of meat from hunted animals.

The economic conditions of people in some WMAs have improved substantially, especially in those areas where benefits are shared between relatively small numbers of households, and where the joint ventures have high commercial value for tourism and trophy hunting. For example, there were very few jobs or sources of cash in the settlements of Sankuyo, Khwai and Mababe prior to them establishing joint ventures, which now provide employment to about 50% of all the resident adults.[23] While the agreements with tourism and hunting operators may impose restrictions on land uses in certain areas, local residents are generally free to practice traditional farming. Cattle are, however, not allowed in the northern WMAs because of veterinary controls.

Communal land provides the poor with places where they can live and farm for free. But communal land is also free for the rich, which often leads to severe over-grazing. As the first president, Seretse Khama, observed in 1975: 'Under our communal grazing system, it is in no one individual's interests to limit the number of his animals. If one man takes his cattle off, someone else moves his cattle in'.

The boundaries of the Ramsar site run around the Delta and enclose a substantial area of Ngamiland. This is one of the largest Ramsar sites in the world, and was so designated in 1997 in recognition of its 'significant value for Botswana and… for humanity as a whole… because of its international significance in terms of ecology, botany, zoology, limnology or hydrology.'[24] The Ramsar site includes Botswana's frontage on the Linyanti Swamps and Kwando River. Since most of these wetlands lie across the border, it would be of value if Namibia were to extend the Ramsar site into its territory.

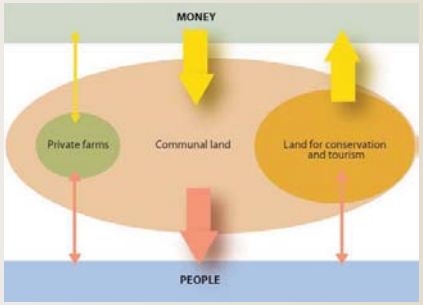


Figure 39 | *Major land use areas, and the flows of money and people into and out of these areas. All land in Ngamiland was originally communal for farming and the harvesting of natural resources. Recently, some land has been given to private commercial farms, while a larger area was set aside for the primary purpose of conservation and tourism and hunting enterprises. Large sums of money flow to sustain families in the remaining communal areas where it is hard to make a decent living, and many people therefore leave to live and work in urban areas. By contrast, large sums of money flow out of profitable wildlife and tourism areas, but critical questions are often asked about the beneficiaries of the revenues. Few questions are raised about the merits of private ranches, however. The narrow arrows reflect the small flows of people and money in and out of private farms, and of people in or out of tourism and wildlife areas.*

Figure 38 provides a perspective on the spatial extent of land uses. Another way of looking at this is provided by (Figure 39) which illustrates the flows of revenue and people associated with different land uses.

The allocation of large areas in and around the Delta for tourism and conservation by the Botswana government has been good for international tourists, the economy of the country, for investors in tourism, and for naturalists who value wildlife and wild places. However, it is often stated that the use of land for wildlife and tourism has been at the expense of rural livelihoods because residents have lost access to natural resources that they harvested traditionally.[25] Areas available for farming, collecting reeds, fishing and hunting, for example, have shrunk. In addition, the number of rural residents has grown, and so less land is available to support more people. Legal restrictions on the use of natural resources have also increasingly been introduced.

The status quo of land allocation in Ngamiland and its uses is frequently lamented. It is strongly argued that the loss of resources is unfair because conservation largely serves the interests of foreign tourists and of investors outside the Delta, many of whom are not Botswana citizens. Moreover, the great majority of beneficiaries are the white owners, senior employees and shareholders of tourism businesses.

Much of this is true, although increasing numbers of black citizens of Botswana are earning revenues from the same tourism industry, largely in the service sectors but increasingly as shareholders and employees in tourism enterprises. For example, a significant proportion of Maun's economy revolves around tourism with its knock-on effects, and the great majority of Maun's approximately 60,000 residents are Botswana citizens.

Furthermore, rural livelihoods are not lost to tourism and conservation as generally and significantly as critics often claim. There are three reasons for this. First, natural resources are lost to other land uses as well, for example through the allocation of communal land to private farms which are given free to select owners, many of whom are not from Ngamiland. Some communal land has also been set aside for government uses that are unrelated to tourism and conservation. And natural resources that should be for the sole use of rural residents, at least from an ethical point of view, are often used disproportionately by relatively wealthy people from towns. They frequently invest some of their savings in cattle which they place at rural cattle posts where their large herds consume much of the available

The Delta attracts about 100,000 visitors each year, largely to about 60 camps and lodges. Revenues earned from them, combined with those from trophy hunters, make up the bulk of Botswana's GDP now generated by tourism. Tourism is thus a major sector in the country's economy, coming second only to diamonds in terms of revenue generated. About 40% of the employment available in Ngamiland is provided by the tourism industry.[26] Some jobs directly serve visitors at lodges and camps or as poling guides, for example, while others indirectly support the tourism industry through services, such as those in retail outlets and the public service. Botswana's tourism policy has three principle goals: (a) to encourage tourists who occupy permanent accommodation, as opposed to casual campers; (b) to maximise financial returns from tourism for the people of Botswana, especially those who tolerate the costs of living close to wildlife, and (c) to ensure that tourism is carried out in an ecologically sustainable way.

pasture. Local, poorer residents with small herds are placed at a significant disadvantage. Frequent bush fires (*see page 84*) and the on-going clearing of land for crops also contribute to the loss of natural resources.

Second, the so-called *dependence* of most rural families on local natural resources is simply exaggerated. As described earlier (*see page 118*), many rural residents gain most of their income as cash from sources that are independent of local natural resources that they may use. Ironically, much of the off-farm income is also a product of tourism and conservation enterprises, the very activities that supposedly limit the economic health of local households. Thus, many salaries, royalties, remittances, social benefits and government subsidies are funded by taxes derived from enterprises that make money from tourists and wildlife.

Third, arguments that rural people should have more land for farming and other forms of natural resource harvesting assume (a) that decent livelihoods can be made from traditional land uses and (b) that rural life is preferable. Both suppositions are tenuous. Even where land is available, farming is difficult for the reasons discussed above (*see page 119*). Fish yields are also very low (*see page 103*) and there are few

People living in rural areas are much more diverse that is commonly perceived. Some are members of rich and large families, others are small and poor. The former usually depend on off-farm incomes for their daily needs, while poorer people depend much on farming and the use of other local resources. In achieving a balance between conservation, the economic value of tourism and trophy hunting, and uplifting the livelihoods of local residents of the Delta, it seems important that these poorer families be given the best opportunities of using natural resources. There is also a need for benefits derived from wildlife to be more evenly spread across the Delta's population.

markets where occasional surpluses can be sold. And this remains true despite significant government subsidies to support small-scale farming and fishing. Rural life also appeals only to certain people, whereas the great majority of schooled men and women are attracted to urban lifestyles.

Debates on the pros and cons of tourism/conservation vis-à-vis the necessity of maintaining rural livelihoods are not easy to conclude. The contentious issues may also be viewed from different angles and framed differently, for example by asking if local interests should prevail over wider ones. Are long term goals more important than those that meet immediate needs? More directly: 'Whose Delta is it?' and 'How long should the Delta's resources remain useful?' And are traditional livelihoods preferable to modern ones and, if so, preferable to whom?

The Botswana government recently grappled with these tough questions while compiling the Okavango Delta Management Plan, which was completed in 2008, and the Ngamiland Integrated Land Use Development Plan, finalised in 2009.[27] Both plans emphasise the economic and conservation values of the Delta's natural resources for the country, international community and local residents, and the need to maintain the natural processes that keep the Delta functioning, as described in Chapter 4. Proposals are made to enhance and distribute the benefits of these resources more fairly. The plans also recommend the expansion of zones for wildlife management, and to physically separate land uses where the potential for conflict is high.[28] These include conflicts between farming and wildlife, and between different kinds of farming. The challenge now remains for these and other useful recommendations to be implemented.

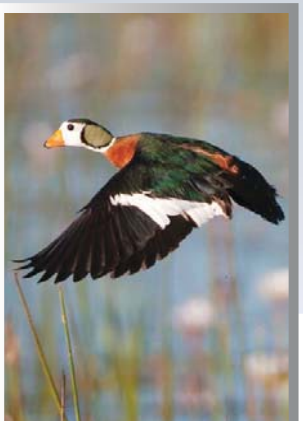
KEY POINTS

1. The population of Ngamiland has grown rapidly as a result of medical services that have improved survival, but growth rates have recently slowed because fewer children are born nowadays.
2. Crop and livestock farming produce low yields, and are risky as a result of disease, pests, shortages of rain, and too much or too little flooding. Inputs to farming are therefore low.
3. In addition to low agricultural production, rural livelihoods are tough as a result of limited access to services, cash incomes and modern necessities.
4. Whilst farming is valuable to very poor families, most income in rural areas is not from farming or from the direct harvesting of natural resources, but rather comes from salaries, business earnings, remittances, social benefits and subsidies.
5. Rates of urbanisation have been high as increasing numbers of people, especially younger men and women, have moved to seek salaries and services in towns. Over half the population now lives in urbanized settings in towns and large villages.
6. The daily activities of most people therefore now focus on earning money, on purchasing food (rather than harvesting it), on buying clothes (rather than making them), on quick, comfortable transportation (rather than walking) and on fast electronic communication (as opposed to the 'bush telegraph').
7. Likewise, modern medicine has largely replaced traditional cures, and food security has taken the place of food self-sufficiency. Formal education is held in high esteem, and its teachings are more highly regarded than folklore. Likewise, public services and government play stronger roles than traditional leadership.
8. Most land is used for three purposes: communal farming, private ranching, and wildlife conservation and tourism.
9. There is considerable debate over the beneficiaries and comparative value of communal land and that used for tourism and conservation.

8

Floods for the future

The Delta has been protected from the kinds of development that often lead to the loss of natural resources. What can be done to secure its good health in the foreseeable future?



Okavango Delta: Floods of Life had its origins in a programme led by the International Union for the Conservation of Nature.[1] A major goal of this IUCN programme was to promote the use of information to monitor the abundance and composition of life in the Delta. What are known as *freshwater biodiversity monitoring* programmes have been implemented elsewhere in the world, particularly along rivers where the deterioration of water quality upstream is likely to cause populations of plants and animals to decline downstream. Such changes are used to flag the possibility that upstream polluters, for example, have added additional or new poisons to their effluent. That information is then passed to people responsible for managing the quality of river water so that the sources of pollution can be tracked down and eliminated.

Many projects to do similar monitoring in the Delta have been implemented. As a first step, baseline information was collected to determine what populations of animals and plants were present. In such a diverse environment, samples had to be taken in different places, and samples had to be collected at various times to account for seasonal changes. Quantitative indices as measures of both the abundance and diversity of organisms were then developed so that future samples could be compared against the baseline indices. Changes in the indices should thus provide warnings that all is not well, either as a result of water being altered locally or as it flows out of Angola and Namibia.

This book was intended to synthesise the baseline monitoring information and experience, and thus to demonstrate the value of monitoring freshwater biodiversity in the Delta. However, it was found that more work was needed to develop appropriate monitoring measures before a synthesis could be attempted.[2] An alternative approach was then taken, which was to summarise what is known about the Delta, in a format that would interest people who should care for the Delta. In other words, since an adequate *supply* of information on freshwater biodiversity monitoring was not yet available, we hoped that this book would create greater *demand* for monitoring and responsive management in the future. Likewise, we hope that the thoughts offered here will raise awareness about the challenges to be faced.

Threats: internal and external

These first few paragraphs touched on the intentions of IUCN and other people to keep an eye on the Delta. For what, however, should the monitoring be? Thoughts on that question are split in two categories: internal risks that originate within and immediately around the wetland, and external factors that potentially affect the Okavango River in its Angolan catchment and its passage through Namibia to Mohembo. We begin with potential internal hazards.

Chemical pollution

Thus far this has not been a major problem in the Delta, perhaps because contamination has not been significant and because wetlands filter out organic compounds so effectively. However, there are concerns about effluent from villages and towns, lodges, camps and boats for tourists. Measures have recently been implemented to require tourism facilities to process sewage water and to bury the remaining concentrates beneath saline sediments in the centres of islands (*see page* 56). Some lodge and camp owners have also implemented their own monitoring programmes to check the quality of water around their facilities.

The use of pesticides to kill tsetse flies has caused considerable alarm. There have been two major recent applications of deltamethrin, in 2001 and 2002, when the entire alluvial fan was sprayed several times from aeroplanes. Deltamethrin was used because it targets invertebrates and degrades rapidly, unlike such persistent and infamous poisons as DDT and dieldrin that further accumulate in deadly concentrations in animals at the top of the food web. The use of deltamethrin is also an improvement over the use of endosulphan (which is toxic to fish) during the 1980s for tsetse fly control in the Delta.[3]

After the deltamethrin spraying, the abundance of aquatic and terrestrial invertebrates was found to have dropped by between 25 and 65%, depending on the family of invertebrate family. Dragonflies (*see page* 95) and beetles were particularly hard hit, while others were less affected.[4] By 2003, many groups had recovered to pre-spraying abundances; and while some species had not recovered, others were more abundant than before the spraying. It is not known if this was due to natural population changes or if the 'new' species occupied niches left vacant by those that were killed. Fish and birds were apparently not harmed by the spraying.

Although contamination by pesticides applied within Botswana has perhaps not been too problematic, this potential hazard needs to be monitored continuously since the impacts of inadvertent poisoning can be utterly devastating, and because residues can remain toxic for so long. Contaminants applied locally could also increase toxic burdens introduced from upstream and atmospheric sources of chemical poisoning.

Alien species

Invasive, exotic plants and animals are another potential threat to the Delta. Like chemical pollution, they may be introduced unwittingly and remain inconspicuous, at least in the beginning. And as with pollutants, there are some problems already.

Foremost of these is the water weed *Salvinia molesta*, which first appeared in the Delta in the mid 1980s. Experiments by Namibians along the Kwando River showed that the weed could largely be contained by *Cyrtobagous salviniae*, a small beetle introduced from Brazil. The Botswana Department of Water Affairs accordingly implemented an on-going programme to

The most serious invasive alien is the water weed Salvinia, mats of which can cover large areas of open water. The weed was first recorded in the Delta in July 1986 at Xini Lake. Adult beetles (above) destroy leaf buds of Salvinia and their larvae tunnel into the rhizomes causing the plants to disintegrate and sink.

introduce the insect, as well as using manual labour to remove mats of Salvinia. So far, these efforts have limited the spread of the weed in the Delta, but the control measures have to be applied repeatedly wherever Salvinia reappears. A good deal of vigilance is thus needed to detect outbreaks and to respond to them in good time. One difficulty arises from the growth of beetle populations apparently lagging behind that of Salvinia, which allows mats of the weed to develop. Fortunately, the low nutrient content of Delta water (*see page 53*) appears to limit the growth and spread of the weed.

A variety of other alien plants occur in the Delta, such as thorn apples or jimson weeds (*Datura ferox* and *D. stramonium*), the burweed (*Xanthium stramonium*), *Mimosa pigra*, *Sesbania* species, syringa (*Melia azederach*) and exotic food plants, such as guavas, pawpaws and cassava. Thorn apples and burweed sometimes cover large areas of disturbed ground in the Delta (*see page 82*), and all these species may be invasive at the expense of natural vegetation.

Unlike most large wetlands elsewhere in the world, no invasive species of fish yet occur in the Delta.[5] However, there are risks of the unwanted introduction of such species as the Nile tilapia (*Oreochromis nilotica*), which might hybridise with several of the tilapia species that are native to the Delta. The possibility of Nile tilapia reaching the Delta from the Zambezi River (through the Chobe River, Linyanti Swamps and Selinda Spillway) appears slight, but the route down the Okavango River is direct and easy to follow should people in Angola or Namibia start to farm with these fish.

Clearing of channels

Development in most societies strives towards stability and predictability, which in the case of the Okavango Delta is in direct conflict with its inherently unstable, shifting nature. Channelling of water and clearing waterways has been done frequently in the past, and is still often proposed to facilitate boat traffic and to provide villages with permanent water supply. However, the removal of blockages will make the channels more permanent which, in turn, will create stable flooding patterns. This is likely to reduce the size of the Delta in the long term, as well as lowering the productivity of floodplains for livestock, wildlife, fish and other populations. Bush encroachment may increase, and biological diversity could be reduced.

Moreover, and perhaps fortunately, clearing activities are usually doomed to fail because they attempt to reverse natural changes. The failure of every historically recorded channel clearing effort over the last century in the Delta bears this out.

Elephants

Populations of these giants have been booming in northern Botswana for the past 20 years. Large swathes of mature riverine forest along the Kwando and Okavango Rivers (in Namibia's Bwabwata National Park) have been entirely decimated, and elephants have done the same to mopane woodlands in some areas of the Delta (*see page 87*). If similar significant damage happens to woodlands on islands there is the risk of transpiration and the concentration of salts being reduced (*see page 55*), and that could lead to the Delta becoming saline.

Although almost everyone condemns the loss of woodland and agrees that there are too many elephants, no one appears willing to take measures to control the problem. Any significant culling programme would elicit howls of protest from animal rights groups, and this could damage Botswana's reputation and tourism industry.[6]

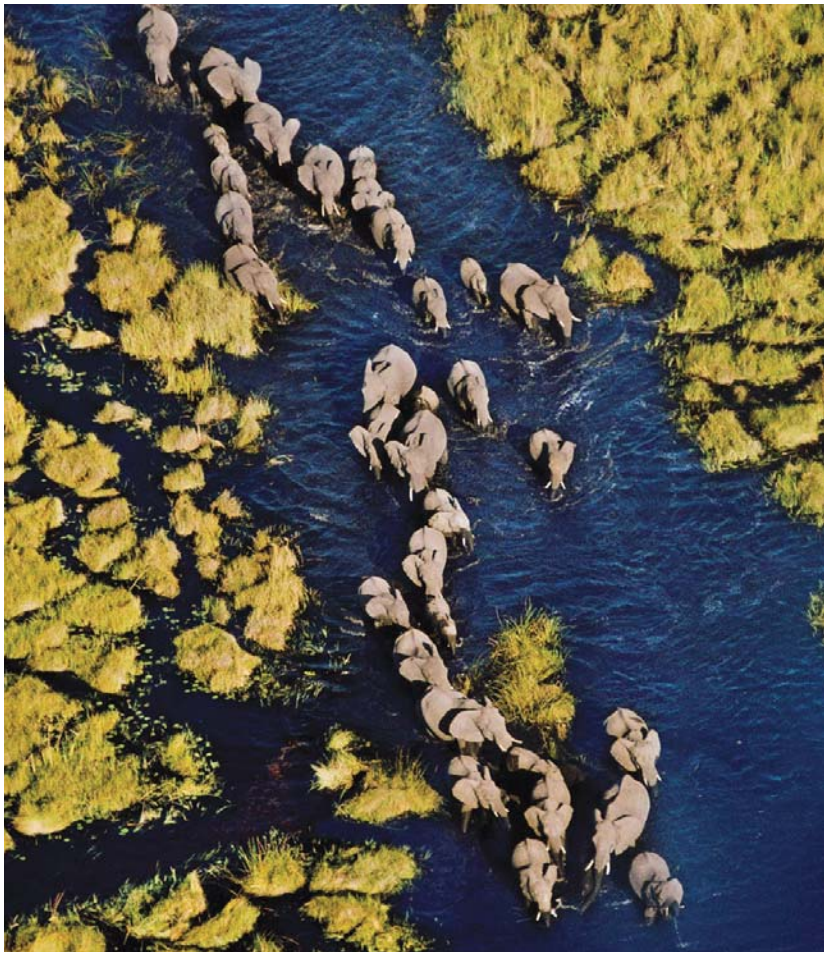
External challenges in the catchment and elsewhere

Large areas of land and natural resources in the Delta have essentially been set aside for conservation. This is economically valuable to the country as a whole and financially beneficial to many local residents. At the same time, this approach does much to safeguard environmental health.

Quite different perspectives and values hold in the Okavango River catchment in Angola and Namibia. Here, little land is allocated for environmental conservation, few people benefit financially from tourism, and more important economic interests elsewhere in the two countries carry much greater weight (*see page 35*).

It is possible that we may one day understand how to manage water flows and flooding patterns to maintain production, but this will require major improvements in our understanding of nutrient cycling and other aspects of the Delta's physiology. Until then, centres of production need to carry on wandering across the floodplains as they do now, unhindered and unmanaged.

Most conservation programmes focus on rare, charismatic or iconic species. But plants (*Chapter 5*) and animals (*Chapter 6*) should look after themselves as long as the functioning (*Chapter 4*) of this wetland is not altered. It is the system functioning of the Delta that is so special, and what we all marvel at is simply the manifestation a big, healthy ecosystem working in an unimpaired way.



The paradox of the Delta is that its productive value lies not in the water, but in the nutrients that the same river system, animals and aerosols have deposited here over at least the last 120,000 years (*see page 24*). Yet, the water and nutrients cannot be separated. Water is needed to release the productive potential of nutrients, but without the nutrients the water would be rather lifeless.

In recent years, several studies and projects have explored development options in the catchment area in Angola and for the flow of Okavango River water as it passes through Namibia.[7] With few exceptions, the postulated development scenarios have focused on (a) options for water use, (b) government policies and programmes for the use of water and (c) water allocations for the three countries. These are all extremely important aspects.

Yet little or no attention has been paid to (a) the financial benefits of tourism and wildlife in Angola and Namibia, (b) the growing use (and likely abuse) of the catchment's resources by private people and companies, (c) the promotion of the Okavango River Basin as a valuable ecological entity, and (d) the sharing of benefits between Botswana, Namibia and Angola. These, too, are important matters, to which we later return.

Namibia

Official perspectives on the Okavango in Namibia concentrate on the use of river water for agricultural, domestic and industrial use and fish farming. Although several non-government organisation (NGO) programmes have promoted non-consumptive uses of the Okavango in Namibia and entrepreneurs have established a number of lodges and camps, the value of the river in attracting tourism revenue is seldom mentioned in government circles.

For the future, we can expect more water to be extracted from the river, both by government projects and private use. Usage will increase gradually for much of the time, but it will also escalate sharply when Namibia next experiences conditions as dry as those in the early 1990s. Plans to pipe limited volumes of water to the central areas of the country were then developed, but were suddenly shelved after good rains fell.

The plans also attracted harsh criticism from many environmental groups who were concerned about the impacts of reduced flow into the Delta. Similar criticism was voiced when Namibia investigated the construction of a hydro-power facility at Popa Falls (*see page 21*).

An important point, however, is that the Namibian population, economy, and demands for water have all grown considerably since the 1990s. Thus, when very dry conditions next occur Namibia is certain to make much greater demands on the river for its water.

Angola

Much of the Angolan catchment remains the *terras do fim do mundo*; the land at the end of the earth, unknown and unseen by most members of the public. The servants of the public in government will probably place emphasis on the development of water resources and more fertile soils elsewhere, which are closer to the more populous regions of the country. Potential for hydro-power development has been identified at several sites along tributaries of the Okavango, but serious plans to develop these have yet to be made. It is possible that 'run-of-the-river' designs could be used to minimize the impacts of hydropower schemes on water flow.

Since rainfall is usually higher and less variable, and evaporation lower in Angola than in Namibia, abnormally dry conditions in the catchment are unlikely to be that demanding of river resources. However, as in Namibia and Botswana, the relatively small population in the catchment will continue to grow steadily, expanding its footprint on the catchment. And as in the other countries, much of the footprint will be from low input, low output traditional farming.

While common sense dictates that the relatively infertile soils and remoteness from markets should make most of the Angolan catchment unsuited to commercial crop production, entrepreneurs may see the broad floodplains of rivers as suitable for large-scale irrigation, perhaps for sugar cane, maize, rice or jatropha, for example. Such developments will doubtless have to be subsidised with public money, thus copying the unprofitable irrigation schemes in Namibia (*see page 35*). Foreign investments and influences may be involved, as is happening elsewhere in several African countries, where large tracts of land are leased to feed foreign consumers and to meet growing demands for biofuels.

The amounts of water used for each irrigation scheme should be relatively small. However, the cumulative offtake of several farms – together with those in Namibia[8] – could be significant, especially if large volumes are removed at the start of the growing season in September and October when river levels are lowest (*see page 41*).

Of greater concern is what might run off all these irrigation schemes. Since the soils are low in nutrients, substantial applications of fertilizers will be required and a good deal of these nutrients could be washed into the adjacent rivers. Insecticides and herbicides

will be needed, and if applied on a large scale, significant residues will find their way into the river water and Delta. A recent study of residues of DDT, aldrin and HCB (hexachlorobenzene) found significant concentrations in sediments in the Delta.

The available evidence indicates that these poisons were washed down the Okavango River into the Delta. Interestingly, progressively higher concentrations were found downstream, so the lowest residues were in the Panhandle and the highest were in Lake Ngami and other distal parts of the alluvial fan.[9]

Erosion off the large irrigation schemes, together with the clearing of land for small-scale cropping could lead to increased loads of suspended clay in the river water. These are unlikely to have an immediate impact on the Delta since much of the clay would be filtered out before reaching the sandy, permeable substrate of the alluvial fan. Over the longer term, however, increasing clay inputs would reduce the chances of the Delta remaining a freshwater system (*see page 53*).

Finally, global forces are likely to shape the Delta in ways that are both unforeseen and less manageable. Climate change is an obvious example. The bedfellows of economics and politics will influence food and energy prices (and therefore motives for irrigation schemes) and the fickle tourism industry, for example, by raising safety concerns and eroding savings for holidays. And tectonic movements inside the Delta may shift the distribution of water in ways that surprise its residents.

Challenges for management

A host of factors can thus compromise the health of the Delta. Some are global in scale, others are founded hundreds of kilometres upstream in the Okavango River catchment. Yet others are local in origin. How should people with responsibilities for managing the Delta respond, and what should be done by those with direct economic and financial interests in the Delta? Likewise, what can the international community do to maintain the wealth and health of this apparent organism (*see page 39*)?

Keeping the overall system dynamic

The biological wealth of the Delta, along with the goods, services and capital it provides is very largely a product of water supply being able to vary across two dimensions: time and space. The pulsing of inflows between seasons and years results in parts of the Delta being inundated and then dried. Similarly, the spatial redistribution of water allows some areas to dry up and others to be flooded afresh. These changes continually shift the interface between water and nutrients, enabling the former to mobilise the latter. The changes also allow desiccation, grazing, fire and decomposition to recycle nutrients into forms available for new bouts of biological production.

Little of this would happen if the changes in time and space were to stop. If the water remains in one place, nutrients there will be locked up in plants, while dormant nutrients elsewhere will lie quietly, their potential locked away by the absence of water. A key measure for the future is therefore to allow the interplay between water and accumulated nutrients to continue moving.

Building demand for information and response

The chapter began by describing how information to monitor the Delta was being developed. The technical challenges in doing this for such a dynamic wetland are enormous. A further challenge lies in the use of monitoring information. Without special measures to develop procedures for its use (including accountability), all that we can *hope* for is that: managers will get the information, will understand its importance, and will respond accordingly.

The same is true for planning. For instance, the recently completed Okavango Delta Management Plan (ODMP) has been hailed as a good example of how planning processes should be done. It also makes excellent recommendations, which everyone *hopes* will be implemented.[10]

But hoping is not enough. Neither is it enough to have lots of information and plans in our shop window if there are no customers. There are no simple methods of developing demand for monitoring (or any other objective) information and implementation. A multitude of approaches are required, many of which will have to be repeated and tuned to different audiences. Accountability and incentives are perhaps the most important facets, as are public awareness, lobbying and political interests.

Enlarging the identity and security of the Delta

In combination, no other wetland in Africa is (a) as large, (b) well protected, (c) so pristine, (d) of such high economic value and (e) as well-known internationally. These attributes probably set the Delta apart from all other African wetlands by an order of magnitude. Indeed, the combination of values could be unique worldwide.

The Okavango Delta is thus a big deal, and it deserves a reputation larger than the one it now enjoys. It also requires an identity that goes beyond its present borders. Its ownership should surpass national pride since this is an international asset, which has been called the Jewel of the Kalahari (which covers a large area of Africa) and the Eden of Africa (which is a significant part of the world).[11]

We close by exploring three aspects that are crucial to a better, more secure future for this very significant wetland.

Going beyond food

Generalised assumptions that agriculture is Africa's salvation are unfortunate, particularly when they are applied to low input, low output farming in areas that are poorly suited to food production and its commercialization. Along with these broad assumptions go a variety of notions, for example that rural Africa is best suited to traditional economies, that nothing better can be done with communal land, that secure tenure is unnecessary or too complicated in communal areas, and that alternative livelihoods are just too remote and challenging. As a result and for example, development programmes vigorously promote food self-sufficiency. Yet virtually every young person in Africa wants food security and cash security, and thus makes the one-way journey from a rural to an urban environment.[12]

Much of the debate about the pros and cons of financial and economic benefits of conservation and tourism are bedeviled by assumptions that low input, low output, traditional farming is a good thing. We are not against farming, and appreciate its value in providing food security for the many poor families in Ngamiland. But surely the development and expansion of farming should be done in places where it is productive, where farmers and families can make a decent living from their harvests, and where the environmental costs of land clearing and grazing are worth bearing?

As discussed previously (*see page 124*), this debate is not easy to resolve. But we do suggest that the debate be tackled earnestly (and honestly, on the basis of economic and environmental arguments) when the use of the Delta's natural resources are considered. Exactly the same objective approach is needed when people ponder over land uses in the Angolan catchment and along the Okavango River in Namibia.

Broadening OKACOM

OKACOM is the river basin commission established between Angola, Namibia and Botswana in September 1994.[13] During its first 10 years, the commission concentrated largely on the concept of water allocations between the countries, and on over-seeing various donor-funded projects. As senior public servants, mostly in departments of water based in Luanda, Windhoek and Gaborone, its commissioners had limited opportunity to engage in day-to-day matters of concern to the Okavango River and its Delta.

More recently, OKACOM has done much more to strengthen and broaden its mandate in the complicated playing field that may see sovereign interest, state responsibility and good neighbourliness as rival themes.[14] Some of these developments were stimulated by Botswana's initiative in having the Delta declared as a Ramsar site, and in formulating the Okavango Delta Management Plan (ODMP).

Other progress has been made through a range of projects conducted under the auspices of OKACOM. These include work to develop (1) support among local communities for the environmental health of the River Basin; (2) approaches to integrated water resource management; (3) trans-boundary diagnostic assessments (TDAs); (4) a strategic action programme (SAP); (5) studies of environmental flows (E-flows). In addition, an OKACOM secretariat has been established in Maun, which is alongside a newly created office for the Botswana Directorate of Environmental Affairs. Such broadening of scope from one purely based on water supply, to one in which water is seen as an ecological driver, is to be commended and supported.[15]

In our view, OKACOM could further enhance its role by obtaining greater representation of local and environmental interests. A broadening of its debating field would also be valuable, especially if greater emphasis were placed on such issues as pesticide contamination, the enrichment of river water by nutrients from farming, private uses of the Okavango's resources, and the creeping expansion of the human footprint on the Okavango River Basin. It would be useful for OKACOM to ensure that environmental impact assessments precede all major developments in the Basin. Regular environmental audits commissioned by OKACOM would provide useful measures to assess the use of water and all other natural resources. The same audits should take stock of benefits of these resources, reporting on which are useful, which require promotion, and how the benefits are used. To reiterate, the human footprint around the Delta and the source of water on which it depends is expanding. The expansion and its implications must be monitored, and OKACOM is the only organisation with the mandate to do the monitoring. By taking on these kinds of responsibilities, OKACOM could evolve from its present advisory capacity into one where it becomes a river basin authority.

In essence, discussions about the interests of Angola, Namibia and Botswana have largely focused on what the three governments do, relationships between them, and on the sharing of water. There has been less discussion on what local people and private enterprises in the River Basin might think. Likewise, focus has been placed on the value of water, rather than on the environmental value of the Basin. For the future, expanded perspectives that reach across national boundaries to recognize the unitary value and integrity of the Okavango River Basin are desirable. In the longer term, each of the three countries stands to gain a great deal from such trans-national perspectives.[16]

Seeing beyond Mohembo

Much of the debate within Botswana about the management of the Delta concentrates on issues in and around the Delta. This is rightly so. But the debates sometimes include the implication that Botswana alone controls the destiny of the Delta. That is misguided, however. For example, the economy of the Delta depends largely on the willingness of foreigners to pay for tourism, and how well the Delta can compete with other foreign holiday attractions. More importantly, the quality and quantity of water inflow is controlled entirely by Namibia and Angola. The Delta is thus surrounded by external influences, with which Botswana should engage.

Broadening the identity of the Delta is necessary for such engagement. Most people now see the Okavango and Delta as the same thing or place, as if only the 'Okavango Delta' matters. The word O*kavango* has virtually been unwittingly commandeered for exclusive use in Botswana, as if the Delta is independent of its Angolan catchment. But the broader area of the Okavango River Basin is actually what counts, both in its own right as a basin covering 192,500 square kilometres, and as the Delta's source of water. And unintended implications that the Delta equals the Okavango diminish value of its catchment. But there is a grand opportunity here, which is to capitalize on the international fame of the Delta and to spread that reputation (and its associated values) across the whole river basin. In essence, use the 'big deal' name of the Delta to give the Okavango River Basin 'big deal' status. Doing so would give greater security to the Delta's water sources by reducing the possibility of the catchment being put to degrading use.

Spreading the fame and brand name is one thing. Another is to extend the vested interests and experience that now lie in the Delta upstream into the Angola. Tourism companies from Botswana, in conjunction with the Botswana government, could give value and protection to the catchment by investing in tourism and wildlife in Angola. Jobs and infrastructure would be created there, and new perspectives on the use of water and natural landscapes would be developed in Angola. Food security for residents of the catchment could come from wildlife, tourism and its associated industries, rather than from slash-and-burn farming that produces low yields.

Having the Botswana government as a partner would give security and credibility to the private sector. Angola's reputation would be enhanced by giving the land at the end of the earth renown and

Much has been learnt about the Delta over the years. Further study will expand our knowledge so that humanity will be better placed to care for the health of this wetland and the value of its wealth.

purpose. Botswana would be the first African country to invest in the protection of a foreign environmental resource. Benevolent organizations and people elsewhere in the world who believe in the value of the Okavango could contribute to these developments. In doing so, they would swell the international community of people who would be vigilant over the entire Okavango.

Elements of these recommendations are to be found in the proposed Kavango Zambezi Trans-Frontier Conservation Area (KAZA).[17] This initiative involves Angola, Botswana, Namibia, Zambia and Zimbabwe, and aims to broaden and connect conservation areas over some 300,000 square kilometres. Tourism is to be promoted, in part to boost the livelihoods of residents of KAZA. While the KAZA area encompasses the Delta, only part of the Cuito River and its tributaries is included in Angola.

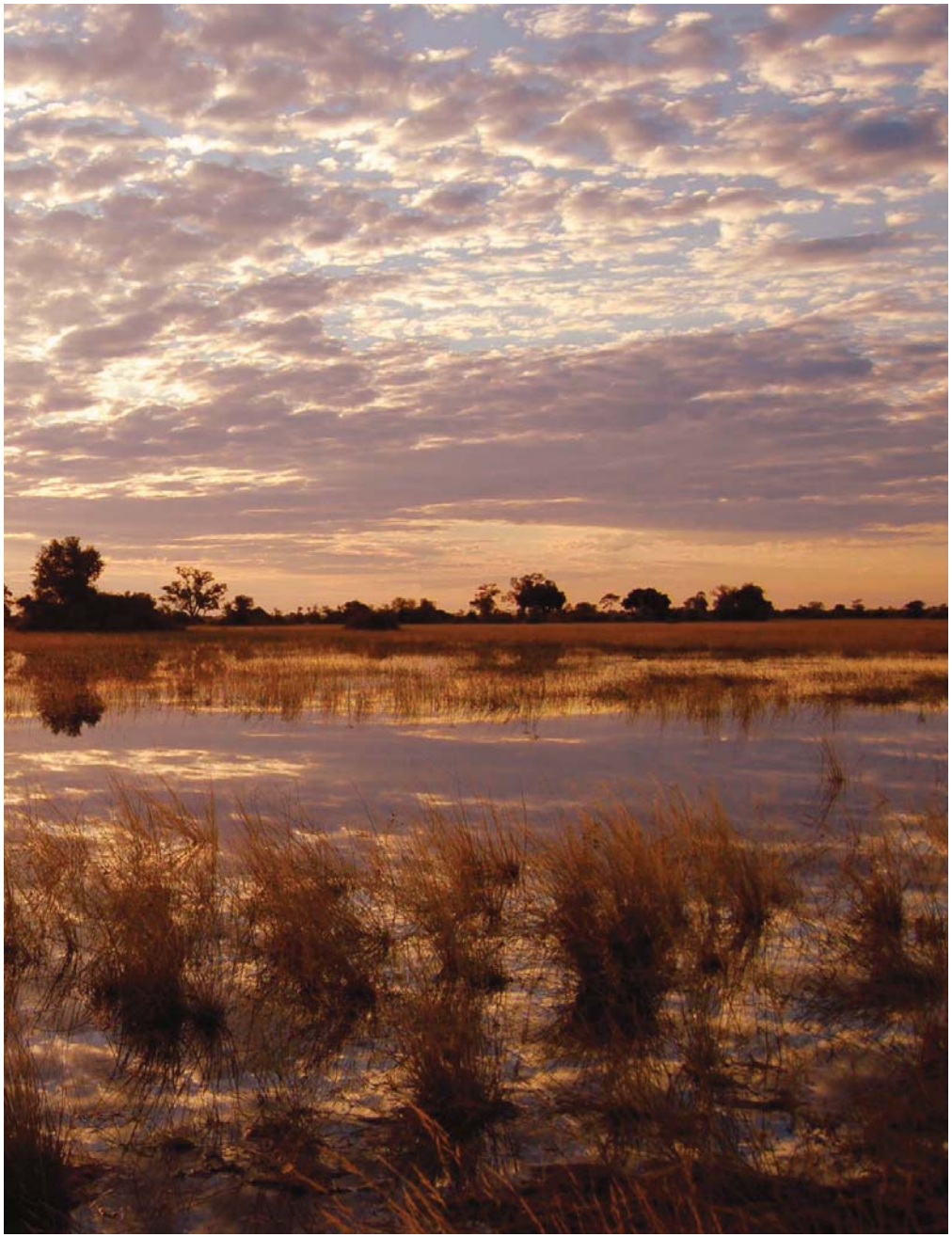
Implementation of the ideas suggested above would also have the private and public sectors of one country invest in another country, and they would focus on development of the Okavango River Basin as a hydrological and ecological entity. Amongst other measures, the current Ramsar site could be extended across the whole Basin.

The whole Okavango River Basin should also be developed into a tourism destination. In addition to visiting individual attractions in the catchment, tourists could also follow the flow of water by boat, road and air from Tchicala Tcholohanga to Menongue, Calai, Andara, Jao and Lake Ngami, for example. How many other places in the world offer journeys and holidays across an entire river basin, much of which is pristine, wild and scenic? The Delta would of course gain by having much greater security over the quantity and quality of water on which it depends. The national economy of Botswana would have greater confidence in counting on future revenues from tourism and conservation.

It is our hope that vision and innovation prevails to expand the concept of the Delta and the resources that are central to its health. This will be to the benefit of the diatoms (*see page 82*), cladocerans (*page 100*), people (*page 109*) and all others who use the Delta's nutrients and waters. It can be done!

KEY POINTS

1. While the Delta is in relatively pristine condition, it faces local threats from chemical contamination, invasive aliens, the clearing of channels, and a burgeoning population of elephants.
2. Since the Delta depends on water from the Okavango's Angolan catchment that passes through Namibia, it may suffer from increasing water extraction for irrigation, and the addition of pesticides, nutrients and clay to water that enters Botswana.
4. Global forces, such as climate change, food and energy prices, and demands for tourism will directly and indirectly influence the future of the Delta.
5. Uncontrolled pulses and shifts in the supply of water across the Delta are crucial for the maintenance of its biological wealth and health.
6. Measures to improve the use of information and the implementation of plans are required to enhance the management of the Delta.
7. Expanding the identity of the Okavango upstream of the Delta would add security to its future, as well as enhancing the value of natural resources and livelihoods in the catchment.
8. Trans-boundary discussions on management of the Okavango should be broadened to include, for example, local interests, environmental impact assessments and audits, and the sharing of benefits from the Okavango.
9. Investments in the catchment by the Botswana tourism industry and government would help protect the Delta's future.
10. Bold, innovative management of the Delta and its catchment will allow those who come after us to benefit from this eden and jewel of the world.



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United Nations Development Program

Endangered Species Management Policy, Implementation Strategy and Action Plan

Review Report

October 2007
This report contains 151 pages
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Review Report

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1 Introduction

1.1 Background to the project

In July 2007, the Environment Support Program and the United Nations Development Program (UNDP, the project sponsors) commissioned KPMG and the Endangered Wildlife Trust to draft an Endangered Species Management Policy, Strategy and Action Plan for Botswana.

The project began in August 2007, with a four-month duration, and is due to be completed by 30 November 2007. The objective is to provide a comprehensive guide for the Botswana Government to optimally manage and protect endangered species. The proposed Strategy and Action Plan will guide the Botswana Government in the development and implementation of species-specific recovery plans.

The term "endangered species" is defined slightly differently by various organizations, but in all its uses, it refers broadly to a species population which is at risk of becoming extinct because it is either few in numbers or threatened by changing environmental influences (e.g. habitat loss through development, climate change, etc.). The level of this extinction risk (also referred to as conservation status of that species) may vary and is therefore defined more precisely by various methods. The most common globally accepted standard is the World Conservation Union's (IUCN) Red Listing of Threatened Species classification (IUCN Classification 2001). However, some organizations have developed bespoke systems e.g. the US Fish and Wildlife Service national level classification in terms of its Endangered Species Act (1973). Many factors are taken into account when assessing the conservation status of a species; not simply the number remaining, but the overall increase or decrease in the population over time, breeding success rates, known threats, and so on.

An Endangered Species Act aims to provide protection to species in danger of extinction in the recognition that they are of esthetic, ecological, educational, historical, recreational, and scientific value to a country and its people.

The way in which endangered species add this value can be summarised as follows:

- Inherent value of each species: Each species has evolved in a certain way, often adapted in very specific ways to its particular habitat, and forms a part of the complex composition of our living world. As a part of our complex global ecosystem, species have a right to exist and should not be unreasonably threatened by human actions.

- Ecosystem functioning: Individual species contribute to the functioning of an ecosystem as a whole and the loss of even one species may cause a number of other species, which are dependent on this one species, to go extinct also. This in turn may have implications for the functioning of the entire ecosystem.

- Ecosystem services: Life on earth depends on ecosystems to provide so called "ecosystem services" such as purifying their air, maintaining water cycles, pollination of food plants, soil genesis, etc. These in turn are a function of a complex web of species within that ecosystem and may include endangered species.

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The protection of endangered species is therefore closely linked with the protection of ecosystems and ecosystem processes. Many countries have laws offering protection to these species: for example, forbidding hunting, restricting land development or creating national parks and reserves. However, the intensive field observations and data collection required to monitor species and ecosystems trends, especially of smaller and less valuable species means that only a few of the many species at risk of extinction actually make it to the lists and obtain legal protection. Many more species become extinct, or potentially will become extinct, without gaining public notice.

It is therefore even more important for endangered species conservation to encompass the protection of ecosystems as a whole, and take into consideration processes such as the movement of animals due to seasonal availability of food and water, or pollination corridors for plant species. By protecting ecosystems and ecological processes, many of the as yet unknown and potentially endangered species are protected through a holistic approach.

1.2 Review methodology

1.2.1 Overview

The overall objectives will be met through the delivery of four distinct reports. Each report relates to the findings, recommendations and agreed outputs of the four phases of work illustrated below. These are scrutinised and approved by the Technical Advisory Group (TAG), a review committee set up by the project sponsors. The TAG members are listed in Annexure A.

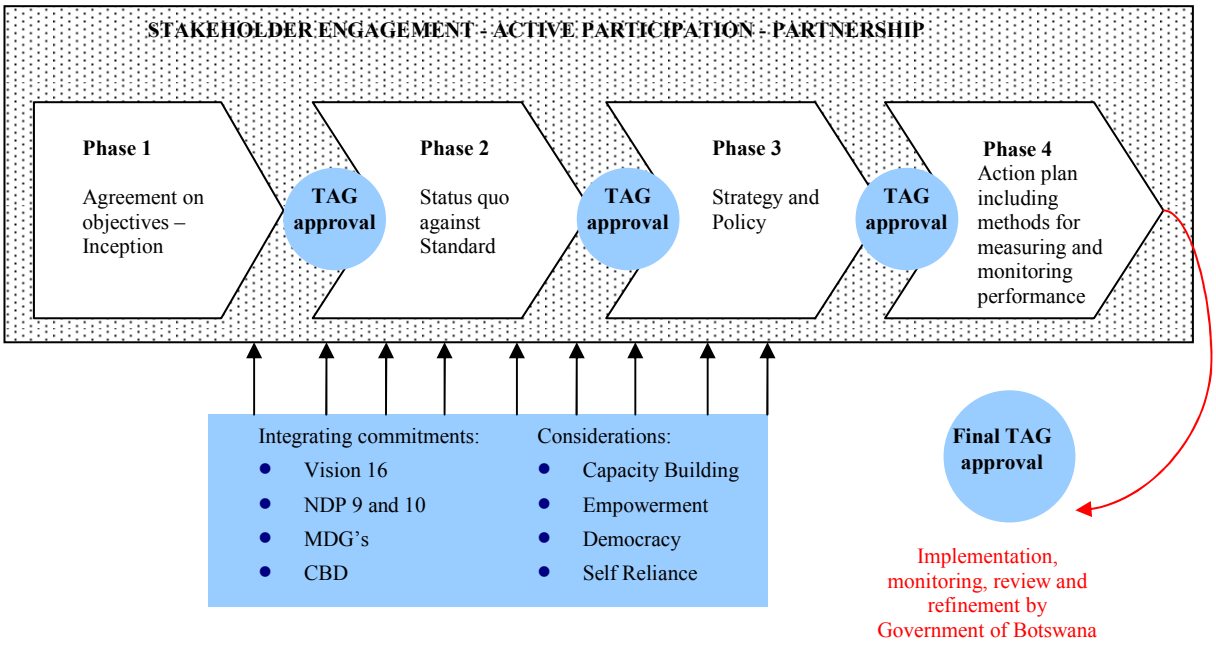

Fig 1 Illustration of Processes and Outcomes for this project

The reports are delivered at the end of each of the four phases of the project:

Phase	Objective	Deliverable
1	Gain consensus on objectives of, and rationale for project, together with review methodology	Inception Report delivered on 21 August 2007
2	Review the current approach to endangered species protection and management in Botswana against best practice elsewhere. Evaluate relevant best practice to identify gaps in the current approach. Also identify areas of potential or real conflict with other national or sectoral strategies and policies.	**This Review Report**
3	Draft a Policy and Strategic Implementation Plan in order to take Botswana from the current situation with endangered species management to the desired situation.	Draft Policy Strategic Plan for implementation
4	Draft an Action Plan that will support the key Strategic Plan milestones. These will include ideas of institutional change, accountability processes, staffing, communications, political process and any further work needed for the prudent management of endangered species	Action Plan

This Review Report details the findings and recommendations from work done in Phase 2. It will form the basis of the development of the Policy and the Strategic Implementation Plan (Phase 3), and the subsequent Action Plan (Phase 4).

1.2.2 Phase 2 approach in detail

The working phase was divided into three distinct processes:

1 **Current Practice Evaluation:** Desktop based research and stakeholder engagement were used to develop an understanding of the status quo of Endangered Species Management in Botswana. This phase was further divided into specific review of:

- The current state of species management in Botswana
- The current state of protected ecosystems and land in Botswana
- The current state of pressures on species and ecosystems in Botswana
- The current state of the strategic and policy environment within Botswana and its relevance to endangered species.

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2 **Best Practice Evaluation:** From this first process a number of principles and challenges emerged, both for the development of a policy and for the implementation of that policy. These principles and challenges were used to guide a search for policy best practice internationally. For example, a principle identified was that the complexity of managing endangered species and the enormity of the task require a collaborative approach with the private sector. This approach ensures that policy practice that was relevant to Botswana was identified.

3 **Gap Analysis:** Finally, the current state within Botswana was compared to the best practice to identify areas of policy and implementation where Botswana excels as well as those areas which need to be addressed in the Project Report.

The three steps combined provide an overall framework to guide the remainder of the project. The areas of focus for policy development emerge and areas that need development within an implementation strategy and action plan become evident.

1.3 Navigating through this report

The report is meant both as a reference point as well as sequential description of the logic process the consulting team went through in compiling the document. It is largely intended to be read in sequence but individual sections can be consulted independently.

The report is structured very much according to the research process outlined above. The next three sections consider the status quo of species and land conservation on Botswana. The **current status of species management and listing** is explored in **Section 2**. This is backed up by a **review of the current status of protected land within Botswana** in **Section 3**. **Section 4** describes a variety of relevant **pressures on endangered species**.

The following section approaches the problem from a more strategic and macro-economic view. In order to establish the overall policy environment in which endangered species must be managed **Section 5** reviews the **Botswana policy environment**.

Section 6 reports back on some of the **themes raised by the stakeholder engagement session** and forms a summary of the key issues discovered thus far in the project. This flows into **Section 7** which reviews the **ecosystem approach** and the justification for the selection of this theoretical framework as the basis for endangered species management in Botswana.

The first seven sections have then built a strong overview of the tools used to manage endangered species and their ecosystems within Botswana. These sections provided direction to **Section 8** which reviews **best practice** in environments that are similar to Botswana. Furthermore, individual principles and pressures that are identified in the review sections 1-7 guide a search for specific examples of policy employed to address them.

The report culminates with **conclusions and a gap analysis** in **Section 9** where areas are identified to guide the structure of the Botswana endangered species management policy and its implementation strategy and action plan. Gaps are areas where principles or issues identified are not currently addressed by the Botswana policy framework. The process for improvement will be guided by instances where best practice examples are available.

2 Current state – Species List

2.1 Overview

This section examines the current status in Botswana with respect to species lists and listing processes. The purpose is to clarify terms and definitions currently in use (international and national), compare the lists available in terms of overlap and/or opposing approaches and propose options for a unified approach to species listing in Botswana. This process may consider international definitions and categories of threat but will need to be made relevant to the national status quo.

2.1.1 Background to Botswana's species conservation

Conservation of endangered wildlife species has been an integral part of Botswana's wildlife management policies since the late 1800s and early 1900s, based on customary and statutory laws. Customary laws came from several Chief's Decrees which were announced and implemented before the Bechuanaland Protectorate (Spinage 1991). Big game (e.g. Buffalo *Syncerus caffer*, giraffe *Giraffa camelopardalis*, gemsbok *Oryx gazella* and zebra *Equus burchelli*) were protected by the Chief's Decree and could only be killed with the Chief's permission. Customary law in 2007 plays no significant role in conservation of endangered species because the advent of the contemporary political system shifted power from the Chiefs who lost their influence, control of land and utilization of wildlife resources. Meanwhile, statutory laws gained more influence. These were in the form of several Proclamations and International Conventions (e.g. The London Convention of 1900 and 1933, and the African Convention of 1968) which were drawn up in the late 1800s and early to mid 1900s. Through those Proclamations and Conventions large herbivores such as giraffe, eland *Taurotragus oryx*, elephant *Loxodonta Africana*(VU), Black Rhinoceros *Diceros bicornis*(CR) and White Rhinoceros *Ceratotherium simum* and several bird species were granted protection status on account of their usefulness, rarity and extermination threats caused by excessive hunting (Spinage, 1991).

A notable proclamation was the Fauna and Conservation Proclamation of 1961 which provided for gazetting of species as conservation animals. Species accorded conservation status by this proclamation were protected from hunting, but it did not clearly define criteria for identifying and listing endangered species. Discussions with relevant officials from the Department of Wildlife and National Parks (DWNP) revealed that, high levels of rarity, trends in populations and trends in spatial and temporal distribution of species, together with the condition of habitats have been used to identify threatened species. Public opinion and perceptions, and input from Non-Governmental Organizations (NGOs) have also been taken into account. In the early 1960s sporadic game counts were conducted, and those species which were found to be persistently low in numbers were afforded protection status. Although hunting is a cause of increased wildlife species population declines in Botswana, loss of suitable habitat for some species has to be considered critically when considering the status of wildlife species in Botswana.

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2.1.2 Current listing status in Botswana

Botswana currently has three forms of species listing processes involving species found within the national borders:

1 IUCN Global Red List (most recently being the IUCN Red List 2007), which assesses the status of a species against set criteria throughout its global range;

2 Species listed under The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); which assigns a listing based on the degree to which the species is threatened by international trade; and

3 National listing of game animals (protected and partially protected) as defined in the Wildlife Conservation and National Parks Act (1992), as well as protected trees as defined in the Forest Act (1968) (hereafter referred to as the "National List").

Many of the species listed in these various listing processes differ between lists. For example with reptiles, under the CITES listing there is one species listed, which is the Nile Crocodile *Crocodylus niloticus*, whereas under the Botswana National listing, the one species listed is the python *Python sebae*. To understand the variance between these lists and work towards a unified approach to listing, it is important to understand the various listing procedures. The full lists of fauna and flora in Botswana for all three categories are shown in Annexure B. Table 1 below illustrates broad differences between the lists:

Table 1: Overview of the number of species listed under the three different listing processes in Botswana.

	Mammals	Birds	Reptiles	Fish	Plants
IUCN Global Red List	8	7	0	2	2
CITES List	11	1	1	0	2
National List	31	Not yet complete	1	0	19

2.2 IUCN Red Listing Process

2.2.1 Categorisation

The IUCN Red Data List of Threatened Species is an IUCN Species Survival Commission (SSC, a Commission within the IUCN) product and was initiated in 1963, as a means of identifying species in need of protection and thereby creating awareness of endangered species. The identification of species whose existence is threatened has since become a key element in the process of defining global and regional priorities for conservation (Barnes 2000) and guiding the conservation efforts of governments and NGOs.

Red Data Lists categorise species according to levels of threat and risk of extinction (see structure of IUCN categories in Fig 2) and therefore serve to direct conservation efforts, affording endangered species a greater level of protection, highlighting species in most danger of extinction and acting as a global index of biodiversity loss. The criteria used to compile Red Data Books have been updated frequently and the latest Red Data Books and Global Red List are based on version 3.1 (2001).

The general aim of the IUCN Red Listing system is to provide an explicit, objective framework for the classification of the broadest range of species according to their extinction risk on a **global** scale. When applied at national or regional levels it must be recognized that a global category may not be the same as a national or regional category for a particular taxon. For example, taxa classified as *Least Concern* globally might be *Critically Endangered* within a particular region where numbers or habitats are very small or declining, perhaps only because they are at the margins of their global range. Conversely, taxa classified as *Vulnerable* on the basis of their global declines in numbers or range might be *Least Concern* within a particular region where their populations are stable (IUCN Classification 2001). It is only where a species is endemic to a country that its national and global status is identical.

The categorization process is only applied to wild populations inside their natural range, and from populations resulting from benign introduction, such as White Rhinoceros in Botswana.

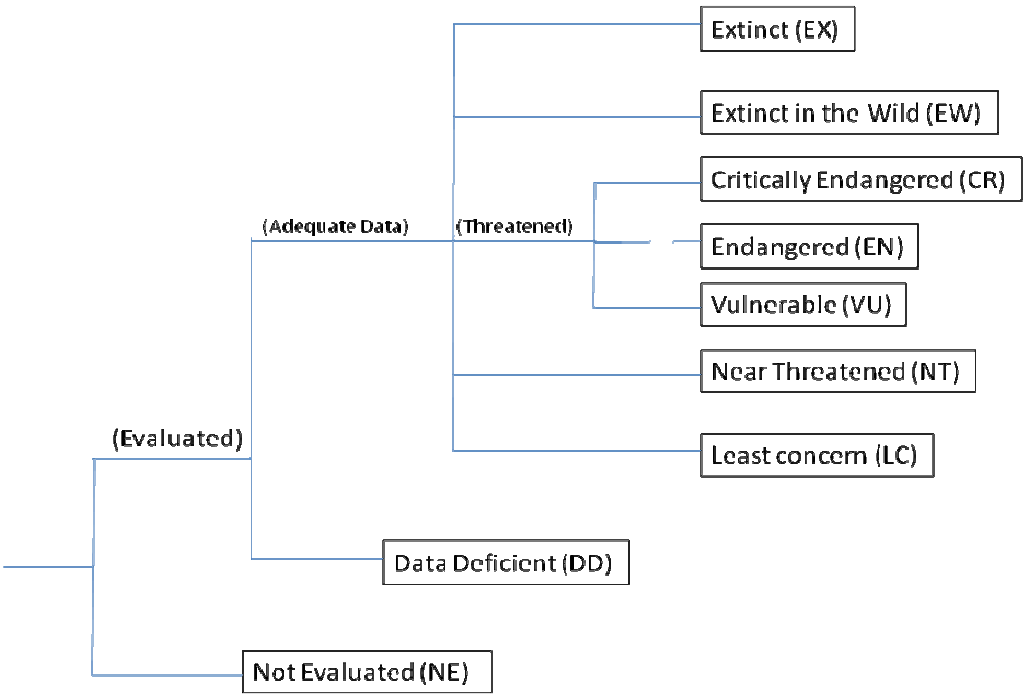

Fig 2: Structure of IUCN Evaluation Categories (IUCN Classification 2001)

The IUCN Red List Categories and Criteria have several specific aims:

- Provide a system that can be applied consistently by different people;
- Improve objectivity by providing users with clear guidance on how to evaluate different factors relevant to species extinction;
- Provide a system which will facilitate comparisons across widely different taxa; and

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- Provide users of threatened species lists with a better understanding of how individual species are classified.

2.2.2 IUCN authorities and review process

The 1994 IUCN Red List Categories and Criteria were revised to increase the objectivity to the process of including species on the Red List. To achieve this objectivity, Red List Authorities (RLAs) have been established for all taxonomic groups included on the IUCN Red List. In most cases, the Red List Authority is the IUCN SSC Specialist Group responsible for the species, group of species or specific geographic area. SSC Specialist Groups are a network of conservation experts providing information to the IUCN on biodiversity conservation, and on the inherent value of species and their role within ecosystems. In the case of birds, BirdLife International is the designated RLA. BirdLife International is a global partnership of conservation organizations that strives to conserve birds, their habitats and global biodiversity, working with people towards sustainability in the use of natural resources.

In cases where the SSC and its partner networks do not cover a particular taxonomic group or geographic region, the Red List Unit staff working together with other IUCN Species Programme staff and the Red List Partners will recommend the appointment of other appropriate organizations or networks as RLAs or National Red List Advisory Groups. The latter will also form a much-needed link between the many national Red List initiatives and the global IUCN Red List. The role of the RLAs is to ensure that all species within their jurisdiction are correctly assessed against the IUCN Red List Categories at least once every ten years and, if possible, every five years (note, any assessments that are older than ten years are flagged as being out of date, as the status and any supporting documentation provided may no longer be correct; such assessments should be used with caution). All assessments should also include the necessary minimum documentation required and should be done in as consultative manner as is possible. The intention is that no new species assessment will be included on the IUCN Red List until it has been evaluated by at least two members of an appointed RLA or by at least two evaluators appointed by IUCN Species Programme staff. This peer review system places greater responsibility on the SSC network and its partners to ensure that what appears on the IUCN Red List is credible and scientifically accurate.

For the purposes of this project, the term “endangered species” is interpreted as those species which meet the criteria to be classified as “threatened” according to the IUCN Red List Categories and Criteria version 3.1 (IUCN Classifications 2001, see Fig 2 above), which encompasses the categories Critically Endangered (CR), Endangered (EN), and Vulnerable (VU) and refers to species that are facing an extremely high, very high and high risk of extinction in the wild respectively, based on population size and geographic range. For a detailed explanation of all categories, please refer to the IUCN Red List Categories and Criteria version 3.1 at http://www.iucn.org/themes/ssc/redlists/RLcats2001booklet.html.

2.3 CITES Listing

2.3.1 Overview

CITES is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival as a species. This means that the degree to which a species is traded is the crucial factor in deciding whether or not a species is listed under CITES. This may coincide with a listing under the IUCN Red List, but is not the deciding factor.

CITES works by subjecting international trade in specimens of selected species to certain controls. All imports, exports, re exports and introductions of the species covered by the Convention have to be authorized through a licensing system. Each Party to the Convention must designate one or more Management Authorities in charge of administering that licensing system and one or more Scientific Authorities to advise them on the effects of trade on the status of the species.

2.3.2 Categorization

The species covered by CITES are listed in three Appendices, according to the degree of protection they need:

- Appendix I includes species threatened with extinction through trade. Trade in specimens of these species is permitted only in exceptional circumstances.

- Appendix II includes species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival.

- Appendix III contains species that are protected in at least one country, which has asked other CITES Parties for assistance in controlling the trade. Changes to Appendix III follow a distinct procedure from changes to Appendices I and II, as each Party's is entitled to make unilateral amendments to it.

2.3.3 Implications for policy development

In Botswana, the DWNP and the Department of Forestry and Range Resources are the implementing authorities for CITES regulations. As relates to wildlife, the provisions of CITES have been wholly imported into the Wildlife Conservation and National Parks Act Schedule 5. While the Forest Act adopts the CITES provisions relating to plants, implementing regulations have not yet been developed and should be addressed in the current review of the National Forest Act. This has implications which will be re examined during the drafting of a comprehensive policy action plan, which will be developed in the next phase of this project.

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2.3.4 Botswana animal and bird species listings

The Wildlife Conservation and National Parks Act (WCNP 1992 Act 28), Parts IV and V, establishes three categories of species, providing different levels of protection from hunting for each:

1 *Protected Game Animals*: WCNP 1992, Schedule 6, lists "protected game animals" (see Annexure B) that cannot be hunted or captured without a permit. The Act imposes criminal penalties of a fine up to P10, 000 and imprisonment up to seven years for violation of this provision.[1]

2 *Partially Protected Game Animals*: WCNP 1992, Schedule 7, Part I lists those animals deemed "partially protected game animals" (see Annexure B). A permit is required to hunt or capture any partially protected game animal. Violation of the Act carries penalties of up to P5, 000 and imprisonment of up to five years. However, if the violation involves an elephant, the penalties are a fine up to P50, 000 and imprisonment up to ten years.[2]

3 *Game Animals*: Game animals that may be hunted with a license are listed in WCNP 1992 Schedule 7, Part II. Since the 1992 Act the elephant population in Botswana has increased to the point where CITES has allowed limited and controlled hunting of elephants, so they are listed as both Partially Protected Game Animals and Game Animals. Schedule 7, Part III contains game birds that may be hunted with a license.

Wildlife not included on these lists may be hunted without a license by a resident of Botswana as long as the hunting does not take place in a national park or game reserve.[3]

2.3.5 Botswana tree listing

According to the Forest Act (1968), the Minister may declare any tree or class of tree (genera) as protected. Such a declaration must be published in the Government Gazette. Should the declaration however be in respect of a tree in a tribal territory, the consent of the relevant District Land Board is needed, similarly if the declaration is in respect of a tree on private land, the consent of the owner is needed. No person shall fell, cut, take, work, burn, injure or remove any protected tree, unless he is authorized to do so in terms of a license issued in terms of the Act[4]. However, according to participants in various stakeholder meetings (Maun Experts Meeting 2007 and First National Consultative Conference 2007), these penalties are seldom if ever implemented. The flora that is listed in the Forest Act is mainly hardwood trees and there is no inclusion of other categories of plants, including medicinal plants (see Annexure B for trees that are protected in Botswana). A new Forestry and Range Resources Act is currently in preparation, which amalgamates the Forest Act 1968, the Herbage Preservation Act 1977, and the Agricultural Resources Conservation Act 1974, which will be implemented by the Ministry of Environment, Wildlife and Tourism where Forestry and Range Resources Department has been moved to from the Ministry of Agriculture.

[1] WCNP Act, Part IV, section 17
[2] WCNP Act, Part V, section 19
[3] WCNP Act, Part V, section 19
[4] Forest Act, section 11(2)

2.3.6 Summary of section on national listing

To implement an endangered species program, Botswana needs a current, accurate list of endangered species and clear definitions of the categories used in this listing. An internal analysis of listing in Botswana has been carried out by the Environment Support Program (Sikuku 2006) to begin this process. Thus far, national listing of species refers mainly to protection from hunting for game animals and birds, and protection from utilization for some trees.

2.4 Comparison of existing lists

2.4.1 Objective

For each taxonomic group (Mammals, Birds, Amphibians, Reptiles, Fish and Plants), the three lists given in Annexure B are compared in order to:

- Assess the areas of consistency between them; and
- Evaluate any discrepancies and resultant implications.

Invertebrates are not listed on any of these lists and have therefore not been included in this section.

2.4.2 Discrepancies identified

The following paragraphs highlight some of the differences between the three lists. Our conclusions from these observations are given in section 2.5.

Mammals

There is one mammal species in Botswana that is globally threatened according to the IUCN (IUCN Red List 2007), but has no formal protection in Botswana - Percival's Trident Bat *Cloeotis percivali* (VU). In addition there are numerous large mammal species which only have partial protection, or no official protection, in Botswana, but have been suggested by specialists (Maun Experts Meeting, Sept 2007) for inclusion in a national list with a higher protection level, based on either research or expert observation over time suggesting a noted decline in numbers. These are lion *Panthera leo* (VU), leopard *Panthera pardus*, Sitatunga *Tragelaphus spekeii,* sable *Hippotragus niger* (VU), eland and Chobe Bushbuck *Tragelaphus scriptus ornatus.* Additional research and analysis of the current status of migratory species such as eland, Red Hartebeest *Alcelphus buselaphus* and zebra suggest that these species may also require attention in a national listing process and in future species management plans.

According to Cheetah Conservation Botswana (CCB, Maun Experts Meeting 2007) there are probably fewer leopards than generally thought and more studies need to be done to monitor trends and avoid over utilization through hunting. They are further threatened due to high predator/livestock conflict.

Reptiles

There is only one protected reptile species in Botswana (National List), the python. The Nile Crocodile *Crocodylus niloticus* is listed in Appendix II of CITES, but it has no protected status nationally. Research in the Okavango Delta (Crocodile Monitoring Program, Management Plan 2007) indicates that the crocodile population is declining due to capture of live breeding females and collecting of eggs.

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Birds
Botswana has 560 species of birds (320 non-passerines and 240 passerines) that have been recorded in the country to date of which more than 500 species are considered to occur regularly (Tyler & Bishop 1998). There is a very low level of endemism in birds in Botswana and the Short-clawed Lark *Certhilauda chuana* is considered to be the only near-endemic to the country with its global stronghold in the southeast.

The National List includes a large number of bird species, referring to whole families as being protected as well as some individual species. Originally the national list considered general families, but increasing research and knowledge has highlighted specific species that require special attention. Most species listed on the IUCN Red List (2007) fall into these families, except for the Black-cheeked Lovebird *Agapornis nigrigenis* (VU). BirdLife Botswana are currently coordinating and implementing a project aimed at producing a Red Data Book for Birds in Botswana. This project aims to produce a comprehensive document covering the distribution of endangered bird species in Botswana; population status; threats, and current and desired measures to counter the threats.

Some species that have been highlighted by experts for inclusion in a National List because of their local decline in numbers include the Black-cheeked Lovebird and the Yellow-throated Sandgrouse *Pterocles gutturalis.*

Plants
Global Classification of the conservation status of plants is based on the 1997 IUCN Red List of Threatened Plants, which still uses the older version of the IUCN classifications (IUCN Classification 1994). Some species that have been evaluated against the new IUCN criteria (IUCN Classification 2001) are listed in the 2007 Red List of Threatened Species. The Southern African Plant Red Data Lists is the primary source of information on endangered plant species in Botswana, listing thirteen globally endangered plants in Botswana, mainly Orchidaceae and Apocynaceae families. Three Orchidaceae species, *Ansellia Africana* (VU), *Eulophia latilabris* (VU) *and Eulophia angolensis* (VU) are listed as vulnerable. Only one species *Hoodia gordonii,* in the *Asclepiadaceae* family, is on the CITES Appendix II list. There is, however no overlap between these two lists and the National List of protected trees appended in the Forest Act (1968). Sikuku (2006) and Setshogo and Hargreaves (2002) recommend a national plant taxonomic and ecological study to address the lack of information on plant species status in Botswana, to be conducted urgently.

Fish, Amphibians, Invertebrates
Little or no information about the listing of any of these species was found to date. In the IUCN Red List (2007), 2 species of tilapia *Oreochromis andersonii* (EN) and *O. macrochir* (EN) occurring in the Okavango Delta are listed as endangered.

2.4.3 Species management plans

The DWNP, within the Ministry and Environment, Wildlife and Tourism, has begun the process of developing Species Management Plans (see Table 2 for current list) for some species requiring focused and specific management, although the procedure by which these species are chosen is not formalized. Currently, the criteria upon which the development of these management plans relies relate either to endangered status according to the IUCN Red List 2007, consumptive/non-consumptive utilization, human-wildlife conflict mitigation or complex management and/or conservation requirements.

A formalized process of prioritization for the development of Species Management Plans is recommended and should be informed by the national list of endangered species that is still to

be revised according to the recommendations of this project. Existing Species Management Plans may also have to be revised in light of the final Endangered Species Policy.

Table 2: Species Management Plans in Botswana

Species	Status of Management Plan
Crocodile	Completed
Ostrich	Completed
Elephant	Existing management plan is currently undergoing a review sponsored by US Fish and Wildlife Service and the Government of Botswana
Falconry	Completed
Rhino	Completed
Exotic Species	Draft stage
Predator Management Plan Fisheries Regulations	Completed Draft stage

2.5 Recommendation for a listing process

In the absence of clearly defined, consistent locally designed guidelines for identification and listing of threatened species, Botswana could make use of the most recent 2007 IUCN Red List as a basis for their listing process. Therefore, all species listed in the most recent 2007 IUCN Red List that occur in Botswana would be included in an initial list that would need to be reviewed for consistency with local conditions applicable to the species listed. The Guidelines for Application of IUCN Red List Criteria at Regional Level (IUCN 2003) may guide this process but should consider the following potential difficulties.

Firstly, the population dynamics of most species in Botswana are largely unknown due to lack of comprehensive demographic data at a national scale.

Secondly, the definition of "regional populations" is a concern. Botswana has various levels of protected area and the boundaries of each demarcate a management unit. Populations within those management units may not necessarily be naturally separate. For example the sable populations are dwindling in the Okavango Delta while they are doing well in the Chobe National Park which is adjacent to the Okavango Delta, but sable from the Okavango Delta can move freely to the Chobe National Park, which means that they cannot be considered separate populations. The same can be said of zebra and wildebeest of the Makgadikgadi National Park and the Central Kgalagadi Game Reserve (CKGR). Should Botswana apply the Guidelines for Application of IUCN Red List Criteria at Regional Level, caution must be taken not to consider the same population as two different populations.

Despite these observations, the Guidelines are coherent and applicable to the Botswana situation. An important aspect is that they recognize that a global category may not necessarily be the same as a national or regional category for a particular taxon. Botswana does not

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necessarily have to develop a new set of guidelines and definitions, but should rather develop a coherent strategy addressing localized situations. For example, some species are low in number in some parts of the country while their numbers are stable or increasing in other parts of the country, e.g. the eland with populations declining in the Delta while they do well in the Kgalagadi area. Variation in population numbers in different areas of the country therefore needs to be considered when adapting the species list to the Botswana situation.

Key recommendation: There is a lack of data about certain species, specifically invertebrates, reptiles, amphibians, fish and plants as well as some mammal and bird species. Research identifying endangered invertebrates, reptiles, amphibians, fish and plants, and a process in which they can be conserved through habitat assessments and protection measures should be implemented. Global trends in the extinction rates of these taxa indicate not only their vulnerability, but also their role as indicator species in healthy ecosystems. Thus the initiative to identify and list species in these taxa, and consider their conservation needs, is taken forward as a key recommendation from this project.

Key recommendation: Botswana clarifies its listing process to ensure consistency. One option is to use the Guidelines for Application of IUCN Red List Criteria at Regional Level (IUCN 2003) since they are largely applicable to the Botswana situation, recognizing that a species global category may not necessarily be the same as a national category. Thus Botswana does not necessarily have to develop a new set of guidelines and definitions, but should rather revise the IUCN Red List (2007) by addressing local situations, including species demography, status and distribution within the national boundaries. Particular attention needs to be paid to endemic species, since although they may not currently be threatened nationally, they are de facto globally threatened species.

2.6 Conclusions

Conclusions and implications for policy development and implementation are summarized in Table 3 below:

Table 3: Summary and Conclusions of Current State: Species List

	Summary of observation	Conclusion
1	Disparities exist between species listed as protected/partially protected in Botswana, and those categorized as critically endangered (CR), endangered (EN) and vulnerable (VU) by the IUCN Red List (IUCN Red List 2007). There are some species, such as Percival's Bat (VU) which are listed as vulnerable in the Red List (IUCN Red List 2007), but have no legal protection in Botswana. There are other species which are considered to have declining populations nationally and may thus be in need of protection, but currently have no up to date IUCN listing, such as the Sitatunga and the crocodile.	A reliable listing process is fundamental to the success of an endangered species policy. A thorough review of the species listed as protected/partially protected in Botswana should be carried out to ensure its completeness and accuracy. The IUCN Global Red List categorization could form the basis of a single coherent list for Botswana. Responsibility and accountability for maintaining the species list needs to be assigned to a specific government department or interdepartmental team

		who should also be responsible for other species listing processes (e.g. CITES). The team responsible for species listing should include RLA and IUCN representatives. Implementing regulations for CITES-listed plants need to be included in relevant legislation.
2	Anecdotal evidence suggests that the current list is incomplete because it does not include certain species believed by experts in the field to be endangered (e.g., sable, roan and leopards)	Further species specific research is needed. Findings from these should inform the updating of the endangered species list. A process is needed to protect species for which there is a lack of data but a consensus amongst experts that the species requires protection. This is necessary because Botswana is a data deficient country, some species will require immediate attention while the formal process is listing is undertaken.
3	Birdlife Botswana is in the process of drafting a Red Data Book of Birds for Botswana based on the IUCN criteria (IUCN Classifications 2001), but applied at the national level.	This drafting is in process. The resultant list should inform the national list.
4	There is a lack of information regarding plant, invertebrate, reptile, amphibian and fish species status in Botswana.	National taxonomic and ecological studies should be conducted as a matter of urgency.
5	Declines of most endangered mammals have been noted since records began, except for elephants, but there is still a lack of understanding of status, trends and causes	Research is urgently needed to quantify declines of key species and adjust listing designations accordingly.

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3 Current State – Ecosystems and Protected Areas

3.1 Overview and relevance to endangered species

Botswana's commitment to the conservation of its natural resources is epitomized in part by the designation of over one third of the country's total area to the protection (at various levels) of its natural heritage (national parks, game reserves & sanctuaries, forest reserves and wildlife management areas). This is in keeping with the goals of Vision 2016 which states "*The natural resources and environment of Botswana are a natural asset, and the policies for their development and protection are of the greatest importance for the future of the nation*".

Extensive areas of protected areas are vital sanctuaries for endangered species. However areas outside of these protected areas are also important, especially for migratory and far-ranging species as well as plant species. Further, some endangered species live entirely outside of designated protected areas. This chapter examines the current network of protected areas and ecosystems in relation to endangered species, highlighting their importance for the protection of endangered species and identifying key areas outside of protected areas which are important for endangered species as well as current threats to these endangered species.

3.2 Protected area definitions and broad issues

3.2.1 Definitions

Whilst Botswana has a very extensive network of protected areas (Fig 3 below), a large proportion of this comprises Wildlife Management Areas (WMA) and Controlled Hunting Areas (CHA), which were designated by a process undertaken by district Land Use Planning Units. Although not legislated in the same category as parks and reserves, WMAs and CHAs are District Land Use Management areas that provide partial protection to wildlife and plants and, importantly, provide buffer zones for animals to move outside of national parks and game reserves. They also allow some degree of human utilization, designated as Community Based Natural Resource Management (CBNRM) areas (Table 4).

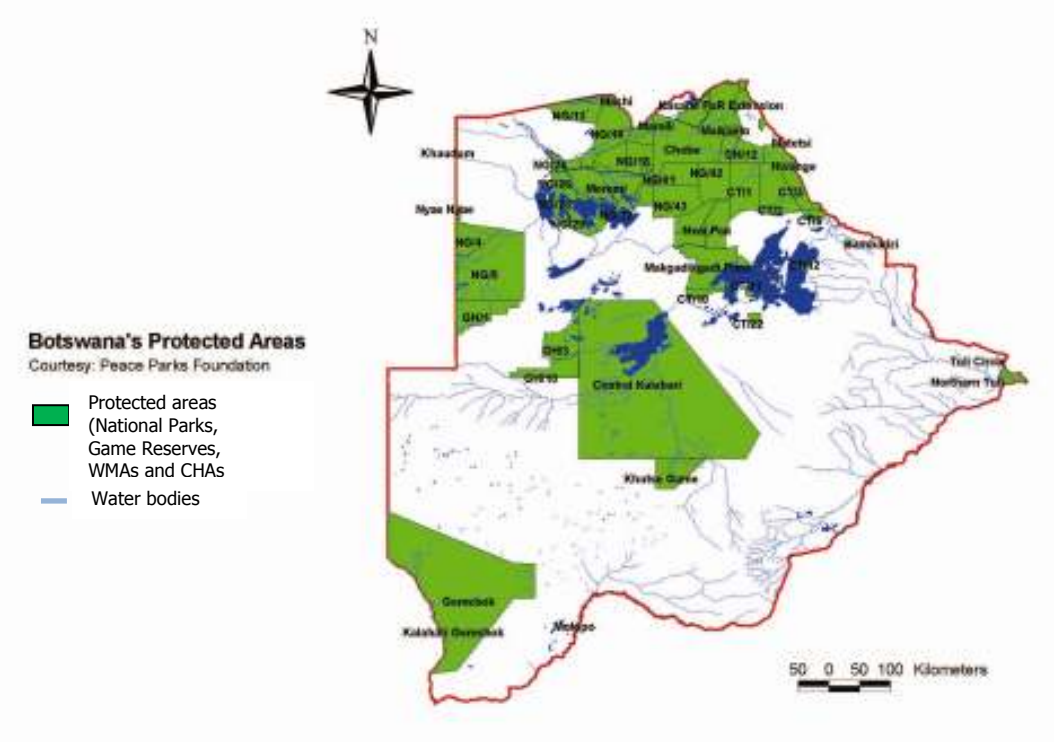

Fig 3: Botswana's Protected Area Network (courtesy: Peace Parks September 2007)

Table 4: Allocation and Extent of Protected Areas in Botswana (information gathered from Wildlife and National Parks Act 1992, National Parks and Game Reserves Regulations 2000, Declaration of Private Game Reserves 1992, Declaration of Controlled Hunting Areas 1968, Forest Act 1968 and updates from Stakeholders)

Protection Status	% of total land area	Description
National Park: Chobe Gemsbok (TFCA) Makgadikgadi Nxai Pan	8%	Conservation of indigenous fauna and flora; no hunting or collecting of plants is allowed; no human settlement is allowed, community use zones are possible (tourism, veldt products); a Management Plan is required
Game Reserves & Sanctuaries: Central Kalahari CT/12 & CT/22 Tachila Gaborone Khutse Manyelanong Moremi Northern Tuli Sichifulo Bathoen Dam	10.4%	No hunting is allowed in Game Reserves; they can also be created on private land; some community use is granted in community use zones (Tourism, veldt products)

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Protection Status	% of total land area	Description
Maun Mogobane Bird Sanctuary Nnwane		
Forest Reserves: Chobe Kasane Kazuma Maikaelo Sibuyu	1%	Protection of some tree species; no settlement or utilisation and no extraction allowed without permits.
Private Game Reserves: Jwaneng Game Park Khama Rhino Sactuary Mashatu Game Reserve Mokolodi Nature Reserve Nata Bird Sanctuary Orapa Game Park	No data available at time of printing	Privately owned protected areas dedicated to nature conservation and wildlife protection and also used for eco-tourism, CBNRM and education; restricted hunting is allowed when declared on application to and approval by the President, but is not usual.
Wildlife Management Areas (WMA): Kwando Okavango Ngamiland Statelands Nunga Nata Statelands Southern District Matlho-a-Phuduhudu Okwa Quago	22% declared so far	Community land, wildlife conservation is the primary land use, sometimes multi-purpose use is implemented with limited livestock permitted; a Management Plan is required; In some WMAs hunting is allowed or dedicated to CBNRM, restrictions to development (e.g. mining) and agriculture
Controlled Hunting Areas (CHAs): Ngamiland Central District Chobe District Kgalagadi District Ghanzi District	No data available at time of printing	Hunting is allowed with permits; kill records are required; hunting can be done by citizens, commercial operators or communities, often CBNRM-based. No activities possibly harmful to wildlife, such as mining, are allowed
RAMSAR Site: Okavango Delta System	5 %	Extent 6 864km^2; see Ramsar Description in box below

3.2.2 Broad issues

Some protected areas have been degazetted or are currently under review. Degazetting results in the loss of the full or partial protected status of land, changing their designated land use status to incorporate greater human utilization, for instance for agricultural use. Examples include the degazetting of NG13 from mixed use to livestock farming; the proposed degazetting of NG 5 from wildlife to cattle farms; and the proposed 60% reduction of the size of Chobe Forest Reserve to allow for a 10,000 ha sugar cane plantation. Such land use changes may impact

severely on endangered flora and fauna species, in the long-term through habitat loss, as well as fragmentation and disruption of migratory patterns of wildlife from infrastructural development such as the erection of fences for cattle or game farms.

There are also land areas, like the Okavango Panhandle, that are unprotected but have been identified as important ecosystems known to harbor endangered species. To afford protection to endangered species and to ecosystem processes important to them, land use change procedures should require provisions to take endangered species conservation into account before land use designations are changed.

3.3 Ecoregions in Botswana

Ecoregions are large areas that contain geographically distinct assemblages of natural communities that share a majority of species and ecological dynamics and conditions which interact in ways that are critical to species persistence. The World Wide Fund for Nature (WWF), an international conservation NGO, has recognized over 1,500 ecoregions worldwide, and after further analysis has identified the Global 200, a list of the most biologically distinct ecosystems, whose conservation is believed to achieve the goal of saving a broad diversity of the Earth's ecosystems. Parts of northern Botswana's wetlands are listed in the Global 200 network, in particular the wetlands of Okavango and Makgadikgadi.

Fig 4 shows the ecoregions in Botswana, in relation to the protected area network, which illustrates the extent to which each ecoregion has protection and which regions could be considered for some form of protection in future. Some ecoregions (Zambezian Flooded Grassland, Zambezian and Mopane Woodland and Makgadikgadi Pans Halophytics) in the northern part of Botswana are covered by a patchwork of protected areas of various levels, but other ecoregions (Southern African Bushveld) have no formal protected areas in place. A framework that takes these ecoregions into considerations for listing key habitats should focus conservation efforts and provide protection for a wider community of species, including endangered species. More data on the presence of endangered species in each of the ecoregions would be a starting point to define such critical habitats. Many of the protected areas shown in the northern region are WMAs and CHAs, so an endangered species management policy also needs to provide a framework for protecting endangered species in these areas.

A brief analysis of key habitats in Botswana is presented in Annexure D.

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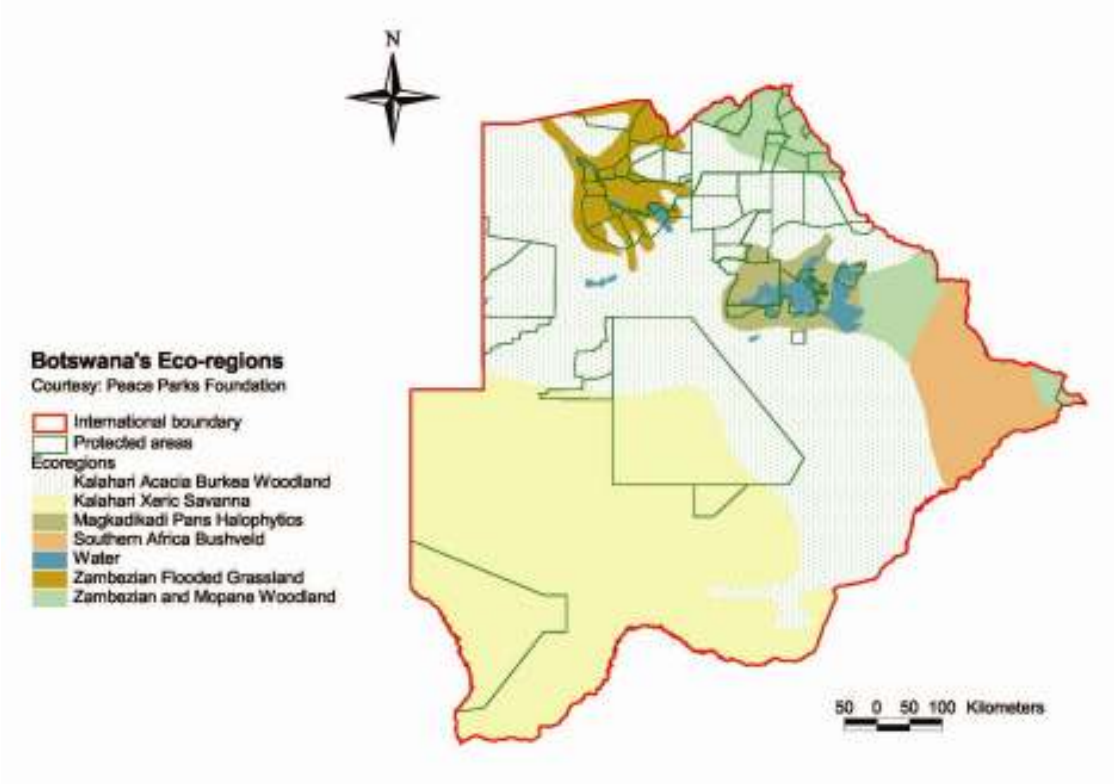

Fig 4: Ecoregions of Botswana (courtesy of Peace Parks, September 2007)

3.4 Priority areas for biodiversity conservation

It is important to ensure the protection of endangered species by protecting ecoregions that support them.

3.4.1 Overview

Botswana has a large extent of wilderness, but its most biodiverse regions are in the north and north-western region of the country, which have been identified as such by the Government of Botswana under Vision 2016 and NDP 9, but also through scientific analysis by major international NGOs such as Conservation International (CI) (Hotspots) and WWF (Ecoregions 200). This is not to say that other areas of Botswana are not significantly important for their natural resources, CBNRM and tourism value, or as a habitat for some endangered species, but they lack information on which endangered species may occur in these areas and are not reviewed in this section. In general stakeholder engagement noted there was a lack of data about and understanding of many ecosystems and threats relating to endangered species. This is a gap which needs to be addressed in future through the process of listing species and evaluating key habitats for endangered species.

The principal areas of conservation importance in northern Botswana and adjacent transfrontier areas, according to Vision 2016, Timberlake & Childes (2004) and others are the Okavango

Delta and the Makgadikgadi Pans and associated saline grasslands. TheMakgadikgadi Pans are an important breeding site for the Lesser Flamingo *Phoenicopterus minor* and feeding area for Greater Flamingo *Phoenicopterus roseus* (McCulloch pers com 2007).

3.4.2 The Okavango Region

The value of the Okavango region is highlighted in Vision 2016, as well as numerous research articles, including by the Harry Oppenheimer Okavango Research Centre (HOORC). The Okavango Delta itself is a relatively unaltered inland wetland and considered important nationally and globally. Covering 15,000 km^2, the Delta is a highly variable and complex aquatic ecosystem, consisting of three major components: the permanent swamp; the seasonal swamp; and the drainage rivers. The greater Okavango and Zambezi/Chobe ecosystem attracts large-scale movements of mega fauna and has the richest mammalian assemblage in southern Africa, with a full complement of both herbivores and carnivores and natural predator/prey cycles. Several endangered animal species occur here including the African Wild Dog *Lycaon pictus* (EN), cheetah *Acinonyx jubatus* (VU) and other threatened species such as crocodile and White Rhinoceros.

Mammals and Birds: Further, the Okavango Delta has 128 species of mammals (including 20 large herbivores), with major populations of large mammals that are not well-represented in other parts of the continent, including the Red Lechwe *Kobus leche* and Sitatunga. It is also an important area for most of Botswana's protected bird species, and a breeding area for endangered species such as the Wattled Crane *Bugeranus carunculatus* (VU) and Slaty Egret *Egretta vinaceigula* (VU).

Reptiles and Amphibians: In Northern Botswana and adjacent transfrontier areas, the reptilian and amphibian fauna from the Kalahari, the Upper Zambezi, and from the broad-leaved woodlands of Central Africa merge. There are 128 species of reptiles and 50 species of amphibians (Timberlake & Childes, 2004). Out of the 178 species recorded, there are five endemic or near-endemic reptiles, namely the Spiny Agama *Agama makarikarica*, Tsodilo gecko *Pachydactylus tsodiloensis*, Long-tailed worm-lizard *Dalophia longicauda*, Barotse Water Snake *Crotaphopeltis barotseensis*, Okavango Hinged Terrapin *Pelusios bechuanicus* and three endemic frogs, Reed Frogs *Hyperolius aposematicus* and *H. rhodesianus* and the Grass Frog *Ptychadena mapacha*. The protection of these endemic species could be facilitated through an Endangered Species Policy, particularly through a National Listing Process which affords them high levels of protection.

Aquatic biodiversity: Aquatic biodiversity is of great significance in the Okavango and Upper Zambezi River systems, while fish species are particularly important to the local people. Fish groups needing taxonomic study include the mormyrid genera *Hippopotamyrus*, *Petrocephalus* and *Pollimyrus*, cyprinids in the *Barbus eutaenia*/*miolepis* species complex and several small spotted *Barbus* species, the distichodontid genus *Hemigrammocharax*, the amphiliid catfish genus *Zaireichthys*, the mochokid catfishes of the genera *Chiloglanis* and *Synodontis* and the cichlids of the genera *Pharyngochromis* and *Sargochromis.*

Invertebrates: Among the many invertebrate groups, only the butterflies (one group of several families within the Lepidoptera) are particularly well-known. There are significant data on the distribution and diversity of dragonflies and damselflies in the Okavango (Timberlake, 2000; CI

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AQUARAP, 2000). The major threats to butterflies are habitat destruction, particularly to riparian and similarly well-developed woodlands, usually from elephant damage (Timberlake & Childes, 2004), and also from aerial spraying of insecticides for Tsetse fly control.

The importance of the protection of the Okavango ecosystem is recognized by the Government of Botswana which has committed to the conservation and "wise use" of the Delta Region under the Ramsar Convention (see box below). Activities to comply with these commitments include the development of the Okavango Delta Management Plan (ODMP final under review, 2007), which is based on the Ecosystem Approach as well as further efforts to protect this area through the involvement of neighboring countries such as Transfrontier Conservation Area (TFCA) initiatives– see further details in 3.4.3, as well as the work of the Okavango River Basin Commission (OKACOM 1994).

Ramsar Convention commitments:

As a signatory to the *Convention on Wetlands of International Importance, especially as Waterfowl habitat* (Ramsar Convention), Botswana has joined an international effort to ensure the conservation and wise use of wetlands. The treaty includes four main commitments that the Contracting Parties have agreed to by joining.

1. Listed sites (Article 2 of the Convention)

The first obligation under the Convention is for a Party to designate at least one wetland at the time of accession for inclusion in the **List of Wetlands of International Importance** (the "Ramsar List") and to promote its conservation, and in addition to continue to "designate suitable wetlands within its territory" for the List (Article 2.1). Selection for the Ramsar List should be based on the wetland's significance in terms of ecology, botany, zoology, limnology, or hydrology. The Contracting Parties have developed specific criteria and guidelines for identifying sites that qualify for inclusion in the Ramsar List.

In Article 3.2, each Party has committed itself "to arrange to be informed at the earliest possible time if the ecological character of any wetland in its territory and included in the List has changed, is changing or is likely to change as the result of technological developments, pollution or other human interference. Information on such changes shall be passed without delay to the Ramsar Secretariat".

2. Wise use (Article 3 of the Convention)

Under the Convention there is a general obligation for the Contracting Parties to include wetland conservation considerations in their national land-use planning. They have committed themselves to formulate and implement this planning so as to promote, as far as possible, "**the wise use of wetlands in their territory"** (Article 3.1).

The Conference of the Contracting Parties has approved guidelines on how to achieve "wise use", which has been interpreted as being synonymous with "sustainable use". The COP has also adopted detailed guidance on the development of National Wetland Policies and on management planning for individual wetland sites.

3. Reserves and training (Article 4 of the Convention)

Contracting Parties have also undertaken to establish Nature Reserves in wetlands, whether or not they are included in the Ramsar List, and they are expected to promote training in the fields of wetland research, management and capacity building for nature guides/ game wardens.

4. International cooperation (Article 5 of the Convention) Contracting Parties have also agreed to consult with other Contracting Parties about implementation of the Convention, especially in regard to transboundary wetlands, shared water systems, and shared species

3.4.2 Transfrontier Conservation Areas (TFCA)

3.4.2.1 Overview

A Transfrontier Conservation Area (TFCA) is a relatively new conservation paradigm. It is defined by SADC's Protocol on Wildlife Conservation and Law Enforcement as ***"the area or a component of a large ecological region that straddles the boundaries of two or more countries, encompassing one or more protected areas as well as multiple resources use areas".***

IUCN has recognized the importance of transboundary conservation and has set up a Transboundary Protected Areas Network *which promotes biodiversity conservation through peaceful cooperation across borders* (www.tbpa.net).

The Peace Parks Foundation (PPF) uses the term "Peace Park" interchangeably with TFCA because they promote peaceful relations and various new levels of cooperation between participating countries. At a generic level, the main objectives of TFCA establishment are

(i) the conservation of biodiversity and endangered species,

(ii) socio-economic development,

(iii) promotion of a culture of peace and regional cooperation and

(iv) the promotion of community interactions across borders.

3.4.2.2 Role of TFCA in the conservation of biodiversity

National parks and game reserves have vitally important roles to play in the conservation of viable populations of a variety of species in natural ecosystems, but are increasingly under threat by land transformation and illegal harvesting. The well-established theory of island biogeography indicates that fragmented, smaller areas will inevitably lose many of their species. It is in the interest of species conservation to join together fragmented habitat patches into a continuum, even when areas cross international border, which is a vitally important objective of TFCA establishment (Hanks 2003).

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3.4.2.3 The Kgalagadi Transfrontier Park

In 2000, President Festus Mogae, together with the President of South Africa, announced Africa's first formally declared transborder conservation area, the Kgalagadi Transfrontier Park. With a combined land area of approximately 38,000 square kilometers, the park is large enough to allow the large-scale migration of wild ungulates, especially species such as eland and Red Hartebeest, and with them the large carnivores, including threatened (IUCN Classification 2007) species such a lions (VU), cheetahs (VU) and Brown Hyenas *Hyaena brunnea*. A healthy predator population also helps support locally endangered birds such as the Cape Vulture *Gyps coprotheres* (VU), Lappet-faced Vulture *Torgos tracheliotos* (VU) and White-backed Vultures *Gyps africanus*, recently suggested as declining in number at the Maun Experts Stakeholder Workshop (2007). This Transfrontier Park is vitally important to the southern Kalahari ecosystem of Botswana, and should the proposed Central Kalahari Game Reserve (CKGR) corridor succeed, a major protected area network would have been achieved, serving as a model for conservation in the 21st century

3.4.2.4 The Kavango-Zambezi Transfrontier Conservation Area (KAZA TFCA)

On 7 December 2006 a Memorandum of Understanding (MoU) was entered into by and between the Governments of Angola, Botswana, Namibia, Zambia and Zimbabwe concerning the establishment of the KAZA TFCA. This is a major new TFCA in the Okavango and Upper Zambezi River Basins encompassing 278,000km^2 of savanna, woodlands, rivers and wetlands in a contiguous area of the five countries (Hanks 2003, see Fig 5).

The Botswana component of the KAZA TFCA embraces the Okavango Delta (including the Moremi Game Reserve), Chobe -Linyanti river system (including the Chobe National Park), Makgadikgadi-Nxai Pan National Park and other land to be determined by migratory wildlife movements. Article 3 of the MoU states that the park extent is not fixed and can be reviewed at a later point. This is an important consideration in relation to the development of policies and strategies for the management of endangered species, as there is a potentially valuable option available for extending the boundaries of the KAZA TFCA to accommodate the movements of endangered species that do or could move across international boundaries or could extend their range around the KAZA TFCA within Botswana. The KAZA TFCA Pre-feasibility Study (TCC, 2006) identified a number of criteria to be used in the assessment of the suitability of additional land for incorporation into the TFCA, and a similar rigorous analysis could be applied to considerations of the adequacy of existing designated protected areas in Botswana to conserve endangered species.

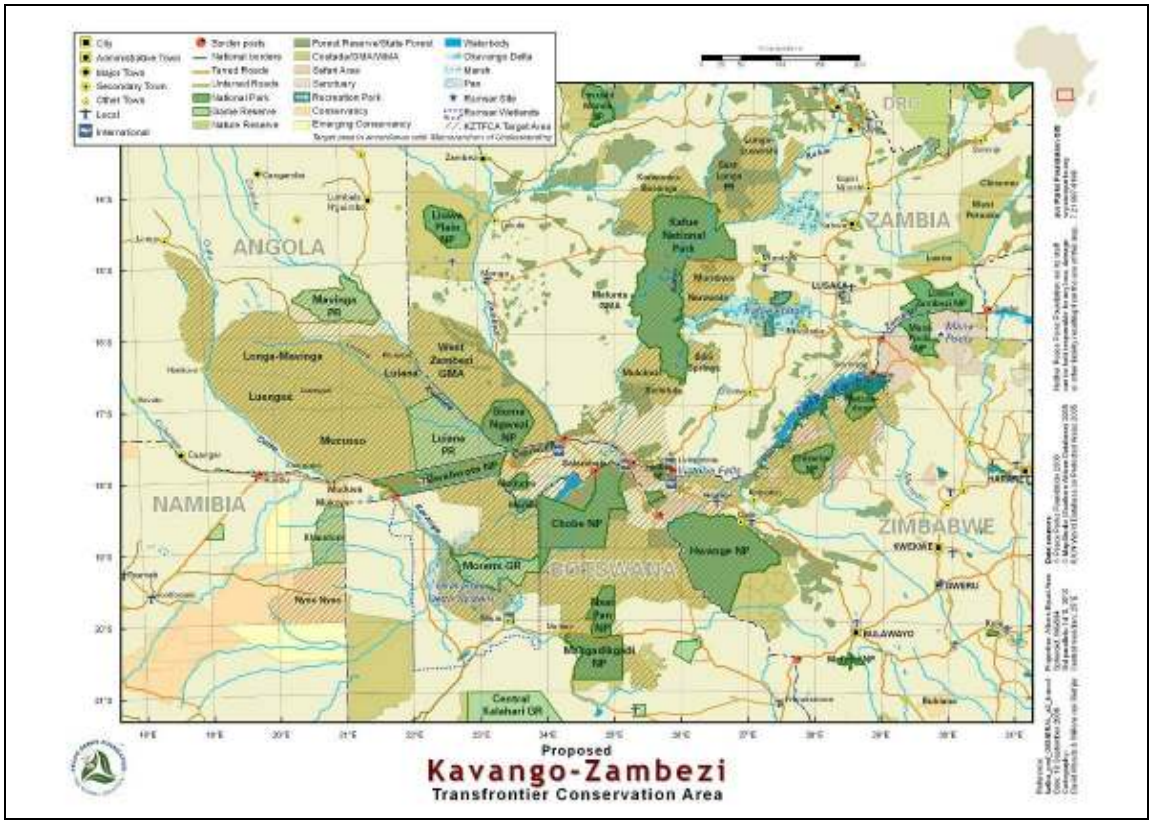

Fig 5. Extent of the Kavango-Zambezi Transfrontier Conservation Area (KAZA TFCA) (hatched areas); Courtesy of Peace Parks Foundation

A number of overarching issues were identified that give relevance of the KAZA TFCA initiative to developing an Endangered Species Policy, Strategy and Action Plan (TCC 2006).

- Consolidation and efficient management of existing designated protected areas and enforcement of laws related to the conservation of endangered species throughout each country, relating to financing, capacity building and the development of new relationships with private sector investors.

- The need for strategies to address human-wildlife conflicts in the region relating to human-elephant conflict (HEC). Mitigation measures are essential to prevent high levels of HWC impacting negatively on efforts to conserve certain endangered species.

- Development of Protocols for the cohesive management of natural resources, which is an integral part of the TFCA states' commitments to harmonize wildlife management between countries and relevant agencies.

- Development of a regional strategy for the management of elephants within the KAZA TFCA linked to existing initiatives within SADC and the IUCN/SSC African Elephant Specialist Group that addresses a policy of sustainable use in appropriate areas is

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considered to be a top priority. This has particular relevance to Botswana which is anxious regarding its growing elephant population.

- Key to these actions is an ongoing investment in training and capacity building in every component of work required to implement programs and plans for endangered species management, including training in law enforcement and anti-poaching, development and running of research and monitoring programs in the biological science, project management skills including report writing and preparation of project proposals, implementation of HEC mitigation programs, computer literacy and environmental education.

3.4.3 Areas requiring special attention:

3.4.3.1 Parts of the Okavango Delta's Panhandle

The Panhandle region of the Okavango Delta is part of the Okavango Delta Ramsar Site, but has no added layer of protection, and does not form part of the KAZA TFCA described above. The fact that this "main artery" to the unique Okavango Delta currently has no formal legal protection is a matter of huge concern. This is highlighted in Vision 2016, which states ***"The Okavango Delta has worldwide interest and attention with an unparalleled diversity of micro-resources, and also features scientific, cultural, social, historical and economic interest that places the delta as Botswana's single greatest potential asset in terms of tourism; and places the importance of natural resources at the forefront of national thinking."***

Furthermore, the Panhandle is a stronghold for two species thought to be declining in Botswana, the crocodile and the Sitatunga (Maun Biodiversity Experts meeting, 2007, Ross 1989) and the listed Red Lechwe is also present in the area, thus the long-term protection of crocodile and Sitatunga and other bird, fish and invertebrate species is probably dependent upon the creation of some form of protected area in the Panhandle region since this is their core habitat. With regards to crocodiles, the Crocodile Monitoring Project (CMP Action Plan 2007) notes: ***"In the 2004/5 nesting season it became evident that there has been a 50-78% decrease in the number of active nesting sites over the last 13 year, due to an increasing human population and the inevitable habitat encroachment. The primary nesting area for crocodiles is now the Phillipi/Moremi (Eastern) channel and it is essential that these areas are turned into a nesting sanctuary as soon as possible."***

The protection of this ecosystem may be incorporated into the protection measures put in place in terms of the TFCA agreements for the KAZA TFCA. This again suggests that a formal process for land use change needs to consider for endangered species present in those areas.

3.4.3.2 The Northern Pandamatenga Plains:

The plains, situated in north-western Botswana, are highly significant for wildlife conservation as they provide habitat for large wild herbivores and specifically several endangered antelope species that prefer marshland fringes, as described by Burgess (see Annexure D) noting the high value of such ecotones, or habitat edges, for rare species. The most important of these are sable and roan, tsessebe *Damaliscus lunatus*, and oribi *Ourebia ourebi*. In addition there are

populations of common small antelope species such as reedbuck *Redunca arundinum*, Common Duiker *Sylvicapra grimmia*, steenbok *Raphicerus campestris*, and Sharpe's Grysbok *Raphicerus sharpei*. The zone is also frequented by herds of large wildlife species including elephant, buffalo, zebra, wildebeest, and by small groups of reedbuck, hartebeest, eland, giraffe, with associated carnivores including lion, leopard and most notably, due to their endangered status, wild dog and cheetah.

The Pandamatenga Plains are divided into northern and southern zones, with the southern zones being heavily utilized for arable agriculture. There is significant political and social pressure to develop the northern Pandamatenga Plains for agricultural purposes, illustrating again the urgent need for a formal land use change procedure to be put in place, which considers the presence of endangered species in the area.

Ecological costs of developing these areas include:

- Fragmentation of an ecologically important zone
- Encroachment on the breeding and year-round habitat for four important antelope species (sable, roan, Oribi, and Tsessebe) and the highly threatened wild dog (EN) and cheetah (VU)(IUCN Classification 2001)
- Blockages to wildlife migration routes
- Increased hunting pressure (legal and illegal) on wildlife and other natural resources in the area (particularly firewood and charcoal)
- Severe loss of population numbers of all species using the region.

The policy for endangered species should acknowledge that there are competitive pressures for the commercial exploitation of land, and recommend a two staged strategy for mitigating negative impacts on such as the northern Pandamatenga Plains. These are:

- Ensuring adequate assessments are carried out over the impacts of proposed land use change on ecosystems and species. This would include an evaluation of the loss of future benefits due to degradation of a potential ecotourism area, and increasing pressure from development on the remaining natural habitat that sustains wildlife and plants, with particular focus on endangered species
- A robust mechanism for conflict resolution to ensure that the impact of proposed land use change on endangered species management and biodiversity conservation in general, is fairly weighed up, including assessments on alternative options that may have lower impacts on species.

3.4.3.3 Important Bird Areas (IBA's)

Important Bird Areas (IBAs) are a network of sites identified by BirdLife International and its partner organizations worldwide, at a bio-geographic scale, that are considered critical for the long-term viability of naturally occurring bird populations, across the range of those bird species for which a site-based program is appropriate (Fishpool, 2001). Twelve of these sites have been identified in Botswana as indicated on the map (Fig 6) below.

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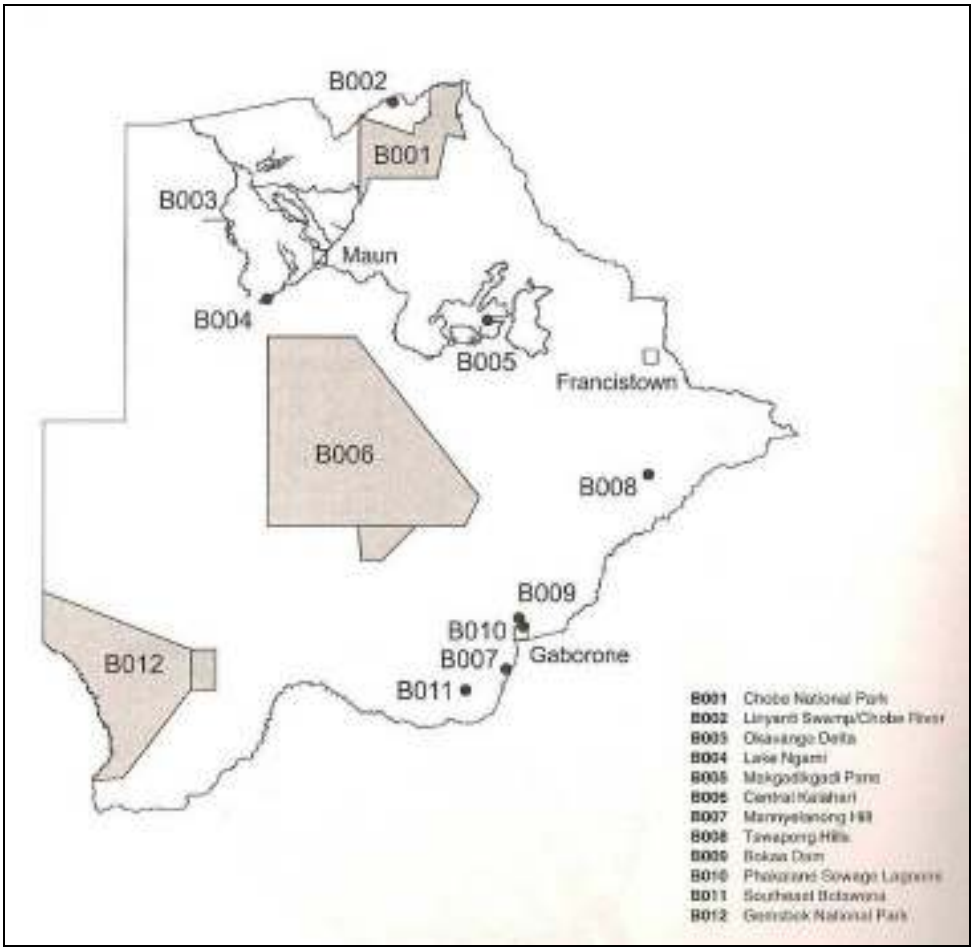

Fig 6: Important Bird Areas (IBAs) in Botswana (from: Tyler, S. J. & Bishop, D.R. 1998. *Important Bird Areas in Botswana*.)

A modified IBA system could potentially provide a suitable framework for the identification and proclamation of additional conservation areas in Botswana that could benefit all endangered species and their habitats. Although it may not be possible to officially protect all identified areas they could form the basis for alternate protection mechanisms. Certainly these areas would provide communication points to focus education, stakeholder communication, and awareness-raising. Furthermore government departments can use these areas to focus their cooperative efforts. The functions of these areas are (Barnes, 1998):

- To assist national organizations and NGOs to identify and conserve areas of high biodiversity value
- To inform political decision-makers and officials at all levels of the significance of these sites to facilitate appropriate decision about the sustainable management thereof
- To assist government in the implementation of, and active participation in, international and regional agreements, such as the Biodiversity Convention and Ramsar Convention

- To serve the conservation activities of, and program co-ordination, among international and local NGOs and government organizations
- To help identify future priorities for action required in species research and conservation in Botswana in order to motivate the scientific community to continue providing data, as well as to stimulate them to fill gaps in knowledge
- To provide relevant and useful material to national educational and training experts

The twelve identified IBAs in Botswana cover a combined area of 130 000km² which represents over 25% of the country's land surface area. All of the national parks and larger game reserves have been included in the network of IBA, but there are five IBAs that currently enjoy no formal protection. This is a gap in the protected areas network of Botswana, and a recommendation for its consideration carried forward in this Review Report. This gap can be identified by Birdlife Botswana who is undertaking an analysis of all bird species of concern in Botswana (Kootsositse, pers com 2007).

3.4.4 Consideration of migratory routes and associated corridors

3.4.4.1 Migratory routes

The KAZA TFCA recognises four potential corridors or migratory routes within the TFCA which required further work on their development and consolidation (TCC, 2006). These corridors could provide essential habitat extensions, particularly for far-ranging species such as the endangered wild dog. They are:

1. The links between the south of the Kafue National Park and the remainder of the KAZA TFCA, part of which could be one or more wildlife corridors from northern Botswana through East Caprivi, or a link with Sioma Ngwezi National Park or to Zimbabwe.
2. The link between Botswana through West Caprivi to south-eastern Angola. This very important corridor will form a major dispersal route for elephants between Botswana and Angola.
3. The need for a corridor to link the north of Khaudum Game Park to Western Caprivi and south-eastern Angola.
4. The link between the protected areas south of Lake Kariba (Hwange) and the remainder of the KAZA TFCA to the west (Chobe).

Although the Pre-feasibility Study recorded several locations of the first two corridors mentioned above, further studies are necessary to determine existing and potential wildlife movements, areas of high biodiversity to be incorporated into the corridors or in the core areas of the TFCA, patterns of present and likely future human settlement, HWC and the extent of land transformation. In areas where proposed corridors will have significant impact on local communities, extensive consultations with residents (especially farmers) must be incorporated into the planning and development processes, ideally linked to reducing HWC to an absolute minimum.

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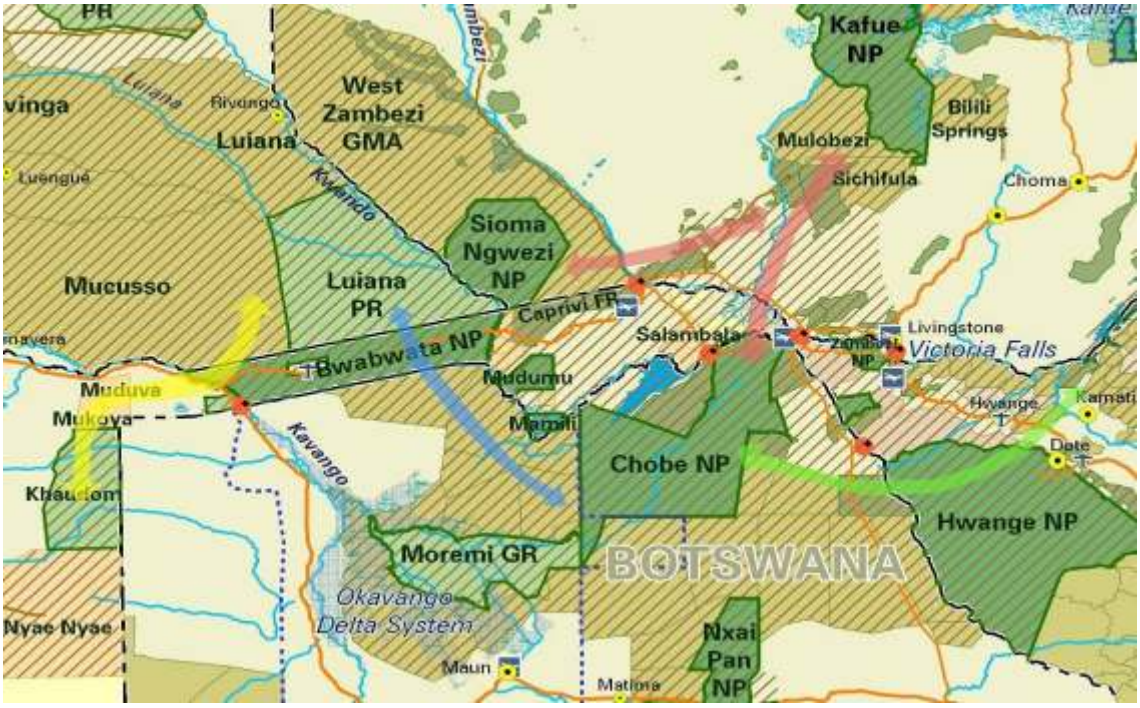

Fig 7: Prospective Wildlife Corridors Linking Core Protected Area (TCC, 2006)

3.4.4.2 Endangered species utilizing corridors

(i) African Elephant (VU)

The IUCN Red List 2007 records the elephant as Vulnerable although it is locally abundant in Botswana. The KAZA TFCA embraces the largest population of elephants in the continent. Estimates in northern Botswana alone are in excess of 150,000 elephants growing at 5% per year, with 50,000 in north-western Zimbabwe and 16,000 in north-eastern Namibia (Martin, 2005; Chase & Griffin, 2005). Accurate estimates are complicated by elephant movement between northwestern Zimbabwe, the Caprivi Strip, southwestern Zambia and southern Angola. Growing human populations, veterinary fences in northern Botswana and civil unrest in Angola have contributed to high concentrations in Botswana by restricting normal patterns of dispersal, resulting in impacts on the environment. Increasing human populations and activities, particularly subsistence farming, have amplified the human-elephant conflict (HEC). As elephant populations become more and more constrained so the need for 'safe corridors' between protected areas becomes even more important (Hoare, 2004).

Elephants have a major impact on the vegetation through feeding, forming paths, opening up water sources and consuming large volumes of water. As elephant numbers increase in south-central Africa and in the absence of any population reduction by culling or poaching, there will be a decrease in the area of woodlands and an increase in the extent of shrubland and grassland (Conybeare, 2004). In Botswana, the DWNP is concerned about the impact elephants have on priority areas such as the riparian strip in Chobe National Park, where adjacent local

communities are also impacted by escalating HEC, including crop-raiding and destruction of crops, damage to wild trees, impeded human movements, and the depletion of dry season water sources. CI has been working with Botswana conservation agencies to determine the abundance, distribution, population structure, habitat needs, and transboundary movements and findings indicate the potential for Botswana elephants to move north into Zambia and Angola once corridors have been established, which could reduce the social and environmental impacts of over-abundance in Botswana and Caprivi (Chase & Griffin, 2005). However, DWNP is concerned that this process may take many years before real elephant population reductions in numbers through corridors.

In the Caprivi as well as other areas, HEC are increasing. Farmers are not free to defend their livelihoods from elephant damage, and there is a growing potential threat to elephants from the inception of a wave of illegal hunting (Martin, 2005). An elephant management plan has been drafted in Namibia which addresses the challenges and opportunities of increased elephant numbers in Caprivi, noting the economic benefits which elephants could generate. The vision statement for the plan expresses Namibia's desire to work with neighboring countries and the international community to enhance the status of elephants, and clarifies Namibia's position on elephants. The plan notes the value of an alliance between Angola, Botswana, Namibia, Zambia and Zimbabwe, aimed at more effective performance in the CITES forum, based on the premise that wildlife products have value and that some legal trade is good for conservation (Martin, 2005).

There is thus a need for a revised Regional Elephant Management Plan that will harmonize elephant management within all five KAZA TFCA partner countries, following on from the seven-country workshop on this subject, developed in consultation with the AfESG (IUCN/SSC African Elephant Specialist Group).

(ii) Wild Dog (EN)

The IUCN Red List 2007 records the wild dog as endangered, having disappeared from much of their former range (Fanshawe *et al*., 1997), with the largest populations today remaining in the KAZA TFCA, western Zimbabwe and the Kafue National Park in Zambia), and the southern part of East Africa (McNutt *et al.,* 2004). Northern Botswana supports approximately 700-800 wild dogs, one of only four populations containing more than 250-300 dogs in the whole of Africa (www.naturalia.org/wild_dog/index.html). Populations continue to decline as a result of habitat transformation and fragmentation, conflict with human activities and an increase in infectious disease (often from dogs in adjacent communities (Maun Animal Welfare Society (MAWS), Maun Experts meeting, 2007). Wild dogs may well be unable to co-exist with the increasing human pressure outside protected areas if local education programs, law enforcement, support programs for HEC and incentives are not implemented. The ranging behaviour of the species leads to a very substantial "edge effect[5]", where they range out of protected areas and even cross international borders from northern Botswana. As human populations continue to increase throughout the continent and move closer or even into some of the protected areas, only the very largest unfenced reserves will be able to provide any level of protection for wild dogs (McNutt *et al.,* 2004). Although wild dogs are protected inside national parks and game reserves, outside of these protected areas enforcement is not always effective.

[5] When an edge is created to any natural ecosystem, and the area outside the boundary is a disturbed or unnatural system, the natural ecosystem is seriously affected for some distance in from the edge.

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Conservation priorities include the following options (McNutt *et al.,* 2004):

- Maintain and expand connectivity of habitat available to wild dogs, particularly in northern and eastern Botswana. Work with communities to reduce killing of wild dogs, and determining the true impact of wild dogs on livestock under different conditions of husbandry;
- Establish effective techniques for protecting small wild dog populations from rabies and canine distemper, and vaccinate wild dogs against them. (Note efforts of NGOs such as MAWS to vaccinate domestic dogs adjacent to protected areas).

Further research on wild dogs in Botswana would be valuable to establish mechanisms of ranging and dispersal, and the extent of their large home ranges (McNutt *et al.,* 2004; Woodroffe *et al*., 1997).

(iii) Sable and Roan Antelopes:

Experts consulted have noted a serious decline of sable and roan in Botswana in the last decade (*pers comm.* Kyriacau and Bonyongo, Maun Experts Meeting 2007), and have highlighted the need for research to determine causes for their current population status, noting "The population of some protected species continues to decline in some parts of Botswana. Typical examples are roan, sable and eland whose populations have declined to an unprecedented level in the Okavango Delta." Certainly veterinary cordon fences and national border fences are known to have impacted sable and roan populations (Scott Wilson 2000), including Botswana's border fence along the Caprivi (Martin 2003), which separates sub-populations between Botswana and Namibia, which could impact species' long term genetic robustness, as well as cause declines in population numbers. According to Dr. Bonyongo of HOORC (pers com 2007) habitat loss and habitat fragmentation brought about by veterinary cordon fences are currently the biggest threat to large herbivore populations in Botswana.

(iv) Cheetahs:

Based on DWNP 2002 surveys, the cheetah population in Botswana is estimated at 1 768 individuals. With the worldwide population estimate at less than 10 000 mature individuals this is a globally important population. In addition observations indicate that their numbers are declining at a rate of almost 10% per annum, mainly due to increased human/wildlife conflict and illegal trade (Botswana's Predator Policy and Strategy 2005).

The DWNP considers that Botswana's protected areas network is not sufficient to conserve viable populations, since most cheetah occur outside protected areas and range extensively into adjacent WMA's, farmlands and across international borders (CCB 2007). Kalahari herbivores have vast home ranges of 3,500 to 6,600 km^2 and predators such as cheetah will range accordingly. Moreover, a major impact on cheetah has been the significant decline of springbok, a major food source for cheetah, outside of protected areas in the Kalahari ecosystem over the past 10 years. Springbok numbers are less than 10% of their former population (estimated at 7,000 in the year 2000, down from 75,000 in 1990) (Thouless and Brett 2000). Although springbok are better able to co-exist with man than most ungulates, their relative tameness makes them more susceptible to illegal hunting, especially from dogs.

The expansion of livestock farming around KTP and CKGR with associated overgrazing, bush encroachment and land degradation, declining prey species, combined with increased encounter

rates between predators and farmers that result in retaliatory killings, are all issues of particular concern for cheetah (CCB pers com. 2007).

Transboundary emigration from the protected areas, in particular KTP has been noted for predators such as cheetah, but mainly quantified for lions through the KTP Lion Research Program. The Lion Research Program noted around 30 lions are shot each year as problem animals on both sides of the border (Thouless and Brett 2000), mainly near cattle posts along the southern Botswana boundary. Studies of the human impact on cheetah through problem animal control and commercial hunting are needed, and capture, translocation (e.g. into the centre of KTP) and/or sale of cheetah that move out or protected areas must be preferable to their continued loss through problem animal control.

Cheetah Conservation Botswana (pers com 2007) have also noted a significant illegal trade in cheetah, with around 80 cheetahs captured annually and taken across the border to South Africa to supply the illegal wildlife trade and for use in canned hunting.

In order to build up viable populations of cheetah, DWNP have proposed the following measures (Botswana's Predator Policy and Strategy 2005):

- To encourage private farm owners to keep cheetah on their property by forming conservancies in key agricultural zones; and encouraging livestock farmers and game ranch owners to play a role in reducing conflicts, and assist in the establishment of a captive breeding programme. In this regard the formation of private public partnerships to undertake this, following the successful model of the Botswana Rhino Management Group (Map Ives, pers com 2007), is suggested.
- In addition to developing a detailed Cheetah Research Program to focus on population dynamics and movement, DWNP proposes to establish a cheetah conservation and compensation fund. Promoting alternative livelihoods and diversification of income generation for communities through CBNRM will encourage communities to attach a value to wildlife thus encouraging their conservation.
- Policies need to be put in place to protect endangered species without alienating communities and such policies to be well enforced.
- Maintaining the integrity of WMAs so that they continue to act as buffer zones or linkages between parks and reserves, including those among international conservation areas (around KTP in the south and KAZA TFCA in the north) This will be achieved by the following:
    i. Intensifying policing of WMAs to prevent encroachment and illegal settlements, and illegal hunting.
    ii. Gazetting of WMAs in the Kgalagadi District proposed under the Botswana's Predator Policy and Strategy (2005).
    iii. Possibility of extending the current KTP boundary fence to separate the park and WMAs from the communal areas.
    iv. Allocation of boreholes for watering livestock on the edge of WMAs will be discouraged to reduce conflicts between predators and livestock.

Thus the most significant opportunity for cheetah conservation is the implementation of DWNP's Botswana's Predator Policy and Strategy (2005), which emphasises the need to educate communities on endangered species conservation, and outlines measures and

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mechanisms for resolving predator-livestock conflicts that are economically and ecologically acceptable.

3.5 Conclusion

Table 5: Summary and Conclusions on Current State – Ecosystems and Protected Areas

	Summary of observation	Conclusion
1	Although Botswana has an extensive protected area network, there are several endangered species that are known to occupy ecosystems outside of formal protected areas.	Increase legal protection status in key areas outside of protected areas such as parts of the Panhandle in the Okavango Delta
2	Research has shown that several endangered migratory species move across national borders.	Endangered species management to take cognizance of TFCA initiatives
3	On occasions the legislation does not encompass all key habitats for endangered species.	Alternative protected areas to be considered, such as IBAs, Ecoregions and TFCA corridors.
4	There is a lack of information regarding fauna and flora species status in Botswana.	A national taxonomic and ecological research strategy to be developed as a matter of urgency.
5	Many declines of endangered mammals have been noted as being caused by HWC.	Increase education and support programs for local communities and farmers, and support for mitigation. Recommendation to be developed in the Strategy and Action Plan.

4 Current State: Pressures on Endangered Species

The list of pressures on endangered species as well as ecosystems and ecological processes is long and not all of them can be addressed in detail here. The major pressures of particular concern on a national scale were raised by stakeholders (Maun Expert meeting, 2007; Start-up Workshop Gaborone, 2007) and are discussed briefly below.

The pressure considered by stakeholders to be of greatest concern is infrastructural developments such as roads and fences. These affect the distribution and survival of endangered wildlife species within and outside protected areas. They may also contribute to the disruption of ecological processes such as migratory patterns or predator/prey interactions, due to habitat fragmentation.

Range depletion from over-grazing and uncontrolled fires has also been noted in the stakeholder meetings as having a major impact on endangered species, both flora and fauna. While fires are addressed under the Herbage Preservation Act of 1977, there are problems with control and enforcement, and questions about what mechanisms should be in place to protect endangered flora and fauna from the threat of fires. These issues will be further exacerbated by climate change, another pressure on all endangered species highlighted by stakeholders (Maun Experts Meeting 2007, First National Consultative Conference 2007).

4.1 Pressures of particular concern

4.1.1 Fences

Botswana has a long history of building veterinary cordon fences to control cattle disease outbreaks, and to separate cattle from wildlife, in particular buffalo that are believed to be the prime wildlife vectors of foot and mouth disease. Such quarantining is required to comply with the strict disease regulations from the European Union, the major importers of Botswana beef under the Lome-Cotonou Agreements. There are lessons to be learnt from the unintended consequences of such agreements which indirectly, through disease control legislation which lead to ad hoc fence construction, led to highly significant land-use changes and wildlife losses.

The most well-known of these fences is the Kuke Fence. Built across the northern border of the CKGR in the 1950's, the fence separates Botswana into the beef cattle export zone to the south and east, and the non-beef export zone to the north. Considerable fence construction has also occurred in Ngamiland during the Contagious Bovine Pleuropneumonia (CBPP) outbreaks in 1988/9. The Kuke fence contributed significantly to the demise of the CKGR's once spectacular wildebeest migration, with over 90% of the wildebeest and hartebeest populations succumbing to restricted access to grazing and water, which also impacted heavily on the large carnivore populations (Williamson 1985). The severe droughts of the 1960's (Campbell 1978) and 1980's was a major contributing factor to the loss of water dependent species such as wildebeest and hartebeest., which had to expand their range considerably in search of water and forage, only to have access to these denied by the fence. DWNP's study of the Kalahari ecosystem (Thouless and Brett 2000) illustrates seasonal movement of arid-land large mammals for forage and water, which extends their range far outside of protected areas. Thus their ability to survive in large

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numbers is dependent on their ability to access huge areas on a seasonal basis, and a major reason why impacts of these infrastructural barriers have been so severe in the Kalahari region.

Whilst Botswana's arid climate accentuates the impact of fences on migratory wildlife, they also act as barriers to wildlife movements in less arid regions by contributing to the fragmentation and isolation of wildlife populations which negatively impacts both endangered large herbivores and the carnivores that depend on them. The Botswana/Caprivi border fence restricted the range of species such as elephant and buffalo populations which once moved freely between the Okavango ecosystem and Namibia's Caprivi Strip. Sable and roan populations were unable to reach water in the Kwando River, which is their main dry season water source. The negative impact was ameliorated when a critical 50 km stretch of border fence was removed near the Kwando River in 1999, thus partly restoring a migratory route. The most recently built fence is the Boteti Fence, built in 2003/4 to separate cattle in community areas from wildlife in the Makgadikgadi National Park. Unfortunately the fence alignment denied wildlife access to water points along the Boteti River, causing many animals to die and thus negatively impacting the migratory zebra population, one of the last major zebra migrations remaining in southern Africa (D. Dugmore, pers.com 2007). Although an EIA was carried out, its recommendations were not followed entirely, which highlights a policy issue regarding the financing of recommendations of EIA's as part of project planning.

Veterinary cordon fences also cause extensive mortality of wildlife that are directly trapped in fences, particularly far-ranging and migratory animals, that move from wet season range to dry season range. Finally, in terms of endangered species management, fences cause habitat fragmentation which impacts the amount of range available to key wildlife populations. Major fences in northern Botswana are listed below.

1 NE of Nata along the Zimbabwe Border – where the fence is open-ended
2 The Makalamabedi fence running northwards to just north of Shorobe
3 The Makalamabedi fence running NE to the northern tip of Nxai Pan National Park has been decommissioned and removed.
4 The Makgadikgadi fence – already mentioned and also called the Boteti Fence.
5. The Southern Buffalo fence along the southern edges of the Okavango Delta, which is important to keep endangered species such as rhinos (Map Ives pers.som.2007) inside the Okavango delta protected areas,
6. The E-W running fences in Ngamiland erected to control the spread of Contagious Bovine Pleuropneumonia (CBPP). These are the Samochimo Fence and the Ikoga Fence. The XaiXai Fence was decommissioned in 2004, and completely removed, following assessments of its impact on wildlife following the CBPP outbreak emergency.
7. The Kuke fence on the N Ghanzi Boundary, preventing southward migration of large wild herbivores into Ghanzi District, and the northward migration of large wild herbivores into Ngamiland from the CKGR.
8. Cattle fences in the southern and eastern regions of Botswana (that lie in the Beef Export zone have been in place for decades, and whilst they may have had impacts on wildlife populations in the past, their impacts have diminished with time since most wildlife/fence interaction occur when the fences are first installed.
9. Game ranch fencing along the road sections just north of Kang on the Ghanzi road – if there are areas with gaps between the fencing it will permit wildlife to move through the area, but generally game farms are a form of agriculture and for

the purposes of endangered species management cannot be considered as protected areas, unless part of specific recovery programs.

4.1.2 Roads

Roads can present significant obstacles to migratory routes of animals especially if they are fenced. Major roads through protected areas threaten the smaller species through an increase in road-kills and also facilitate human access into wilderness areas opening up new opportunities for illegal hunting and gathering of a variety of endangered species, both flora and fauna.

The main roads that traverse key habitats for endangered species, in order of significance are:

1. Pandamatenga - Kasane Highway, affecting roan, sable, oribi, tsessebe and wild dogs, as well as all the less threatened species.
2. Nata - Pandamatenga Highway affecting localised and wider populations and migrations of eland, giraffe, springbok, wildebeest, hartebeest, gemsbok, elephant, buffalo, zebra and large carnivores that follow these populations.
3. Nata - Maun Highway, affecting north-south and/or NE-SW migrations of wildlife across the pans systems and into the Boteti River ecosystem in the west.
4. Orapa - Rakops - Mopipi Highway, affecting the east-west migration of wildlife from the Hainaveld area into the Makgadikgadi Pans system. This highway does not pose as great a barrier to migration, however, as the game fence along the Boteti River from Mopipi down to Rakops, which has caused considerable wildlife losses.
5. Sehitwa - Shakawe Highway, affecting east-west migrations of large herbivores, mainly giraffe, wildebeest, hartebeest, gemsbok, elephant, buffalo, zebra, from the Okavango ecosystem into the western Kalahari ecosystem on the Namibian border. This road also runs parallel to a buffalo fence along the western Okavango, resulting in fragmentation and barriers to migration of many of the large wild herbivores in the area.
6. The Sekoma-Kang-Ghanzi Highway, affecting migrations of wildebeest, hartebeest, eland, gemsbok and springbok from the pan systems in the Northern Kgalagadi District across to the southern Central Kalahari Game Reserve and the Okwa Valley Fossil Drainage system.
7. The Letlhakeng – Dutlwe – Tshwane – Motokwe – Phuduhudu road, currently under construction and providing an alternative route from Gaborone to Kang via Molepolole across the southern boundary zone of the Central Kalahari Game Reserve (CKGR). This will affect the same species as for the Sekoma-Kang highway.

4.1.3 Mining

Mining is the mainstay of Botswana's economy, contributing over two-thirds of the nation's GDP, and should be considered in relation to endangered species management, mainly due to possible impacts of mining on endangered flora in particular from disturbance of above ground habitats. In addition, mines require large amounts of water and local impacts will be felt from groundwater depletion, as well as from water pollution and from altering water courses which affect access to water for wildlife. Examples of this include the impact on migratory wildlife such as wildebeest in the CKGR from the draining of Lake Xau to provide water to Mopipi dam for the Orapa mine, and the potential impacts noted by the IUCN Review Team from the proposed "Boro Dredging Project" or Southern Okavango Integrated Water Development

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Project (SOIWDP) (Skudder *et al.* 2003). The mining sector needs to continue to address best practice regarding surface water and groundwater abstraction, as well as the rehabilitation of degraded lands. Compliance to EIA legislation is of course important, which would also highlight the importance of correct water treatment to avoid the poisoning of local habitats, as has occurred in the mining areas in South Africa. Regulations should continue to be implemented in order to manage pollution and waste which threaten ecosystems, and analysis undertaken on the consistency of consent limits with tolerance and sensitivity levels of habitats.

4.1.4 Availability and abstraction of water

Vision 2016 has identified water resources as a critical management issue in Botswana, and certainly this issue would affect endangered species management. In particular with regard to the Okavango Delta, close attention should be given to inappropriate developments in the catchment, developments such as dams, hydroelectric power (HEP) schemes, large plantations and extensive agriculture, and catchment management implementation need to be addressed. In 1999 Namibia's proposal to build a pipeline to divert Okavango water to Windhoek and surrounding drylands was put on hold following concern from Delta stakeholders and NGO's, which resulted in a review of Namibia's groundwater resources and Windhoek's water needs, both which were found to be sufficient in the short-term (Ross 2003). However, in this arid sub-region similar threats of high-impacting water abstractions are constantly being raised.

A new threat to the Okavango Delta has emerged in the form of a proposed HEP weir at Popa Falls on the Kavango River in the Caprivi Strip. The Namibian power company, NamPower, has undertaken a pre-feasibility study of the hydroelectric potential, reviving a preliminary feasibility investigation that was carried out in 1969. The proposed weir would be between 6 and 8 meters high and the station would have an estimated output of between 20 and 30 MW. The most significant effect will arise from the impoundment of the river sediment by the weir. Approximately 100 000 cubic meters of sand are brought into the Panhandle portion of the Okavango swamps each year (McCarthy 2003) and this sediment is vital to the functioning of the ecosystem and would threaten the continued existence of the Delta and therefore, over time, all species occurring there.

In the Okavango Delta some 98% of water is lost to through evapo-transpiration each year. Dissolved salts accumulate locally to toxic levels, particularly on islands. The Delta's networks of channels wax and wane as sand sediments accumulate, and eventually the river channels fail and are abandoned. This process results in the periodic desiccation of flooded areas as water shifts elsewhere. During these periods rain flushes out the toxic salts that have accumulated on the soils. Salts are thus flushed and diluted into the water as it exits the Delta system, in a continual process that maintains the freshness of the Delta. This process is important to the ecosystem because it forces constant change, limits salt toxicity, and is a mechanism that ensures a diversity of habitats. Removal of the bedload sediment by the proposed Popa Falls HEP weir, or any upstream dam structure, will threaten this dynamism and the entire Delta system and thereby impact key habitats for endangered species.

War ravaged Angola is undergoing reconstruction following 25 years of civil war. Chinese interests in the region could include developments such as dams on the headwaters of the Okavango River. The Angolan Government, funded by various agencies, could develop the catchment area with irrigated agriculture and other development activities. Whilst agreements between the three countries of Botswana, Angola and Namibia are underway through the Okavango River Basin

Commission (OKACOM 1994), it will be some time until the level of water off-takes and other user rights are agreed upon.

Mechanisms such as World Heritage Listing would give the Okavango River Basin an added layer of international protection and recognition as an ecosystem of global value, and important for endangered species survival, and as such should be considered for further protection.

4.1.5 Hunting

There are a number of activities of the hunting industry for endangered species (Maun Experts Meeting, 2007). There is concern over the reliability of methodologies whereby hunting quotas are determined, particularly for those species believed to be declining in numbers, such as zebra, sable, lion and leopard, even though such impressions are often allegorical but extracted from long time periods spent in the field (Maun Experts Meeting 2007). Greater confidence in the quota system is only possible with more intense surveys of species population status and trends. Limited aerial surveys are currently undertaken by DWNP throughout the country, but these could be increased in frequency, with additional ground surveys especially for large carnivores. BASIS (Botswana Aerial Survey Information System), a new map/GIS-based system for analysis of all past and present aerial survey, was developed through a consultancy and established in the offices of the districts and at several divisions in DWNP headquarters. The software greatly increases the precision of estimates/trends and the ease of analysis of information on the number and distribution of Botswana's large animal fauna (Thouless and Brett 2000). Continued support of this important DWNP species and habitat monitoring capacity is an action recommendation of this report.

The potential impact of trophy hunting on endangered species could be assessed by measuring declining trophy size over time, so decline in size could indicate impacts on the gene pool of that species that might arise from excessive trophy hunting of prime males. The hunting industry should continue to maintain records of quotas, number of licenses issued, and actual off-take achieved, which should be sent to a central register. Measurements of skull and trophy (manes, tusks, horns) size as well as body size should be recorded for all individuals killed. Trophy age should be assessed where possible and hunters should record off-take locations as accurately as possible using a GPS of all animals shot. All these records should be collated in the central database of DWNP to monitor intensity of use, and identify trends in trophy size. DWNP should also regularly re-evaluate the hunting of species that are globally threatened but not on the Botswana protected list, such as leopard, lion, sable antelope and eland, and regularly update such appraisals. Many of these actions are already in place, but need refining and coordination. This is an action recommendation for the project, based on best practice identified in southern Africa (EWT Carnivore Conservation Group, 2007).

Unlicensed hunting, considered 'poaching', is a threat to some endangered species in Botswana. (Bonyongo 2007). In the 1980s, poaching had increased to high levels and became too sophisticated to control, and rhinos in particular were heavily affected by high levels of illegal hunting, with black rhinos becoming near-extinct in Botswana for the second time (Map Ives, pers. com.2007) Other species negatively impacted on by illegal hunting include elephant, giraffe, eland, sable and roan with huge declines in numbers in the Okavango Delta. The Government of Botswana through the Botswana Defense Force Anti-poaching Unit (APU) has

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assisted the DWNP by undertaking effective anti-poaching campaigns, thus continued APU surveillance is an important activity for endangered species management.

HEC and problem animal control also contributes pressure on some endangered species. Whilst there is a system for compensation to farmers whose livestock are predated on, there are limitations to this regarding the costs and the time constraints to get evaluate claims There is also a need to enforce legislation which encourages livestock management techniques which mitigate these conflicts in order to qualify for compensation (Boggs 2000). Further studies are needed to assess the impact of predator/livestock conflict on threatened carnivore populations (wild dogs, lions and cheetahs), which is still high outside of protected areas (Thouless and Brett 2000). There is a strong need to raise awareness amongst communities about the status of carnivores and other endangered species, regarding their value economically and the need for effective livestock management techniques to reduce such losses. Effective mitigation and compensation measures need to be reevaluated and put in place. Thus community education and awareness-raising is an action/ policy recommendation of this report.

4.1.6 Infrastructure projects

Large factories such as the Selebi Phikwe mines have a noticeable impact on the environment, most noticeably in terms of pollution, but impacts have not been fully quantified. It is known, however, that factories such as the Sua Pan Soda Ash factory, which mines large quantities of salt and soda ash from salt pans, are known to impact negatively on both species of flamingoes (McCulloch, pers com 2007), mainly through fences, which trap young birds.

Power-lines throughout the country impact negatively on large raptors and vultures (Maun Experts meeting 2007). Best practices on these issues in South Africa could guide mitigation measures in Botswana in future. A strategic partnership between the national power company in South Africa, Eskom, and a national conservation NGO – the Endangered Wildlife Trust was launched in 1996 in response to the problems associated with wildlife interaction with electrical infrastructure. Issues addressed include electrocution of birds and other wildlife on the infrastructure, collision of birds with overhead power lines, and the impact of birds and other wildlife on the quality of electrical supply by causing electrical faults or short circuits. These issues are being addressed through the implementation of a national wildlife incident register, a research programme, capacity building programme, input into design of new lines, reporting and advocacy. In the current climate of increased plans for electrification of the African continent, these activities could play a large role in the protection of endangered bird species such as the Cape Vulture (VU).

4.1.7 Drought and rainfall patterns

Botswana's climate is arid to semi-arid, with highly erratic rainfall, ranging from 250 mm in the south west to over 650mm in the north-east. The national average of 475 mm per year is half the global average annual rainfall, with frequent drought taking place as a result of El Nino events (Ministry of Works, Transport and Communications 2001). The severity and frequency of drought in Botswana has significant implications on endangered species, both fauna and flora. Essentially, species need to be able to adapt and move in response to changing climate and availability of water for plant growth and therefore forage for wildlife.

Data from the DWNP since 1989 indicate that populations of several endangered wildlife species have declined substantially within the protected areas of Botswana including some that are classified as protected. Reasons for their decline have not been clearly determined but are thought to be a combination of factors including possibly changes in rainfall patterns (Bonyongo 2007). The abundance of large herbivores is primarily determined by rainfall and the nutrient status of the soil, via their effects on the quantity and quality of primary production. This scenario is exacerbated by infrastructural developments such as fences that prevent free movement of wildlife in times of drought, as noted earlier. A policy recommendation of this report is a retrospective EIA of all fences in Botswana, similar to the Ngamiland study on fences (Scott Wilson 2000) as a means of determining which fences still impact on migration routes and alignment of possible corridors as a form of mitigation.

The effect of annual rainfall variation on large herbivore populations is more pronounced in the savannah ecosystems such as the Kalahari, as noted in the comprehensive DWNP/EU study of migratory species such as eland, wildebeest and hartebeest (Thouless and Brett 2003). All large herbivores migrate out of the protected areas of the CKGR and the Kgalagadi Transfrontier Park (KTP) in response to rainfall, although findings noted that wildebeest move to the Schwelle area to calve, thought to be related to forage and mineral salts. Thouless and Brett (2000) state that "Results of VHF and GPS radio-telemetry of eland, hartebeest and wildebeest in the KTP, CKGR and intervening areas confirmed distinctive seasonal movements within and outside protected areas, and identified important areas in the WMAs and pastoral land used by wildebeest, particularly during wet seasons. The telemetry study during the project, a period of relatively high rainfall, has not witnessed significant collective long-distance or migratory movements of any ungulates across the system. However, the very wet season of 1999-2000 still included long-distance movements of wildebeest within the CKGR and out of the reserve. The importance of pan and fossil valley systems for ungulates, and the strong influence of green vegetation on movements were confirmed."

A policy recommendation would be to secure critical parts of this pan and fossil valley system, called the "Schwelle", with some form of protected area status since it lies outside of the CKGR and KTP.

4.1.8 Climate change

Botswana was a founding signatory of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, and ratified the Convention in 1994, later ratifying the Kyoto Protocol and the Montreal Protocol. Although Botswana is a minor contributor to the problem of global warming and climate change, projections and impact studies to date indicate that the country will be significantly impacted by climate change (Botswana's Initial National Communication to UNFCCC 2001). Therefore, Botswana needs to address impacts of climate change and must institute policies that will help the country to adapt to such changes. The welfare of the people of Botswana, the performance of the economy, and the state of the environment in Botswana are all very closely linked to climate.

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Climate change will impact on the livestock sector, since desertification is a major concern in Botswana. Unlike desert-adapted large herbivores, cattle are highly water-dependent which ties them to fixed water sources, causing local over-grazing around water-points due to constant trampling of vegetation, which exacerbates the problem. Nearly 50% of methane emissions from Botswana originate from enteric fermentation in livestock (Botswana's Initial National Communication to UNFCCC 2001).

As yet, not much is known about the potential impacts of climate change on endangered species in Botswana, but the expected impact on rainfall patterns and subsequent shifts in vegetation types will likely impact all genera of endangered species, both fauna and flora, which will need to be able to shift geographic location according to climatic conditions. Fortunately most large herbivores are adapted to move or migrate in response to rainfall patterns and predators follow accordingly. What is critical is that large enough areas are set aside so that wildlife can move enough to satisfy their forage and water needs. It also highlights the importance of enhanced connectivity through ecological corridors and buffer zones, as endangered species will need the flexibility to adjust their range extent to compensate for climate change. Flora will need to have similar flexibility to change geographical range in response to climatic changes. This is a highly complex scenario, and it is recommended that an action of this report is that agencies in Botswana tasked with mitigating climate change work with the SANBI Climate Change Research Group (Guy Midgeley, pers com 2007) or similar agencies to develop predictive models that would enable timely adaptation and responses to climate change, including suggested alignment of key corridors.

While Botswana is currently believed to be a net sink for greenhouse gases (Botswana's Initial National Communication to UNFCCC 2001), there are areas of concern, particularly the loss of forests, as well as rangeland from overgrazing and fires (the largest single source of nitrous oxide, another greenhouse gas is from burning rangelands). Of greenhouse gases, 52% were CO_2 emissions, mainly from a coal-fired electrical power station, the Sua soda ash plant, and the copper-nickel smelter at Selebi-Phikwe (Botswana's Initial National Communication to UNFCCC 2001). The proposed development of the Mamabula Coal Project and the Morupule Power Project could significantly increase the output of greenhouse gas emissions in Botswana, and emissions need to be controlled. The Mamabula Coal Project is intended to be an exporter of power to other southern African states, including South Africa which currently generates 90% of its power from coal, and since coal is known to be a major producer of greenhouse gases mitigation measures need to be put in place,

Botswana does not have a dedicated policy to respond to climate change, and this is a gap in terms of endangered fauna and flora species survival, which needs to be addressed in the Policy. This would include recommendations on predictive modeling work with the SANBI Climate Change Research Group or similar agency, enabling policy to create corridors where needed; as well as building capacity in research to reduce uncertainties and allow for adaptive management.

4.2 Possible solutions for increased protection of critical areas

While it is unlikely that many additional protected areas will be created in Botswana, on account of the high percentage already in place, there is a need to provide more formal protection for some key areas that expert stakeholders have identified (see section 3.4.3) as critical for the

protection of certain endangered species, as well as control the ad hoc changing of land use designations.

A system needs to be adopted by relevant agencies, in a country-wide approach and based on a set of national criteria that can address this issue, and determine which key or critical areas are needed for endangered species conservation, including in-situ conservation of plants. Some of the areas highlighted by stakeholders are already being addressed in various ways, for example the KAZA TFCA development, and CKGR/KTP corridor, but there is a need for a formal high-level national process to address all key areas within Botswana. Certainly, one of the most effective solutions for endangered species management is the concept of conservation corridors which connect protected areas and allow for species movement and dispersal, thus creating more robust populations. This is particularly important given the probable changes in weather patterns and thus changes in ecosystems predicted as a result of climate change. An intensive modelling research programme of such changes for Botswana would provide a great deal of information on how to plan for protected area changes and corridor alignments for the foreseeable future (see section on Climate Change).

4.2.1 Partnership for conservation

In areas where human settlement is established, protection measures need to include human activities and could involve CBNRM and public-private partnerships (including tourism, hunting, game ranching, educational activities) as well as partnerships with NGOs, either within WMAs or on private nature reserves and even game ranches. A sound example of public-private partnerships is that of the Botswana Rhino Management Committee (BRMC), which incorporates a successful partnership between DWNP, the Anti-poaching Unit (APU) and a private company, Okavango Wilderness Safaris. The BRMC have successfully re-introduced white rhinoceros into the Okavango Delta, and the numbers have grown to 40 animals, representing a growth rate of 12.6% over three years. The success of this initiative has largely been attributed to the nature of the public-private partnership (BRMC Chairman, pers. com 2007), and could serve as a model for other partnerships that can enhance endangered species recovery in Botswana. Local residents are valuable partners in the conservation of endangered species, as their livelihoods depend on the natural resources in their area and thus are directly influenced by any utilization regulated through policy. Therefore, CBNRM in non-protected areas may provide an important contribution to endangered species management.

4.2.2 Managing human-wildlife conflict

In addressing human-wildlife conflict, various measures are in place already and need to be incorporated into these solutions for protection of endangered species and key conservation areas. The level of conflict often revolves around the issue of access to resources. The increasing elephant population is encroaching on the livelihoods of rural populations, and for scarce resources such as food, water, and land. Protected area boundaries in Botswana separate the human settlements and farms from natural ecosystems but these are imaginary lines which are not always recognized by animals. Most of the settled areas surrounding the protected areas were once inhabited by wildlife. Occasionally, and in some cases regularly, if an opportunity occurs, animals (especially elephants) venture into their old home range which is now settled and farmed by humans, leading to conflicts between wildlife and people. Competition for grazing land between wildlife and livestock is also prevalent in Botswana, such as the

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Gweta/Makgadikgadi where livestock regularly go into the National Park to seek better grazing resources. Also predation on livestock by protected predators such as lion, leopard and cheetah is also a source of major conflict between humans and endangered species. The paragraphs below describe the current system for compensation of losses through wildlife and problem animal control.

4.2.2.1 DWNP managed compensation scheme

In Botswana, the DWNP is responsible for the state funded compensation scheme for livestock depredation or crop destruction by wild animals. A claim must be filed at the DWNP then validated, by investigating the evidence and ensuring that the damage was caused by one compensated species. In practice, it is very difficult to verify all claims (Hemson 2003). In 1997, the DWNP compensation scheme excluded livestock losses by cheetahs and other species that were not listed as dangerous in the Botswana Wildlife Conservation and National Parks Act No. 28 of 1992 (BGG 1996). The exclusion of cheetah depredation from compensation and the ban on killing of problem cheetahs may also have contributed to low tolerance by farmers (Selebatso 2006). In response to this, cheetah and wild dog were added to the list of compensated animals in April 2004. It was hoped that this will increase tolerance towards these predators, but in practice communities are not satisfied with the current compensation system. It is felt the reimbursements are insufficient and untimely. DWNP officers may have difficulties getting to claims in time and this can cause friction with local farmers (DWNP officers, per comm.).

4.2.2.2 DWNP managed problem animal control (PAC)

In Botswana, Problem Animal Control (PAC) is the responsibility of DWNP PAC officers. After an initial complaint, PAC officers advise the complainants of methods that can reduce the problem. Livestock owners are advised to herd stock during the day and kraal animals at night. PAC officers also address communities through traditional council meetings. The second stage in PAC is non-lethal control. PAC teams may chase the predator, shoot over the animal's head and use non lethal explosives to move the animal away, normally towards a protected area. Translocations may also occur if predator returns, which must be done in the presence of a licensed veterinarian. Occasionally, with persistent problem animals or when there is threat to human life, lethal control may be considered. This rarely happens in the case of cheetahs. There is no clear evidence that these methods are effective in decreasing conflict, although it is hoped that these measures will reduce the number of cheetahs killed by farmers (Moses Selebatso, pers comm.).

4.3 Conclusion

Table 6: Summary and conclusions for Current State: Pressures on Endangered Species

	Summary of observation	Conclusion
1	There are a variety of pressures on endangered species inside and outside of protected areas such as ad hoc land use change such as habitat fragmentation from	Realistic threat assessment for the different areas needed Instigate a process of examining critical

	roads and fences,	habitats for endangered species especially with regard to location of corridors.
2	Habitat transformation from over-grazing, human and elephant impacts, fires and human-wildlife conflict.	Methods to mitigate and control negative impacts on endangered species must be identified and implemented
3	Mines, factories and related infrastructure have impacts on the environment and endangered species.	Mechanisms to ensure compliance to EIA findings, with specific consideration during project planning phase
4	Communities and private sector are closely linked to endangered species management as they co-exist with species and may stand to benefit or incur costs through endangered species and habitat protection	CBNRM and public-private partnerships can support and enhance endangered species management on the ground.
5	Water is a very rare resource in Botswana, and access is important to some endangered species	All water abstraction and/or water diversions need to take endangered species into consideration in planning (including EIA's) to ensure sustainability.
6	There is a lack of data on some key species in the hunting quota system. Some key endangered wildlife species are lost through PAC and HWC	Enhance DWNP's capacity to monitor wildlife numbers and trends, set accurate quota's and track trophy quality, and undertake PAC work Current and thorough surveys across the country, undertaken by DWNP and DFRR, in partnership with designated scientific institution.
7	Climate change will impact on endangered species, both flora and fauna	Agencies tasked with assessing climate change should collaborate with DWNP and DFFR in identifying key mitigation actions with relation to endangered species.
8	Need innovative and cost effective ways on instituting species and habitat recovery	Provide necessary legislative framework and incentives to encourage public-private partnerships in species recovery

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5 Current State: Policy and Strategic Environment

5.1 Objective

A review of relevant Botswana endorsed Policies, Acts, Treaties and Conventions was carried out to understand the extent to which:

- The overall strategic direction of the country is aligned with the objectives of an endangered species policy;
- The current policy environment included measures that support the protection of endangered species;
- An endangered species policy would conflict with or support other policies.

The objective of this review is to inform policy development and to identify approaches for neutralizing areas of conflict and magnifying complementary objectives and processes. This is illustrated in Fig 8.

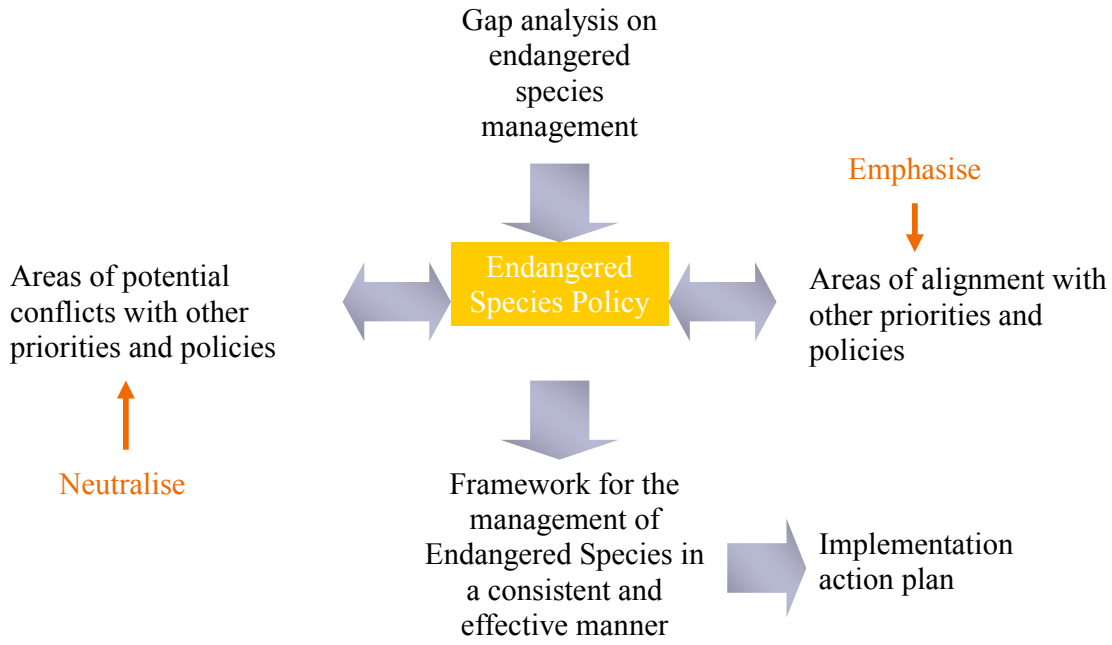

Figure 8: Concept for Development of an Endangered Species Management Policy

The results of the review are summarized in Table 7, 8, 9 and 10 below. The policies have been listed under the following headings:

- International policies regarding the management of biodiversity;
- National policies regarding the management of biodiversity;

- Millennium Development Goals;
- Vision 2016; and
- SADC goals and objectives for sustainable development

The perceived impact that the policy would have on specific sectors and the Botswana economy as a whole is analysed and well as the size of the impact. Learning points are captured in the right column, which will be used to inform policy development.

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5.2 Key findings and implications for policy development and implementation

5.2.1 Policies regarding the management of biodiversity – international

Table 7: International Policy Review

Strongly conflicting	Mildly conflicting	Neutral	Mildly complementary	Strongly complementary
-2	-1	0	+1	+2

Policy / Goal	Sectors affected	Potential impact on endangered species management	Perceived nature of impact	Potential impacts on the wider economy	Lessons for policy development to neutralise conflicts and enhance complementarities
Convention on International Trade in Endangered Species of Wild Flora and Fauna [CITES]	Agriculture and (MoA) horticulture, Tourism (MEWT) Hunting industry (BWMA)	Contains provisions and controls for the trading of species with the aim of protecting endangered species	+2	• Increases the value and exclusivity of legitimate trophy hunting • Increases value of ecotourism • May increase the amount of illegal trade of these species • May positively affect tourism if these endangered species are protected and therefore increase employment levels and income in this sector	The Endangered Species Policy should be aligned with the Convention: List of relevant species should be compared to the Convention's list. Protection may perversely increase incentive for illegal hunting and trade in endangered species; Enforcement must be adequate and supported by education. Value created through legitimate hunting should be equitably distributed to those who would otherwise profit through illegal activities.

Policy / Goal	Sectors affected	Potential impact on endangered species management	Perceived nature of impact	Potential impacts on the wider economy	Lessons for policy development to neutralise conflicts and enhance complementarities
National Policy on Natural Resources Conservation and Development	All ministries	Increasing effectiveness of natural resources use and management to maximise the benefits and minimise undesirable side effects. The emphasis on the sustainable conservation of biodiversity for economic development is threaded through all the national legislation related to biodiversity that has followed. Diversification of rural economy may impact on ecosystems and the management of endangered species Improvement of rural livelihoods through more equitable sharing of natural resources.	+2	• Diversification of the rural economy in a manner that conserves natural resources should lead to sustainable employment growth and equitable resource sharing • Development of multiple purpose natural resource users, exploiting the maximum value of natural resources and increased education of communities over the value of natural resources should lead to greater awareness of the importance and value of conservation • The prolonging of Botswana's natural resources will promote tourism and impact positively on GDP • Conflicts exist between conservation and sustainable harvesting of natural resources and the development agenda – compliance with the principles of this policy may reduce diversification opportunities in mining, energy and transport and lead to perceptions that conservation prevents employment growth	Although not focused on endangered species, specifically, the policy addresses the challenge of development in a sustainable and cautious manner that does not impact negatively on biodiversity and the ability of natural resources to regenerate. This challenge is relevant to the management of endangered species and should be similarly addressed in the future policy. Maximisation of value creation and recognition are critical to the proper protection and management of endangered species: • Value creation = identification of innovative, diversified products harvested from the environment in a sustainable manner for the benefit of society/ communities • Value recognition = education and communication; adequate and equitable rewards

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Policy / Goal	Sectors affected	Potential impact on endangered species management	Perceived nature of impact	Potential impacts on the wider economy	Lessons for policy development to neutralise conflicts and enhance complementarities
National Biodiversity Strategy and Action Plan (BSAP)	All sectors including manufacture, minerals, transport, agriculture	Details a strategy for the protection of eco-systems and sustainable and wise use of resources to improve biodiversity. BSAP identified the major threat to biodiversity as habitat destruction and reduction, caused by a variety of factors ranging from direct destruction through construction of houses, roads and other infrastructure, to damage caused by pollution, unsustainable land and resource use, including unsustainable rangeland management (localised overgrazing and bush encroachment), over harvesting and excessive water abstraction. The	+2	• Will negatively affect the agricultural sector by likely reducing the amount of land that can be used for farming • Policy for reduced levels of pollution will negatively affect the manufacturing sector by increasing cost of compliance. Output will likely be reduced, or in the extreme, factories or companies may relocate to places with less pollution controls. This may negatively affect employment in the sector, as well as GDP • Regulations regarding pollution may also affect the construction sector in terms of waste disposal. This may reduce employment in the sector. • Tourism would benefit from the better management of biodiversity and protection of ecosystems. • Will impact positively on environmental threats related to global climate change	The policy should take account of the major threats and strategies identified in the BSAP and ensure that key conflicts are addressed in the overarching approach to endangered species management: • Need to use ecosystems approach • Evaluate extent to which strategies identified to mitigate habitat destruction address endangered species protection • Examine the adequacy of protected areas against the location of ecosystems in which endangered species thrive • Consider the concept of migratory routes in the overall management approach • Assess need for conflict resolution mechanisms to facilitate equitable decision-making where there are conflicts between ecosystem protection and the interests of other sectors.

Policy / Goal	Sectors affected	Potential impact on endangered species management	Perceived nature of impact	Potential impacts on the wider economy	Lessons for policy development to neutralise conflicts and enhance complementarities
		effects of global warming also are likely to be significant. BSAP recommends an ecosystems approach and species and genetic conservation measures. Other issues identified include a need to review the adequacy of the protected areas network. BSAP also notes that it also is critical to make sure that the network includes migratory routes and that the areas set aside for conservation are large enough to support genetic diversity and evolutionary processes.			

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Policy / Goal	Sectors affected	Potential impact on endangered species management	Perceived nature of impact	Potential impacts on the wider economy	Lessons for policy development to neutralise conflicts and enhance complementarities
Protocol on Wildlife Conservation and Law Enforcement in the Southern African Development Community	Agriculture, tourism Hunting industry	Regional commitment from SADC countries to ensure conservation and sustainable use of wildlife. Consistency in legal instruments encourages cross-border cooperation on enforcement, a key building block for the establishment of trans-frontier conservation areas. Supports the protection of endangered species in ecosystems that stretch across national borders.	+1	Potential impacts include: • Harmonisation of regulations for the hunting industry • Promotion of tourism through better wildlife conservation [What is the problem though – does the protocol specify standards? Does it apply to all lands including non-protected areas?] • Will promote ecosystem sustainability including ecosystem services through transboundary conservation cooperation	This Protocol highlights the need for cross border cooperation and harmonisation of standards over the protection of endangered species, which is consistent with the ecosystem approach to habitat protection. It also reduces the risk of 'leakage' – the shifting of hunting/poaching from high regulation/enforcement areas to more lax environments.

Policy / Goal	Sectors affected	Potential impact on endangered species management	Perceived nature of impact	Potential impacts on the wider economy	Lessons for policy development to neutralise conflicts and enhance complementarities
African Convention on the Conservation of Nature and Natural Resources	All sectors	Enhance environmental protection, foster conservation and sustainable use of natural resources, harmonise and coordinate policies between members of the African Union. Specific action with regard to land and soil, water, vegetation cover, animal and plant species and genetic diversity, protected animal and plant species, trade in animal or plant or micro organism, whether alive or dead, conservation areas, mitigation and elimination of detrimental effects on the environment and sustainable development are set out.	+2	Potential impacts and conflicts include: Development that does not have detrimental effects on flora and fauna. What level of mitigation of environmental impacts is sufficient to allow development to proceed? How do we weigh up the benefits of development with the degradation of the environment? (EIA policy?) • Elimination of toxic substances may negatively affect GDP and employment if factories change their production techniques or amount that they produce, or close down or relocate.	The Policy would need to reflect on the following: • The definition for 'threatened species', which includes critically endangered, endangered and vulnerable, which are different to the definitions used in Botswana legislation • The reasonableness of trade offs between development and environmental protection is harder to evaluate when the benefits of the former tend to be more tangible. How can the Policy allow the intangible benefits of conservation to be better recognised and appreciated? • Where there are regulations in place to manage pollution and waste which threaten ecosystems, how consistent are consent limits with tolerance and sensitivity levels of habitats? • Are the species consequences of non-enforcement of existing policies and regulations understood?

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Policy / Goal	Sectors affected	Potential impact on endangered species management	Perceived nature of impact	Potential impacts on the wider economy	Lessons for policy development to neutralise conflicts and enhance complementarities
1971 Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention)	Tourism, agriculture, fisheries, water (MEWT)	Promote the conservation of wetlands as well as the wise use of wetlands. The Ramsar Convention requires Botswana to develop an integrated management plan for the Okavango Delta to guide and regulate all activities taking place within the Delta. Such a plan should take account of endangered species.	+2	Potential impacts include the following: • Will impact positively on the tourism sector and may have impacts on land use and possibly agriculture, especially in areas of the delta that are outside protected areas. • May impact on activities that take place adjoining the Ramsar site • Will positively impact sustainability of ecosystem services in particular potable water (cf. Okavango delta)	With regard to species, the Okavango Delta system is important for terrestrial and water bird species with 650 birds species identified. Two resident species, the Wattled Crane (*Burgeranus carunculatus*) and the Slaty Egret (*Egretta vinaceiqula*), are globally threatened. The Delta contains high densities of large mammal species particularly elephant. It is also the habitat of one of the largest remaining populations of the African wild dog (*Lycaon pictus*) and is a stronghold for the sitatunga (*Tragelaphus spekii*) and the Nile crocodile (*Crocodilus niloticus*). There is a high floral diversity with 208 aquatic and semi-aquatic species, 675 herbs and grasses and 195 woody species. Therefore, the ODMP should be scrutinized for learning points in the development of the Policy.

5.2.2 Policies regarding the management of biodiversity – national

Table 8: National Policy Review

Policy / Goal	Sectors affected	Potential impact on endangered species management	Perceived nature of impact	Potential impacts on the wider economy	Lessons for policy development to neutralise conflicts and enhance complementarities
Tribal Land Act (amended)	Agriculture, (MOA) tourism, veldt products, (ME&AT) Hunting (BWMA)	Act provides for the establishment and operation of the Land Boards which are tasked with imposing restrictions on tribal land use. Act also ensures that land use is consistent with the land use zones. District Land Boards are responsible for zoning of land and the development of management plans. It therefore has a significant potential to impact species and ecosystems outside Wildlife Management Areas (WMAs).	0	These include the following: • Land is typically used for grazing, hunting and harvesting of veldt products, which are the major sources of employment and income for the rural economy. Any restrictions on these activities impact significantly on rural livelihoods of communities. • As it governs the distribution of tribal land, it may impact on the agricultural sector, as well as the tourism sector. • Can have a positive impact on environment and wildlife conservation. ALL WMA's are on Tribal Land and so is the Okavango Delta.	To the extent that WMAs may not fully overlap ecosystems in which endangered species thrive, the Policy should evaluate the ability of the Land Board to incorporate endangered species considerations and management requirements into its decision-making on zoning as well as the conditions for land grants and monitoring thereof.

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Policy / Goal	Sectors affected	Potential impact on endangered species management	Perceived nature of impact	Potential impacts on the wider economy	Lessons for policy development to neutralise conflicts and enhance complementarities
Wildlife Conservation Policy of 1986	Agriculture (MoA) Tourism and wildlife management (DWMP) Hunting industry	Policy provides a framework for the conservation and sustainable utilisation of wildlife, and incorporates the establishment of National Parks and WMAs The objective is to realise the full potential of wildlife resources e.g., through the development of a commercial wildlife industry. A commercial wildlife industry, which allows communities to derive benefit from the production of game meat, may deter subsistence or commercial poaching.	+2	• The promotion of commercial wildlife products will create economic opportunities, employment and incomes – There is a focus on the exploitation of natural resources for the benefit of citizens. • Positive impact on tourism, both economically and in terms of species management and conservation.	Again, there is a strong link between conservation and realisation of wildlife value for the economy and communities. The emphasis is on sustainable development opportunities that support wildlife conservation. The Policy should consider: • Mechanisms for assessing the effectiveness of the wildlife conservation policy (and others) in addressing the risks to endangered species • The need for evaluations on the negative impacts to ecosystems of the commercial wildlife industry, and recommendations on mitigation approaches.

Policy / Goal	Sectors affected	Potential impact on endangered species management	Perceived nature of impact	Potential impacts on the wider economy	Lessons for policy development to neutralise conflicts and enhance complementarities
Wildlife Conservation and National Parks Act of 1992	Tourism Agriculture- in particular livestock industry Hunting industry	Regulation of hunting and also damage-causing animals. Creation and regulation of game reserves and sanctuaries. Act provides for the establishment and management of Wildlife management areas. The Act provides for the categorisation of species and issuance of licence, and damage-causing animals – all significant aspects of species management. Part IV of the Act addresses the fencing of game ranches, hunting, and management of dangerous animals.	+2	• WMAs restrict access by some non-community sectors to natural resources and minerals. Competition for land gives rise to conflicts between protection of wildlife and economic development. • Positive for tourism. • Enables legitimate hunting industry in WMAs and CHAs. • Supports the development of game ranching. • Sets rules for the killing of damage-causing animals and predators for the prime reason of protecting property/livestock or human life. Human-Animal conflicts have to be minimised following guidelines.	Questions that need to be addressed and considered for incorporation into the Policy include: • How aligned are species categorisation and licensing approaches with the specific management needs of endangered species? • How does the DWNP allocate hunting quotas within CHAs? How are they consistent with the protection needs? How is this system vulnerable to mis-reporting by hunters? • The right to hunt is granted to citizens who can use these rights for hunting or meat production, or to sell on to non-citizens. Does this 'secondary market' in hunting adversely impact species management? • How does full or partial fencing of game ranches contribute to habitat fragmentation?

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Policy / Goal	Sectors affected	Potential impact on endangered species management	Perceived nature of impact	Potential impacts on the wider economy	Lessons for policy development to neutralise conflicts and enhance complementarities
Predator management strategy 2005	Agriculture	Strategy outlines measures for resolving predator-livestock conflicts, with the aim of avoiding the killing of large numbers of lions, leopards, cheetahs, wild dogs and hyenas.	+2	• The aim is to allow agriculture to thrive without resorting to killing wildlife. Impacts are therefore believed to be mainly positive for livestock agriculture. • Protection of endangered species impacts positively on tourism	The management goals and strategy provide relevant approaches that should be considered for inclusion into the Policy at a high level.
Fish Protection Act of 1975	Agriculture	Regulates fishing and protects fish, including: regulations for determining the times and seasons at which the taking of any species of fish shall commence and cease; issuing of licences and certificates authorising persons to take any fish	+2	• No significant impacts identified. • Enhances sustainable use of aquatic ecosystem, which benefits tourism, sustainable utilization of fish and thus rural livelihoods of some local communities.	How are hunting and fishing seasons determined and consistent with the management strategies of endangered species? Ditto above

Policy / Goal	Sectors affected	Potential impact on endangered species management	Perceived nature of impact	Potential impacts on the wider economy	Lessons for policy development to neutralise conflicts and enhance complementarities
Elephant Management Plan for Botswana	Agriculture and Tourism	Plan optimises the socio-economic benefits from use of elephants, protects elephants through legislation and law enforcement and aims to reduce human-elephant conflict. Habitats threatened by elephants will be better protected.	+1	• A positive impact on economy will be via tourism linked job creation initiatives in local communities. • Also benefits to local communities due to reduced animal conflict, and also alternatives in rural livelihoods through sustainable utilization. • Supports agriculture, through introducing elephant-free areas and physical barriers, and reducing human/anima conflict.	Value creation and recognition are key pillars of the plan – ensuring that communities benefit from elephants through tourism, hunting or sale of elephant parts. Principles applied may be useful for consideration of the Policy: • Least risk option • Adaptive – management activities learn from past lessons • Options must be feasible, practical, economic and aesthetically acceptable.

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Policy / Goal	Sectors affected	Potential impact on endangered species management	Perceived nature of impact	Potential impacts on the wider economy	Lessons for policy development to neutralise conflicts and enhance complementarities
Crocodile Policy and Management Plan	Tourism	Regulates sport hunting of crocodiles and other commercial uses of crocodile in Botswana. Control of export of live crocodiles especially breeding females, as well as egg collecting	+2	• The plan encourages the consumptive and non-consumptive exploitation of crocodiles for the economic benefit of Botswana. • Maintenance of biodiversity of a species that has an important niche in the Okavango ecosystem	Aspects of the Policy and Plan for consideration in the Endangered Species policy: • Monitoring and research on crocodile populations • Protected area for breeding of crocodiles, now locally threatened • Sporting and hunting quotas • Problem animal procedures and responsible bodies • Commercial use of ranched and wild stocks • Relevance of conventions and other policies (e.g., CITES).

Policy / Goal	Sectors affected	Potential impact on endangered species management	Perceived nature of impact	Potential impacts on the wider economy	Lessons for policy development to neutralise conflicts and enhance complementarities
National Policy on Agricultural Development (government paper No. 1 or 1991)	Agriculture Tourism Hunting industry	The policy aims to improve the sector's contribution to the economy in general and the rural population, in particular. Recommends the fencing of grazing land to improve livestock management and try to correct the problem of overgrazing and degradation of land. Expansion of agriculture will result in habitat change and fragmentation – through the building of fences. However, conservation, responsible use and rehabilitation of forest and range resources will be encouraged.	-2	• Should improve the Agricultural sector's contribution to the economy • The fencing of grazing land to improve livestock management and lessen the problem of overgrazing should improve on the quality of the land, nut past experiences from the Hainaveld and other fenced farmlands do not suggest it will. • Fenced farms in Tribal Grazing Lands and WMA's will negatively impact the movement of larger herbivores, and thus the carnivores dependent on them. • Wildlife deaths on fences will negatively impact wildlife populations across the board	Guidelines provide for the zoning and allocation of livestock grazing land. The Ministry of Agriculture will develop land use maps based on soil mapping studies to ensure efficient use of land and propose land use plans. The Policy should consider how the basis for assessing efficient land use could take account of presence wildlife and endangered species. The Policy should also reflect on the possible conflict between fencing to rehabilitate land suffering from overgrazing and the impact on wildlife from habitat fragmentation. The policy should reflect sensitive areas for endangered species where fenced farms should not be permitted.
Agricultural	Agriculture	Aims to regulate the	+2	• Impact on agricultural sector,	The Agricultural Resources Board

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Policy / Goal	Sectors affected	Potential impact on endangered species management	Perceived nature of impact	Potential impacts on the wider economy	Lessons for policy development to neutralise conflicts and enhance complementarities
Resources (Conservation) Act		conservation of the country's agricultural resources. Regulations cover: the setting on, clearing or destruction of vegetation and its protection against fire, the afforestation and reforestation of land, the protection of catchment areas, and the fencing of land	-2	protection of agricultural resources may affect commercial and subsistence farmers. • Act seems to be lacking teeth – how can a Forestry reserve be de-gazetted for sugar cane plantations?	(ARB) has no power in national parks but does have power in all other land. To what extent can and should the Policy inform decisions by the ARB over land changes – e.g., afforestation or reforestation and commercial farming – land clearing and fencing. Given that there could be significant implications for ecosystems and wildlife, the purpose of the Policy should be to facilitate informed decision-making.
Natural Resources Protection (Model) By laws 1992		Regulates the removal of natural resources within their jurisdiction	0	• Positive on Tourism sector • Supports legitimate CBNRM	How are these regulations enforced, monitored and assessed for effectiveness?

Policy / Goal	Sectors affected	Potential impact on endangered species management	Perceived nature of impact	Potential impacts on the wider economy	Lessons for policy development to neutralise conflicts and enhance complementarities
Forest Act 23 of 1968 (amended)		Allows for the declaration of forest reserves on State land, local authority land and tribal land Protects certain types of trees and their fruit where applicable.	+1	Impacts on land competition with other sectors, namely agriculture. • Conservation and increase in forests will have numerous positive impacts on biodiversity and endangered species conservation. • Conservation and increase in forests will have future positive impacts on climate change in future • Conservation and increase in forests will have a positive impact on rural livelihoods	Issues to consider include: • What are the conservation, biodiversity and wildlife protection arguments supporting the gazetting of forests? To what extent does land use change impact adjoining ecosystems? • What are the implications on water use and change in ecosystems? • To what extent can forests reserves be re-zoned? What are the implications of this on biodiversity and wildlife? How should these considerations be taken into account in decision-making?
Herbage Preservation (Prevention of Fires) Act of 1977	Agriculture Tourism and wildlife hunting	Prohibits the setting of fires on certain vegetation. Fires are known to be a major threat to habitat destruction and loss of species, particularly birds.	+1	• Fires have been identified as a major threat to endangered species. • Therefore they are also a threat to biodiversity • And cause habitat loss and loss of grazing that impacts on biodiversity and rural livelihoods • Probably the hunting industry is the only sector to benefit	How should the Policy inform the basis for permission being granted to set fire to land? What mechanisms should be in place to protect wildlife from the threat of fires?

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Policy / Goal	Sectors affected	Potential impact on endangered species management	Perceived nature of impact	Potential impacts on the wider economy	Lessons for policy development to neutralise conflicts and enhance complementarities
Game Ranching Policy	Agriculture Tourism and wildlife	Aimed at developing a game ranching industry that will provide a commercially viable and sustainable alternative for livestock enterprises either on its own or in mixed livestock/game ranches	+1	• Promotion of game and livestock farming on ranches may increase employment • However, this land use may be in conflict with agricultural policy as land previously used for farming (including subsistence farming) may now be used for ranches • The aim to increase economic returns will increase GDP • Joint ventures with foreign investors will be positive for GDP • Provision of training and the dissemination of data will be positive for all future policy in this regard • Since the private sector will be the main driving force, wealth may be concentrated in a small minority of the population.	To what extent does Game Ranching support the management of endangered species? The Policy will need to consider any negative impacts and seek to neutralise these. Examples of this would be the impact of fenced game farms in ecosystems important to some endangered species, since fences have the same negative impact, regardless if the farm is for cattle or for wildlife. Will have a negative impact on most large carnivores, as game farmers generally do not tolerate them due to loss of their wildlife stock. Captive Breeding on Game ranches can make a contribution to endangered species recovery (eg rhinos).

Policy / Goal	Sectors affected	Potential impact on endangered species management	Perceived nature of impact	Potential impacts on the wider economy	Lessons for policy development to neutralise conflicts and enhance complementarities
Diseases of Animals Act	All sectors, especially Agriculture	The Act allows Minister to declare diseases. The Director of Veterinary Services may declare areas to be infected areas of declared diseases, alter the limits of such an area, and prohibit the movement into or out of such an area of any animal carcass, litter, dung, fodder. The Minister may declare stock free zones, establish quarantine stations, and erect fences on any land for controlling disease. The positive impact is that it prevents the spread of disease to wildlife species. The negative impact is that the construction of vet fences prohibits the free movement of species and divides their habitat into segments that may negatively effect them.	0	• Benefits agriculture by controlling the spread of disease.	The positive impact is that it prevents the spread of disease to wildlife species. The negative impact is that the construction of vet fences prohibits the free movement of species and divides their habitat into segments that may negatively effect them. There should be a review of the placement of vet fences so that they do not impair the free movement of wild animals.

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Policy / Goal	Sectors affected	Potential impact on endangered species management	Perceived nature of impact	Potential impacts on the wider economy	Lessons for policy development to neutralise conflicts and enhance complementarities
Community Based Natural Resources Management	All sectors	The Act allows communities to establish a Trust representing the community; once a community-based organization is authorized, it may decide how best to use the quota to benefit the community, either by undertaking joint ventures with sport hunting, photographic tourism, or schemes to produce meat for the community.	+2	• The CBNRM funnels wildlife profits directly to the community.	By allowing the community to benefit from the wildlife (flora and fauna) resource, the community understands the value of the resource and will work to protect it and use it sustainably.

5.2.3 Millennium Development Goals

Table 9: Millennium Development Goals

Policy / Goal	Sectors affected	Potential impact on endangered species management	Perceived nature of impact	Potential impacts on the wider economy	Lessons for policy development to neutralise conflicts and enhance complementarities
Eradicate extreme poverty and hunger	All sectors	May make the management of endangered species more difficult		Poverty levels may be negatively affected by endangered species management as well as land use management. Many people in Botswana rely on subsistence farming for employment and livelihood, if this is lessened to make way for more veldt for wildlife, this will negatively affect poverty as well as hunger. Any policy which reduces employment will also increase poverty and hunger. Any impact on the mining and agricultural sectors especially will negatively impact poverty and hunger.	This is the key perceived conflict that needs to be managed. Consistent with other strategies and policies identified above, the management of endangered species has to be designed in a way that provides greater opportunities for employment and income to local communities. It should also seek to complement/ widen access to food.
Achieve universal primary education	All sectors	May help in educating the nation on endangered species management		The education of the population of Botswana may help in informing the nation of endangered species management. A more educated nation may be able to better preserve the country's natural resources, as well as perhaps better understanding of wildlife migratory patterns. An important goal of Vision 2016.	Education and communication of the value of endangered species/wildlife have been identified as critical to gaining buy-in from communities and other sector supporters over the Policy.

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Policy / Goal	Sectors affected	Potential impact on endangered species management	Perceived nature of impact	Potential impacts on the wider economy	Lessons for policy development to neutralise conflicts and enhance complementarities
Promote gender equality and empower women	All sectors	Women an important part of rural livelihoods. Also in education and healthcare of nations youth		Promotion of CBNRM would provide more opportunities to women in rural communities for income creation and employment.	As for universal primary education above.
Reduce child mortality		None other than impact on human population size. Note that other significant pressures on the environment from humans are coming from large movements of people from Zimbabwe into Botswana.		Reduced child mortality will increase the population size. This may impact negatively on the environment. Increased population size has various other impacts including consumption levels, saving levels etc. However, reduced child mortality should be the by-product of education, which is positive for the environment. Also, the increase in population size should be more than offset by the move by rural population into urban areas.	Human-animal conflicts and competition for land have been discussed above. The Policy should address these challenges.
Improve maternal health		None other than impact on human population size		Improved maternal health may reduce infant mortality which would increase population size. This could impact negatively on the environment. However, improved maternal health will most likely be through improved education which could be positive for the environment.	As above

Policy / Goal	Sectors affected	Potential impact on endangered species management	Perceived nature of impact	Potential impacts on the wider economy	Lessons for policy development to neutralise conflicts and enhance complementarities
Combat HIV/Aids, Malaria and other diseases		Disease control in general may have negative impacts on wildlife and habitats, but a stable society is less likely to need to take natural resources in an unsustainable way.		Reduced mortality, increased productivity.	Disease control – both human and animal – may have impacts on habitats. To what extent should the Policy address these risks?
Ensure environmental sustainability	All sectors	Positive impact on the environment as well as on wildlife		Management of other sectors in a manner that does not result in long term environmental degradation may lead to shorter term restrictions on development.	Integrate the sustainability principle and goal into the Principle.
Develop a global partnership for development	All	Development may contribute to habitat destruction, but also enable better awareness and ability to manage risks e.g. Climate Change		Growth across all sectors	Examine the extent to which sustainable development could be incorporated as a key principle of the Policy Incorporate the principles and goals of CBNRM into the Policy Assess the role of Public-Private Partnerships in the implementation of the Policy

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5.2.4 Relevant 2016, SADC and NDP Goals

Table 10: Vision 2016, SADC and NDP Goals Review

Relevant 2016, SADC and NDP aims	Relevance to Policy development
Botswana will be an educated and informed nation	Education and being informed about the value of wildlife and conservation will facilitate implementation of the Policy
Botswana will be a prosperous, productive and innovative nation	Prosperity is not, and should not be seen to be at odds with the Policy. The Policy should explicitly make the link to the diversified growth agenda
Botswana will be a compassionate and caring nation	A compassionate and caring nation supports protection measures over natural assets and wildlife
Botswana will be a safe and secure nation	Security depends to some extent on adequate enforcement of laws to protect life and property, including natural assets
To accelerate economic growth with greater equity and self-reliance	NDP 9 recommends diversification and support of other sectors. Growth threatens ecosystems and checks and balances are required to ensure it is achieved in an equitable manner, which requires a good understanding of potential negative impacts on biodiversity and endangered species
To improve the health, income and living conditions of the poor majority	There is a role for the sustainable utilisation of natural resources to benefit the poor rural population
To ensure equitable and sustainable use of the environment and natural resources for the benefit of present and future generations	Fundamental principle on which the Policy should be framed

5.3 Summary of findings and conclusions

5.3.1 High level observations

The policy review identified significant positive complementarities between International and National conventions and policies:

- There is a patchwork of policy instruments that address conservation, biodiversity and wildlife. Endangered species are specifically referred to in CITES and the BSAP. Principles relevant to endangered species include:
    - The use of the ecosystems approach and the identification of threats to habitats (BSAP);
    - Maximising benefits to communities through sustainable harvesting of natural resources (National Policy on Natural resources Conservation and Development);
- Management plans at an ecosystems (ODMP) and species level (predator, crocodiles and elephant) have also been developed, which outline principles and guidance that would be relevant to the development of an Endangered Species Policy.

Areas of perceived conflicts with the proposed Policy or gaps stem from the challenge of encouraging human development while at the same time ensuring conservation of natural resources. Given the national imperative to diversify of the economy, create employment and eradicate poverty, there will be increasing pressures placed on ecosystems through land use changes, extraction of scarce resources such as water and pollution. Potential conflict areas include:

- Fence policies for game ranches and agriculture;
- Rezoning of WMAs and forest reserves to enable commercial activities;
- Hunting regulations.

5.3.2 Key themes

Areas of alignment and conflict are analyzed below according to key themes, which will be assessed against international best practice in Section 8 later. These themes are discussed below:

Value creation and recognition

CBNRM must be used to identify opportunities for rural communities to benefit from the protection and sustainable harvesting of flora and fauna. The protection of biodiversity, which gives rise to intangible long term benefits to society needs to be felt more immediately and tangibly through policies and regulations.

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Public-Private Partnerships (PPP) opportunities should be explored to pool together the resources and expertise of the public and private sector to enable value to be created and recognized.

Education and communication approaches should be reviewed and strengthened with regards to the value of conservation.

Secondary effects:

The review carried out above should be validated through further research. In particular:

- The basis for environmental, land zoning and hunting regulations should be evaluated to assess the extent to which they facilitate or hinder habitat and species protection. How are consent limits determined? Are these sufficiently low to limit damage to ecosystems? How do hunting quotas and seasons enable species to thrive?

- Measures put in place to manage other environmental issues (e.g., overgrazing and soil erosion) and sectors (e.g., agricultural fences and game farms) have implications for habitats and species survival. These secondary effects have been highlighted in the above review, and although the Policy will be developed to address these issues, it will lead to a recommended action for retrospective reviews of other policies believed to have potential negative impacts on endangered species.

Informed decision-making over land use changes

The review identified a need to carry out further investigation into the basis for decision-making:

- How are protected areas determined and to what extent do they enable species survival within important ecosystems and through migratory channels?

- How does the process of de-zoning protected areas for commercial activities assess impacts on immediate and adjacent ecosystems and species?

Conflict resolution

Conflict between protection of species and human activity/development should be avoided through adequate HWC policies and implementation mechanisms. Where there is conflict, the real and potential value of conservation should be clearly understood and factored into decision-making. The Policy should recommend a conflict resolution mechanism to facilitate equitable outcome.

Monitoring and evaluation

Monitoring and evaluation is applicable to the implementation strategy for the Policy. It should also be a recommendation with regards to current policies and regulations. There needs to be reviews conducted over the impacts, both positive and negative, of current measures developed to conserve natural resources and biodiversity as well as promote commercial activities.

6 Stakeholder Engagement

6.1 Overview

Stakeholder engagement is a critical aspect of consultation with civil society and government officials, and as a principle it is highlighted in Botswana's Vision 2016 which states "The Vision will have widest possible consultation or "therisanyo". Citizens need to identify with goals to implement strategies that can meet them." As well as consultation and information gathering, proper stakeholder engagement instils confidence and trust among its stakeholders and creates a roadmap to practical and effective courses of action and is fundamental to the success of the project.

In keeping with Botswana's democratic principles, and in keeping with Vision 2016 and the Ecosystem Approach, proper stakeholder consultation is an integral part of this project and is guided by a Stakeholder Engagement Plan. Continual stakeholder engagement, both during the project and during the implementation phase, will produce a number of benefits including:

- Promote awareness and value of biodiversity conservation and its contribution to national GDP and livelihoods;
- Enhance current knowledge through sharing of ideas and information between sectors;
- Promote discussion and debate, and in so doing, enhancing capacity and knowledge sharing; and
- Build trust amongst stakeholders and government and gaining buy-in for the resultant strategy, policy and action plan.

The project time scale is short and it is not possible to meet with all stakeholders. Consequently the stakeholders have been prioritized, and divided into categories according to their expertise or operational area such as biodiversity experts, private sector representatives, policy and economic experts, and government officials. The backbone of communicating deliverables and obtaining feedback from stakeholders are biodiversity expert meetings, the start up workshop and the two National Consultative Conferences. Results and comments from the first National Consultative Conference are incorporated into the review report.

The Project team believes that stakeholder consultation is a vital part of the process of developing an endangered species management policy. However, due to the severe time restrictions of this study, it is likely that certain stakeholders may not be available at the times chosen for the National Stakeholder Consultation Conferences. Where meetings or attendance at conferences are not possible, stakeholders were communicated with individually, in person or by phone or email.

The stakeholders were divided into their expertise groups and listed with the planned from of engagement. When not possible to meet with stakeholder individually either due

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to their busy schedules or physical location, they were communicated with by telephone and email.

The Stakeholder Engagement Plan for the project, which lists the key stakeholders the project team planned to engage with, is attached as Annexure C. However the broad points raised during the Biodiversity Expert Workshop, Start-up Workshop and various individual interviews are aggregated here. As would be expected the participants of the biodiversity workshop had a focus that was more management and specific threat oriented. This is in line with their daily experience and their concern over specific species. This was complimented by the start up workshop which was attended largely by government officials, education officers and industry representatives. Consequently the issues raised were at a broader national and strategic level. The insights raised at workshops were investigated further by individual interviews which allowed the luxury of probing questions.

The issues raised can be divided into a few broad themes:

- Policy Development
- Policy Implementation
- Recommendations for Action Plans

6.2 Specific feedback

6.2.1 Policy development

Table 11: Stakeholder Recommendations/Concerns for Policy Development

Issues Raised	Biodiversity Workshop	Start Up Workshop	Individual Consultation
The high cost low volume approach used uniformly in Botswana is not always appropriate. Some less sensitive areas could be low cost high volume.	✓		✓✓
The lists of species are inadequate and do not include smaller less popular species.	✓	✓	✓
The impact of neighboring countries can be significant in both a positive and negative manner. Trans-boundary issues should be considered.	✓	✓	✓
The policy should be incorporated with the other policy goals of Botswana, especially poverty reduction	✓	✓	✓
Coordinate efforts from this project with the review of the conservation act and the general review of natural resource management policy		✓	
Decentralize government	✓	✓	

6.2.2 Policy implementation

Table 12: Stakeholder Recommendations/Concerns for Policy Implementation

Issues Raised	Biodiversity Workshop	Start Up Workshop	Individual Consultation
Lack of implementation of a wide range of policies	✓	✓	✓
Lack of adequate resources in government departments	✓	✓	
Government department budgets are not being spent	✓	✓	
Lack of capacity within government to cope with the complex issues surrounding natural resource management	✓		✓
Lack of cooperation between departments	✓	✓	✓
Guidance must be provided to translate higher level policy into more easily understood local implementation plans		✓	✓
A system should be put into place to help executive government to fairly and transparently prioritize the intentions of the range of government policy.		✓	✓
Local communities, civil society and the private sector should be involved in policy implementation.	✓	✓	✓

6.2.3 Action plans

Table 13: Stakeholder Recommendations/Concerns for Action Plans

Issues Raised	Biodiversity Workshop	Start Up Workshop	Individual Consultation
Budgets of government departments are not allocated for the management of endangered species	✓		✓
List of endangered species is out of date	✓	✓	✓
Inadequate knowledge of ecosystem processes and certain species groups	✓		✓
Loss of habitat due to human encroachment	✓	✓	✓
• Agricultural expansion			
• Use of fire			
• Invasive alien species			
• Poaching			
• Infrastructure development (including fences and road)			
• Disease			
• Enviropiracy			
Lack of basic data (including land use, population size and dynamics)	✓	✓	✓
Insufficient resources and funds allocated to anti-poaching	✓	✓	
Environmental Impact Assessment results are not adequately included in land use change decisions.	✓	✓	
The trade of endangered species and the fact that to a degree this is encouraged by tourism.		✓	

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6.3 Principles and solutions

6.3.1 Lack of data and research

The greatest concern raised by people responsible for the management of endangered species, present at the Biodiversity Expert Workshop, was a lack of data about and understanding of ecosystems and threats relating to endangered species. This data is essential for the planning and implementation of interventions. Unfortunately, gathering of this kind of data and conducting research on ecosystem processes is a long-term process.

What then are the implications for the development of an endangered species management policy? Obviously one cannot wait as key species may be lost or their populations critically reduced in the interim. The stakeholders suggested a number of solutions:

- Start mitigation based on population trends.
- Population trends should be established by stakeholder communication with local biodiversity experts as well as local populations who have been living in the area for long periods. While this may be based on a "gut-feel" approach many species will be identified that would be confirmed by more detailed studies. This is also inline with the precautionary approach.
- Concurrently run research programs which are coordinated by a central body that holds the data for other uses.
- A central body needs to be set up to coordinate research and data gathering and storage.

6.3.2 Inadequate species listing

Closely aligned to the lack of data and understanding of ecosystems housing endangered species is the fact that listing of endangered species in Botswana is out of date. These lists seem to have been developed using an *ad hoc* process and no specific process exists for reviewing the list. Furthermore, protection assigned to species identified is relatively limited. Specific solutions suggested by stakeholder were:

- Use objective criteria based on internationally accepted standards (IUCN) to facilitate the identification of endangered species;
- Develop objective procedures and business process flows for the identification and updating of endangered species listings;
- Assign specific rights to species based on their assigned threat level;
- The application of global criteria need to be customized for Botswana and may need to be regionally applied; and

- The committee assigned to determine the protected status of species should be multidisciplinary and informed by the IUCN process.

6.3.3 Creative multidisciplinary approach to conservation

It was noted that endangered species exist outside protected land, some of which exist on private land. Many practitioners find it difficult to gain access to private land both for management and for data acquisition. In addition the species that exist outside the formal protection of protected land will have to be protected using other creative methods. This will necessitate cooperation amongst several departments. Specific recommendations made were:

- Education will provide a fundamental feature of creative solutions to protect endangered species. For example customs and law enforcement officials should be educated to recognize endangered species helping them to prevent smuggling and enviropiracy. Awareness programs, such as the effective WWF SA "Sustainable Seas Initiative" should be run to inform local communities of an appropriate manner to interact with endangered species and to learn from their on the ground experiences.

- Developing mechanisms to facilitate the cooperation of government across different departments and ministries.

- Focus the attention of conservation bodies and natural resource managers outside protected areas using a concept aligned to Birdlife International's Important Bird Areas.

6.3.4 Poor policy implementation

Many stakeholders raised the issue that there is a solid base of policy for the management of natural resources and if they were adequately implemented, there may be no need for a specific endangered species management policy, and questions asked on how this can be answered given current constraints in management. It was generally felt that these policies are not implemented because there are two many vacancies within government departments and that the budgets are not being spent. Consequently, a critical step in the successful protection of endangered species is to ensure the adequate implementation of policy including a potential endangered species management policy. Specific solutions suggested by the stakeholders were:

- Establishment of monitoring and feedback system for departments responsible for implementation;

- Establish an incetivisation program;

- Ensure that internal government vacancies are filled; but note that training of personnel is vital for this action.

- Ensure that budgets allocated for natural resources management are spent;

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- Local communities, civil society and the private sector should be involved in policy implementation;

- Some local communities have environmental committees which are not often consulted;

- Decentralize government decision making to reduce the time it takes to authorize actions intended to manage natural resources and endangered species.

6.3.5 High poverty levels and low understanding of the value of natural resources amongst rural populations

Poverty alleviation is a critical millennium development goal that is embraced by the government of Botswana. Discussions with local economists identified that the very worst levels of poverty occur in rural populations. It is consequently unsurprising that local communities are happy to engage in unsustainable harvesting of natural resources to supply the larger markets in cities and adjacent countries. Furthermore, commercial poaching is a very viable career choice when options for employment are limited. Consequently it is essential that the economic incentives that drive unsustainable harvesting are addressed. The jobs created by the management of endangered species and the multiplier effect of tourism are essential tools in this process.

The significant economic benefits that arise out of the managing of natural resources, be it for game farming, hunting or tourism, are not understood by local communities. It is essential for government to make the link between local infrastructure development and the taxes earned from natural resource management. This will help communities understand the importance of their natural resources. To compliment this understand communities need to be educated on ecosystem processes in order to understand how they might play a role in ensuring their sustainability.

Specific solutions suggested by stakeholder were:

- Education/Information at community level around the benefit of natural resources including endangered species;

- Education/Information at community level around how they can play a role in ensuring the sustainable use of natural resources including endangered species;

- Ensure local poverty is reduced by sustainable use of natural resources;

- Ensure jobs are created by spending government budgets and staffing departments.

6.3.6 Land use zoning

The systems in place for changing a land use allocation are not clear. Many respondents felt that EIAs were being conducted as check box exercises and did not affect the decision to change a land use or not. This creates a huge amount of conflict between different stakeholder groups concerned with a specific land use change. A classic example is the

proposed use of a significant part of the Chobe Forest Reserve for a sugar cane plantation. Undoubtedly, the project has significant economic benefits but at a certain environmental cost. Specific suggestions made by stakeholder were:

- Ensure that the EIA process is transparent and conducted with a thorough regard for environmental costs both on and off site.

- Develop business process flows to and legislative checks to ensure that the land use change process includes important steps like EIA's and stakeholder engagement.

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7 Rationale for adopting the ecosystem approach

The Ecosystem Approach has been identified in the terms of reference to this project as the preferred approach in terms of implementing conservation measures in Botswana. Therefore it needs to be understood completely to be considered in the development an Endangered Species Management Policy, Action Plan and Strategy for Botswana (ToR for this project).

The Ecosystem Approach is defined as a strategy for the management of lands, water and living resources that promotes conservation and sustainable use in an equitable way. Although the Ecosystem Approach has been developed as a tool to assist in the implementation of the Convention on Biological Diversity (CBD), it can be adopted by any entity, public or private, involved in the regulation or management of the environment. Its relevance to endangered species management in Botswana is explained below.

7.1 Background

The Ecosystem Approach was endorsed as Decision V/6 by the fifth Conference of the Parties (COP-5) to the Convention on Biological Diversity (CBD) in Nairobi, Kenya in May 2000. The approach puts people and their natural resource use practises at the centre of the decision-making framework. It is therefore useful in the regulation or management of human uses of the environment, as well as for the management of areas that are protected for biodiversity and endangered species management. The Ecosystem Approach has been widely endorsed as a highly appropriate framework for delivering the objectives of the CBD. In many respects it is similar to other integrated approaches to conservation, development and natural resource management, and serves more as a means of 'codification' of previous strategies, and as a tool that can promote efforts to integrate biodiversity management into conservation practise and decision making (Smith and Maltby, 2003). The key distinguishing features of the Ecosystem Approach are:

- It is designed to balance the three CBD objectives (conservation, sustainable use and equitable benefit-sharing from the use of genetic resources).
- It puts people at the centre of biodiversity management.
- It extends biodiversity management beyond protected areas while recognising that protected areas are also vital for delivering CBD objectives.
- It engages the widest range of sectoral interests.

In endorsing the Ecosystem Approach, the parties to the CBD called for 'practical expressions of the approach in various contexts to be developed using case studies and workshops' and to 'use lessons learnt to prepare guidelines on implementation of the approach'. These two components of Decision V/6 motivated IUCN's Commission on Ecosystem Management (CEM) to work with the CBD Secretariat, and as well as the University of London, UNESCO-MAB, the Ramsar Secretariat and WWF International to co-convene three regional workshops (Southern Africa, Southeast Asia and South America) in 2000 to draw lessons, recommendations and a framework to assist in the

implementation on the Ecosystem Approach. This process resulted in the definition of 12 guiding Principles, and five points of Operational Guidance, which listed below (from Smith and Maltby 2003).

7.2 Principles of the Ecosystem Approach

The principles are as follows:

1. Objectives of management of land, water and living resources are a matter of societal choice.

2. Management should be decentralized to the lowest appropriate level.

3. Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.

4. Recognizing potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context, which should:

- Reduce those market distortions that adversely affect biological diversity;
- Align incentives to promote biodiversity conservation and sustainable use;
- Internalize costs and benefits in given ecosystem to extent feasible.

5. Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.

6. Ecosystems must be managed within the limits of their functioning.

7. The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.

8. Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long-term.

9. Management must recognize that change is inevitable.

10. The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.

11. The ecosystem approach should consider all relevant information, including scientific and indigenous and local knowledge, innovations and practices.

12. The ecosystem approach should involve all relevant sectors of society and scientific disciplines.

Points of Operational Guidance:

When applying the 12 Principles of the Ecosystem Approach, the following five points are proposed as operational guidance.

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a) Focus on the functional relationship and process within ecosystems.

b) Enhance benefit sharing.

c) Use adaptive management practices.

d) Carry out management actions at the scale appropriate for the issue being addressed, with decentralization to the lowest level, as appropriate.

e) Ensure intersectoral cooperation.

7.3 Lessons learnt from case studies

In general the IUCN workshop participants (Smith and Maltby 2003) thought that the Ecosystem Approach was not entirely new, as it has many similarities to other conservation and development strategies such as Biosphere Reserves, Ecoregions and Ramsar sites, but rather than a duplication, the development of the Ecosystem Approach was welcomed as an appropriate codification of actions and strategies that will assist in the mainstreaming of biodiversity management into development practice and decision-making. As such it was seen as holistic, flexible, socially orientated, scientifically based and respectful of different cultures. In particular the case studies demonstrated that a range of scale (from a farm to a nation) and diversity of problems that can be tackled using the biodiversity approach. There was variation in the perceived relevance of the Principles. Principle 1, 2 and 12 had the greatest overall relevance to the case studies, and Principles 3, 6, 7 and 9 the least relevant.

7.4 Application to endangered species management

Awareness and understanding: Within the activities undertaken in this project particular attention was paid to Principle 12: *The ecosystem approach should involve all relevant sectors of society and scientific disciplines'.* In this regard Botswana has approached much of its conservation policy work de facto along the lines of the Ecosystem Approach, simply because of its well rooted tradition of thorough consultation.

The principle has been applied to project inputs as well as making recommendations for outputs:

Inputs: The project team has worked to build awareness and understanding amongst the widest possible array of stakeholders by engaging diverse sectors of the economy and society to ensure a holistic framework for decision-making and action and to achieve the necessary mainstreaming into policies. Consultation needs to equally engage institutions that could be in conflict over project goals, for instance between the DWNP and the Department of Animal Health and Production over land use in areas key to endangered species survival.

Outputs: Understanding of ecosystem functioning and awareness of the importance of biodiversity is still lacking amongst most levels of society, including policy makers in sectors outside that of the environment., which is necessary if the Ecosystem Approach is to be embraced by most sectors of society, which is important if policies are to be

implemented. This is a matter of education and awareness-raising, at all levels, which will be highlighted among the actions needed during the development of a Strategy and Action Plan for Endangered Species Management in Botswana.

Equitable sharing of natural resources: An element of the Ecosystem Approach is in the key point of making people a part of, and a beneficiary for, biodiversity management, through the equitable sharing of natural resources. In Botswana progress has been made in this regard, particularly with the development of the CBNRM policy (CBNRM, MEAT Policy paper 2006), and CBNRM activities which are focused on benefit sharing of natural resources. Under Decision V/6 benefit sharing includes ecosystem services, which has yet to be quantified in Botswana CBNRM policy. Furthermore, much work through capacity building, additional incentives, and education is still needed (CBNRM Review, IUCN & Centre Applied Research 2003). The Ecosystem Approach provides a framework for action that links biological, social and economic information and aims to achieve a socially acceptable balance between economic, social and environmental considerations. By doing so it places people firmly within the context of ecosystem management. Good ecosystem management is necessary for endangered species management.

Structural and inter-sectoral issues: The Ecosystem Approach requires unprecedented cooperation between government and other administrative sectors. However, case studies identified the sectoral structure of government as a major obstacle to its implementation. While changing the structure of government is impractical in most cases, the harmonisation of policies, institutional mandates and laws to remove inconsistencies is more feasible. An example of best practises in managing inter-sectoral conflicts could be the development of agencies that cut across government sectors, as in Kenya, to implement their Environmental Management and Co-ordination Act No. 8 of 1999. The Act provides for the establishment of an appropriate legal and institutional framework for the management of the environment. Below the parent Ministry is an Environment Council, with a Board of Management of various authorities that preside over the National Environmental Management Authority (NEMA), which advises, coordinates, and implements policies relating to the environment.

7.5 Problems of the Ecosystem Approach that still need to be addressed:

- Relevance to implementation of wide-ranging environmental legislation and policy instruments need to be defined and promoted.
- Need to develop and publish more case studies as part of ES, using Clearing House Mechanism (CHM)
- Need to examine more effective integration within conservation Strategies such as National Biodiversity Strategies (NBSAP).
- Capacity building, to meet specific human, technical and institutional needs is a high priority for the use of the Ecosystem Approach.

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- The non-conservation community, such as industry, trade and finance sectors, must be engaged in the use of the Ecosystem Approach.

7.6 Lessons learnt from Botswana case studies:

As noted, many of the Principles of the Ecosystem Approach are already integrated into activities in the environmental sector. Clear gaps identified in this Endangered Species Management Project are in:

- Capacity building
- Education and awareness
- Multi-sectoral legislation and implementation.

7.7 Ecosystem Approach and the Convention on Biological Diversity (CBD):

The Ecosystem Approach is a tool to assist governments to meet their obligations under the CBD, to which Botswana has been a signatory since 1995. There are several obligations for the CBD, including the development of a National Biodiversity Strategy and Action Plan (NBSAP), which Botswana finalized in 2004. There are key steps to help implement the NBSAP which can be done using the Ecosystem Approach, if the 5 operational guidelines are followed as per: Focusing on ecosystem function whilst using adaptive management at the appropriate scale and keeping people centered by ensuring inter-sectoral cooperation and enhancing benefit sharing.

The NBSAP should then highlight priority actions for a set time period, with lead agents and targets clearly articulated.

The CBD also requires the listing of endangered species, and the identifying of critical ecosystems. Botswana will need to develop criteria for identifying ecosystems that should be listed, as well as mapping such ecosystems. While different scales for ecosystem mapping are possible, a fine-scale is needed in the case of Endangered Species Management, to map local-scale biodiversity features which highlight threatened or protected ecosystems. Such listed ecosystems should be identified as critical biodiversity areas. The habitat of endangered species should be taken into account and in this way listed as a critical biodiversity area.

SUMMARY:

The Ecosystem Approach provides an internationally accepted framework to facilitate implementation of policy principles in Botswana. The structured approach will help mitigate the problems government departments have in implementation. Furthermore the objectives of the CBD are closely aligned to those of managing endangered species; in fact one could be considered to be a subset of the other. Fundamentally it provides a process to incorporate the views and actions of a cross sector of public and private

stakeholders and focuses on the interests of people whose extrication from poverty depends on natural resources. Furthermore it recognises that ecosystem and endangered species cross the boundary of protected areas and creates mechanisms for managing endangered species wherever they occur.

It is consequently a highly relevant and useful approach to the management of endangered species and the ecosystem approach will inform the next steps in developing an endangered species policy, strategy and action plan.

Key recommendation 1: The Ecosystem Approach is a valuable tool, and a key recommendation taken forward in this study is for its use in Botswana's compliance to the CBD and the implementation of the country's BSAP. Although Botswana's BSAP clearly spells out its strategic objectives, it gives no special attention to the conservation and management of endangered species in Botswana.

Key recommendation 2: Whilst the Ecosystem Approach has been identified and followed in this study, it is also necessary for the implementation of the Endangered Species Policy, Strategy and Action Plan that the Ecosystem Approach be used as a tool and benchmark.

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8 Comparative Analysis and Best Practice of Other Endangered Species Schemes

8.1 Overview

In the African context, we found no legislation directly addressing endangered species management, with many countries basing species specific activities on existing wildlife and biodiversity legislation. Many African countries, including Botswana, have, however, subscribed to the Convention on Biological Diversity and have developed (or are in the process of developing) National Biodiversity Strategy and Action Plans, which aim to support national efforts to conserve biodiversity as a whole. An Endangered Species Management Policy would need to align closely with this Strategy and Action Plan and to enhance activities directed towards endangered species.

Below is a comparative analysis of the regulatory schemes implemented by South Africa, Australia, South Africa, and the United States for protection of threatened and endangered species. Kenya's Environmental Management and Coordination Act of 1999 requires that a list of threatened, endangered, or rare species be compiled and that agencies monitor the biodiversity but does not really have a complete program for protection of species and was not, therefore, included in this analysis. In general, the schemes for protecting species differ in some key respects:

- The American and Australian programs provide for on-going identification of threatened and endangered species with mandatory listing of such species, and then the development of a recovery plan, protection of habitat, and a prohibition on "taking" any listed species.

- The Australian plan, and to a lesser degree the American scheme, focus on identifying and reducing the key threats to the species.

- South Africa, in contrast, protects endangered species through the publication of lists of those species that are "threatened or protected" and controls on how such species may be hunted or otherwise used. The South Africa scheme is one of sustainable use of the species through the issuance of a permit system for and controls on hunting or other use. While habitat may be protected through the existence of a national park or protected area, the listing of a species as threatened or endangered does not require the protection of habitat.

Namibia protects species through a conservancy approach. The Communal Area Conservancy Programme creates communal areas that are managed and protected by local citizens who then benefit from wildlife and other natural resources. Like the South African approach, this assumes that one of the main threats to species is hunting (NACSO, 2006).

8.2 The Australian Programme

8.2.1 Australia's Environment Protection and Biodiversity Conservation Act of 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's principal piece of environment legislation. The EPBC Act protects Australia's native species and ecological communities by providing for:

- Identification and **listing** of species and ecological communities as threatened;
- Development of conservation advice and **recovery plans** for listed species and ecological communities;
- Development of a register of critical habitat;
- Recognition of **key threatening processes;**
- Where appropriate, reducing the impacts of these processes through **threat abatement plans.**

8.2.2 Species Listing

Categories of threatened species are: (1) extinct (there is no doubt that the last member of the species has died); (2) extinct in the wild (it is known to only survive in cultivation, in captivity or as a naturalized population well outside its past range, or if it has not been recorder in its known and /or expected habitat, at appropriate seasons, anywhere in its range, despite exhaustive surveys over time frame appropriate to life cycle); (3) critically endangered (is facing an extremely high risk of extinction in the wild in the immediate future); (4) endangered (is not critically endangered and is facing a high risk of extinction in the wild in the near future); (5) vulnerable (is not critically endangered or endangered and is facing a risk of extinction in the wild in the medium-term future); (6) conservation dependant (is the focus of a specific conservation programme the cessation of which would result in the species becoming vulnerable, endangered or critically endangered)

8.2.3 What happens once a species is listed: recovery plans: key threatening processes; and threat abatement plans.

8.2.3.1 Recovery plans

Key points

The Commonwealth/Australian Government Minister for the Environment and Water Resources may develop and implement recovery plans for threatened fauna, threatened flora and threatened ecological communities listed under the EPBC Act.

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Recovery plans set out the research and management actions necessary to stop the decline of, and support the recovery of, listed threatened species or threatened ecological communities. The aim of a recovery plan is to maximise the long term survival in the wild of a threatened species or ecological community.

Recovery plans should state what must be done to protect and restore important populations of threatened species and habitat, as well as how to manage and reduce threatening processes. Recovery plans achieve this aim by providing a planned and logical framework for key interest groups and responsible government agencies to coordinate their work to improve the plight of threatened species and/or ecological communities.

A recovery plan must include the most efficient and effective use of the resources that are allocated for conservation of species and ecological communities and, consistent with the principles of ecologically sustainable development, minimise any significant adverse social and economic impacts.

The recovery plan sets out the research and management actions necessary to stop the decline of, and support the recovery of, the species or community so that its chances of long-term survival in nature are maximised. In particular, the recovery plan must: (1) state the objective of the recovery plan (for example, removing the species or community from a list, or indefinite protection of existing populations of the species or community); (2) set out criteria against which achievement of the objective is to be measured (for example, a specified number and distribution of viable populations of the species or community, or the abatement of threats to the species or community); (3) specify the actions needed to satisfy the criteria; (4) identify and specify the actions needed to protect the habitats that are critical to the survival of the species or community; (5) state the estimated duration and cost of the recovery process; (6) identify: a) interests that will be affected by the plan's implementation; and b) organisations or persons who will be involved in evaluating the performance of the recovery plan; and (7) specify any major benefits to non-target species or non-target ecological communities that will be affected by the plan's implementation.

Recovery plans are normally adopted to cover a five-year period, but the period can be shorter or longer depending on the ecological requirements of the species or ecological community. At the end of this period, the plan is reviewed and may be revised

Public Participation in Making or Adopting a Recovery Plan

Public participation is a key element of a Recovery Plan. Before making a recovery plan for a listed threatened species or listed threatened ecological community, the Minister must: (1) consult with the appropriate Minister of each State and Territory in which the species or ecological community occurs; (2) consider advice from the Threatened Species Scientific Committee; (2) invite public comment on the proposed plan; and (3) consider all comments received.

8.2.3.2 Key threatening processes

Key points

The EPBC Act provides for the identification and listing of key threatening processes. A threatened process is defined as a key threatening process if it threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community (for example, predation by the European Red Fox). A process can be listed as a key threatening process if it could: (1) cause a native species or ecological community to become eligible for inclusion in a threatened list (other than the conservation dependent category); or (2) cause an already listed threatened species or threatened ecological community to become more endangered; or (3) adversely affect two or more listed threatened species or threatened ecological communities.

The assessment of a threatening process as a key threatening process is the first step to addressing the impact of a particular threat. Once a threatening process is listed under the EPBC Act, a threat abatement plan can be put into place if it is shown to be 'a feasible, effective and efficient way to abate the threatening process. The Australian Government Minister for the Environment and Water Resources may decide whether to have a threat abatement plan for a threatening process in the list of key threatening processes established under the EPBC Act. Threat abatement plans provide for the research, management, and any other actions necessary to reduce the impact of a listed key threatening process on native species and ecological communities. Implementing the plan should assist the long term survival in the wild of affected native species or ecological communities.

Nominations for listing threatening processes

Any person may nominate a threatening process for listing under the EPBC Act. An invitation to nominate is extended by the Minister each year ahead of a new assessment cycle. Nominations received during the invitation period are considered by the Threatened Species Scientific Committee for inclusion in a Proposed Priority Assessment List.

Nominations included on the Finalised Priority Assessment List are assessed by the Committee, which makes these nominations available for public and expert comment. After assessment, the Committee's advice is forwarded to the Minister, who decides whether a threatening process is eligible for listing under the EPBC Act.

Threat abatement plans

Once a threatening process is identified, a threat abatement plan is developed. Threat abatement plans establish a national framework to guide and coordinate Australia's response to key threatening processes registered under the EPBC Act. The plans identify research, management and other actions needed to ensure the long-term survival of native species and ecological communities affected by key threatening processes. The plans should be read in conjunction with their accompanying background documents which provide information on the biology, distribution, impacts and current management practices relevant to the respective threat. The Minister for the Environment and Water Resources is required to review threat abatement plans at least every five years.

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Making or adopting a threat abatement plan

Within 90 days of listing a key threatening process the Minister for the Environment and Water Resources must decide if a threat abatement plan should be made or adopted. This decision is based on whether having and implementing a plan is the most 'feasible, effective and efficient way to abate the process'. The Minister will consult the Threatened Species Scientific Committee and interested government agencies before making this decision. If a threat abatement plan is needed, one will be developed in accordance with the requirements specified in the EPBC. Having decided to have a plan, before making or adopting the plan the Minister must consult widely. Consultation includes advertising and inviting comment on the plan during a specified period.

8.3 The USA programme

8.3.1 United States' Endangered Species Act of 1973

The Endangered Species Act of 1973 (ESA) provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The U.S. Fish and Wildlife Service (FWS), an agency within the Department of the Interior, is the lead agency responsible for the implementation and oversight of the ESA. The purposes of the Act include: providing a means of conserving the ecosystems upon which endangered and threatened species depend and establishing a program for conserving those species.

8.3.2 Endangered and Threatened Species Defined

The ESA protects plants and animals that are listed by the federal government as "endangered" or "threatened." An "endangered" species is one that is "in danger of extinction" throughout all or a significant portion of its range. A "threatened" species is one that is "likely to become endangered" within the foreseeable future. The assessment of the endangered or threatened status of the species is measured using five factors: (1) impacts to the species' habitat or range; (2) overuse of the species by humans; (3) disease or predators; (4) inadequacy of existing legal protections; or (5) "other natural or man-made factors" affecting the species' continued existence. This allows the agency to identify the threatened or endangered species and the main threats to that species.

Importantly, the decision to list is made "without reference to possible economic or other impacts of such determination." It is made solely on biological grounds, without consideration of economic or other issues.

Once a species is listed as "threatened" or "endangered", there is no practical difference in how they must be handled.

The Act requires the Department of the Interior to publish lists of all species determined to be endangered or threatened, the range over which they are endangered or threatened, and their critical habitats. The Secretary must revise lists periodically to reflect recent actions and is required to review the list at least every five years to determine the need for removal or change in status.

8.3.3 Species Listing

The listing process starts either with: (1) the nomination of a species by the Fish and Wildlife Service or (2) by a petition from anyone or any agency (a petition must include information supporting the listing.) Once the FWS decides that there is substantial information that petition for listing is warranted, it undertakes a "status review" and within a year must decide to list the species, reject the proposal or petition, or give itself more time. There also are emergency procedures for listing of species. In addition, "candidate" species are species that FWS is considering listing as endangered or threatened but which are not yet the subject of a proposed rule. From time to time FWS publishes a notice in the Federal Register listing "candidate or proposed" species. Candidate species are afforded no protection under the ESA, but the Act requires the agencies to monitor the status of certain candidate taxa "to prevent their extinction while awaiting listing." Listing is mandatory if warranted. There is public comment on listing.

8.3.4 What Happens Once a Species Is Listed: Recovery Plans and Critical Habitat

Once a species is listed, the FWS must develop and implement a recovery plan for the conservation and survival of the species, unless such plans will not promote species conservation. To the maximum extent practicable, priority is given to endangered or threatened species most likely to benefit from recovery plans, especially those species in conflict with development projects or other economic activity. Plans are to include site-specific management actions, measurable criteria which, when met, would result in delisting, and estimates of time and cost for intermediate and final goals of recovery plans. Public and private agencies and institutions may be enlisted for a recovery team.

When the FWS determines that a species is "endangered" or "threatened", it is also supposed to designate the species' "critical habitat." "Critical habitat" is a specific geographic area(s) that contains features essential for the conservation of a "threatened" or "endangered" species and that requires special management and protection. Critical habitat may include an area that is not currently occupied by the species but that will be needed for its recovery. An area designated as critical habitat is not a refuge or sanctuary for the species. Listed species and their habitat are protected by the ESA whether or not they are in an area designated as critical habitat. The designation of an area as critical habitat restricts only federal activities on that land. Development can still occur in an area designated as critical habitat if the activity does not involve require any sort of federal permit or permission or activity. Only activities that involve a Federal permit, license, or funding, *and* are likely to destroy or adversely modify the area of critical habitat will be affected by the designation. If this is the case, the FWS works with the Federal agency and, where appropriate, private or other landowners to amend their project to allow it to proceed without adversely impacting the critical habitat. Thus, most Federal projects are likely to go forward, but some will be modified to minimize harm to critical habitat.

The agency must use the "best scientific data available" to designate critical habitat but the economic impact must also be considered: an area can be excluded from "critical habitat" on a cost-benefit basis, unless excluding it would "result in the extinction of the species."

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8.3.5 Prohibited Activities

Once a species is listed as threatened or endangered, the ESA makes it illegal to "take" a listed animal. "Take" is defined to include harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct and this includes significantly modifying its habitat. This prohibition applies to private parties and private land; a landowner is not allowed to harm an endangered animal or its habitat on his property. The prohibition against "take" covers fish and wildlife but not plants. It is, however, illegal to remove an endangered plant from federal land.

8.3.6 Applying the ESA to Federal Activities

Federal agencies also have an affirmative duty to ensure that their actions (including not just those activities that they carry out themselves but also any activities that they fund or approve by issuing a permit) do not jeopardize the continued existence of a listed species or result in the destruction or modification of critical habitat. Before a federal agency can issue a permit authorizing an activity, it must make a "no jeopardy" finding. To make this finding of "no jeopardy", the federal agency must consult with the FWS to ensure that the activity will not jeopardize the survival of a threatened or endangered species. This is known as consultation.

In consultation for those species with critical habitat, federal agencies must also ensure that their activities do not adversely modify critical habitat to the point that it will no longer aid in the species' recovery.

Consultation has several steps. First the agency asks the FWS whether a protected species "may be present" in the area. If so, the agency prepares a "biological assessment" to determine the impact. (A biological assessment is mandatory for federal actions that are "major construction activities.") Next FWS reviews the information and prepares a "biological opinion." If it finds the proposed action "not likely to jeopardize" the plant or animal (a "no jeopardy" opinion), it must specify the impact of any "incidental take" of the species, necessary mitigating measures, and conditions that should be imposed on the activity.

If the FWS issues a "jeopardy" opinion, it must also propose reasonable and prudent alternatives that would not violate the ESA. The applicant then has several choices. He can take the "reasonable and prudent alternative" offered by FWS. He can appeal to the Endangered Species Committee, which is expensive and time-consuming. Or he can seek judicial review in federal court.

8.3.7 Exceptions to the prohibition on "taking" a listed species.

i. **Scientific Purposes**: The FWS may permit a prohibited act for scientific purposes, for the establishment and maintenance of experimental populations, or otherwise to enhance the propagation and survival of an affected species.

ii. **Habitat Conservation Plans:** Another exception to the prohibition on "taking" endangered species is through the development of a Habitat Conservation Plan. This is a tool that allows private development to proceed even if it may result in the incidental "taking" of a listed species. To avoid the situation where private landowners conducting lawful activities on their land find themselves subject to civil

and criminal penalties for incidentally harming (or "taking") endangered or threatened wildlife, the ESA allows the issuance of an "incidental take permit" from the FWS.

To obtain a permit, the applicant must develop a Habitat Conservation Plan (HCP), designed to offset any harmful effects the proposed activity might have on the species. The purpose of the HCP is to ensure that the effects of the permitted action on listed species are adequately minimized and mitigated. Private landowners are assured that if "unforeseen circumstances" arise, the FWS will not require that the landowner put aside additional land, water, or money for compensation beyond the level agreed upon in the HCP.

iii. **Subsistence Hunting**: An Indian, Aleut, or Eskimo who is a native and resident of Alaska may "take" a threatened or endangered species if the taking is primarily for subsistence and is accomplished in a non-wasteful manner. However, if the FWS determines that such taking materially and negatively affects the species, the Department of Interior may issue regulations controlling such takings Act.

8.3.8 Delisting

Species may be de-listed if the best scientific data substantiates either that it is extinct, that it has recovered, or that the original data used for listing were in error.

8.4 The South Africa Programme

8.4.1 South Africa's Biodiversity Act of 2004 and Threatened or Protected Species Regulations of 2007.

South Africa, like Botswana, signed the CBD and in 2005 issued a National Biodiversity Strategy and Action plan. Eventually this may lead to a more ecosystem-based approach to protection of species that takes into consideration a wide range of threats. Currently, however, South Africa has identified species as "threatened or protected" and has implemented a system that views hunting as the main threat to listed animal species.

8.4.1.1 National Environmental Management: Biodiversity Act 10 of 2004.

The Biodiversity Act, enacted in 2004, is the primary mechanism for implementing the policies and goals relating to plant and animal conservation established in the CBD. The Biodiversity Act aims to provide for the consistent management and conservation of South Africa's biodiversity, the protection of species and ecosystems in need of protection, among other things.

Several Chapters of the Act operate in concert to protect wildlife. Chapter 1 states that the Biodiversity Act gives effect to the international treaties to which South Africa is a signatory. Chapter 2 establishes the South African National Biodiversity Institute which must monitor the conservation status of all biodiversity, including alien species and listed protected or threatened species. Chapter 3 requires the creation of a national biodiversity framework and bioregions that will provide for a uniform approach to biodiversity management by all levels of government.

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Chapter 4 most directly provides for wildlife management and conservation by authorising the Minister of DEAT to publish a list of critically endangered, endangered, vulnerable, or protected species and to provide for the protection of those species to ensure their survival in the wild. Chapter 4, together with Chapter 7, establishes a system in terms of which a permit must be obtained when certain "restricted activities" involve listed "threatened or protected species." The Minister of DEAT is authorised to develop regulations on the "restricted activities." In addition, the Minister of DEAT may entirely prohibit an activity that negatively impacts the survival of a threatened or protected species.

Pursuant the authority of the Biodiversity Act, in 2007 DEAT issued the Threatened or Protected Species Regulations.

8.4.2 Species listing

Legislation does not provide any criteria for the classification and listing of threatened or protected species. Their selection is instead carried out through an internal administrative process. The IUCN Red List of Threatened Species provides a snapshot of the state of the world's plant diversity and lists species that are threatened to some degree with eventual extinction.

There is no also obligation on the legislators to protect a species which is known to be endangered. Nor is there any restriction against listing a species which is not endangered.

However, before publishing any lists of threatened or protected species (or amending or repealing any such lists), the Minister must follow a consultative process which includes consultation with relevant Cabinet members and MECs for Environmental Affairs of the provinces and allow for appropriate public participation.

In February 2007, the Minister of DEAT published the *"Lists of Critically Endangered, Endangered, Vulnerable and Protected Species."* These nationally listed species have uniform conservation status across the country.

The listing is divided into four categories: (1) Critically Endangered Species (i.e. Indigenous species facing an extremely high risk of extinction in the wild in the immediate future); (2) Endangered Species (i.e. Indigenous species facing a high risk of extinction in the wild in the near future, although they are not a critically endangered species); (3) Vulnerable Species (i.e. Indigenous species facing a high risk of extinction in the wild in the medium-term future, although not a critically endangered species); and (4) Protected Species (i.e. Indigenous species of high conservation value or national importance that require national protection).

8.4.3 Restricted activities

Once a species is listed, a person may not undertake a "restricted activity" without a permit. Restricted activities include:

- Hunting, catching, capturing or killing any living specimen of the listed threatened or protected species by any means method or device whatsoever including searching, pursuing, driving, lying in wait, luring, alluring, discharging a missile or injuring with intent to hunt catch capture or kill any such specimen;

- Picking parts of, or cutting, chopping off, uprooting, damaging or destroying, any specimen of a listed or protected species;
- Importing into the Republic, including introducing from the sea, any specimen of a listed threatened or protected species;
- Exporting from the Republic having in possession or exercising physical control over any specimen. . . growing, breeding. . .conveying, moving, or translocating any listed species;
- Selling or otherwise trading in any listed species.

A *restricted activity* as defined by the Biodiversity Act however makes a general exclusion of unintentional taking. The law thus fails to prohibit activities that might disturb animals belonging to such threatened or protected species or their nest or breeding places.

There are few laws that provide for active measures to promote the recovery and rehabilitation of threatened or protected species. An exception is National Environmental Management: Protected Areas Act that recognises the need to establish protected areas 'to rehabilitate and restore degraded ecosystems and promote the recovery of endangered and vulnerable species.'

8.4.4 Permit system for listed threatened or protected species

The regulations establish a permit system that applies to all restricted activities involving threatened or protected species. The regulations provide guidance on the permit process, such as who may apply for a permit and to whom that application must be made, permit conditions including circumstances in which permit application must be refused and cancellation of renewal of permits. As a result of the information that must be collected and evaluated during the permit application process, the permit issuing entity should have a solid understanding of the status of the species and how the decision to issue a permit will impact the continued existence of that species.

Factors to be considered by the issuing authority in deciding whether a permit should be granted include: the categorization of the species in the Listed Threatened or Protected Species; the IUCN Red Data List status; whether the species belongs to a wild population; the biodiversity management plan for the species; any risk assessment or expert evidence by the issuing agency, and whether the permit seeker has had other permits cancelled.

Additional consideration must be weighed if the application involves a wild population of a listed critically endangered species. A permit application that impacts a wild specimen also requires the development of a risk assessment, and that consideration be given to whether the restricted activity applied for is consistent with the species biodiversity management plan. If the application is for a hunting permit, the issuing authority must also take into account other factors such as whether the permit involves a prohibited activity and the prohibited methods of hunting as well as who is seeking the permit (e.g. Is the applicant a member or a recognized hunting organisation)?

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8.4.5 Damage causing animals

In order to balance the protection of these "damage causing animals" with the safety and property concerns that have caused their deaths, the new regulations establish a heightened standard for both damage and causation. A listed Threatened or Protected Species is deemed a "damage causing animal" if it causes losses to stock or wild specimens, *excessive* damage to cultivated trees, crops, or other property, threatens human life, or *materially* depletes agricultural grazing may be deemed a "damage causing animal" if there is *"substantial proof"* that the particular animal is the source of the problem.

The Regulations prohibits the hunting of a damage causing animal through a concession and specify that the provincial department responsible for nature conservation must determine whether a listed threatened or protected species is in fact a damage causing animal. If a damage causing animal originates from a protected area, then the regulations establish options for handling the animal: (1) capture and relocation; or (2) culling by the provincial department or the protected area management authority (killing the animal "as a last resort") according to detailed criteria; or (3) capture and relocation by a person, not a hunting client, designated by the provincial agency or national management authority again according to the proscriptions set forth in the Regulations. The killing of the "damage causing animal" must be "as a matter of last resort." A landowner may kill a damage causing animal in self-defense where human life is threatened. Within 24 hours of such an incident, the killing must be reported to the authorities who will then evaluate the circumstances and may either condone the killing or institute criminal proceedings.

Additional national legislation regulating the control of "damage causing animals" that are not threatened or protected species is currently being developed.

8.5 Recommendations flowing from analysis of international best practice

The designation of "Best Practices" is a helpful way of learning from the experience of others while developing your own program. The identification of "Best Practices" does not commit you to one inflexible way of proceeding but instead, and especially in this context, provides some guidance in the form of the experiences of other nations as they developed and implemented endangered species programs. In short, what works, what does not work, and what should be considered as Botswana develops its own legislation. The systems analyzed above were developed in a particular national context and reflect the particular characteristics of each nation. Still there are elements of each program that are important components of an effective endangered species program. These elements could be extracted and reworked for implementation in Botswana.

8.5.1 Listing of species

Lessons gained from best practice over listing of species are:

I. The list of threatened or endangered species should be current and updated periodically.

- Both the United States and Australia have a dynamic process of listing that keeps the listing of species that are threatened or endangered up to date. Use of the IUCN Red List might be one way of ensuring that the list of threatened or endangered species reflects the true status of the species.

- South Africa has a fairly static list of threatened and endangered species but does have the South African National Biological Institute and other research institutions that may be useful in identifying new threats to species.

II. The decision to list a species should be made without reference to possible economic or other impacts of such determination.

- In the United States and Australia, the decision to list a species is made solely on biological grounds, without consideration of economic or other issues. Economic and other issues may be considered later as a recovery plan is developed.

III. The decision to list a species should be made using the best available science.

8.5.2 Identifying and responding to threats and recovery plans

Lessons gained are as follows:

I. There should be some process for identifying and evaluating on-going threats to species such as invasive species, new diseases, or climate change. While habitat destruction is the main threat to species, it is not the only one:

- In the United States, the use of the five factors to assist in determining whether a species is threatened or endangered helps the FWS understand the extent and immediacy of the threat to the species.

- Australia establishes a process for key threat identification and provides for the development of threat abatement plans. The plans identify research, management and other actions needed to ensure the long-term survival of native species and ecological communities affected by key threatening processes.

- South Africa's SANBI and other research institutions may help it identify new threats to biodiversity.

II. Habitat and ecosystem protection is necessary for complete protection of threatened and endangered species. This includes wildlife corridors to expand habitat, buffer zones, reduction in roads and fences that split habitat (or, alternatively, there are instances when a way across a road or fence will suffice):

- The United States also identifies "critical habitat" which are the areas that are vital to the preservation of the species such as breeding grounds.

- South Africa will identify species habitat as part of its implementation of the CBD and the Biodiversity Act.

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III. Once a species is listed, a recovery plan with measurable objectives that takes into account the economic and social impacts of recovery should be developed. The recovery plan must be specific, with a measurable definition of "recovery" (i.e. What does recovery look like for the particular species), specific guidance on steps required for recovery, including addressing habitat needs.

IV. The successful management of threatened and endangered species depends on cooperation between governments as well as local landowners. Community input is vital. There should be opportunity for comment on the recovery plan so that the effected communities are able to have meaningful input into decisions that may affect their lives and livelihood and so that they support the program.

- Where hunting and subsistence farming compete with threatened and endangered species, it is important to include the community in the protection of the species. In Namibia, The Communal Area Conservancy Programme creates communal areas that are managed and protected by local citizens who then benefit from wildlife and other natural resources.

- South Africa, Australia, and the United States have an administrative process for notice and comment. In the United States, the Inuit are permitted subsistence hunting as long as it does not imperil the species.

V. Provide incentives for landowners and land users to protect habitat.

- In Namibia, the communal areas are managed by the community who benefit from the wildlife and natural resources.

- In the United States, the development of a habitat conservation plan involves a landowner and community in protecting species in return for the ability to develop some portion of the habitat. This can be done before a species is listed in an effort to prevent listing. The issuance of a permit to undertake a "restricted activity" should take into account the status of the species.

- South Africa requires that the following factors be considered by the issuing authority in deciding whether a permit should be granted include: the categorization of the species in the Listed Threatened or Protected Species; the IUCN Red Data List status; whether the species belongs to a wild population; the biodiversity management plan for the species; any risk assessment or expert evidence by the issuing agency, and whether the permit seeker has had other permits cancelled. Additional consideration must be weighed if the application involves a wild population of a listed critically endangered species. A permit application that impacts a wild specimen also requires the development of a risk assessment and that consideration be given to whether the restricted activity applied for is consistent with the species biodiversity management plan.

VII. Restrictions on harm to species and activities should apply also to government actions.

- In the United States, the government is forbidden to put a species in jeopardy through any action, funding of any program, or issuing of a permit.

VIII. Captive breeding programs allow the establishment of captive populations that are large enough to be demographically stable and genetically healthy.

8.5.3 Enforcement

There must be penalties for violations of the legislation protecting threatened or endangered species.

South Africa, United States, and Australia all have civil and criminal penalties for violation of the provisions relating to threatened and endangered species.

8.6 International legislative overview

Table 14: Species Recovery Programmes - International Overview (adapted from Guidelines for Action Plans for Animal Species: Planning Recovery (Machado, 1997)

Country	Legislation	Implementing Agency	Species Recovery Plan examples
Australia	Endangered Species Protection Bill 1992, Threatened Species Strategy (in National Strategy for the Conservation of Australia's Biological Diversity)	Australian Government	Rock Wallaby (successful)
Finland	Nature Conservation Act	Ministry of Environment & Ministry of Agriculture and Forestry	
France	Action Plan for Fauna and Flora (under Biodiversity in France)	Ministry of Environment & multiple partners	
Netherlands	No specific legislation, but Dutch Nature Policy Plan	Dutch Government	Partridge, Black Grouse, Spoonbill, etc.
New Zealand	no specific legislation for Species Recovery Program	Department of Conservation	Kiwis
Spain	Statutory Law 4/1989 on the Conservation of Natural Areas and of Wild Flora and Fauna, Listing regulated in Royal Decree 439/1990	National Conservation Agency (ICONA), Autonomous Parliaments	Black Stork, Brown Bear, Lammergeier
Sweden	no specific legislation for RSP	Swedish Environmental Protection Agency	Peregrine Falcon, Pearl Mussel, Woodland brown butterfly
UK	no specific legislation for RSP, but under UK Biodiversity Action Plan Objectives, the Species Recovery Programme was launched in 1991	English Nature	

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Country	Legislation	Implementing Agency	Species Recovery Plan examples
USA	Endangered Species Act 1973	Fish & Wildlife Service (main), National Marine Fisheries Service, all federal agencies	Bald Eagle (successful), Peregrine Falcon (2 spp. successful), American Alligator (successful), Californian Condor (successful)

9 Overall conclusions

9.1 This section

This section summarizes the key gaps identified the review process and proposes recommendations for the development and implementation of an Endangered Species Management Policy.

9.2 Gaps: listing issues

The issues identified in section 2 are as follows:

- Botswana has three forms of species listing processes which apply different categorization definitions and processes. In addition to the IUCN Red List, Botswana is also informed by two other sources: CITES; and the National listing of game animals as defined in the Wildlife Conservation and National Parks Act (1992). There are considerable differences and discrepancies between all three lists.

- In relation to the IUCN Global Red List for the listing of endangered species, Botswana has not applied the Guidelines for the application of the Criteria at a regional level. Global categorization is not necessarily the same as a national or regional categorization.

- Data gaps: Anecdotal evidence suggests that the current list is incomplete because it does not include certain species believed by experts in the field to be endangered; there is a lack of information regarding plant species status in Botswana; declines of most endangered mammals have been noted but there is a lack of understanding of status, trends and causes.

Our recommendations with regards to the above observations are as follows:

- There is a need to carry out a coordinated nationwide Red List update, based on agreed criteria and guidelines informed by the IUCN Red List criteria. Alongside this process, there needs to be more coordinated research on species and processes of relevant ecosystems. The outputs from Birdlife Botswana's development of a national Birds Red List should be incorporated into the nationwide Red List.

- The species clarification system needs to include Red List Authorities (RLA) broken up for species, species groups and geographic areas. To facilitate consistency of criteria and outcomes, the Endangered Species Evaluation Committee should include representations from the IUCN Red List staff. Furthermore, the responsibility for the management of all species lists should be given to one organisation. E.g. Cites and IUCN should be managed by the same people.

- A continuous review process should be implemented to ensure that the Red List is updated on a timely basis.

- Implementation recommendations for CITES need to be included in appropriate legislation.

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9.3 Gaps: ecosystems and park extent

The issues identified in section 3 are as follows:

- There are endangered species that are known to occupy ecosystems outside formal protected areas.
- Research has shown that several endangered migratory species move across national borders; Transfrontier conservation initiatives are at an early conceptual phase development.
- There is a lack of information regarding plant and animal species status in Botswana.
- Many declines of endangered mammals have been noted as being caused by human-animal conflict.

Our recommendations with regards to the above are as follows:

- Consider how, and review the rationale for assessing whether, protected can be accorded to areas currently outside protected areas e.g., the Panhandle of the Okavango Delta, Important Bird Areas, Eco-regions and Ecological corridors.
- Endangered Species Management should recognize the importance of migratory corridors and take cognizance of Transfrontier Conservation initiatives.
- The recognition and mitigation of, Human Wildlife Conflict should be clearly addressed in the Policy.
- The Policy needs to include an appropriate way to manage the change of land use classification in a manner that acknowledges and takes account of the impact on endangered species.
- The wise use of wetlands needs to be included in all natural resource planning processes within Botswana which is necessitated by the RAMSAR convention.
- Support the establishment of TFCAs in order to protect critical processes within ecosystems
- The protection of key ecosystems is essential to the tourism industry. The Botswana Tourism Board also expressed that the presence of species considered to be endangered are big draw cards.
- The Panhandle and Pandamatenga Plains requiring extra protection illustrated that an effective land use conversion and approval process needs to be in place. This would include the adequate consideration of EIA results and not conducting EIA's to fulfil regulatory requirements.
- A modified use of the important bird area could provide a means for identifying areas of importance for conservation. This will enable the communication of the importance of areas that exist outside national parks and other protected areas. Once communicated, these areas can be protected using creative solutions through multi-departmental teams. Having specific areas identified as sensitive will help focus awareness and training programs as well as forming a basis for the identification of stakeholders.

- If we use the IBA concept adjusted to include important conservation areas there may need to be a coordinating body to communicate these areas. Also these areas may represent a significant land surface and may need significant resources.
- The use of TFCAs will benefit Botswana in that by allowing the natural migration of species, certain species particularly elephant will become less abundant and return to more natural and sustainable population sizes.
- The TCFA concept is therefore an important weapon in the arsenal for protecting endangered species

9.4 Gaps: pressures on endangered species

The analysis on pressures that face endangered species can be summarized as follows:

- There are significant natural and human induced pressures placed on ecosystems and species. Natural pressures include weather patterns and drought cycles, and competition between species. Human induced pressures include: infrastructural development such as roads; habitat fragmentation through commercialization of land for sectors such as agriculture and minerals; and disruption of migratory routes through the implementation of agricultural veterinary controls such as fences.

- It is not clear how the planning and approval of projects recognizes and adequately mitigates the impact on ecosystems and endangered species. Furthermore, it is not clear how alternative options are assessed and appropriate value is ascribed to natural assets in a manner that facilitates consistent, objective and equitable decision-making.

Our recommendations from this analysis are as follows:

- The Policy should identify and outline a strategic response to all key pressures facing endangered species. Its direction should be consistent with and support the National BSAP.

- The Policy must recognize competing pressures for human development and seek to outline a framework for the fair appraisal and resolution of conflicts. This recommendation is further fleshed out in section 9.5 below.

9.5 Gaps: policy and strategic environment

Areas of potential conflict with the proposed Policy stem from the challenge of encouraging human development while at the same time ensuring conservation of natural resources and protecting ecosystems. Gaps identified based on interviews include the following:

- The lack of clarity over how commercial activities are planned and approved with the impact on endangered species in mind. If there is a mechanism for assessing impacts (e.g., EIAs), what standards and criteria are applied to enable judgment to be made over the acceptability of proposed impacts on endangered species and ecosystems, and the reasonableness of mitigation strategies?

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- In relation to WMAs and forest reserves, what safeguards are in place to ensure appropriate decisions-making regarding de-gazetting?

- How do hunting regulations and quotas reflect the pressures faced by, and breeding patterns of, endangered species? The policy review did not identify a clear link here.

- Regulations in place to address issues such as overgrazing and soil erosion have potential negative impacts on endangered species.

Our recommendations flowing from this review are as follows:

- The value of conservation needs to be recognized by communities through CBNRM and Public-Private Partnerships (PPP). Botswana is in the process of drafting policies for CBNRM and PPP. Education and effective communication approaches should be reviewed and evaluated for effectiveness.

- Environmental, land zoning and hunting regulations should be reviewed to assess how they consider and mitigate pressures faced by endangered species.

- A review should be carried out over the negative secondary effects on endangered species flowing from certain regulations put in place to manage the environment and agriculture (e.g., overgrazing and veterinary fences).

9.6 Gaps: best practice benchmarking

The best practice review described in section 8 did not specifically contrast leading global benchmarks against Botswana's current gaps. However, a comparison between the gaps summarized above and the recommendations detailed in section 8.5 shows that many benchmark recommendations over the listing of species and the response to threats are relevant to Botswana and should be incorporated into the Policy and Action Plan. The 'top down' approach here has further provided suggestions in relation to the following:

- Compiling lists purely on biological grounds and not economic considerations;

- The prerequisite for the development of effective recovery plans is access to current information on threats to habitats and species. Abatement plans need to incorporate research, management and other actions needed to ensure long term survival of species.

- Critical habitats should be researched and identified to ensure complete protection of threatened and endangered species.

- Recovery plans should incorporate economic and social impacts and demonstrate benefit to communities. Community buy-in and participation is vital. Incentives to stakeholders to protect habitats should be identified, communicated and implemented.

- Restrictions on harm to species should apply to government actions.

- A captive breeding program can facilitate the creation of populations of species that are large enough to be demographically stable and genetically healthy.

9.7 Recommendations

Considering the issues raised in the desktop based research and stakeholder engagement processes represented above, the consulting team has the following recommendations for the policy, strategy and action plans:

1 Establish a high level multi-department governance committee to oversee:

- Coordinating relevant research and data gathering,
- Input into land use change decisions,
- Approve listing and delisting of species,
- Coordinate important conservation area classification and resulting education/awareness programs,
- Coordinate and encourage interdepartmental solutions,
- Application for areas requiring additional protection.

2 Assign responsibility for the implementation of governance committee recommendations to a single relevant Ministry.

3 Review the listing processes to be inline with the IUCN process (strong scientific processes) and conduct and initial assessment and periodically repeat. This starting point can then be modified by local experts for Botswana conditions.

4 Establish the level of protection assigned to species listed

5 Review and conduct research on areas that may need additional protection for the sake of endangered species and motivate to the appropriate government department. Economic and social balancing would need to be part of this process which should also be informed by the tools of the BSAP and the world wildlife fund eco-region designation.

6 Conduct relevant research and data gathering focused on ecosystem processes as well as movement and demographic trends of large mammals, as well as the less understood species groups (plants, amphibians, reptiles, fish and invertebrates).

7 Incorporate local communities, civil society and the private sector in the management of endangered species by aligning policy with CBNRM and PPP processes

8 Develop education processes to help local communities understand their relation to ecosystems on which they depend.

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9 Employ a system based on the Birdlife international important bird areas, where important conservation areas are identified. These areas are essential for the survival of a particular species or ecological process. The important conservation areas can then guide interdepartmental solutions, land use decisions and education and awareness programs. The process should consider all threats to populations beyond hunting like fencing, infrastructure, disease etc. This will guide a process to respond to these threats.

10 Encourage the use of the Transfrontier Parks to facilitate migratory paths for species.

11 Review the hunting quotas and local permitting system and in particular the process for measuring the impact of hunting

12 Implement a process for stakeholders to bring a specific threat to the attention of a coordinating body who are responsible for introducing a threat mitigation plan.

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B Tables of Protected or Listed Species in Botswana

Table 15: Listed mammals extracted from Botswana lists

Taxon	Common Name	IUCN[6]	CITES[7]	GoB[8]
Proteles cristalus	Aardwolf			Protected
Orycteropus afar	Antbear			Protected
Felis nigripes	Blackfooted Cat	VU C2a(i) ver 3.1 (2001)	Appendix I	Protected
Hyaena brunnea	Brown Hyena	LR/nt ver 2.3 (1994)	Appendix I	Protected
Acinonyx jubatus	Cheetah	VU C2a(i) ver 3.1 (2001)	Appendix I	Protected
Viverra civetta	Civet			Protected
Panthera leo	African Lion	VU A2abcd ver 3.1 (2001)	Appendix I	Partially Protected
Panthera panthera	Leopard		Appendix I	Partially Protected
Felis serval	Serval			Protected
Lycaon pictus	Wild dog	EN C2a(i) ver 3.1 (2001)		Protected
Mellivora capensis	Honey Badger			Protected
Aonyx capensis	Otter			Protected
Hippopotamus amphibius	Hippopotamus	VU A4cd ver 3.1 (2001)		Protected
Galago senegalensis	Night-ape			Protected
Manis temmincki	Pangolin		Appendix I	Protected
Oreotragus oreotragus	Klipspringer			Protected
Giraffa camelopardalis	Giraffe			Protected
Redunca fulvorufula	Mountain Reedbuck			Protected
Ourebia ourebi	Oribi			Protected
Kobus vardoni	Puku	LR/cd ver 2.3 (1994)(out of date)		Protected

[6] IUCN - Global Status according to the IUCN Red Data List of 2007, including the criteria upon which this listing is based
[7] CITES Status in terms of threats through trade according to the CITES database for Botswana (http://www.cites.org/eng/resources/species.html, 1 Oct 07)
[8] GoB Status under Schedule 6 and Schedule 7 Part I of the Wildlife and National Parks Act of 1992

Diceros bicornis	Black Rhinoceros	CR A2abc ver 3.1 (2001)	Appendix I	Protected
Ceratotherium simum	White Rhinoceros		Appendix I	Protected
Raphicerus sharpe	Sharpe's Steenbok			Protected
Pelea capreolus	Vaal Rhebuck			Protected
Kobus ellipsiprymnus	Waterbuck	LR/cd ver 2.3 (1994)(out of date)		Protected
Hippotragus equinus	Roan Antelope	LR/cd ver 2.3 (1994)(out of date)		Protected
Tragelaphus spekeii	Sitatunga	LR/nt ver 2.3 (1994) (out of date)		
Hippotragus niger	Sable Antelope			Partially Protected
Taurotragus oryx	Eland			Partially Protected
Tragelaphus scriptus ornatus	Chobe Bushbuck			Partially Protected
Kobus leche	Red Lechwe		Appendix I	
Loxodonta africana	African Elephant	VU A2a ver 3.1 (2001)	Appendix I & II	Partially Protected
Procavia capensis	Rock Dassie			Protected
Heterohyrax brucei	Yellow spotted Dassie			Protected
Cloeotis percivali	Percival's Trident Bat	VU A2bc+3bc; C1 ver 3.1 (2001)		

Table 16: Listed birds extracted from Botswana lists

Family	Taxon	Common Name	IUCN*	CITES**	GoB***
Gruidae	*Balearica spp*	*All Crowned-Cranes*			Protected
Accipitridae		*All Eagles*			Protected
Accipitridae		*All Buzzards*			Protected
Accipitridae		*All Kites*			Protected
Accipitridae		*All Vultures*			Protected
Accipitridae	*Circus spp*	*All Harriers*			Protected
Accipitridae	*Accipiter spp*	*All Sparrow hawks*			Protected
Ardeidae		*All Herons*			Protected

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Egretta spp		*All Egrets*			Protected
Falconidae		*All Falcons*			Protected
Phoenicoplterus spp		*All Flamingos*			Protected
Melierax spp		*All Goshawks*			Protected
Jacanidae		*All Ibises*			Protected
Jacanidae		*All Jacanas*			Protected
Pelecanus spp		*All Pelicans*			Protected
Ciconiidae		*All Storks*			Protected
		All Bitterns			Protected
Sagittariidae	Sagittarius serpentarius	Secretary Bird			Protected
Threskiornithidae	Platalea alba	African Spoonbill			Protected
Scopidae	Scopus umbretta	Hammerkop	LC		Protected
Otididae	Ardeotis kori	Kori Bustard			Protected
Strigidae	Scotopelia peli	Pel's Fishing Owl	LC		Protected
Trogonidae	Apaloderma narina	Narina Trogon	LC		Protected
Psittacidae	Agapornis nigrigenis	Black-cheeked Lovebird	VU C2a(ii) ver 3.1 (2001)		
Sylviinae	Acrocephalus griseldis	Basra Reed Warbler	EN		
Rynchopidae	Rynchops flavirostris	African Skimmer	NT		
Estrildidae	Ortygospiza locustella	Locustfinch	NT		
Glareolidae	Glareola nordmanni	Black winged Prantincole	**DD**		
Otididae	Neotis denhami	Stanley's Bustard	NT		
Gruidae	Grus carunculatus	Wattled Crane	VU A2bcde+3bcde; C1+2a(ii) ver 3.1 (2001)		
Gruidae	Grus paradisea	Blue Crane	VU		

Accipitridae	Gyps coprotheres	Cape Griffon	VU C1+2a(ii) ver 3.1 (2001)		
Accipitridae	Torgos tracheliotos	Lappet-faced Vulture	VU C2a(ii) ver 3.1 (2001)		
Accipitridae	Trigonoceps occipitalis	White-headed Vulture	VU C2a(ii) ver 3.1 (2001)		
Accipitridae	Circus maurus	Black Harrier	VU D1 ver 3.1 (2001)		
Ardeidae	Egretta vinaceigula	Slaty Egret	VU C2a(ii) ver 3.1 (2001)		
	Falco peregrinus	Pelegrine falcon	VU	Appendix I	
	Falco naumanni	Lesser Kestrel	VU A2bce+3bce ver 3.1 (2001)		
Phoenicopteridae	Phoenicopterus minor	Lesser Flamingo	NT		
Phoenicopteridae	Phoenicopterus roseus	Greater Flamingo	LC		

Table 16: Listed reptiles extracted from Botswana lists

Taxon	Common Name	IUCN*	CITES**	GoB***
Python sebae	Python			Protected
Crocodylus niloticus	Nile Crocodile	LR/lc ver 2.3 (1994) (out of date)	Appendix II	

Table 17: Listed fish extracted from Botswana lists

Taxon	Common Name	IUCN*	CITES**	GoB***
Oreochromis andersonii	Three-spot Tilapia	VU A3e ver 3.1 (2001)		
Oreochromis macrochir	Greenhead Tilapia	VU A3e ver 3.1 (2001)		

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Table 18: Listed plants extracted from Botswana lists

Taxon	Common Name	IUCN	CITES	GoB
Adenium boehmianum		EN D		
Adenium oleifolium		VU B1B2ce		
Ceropegia floribunda		R		
Hoodia gaudia		VU A1de		
Huernia levyi		VU D2		
Orbea tapscottii		EN A1ac		
Orbeopsis knobelii		VU D1D2		
Arctotis rogersii		DD		
Arctotis serpens		DD		
Erlangea remifolia		DD		
Rennera laxa		DD		
Eleocharis cubangensis		DD		
Eriospermum linearifolium		DD		
Eriospermum seineri Engl. & Krause		DD		
Euphorbia venteri		EN C2a		
Acacia hebeclada subsp. tristis		DD		
Nesaea minima		VU D2		
Nananthus aloides		DD		
Nananthus margaritiferus		DD		
Ansellia africana		VU A1ad	Appendix II	
Eulophia angolensis		VU A1ad		
Eulophia latilabris		VU A1ad		
Eulophia holubii			Appendix II	
Anacampseros rhodesiaca		VU A1ad.		
Erythrophysa transvaalensis		VU D1D2		
Afzelia quanzensis Welw	Pod mahogany, mwande, ikonkamukota			Protected
Baikiaea plurijuga Harms	Rhosesian teak, *mukusi*)			Protected
Entandophragma caudatum Sprague	Brown mahogany, mopomena			Protected

Guibourtia coleosperma	Rhodesian copal wood,Tsaudi, isibi			Protected
Pterocarpus angolensis	Mukwa, blood wood, muninga, ilombe			Protected
Brachystegia spp	Mowombo			Protected
Sprirostachys africana	Morukuru, tamboti			Protected
Adansonia digitata	Baobab, mowana, ibozu, mubuyu			Protected
Berchemia discolor	Bird plum (mozinzila)			Protected
Diospyros mespiliformis	African ebony, mokochong,Mochenje, isuma			Protected

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C Stakeholder Engagement Plan

The stakeholders are divided into their expertise groups and listed with the planned from of engagement. It is not always possible to meet with stakeholders individually either due to their busy schedules or physical location. Consequently all stakeholders have been invited to engage via email or telephone.

As some stakeholder may fall into one or more groups, an individual stakeholder may appear more than once.

Biodiversity Experts

The biodiversity experts were selected on the basis that expert representatives from the relevant government departments were included (DWNP, ESP, HOORC, Forestry Dept). Non governmental experts were selected to ensure coverage of all relevant species groups.

Name	Focus	Organisation	email address	Phone/ Address	Initial Contact	Future Contact
Alison Leslie	Crocodiles		aleslie@sun.ac.za	-	Email	Email
Andre Botha	Birds	BoPWg, Endangered Wildlife Trust	andreb@ewt.org.za		Project Team	Continuous
Anne-Marie Houser	Cheetahs	Cheetah Conservation Botswana	ahouser@debswana.bw		WKS Maun	Email
Bonatla Tsholofelo		Kalahari Conservation Program	clo_co@kcs.org.bw		WKS Maun	Email
Dr. Casper Bonyongo		HOORC	ebonyongo@orc.ub.bw		Continuous	Continuous
Chi Mun Woo	Policy & Strategy	KPMG Sustainability Services	chimun.woo@kpmg.co.za		Project Team	Continuous

Name	Focus	Organisation	email address	Phone/ Address	Initial Contact	Future Contact
Dr. Chris Brooks	Herbivores	Ecosystems Solutions for Africa	chris.brooks@bristol.ac.uk	Tel: (+268) 518 4011 ext. 2322	WKS Maun	Email
Christiaan Winterbach	Carnivores	Private	2tau@bushmail.net		WKS Maun	Email
David Dugmore	Zebra	KK Safaris	david.dugmore@kalaharikavango.com		Invite to Maun	Email
Derek Flatt	Tourism	Desert & Delta Safaris	derek@dds.co.bw		WKS Maun	Email
Derek & Beverly Joubert	Carnivores	Photographers	keithjoubert@lantic.net			possibly email
Dr Kate Evans	Elephants	Private	elephantresearch@yahoo.co.uk		WKS Maun	Email
Dr Kyle Good		Private	kmgood@accelerate-it.co.bw		Email	Email
Dr. Ara Monagdem	Bats	University Swaziland	ara@uniswacc.uniswa.sz			possibly email/one-on-one
Dr. J.S. Perkins	Biodiversity	University of Botswana	perkinsjs@mopipi.ub.bw	3552526 or 365000/ Fax: 3552908 or 3956591	Invite to Maun	one-on-one, email
Eleanor & Larry Patterson	Conservation/ Vet Issues	ex-KCS/Vet			Invite to Maun	one-on-one, email
Elsie Alexander	CBNRM	UB	ALEXANDE@mopipi.ub.bw		Invite to Maun	one-on-one 6 Sept
Felix Monggae	Biodiversity Conservation	Kalahari Conservation Society	ceo@kcs.org.bw	+267 713 12447	TAG	one-on-one, email

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Name	Focus	Organisation	email address	Phone/ Address	Initial Contact	Future Contact
Gaseitsiwe Masunga	Herbivores	DWNP	gaseitsiwe.masunga@gmail.com		WKS Maun	Email
Glyn Maude	Brown Hyaena	Researcher	brownhyaena@info.bw	Phone: +27 11 7013914/ +27 (0)722511491	WKS Maun	Email
Gosiame Neo-Mahupeleng*	Carnivores	AWF	gneomahupeleng@botsnet.bw	Private Bag K88, Kasane, Botswana	Invite to Maun	Email
Dr. Graham McCulloch	Flamingos	Private	gmcculloch@info.bw	-	Email	Email
Grant Woodrow	White Rhinos	Wilderness Safaris	grantw@wilderness.co.bw	-	Invite to Maun	one-on-one, email
Harriet Bartlam	Herbivores	Okavango Herbivore Research	hattiebartlam@gmail.com	-	WKS Maun	Email
Harriet Davies-Mostert	Carnivores	Carnivore Conservation Group, Endangered Wildlife Trust	harrietd@ewt.org.za		Project Team	continuous
Harry Charalambous	Hunting	Botswana Wildlife Management Association	nemesis@dynabyte.bw		WKS Maun	Email
Jeanette Slier	Elephants	Mashatu Research - Elephant Tuli	mashatu.research@telkomsa.net		WKS Maun	Email
Joseph Mbaiwa		HOORC	jmbaiwa@orc.ub.bw		WKS Maun	Email

Name	Focus	Organisation	email address	Phone/ Address	Initial Contact	Future Contact
Kabelo J. Senyatso	Birds	Birdlife Botswana	blb@birdlifebotswana.org.bw	+267 72168229	TAG	one-on-one, email
Dr. Karen Ross		Endangered Wildlife Trust/Wilderness	karenross@mweb.co.bw		Project Team	continuous
Dr. Kathy Alexander	Biodiversity/ CBNRM	CARACAL	caracal@botsnet.bw / kathy@caracal.info		Invite to Maun	one-on-one, email
Lisa Fulton Brebner	CBNRM/disease control	Maun Animal Welfare Society	mawsbots@gmail.com		WKS Maun	Email
Dr. C. Bonyongo	Herbivores	HOORC	cbonyongo@orc.ub.bw	-	Project Team	continuous
Mark Kyriacou	Hunting	Botswana Wildlife Management Association			WKS Maun	one-on-one 5 Sept, email
Mark Muller	Birds	Birdlife Botswana	muller@ngami.co.za	+267 6862979	WKS Maun	Email
Dr. Mark Vandewalle	Biodiversity/ CBNRM	CARACAL	mark@caracal.info		Invite to Maun	Email
Dr. Markus Gusset	Wild Dogs	Predator Conservation Program	mgusset@bluewin.ch		WKS Maun	Email
Mervyn Palmer	CBNRM/disease control	Maun Animal Welfare Society	palmermw@dynabyte.bw		WKS Maun	Email
Dr. M. Chase	Elephants	Private	er@info.bw		Invite to Maun	Email

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Name	Focus	Organisation	email address	Phone/ Address	Initial Contact	Future Contact
Mokgadi Monamati	ODMP	DEA (ODMP)	mmonamati@gov.bw		WKS Maun	one-on-one, email
Moses Selebatse	CKGR corridor project	Conservation International	m.selebatso@conservation.org	+267 71639370	Email	one-on-one, email
Paul Sheller		Botswana Wildlife Management Association	ndsmaun@dynabyte.bw		WKS Maun	Email
Pelotshweu Pearl Galebotswe	Herbivores	Department of Wildlife	gpelotshweu@gov.bw		WKS Maun	Email
Pete Hancock*	Birds	Birdlife Botswana	birdlifemaun@botsnet.bw		WKS Maun	one-on-one, email
Prof. Phil Hockey	Birds	UCT			Email	
Prof. L. Ramberg	Water Invertebrates	University of Botswana		Tel: 6861833 Fax: 6861835		possibly email
Rebecca Klein	Cheetahs	Cheetah Conservation Botswana	rebecca@cheetahbotswana.com		WKS Maun	Email
Ruud Jansen	Facilitator	Envronment Support Program	rjansen@gov.bw		WKS Maun	
S.W. Makhabu	Herbivores	DWNP	smakhabu@yahoo.co.uk	-	WKS Maun	
Sam Kaunda*	Carnivores/ Conflict	University of Botswana	kaundakk@mopipi.ub.bw		Invite to Maun	one-on-one, email
Sedia Modise	Transfrontier	PPF	peaceparks@botsnet.bw	+267 72 311 163/ +267 71 707 745	one-on-one 6 Sept	Email

Name	Focus	Organisation	email address	Phone/ Address	Initial Contact	Future Contact
Sibangani Mosojane	Wildlife	Biokavango (TLB)	smosojane@gov.bw / sibanganimosojane@yahoo.com	+267 71606324	WKS Maun	intro to land board, email
Steve Boyes	Biodiversity	Private	meyersproject@yahoo.com		Email	personal meeting
Thoralf Meyer	GIS/ Ecosystem Services	Private	tmeyer@gmail.com			possibly email
Tico McNutt*	Carnivores	Predator Conservation Program	predator@gmail.com lycaon@info.bw		WKS Maun	Email
Vince Shacks Map Ives, OWS	Crocodiles Rhino conservation	Researcher Botswana Rhino Management Group	vshacks@gmail.com	 71658686	WKS Maun Meeting GBN	Email telephone

Private Sector Representatives, Policy and Economic Experts

The private sector stakeholders were selected on the basis that an Endangered Species Policy may, and should, impact on many sectors of the economy e.g., Tourism, Energy, Agriculture and Mineral. It was also felt that private sector stakeholders may have important roles to play in the implementation of the policy. Consequently, the consultants identified stakeholders from key industries for consultation, as well as individuals who could advise on policy making in Botswana.

Name	Focus	Organisation	email address	Phone	Initial Contact	Future Contact

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Name	Focus	Organisation	email address	Phone	Initial Contact	Future Contact
Mr Douglas Thamage	Endangered Plants, CBNRM	Veldt Products (Research and Development)	veldprod@info.bw	3947343	WKS GBN	one-on-one, email
Mr Felix Monggae	TAG	Kalahari Conservation Society	ceo@kcs.org.bw	3974557	Invite to WKS GBN	TAG
Mrs. Morongwe Ntloedibe Disele(CEO)	Tourism	Hospitality and Tourism Association of Botswana	mdisele@hatab.bw	3957144	Invite to WKS GBN	email
Chairman	Hunting	Botswana Wildlife Management Association	trophy@info.bw		WKS Maun	one-on-one 5 Sept
Peter Dow	Education curricula	Mokolodi Nature Reserve		3161955	WKS Gaborone	one-on-one, email
Mr Kabelo Senyatso	TAG	Birdlife Botswana	blb@birdlifebotswana.org.bw	3190540	Invite to WKS Maun & Gaborone	
Mr Michael Ramaano	CBNRM	CBNRM Forum Secretariat		3974557	Invite to WKS GBN	One-on-one (CBRNM Report)
Director	OMDP	IUCN Botswana	iucnbotswana@iucn.org	3931883	Invite to WKS GBN	Email
Mr Mabei	CBOs	BOCOBONET		3180581	Invite to WKS GBN	one-on-one
Dr Happy Fidzani	Development	Botswana Institute for Development Policy Analysis (BIDPA).	nhfidzani@bidpa.bw / charike@bidpa.bw	3971750	Invite to WKS GBN	One-on-one

Name	Focus	Organisation	email address	Phone	Initial Contact	Future Contact
Ms. Portia Segomelo	ODMP	Okavango Delta Management Plan	psegomelo@gov.bw	6801237	Invite to WKS GBN	One-on-one
Dr. Hillary Masundire	Research	University of Botswana, Dept. of Biological Science	cemchair@iucn.org	3550000	Invite to WKS GBN	One-on-one
Debbie Peake	Wildlife Issues General	Wildlife Association of Botswana	trophy@info.bw	6864882	Invite to WKS GBN	Email
Dr C. B. Monkge	Economy/Development	Vision 2016 Council	monkgec@bidpa.bw	3971750	Invite to WKS GBN	One-on-one
Peter Bateman	Industry	Kalahari Gas Corp	peterb@scales.co.bw	397 3386	Invite to WKS GBN	One-on-one
Chairman	NGOs	BOCONGO			Invite to WKS GBN	One-on-one
Dr. J.S. Perkins	Plants	University of Botswana	perkinsjs@mopipi.ub.bw	3552526 or 365000	Invite to WKS Maun	One-on-one (flag potential plant experts at UB)
Keith Jeffries	Economist				One-on-one	Email
Elanor Patterson	Secretary	Botswana Wildlife Producers' Association (BWPA)	patt@info.bw	+267-3959889	One-on-one	Email
Norman Moleele	Deputy Executive Director	BOCCIM	nmoleele@boccim.bw	72106333	One-on-one	Email

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Name	Focus	Organisation	email address	Phone	Initial Contact	Future Contact
Jaap Arntzen		Centre for Applied Research		3903401	One-on-one	Email
David Parry		Ecosurv Pty Ltd.	david@ecosurv.com	267 3161533	One-on-one	Email
Dr Raborokwe	Cattle Farming & animal diseases	Botswana Meat Commission			One-one-one	Email

Government Representatives

Key government departments that may affect the policy or may be affected by the policy or who may be involved in its implementation are listed.

Name	Focus	Organisation	email address	Phone	Initial Contact	Future Contact
Dr Cyril Taolo	TAG	DWNP	ctaolo@gov.bw	3191048	WKS GBN	TAG
Mr Raymond Kwerepe	Rangeland & carrying capacity	DFRR	rkwerepe@gov.bw	3954050	Invite to WKS GBN	one-on-one, email
Wazha Tema	Tourism & Tourism Policy	Dep. of Tourism	wtema@gov.bw	3953024	Invite to WKS GBN	one-on-one, email
Mr Jan Broekhuis	General	MEWT	jbroekhuis@gov.bw	3914955	Invite to WKS GBN	One-on-one, broad overview
Ms Myra Sekgororoane	Tourism	Botswana Tourism Board	msekgororoane@botswanatourism.co.bw	3913111	Invite to WKS GBN	Email
Director		National Museum	3974616	3610400/	Invite to WKS	One-on-one
Director	Infrastructure	Dept. of Roads		3913511	Invite to WKS	One-on-one

					GBN	
Director	Infrastructure	Botswana Power Corporation		3603000	Invite to WKS GBN	One-on-one
Director	Infrastructure	Dept. of Water Affairs		3607100	Invite to WKS GBN	One-on-one
Director	Infrastructure/Economy	Dept. of Mines		3657000	Invite to WKS GBN	One-on-one
Dep. Perm Sec.	Economy	Ministry of Trade and Industry, Trade Regulation Unit		3975240	Invite to WKS GBN	One-on-one
Moemi Batshabang	Management & Utilisation	DWNP		397 1405	Invite to WKS GBN	One-on-one (6 Sept)
Rapeleng Mojaphoko	Director	DWNP		397 1405	Invite to WKS GBN	
Anthony Tema	Forestry/Plants	MEWT, DFRR		364 7951	Invite to WKS GBN	WKS Gabs, one-on-one
Deputy Perm Secretary		Ministry of Finance		395 4525	Invite to WKS GBN	One-on-one
Commander	Antipoaching Unit (APU)	Botswana Defence Force		366 7100	Invite to WKS GBN	WKS Gabs, email?
Director	Animal Health and Production	Ministry of Agriculture		397 1169	Invite to WKS GBN	One-on-one
Hon Jacob Nkate	Education	Minister of Education	jnkate@gov.bw	365 5462	Invite to WKS GBN	One-on-one
Director	Land use	Ministry of Lands		390 4223	Invite to WKS GBN	One-on-one
Secretary	Tribal Administration	House of Chiefs		397 4986	Invite to WKS GBN	One-on-one

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Stakeholders to be Invited to the National Conferences

In addition to all the members of the TAG and those that attended the start up workshop it would be advisable to invite the following people (or where names are not available a representative at an appropriate level) to the national conference.

Name	Organisation	email address	Phone
Bonyongo, Casper	HOORC	ebonyongo@orc.ub.bw	
Dow, Peter	Mokolodi Nature Reserve		
Director	IUCN Botswana	iucnbotswana@iucn.org	3931883
Dr Fidzani	Botswana Institute for Development Policy Analysis	nhfidzani@bidpa.bw / charike@bidpa.bw	3971750
Chairman	BOCONGO		
Moleele, Norman	BOCCIM	nmoleele@boccim.bw	72106333
Arntzen, Jaap	Centre for Applied Research		3903401
Parry, David	Ecosurv Pty Ltd.	david@ecosurv.com	267 3161533
Dr Raborokwe	Botswana Meat Commission		
Kwerepe, Raymond	DFRR	rkwerepe@gov.bw	3954050
Tema, Wadja	Dep. of Tourism	wtema@gov.bw	3953024
Broekhuis, Jan	MEWT	jbroekhuis@gov.bw	3914955
Sekgororoane, Myra	Botswana Tourism Board	msekgororoane@botswanatourism.co.bw	3913111
Representative	Dept. of Museum and Art		3610400/ 3974616
Representative	Dept. of Roads		3913511
Representative	Botswana Power Corporation		3603000
Representative	Dept. of Water Affairs		3607100
Representative	Dept. of Mines		3657000
Representative	Ministry of Trade and Industry,		3975240

Name	Organisation	email address	Phone
	Trade Regulation		
Batshabang, Moemi	DWNP		397 1405
Mojaphoko, Rapeleng	Director, DWNP		397 1405
Tema, Anthony	MEWT DRRI		364 7951
Representative	Ministry of Finance		395 4525
Commander, APU	Botswana Defence Force		366 7100
Animal Health and Production	Ministry of Agriculture		397 1169
Hon Jacob Nkate	Ministry of Education	jnkate@gov.bw	365 5462
Representative	Ministry of Lands		390 4223
Chairman	Tribal Administration House of Chiefs		397 4986
Motshereganyi Virat Kootsositse and other representatives	Birdlife Botswana	ibmanager@birdlifebotswana.org.bw	319 0540
Modise, Sedia	Peace parks Foundation	peaceparks@botsnet.bw	390 2407
Kyriacau, Mark	Hunters Association of Botswana	trophy@info.bw	
Garekwe, D.	Gaborone City Council		3956169
Hester, H.	Chairman, BirdLife Botswana	haroldh@info.bw	319 0540
Koketso, S.	National Conservation Strategy Agency	skoketso@gov.bw	3902050
Mabei, Mr.	BOCOBONET		3180581
Monkge, C. B.	Vision 2016 Council	monkgec@bidpa.bw	3971750
Moruti, T.S.	Plant Protection Division, Ministry of Agriculture	tmoruti@gov.bw	3928745
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Mosugelo, D.K.	DWNP	davidmosugelo@yahoo.com	6540201

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Name	Organisation	email address	Phone
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Peake, Debbie	Wildlife Association of Botswana	trophy@info.bw	6864882
Perkins, J.S.	University of Botswana	perkinsjs@mopipi.ub.bw	3552526 or 365000
Raj, G.	Department of Tourism	eraj@gov.bw	3953024
Ramaano, Michael	CBNRM Forum Secretariat		3974557
Riddoch, B.	DoBS, University of Botswana	riddochb@mopipi.ub.bw	3552596
Segomelo, Portia	Okavango Delta Management Plan	psegomelo@gov.bw	6801237
Senyatso, Kabelo	Birdlife Botswana	blb@birdlifebotswana.org.bw	3190540
Seonyatseng, E.	DWNP	eseonyatseng@gov.bw	3971405
Setshogo, M.P.	DoBS, University of Botswana	setshogo@mopipi.ub.bw	3552602
Taylor, J.E.	DoBS, University of Botswana and BirdLife Botswana	taylor@mopipi.ub.bw	355-5064
Thamage, Douglas	Veldt Products (Research and Development)	veldprod@info.bw	3947343
Zuze, C.	DWNP	cszuze@hotmail.com	6860835
Masundire, H	University of Botswana	masundh@mopipi.ub.bw	3550000
Ives, Map	Chairman, Rhino Management Gp.		71658686

D Key Habitat Analysis

Definition of Endangered Species in relation to habitats

The analysis for key habitat in conservation and/or preservation must cover the critical ecological parameters that define habitats in general. In some sense, plants and animals become endangered because of habitat anomalies, or through habitat encroachment, most often by man, but also by natural incidences for example, of flood, fire, landslides, disease, predation, excessive harvesting, erratic climate changes (too hot, too dry, too cold, too windy) and so on.

Endangered species are generally considered threatened, because they are hard to find, not easily identified, or known to have declining populations that without conservation, would result in extinction of the species. In the latter instance, a population becomes vulnerable because it is not able to sustain itself. Thus, we find new species that are threatened, but are also aware of declining populations of well known species.

Additionally, however, some species may be declared endangered because they are not locally common being out of their usual habitat range, taking on a localised '**Ecotype**'. In such instances such species may be declared sub-species due to morphological differences. This raises the question of how did a species arrive at a specific location, from another location? In many instances species have been linked by contiguous habitats that subsequently fragmented, resulting in small 'island populations', for example, many groups of plants found on high mountains in Africa are similar in species composition and structure, despite being many thousands of kilometres apart.

In order to decide, or determine important habitats in Botswana, it will be best to define the term habitat, in the context of identifying Endangered Species. This has been done by IUCN (2001), in their Red List of Threatened Species: Categories and Criteria, version 3.1.

Definition of Habitat

Habitat is defined here as an environment (natural or otherwise) that sustainably supports life forms and enables these life forms to successfully reproduce and maintain viable population numbers to continue the survival of each species' population.

This is quite a broad definition, however, and in order to understand the effect of habitat, parameters explaining Habitat should perhaps also be clarified in a set of parameters:

- Firstly we have scale (size of area), extensive, such as the Sahara Region, the Equatorial Belt, the Kalahari, localised, such as the Cape Fynbos Region and numerous hill ranges, or highly localised such as around pans and small wetlands
- Effects of geomorphological processes, with varying rates of change from extremely slow (Kalahari), to rapid (Volcanic Islands), acidic volcanic rocks, basic igneous rocks, providing the initial soil substrate
- Effects of climate: Tropical, sub-Tropical, Temperate, Arctic
- Effects of altitude, slope and aspect affecting local microclimate, soil formation processes and soil moisture retention
- Proximity of similar habitats: are they close, or are they isolated - effectively forming islands, are they linked by narrow corridors, such as along rivers?
- Proximity of other habitats, creating inter-habitat **Eco-zones** (patch dynamics)
- The presence/absence of perennial surface water

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How Habitats are Created

Land-forms

Physical land-forms are derived from continuous, location-specific land-formation processes, mostly driven by topography and climate, most notably rainfall and land gradient. But these are modified by the physical weatherability (hard, soft, somewhere in between) of the land surface.
Thus subsurface geology and surficial geomorphology are known to affect soil chemistry, soil pH, physical structure, soil moisture and surface water dynamics (creating aquatic habitats: rivers, pans, lakes, seas). They also affect how soils react under the effects of climate.

Plant habitats

The basic geomorphology and climate affect the types of plants that can grow, and where the plants do grow on the landscape according to variations in the availability of moisture, light, soil nutrients and deep enough soils to establish a viable root system.

The presence of some plants then ameliorates the microclimate and living conditions for other plant forms, which introduces the concept of habitat variety, or **Ecozone**, but which is commonly referred to for planning purposes as **Vegetation Types**.

In some places, different Ecozones are found in close proximity, contributing to merging habitats, basically areas where different Vegetation types combine, creating high diversity of plant species and subsequently unique habitats for animals and plants alike. These are most commonly found on the ridges and at the bases of hills and escarpments, around the edges of pans in the depressions between (parallel) sand dunes and along river systems.

Habitats for animals, insects, and lesser non-plant life-forms

The establishment of plant habitats (vegetation) then provides the basis for other life forms to colonise an area since the vegetation provides shelter and food. Plant habitats also provide the basis for feeding strategy by animals (herbivorous, omnivorous, carnivorous, insectivorous, etc), and, the time of day, or night when they feed. Plant habitats therefore also perform a critical function by providing **refuge** for prey species from their natural predators.

In arid and semi-arid ecosystems, important habitats include dry-river beds and pans with sub-surface moisture, where small animals (predominantly non-mammals, such as macropods and arthropods, but some fish species are also known to survive in moisture pockets in dry sand-rivers) can aestivate during dry periods, before emerging when water appears in the depression. These very small organisms provide food for larger organisms, so the apparently dry depressions are critical in the life support system of larger animals.

In desert conditions, objects such as standing vegetation, fallen trees, large rocks and anything that provides shade and therefore a moisture gradient in the soil, also create habitats for lesser plants, fungi, lichens and animal life.

Finally, and of great importance, are ‘tension-zones’ that occur where different Ecozones converge, and often bringing a large variety of plant and animal species into close proximity. These areas provide opportunities for conservation and ecotourism based opportunities with minimum intervention by humankind.

Impacts of Man on Habitats
Humankind has had a major impact on the sustainability, or lack there of on the environment. Much of the damage has been due to the need for natural resources: minerals, water, fuel, and for pace to inhabit, grow food under undertake economic activities. This is commonly referred to as Development, and requires extensive infrastructure to achieve successfully.

The important impacts of humankind on habitat, therefore, are through habitat fragmentation, encroachment, over-harvesting of natural populations (fish, whales, antelope etc) for economic gain, and clearing of vegetation with negative impacts on climate, hydrology and viability of many species of plants and animals.

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Important Habitats in Botswana

In terms of conservation and the protection of endangered species in Botswana, the important habitats are represented by areas that provide unique living conditions for plants and animals: mammals, birds, fish, amphibians, reptiles and lesser organisms.

To determine where the habitats are, and how they are represented, reference is made to information made available by the Ministry of Agriculture on land systems (Figure 1 and Legend in Table 1 below), the classification of the sandveld vegetation systems (Thomas and Shaw, 1991[9]), (Figure 2).

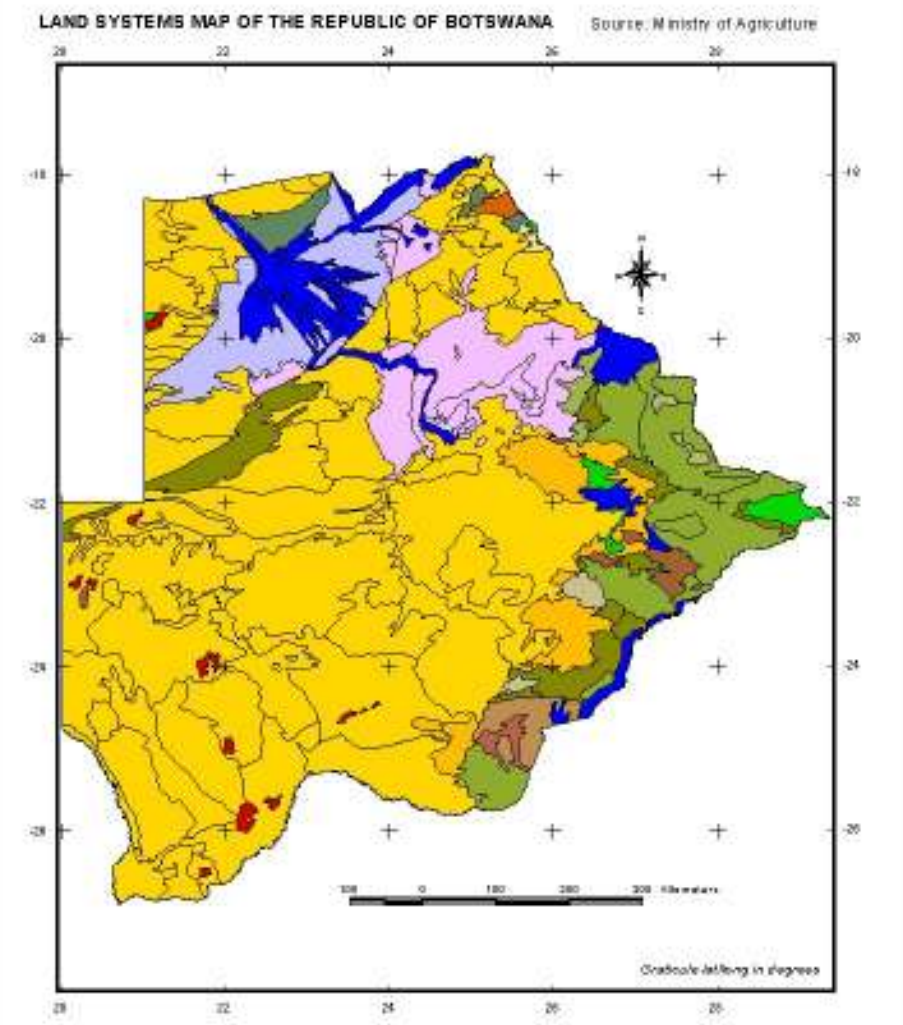

Fig 1: Land Systems Map of the Republic of Botswana (Source: Ministry of Agriculture/ FAO (1991[10]))

[9] Thomas, D.S.G. and P.A. Shaw 1991. **The Kalahari Environment.** Cambridge University Press.

[2] FAO, 1990c. *Land Systems Map of the republic of Botswana.* Soil Mapping and Advisory Services Project. AG:DP/BOT/85/011. Ministry of Agriculture, Gaborone Botswana/FAO/UNDP.

Table 1: Legend for the Land Systems Map

Land System	Colour Code	Basal Soil	Landscape Type	Major Land Uses
Sandveld		Aeolian sand deposits	Flat to undulating plains, sometimes with sand dune systems and fossil river valleys and pans	Wildlife - mainly in reserves, but increasingly on fenced game ranches, Livestock - both on common (tribal) land and in fenced farms and ranches Cropping - few, small and low output arable fields - mainly producing sorghum, groundnuts and melons, particularly on the lower slopes of ridges and sand dunes, and along the bottoms of drainage lines where the soils are not too salty Forest Reserves - on State Lands.
		Superficial aeolian sand deposits on calcrete	Flat to almost flat plains	
		Superficial aeolian sand deposits on sandstone and other sedimentary rocks	Almost flat to undulating plains	
		Superficial aeolian sand deposits on basalt and other sedimentary rocks	Flat plains with minor valleys and ridges to low hills	
		Superficial aeolian sand deposits on dolomite and other sedimentary rocks	Almost flat to gently undulating plains	
		Partly submerged aeolian sand deposits	Almost flat to gently undulating, with parallel sand dunes and/or major pans	
Hardveld		Amphibole-rich, meta-basic rocks	Undulating plain with occasional hill ranges	Livestock - Communal (tribal) grazing areas and fenced freehold and leasehold ranches Wildlife - on game reserves and conservancies Forest Reserves - on State Lands Cropping - on fenced tribal land, and on leasehold farms, using lower lying areas with alluvial soils. Main crops are sorghum, melons, millet, dry beans/cow peas, groundnuts and sunflowers Also irrigated vegetables - mainly melons, maize, sorghum and millet, and dry beans
		Basalt	Plateaux, escarpments and almost flat plains with associated alluvium/colluvium	
		Sandstone	Varied, from flat to undulating with infrequent hills and rock outcrops, through to hilly escarpments and fossil river valleys	
		Granitic gneiss	Gently undulating to undulating with eroded valleys, to rugged hilly areas, with flat areas incised by drainage lines	
		Dolerite	Hills with flat alluvium and almost flat to gently undulating pediments	
		Dolomite and sedimentary rocks	Hills with associated almost flat to gently undulating pediments	
		Acid volcanic lavas	Hills with undulating pediments	
		Granite	Almost flat to gently undulating plain with rock outcrops (kopjies)	
		Sedimentary rocks	Hilly dissected plateaux with pediments and associated alluvium	
Lacustrine		Major lake and depression deposits	Flat to almost flat salt pans prone to flooding, plains with major pans, ancient lake beds with shorelines and	Livestock - grazing on common (tribal) land Wildlife in common lands areas

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			plains, and fossil lagoons	
		Superficial lacustrine deposits on sandstone	Flat to almost flat plains	Livestock - grazing on common (tribal) land Wildlife in common lands areas
		Vlei (seasonal march) deposits	Flat plains	Wildlife on State Lands Intensive Cropping on leasehold farms - mainly sunflower, cotton, maize, millet and sorghum.
Alluvium		Recent alluvial deposits	Flat to almost flat river floodplains to fans, fans with sand ridges, delta floodplains and perennial swamps	Cropping Small-scale village fields - using flood recession agriculture, growing vegetables, melons, maize, sorghum and millet, groundnuts and dry beans/cow peas Some commercial irrigation farming on freehold farms e.g. in the Limpopo and other river valley systems - growing citrus, and mixed vegetables Livestock - mainly common-land grazing on delta floodplain fringes Some dairying Commercial ostrich farming Some wildlife ranching Wildlife - on the delta floodplains
		Fossil alluvial deposits	Flat to gently undulating river and delta floodplains	

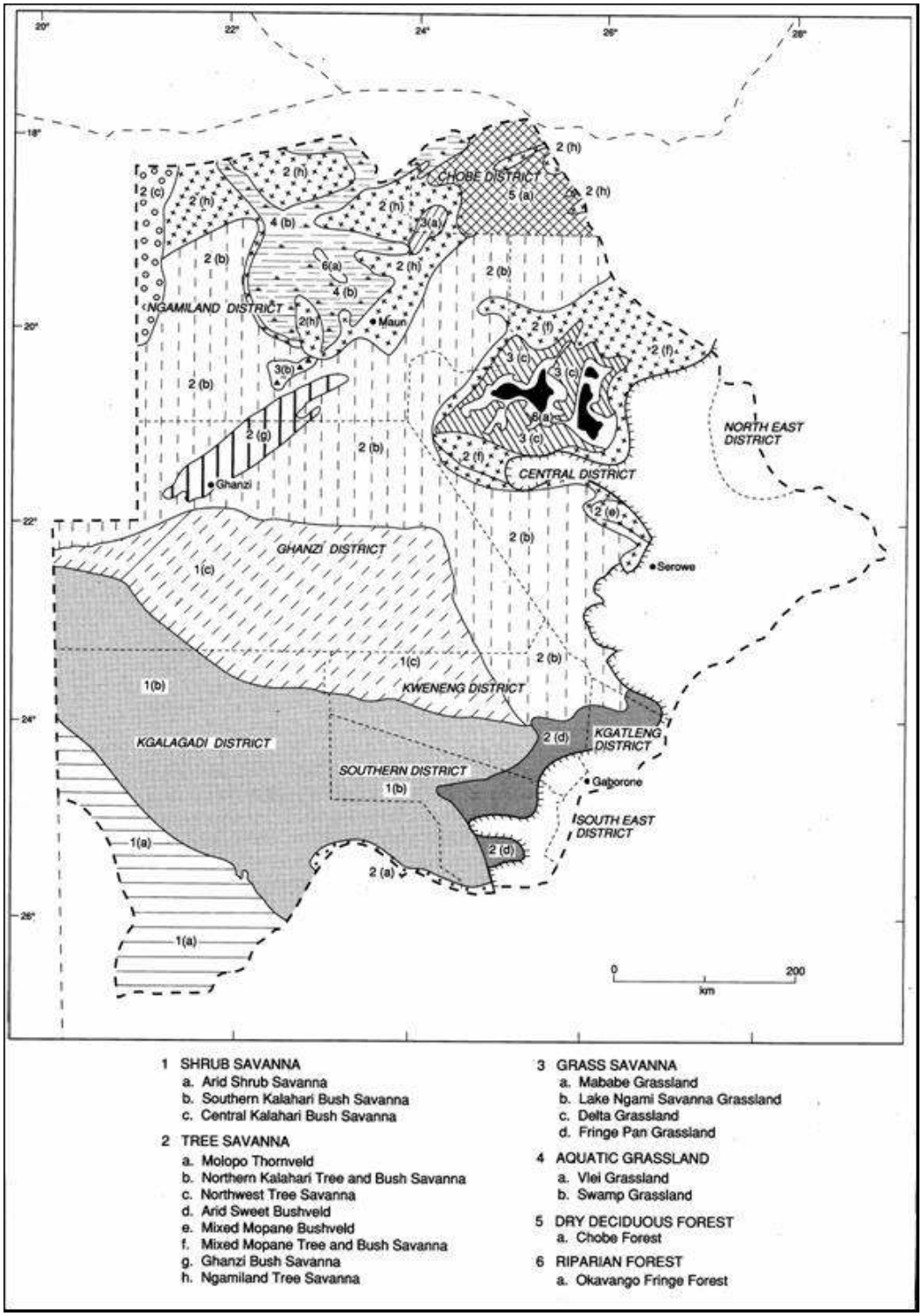

Fig 2 Land Systems Map & Legend (Source: Thomas & Shaw (1991))

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The Maps and accompanying legend tables are reconciled to a scale of 1:250,000, so they can only represent key major habitats. In order to identify key habitats[11] for species conservation, it is important to list the broad habitat types, and then narrow them down to areas of specific importance according to variability in climate, topography, soil types, availability of (sub-) surface water and habitat encroachment/fragmentation due to the development process.

The following Table (Table 2) attempts to draw out the different landscape types (as subtypes of the maps shown) in Botswana, and provide examples of important habitats that should be carefully studied prior to permitting major developments and/or human activities from disrupting the ecosystem.

The main recommendation, however is that for the purposes of this document (Endangered Species Conservation Policy and Guidelines), the table could form the basis for further, more detailed work on habitats and in identifying key areas for conservation of endangered species, as well as areas that are critical in preserving landscape function (climate amelioration, water catchments, CO_2 sinks and other key elements within Botswana's environment.

[11] The bulk of the information is taken from the FAO Range & Pastures Web Pages on Botswana: <http://www.fao.org/ag/AGP/AGPC/doc/Counprof/Botswana/botswana.htm>

Table 2 Broad Habitat types in Botswana

Broad habitat types	**Hardveld**		**Sandveld**		
Landscape position	**Example Locations**	**Significance**		**Example Locations**	**Significance**
Hill outcrops	Southeast, Central, Kweneng, & Kgatleng Districts	Wildlife refuges Water catchment areas	**Extremely Arid** • Shifting sand dunes **Arid to Mesic** • Large, vegetated dunes	W Kgalagadi District Ngamiland & Chobe Districts	Desert fauna and flora, especially small animals and micro-fauna and flora Habitat for medicinal plants e.g. Hoodia spp.
Rock outcrops	Tuli Circle, Francistown area, Serowe, Shoshong, Tswapong Hills, Lepokole Hills and most of E and SE of Botswana	Wildlife refuges	**Rock outcrops**	Tsodilo Hills Qangwa Hills Hainaveld & Kgwebe Hills	Caves provide habitats for unusual rodents and bats Provide water catchment zones with higher soil moisture content around the base of the hills
Hill footslopes	As above Gaborone – Kgale hill	Groves of tall trees and shrubs Wide variety of woody plant species in narrow eco-zones	**Interdune zones**	Ngamiland & Chobe Districts	Different soils and higher moisture collection and retention with higher quantities of forage for wildlife and livestock
Escarpments	Kanye, Thamaga, Shoshong Serowe, Tswapong	Important vulture nesting sites Vegetation species anomalies – species found 'out of place'	**Escarpments**	S Sua Pan	Vegetation species anomalies – species found 'out of place' Year round water seeping from lower footslopes crating

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Broad habitat types	**Hardveld**		**Sandveld**		
					habitat for water dependant species
Ridges	Central Tuli Block Mashatu – Tuli Circle	Important vulture nesting sites	**Ridges**	Ghanzi Boteti – Limpopo fossil drainage system ridge from Rakops to the Mashatu /Tuli Circle area	Hardveld corridor in the sandveld Habitat for plants such as *Sesamothamnus* and *Hoodia* plants
Rolling hills	Pandamatenga area	Hills are basic igneous providing soil parent material for the Pandamatenga Plains and rainfall runoff to recharge the seasonally inundated grasslands on heavy clay soils	**Rolling dunes**	Long parallel dune systems across northern Botswana, e.g. Chobe, Ngamiland	Seasonal migration corridors for elephant buffalo and other large wild herbivores moving from E to W and back
Lower plains	Limpopo River Valley, Tuli Block	Wildlife habitat, migration corridor for birds, aquatic life	**Upland Plains**	Chobe Forest Reserve	Year-round habitat for forest dwelling wildlife species Seasonal migration corridors for elephant buffalo and other large wild herbivores moving from E to W and back
Alluvial floodplains	**Pandamatenga**	**Breeding and Refuge habitat for important, globally threatened antelope species: Roan, Sable and Oribi**		**Selinda** **Okavango**	Wetlands of Major International Importance

Broad habitat types	Hardveld		Sandveld		
	Lerala, E Tuli Block	Uncertain status		**Linyanti Swamps** **Parakarungu (Chobe Enclave)**	
Pans	Nunga River	Series of pans along a fossil river valley draining across from S Pandamatenga – Sibuyu Forest area into the N Nxai Pan area Forms the alignment of a major wildlife migration from Hwange Game Reserve in Zimbabwe to Nxai Pan and westwards to the Okavango Delta	**Pans**	NW Kgalagadi District to Southern District (Ukwi Pan to Good Hope via Kang, Hukuntsi, Sekoma) Also Nxai Pan and adjacent pans associated with the N Makgadikgadi Pans area	Pans are aligned in a broad NW-SE trend from NW Kgalagadi District into SW Ghanzi District to the upper catchment of the Okwa Valley system. This system provides a widespread seasonal migration destination for large herbivores (mainly cattle nowadays) from W Botswana to the CKGR
Rivers	Important hydrological function: sustaining moisture and affecting local climate				
• **Perennial** • **Ephemeral**	Chobe, Zambezi, Limpopo Shashe, Tati, Notwane, Metsemotlhaba	Important, seasonal bird migration routes Seasonal foraging and watering resources between	• **Ephemeral**	Boteti, Molopo Okwa & Serorome Fossil Drainage Valleys Subsurface water found by digging in the sand /	Seasonal foraging and watering resources between the surrounding vegetation and the river for many wildlife species (and livestock)

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Broad habitat types	**Hardveld**		**Sandveld**		
		the surrounding vegetation and the river for many wildlife species (and livestock) Provide linking habitats for plant species associated with river systems found far from their main habitats	• **Permanently dry**	mud Nossop - Auob Rivers	Different soils and higher moisture collection and retention with higher quantities of forage for wildlife and livestock
Riverine fringes	Limpopo, Motloutse, Shashe, Tati, Chobe, Okavango, Zambezi Selebi-Phikwe, Mashatu	Refuge and breeding habitats for many wild animals and birds Specific habitat for large groves of large trees (*Acacia galpinii, Zanthoxylum capensis*) Provide contiguous habitat corridors to enable wildlife species to move long distances improving species viability and survival rates	**As above**	As above	Fringing vegetation is generally taller, providing shade and refuge for wildlife, birds etc., and fuel wood for people
Reservoirs (and Sewerage ponds)	Gaborone, Shashe, Letsibogo, Bokaa, Notwane, Dikabeya	Important, seasonal bird migration routes Important seasonal breeding and feeding grounds for many aquatic birds, reptiles, amphibians etc.	**Dry lakes**	Makgadikgadi Pans	Important breeding habitat for Pelicans and Flamingos Breeding habitat for fish species and macropods, gastropods etc, important in the food chain for Flamingos and Pelicans

Broad habitat types	Hardveld		Sandveld		
Geological anomalies	Gypsum deposits near Foley Siding and in Maitengwe Artesian water supplies near Bobonong and in S Sua Pan	Sole known habitat for certain *Euphorbia* plant species Formation of very small wetland areas (<1ha. Extent) providing habitat for various frogs, turtles and other wetland species in unusual locations	**Geological anomalies**	Kimberlite deposits sub-cropping e.g. Orapa, Letlhakane, Jwaneng, Tswapong Shinamba Hills in E Chobe National Park near the Maikaelelo Forest Reserve	Vegetation changes due to hardveld sub-cropping into the sandveld High economic potential of these areas leading to major economic activity and demand for resources from adjacent areas – predominantly water
Tension Zones	Ngwapa and Tswapong Hills and lower footslopes **Lepokole Hills** S Sua Pan area N Ghanzi area	Rapid landscape changes from rocky hills to clayey alluvium &/or sandveld with perennial springs provide habitat for a wide variety of water-dependant wildlife species – good for ecotourism Convergence zone for Ghanzi rock subcrop - Hainaveld hills – W Kalahari Sandveld and Mopane woodland with a series of pans providing water, forage, refuge and breeding habitat for a wide variety of water-dependant wildlife species – good for ecotourism	**Tension Zones**	Thamalakane Fault Nata and Nata-Sibuyu Forest inter-zone	Rapid landscape changes from sandy ridges to clayey alluvium &/or sandveld with artesian springs &/or shallow ground water in pan systems providing water, forage, refuge and breeding habitat (Miombo woodland, Delta fringe, Mopane woodland and Sandveld vegetation convergence zone) for a wide variety of water-dependant wildlife species – good for ecotourism

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13 December 2013

IUCN Evaluation of Okavango Delta (Botswana) – Request for Supplementary Information

Dear Ambassador,

The IUCN World Heritage technical evaluation mission to the Okavango Delta was undertaken by Mr Peter Howard and Mr Alan Wheeler from 13 to 20 October 2013. The evaluators greatly appreciated the excellent support and co-operation provided by your colleagues in the preparation and implementation of the mission, and the kind welcome of the State Party throughout the mission. Please convey our sincere thanks to all of the officials, scientists and contributors that assisted the evaluator in undertaking the mission.

The IUCN World Heritage Panel is in the course of examining World Heritage nominations for natural and mixed properties, and cultural landscapes. This process will conclude in March 2014. At its first meeting earlier this month, the IUCN Panel examined in detail each nomination dossier, reports and desktop reviews of field evaluators and external reviewers, as well as other references regarding the nominated properties. We have subsequently been considering further the findings of the Panel on the different nominations being evaluated this year.

As noted in previous correspondence, IUCN seeks to develop and maintain a dialogue with States Parties during the evaluation process. The Panel noted some points where additional information is required, and we would be grateful for the State Party's response on the following points, and for a separate answer to be given to each point raised:

1- OKACOM endorsement of the nomination: we would be grateful for written confirmation that an official statement confirming that Botswana's proposal to nominate the Okavango Delta as a world heritage site was approved at the June 2013 meeting of the Permanent Okavango River Basin Water Commission (OKACOM). We would be grateful for a copy of this statement.

2- Buffer Zone description: we would be grateful for a further explanation of the proposed Buffer Zone, its technical rationale, and its relationship to the property. In particular, the description of the Buffer Zone should address the specific issues specified in the Operational Guidelines (paras 103-107), and summarise the protection and management issues that the buffer zone will address, and how it will do so. We note that Buffer Zones are not considered to be part of the nominated property, but instead are conceived to protect the Outstanding Universal Value of the property that has been nominated.

3- Mineral prospecting licenses: IUCN notes the clear position of the World Heritage Committee that extractive industry is incompatible with World Heritage Site status. We would therefore be grateful for a map showing the remaining extant prospecting licenses, which we understood currently cover part of the nominated property, together with an itemized list linked to the map of the status of each of these concessions, and confirmation that each concession is neither currently active, nor will become active. We would further be grateful for a clear statement, from the responsible authority for mining activities

in Botswana to assure that these licences will not be exploited, and provide a clear commitment to their termination, including a timeframe for completing this process. We would further request information on the status of licences in the Buffer Zone, and what measures (including EIA and other safeguards) are anticipated to ensure that these do not create impacts on the nominated property.

4- San People's cultural heritage and user access rights: the Panel considered that additional recognition needs to be given to the cultural heritage of the indigenous inhabitants of the delta region, and that some fears of eviction from the property were raised during the evaluation mission. We noted concerns were raised by some groups during the evaluation that the nomination would lead to the loss of rights, and also noted that assurances have been given that this is not the case. We would be grateful if the commitment of the State Party to recognizing the rights of indigenous peoples with the nominated property could be stated in writing, including regarding recognition that traditional access rights – to material resources and cultural sites - will be respected and incorporated into future management arrangements. We would be grateful for specific confirmation that no eviction of indigenous peoples is foreseen, or will be undertaken. We would also be grateful if the State Party could provide a summary of the main cultural groups and their specific cultural attributes and association with the land and its resources.

5- Management Planning arrangements. Each of the main recognised land management categories within the core area of the nominated property (e.g. Game Reserve, Wildlife Management Area – commercial leasehold, WMA – Community Trust, Open Residential/Pastoral etc) needs to be described, with details of its legal status (e.g. at what level of government are decisions taken to designate or re-classify an area?) and main management features/agency responsibilities. This description should include a Table showing the area, legal and management status (lease type and number) for each land management unit (e.g NG/10, NG/12, NG/25, NG/38 etc). Given the complexity of management of the property, we would also be grateful for a simple summary of the extent of coverage of the property by management plans, and with examples of plans provided for Wildlife Management Areas that fall within the nominated area and are managed by (a) a Community Trust, (b) an exclusive-area tourism leasehold, and (c) are based on multi-leasehold tenure (facility-based leaseholds).

6- Update on animal population census results: following the completion of a comprehensive aerial census of the principal large mammals by the DWNP in 2012, a review of present population estimates for key species and trends over the delta area should be included, showing comparable statistics from previous periods. A detailed monitoring program is also requested.

7- We would be grateful for a succinct statement regarding the approach proposed by the State Party to hunting within the property.

8- We noted the long-standing concerns regarding biodiversity conservation within the Okavango in relation to the impacts of fencing on migratory species, and the sensitivity of this issue. We would be grateful if the State Party could indicate its vision regarding the management of fencing of the property, and the potential to eliminate barriers to migratory corridors, to the extent possible, together with the forward plan of management of fencing, and fencing removal in relation to the property.

We would appreciate your response to the above points as soon as possible, in order to facilitate the evaluation process, but **no later than the 28 February 2014**, as per paragraph 148 of the Operational Guidelines. Please note that any information submitted after this date will not be considered by IUCN in its evaluation for the World Heritage Committee. It should be noted, however, that while IUCN will carefully consider any supplementary information submitted, it cannot properly evaluate a completely revised nomination or large amounts of new information submitted at the last minute. So we request to keep your response concise and respond only to the above requests.

Supplementary information should be submitted officially in three copies to the UNESCO World Heritage Centre in order for it to be registered as part of the nomination. An electronic copy of any supplementary information to both the UNESCO World Heritage Centre (a.balsamo@unesco.org) and IUCN Headquarters (christelle.perruchoud@iucn.org) would also be helpful.

Taking into account your response, IUCN will formulate its final recommendation to the World Heritage Committee which will meet from 15 to 25 June 2014 in Doha, Qatar.

In the interests of ensuring full transparency and dialogue regarding the IUCN evaluation process, we are happy to respond to any questions you may wish to raise regarding IUCN's work on the World Heritage Convention, including the present evaluation. I will be present in Paris several times during the early part of 2014, and available to meet if this would be helpful. You are also most welcome to visit IUCN if you wish.

Please do not hesitate to contact Ms Christelle Perruchoud, World Heritage Programme Assistant (Tel: +41 22 999 0358; Fax: +41 22 999 0002; email: christelle.perruchoud@iucn.org) if you have any questions.

Let me again reiterate our thanks for your support of the World Heritage Convention and for the conduct of IUCN's recent mission. We look forward to your kind cooperation in furnishing responses to the abovementioned points.

Yours sincerely,

Tim Badman
Director - World Heritage Programme

cc. Botswana National Commission for UNESCO, Mrs Kholeka Moilwa, Acting Secretary-General
UNESCO World Heritage Centre, Mr. Lazare Eloundou Assomo and Mr. Alessandro Balsamo
IUCN Regional Office for Eastern and Southern Africa, Mr. Ali Aliraza Kaka, Regional Director

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Att: The World Conservation Union

Date: 17/02/2014

Ref: Listing of the Okavango Delta as a World Heritage Site

Dear Sir/Madam

This letter is meant to inform that the listing of the Okavango Delta as a World Heritage Site, has been submitted for OKACOM discussions and consideration in a number of occasions that started in 2010 during the 16th OKACOM meeting held in Gaborone. At this occasion it was indicated that a decision on the way forward had to be guided by proper understanding of the implications of such a listing on the upstream riparian States.

During the 19th OKACOM meeting held in May 2013 in Maun the matter was once again put under OKACOM discussions and consideration, and overall, OKACOM delegations from the upper catchment namely, Angola and Namibia expressed they support to Botswana's proposition to nominate the Okavango Delta as a World Heritage following the outcomes of the consultation process conducted with various stakeholders across the various countries and sectors as per recommendation made in previous discussions over the subject matter.

OKACOM as a transboundary River Basin Organization has, therefore, endorsed the listing process with a recommendation for it to move forward while securing continuous engagement and exchange of critical information with all relevant stakeholders across the basin. It was also noted that such a listing should not be perceived as another red tape preventing upstream riparian states to also extract benefits from the sustainable use of basin resources for the improved livelihoods of basin population. This communication should be regarded as the official OKACOM position adopted at the 19th OKACOM meeting held in June 13, 2013, Maun Botswana.

Yours Sincerely,

Ebenizario Chonguiça
Executive Secretary
OKACOM Secretariat

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OKACOM

PERMANENT OKAVANGO RIVER BASIN WATER COMMISSION

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Summary Document:

Revision of the boundaries of the core and buffer zones of the proposed Okavango Delta World Heritage Site & a focus on the role of the buffer zone

The revision of the Boundaries

A revision of the boundaries of the proposed Okavango Delta World Heritage Site was undertaken because of concerns raised over the alignment of the originally proposed core and buffer zone boundaries, which may potentially undermine the capacity of the site to preserve the Outstanding Universal Value of the Delta. Specific issues of concern which were raised include; the exclusion of particular habitats and areas important for hydrological processes, the exclusion of dry land areas around the Delta on which many wildlife populations in the Delta depend, the inclusion of large settlements within the core, the alignment of the buffer which may conflict with developments such as mining, and a concern about the transparency and robustness of the process used to align the original boundaries.

A multi-criteria GIS-based analytical approach was used to overcome the issues of transparency and to ensure all of the critical habitats, wetland systems and channels are included within the core and buffer zones. Using the selected features a multi-criteria evaluation embedded within a GIS allowed for a transparent process to identify those areas of the system that are most important to preserve the stated Outstanding Universal Value and those areas that are most vulnerable to the key negative driving forces affecting the system.

The process included preparation of GIS base data, structured consultation with a broad range of stakeholders within the region, incorporation of stakeholder feedback into the analysis, a stakeholder review workshop, development of site delineation rules, and development of proposed boundaries derived from the analysis and stakeholder inputs. The boundaries were validated by expert and government stakeholders, with the latter process being facilitated by the Department of National Museum & Monuments. The process resulted in revised WHS core and buffer areas, with a clear justification for the boundaries.

The original proposal identified a core area of approximately 1,650,000ha, with a buffer of approximately 3,480,000ha. Following the revision these areas were adjusted, with an increase in the size of the core area to 2,023,590ha, but a reduction in the size of the buffer zone to 2,286,630ha. The buffer zone was reduced in size to the west of the Delta, while maintained to the east of the Delta. Specific concerns about the alignment of the buffer to the west of the Delta were raised in relation to the prevalence of prospecting licences for mining in the far northeast, but also in terms of potentially unjustified limitations posed by the very extensive buffer proposed elsewhere along the west and south of the Delta. The extension of the buffer zone to the International Boundary with Namibia was justifiable as there were limited restrictions on development activities and the overlap of the Buffer with important migratory wildlife corridors.

The operational guidelines provide guidance in terms of necessary boundary alignment for effective protection of the property:

a. Boundaries should be drawn to ensure the full expression of the Outstanding Universal Value and the integrity and/or authenticity of the property.
b. For properties nominated under criteria (vii) - (x), boundaries should reflect the spatial requirements of habitats, species, processes or phenomena that provide the basis for their inscription on the World Heritage List. The boundaries should include sufficient areas immediately adjacent to the area of Outstanding Universal Value in order to protect the property's heritage values from direct effect of human encroachments and impacts of resource use outside of the nominated area.
c. The boundaries of the nominated property may coincide with one or more existing or proposed protected areas.

The Operational Guidelines also provide guidance on buffer zones, which are not in themselves part of the WHS, but which surround the nominated property and have restrictions placed on their use and development to give the property effective protection. The Operational Guidelines specify that:

a. A buffer zone is required wherever it is necessary for the protection of the property.
b. They should include the immediate setting of the nominated property, important views and other areas or attributes that are functionally important as a support to the property and its protection.
c. The area constituting the buffer zone should be determined in each case through appropriate mechanisms.

Based on the above guidance it was clear that:

- The delineation of the property needs to be specifically linked to the features and processes which are the basis for its Outstanding Universal Value.
- The boundaries need to be sufficient to fully include areas necessary for these features and processes.
- The buffer area needs to be sufficient to protect the core area from unacceptable impacts.
- The basis for determining the boundaries needs to be robust, transparent and clearly explained.

NB: Refer to document annexed on Boundary Revision Outline for the rationale and justification for revising the boundaries.

Boundary Description of the Core and Buffer Areas

BOUNDARY DESCRIPTION

THE CORE AREA

Commencing at a point marked NG/7/10/NA (app. co-ord. 34E581110N7981350), being a point on a cutline indicating the international boundary of Botswana with Namibia at the western bank of the Okavango River basin, in a point marked NG/10/11/NA (app. co-ord. 34E583290N7981730),the boundary crosses the Okavango River eastwards along a cutline indicating the international boundary of Botswana with Namibia at the eastern bank of the Okavango River basin and follows the said bank north-eastwards then south-eastwards (133°) for app. 79km to a point marked NG/10/11/12 (app. co-ord. 34E649300N7919610), being a point along the banks of the Okavango River in Seronga Village; thence follows the banks of the Okavango River in a southwards (189°) for app. 1km to a point marked NG/10/12 (app. cord. 34E649140N7918570), being a point at the Seronga boat jetty; point marked NG/10/11/12 (app. co-ord. 34E649300N7919610), thence follows the main Selinda Spill-way channel north-eastwards then eastwards to a point marked NG /12/16/22 (app. Co-ord. 34E710900N7925400) being a corner of the northern Buffalo Fence at Sandoroka lagoon; thence following the fence line due north to a point marked NG /11/12/14/16 (app. Co-ord. 34E714800N7947300) being the point of intersection of the Seronga-Savuti road with the south-north intersection of the northern Buffalo fence, the boundary follows the said road in a southeasterly direction (105°) to appoint of intersection of the road with Selinda Spillway; thence following the most northern channel of the said spillway in a northeasterly direction (74°) to a point marked NG /14/16/C (app. co-ord. 34E768400N7955200), thence in an easterly direction to a point marked NG 14/15/16/B (app. co-ord. 34E77120000N7955000) being a point in the middle of the Kwando which is forms the International boundary with Namibia; thence in a straight line in a southwesterly direction(196°) to a point marked NG 15/16/18/20 (app. co-ord. 34E767800N7943900) being a point on the southern bank of the beginning of the Savuti Channel; thence south-eastwards and eastwards along the Seronga-Savuti road to a point marked NG/15/18/CH3 (app. co-ord. 34E804700N7926300), being the point of intersection of the said road with the Chobe National Park boundary due south to a point marked NG/18/19/40 (app. co-ord. 34E803400N7892900); thence in a straight line due west to a point marked NG/18/19/C (app. co-ord. 34E798900N7892900), being a point at the top of Khwai north air strip; thence follows the airstrip in a westerly direction to a point marked NG/ 18/19B (app. co-ord. 34E797900N7892400), being a point just south of the airstrip at the road from the airstrip to a beacon BPS256 thence following the said road in a west-southwesterly direction to appoint marked NG /18/19/A (app. co-ord. 34E785500N7888200)NGH /18/19/28; (app. co-ord. 34E785500N7878900); on the northern bank of the Khwai River, thence follows the Khwai River in an easterly direction to a point marked NG/19/28/40 (app.co-ord. 34E803400N7882700) to the Chobe National Park boundary, thence follows the said marked park boundary due south to a point marked NG 18/19/40 (app. co-ord. 34E804700N7926300), being the point of intersection of the said Chobe National Park boundary due south to a point marked NG /18/19/40 (app. co-ord. 34E803400N7892900); thence in a straight line due south for about 85km to a point marked NG/ 41/42/CH 3 thence south-wards then west-wards, thence follows the said cutline

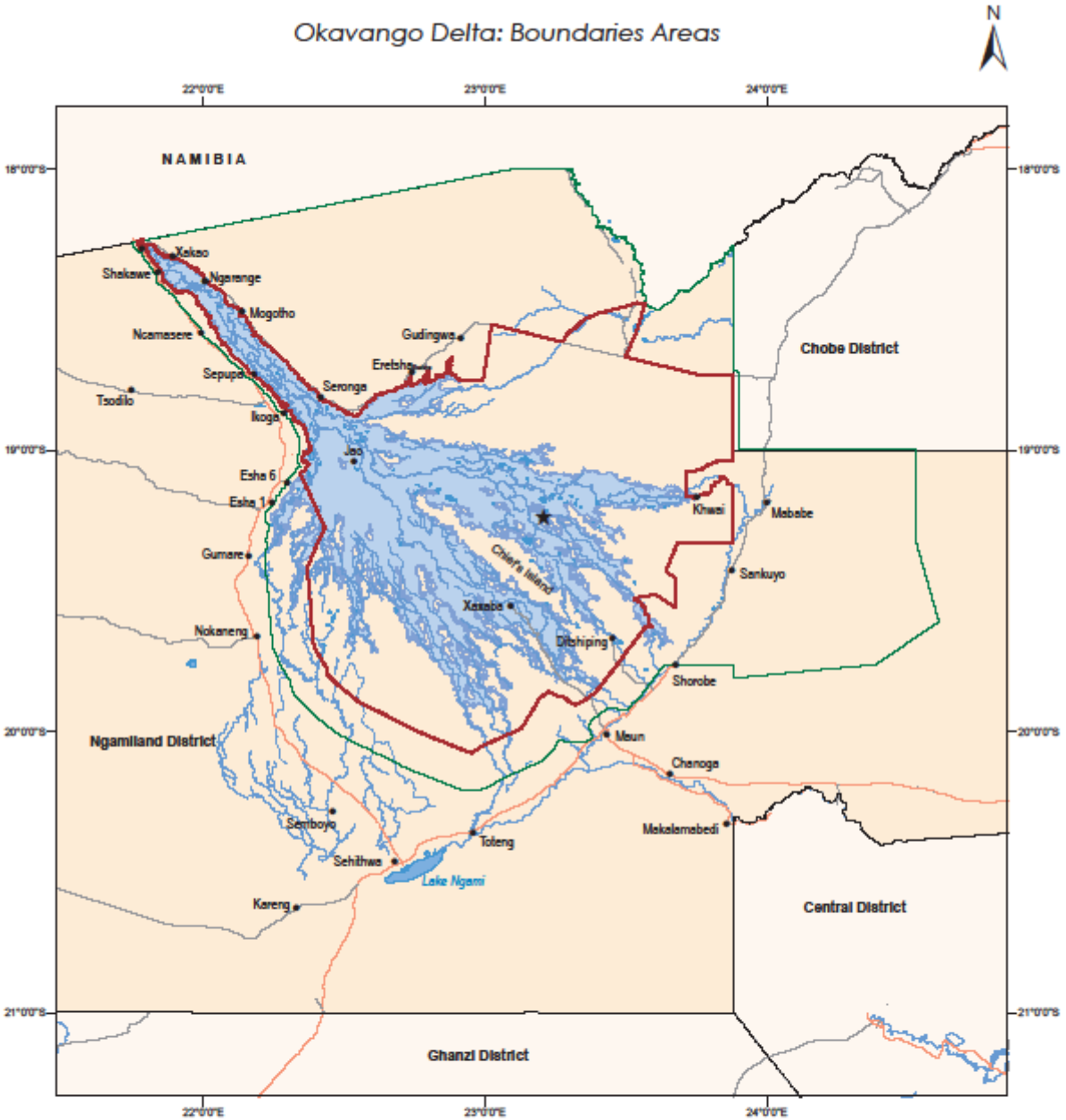
southwards to a point marked NG/28/34/40/41/43 (app. co-ord. 34E802880N7860020), being the point of intersection with a cutline and a track, indicated by an iron standard set in concrete marked 76; thence follows the said cutline westwards to a point marked NG/28/34 (app. co-ord. 34E782200N7860150); being a corner of Moremi Game Reserve), thence due south to a point marked NG /28/33/34A (app. co-ord. 34E777500N7849700) being the entrance point to Moremi Game Reserve; thence along the road to Maun in a southeasterly direction to a point marked NG /33/34/A (app. co-ord. 34E7808000N7846900); thence in a southerly direction to a point marked NG/32/34/35 (app. co-ord. 34E771300N7827780), being the point of intersection with the most western channel of the Gomoti River, indicated by an iron standard set in concrete marked 106 and NG/32/34/35 (app. co-ord. 34E771300N7827780), being the point of intersection with the southern buffalo fence, thence follows the said fence westwards, south-westwards and northwestwards to a point marked NG/30/32/35 (app. co-ord. 34E733130N7802920), being a corner point in the fence, indicated by an iron standard set in concrete marked 115; thence follows the fence southwestwards to a point marked NG/29/30/35 (app. co-ord. 34E717620N7785930), being the point of intersection with Xudum River; thence follows the said fence southwestwards and northwestwards to a point marked NG/8/26/29 (app. co-ord. 34E650400N7813340), being a point at a bend in the western buffalo fence near Habu Gate; thence follows the said fence northwards to a point marked NG/8/25/26 (app. co-ord. 34E648180N7862790), being a point on the western buffalo fence;; thence follows the said fence northeastwards (24°) for app. 4km to a point marked NG/7/8/25 (app. co-ord. 34E649820N7866500), being a point at a bend in the western buffalo fence; thence follows a straight line northwards to a point marked NG/7/24/25 (app. co-ord. 34E643810N7884050), being a point on the edge of Thaoge River, east of Wabe Lagoon; thence follows the said river northwards to a point marked NG/7/10/24 (app. co-ord. 34E640770N7910570), being a point in the middle of the said river,; thence in a straight line north-westwards to a point marked NG/7/10/A (app. co-ord. 34E635280N7913710), thence follows the fringes of the Okavango River basin in a north-westward direction to the point of commencement.

The Buffer Area

Commencing 2km west of a point marked NG/7/10/NA (app. coord. 34E581110N7981350), being a point on a cutline indicating the international boundary of Botswana with Namibia at the western bank of the Okavango River, thence follows along the international boundary to a point marked NG/10/11/A (app. co-ord. 34E583290N7981730), being the point of intersection with a cutline indicating the international boundary of Botswana with Namibia; thence follows the said cutline eastwards to a point marked NG/ 13/14/NA (app. co-ord. 34E742130N8008510) being the point of intersection with the middle of the Kwando River, the boundary follows the middle of the Kwando River southeastwards (152°) for app. 60km to a point marked NG/14/15/16/NA (app. co-ord. 34E771420N7954990), being a point in the middle of the said river to a point marked NG/15/CH/3/NA (app. co-ord. 34E804800N7977640), being the point of intersection with a cutline indicating Chobe National Park boundary, on the line of projection from iron standard marked15, through and indicated by an iron standard set in concrete (app. co-ord. 34E770270N7955070), marked 14, the boundary follows the said cutline southwards (181°) for app. 47km to a point marked NG/15/18/CH/3 (app. co-ord. 34E803980N7926540), being the point of intersection with the

Savuti-Seronga track, thence eastwards for 2km into the Chobe National Park thence southwards parallel to the core boundary, thence follows the said cutline southwards (181°) for app. 34km to a point marked NG/18/19/40 (app. co-ord. 34E803430N7892900), thence eastwards along the boundary following the said cutline eastwards (88°) to a point marked NG/41/42/CH/3 (app. co-ord. 35E240320N7897480), thence follows a straight line southwards (179°) for app. 37km to a point marked NG/41/42/43 (app. co-ord. 35E240840N7860300), thence follows a straight line southwards (164°) for app. 32km to a point marked NG/42/43/47 (app. co-ord. 35E249470N7829910), thence follows in a southwestwards direction (234°) for app. 29km to a point marked NG/43/47, (app. co-ord. 35E226010N7812770), thence westwards (263°) for app. 53km to a point marked NG/35/43/45, being the point of intersection with the fence at the northwestern corner of the Makalamabedi BLDC ranch (app. co-ord. 35E173390N7806500); thence in a southwesterly direction to join Maun Planning Area boundary to the west, circumventing the town of Maun to maintain the 15km radius from the core boundary in a southwesterly, northwesterly and northerly direction to a point marked NG/7/8 (app. co-ord. 34E626300N7875320), being a point at the intersection of the Shakawe/Gumare road, thence follows the road to Shakawe in a northerly and northwesterly direction and from here, maintaining a 2km core-buffer radius to the international boundary with Namibia which is a point of commencement.

Okavango Delta: Boundaries Areas



1 : 2 000 000

Area of Core Zone: 20 247.9 Sqkm

Area of Buffer Zone: 22 854.3 Sqkm

Coordinates of Center of Property: 23.094
-19.2003

★ Center of Property

Core Zone Boundary

Buffer Zone

Okavango Delta

• Settlements

Tarred Road

Gravel/Sandy Road

Prepared by Department of Surveys and Mapping

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No.	PROSPECTING LICENCES	EXPIRY DATE	STATUS EXPIRED OR ACTIVE	MINERAL	LOCATION	Company
1.	PL703/2009	30TH September 2012	Expired	Coal & CBM	Buffer	Greatways
2.	PL154/2012	30th September 2016	Active	Petroleum	Buffer	Baobab Resources
3.	PL641/2009	30th September 2012	Expired	Precious stones	buffer	Gcwihaba Resources
4.	PL642/2009	30th September 2012	Expired	Precious stones	buffer	Gcwihaba Resources
5.	PL046/2011	31st December 2013	Expired	Radioactive	Buffer	Gcwihaba Resources
6.	PL047/2011	31st December 2013	Expired	Radioactive	Buffer	Gcwihaba Resources
7.	PL050/2010	30th June 2013	Expired	Radioactive	Buffer	Gcwihaba Resources
8.	PL046/2009	31st December 2011	Expired	Radioactive	Buffer	Namenco Energy
9.	PL047/2009	31st December 2011	Expired	Radioactive	Buffer	Namenco
10.	PL048/2009	31st December 2011	Expired	Radioactive	Buffer	Namenco
11.	PL100/2012	31st March 2015	Active	Metals	buffer	Zhong gan
12.	PL099/2012	31st March 2015	Active	Metals	buffer	Zhong gan
13.	PL109/2012	31st March 2015	Active	Metals	buffer	Midgell
14.	PL571/2009	30th Sept 2014	Active	Base and Precious Metals	buffer	New Hana
15.	PL570/2009	30 Sept 2014	Active	Base and Precious Metals	Buffer & core	New Hana
16.	PL569/2009	30th Sept 2014	Active	Base and Precious Metals	Buffer & core	New Hana
17.	PL568/2009	30th Sept 2014	Active	Base and Precious	Buffer &	New Hana

				Metals	core	
18.	PL567/2009	30th Sept 2014	Active	Base and Precious Metals	Buffer	New Hana
19.	PL566/2009	30th Sept 2014	Active	Base and Precious Metals	Buffer	New Hana
20.	PL185/2013	30th Sept 2016	Active	Base and Precious Metals	Buffer	Hana Ghanzi
21.	PL098/2012	31st March 2015	Active	Base and Precious Metals	Core	Zhong Gan
22.	PL264/2012	30th Sept 2015	Active	Base and Precious Metals	Buffer	Zhong Gan
23.	PL040/2012	31st Dec 2014	Active	Base and Precious Metals	Buffer	Triprop
24.	PL059/2010	31st March 2013	Expired	Base and Precious Metals	Buffer	Manica
25.	PL062/2011	31st Dec 2013	Expired	Base and Precious Metals	Buffer	Pinette
26.	PL061/2011	31st Dec 2013	Expired	Base and Precious Metals	Buffer	Pinette
27.	PL392/2008	31st Dec 2013	Expired	Base and Precious Metals	Buffer	Gcwihaba Resources
28.	PL390/2008	31st Dec 2013	Expired	Base and Precious Metals	Core & Buffer	Gcwihaba Resources
29.	PL388/2008	31st Dec 2013	Expired	Base and Precious Metals	Core & Buffer	Gcwihaba Resources
30.	PL387/2008	31st Dec 2013	Expired	Base and Precious Metals	Buffer	Gcwihaba Resources
31.	PL386/2008	31st Dec 2013	Expired	Base and Precious Metals	Core & Buffer	Gcwihaba Resources
32.	PL393/2008	31st Dec 2013	Expired	Base and Precious Metals	Core & Buffer	Gcwihaba Resources
33.	PL394/2008	31st Dec 2013	Expired	Base and Precious Metals	Buffer	Gcwihaba Resources
34.	PL395/2008	31st Dec 2013	Expired	Base and Precious Metals	Buffer	Gcwihaba Resources

35.	PL095/2012	30th June 2012	Expired	Base and Precious Metals	Buffer	Gcwihaba Resources
36.	PL097/2012	31st March 2015	Active	Base and Precious Metals	Buffer	Gcwihaba Resources
37.	PL096/2012	31st March 2015	Active	Base and Precious Metals	Buffer	Gcwihaba Resources
38.	PL115/2010	31st March 2013	Expired	Base and Precious Metals	Core & Buffer	Cambow
39.	PL590/2009	30th June 2012	Expired	Base and Precious Metals	Core & Buffer	Gcwihaba Resources
40.	PL592/2009	30th June 2012	Expired	Base and Precious Metals	Core and Buffer	Gcwihaba Resources
41.	PL588/2009	31st December 2012	Expired	Base and Precious Metals	Buffer	Gcwihaba Resources

REPORT ON THE STATUS OF MINERAL CONCESSIONS WITHIN THE OKAVANGO DELTA

Prospecting Licenses (PLs) found in the Core and those overlapping the Core and Buffer Zones are mainly Metal Minerals, which is Base and Precious Metals. They are eleven (11) in total. There is one prospecting license that is in the Core Area and it is expiring on the 31st March 2015. The rest of the ten (10) Prospecting Licenses are overlapping the Core and Buffer Zone, seven (7) have expired, while three (3) are active and expires on the 30th September 2014.

The government of Botswana through the Ministry of Minerals, Energy and Water Resources has taken a position that it will not issue any new mineral concessions within the Core area of the delta. The Ministry will further engage with the holders of the few existing licenses within the Core area of the delta with a view to eventually expunge those portions of the licenses which overlap the core. Regarding the buffer area, stringent environmental protocols and practices will be adhered to, to protect the integrity of the Delta.

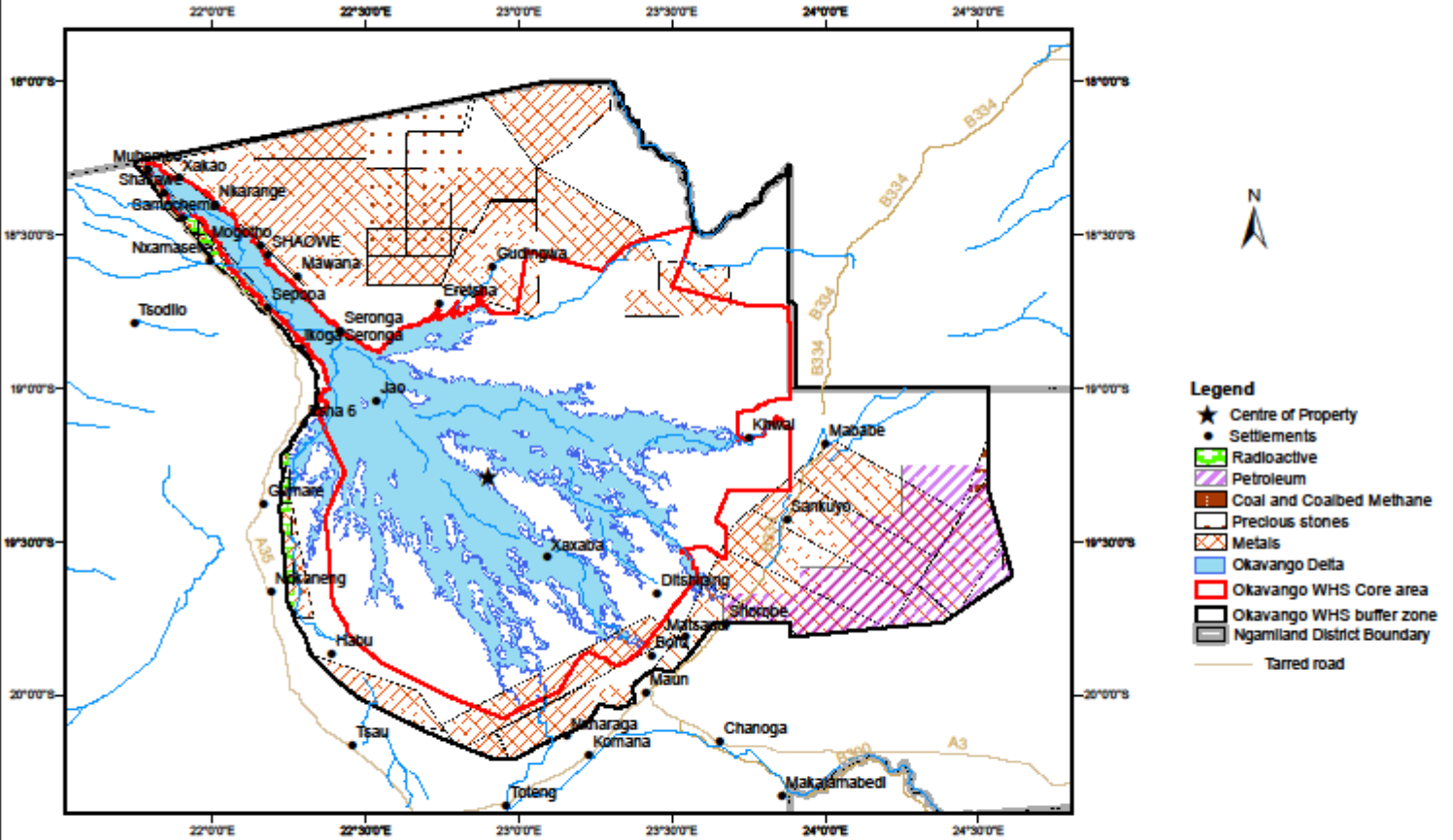
PROSPECTING LICENSES (PLs) IN THE CORE AND THOSE OVELAPPING THE CORE AND BUFFER ZONE

No.	PROSPECTING LICENCES	EXPIRY DATE	STATUS EXPIRED/ACTIVE	MINERAL	LOCATION	COMPANY
1.	PL098/2012	31st March 2015	Active	Base and Precious Metals	Core	Zhong Gan
2.	PL590/2009	30th June 2012	Expired	Base and Precious Metals	Core & Buffer	Gcwihaba Resources
3.	PL115/2010	31st March 2013	Expired	Base and Precious Metals	Core & Buffer	Cambow
4.	PL592/2009	30th June 2013	Expired	Base and Precious Metals	Core & Buffer	Gcwihaba Resources
5.	PL386/2008	31st December 2013	Expired	Base and Precious Metals	Core & Buffer	Gcwihaba Resources
6.	PL388/2008	31st December 2013	Expired	Base and Precious Metals	Core & Buffer	Gcwihaba Resources
7.	PL390/2008	31st December 2013	Expired	Base and Precious Metals	Core & Buffer	Gcwihaba Resources
8.	PL393/2008	31st December 2013	Expired	Base and Precious Metals	Core & Buffer	Gcwihaba Resources
9.	PL568/2009	30th September 2014	Active	Base and Precious Metals	Core & Buffer	New Hana
10.	PL569/2009	30th September 2014	Active	Base and Precious Metals	Core & Buffer	New Hana
11.	PL570/2009	30th September 2014	Active	Base and Precious Metals	Core & Buffer	New Hana

MAP SHOWING PROSPECTIVE LICENSES WITHIN THE CORE AND BUFFER OF THE PROPOSED OKAVANGO DELTA WORLD HERITAGE SITE

Proposed Okavango World Heritage Site

Expired and Active Prospecting Licences - Okavango Delta



Topographic data from Department of Surveys and Mapping
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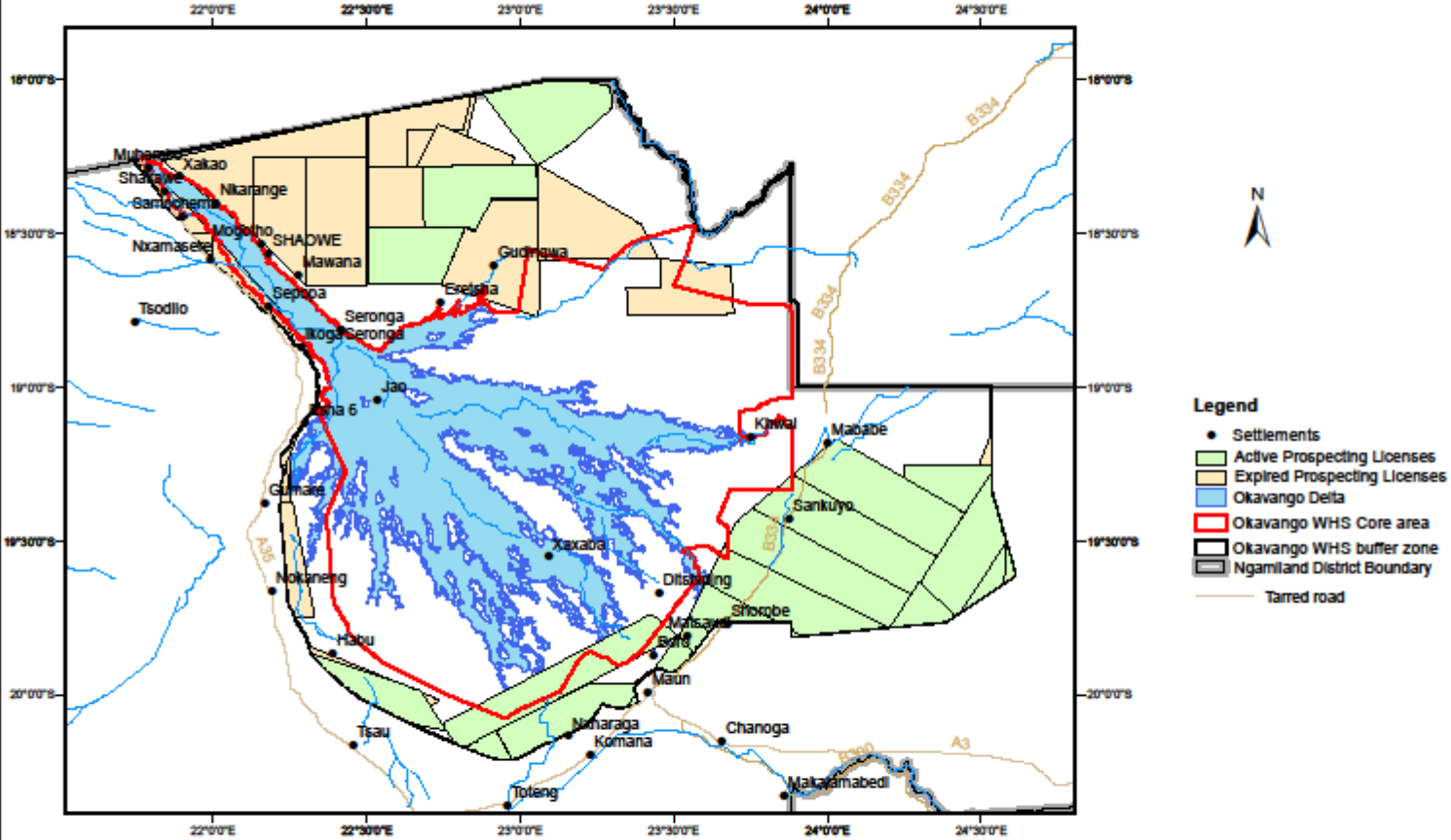
Scale: 1 : 2 000 000

Proposed Okavango World Heritage Site

Expired and Active Prospecting Licences - Okavango Delta



Legend

- Settlements
- Active Prospecting Licenses
- Expired Prospecting Licenses
- Okavango Delta
- Okavango WHS Core area
- Okavango WHS buffer zone
- Ngamiland District Boundary
- Tarred road

Topographic data from Department of Surveys and Mapping
Prepared by The Department of Mines
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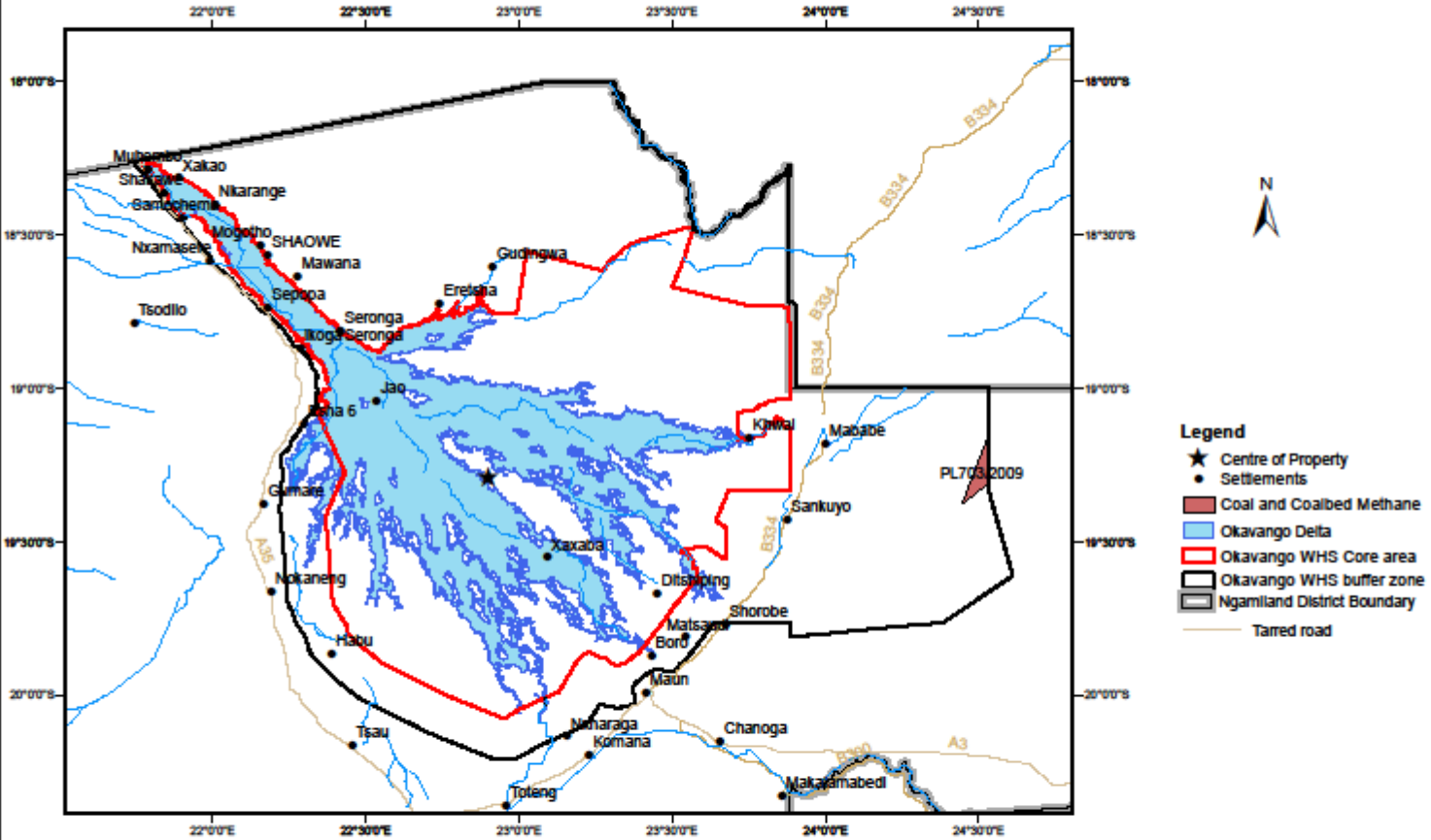
0 25 50 100 Kilometers

Scale: 1 : 2 000 000

MAPS SHOWING PROSPECTING LICENSES (PER MINERAL) WITHIN THE CORE AND BUFFER OF PROPOSED OKAVANGO DELTA WORLD HERITAGE SITE

Proposed Okavango World Heritage Site

Prospecting Licences (PLs) for Coal & Coalbed Methane



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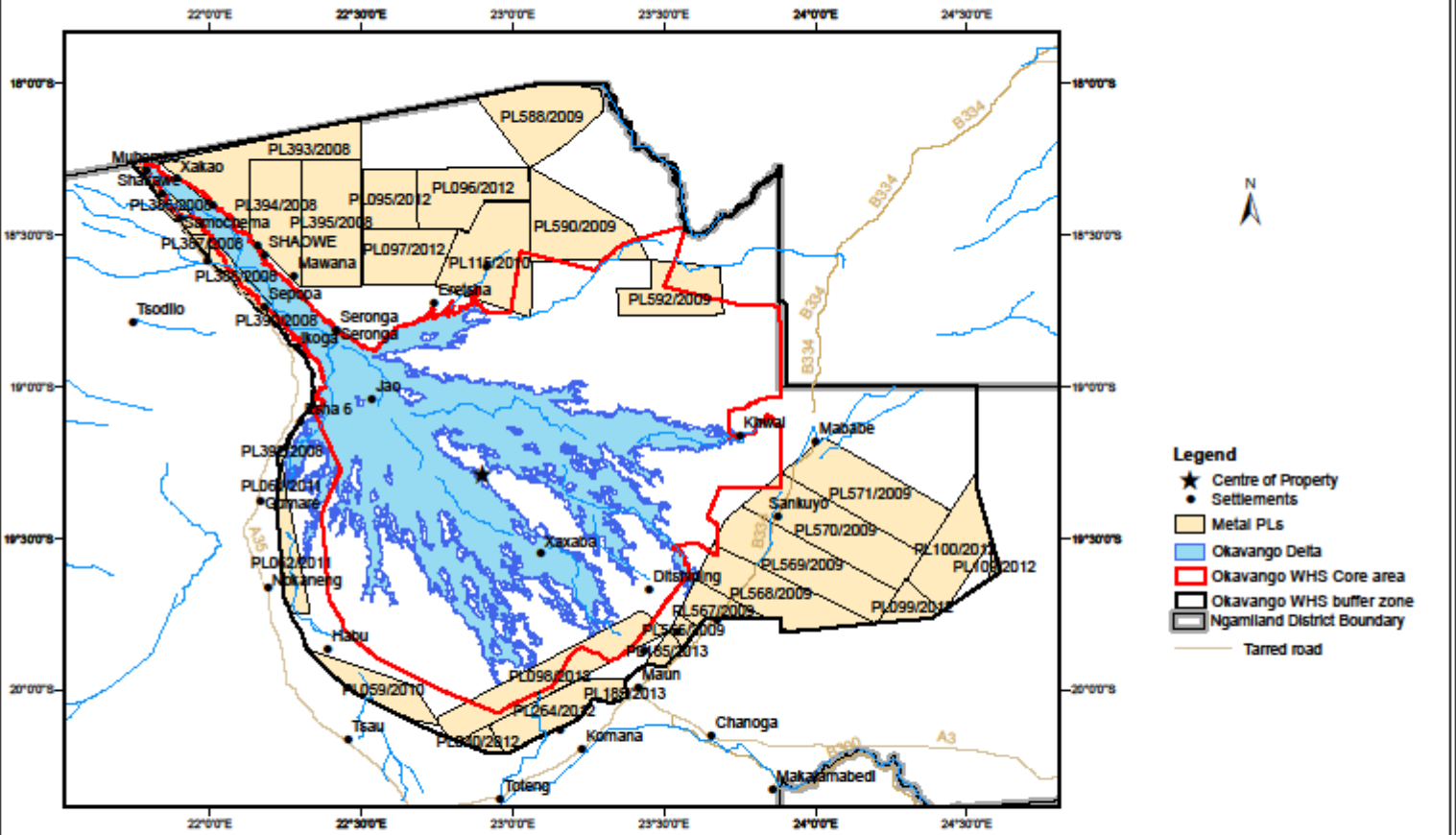
Proposed Okavango World Heritage Site

Prospecting Licences (PLs) for Metal Minerals



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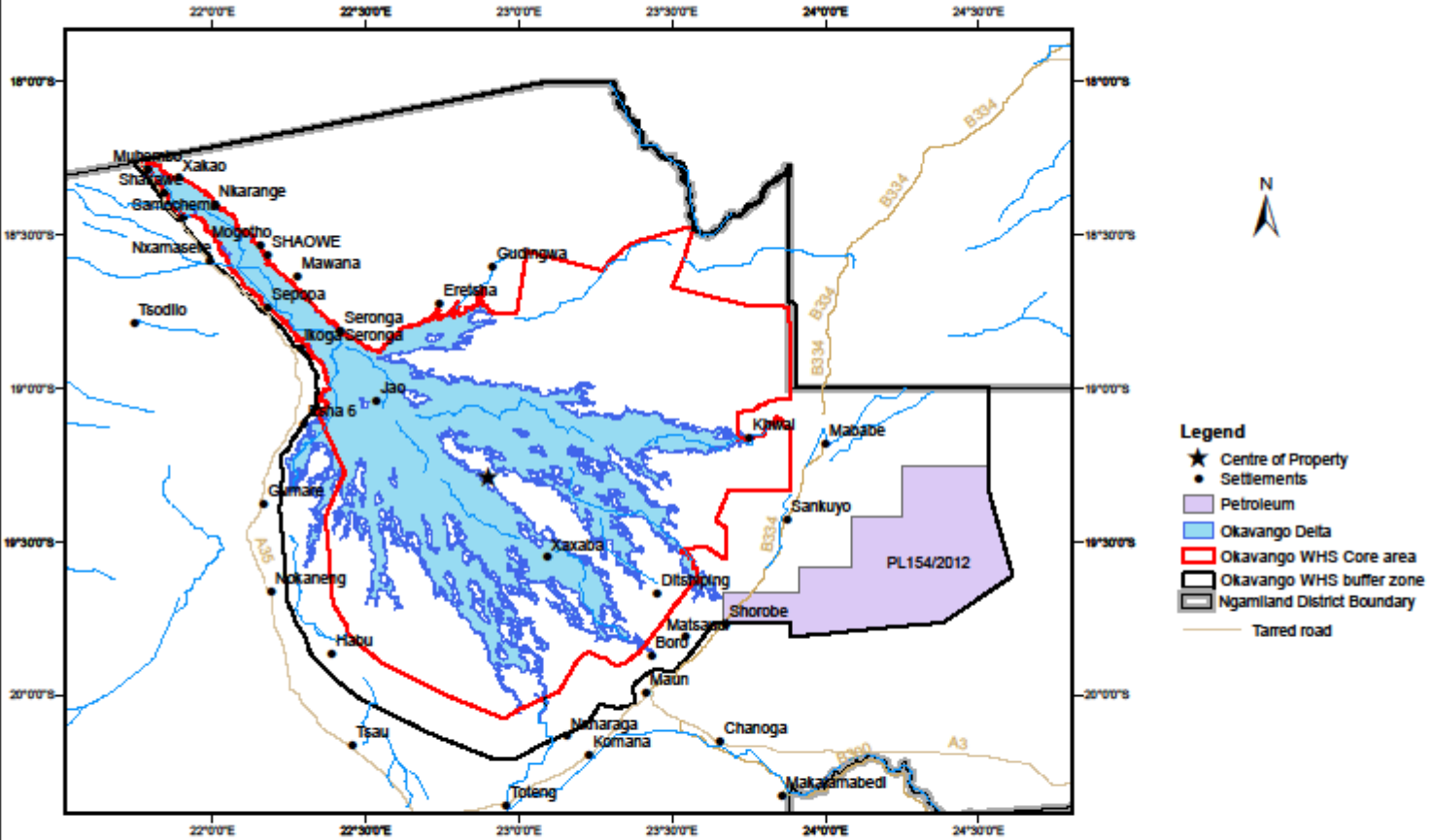
Proposed Okavango World Heritage Site

Prospecting Licences (PLs) for Petroleum



Topographic data from Department of Surveys and Mapping
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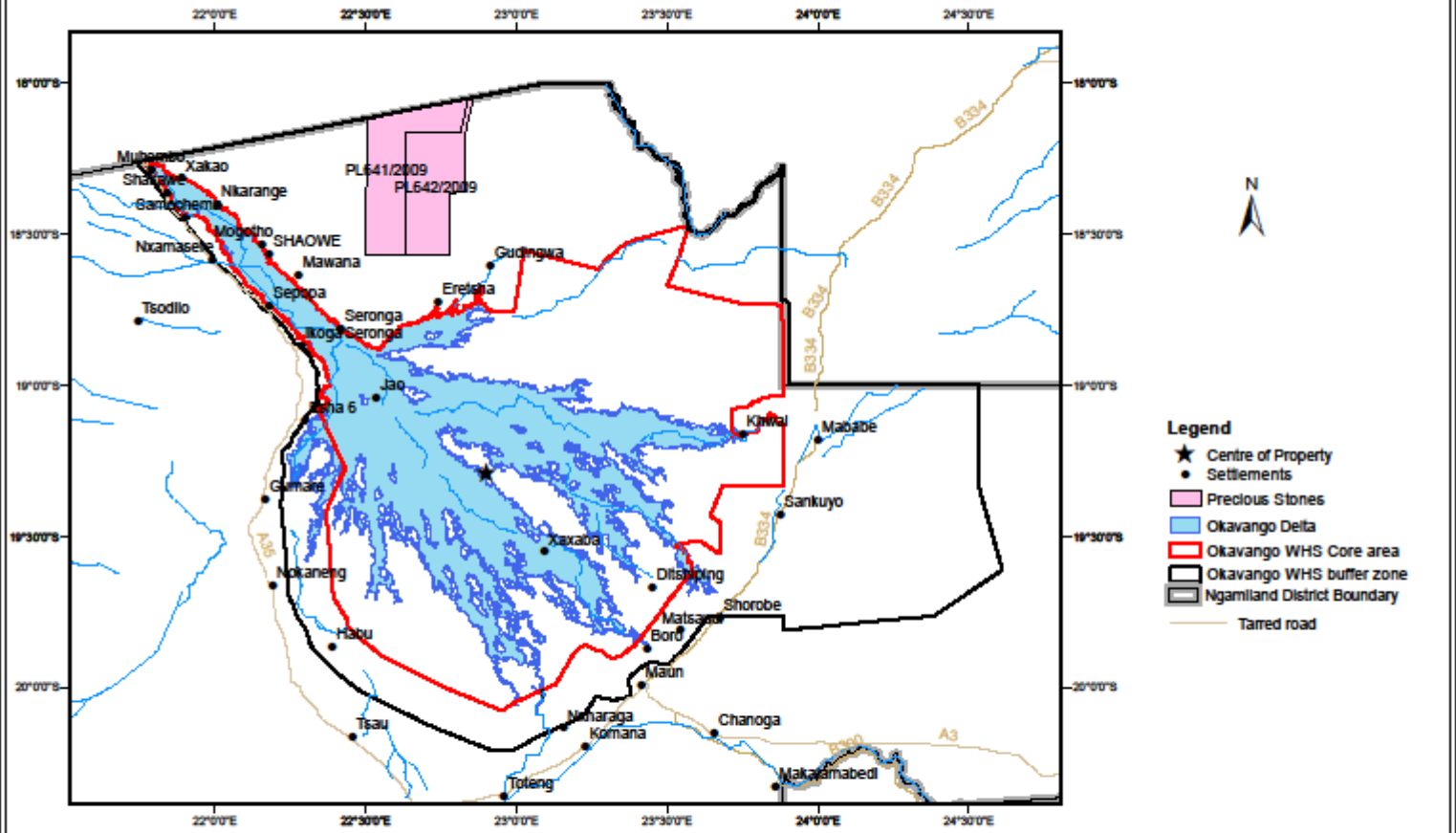
Proposed Okavango World Heritage Site

Prospecting Licences (PLs) for Precious Stones



Topographic data from Department of Surveys and Mapping
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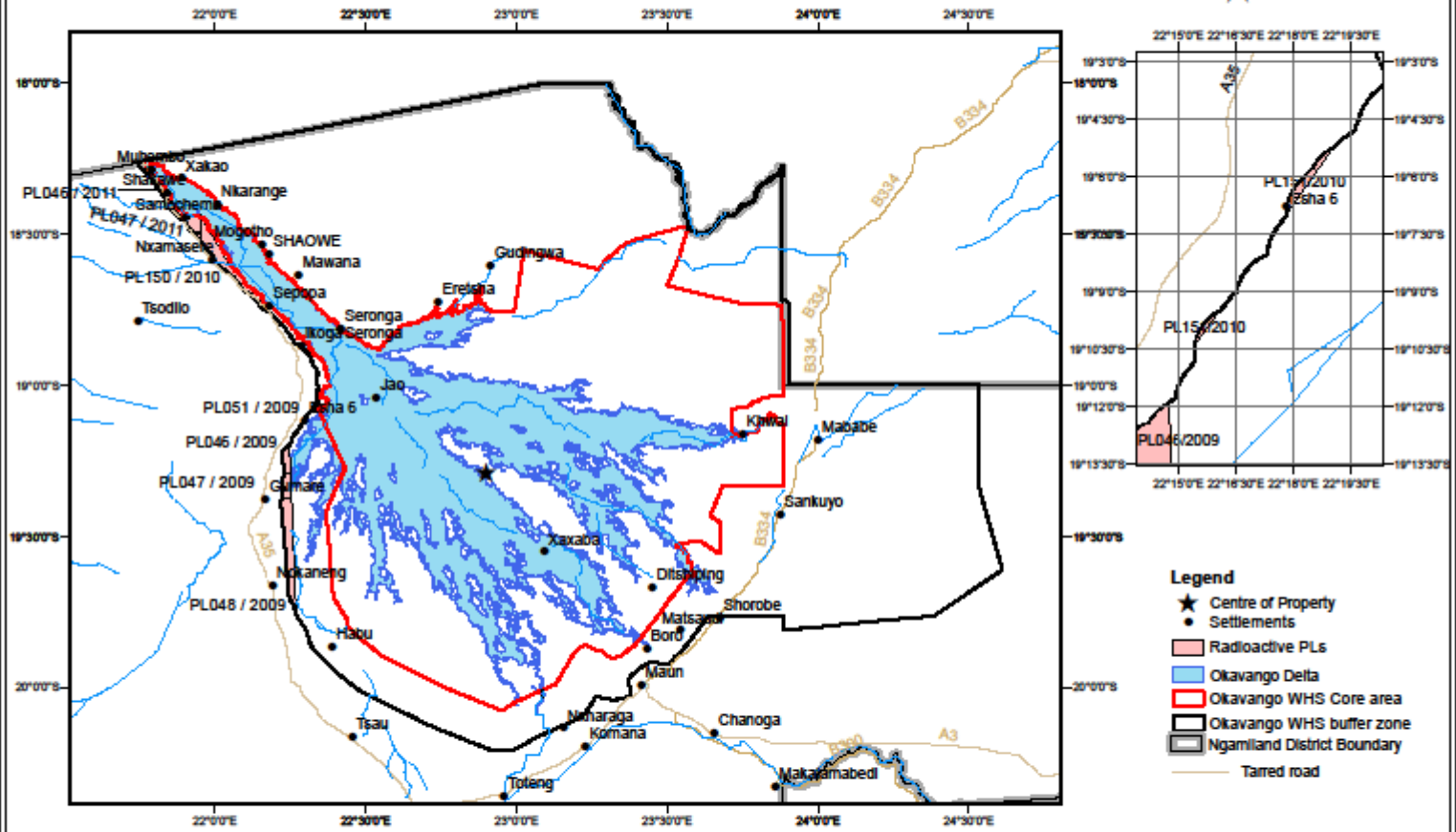
Proposed Okavango World Heritage Site

Prospecting Licences (PLs) for Radioactive Minerals



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SAVINGRAM

FROM: Permanent Secretary, Ministry of Minerals, Energy and Water Resources

B. Paya

TEL: 3656600

FAX: 3909368

TO: Permanent Secretary
Ministry of Environment, Wildlife and Tourism
Attention: Jimmy R. Opelo

REF: CMMEWR 1/8/9 I (6) 21 February 2014

RE: IUCN SUPPLEMENTARY INFORMATION

1. Reference is made to your Savingram, EWT 1/5/21 V (59), of the 16 January 2014 and our Savingram, CMMEWR 1/8/9 I (5) of the 19 February 2014.

2. There are six licences that partly fall within the Okavango Delta core area. Of the six, three have expired, two will expire in September 2014, while one will expire in March 2015. The Ministry will not renew any portions of licences that fall within the core zone. Negotiations will be triggered immediately to sensitize licence holders and to find amicable solutions to any potential queries.

3. Attached to this letter is a list of the above mentioned licences.

No.	PROSPECTING LICENCES	EXPIRY DATE	STATUS EXPIRED OR CURRENT	MINERAL	LOCATION	Company
1	PL570/2009	30-Sep-14	Current	Base and Precious Metals	Buffer & core	New Hana
2	PL568/2009	30th Sept 2014	Current	Base and Precious Metals	Buffer & core	New Hana
3	PL098/2012	31st March 2015	Current	Base and Precious Metals	Core	Zhong Gan
4	PL115/2010	31st March 2013	Expired	Base and Precious Metals	Core & Buffer	Cambow
5	PL590/2009	30th June 2012	Expired	Base and Precious Metals	Core & Buffer	Gcwihaba Resources
6	PL592/2009	30th June 2012	Expired	Base and Precious Metals	Core & Buffer	Gcwihaba Resources

SAVINGRAM

FROM: Director
Department of Environmental Affairs

P.K. Segomelo

TEL: 3902050
FAX: 3902051

TO: Permanent Secretary
MEWT

REF: DEA/ENV 8/6 IV (42) 21st February, 2014

RE: IUCN SUPPLEMENTARY INFORMATION: OKAVANGO LISTING AS A HERITAGE SITE

The Department of Environmental Affairs in its auspices as coordinator of implementation of the Okavango Delta Management Plan (ODMP) as well as the competent authority in the administration of the Environmental Assessment Act submits advise on this subject as follows:

a) The recent Strategic Environmental Assessment (SEA) of the Okavango Delta, has identified mining as a threat to the Delta. Mining will compromise the integrity of the Delta in terms of:

- threat to biological diversity
- pose adverse consequences on the quality of the water resources due to mining waste
- increase abstraction of water in quantities that may disrupt the ecological balance within the delta
- and the loss of the aesthetic view of the system.

b) The undertaking of Environmental Impact Assessments (EIAs) in order to inform the issuance of Prospecting Licences within Delta leads to activities such as drilling, pumping water and use of lubricants as oil. These make mining a less desirable activity in a near pristine ecosystem of the status that the Okavango Delta is renowned for.

Therefore, as the Competent Authority we recommend that:

1) EIA's will not be allowed on the Delta ecosystem for mining activities including (prospecting and actual mining).

2) Other activities such as tourism camps - the limits of acceptable change will be effected closely in order to prevent that carrying capacities are observed.

These provisions will take effect with a view to maintain the integrity of the Okavango Delta Ecosystem and qualify it to world heritage status.

Thank you.

San People's Cultural Heritage and Access Rights

Communities in the Core Area of World Heritage Site

The Core area of the proposed World Heritage Site consists of three small settlements, namely Ditshiping, Jao and Xaxaba. These three settlements have a total population of 530 people. There are no people of San or Basarwa origin in these three settlements. For example, at Ditshipng the majority of the people are Bayei, at Jao, they are Hambukushu while at Xaxaba, and it's a combination of Bayei, Batawana and Humbukushu. Although, a total of 530 people, live in these settlements within the core area of the delta, there is another 1666 people who works in the tourists camps and lodges within the core area of the property (table 1). However, workers in tourists lodges and camps are come from different parts of the country and usually do not consider the Okavango Delta as their permanent home.

Table 1: Total Human Population in the Core

Name of Location/Area	**Population (2011 Census)**
Jao	229
Ditshiping	139
Xaxaba	162
Camps & Lodges	1,666
Total	**2,196**

The three settlements Ditshiping, Jao and Xaxaba are not gazzeted as villages. This means, they cannot be provided with services such as schools, hospital, and tarmac roads. According to Botswana's settlement Policy, ungazetted settlements are not provided with such services. However, they are provided with the basic human needs such as health through mobile clinics, water reticulation and shelter. These communities have access to other services such as education outside the core.

The cultural heritage and user access rights of communities living in the core areas of the property are legal guaranteed. For example, the Okavango Delta Management Plan (ODMP) of 2007 notes that all these communities depend entirely on natural resources for their livelihoods, either directly or indirectly. Communities have access to natural resources in their surrounding when considering the collection of veld products particularly fishing, harvesting of reeds, thatching grass, medicinal plants, cutting of polls for building their houses and many others. In addition, the Community-Based Natural Resource Management Policy of 2007 allows communities living in natural resource rich areas such as those of Ditshiping, Jao and Xaxaba to be involved in community-based tourism projects. For almost two decades, these communities have benefited significantly from wildlife-based tourism which comprised both photographic tourism activities and safari hunting tourism. Xaxaba and Ditshiping are part of the Okavango Kopano Mokoro Community Trust (OKMCT), a community Trust formed to benefit from tourism in the Okavango Delta for hunting (consumptive) and non-consumptive tourism, as well as *mokoro* (dug-out cannoning) experiences.

Communities in the Buffer Area of the World Heritage Site

Within the buffer, the Basarwa/San communities include those who live in villages of Khwai, Mababe, Gudigwa and Tobere. The rest of the communities in the buffer area are not of Basarwa/San origin. As is the case with other communities living outside the buffer area of the property but within the vicinity of the property, the cultural heritage and user access rights of the people in terms of natural resources are guaranteed. As noted earlier, the ODMP of 2007 and the CBNRM Policy of 2007 allows communities to have access to natural resources and to tourism development respectively. The different legislation including the ODMP guarantees communities in the buffer area free access and traditional user rights to activities such as fishing skills; pastoral farming, crop production, harvesting of thatching grass etc. The Basarwa of Khwai, Gudigwa, Mababe and Tobera are involved in tourism development in the Okavango Delta through the CBNRM programme. These communities significantly benefit from tourism development in the Okavango Delta. Finally, communities living within the core, buffer and surrounding areas of the property have their cultural heritage and user access rights guaranteed irrespective of their ethnic background.

Importance of land to the San Communities in the Pan handle

Introduction

The Okavango delta (panhandle) in Botswana have indigenous peoples who have inhabited the areas surrounding the delta over hundreds of years and they include the Khwe (//Anikhwe, Bugakhwe) communities. The //Anikhwe were said to be to the fishers and played small populations of hunter-gatherer in the river run forest and islands. The Bugakhwe were many indigenous peoples living in remote forests. The Bugakhwe would seasonally visits the delta during the very dry seasons especially when the forest pans dry up as a result of poor rains or drought. This resulted to establishment of their permanent and seasonal camps linked by tracking routes and animal corridors to the Okavango River. The interpretations on Khwe relationship to the delta displays a crucial role habitual to that ecosystem. However the indigenous titles to the land has been manipulated by the government in promoting communal tittles that encompasses all the interacted society. Rampant land grabs have been in rise by powerful members of the general public. According to Molokomme el at. 2003, in natural resource management (NRMP) there was initially little attention for the development and co-ordination of support agencies and for policy and legislative development. Both policy and legislative development lag behind even to-date. Thus, it is evident on how the “communal title” has brought a new threat of limiting indigenous ownership to available land around the delta.Although Botswana has several laws

and policies on land and other natural resources, none of these provide legal recognition of ethnic minorities' customary collective rights to the land and their resources and the land policies are general and progressive.

Importance of land to Khwe Communities Surrounding the Delta

Land (forests and the delta) remain an important productive resource for most Khwe (indigenous minority people in the panhandle). They have special relationships with their land and attach high social and cultural significance to them. This relationship goes beyond ordinary economic attentiveness and includes cultural to spiritual acquaintances to the places they have inhabited for generations. The land become the Khwe ancestral domains which they have admired, honored and played a sacred role from time in memorial where they have expressed mandate to manage special and vulnerable environmentally significant areas.

Land Uses

Spirituality

Beliefs forms an integral part in a daily lives amongst Khwe society and it cannot be separated from their culture. The leaders of each Khwe clans would summon the ancestors every morning and late in the afternoon. They sent their requests to their ancestors in the morning to protect them for the day and provided them with enough food for their families when they set out for hunting and gathering. They also vividly displayed thanks giving ceremony or ritual to the ancestor from their day's harvests and counter request for more in future. The divinity was done at specially chosen places linked with its ancestral, historical and spiritual values. This spiritual attachments to the land gave the Khwe community's a system of value preposition that provide for the norms and customs they can observe in the pursuit of their utilitarian gains. Therefore the, Khwe have anticipated careful husbandry to their ecosystem since they become the environmental stewards.

Hunting

Hunting and hunts played the most significant heritage value to the Khwe communities. The bulk of consumed food staff came from hunted animals. Through hunting they learned their traditional territories, animal ecology, bio-systems and the relationship between existences. A hunter would have

to know their hunting grounds by heart during day or nights. The hunter is responsible to ensure that the animal population is maintained by taking care of the environment. The hunter was skilled to know which animal ho hunt for at a given period. It was associated with what is easy to hunt and when? This phenomenon was referred to by (Liebenberg, 2013) as based on inductive-deductive reasoning. It gives explanation of observations in terms of hypothetical causes. There were a variety of tools used in hunting, amongst which were bows and arrow, spears, and sometimes snares and traps were used. They Khwe used Koro (narrow ditch) to catch nocturnal animals. They laid their Koro's in animal's corridors to the water points.

Khwe supported the veldt by practicing early burning as means to control fuel load or accumulation on the veld to avoid escalation of devastating fires associated with high fuel load that eventually destroys some species. The time of burning was also considered and the appropriate time to do burn the veldt was when there was a considerable moisture content on the veldt that would result in slow fires observed at consuming only the dry contents of the veldt. It was dedicated to destroy host to the life sequences of disease vectors to wild animals.

Khwe boys were taught how to read signs and animal prints. Lone and Satau, 2011 (unpublished) indicated San art of tracking as a science. (Liebenberg, 1990) describes the concepts of San tracking as an origin of science. Tracking knowledge marks the fundamental science the Khwe groups have and other observers are rarely in position to known full range of animal skills and behaviour. Liebenberg reiterated the component of science in tracking by revealing 'The art of tracking is a science that requires fundamentally the same intellectual abilities as modern physics 'adding which may be regarded as quasi-empirical and involves essentially the same intellectual processes as science. The tracking life associated the hunters with a knowledge of interpreting animal prints and scaling it to time, animal species, its behavior and the animals' possible location. The life of tracking also signified the boys to become man with a potential to fend for their family. It morally taught them to be patient, courageous and determined to endure the monotony associated with wild experience of persistence hunting.

Amongst the knowledge of hunting, the hunter was equipped with a unique medicinal knowledge to help himself when alone in the bush. Liebenberg contended this knowledge as every person's participation in science and if they originated in anticipation of a future need, then they must be the direct creation of a higher intelligence. The hunter would know which plants species to take in order to maintain his energy in very hash condition and thirst. The hunting stories were often shared around the fire cycles during the evenings to disseminated knowledge to the younger generations.

Gathering and foraging

When gathering Khwe were searching for and collecting of plant foods and scavenging some predator kills. Various nature facts have been utilized by the Khwe hunter-gatherers, among them sticks, stones, pebbles, shells, thorns, leaves, twigs, bones, porcupine quills and teeth (Liebenberg, 2013). In this set-up human are seen as a biological community and an agent interacting to the environment to changing day to day practices. The matrilineal members were keen to do the gathering of edible bulbs, tuber, roots, wild vegetables, small animals and accustomed themselves with Khwe medicinal plants knowledge and foods.

In the lives of hunter- gatherer, Khwe people learned to invent means of communication to the wild creatures. They followed the honey guide birds to locate bee hives, vultures to locate carcass of predator kills, some other bird's calls and movement to specific experiences as a warning or informative signs. Likewise, other animals nor fishes had adaptive majors that formed communicative symbol that was understood by the hunter- gatherers.

Challenges to land ownership by Khwe Communities

The traditional land they called their own has come under threat from other sources related to changes in global commodity markets and governance regimes. Increasing demand on economic exercises is leading to revalorization of the land, foreign and powerful citizens, state companies and foreign investors alike. This factors causes a serious conflict between Khwe communities and outsiders more so that it further marginalizes them. Given that Botswana has no special laws or policies recognizing and protecting ethnic minority customary land rights, the tenure rights for ethnic minorities remain uncertain.

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Some key cultural landscapes of the San along the Okavango panhandle

1. Goxa island (between Mohembo East and Kauxwi)
   Chief N//aekhwe of the //Anikhwe was killed and buried here after a protracted battle with Chief Sekgoma Letsholathebe of the Batawana. This island is of both spiritual and historical importance to the //Anikhwe. It has previously been used as a permanent camp and fishing ground.

2. //uakao on the southern tip of Xakao village.
   This was Chief N//aekwhe's home and court. Many //Anikhwe ancestors were buried here as the community lived here over many years practising a riparian lifestyle.

3. N/oaxom (The red cliff)
   This was a permanent camp for the //Anikhwe. The place is between Ngarange and Mogotlho. N/oagom is one of the most important spiritual sites of the //Anikhwe where sacrifices of animals and livestock have been made in honour of the ancestors.

4. Tcoyi (island) next to N/oaxom
   This is a sacred place of the Gumayi people, a clan of the //Anikhwe. It is regarded as the birth place of the clan, thus a point of reference for their identity. Their ancestors lie here. It is also the place of powerful spirits summoned in difficult times such as droughts. Animal sacrifices have been done here too.

5. Gombo Island in the east of Eretsha.
   The place was the hunting and gathering ground for the Bugakhwe. Oral testimonies states that Biro the first Khwe chief was bitten by a mamba here while he was out with his regiments in a hunt at this area and was buried and was buried on the spot. The island is of spiritual and historical importance to the Bugakhwe, who have used it to consult their ancestors and perform sacred sacrifices.

6. Mahaya (also known as Du#uxa) located between Ngarange and Xakao.
   It was a Bugakhwe permanent camp. The place was a wildlife corridor between the forests and the river, and hence an easy hunting ground for the Bugakhwe who laid their snares and traps along the corridor. Many Bugakhwe ancestors lie here.

7. Khwaxa (also known as Kachirachira), between Gunotsoga and Eretsha.
   This was a permanent camp of the Bugakhwe occupied during the dry season. It is between two animal corridors. Many were buried here and it has been used as a spiritual site.

8. Other seasonal Bugakhwe camps include Mokgatsha (between Mogotlho and Seronga); Kyauo (also known as Matswii) and Beetsha, which is believed to be the site where the first group of Bayeyi met the Bugakhwe community. All these places hold spiritual significance as many ancestors were buried there.

Basarwa Sacred sites in the Okavango Delta

The Bukhakhwe of Khwai Village

Khwai village is situated about 150km North West of Ngamiland. It is predominantly inhabited by the Bukhakwe San tribe, though there are few bayei.

The Bukhakhwe used to live through hunting and gathering in Moremi Game Reserve before they were driven out by the Batawana to declare the area a Game Reserve. Within the Moremi Game reserve there are some areas that are sacred to the Bukhakhwe people. The areas have been used for hunting and gathering, and ancestral visits. Notable of these areas are:

- Kangjiye Pool: This area is used by the Bukhakhwe of Khwai for grass harvesting and wild berry gathering.
- Nbudi Island: This island has been used for fishing and it is in NG 19
- Xuku (Hippo) Pool: it is inside the Moremi Game Reserve. It has been used for fishing. It also has spiritual attachment to the Bukhakhwe
- Jamakata: it has been used for reed and grass harvesting
- Segagama: also for grass harvesting
- Sexeku: also used for reed and grass harvesting, and gathering of wild fruits like *mokutsumu*

Mababe Village

Mababe village is situated approximately 120km west of Ngamiland. The inhabitants of this area are the San known as Tsega and Dinisini. The Basarwa of Mababe lived in this area for so many years before Chobe National Park was established. The establishment and extension of Chobe National Park 3 km from the village has affected their livelihood. There are some areas in the park that are of significant to the Basarwa of Mababe. The following areas are noted:

- Makgapha: a spiritual place for the Basarwa of Mababe
- Mozhwamo: their hunting and gathering ground. It is significant for them for *kaoong; a* visit into the wilderness to cleanse the spirit
- Dexamma: gathering places for wild fruits like *motsentsela and Hututuruu (* wild oil)
- Qhodoo: water place
- Tanxara: spiritual place
- Qlweeo: a place of visit. These visits are usually done to enable the people to be in touch with nature.

MANAGEMENT OF THE NOMINATED AREA

The Core area of the proposed World Heritage Site consists of three small settlements which have not been gazzeted as villages. According to the settlement Policy this means that only certain developments are allowed in the area. As per the 2011 Population Census, the population of the settlements in the core area is 530. There are also 1666 people who work in the tourist Camps and Lodges within the Core area of the property.

NAME OF LOCATION/AREA	POPULATION (2011 Census)
Jao	229
Ditshiping	139
Xaxaba	162
Camps & Lodges	1,666
Total	**2,196**

The nominated area or core area consists of protected areas such as Moremi Game Reserve, Wildlife Management Areas (WMA), ungazzeted settlements which fall within Wildlife Management Areas. The Moremi Game Reserve was established through the Wildlife Conservation and National Parks Act of 1992 and is managed by the Department of Wildlife and National Parks. According to the Wildlife Conservation Policy of 1992, the primary purpose of the Parks and Reserves is the total preservation, as distinct from conservation, of all resources. Their secondary purpose is to encourage tourism attracted by the abundant wildlife and wide range of scenic habitat. Wildlife Management Areas have also been established through the Wildlife Conservation and National Parks Act of 1992 and their implementation is guided by the Wildlife Conservation Policy. According to the Wildlife Conservation Policy of 1992, Wildlife Management Areas are still rich in wildlife and those in the Okavango are unique and important for tourism development. Therefore Wildlife utilization and management will be the recognized primary form of land use. Wildlife Management Areas have been divided into Commercial Wildlife Utilization Areas and Community Managed/Utilization Areas.

According to the Wildlife Conservation and National Parks Act of 1992, the President of Botswana may by order published in the Government Gazette, declare any area to be a Game Reserve.

Section 92 of the same act gives the Minister responsible for the management of National Parks and Game Reserves the powers to make regulations governing the management of Game Reserves. Currently, the reserve is managed through the National Parks and Game Reserves regulations of 2002. In broad terms the regulations stipulate and govern developments that are permissible in Game Reserves. It further indicates activities that may be carried out in the Game Reserve as well as those that are prohibited. The regulations also stipulate that the Director of Wildlife and National Parks shall ensure preparation of a management Plan to cover aspects of development and management of a

Game Reserve. The Regulations also indicate that in cases whereby the Reserve is on Tribal land, the Management Plan would be approved by the Director of Wildlife and National Parks and the appropriate Land Board.

Moremi Game Reserve is on Tribal land and belongs to the Batawana. Initially it was managed by the Ngamiland Fauna Conservation Policy on behalf of Tawana Land Board. In 1979 management of the Reserve was taken over by the Department of Wildlife and National Parks. Tawana Land Board however, remains the body responsible for any land issues pertaining to the Reserve and is the legal Lessor for any leases awarded therein. Moremi Game Reserve is thus also managed through a Management plan that was approved by the Director of Wildlife and National Parks and the Chairman of the Tawana Land Board in 2008.

All the legal instruments referred to above are formulated through a consultative process, which ensures that all the stakeholders are considered.

WILDLIFE MANAGEMENT AREAS

The concept of Wildlife Management Areas arose from Botswana Tribal Grazing land policy (TGLP). TGLP paper (government paper No.2 of 1975) directed that there would be zoning categories for land namely; Commercial Farming Areas, Communal Grazing Areas and Reserved Areas. Wildlife Management Areas (WMAs) are considered as a form of zoning of land for wildlife utilization in the Reserved Areas category. According to the Wildlife Conservation Policy of 1986, sustained wildlife utilization will be actively encouraged in these areas as compared to Game Reserves which are primarily established for total preservation. The policy further states that other forms of use will be allowed if they are compatible with sustainable land use. WMAs adjacent to National Parks and Game Reserve act as buffer zones to prevent conflict between the latter and areas of more intensive agricultural uses. Others provide protection to migrating wildlife by safe guarding migratory corridors.

Just as the power for the declaration of Game Reserves lies with the President, WMAs are also declared or abolished in the same manner.

CONTROLLED HUNTING AREAS

The Wildlife and National Parks Act of 1992 gives the Minister responsible for the management of Wildlife the power to declare and abolish Controlled Hunting Areas (CHAs). In these areas, controlled hunting is allowed but there is no control over other activities even if they are detrimental to wildlife populations. In many instances controlled hunting areas fall inside Wildlife Management Areas (WMAs).

In Ngamiland, majority of the land is concession areas in the form of CHAs leased on 15 year head leases to legally registered Community Based Organizations (CBOs) that are in engaged in the Community Based Natural Resources Management (CBNRM) program. These concession areas are awarded to the CBOs upon approval of Land Use Management Plans by the Tawana Land Board. CBOs/ Trusts can either enter into a Joint Venture Agreement or Partnership with Private Operators as their business partners. Communities with head leases can either conduct photographic safaris or hunting in their concession areas except those within 25km of Wildlife Management Areas in the form of Game Reserve

and National Park where hunting is prohibited. Some of the WMAs are in the form of private concessions leased directly to private safaris and there is also WMAs in the form of citizen hunting areas where all citizens can partake in a raffle to hunt in such areas. The government of Botswana has nonetheless as a precautionary measure suspended hunting indefinitely following signs of declines in wildlife populations. As a result, CBOs are currently aligning their management plans to photographic tourism so that they continue benefiting from the natural resources around them.

SUMMARY OF MANAGEMENT AREAS

NOMINATED AREA (CORE AREA)

NAME OF AREA	CATEGORY	LEGAL DESCRIPTION	STATE LAND/TRIBAL LAND	MANAGEMENT AGENCY
Moremi Game Reserve – NG/28	Game Reserve	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	Tribal Land	Department of Wildlife & National Parks (DWNP) Tawana Land Board
NG/10	Controlled Hunting Area (CHA)	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	Tribal Land	DWNP Tawana Land Board
NG/12	WMA Commercial	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	Tribal Land	DWNP Tawana Land Board
NG/16	WMA Commercial	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	Tribal Land	DWNP Tawana Land Board
NG/17	WMA Commercial	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	Tribal Land	DWNP Tawana Land Board
NG/18	WMA Community	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	Tribal Land	DWNP Tawana Land Board Leased to Khwai Development Trust

				(KDT)
NG/20	WMA Commercial	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	Tribal Land	DWNP Tawana Land Board
NG/21	WMA Commercial	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	Tribal Land	DWNP Tawana Land Board
NG/22	WMA Community	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	Tribal Land	DWNP Tawana Land Board Leased to Okavango Community Trust (OCT)
NG/23	WMA Community	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	Tribal Land	DWNP Tawana Land Board Leased to Okavango Community Trust (OCT)
NG/24	WMA Community	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	Tribal Land	DWNP Tawana Land Board Leased to Okavango Jakotsha Community Trust (OJCT)
NG/25	WMA Commercial	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	Tribal Land	DWNP Tawana Land Board
NG/26	WMA Commercial	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	Tribal Land	DWNP Tawana Land Board
NG/27A	WMA Commercial	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	Tribal Land	DWNP Tawana Land Board
NG/27B	WMA Commercial	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	Tribal Land	DWNP Tawana Land Board

NG/29	WMA Commercial	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	Tribal Land	DWNP Tawana Land Board
NG/30	WMA Commercial	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	Tribal Land	DWNP Tawana Land Board
NG/31	WMA Commercial	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	Tribal Land	DWNP Tawana Land Board
NG/32	WMA Community	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	Tribal Land	DWNP Tawana Land Board Leased to Okavango Community Trust (OKMCT)
NG/33	WMA Community	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	Tribal Land	DWNP Tawana Land Board Leased to Sankoyo Tshwaragano Management Trust (STMT)

BUFFER AREA

NAME OF AREA	CATEGORY	LEGAL DESCRIPTION	STATE LAND/TRIBAL LAND	MANAGEMENT AGENCY
NG/11	Communal Land Pastoral, Arable, Residential	Tribal Land Act 1968	Tribal Land	Tawana Land Board
NG/13	WMA	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	Tribal Land	DWNP Tawana Land Board
NG/14	WMA Commercial	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	Tribal Land	DWNP Tawana Land Board
NG/15	WMA Commercial	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	Tribal Land	DWNP Tawana Land Board
NG/19	WMA Commercial/Communal Khwai Village	Tribal Land Act 1968	Tribal Land	Tawana Land Board
NG/40	WMA	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	State Land	DWNP Tawana Land Board
NG/41	WMA Communal/Commercial Mababe Village	Tribal Land Act 1968	State Land (in the process of tribalisation)	Department of Lands
NG/34	WMA Communal/Commercial Sankoyo Village	Tribal Land Act 1968	Tribal Land	Tawana Land Board
NG/43	WMA Commercial	Wildlife Conservation & National Parks Act 1992 Tribal Land Act 1968	State Land	DWNP Department of Lands

CONCESSION	LESSEE	SIZE	JVP/CBO/PRIVATE	LEASE TYPE	LEASE EXPIRY DATE	STATUS CURRENT ACTIVITIES LODGE (CAMP)
NG/28 MOREMI GAME RESERVE MGR 1	Chobe Holdings	4.9ha	Chobe Holdings	Photographic	01/01/13-31/12/2027	Camp Moremi – operating Xakanaka – operating
MGR 2	Moremi Crossing	4 ha	Moremi Crossing	Photographic	01/01/13-31/12/2027	Camp Okuti – operating
MGR 3	Chobe Holdings	1.5ha	Chobe Holdings	Photographic	15/05/07-14/05/2022	Mombo & Little Mombo – operating Chief's Camp – tender ongoing
MGR 4	Okavango Wilderness Safaris	3 ha	Okavango Wilderness Safaris	Photographic	08/05/99-08/05/2014	Xigera - operating
MGR 5	Abercrombie & Kent	3 ha	Abercrombie & Kent	Photographic	01/01/99-31/12/2013	
MGR 6	Great Exploration	3 ha	Great Explorations	Photographic	08/05/04-08/05/2014	

NG/10						
NG/12	Okavango Polers Trust All Star Investments Katizora Monnaapina Watuka Takwenda Adventure Safaris Bukakhwe Cultural Conservation Trust Jubilee Holdings	2.288ha 16,3906ha 3ha 6.6297ha 5 9344ha 4.4ha	Trust/CBO Private Private Private Trust/CBO Private	Photographic Photographic Photographic Photographic Photographic – cultural village Photographic	24/12/99-24/12/2013 08/08/08-08/08/2023 18/08/06-31/07/2016 08/2011-31/08/2026 27/11/01-26/11/2016 20/04/10-31/12/2018	Mbiroba Lodge - operating Pepere Island Lodge – operating Kadizora Pool Lodge – under development,not operating Etsatsa – not operating Not operating Mmaphula Lodge - operating
NG/16	Linyanti Explorations	1,350,00ha	Private	Photographic	01/01/10-31/12/2025	(1) Selinda Camp (2) Zarafa Camp (3) Motswiri Camp operating

NG/17	VACANT					
NG/18	Khwai Development Trust (KDT)	175 652ha	JVP with community Soren Lindstrom Safaris Okavango Wilderness Safaris	Photographic	17/2/10-16/02/2025	(1) Banoka Camp (2) Wilderness tented Camp (3) Tau Camp (4) Hyena Pan
NG/20			Private			(1) Kwara (2) Little Kwara Operating, lease under dispute
NG/21	Ker & Downey Desert & Delta Safaris Delta & Delta Safaris	5 ha 5 ha 70 acres	Private Private Private	Photographic Photographic Photographic	01/01/95-12/31/2013 12/31/2013 01/01/2004-31/12/2018	(1) Shindi Camp Tender ongoing Camp Okavango Tender ongoing Xugana Lodge Lodge - operating
NG/22	Okavango Community Trust (OCT)	5800 000ha	JVP with community trust Okavango Wilderness Safaris	Multipurpose	4/15/2011	(1) Vumbura (2) Little Vumbura No current lease, (dispute)
NG/23	Okavango Community Trust	34 00 000ha	JVP with community trust Okavango Wilderness Safaris	Multipurpose	5/6/2011	Duba Plains No current lease (dispute)

NG/24	Okavango Jakotsha Community Trust (OJCT)	53 000 00ha	JVP with community trust Eland Tours- proposed	Multipurpose	17/10/2000-16/10/2015	Jedibe Lodge Tender closed 15/08/13
NG/25	Ngamiland Adventure Safaris	630 000ha	Private	Photographic	08/05/2004-08/05/2014	(1) Jao Camp (2) Kwetsani (3) Tubu Tree (4) Pelo Mokoro (5) Jacana Management plan ongoing
NG/26	Elephant Back Safaris	1725km2	Private	Photographic	01/01/2010-31/12/2025	(1) Seba (2) Abu Camp (3) African Horseback Safaris operating
NG/27 A Zone 1 Zone 2 Zone 3 NG/27 B Zone 1 Zone 2	Afro Ventures Botswana Chobe Fish Eagle Chobe Holdings Orient Express Lodges of	85.6km2 70.1km2 94.8km2 52.7km2 55.0km2	Private Private Private Private Private	Photographic Photographic Photographic Photographic Photographic	01/01/2013-31/12/2027 01/05/2002-31/12/2014 01/01/2013-31/12/2027 01/01/2013-31/12/2027	Nxabega – operating Pom Pom – operating Kanana Camp – operating Xaxaba Camp – operating (1) Delta Camp (2) Odd Balls Camp

Zone 3	Botswana Chobe Fish Eagle	50.0km2	Private	Photographic	01/02/1979-31/01/2029	Lost tender (dispute) (1) Gunns Camp (2) Moremi Crossing operating
NG/29	Afro Ventures Botswana	1847.93km2	Private	Photographic	01/01/2010-31/12/2025	Xaranna - operating
NG/30	Afro Ventures Botswana	905.0km2	Private	Photographic	01/01/2010-31/12/2025	Xadum - operating
NG/31 Zone 1 Zone 2	Flamingo Investments Southern Quest T/a & Beyond	112.1km2 112.8km2	Private Private	Photographic Photographic	01/01/2013-31/12/2027 01/01/2013-31/12/2027	Chitabe – operating Sandibe - operating
NG/32	Okavango Kopano Mokoro Community Trust (OKMCT)	12 250 000ha	JVP with community trust (CBO) Johan Calitz Hunting Safaris Abecrombie Kent	Multipurpose	12/08/1997-11/08/2012	Multiple Sub leases-hunting & photography Converting to photographic, tender process ongoing 1 year extension, awaiting new lease
NG/33	Sankoyo Tshwaragano Management		JVP with community trust Okavango Wilderness	Photographic	02/24/2016	Santawani Lodge – awaiting lease extension

	Trust (STMT)		Safaris (under negotiation)			

BUFFER AREA

CONCESSION	LESSEE	SIZE	JVP/CBO/PRIVATE	LEASE TYPE	LEASE EXPIRY DATE	STATUS CURRENT ACTIVITIES LODGE/CAMP
NG/11	N/A		N/A	N/A	N/A	N/A
NG/13	Vacant					
NG/14	Hunters Africa		Private	Photographic	01/01/2010-31/12/2025	(1) Lebala Camp (2) Lagoon Camp operating
NG/15	Linyanti Investments	1 231,72km2	Private	Photographic	01/01/2010-31/12/2025	(1) Savuti Camp (2) King's Pool (3) Duma Tau (4) Linyanti Tented Camp operating
NG/19	Khwai Development Trust	5ha	Community trust	Photographic	10/10/2002-10/01/2017	Tsaro Lodge – tender for re-opening ongoing
	Game Trekkers		Private	Photographic	30/04/1971-30/04/2021	Khwai River Lodge Operating
	Tsie Safaris	8,2202ha	Private	Photographic	21/12/2011-21/12/2061	Mochaba Lodge operating

NG/34	Sankoyo Tshwaragano Management Trust (STMT)	87 000ha	JVP with community trust Wild scenes Okavango Wilderness	Multipurpose	15/03/1996-14/03/2011	Multiple subleases – hunting and photographic, extended twice for 1 year-tender process ongoing
NG/40	Vacant					
NG/41	Mababe Zokotshama Community Development Trust (MZCDT)	2181.1ha	JVP with Community trust African Field Sports Services	Multipurpose	01/08/2002-31/07/2017	Hunting & Photographic Dizhaana Camp Hunting ongoing & photographic not operating
NG/43	Kgori Safaris	34 600ha	Private – Kgori Safaris	Multipurpose	18/03/2008-17/03/2013	Mankwe Camp Hunting Tender ongoing

UPDATE ON ANIMAL POPULATION CENSUS RESULTS IUCN - OKAVANGO DELTA

KEY SPECIES IN THE DELTA _STRATUM 27 DDELTA

Species	Year	Season	Estimated	Density (animals/sq km)	95 % Confidence Limits	Maximum Estimates	Minimum Estimates
Baboon	2012	Dry	555	0.04	138.12	922	188
Buffalo	2012	Dry	40984	2.89	62.987	53673	28295
Carcass	2012	Dry	92	0.01	179.95	133	51
Cattle	2012	Dry	36543	2.58	123.84	39454	33632
Crocodile	2012	Dry	213	0.01	129.04	300	126
Donkey	2012	Dry	2827	0.2	133.84	3281	2373
Elephant	2012	Dry	53386	3.76	33.45	57046	49726
Giraffe	2012	Dry	2731	0.19	42.752	3261	2201
Hartebeest	2012	Dry	547	0.04	206.98	1104	-10
Hippo	2012	Dry	2293	0.16	56.409	2864	1722
Horse	2012	Dry	1233	0.09	154.96	1494	972
Impala	2012	Dry	64715	4.56	33.472	72544	56886
Kudu	2012	Dry	2833	0.2	53.825	3347	2319
Lechwe	2012	Dry	25189	1.78	35.723	28575	21803
Ostrich	2012	Dry	878	0.06	100.09	1085	671
Roan	2012	Dry	123	0.01	201.73	165	81
Sable	2012	Dry	18	0	413.57	55	-19
Sheep_goat	2012	Dry	2621	0.18	127.2	3415	1827
Sitatunga	2012	Dry	63	0	243.21	124	2
Steenbok	2012	Dry	19	0	407.96	24	14
Tsessebe	2012	Dry	1547	0.11	74.968	1941	1153
Warthog	2012	Dry	902	0.06	90.153	1120	684
Waterbuck	2012	Dry	18	0	408.87	25	11
Wildebeest	2012	Dry	2318	0.16	142.09	2940	1696
Zebra	2012	Dry	18022	1.27	49.877	21026	15018

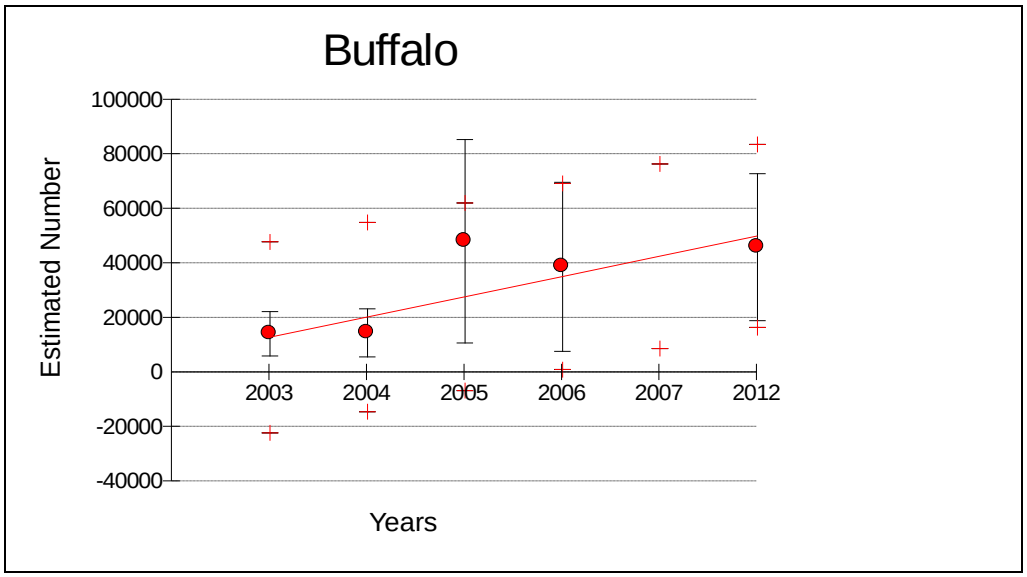
SPECIES ESTIMATES BY CONTROLLED HUNTING AREAS IN AND AROUND THE DELTA

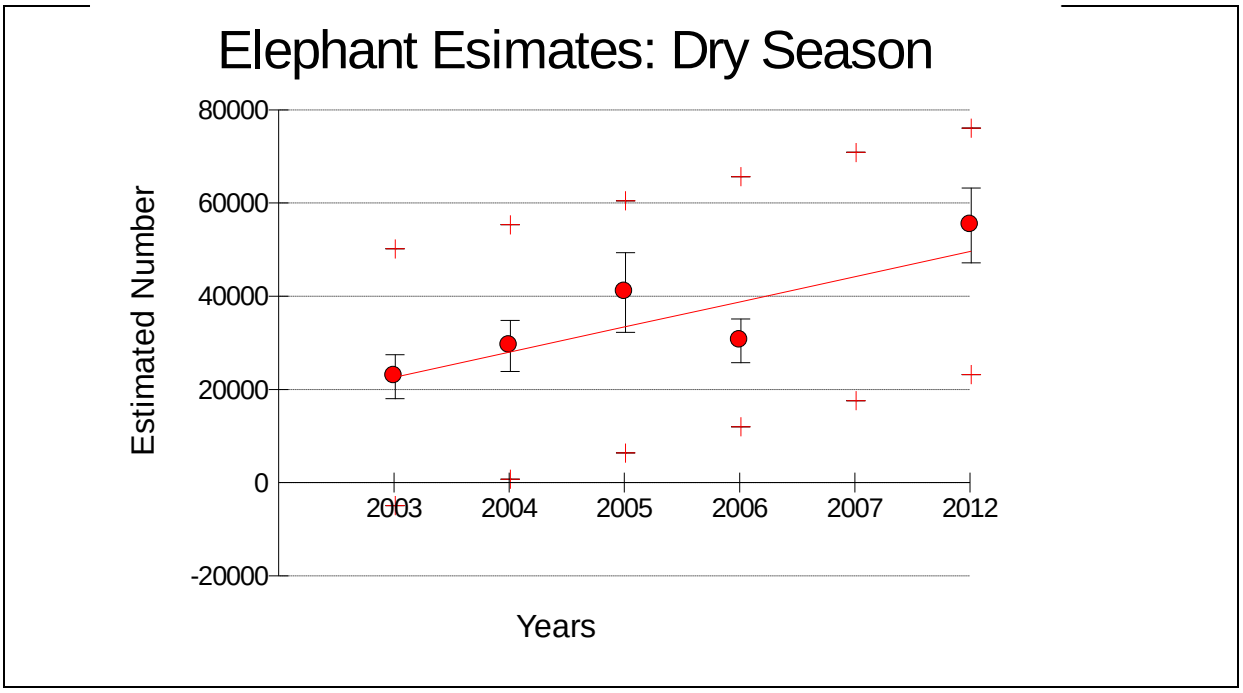
Species	Year	Identifier	Estimated number	Density(animals /sq km	95% Confidence Limit	Maximum Estimate.	Minimum Estimate.
Buffalo	2012	NG/12	194	0.18	159.52	310	78
Buffalo	2012	NG/22	4486	7.66	157.31	5562	3410
Buffalo	2012	NG/23	81	0.23	158.55	106	56
Buffalo	2012	NG/28	4178	0.92	100.48	5959	2397
Buffalo	2012	NG/25	16	0.03	251.37	32	0
Buffalo	2012	NG/26	12865	8.17	80.587	17440	8290
Buffalo	2012	NG/31	8352	40.89	334.79	17023	-319
Buffalo	2012	NG/27A	72	0.31	289.05	146	-2
Buffalo	2012	NG/32	6747	10.06	222.18	13362	132
Buffalo	2012	NG/30	1145	1.31	163.26	1907	383
Buffalo	2012	NG/29	6684	5.34	68.224	8753	4615
Elephant	2012	NG/10	2709	3.3	260.75	5101	317
Elephant	2012	NG/7	207	0.07	287.21	391	23
Elephant	2012	NG/12	4102	3.89	64.016	5261	2943
Elephant	2012	NG/22	5007	8.55	127.59	7482	2532
Elephant	2012	NG/24	127	0.33	191.2	178	76
Elephant	2012	NG/23	838	2.39	136.25	1136	540
Elephant	2012	NG/28	17103	3.75	32.519	19468	14738
Elephant	2012	NG/21	721	3.08	153.45	1150	292
Elephant	2012	NG/25	1358	2.58	127.86	1441	1275
Elephant	2012	NG/26	5749	3.65	70.933	6963	4535
Elephant	2012	NG/31	1283	6.28	105.79	1704	862
Elephant	2012	NG/27A	433	1.85	196.37	488	378
Elephant	2012	NG/17	73	1.26	-99	144	2
Elephant	2012	NG/32	8993	13.41	133.64	9580	8406
Elephant	2012	NG/27B	156	0.98	182.89	267	45
Elephant	2012	NG/30	4209	4.82	70.877	4972	3446
Elephant	2012	NG/29	2160	1.72	45.632	2607	1713
Giraffe	2012	NG/22	294	0.5	106.97	416	172
Giraffe	2012	NG/28	1032	0.23	69.381	1380	684
Giraffe	2012	NG/21	68	0.29	177.6	115	21
Giraffe	2012	NG/26	486	0.31	93.076	686	286
Giraffe	2012	NG/31	211	1.03	238.23	247	175
Giraffe	2012	NG/27A	36	0.16	262.28	59	13
Giraffe	2012	NG/32	67	0.1	220.43	125	9
Giraffe	2012	NG/30	204	0.23	141.88	318	90
Giraffe	2012	NG/29	226	0.18	132.69	362	90
Hippo	2012	NG/10	754	0.92	153.07	1113	395
Hippo	2012	NG/7	111	0.04	269.38	197	25
Hippo	2012	NG/12	99	0.09	92.453	127	71

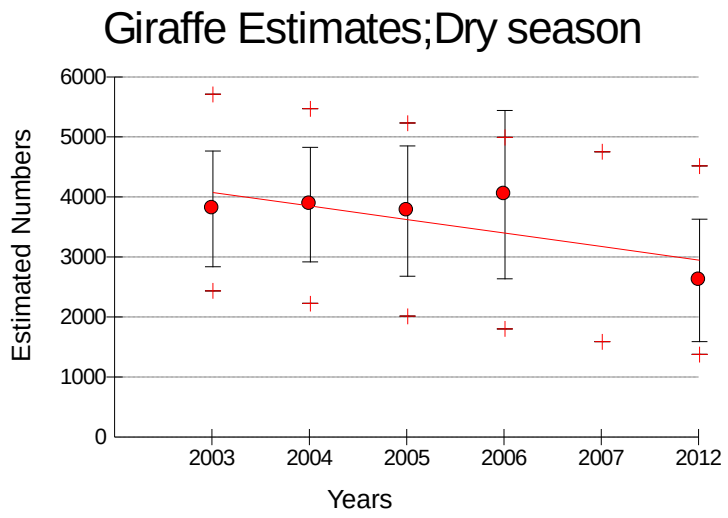
Hippo	2012	NG/22	79	0.13	197.59	115	43
Hippo	2012	NG/24	191	0.5	145.66	299	83
Hippo	2012	NG/23	78	0.22	196.95	111	45
Hippo	2012	NG/28	958	0.21	75.018	1307	609
Hippo	2012	NG/21	360	1.54	162.56	411	309
Hippo	2012	NG/25	216	0.41	112.17	315	117
Hippo	2012	NG/26	32	0.02	318.43	43	21
Hippo	2012	NG/32	270	0.4	163.28	465	75
Hippo	2012	NG/27B	14	0.09	295.73	30	-2
Hippo	2012	NG/30	31	0.04	284.76	66	-4
Hippo	2012	NG/29	63	0.05	255.49	86	40
Impala	2012	NG/7	239	0.09	282.51	448	30
Impala	2012	NG/12	308	0.29	224.73	372	244
Impala	2012	NG/22	1343	2.29	142.03	1931	755
Impala	2012	NG/23	87	0.25	213.51	153	21
Impala	2012	NG/28	38849	8.52	36.445	44171	33527
Impala	2012	NG/21	685	2.93	152.35	1089	281
Impala	2012	NG/25	872	1.66	145.65	1061	683
Impala	2012	NG/26	3623	2.3	46.434	4365	2881
Impala	2012	NG/31	2513	12.3	114.54	3258	1768
Impala	2012	NG/17	806	13.81	-99	1589	23
Impala	2012	NG/32	4719	7.04	101.91	6518	2920
Impala	2012	NG/30	6332	7.25	92.895	8380	4284
Impala	2012	NG/29	2047	1.64	75.795	2751	1343
Kudu	2012	NG/7	162	0.06	276.06	326	-2
Kudu	2012	NG/22	83	0.14	256.04	131	35
Kudu	2012	NG/23	18	0.05	271.33	35	1
Kudu	2012	NG/28	812	0.18	84.037	1034	590
Kudu	2012	NG/25	95	0.18	227.01	183	7
Kudu	2012	NG/26	526	0.33	138.23	700	352
Kudu	2012	NG/31	103	0.5	209.87	155	51
Kudu	2012	NG/17	29	0.5	-99	57	1
Kudu	2012	NG/32	73	0.11	257.62	118	28
Kudu	2012	NG/27B	43	0.27	272.93	88	-2
Kudu	2012	NG/30	328	0.38	236.33	346	310
Kudu	2012	NG/29	74	0.06	209.27	102	46
Lechwe	2012	NG/10	264	0.32	165.22	433	95
Lechwe	2012	NG/12	106	0.1	165.99	134	78
Lechwe	2012	NG/22	631	1.08	217.77	768	494
Lechwe	2012	NG/24	109	0.29	171.43	173	45
Lechwe	2012	NG/23	2936	8.36	105.18	3946	1926
Lechwe	2012	NG/28	13778	3.02	39.475	15537	12019
Lechwe	2012	NG/21	602	2.57	158.55	681	523
Lechwe	2012	NG/25	1510	2.87	106.51	1761	1259

Lechwe	2012	NG/26	1119	0.71	119.17	1366	872
Lechwe	2012	NG/31	703	3.44	138.7	1005	401
Lechwe	2012	NG/27A	1033	4.42	56.176	1241	825
Lechwe	2012	NG/32	547	0.82	175.78	805	289
Lechwe	2012	NG/27B	29	0.18	278.8	60	-2
Lechwe	2012	NG/30	1286	1.47	88.967	1685	887
Lechwe	2012	NG/29	1004	0.8	103.95	1397	611
Roan	2012	NG/28	18	0	344.16	42	-6
Roan	2012	NG/26	90	0.06	277.05	188	-8
Sable	2012	NG/12	362	0.34	224.18	537	187
Sitatunga	2012	NG/28	63	0.01	210.76	124	2
Steenbok	2012	NG/28	19	0	344.32	25	13
Tsessebe	2012	NG/12	45	0.04	245.02	94	-4
Tsessebe	2012	NG/22	90	0.15	255.64	179	1
Tsessebe	2012	NG/24	61	0.16	269.68	119	3
Tsessebe	2012	NG/28	713	0.16	89.263	909	517
Tsessebe	2012	NG/21	134	0.57	277.74	224	44
Tsessebe	2012	NG/25	15	0.03	267.65	22	8
Tsessebe	2012	NG/31	44	0.21	281.66	70	18
Tsessebe	2012	NG/32	55	0.08	249.11	109	1
Tsessebe	2012	NG/29	127	0.1	224.97	255	-1
Waterbuck	2012	NG/32	18	0.03	320.98	34	2
Wildebeest	2012	NG/7	259	0.09	257.28	515	3
Wildebeest	2012	NG/28	194	0.04	142.33	328	60
Wildebeest	2012	NG/31	769	3.77	164.68	899	639
Wildebeest	2012	NG/32	1038	1.55	194.71	1930	146
Wildebeest	2012	NG/29	16	0.01	378.41	24	8
Zebra	2012	NG/7	298	0.11	445.49	594	2
Zebra	2012	NG/12	4016	3.81	101.69	5582	2450
Zebra	2012	NG/22	816	1.39	193.72	1333	299
Zebra	2012	NG/23	181	0.52	271.33	357	5
Zebra	2012	NG/28	3668	0.8	60.858	4317	3019
Zebra	2012	NG/21	168	0.72	164.17	272	64
Zebra	2012	NG/26	1901	1.21	122.45	2240	1562
Zebra	2012	NG/31	176	0.86	268.98	280	72
Zebra	2012	NG/27A	363	1.56	225.93	593	133
Zebra	2012	NG/32	1024	1.53	89.477	1114	934
Zebra	2012	NG/30	3590	4.11	139.84	4563	2617
Zebra	2012	NG/29	2395	1.91	99.774	3072	1718

POPULATION TRENDS IN AND AROUND THE DELTA






Giraffe Estimates;Dry season
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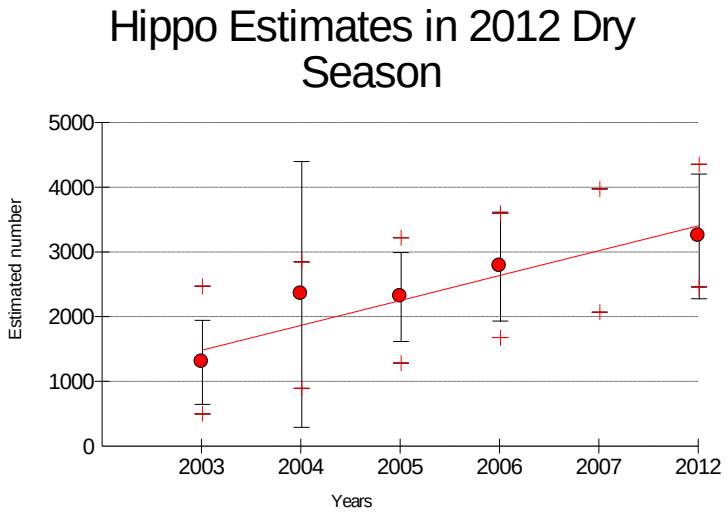
2005
2006
2007
2012
Years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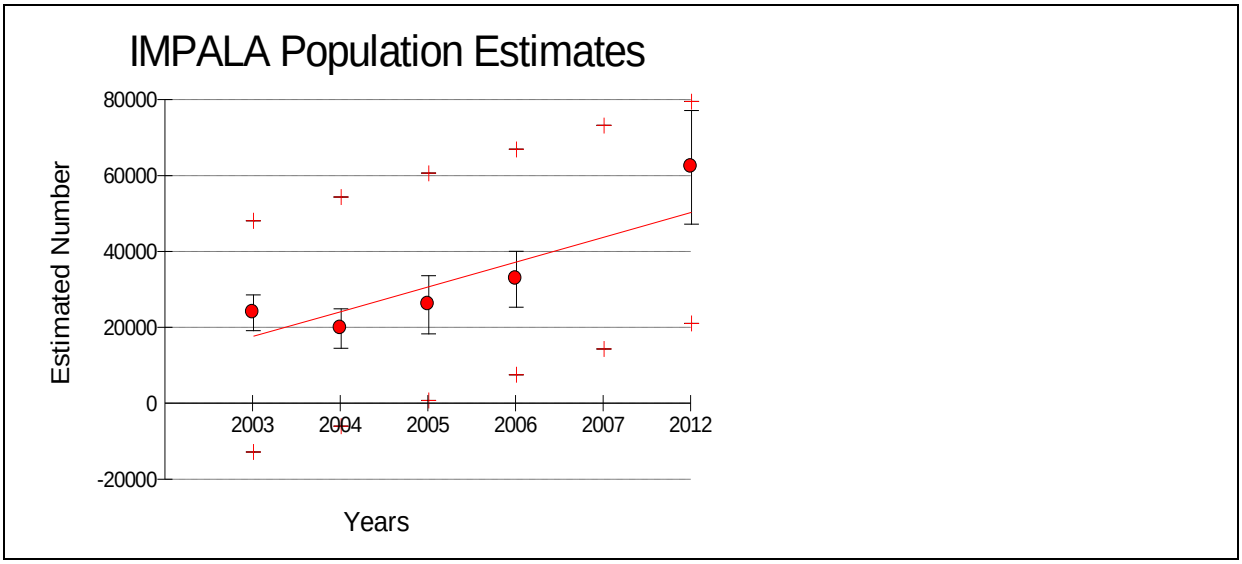
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2004
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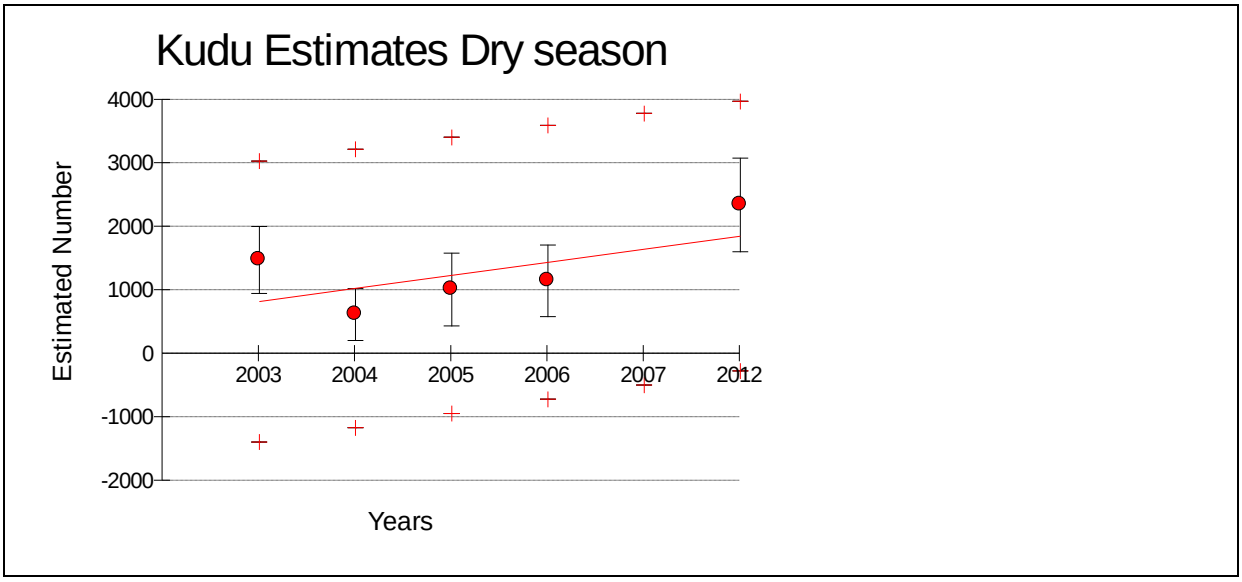
2007
2012
Years


Kudu Estimates Dry season
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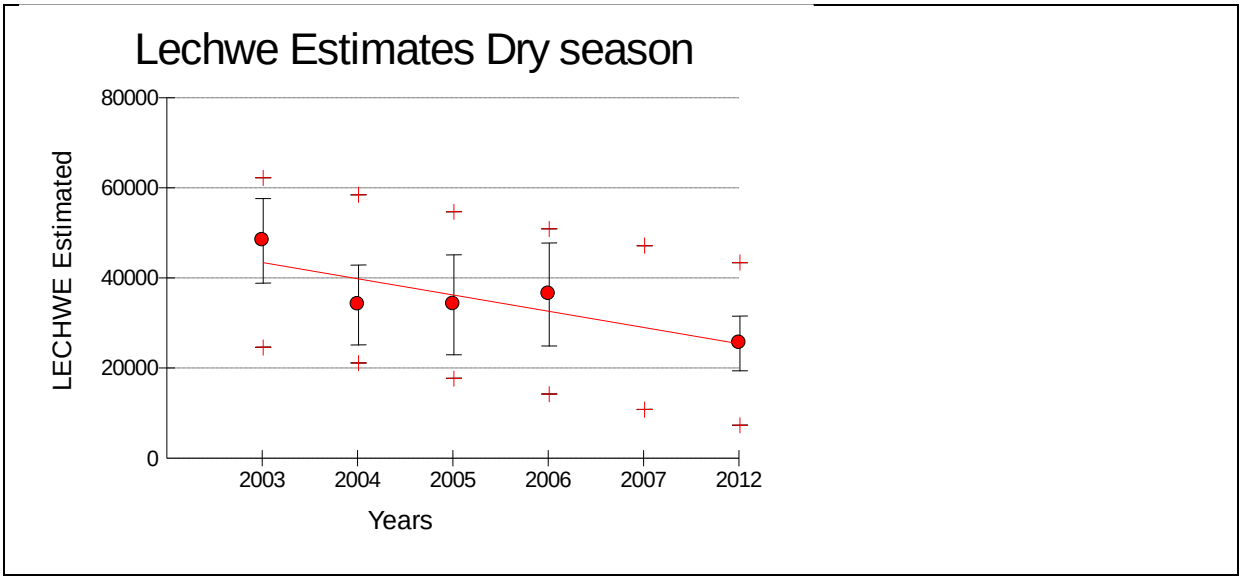
Lechwe Estimates Dry season
LECHWE Estimated
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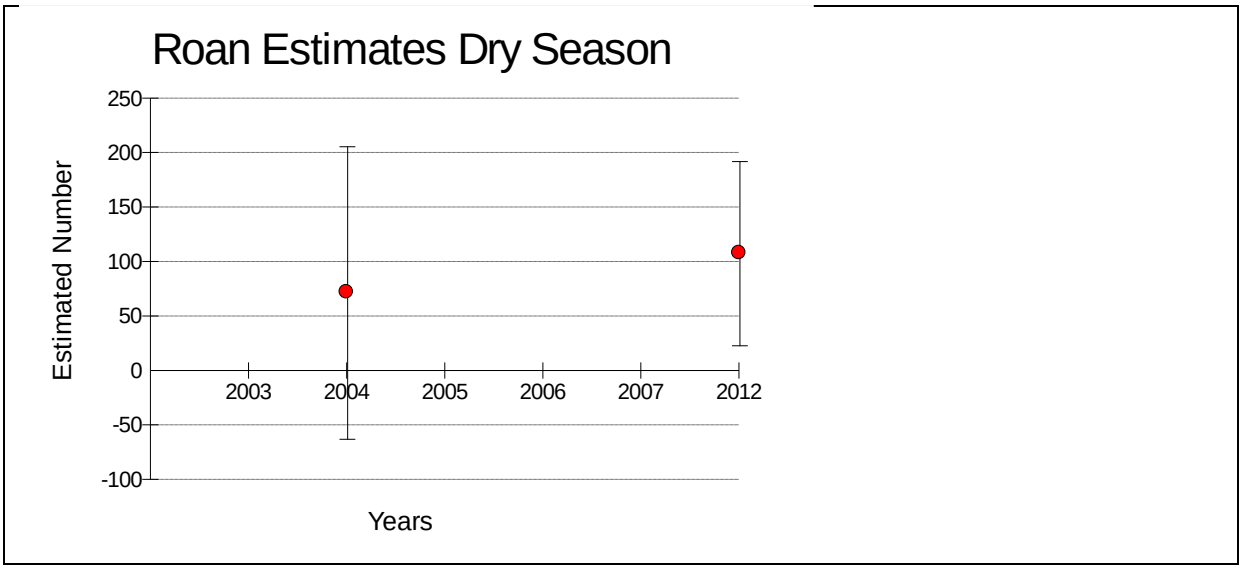
2006
2007
2012
Years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2006
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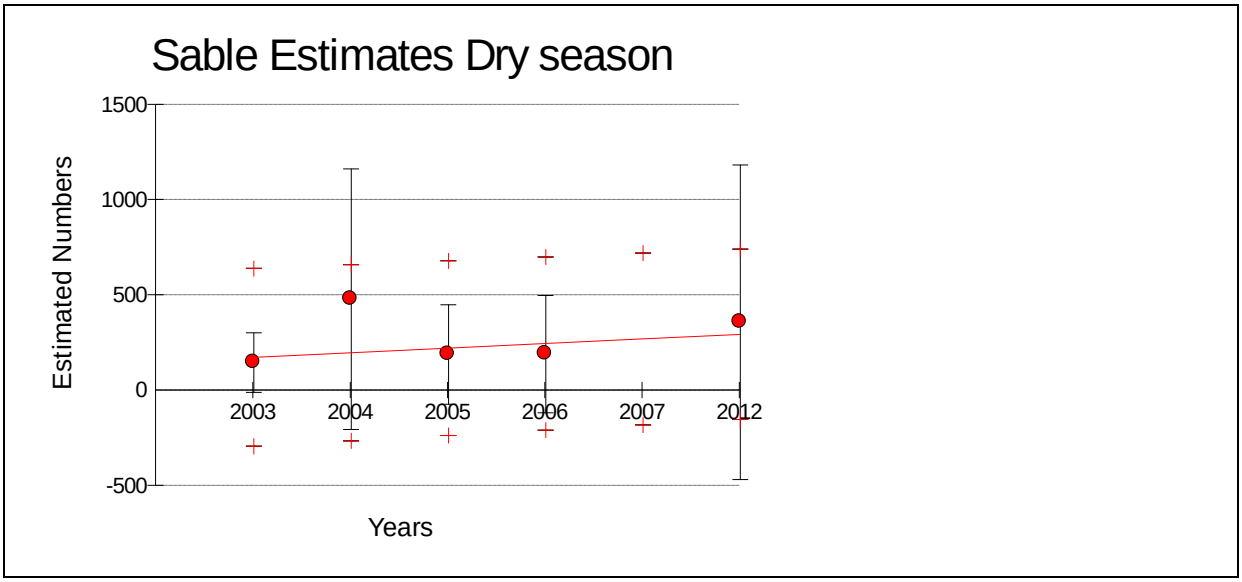
2012
Years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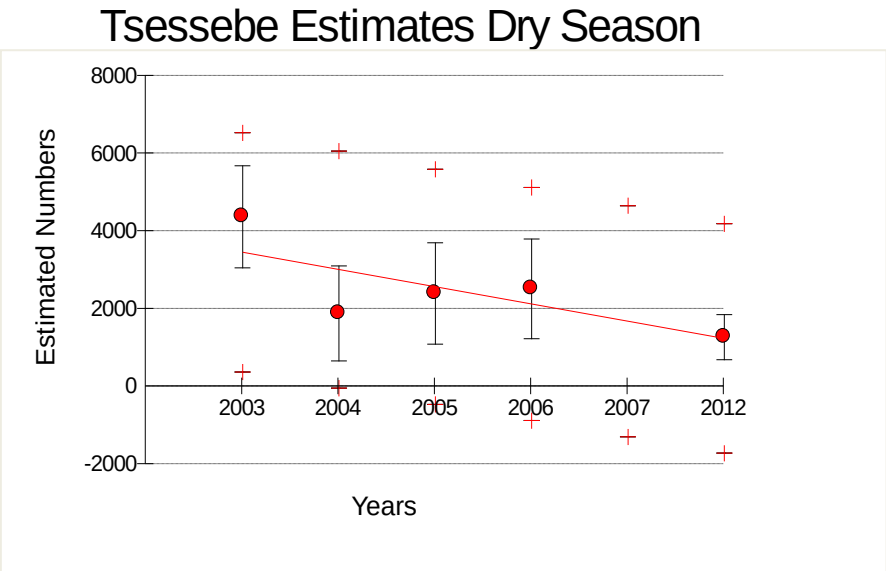
2006
2007
2012
Years

TSESSEBE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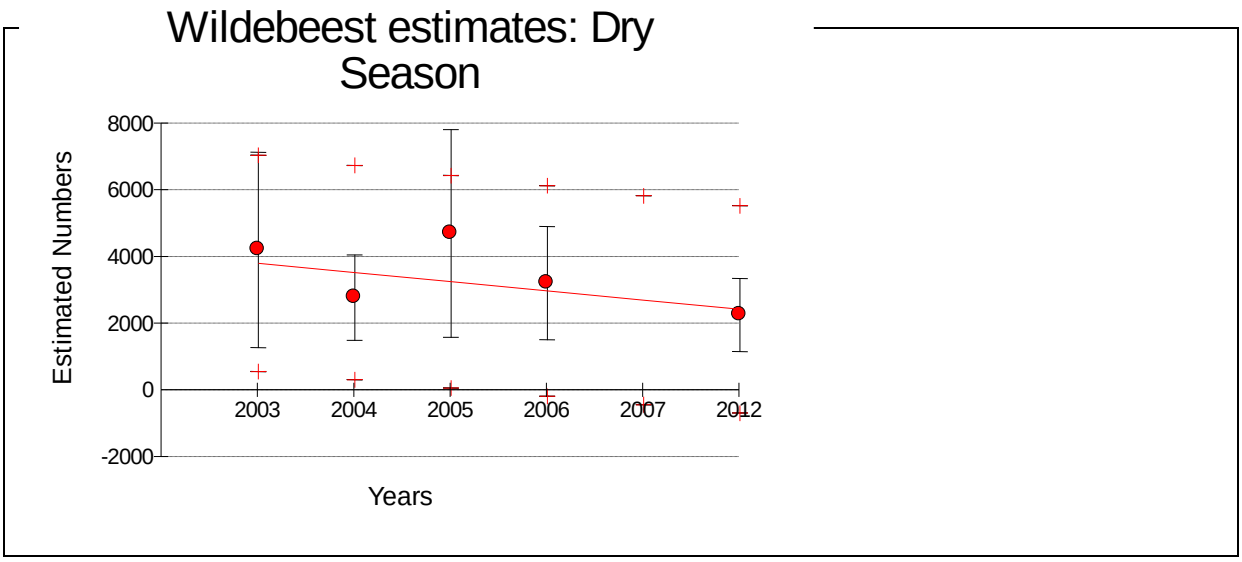
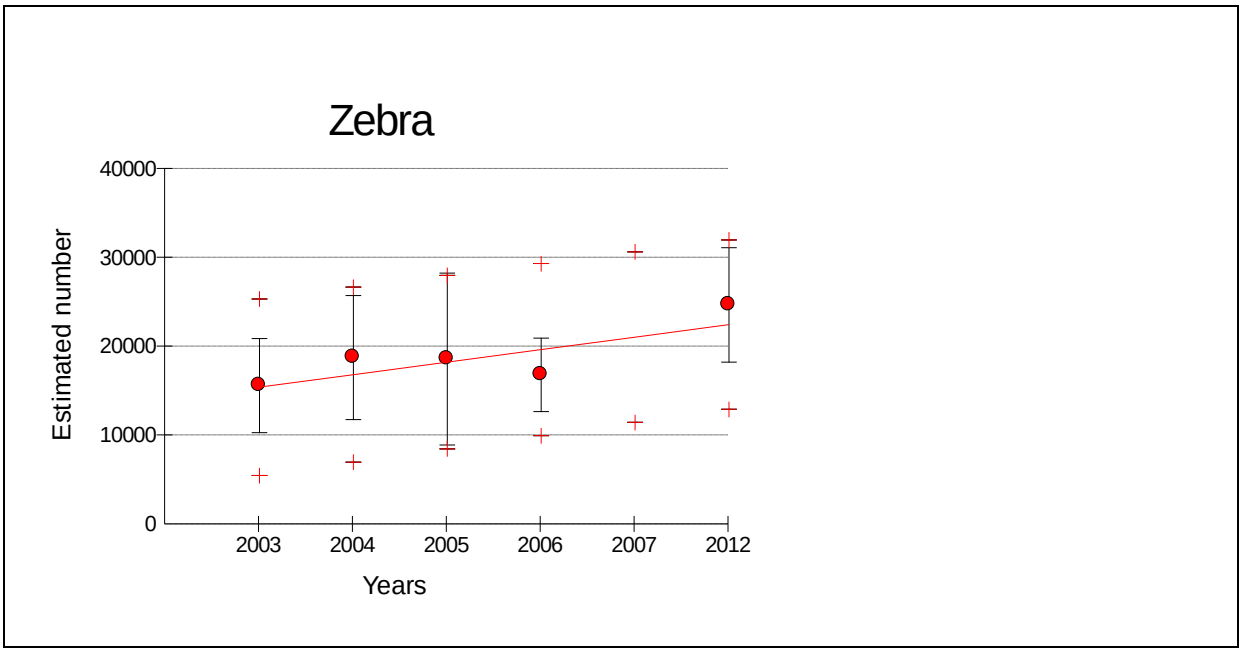
2012
Years





WILDLIFE MONITORING IN THE OKAVANGO DELTA

The Department of Wildlife and National Parks (DWNP) has a mandate of monitoring wildlife through the Research and Statistics Division. The Division is charged with three functions; which are, applied research; monitoring and veterinary services. All research is guided by the Strategic Plan for Wildlife Research in Botswana approved in 2005, with an overall goal to obtain information which will contribute to the effective management and conservation of Botswana's wildlife and habitats. The Division focuses on wildlife monitoring in order to optimally utilize the limited resources available, while independent researchers address other objectives in the strategic plan.

The DWNP has been supporting the introduction of the Management Orientated Monitoring System (MOMS) into communities, while also using this system in the protected areas of Botswana. This system involves field staff and community members deciding what information is important for them to collect. They are then assisted in designing and undertaking the data collection, recording and analysing with minimal support from external or senior technicians. It is a simple and cost effective approach that was initially developed for community managed conservation areas that had limited long term funds and resources to conduct high-tech monitoring systems. The paper based system provides sufficient data to guide management decisions, build capacity of field staff, stimulate discussion amongst local resource users and encourage local participation. The MOMS process ensures that monitoring objectives are clear, that expectations and information needs are met, and that the end user of data is identified.

The MOMS system is designed to collect information on those natural resources, resource processes and events that are of significance to the user on an ongoing basis through events books. These data are captured monthly into monthly report cards called Field Events Cards (Yellow), which are transferred into an Occurrence Book. This is a monthly summary that can then be used to produce quarterly reports, and finally all information is updated annually (Red charts). During a recent MOMS workshop with the DWNP, feedback was obtained for the MOMS data collected in each of the protected areas in Botswana, and the usefulness of the system was self-evident in a management role. Managers obtain vital information from each of their stations, and this information can then be used in a constructive manner. The MOMS approach has been adopted with good results in the communal areas of Namibia and been expanded to other state protected areas in Namibia, Botswana, and Mozambique. The MOMS approach uses a geographical grid-based approach to identifying localities in the absence of GPS units. The grid system allows field operatives to develop spatial data, without the use of expensive equipment, within their areas of operation. As a result of this accurate local information, a clear picture emerges over the entire region. This is because local knowledge of the conservation areas is very accurate and, given maps with geographic grids on them, individual localities can be plotted precisely by community escort guides (CEG's) and safari operators.

In the past year a standardized wildlife monitoring protocol has also been developed that is designed to mesh seamlessly with the MOMS approach, with the addition of a more scientifically rigid approach to the monitoring of fauna and flora in the concessions in the form of a bi-annual series of transects, in March and October, specifically undertaken in each concession and aimed at observing population demographic patterns of both herbivores and carnivores. These data will augment the continuous sightings and events data that is already collected by in community and privately managed Wildlife Management Areas by community guides and Safari tour guides within the various concessions, assisting in providing a reliable and effective monitoring approach. Developed in partnership with the USAID funded Southern Africa Regional Environment Program (SAREP) the standardized data will help to define the causal reasons for observed wildlife declines within northern Botswana. Fourteen monitoring activities have been defined though collaborative stakeholder process, including the University of Botswana, independent researchers and the concessionaires.

Designed to mesh seamlessly with the Management Orientated Monitoring System (MOMS), these monitoring data are collected by guides, under the responsibility of concessionaires, for the long-term trend assessment of flora and fauna and observation of wildlife population demographics in Ngamiland. The data collected from the protocol will be applicable at the local and national level. Predator densities and movements, as well as long-term herbivore population trends, will be obtained for management purposes; local game hotspots can be determined, rare species recorded and general dynamics (bush encroachment, stochastic local processes such as disease outbreaks etc.) can be observed and addressed fairly rapidly.

Aerial surveys have, throughout the years, remained a major undertaking for the Division and the latest survey was conducted during the dry season of 2012.

The bulk of wildlife monitoring in the Okavango Delta is undertaken through MOMS (including the standardized monitoring protocols for concessionaires); covering all animal species but with particular attention given to those listed in the Red List of IUCN. The tool also covers different aspect of wildlife including harvesting, illegal activities, Problem Animal Control (either by farmers or wildlife officers), wildlife species sightings and visitor numbers for Protected Areas; as well as other aspects of wildlife management like human resources management and budgeting.

Rhino Monitoring

In addition to the MOMS and standardized monitoring protocols specific monitoring is undertaken on Rhinoceros. Rhinoceros were almost exterminated in Botswana at one point due to poaching and the few remaining animals were captured and translocated to Khama Rhino Sanctuary. Some rhinos were later released into the wild (when the population could no longer sustained by the sanctuary), together with others from South Africa. The rhinos that were re-introduced to the Okavango Delta are most confined to Mombo (an area in Chief's Island) although some have since dispersed to Makgadikgadi region. Since their re-introduction, the DWNP and Okavango Wilderness Safari (OWS) have been monitoring the rhinos, through the use of notches and radio/satellite collars. In order to retain these charismatic animals which complements the Big Five in Botswana. The rhino population has been steadily increasing although some were lost to poaching.

HUNTING BAN IN BOTSWNA

The Ministry of Environment, Wildlife and Tourism, pursuant to Statutory Instrument 2 of 2014 (attached), has declared a ban on hunting of wildlife in all controlled hunting areas in Botswana including the Okavango Delta with effect from 2014. It is anticipated that the ban which will be renewed on an annual basis will allow research to understand the causes of observed wildlife declines and to allow interventions to reverse declines to take effect. No quotas, licenses or permits will be issued for hunting of Part I and Part II Schedule game animals as listed in the Wildlife Conservation and National Parks Act.

The decision to temporarily ban hunting has been necessitated by available information which indicates that several species in the country are showing declines. The causes of the declines are likely due to a combination of factors such as anthropogenic impacts, including illegal offtake and habitat fragmentation or loss. The suspension of hunting will allow the Ministry of Environment, Wildlife and Tourism, working with all stakeholders, the opportunity to focus on understanding the causes of any declines and, where possible, to put in place remedial measures which can assist to reverse these declines. The Ministry will continue to monitor wildlife trends using suitable methodologies and regularly update the public on the status of the wildlife resource.

FENCES IN THE PROPOSED OKAVANGO DELTA WORLD HERITAGE SITE

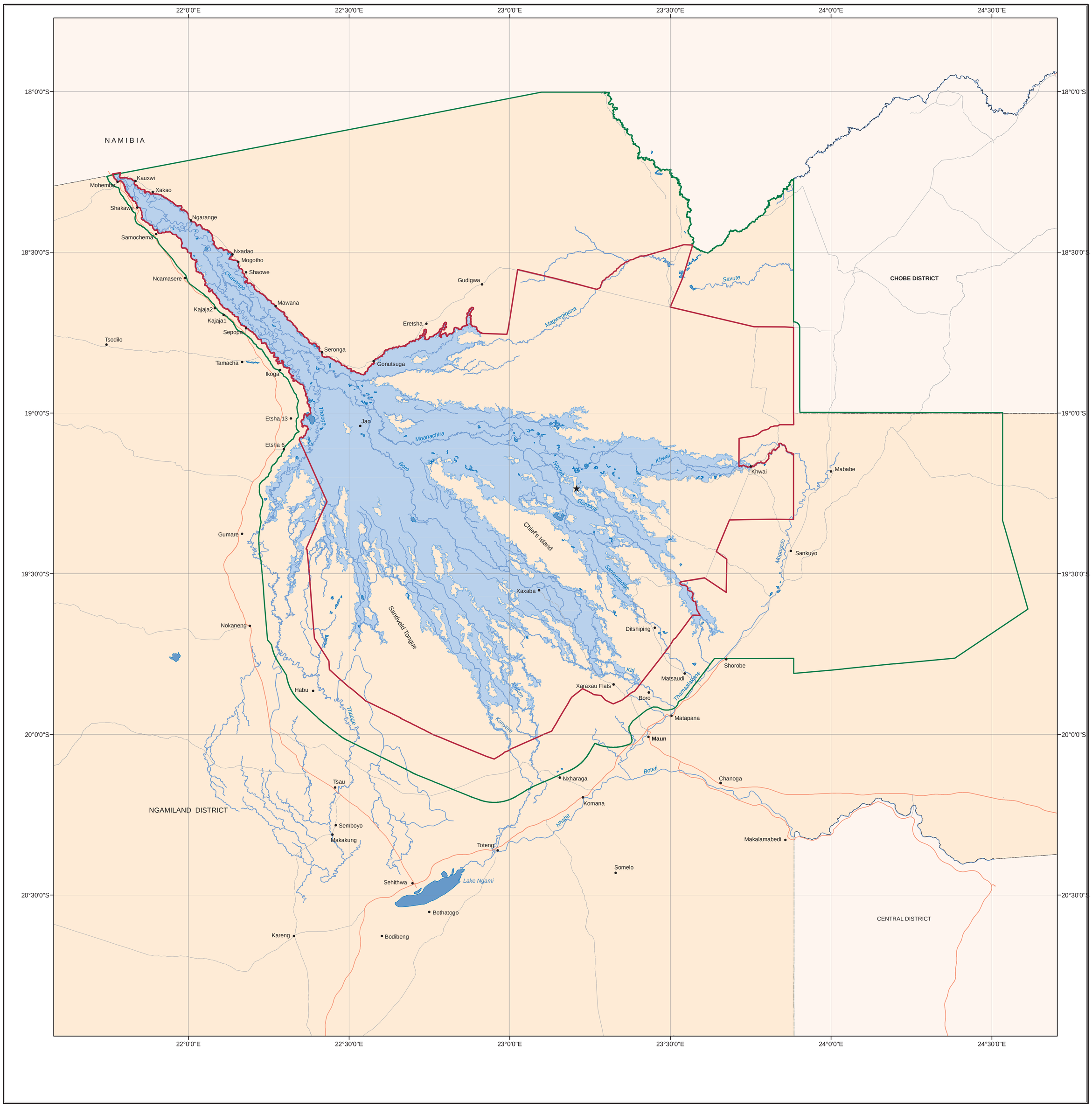
Periodic outbreaks of foot and mouth disease (FMD) between 1930 and the late 1970s resulted in the erection of the Southern Buffalo Fence around the southern edge of the Okavango Delta in 1982, to minimise contact between buffalo, which are the primary sources of the virus, and the cattle in the surrounding area. The Northern Buffalo Fence was started in 1991 around the northern edge of the Delta, but not completed until 1996 after the outbreak of CBPP, when it was extended northwards to the border with the Caprivi Strip. There still exists a gap between the ends of the Northern and Southern Buffalo Fences, through an area of permanent and seasonal swamps; this represents a possible area of contact between buffalo and cattle, and hence a site of potential outbreak of FMD.

The Southern and Northern Buffalo Fences have preserved the integrity of the Okavango Delta by limiting the incursion of livestock into the core of the Delta. The integrity of the fences has been challenged by increased flood levels and a rising elephant population. As the elephant distribution has increased in Ngamiland over the last twenty years, instances of damage to the fences have increased. Wildlife densities tend to be greater where livestock densities are lower (see wildlife aerial census report for 2012).

Ngamiland wildlife communities with large herbivores moving out of the Delta in the wet season and moving back in the dry season. These movements are potentially affected by fences and this has in the recent past led to consideration of and re-alignment and decommissioning of parts of the veterinary fences around the Delta. These include re-alignment of the northern Buffalo to meet the fence along the Botswana-Namibia border. The gap has facilitated the movement of elephants into Caprivi and onto Angola. It is anticipated that the creation of such corridors under the auspices of the Kavango-Zambezi (KAZA) Trans frontier Conservation Area will assist, in the medium to long term, to ease elephant pressure on fragile habitats found within the Delta.

Maintenance of the Buffalo fence has become a challenge and it is likely that innovative solutions will be required to reduce the maintenance burden. These include wildlife friendly fencing which will separate livestock and buffalo while allowing elephants to easily negotiate such fencing to reduce damage. The long term survival of wildlife populations in the Delta is dependent upon retaining, as much as possible, their natural movements. Recent research has shown that when certain migratory routes are re-opened, links between different parts of the wildlife range are re-established. A case in point is the re-establishment of the seasonal movement of zebra between the Okavango Delta and the Makgadikgadi Pans following the de-commissioning of a fence.

Okavango Delta: Boundaries



Area of Core Zone: 20 247.9 Sqkm

Area of Buffer Zone: 22 854.3 Sqkm

Coordinates of Center of Property: 23.094
-19.2003

1 : 700 000

0 25 50 100 Kilometers

Legend

- Center of Property
- Settlements
- Core Zone Boundary
- Buffer Zone
- District Boundary
- Tarred Road
- Gravel/Sandy Road
- Lakes/Lagoons
- OkavangoDelta

Prepared by Department of Surveys and Mapping

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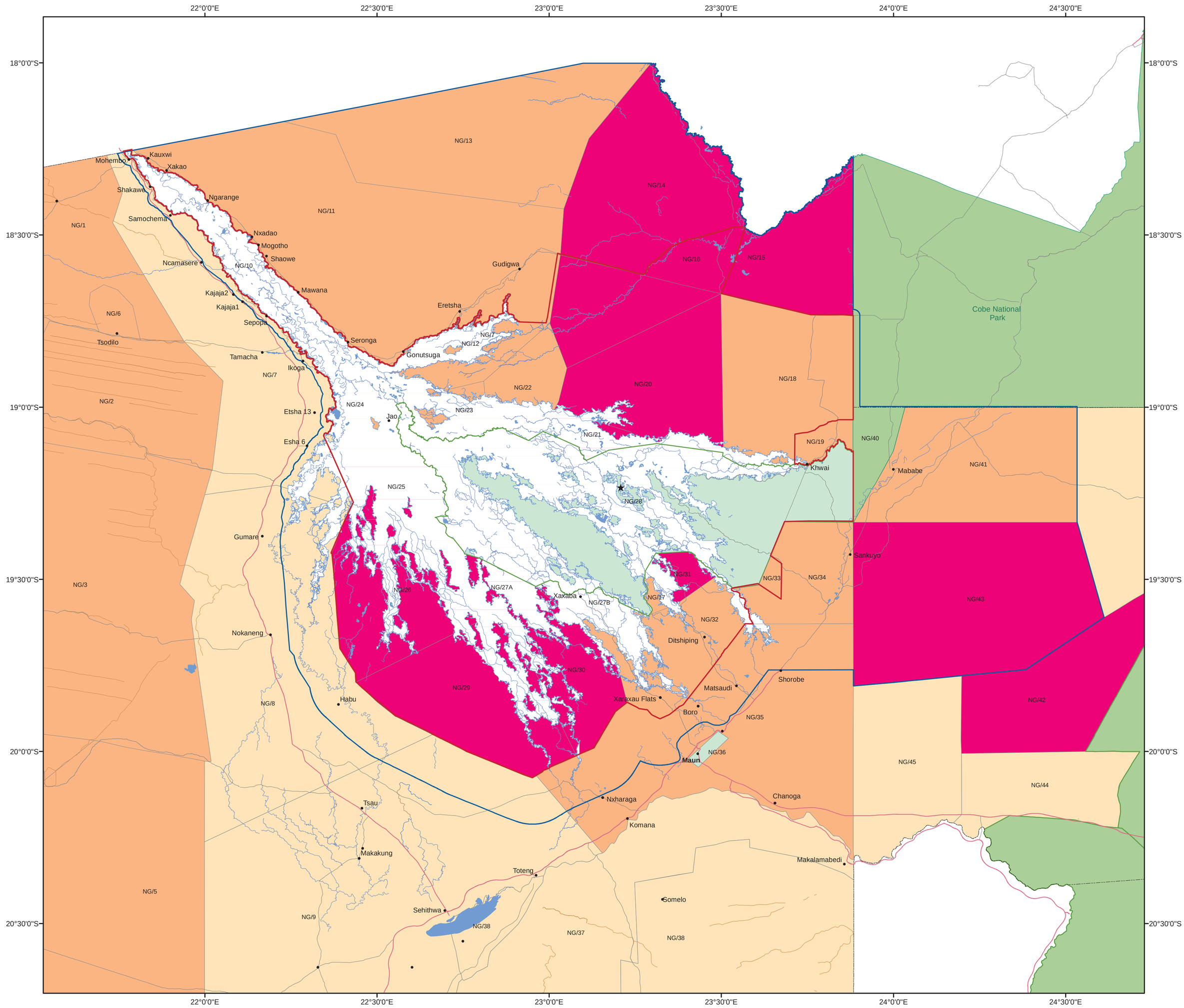
Okavango Delta: Landuse Designations



Scale 1 : 700 000

0 25 50 100 Kilometers

Source Data fron Botswana National PC Atlas, 2002
Prepared by Department of Surveys and Mapping
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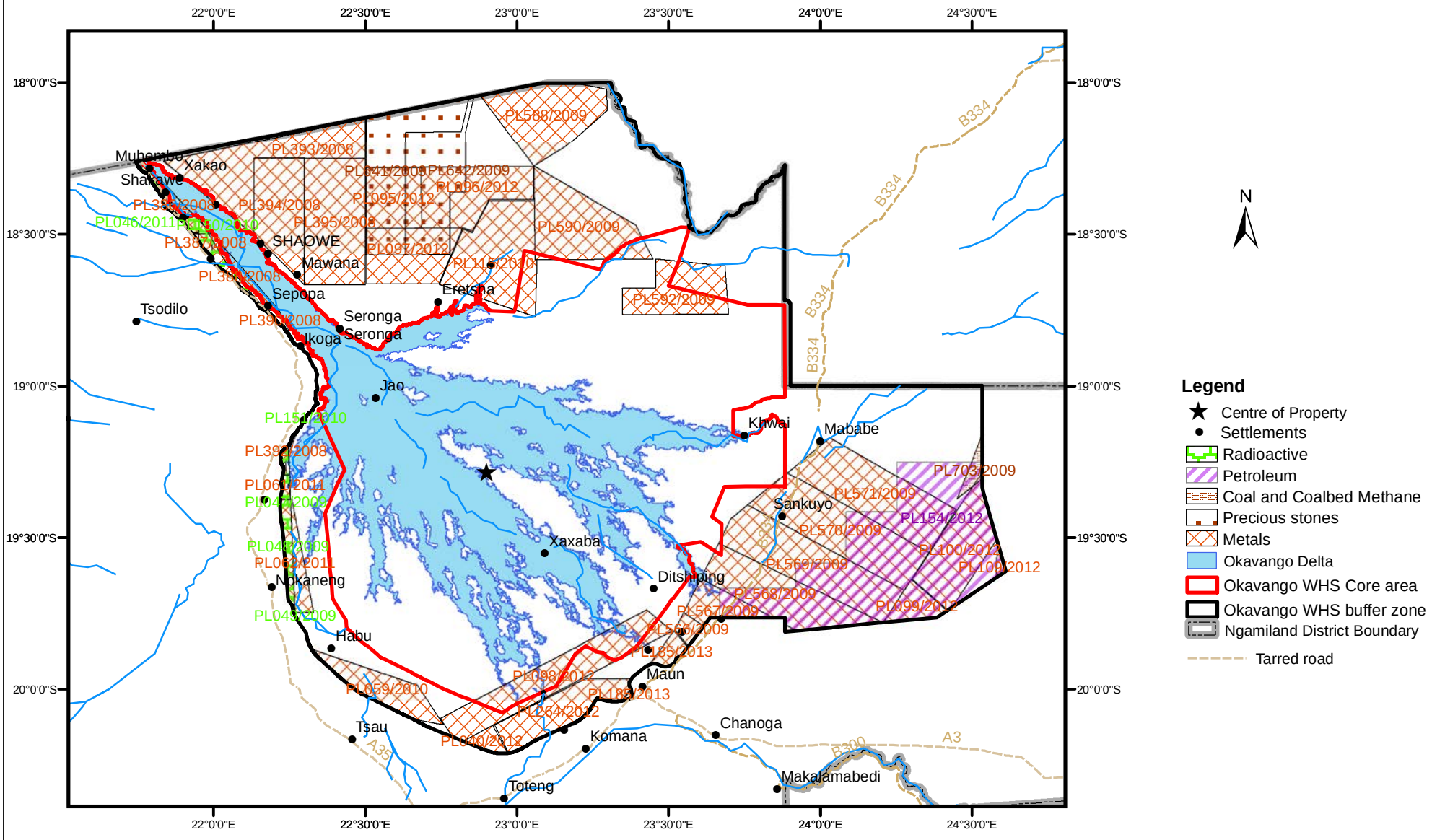
Center of Property
Settlement
Core Zone Boundary
Buffer Zone
Tarred Road
Gravel/Sandy Road
Lake/Lagoons

Landuse Designations

National Park
Game Reserve
Commercial Wildlife Utilization Areas
Community Managed /Utilization Wildlife Areas
Undesignated Areas

Proposed Okavango World Heritage Site

Expired and Active Prospecting Licences - Okavango Delta



Topographic data from Department of Surveys and Mapping
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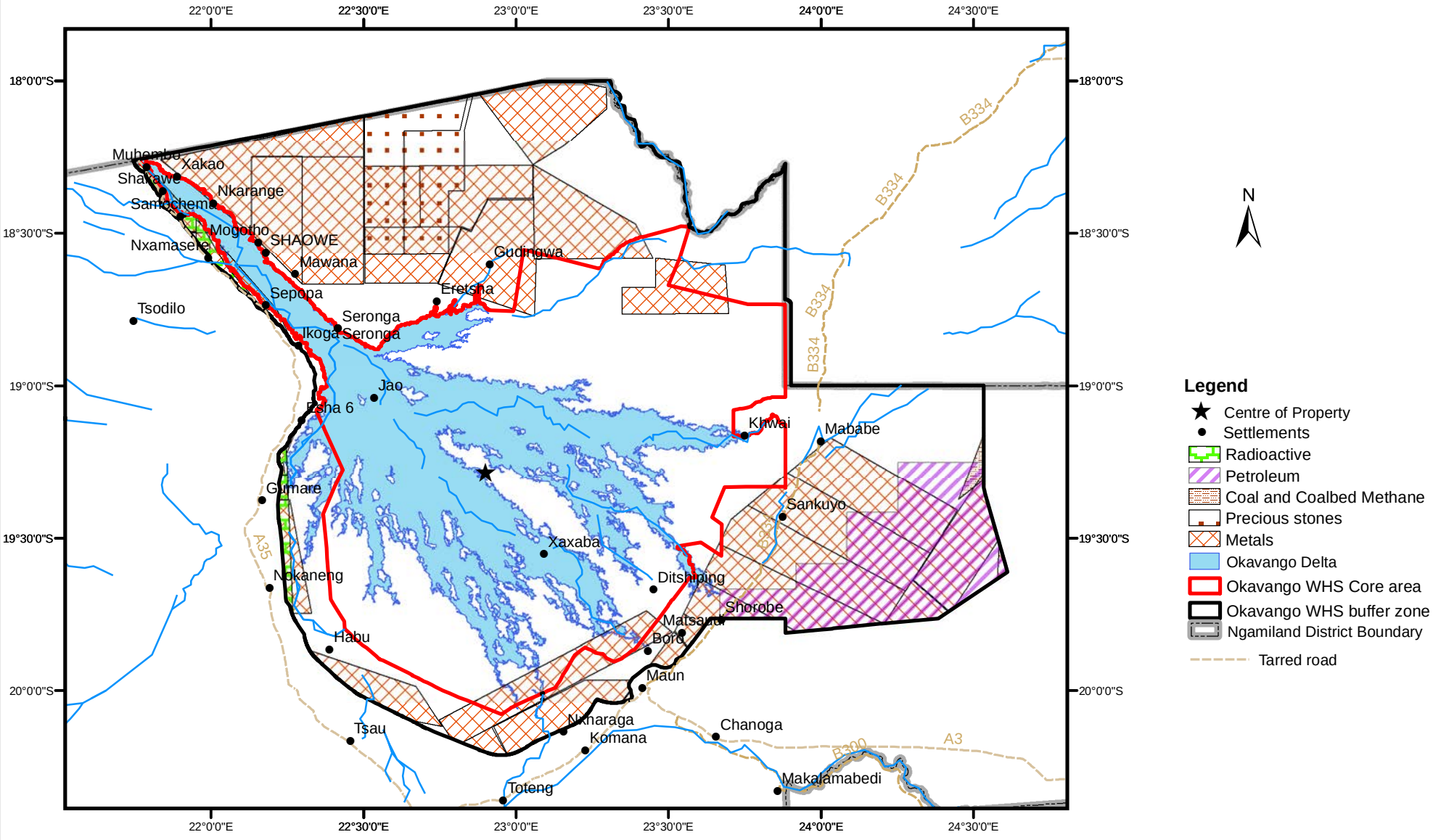
Proposed Okavango World Heritage Site

Expired and Active Prospecting Licences - Okavango Delta



Topographic data from Department of Surveys and Mapping
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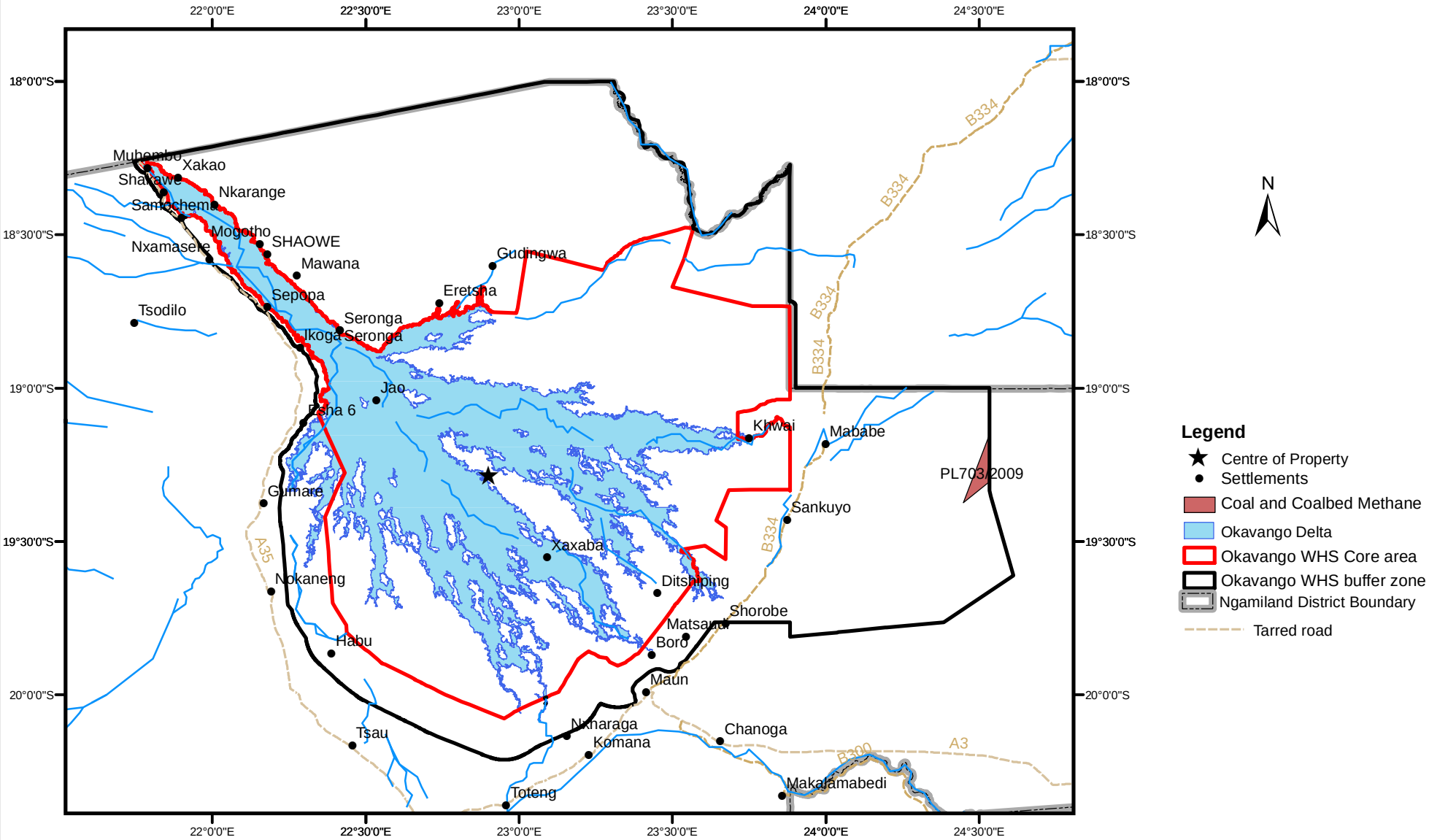
Scale: 1 : 2 000 000

Proposed Okavango World Heritage Site

Prospecting Licences (PLs) for Coal & Coalbed Methane



Topographic data from Department of Surveys and Mapping
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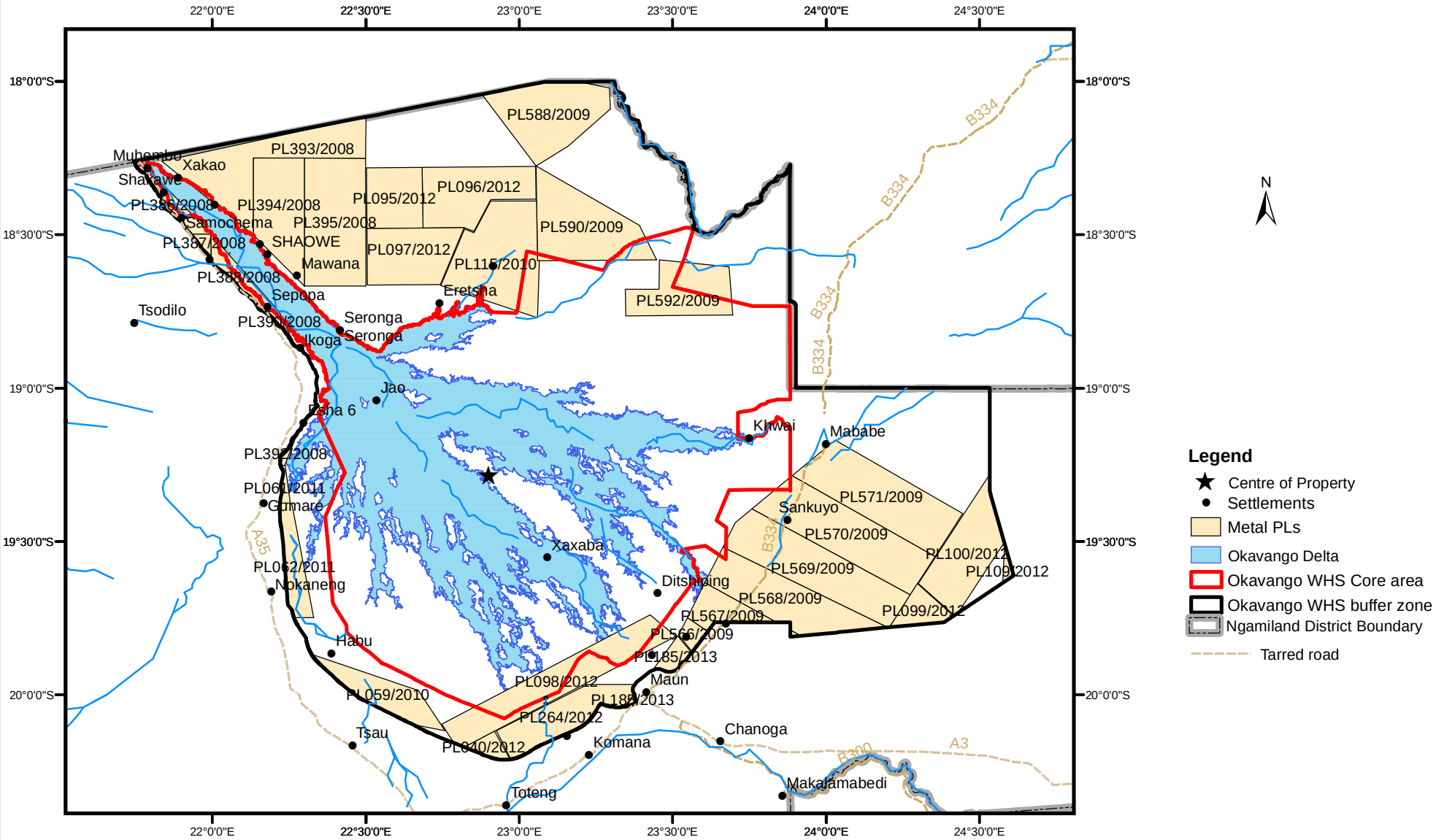
Scale: 1 : 2 000 000

Proposed Okavango World Heritage Site

Prospecting Licences (PLs) for Metal Minerals



Legend

- Centre of Property
- Settlements
- Metal PLs
- Okavango Delta
- Okavango WHS Core area
- Okavango WHS buffer zone
- Ngamiland District Boundary
- Tarred road

0 25 50 100 Kilometers

Scale: 1 : 2 000 000

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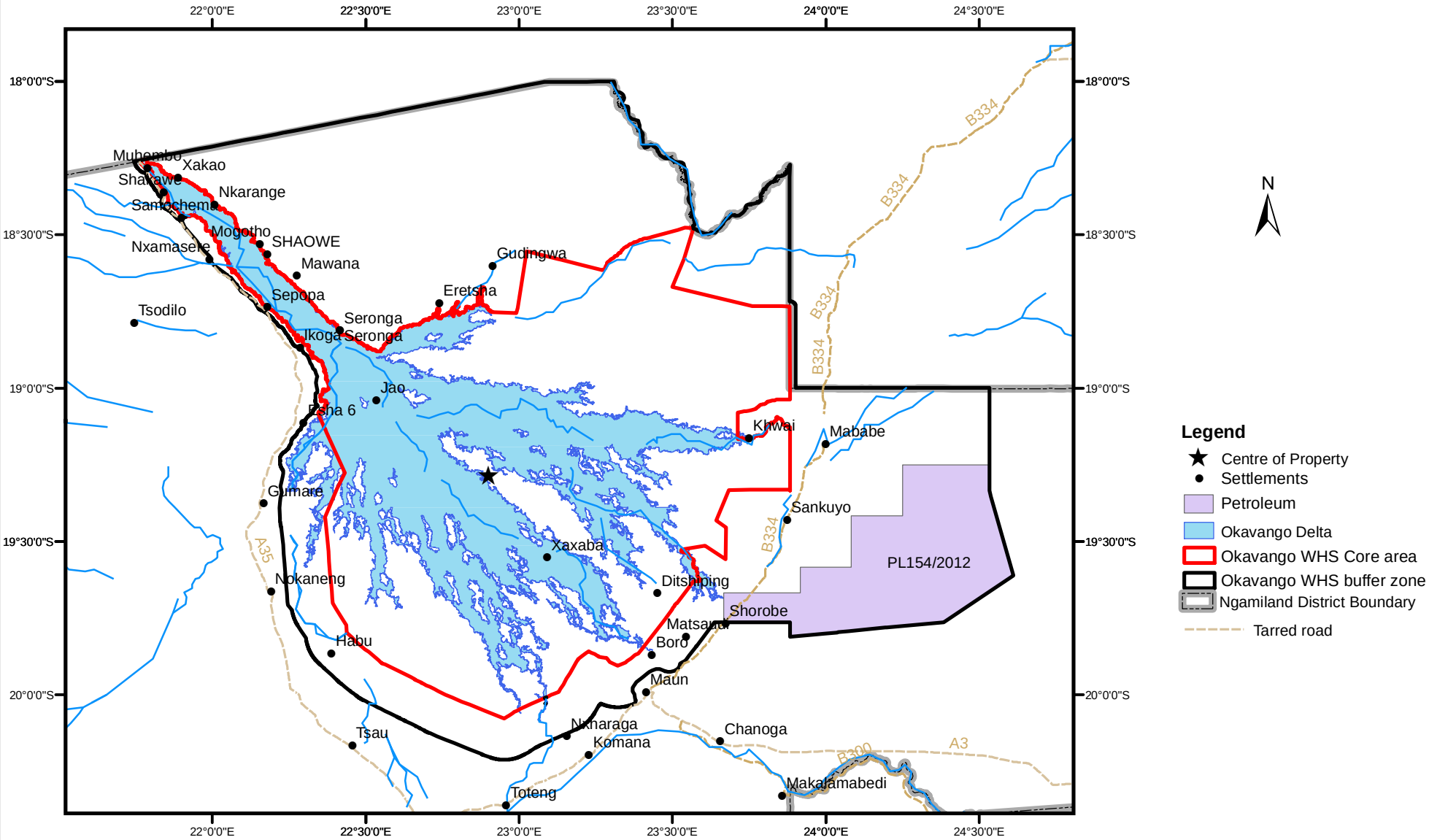
Proposed Okavango World Heritage Site

Prospecting Licences (PLs) for Petroleum



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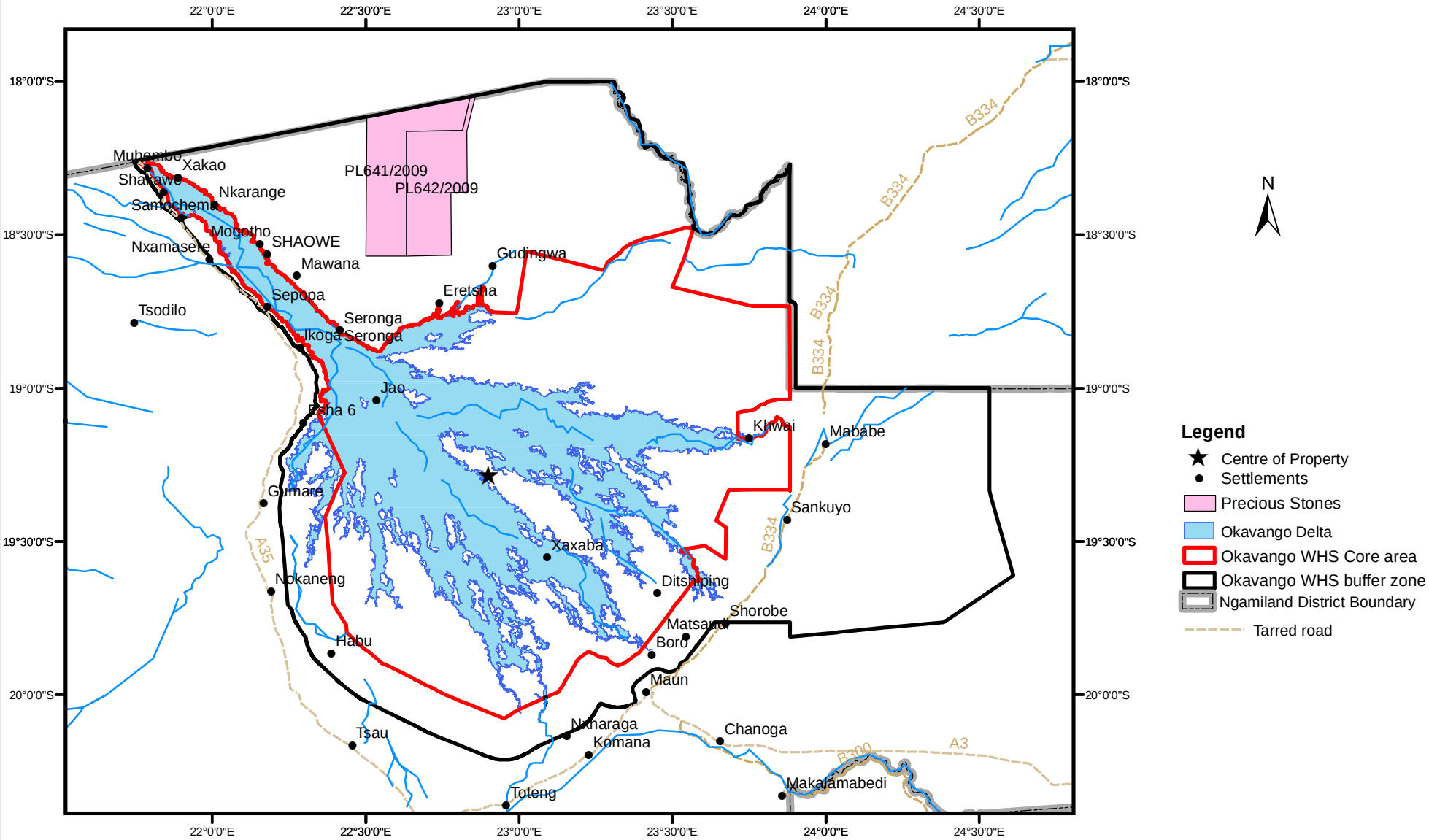
Scale: 1 : 2 000 000

Proposed Okavango World Heritage Site

Prospecting Licences (PLs) for Precious Stones



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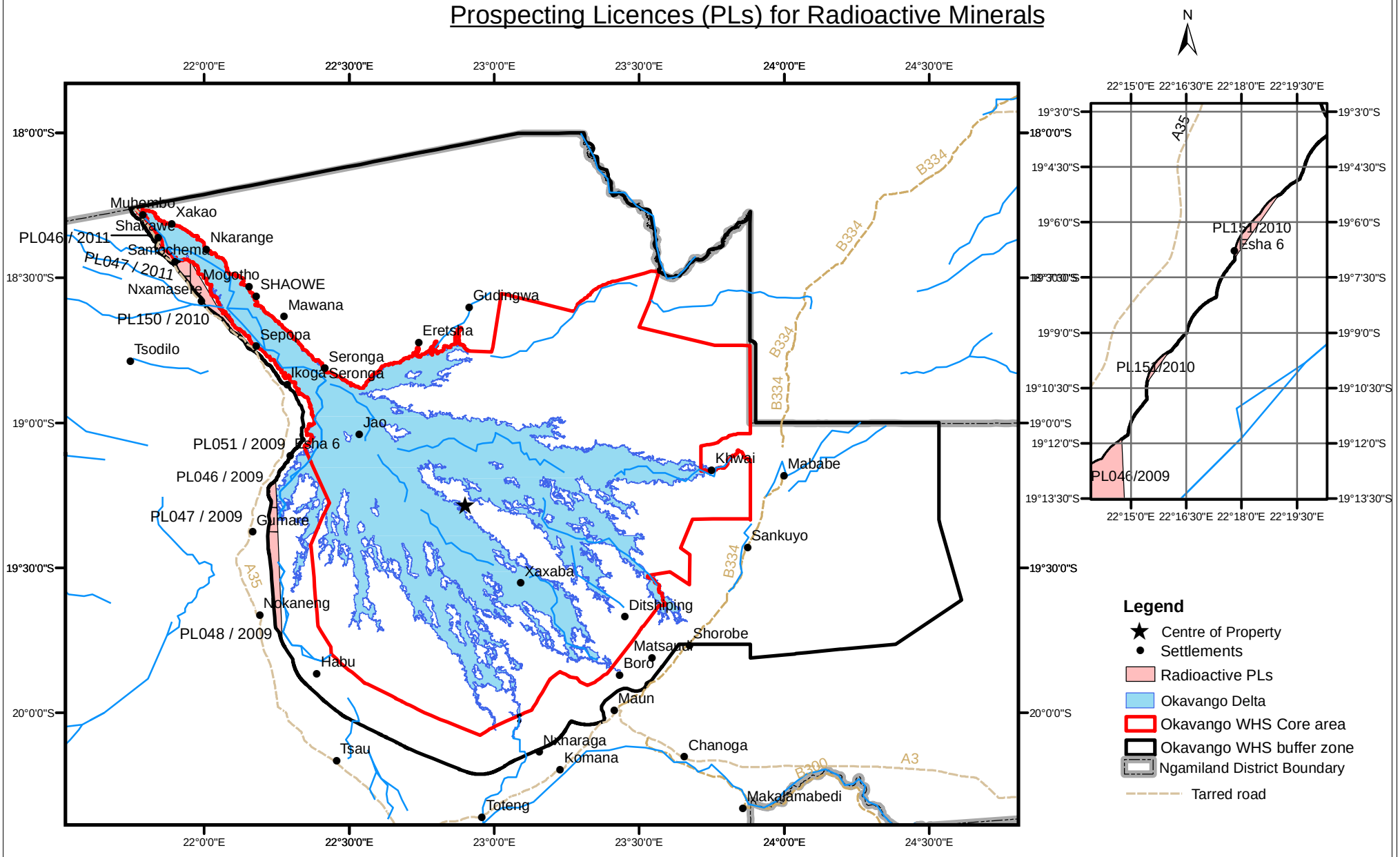
Proposed Okavango World Heritage Site

Prospecting Licences (PLs) for Radioactive Minerals



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