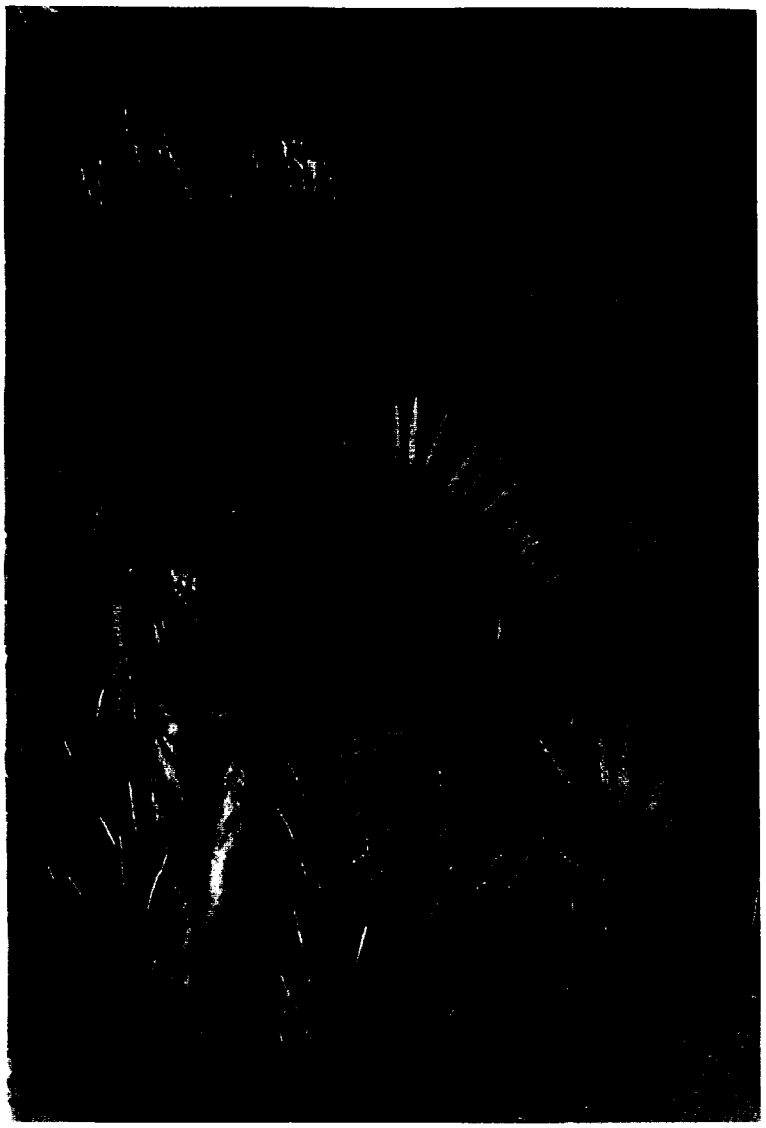
SUNDARBAN WILDLIFE SANCTUARIES

BANGLADESH



WORLD HERITAGE NOMINATION - IUCN TECHNICAL EVALUATION

SUNDARBAN WILDLIFE SANCTUARIES (BANGLADESH)

1. DOCUMENTATION

(i) IUCN/WCMC Data Sheet (25 references)

(ii) Additional Literature Consulted: Dugan, P. ed. 1993. **Wetlands in Danger**; Mackinnon, J. 1997. **Protected Area Systems Review of the Indomalayan Realm**. World Bank Report; Alcom, J.B. and N. Johnson. 1989. Conservation of Biodiversity in Bangladesh. WRI/USAID Report; Nazrul-Islam, A.K.M. 1993. Environment and Vegetation of Sundarbans Mangrove Forest. in Lieth, H. ed. **Towards the Rational Use of High Salinity Tolerant Plants**. Kluwer; Pernetta, J. ed. 1993. Marine Protected Area Needs in the South Asian Seas Region Vol. 1 Bangladesh. IUCN; Global Status of Mangrove Ecosystems. IUCN. 1983; **Handbook for Mangrove Area Management**. IUCN. 1984.

(iii) Consultations: 6 external reviewers, Ministry of Environment and Forest officials, University of Dhaka and Khulna staff; conservation Non-Governmental organisations (Wildlife Society, CARDMA).

(iv) Field Visit: J. Thorsell, February, 1997

2. SUMMARY OF NATURAL VALUES

The Sundarbans mangrove forest, one of the largest such forests in the world is formed at the delta of the Ganges, Brahmaputra and Meghna rivers on the Bay of Bengal. Total area of the entire Sundarbans is about one million ha, 60% of which is found in Bangladesh and the rest in India. The initial area nominated was the Sundarbans West Wildlife Sanctuary, a 71,500ha area adjacent to the border of India's Sundarbans World Heritage site. The Raimangal River separates the two countries. In response to the recommendation of the Bureau the Bangladesh government agreed to also include the Sundarbans South (37,000ha) and Sundarbans East (31,000ha) Sanctuaries. Total size of the three sanctuaries is 139,700ha. The three sanctuaries are intersected by a complex network of tidal waterways, mud flats and small islands of salt tolerant mangrove forests. The area is flooded with brackish water during high tides which mix with freshwater from inland rivers.

Because of the dominance of saline conditions, the forest flora in the western Sundarbans is not as diverse as in the east. Forest areas are dominated by a few species mostly *Sundri* and *Gewa* and patches of Nypa palm and several other of the 27 species of mangrove that are found in the Sundarbans. The fauna of the three sanctuaries, however, is very diverse with some 40 species of mammals, 260 species of birds and 35 species of reptiles. The flagship species is the Royal Bengal Tiger of which an estimated 350 remain in the Bangladesh Sundarbans. Other large mammals are wild boar, spotted deer, Indian otter and macaque monkey. Five species of marine turtles frequent the coastal zone and two endangered reptiles are present - the estuarine crocodile and the Indian python. Crustacea (fiddler and mud crabs) account for the largest portion of the animal biomass. Rainfall along the coast is as high as 2,800mm with a six month dry season followed by a monsoon during June to October. Storms, cyclones and tidal surges up to 7.5m high are features of the area.

The specific criteria on which the Sundarbans Wildlife Sanctuaries (SWS) is being nominated were not provided in the nomination but are imputed to be criteria (ii) and (iv) (the same as used for the adjacent Sundarbans World Heritage Site in India).

3. COMPARISON WITH OTHER AREAS

Mangroves are characteristic littoral plant formations found on sheltered coastlines throughout the tropics and subtropics. Countries with the greatest extent of mangrove forests are Brazil, Indonesia, Australia and Nigeria. The Sundarbans mangrove area of India and Bangladesh when taken together forms one of the world's largest single patches: some one million ha. In terms of species richness, the mangroves of the Indomalayan Realm have the greatest diversity and the Sundarbans are the only mangrove area in the world inhabited by tigers.

Some 18 countries have established protected areas in mangrove forests: In most of these countries the individual areas under protection are less than 1,000ha. However, protection is afforded to a total of over 11,000ha in four reserves in Venezuela and 26 reserves totalling more than 80,000ha have been established in Australia. The Everglades World Heritage Site contains almost 100,000ha of mangrove making it the world's second largest mangrove protected area after the Sundarbans. There are also significant amounts of mangrove in Australia's Kakadu National Park and in the Wet Tropics and small amounts in the Aldabra and Belize Barrier Reef World Heritage sites.

Within the Sundarbans there are four protected areas including the Sundarbans National Park and World Heritage Site in India (133,000ha). Three of the four are contiguous. As the salinity gradient is from west to east, the most biologically rich areas of the Sundarbans are in the east where freshwater influences are greater. The existing Sundarbans site in India and the adjacent Sundarbans West Sanctuary in Bangladesh are thus in the strongly saline zone where diversity is lowest and the trees are stunted and have a poor form. All the above four protected areas in the Sundarbans collectively conserve the only remaining habitat in the lower Bengal Basin for a variety of faunal species, many of them threatened.

4. INTEGRITY

The Sundarbans region of Bangladesh and India has changed substantially. It is today only one half the size it formerly was, the other half being cleared and converted to agricultural uses over the past 150 years. There have been significant changes due to the reduced quantity of freshwater inflow (40% of the dry season flow is diverted by the Farraka Barrage) and declining water quality. Six major animal species have been extirpated this century: the Javan rhino, wild buffalo, swamp deer, hog deer, gaur and mugger crocodile. Therefore, the Sundarbans of today are greatly reduced in both extent and diversity.

There are no villages in the Sundarbans sanctuaries but the whole area provides a livelihood for some 300,000 people, working seasonally as wood-cutters, palm collectors, fishermen, and honey hunters. About two million live in villages surrounding the Sundarbans and depend for much of their subsistence on products from the Sundarbans. The SWS amounts to 24% of the total Sundarbans in Bangladesh and uses inside the area are strictly controlled.

The whole of the Sundarbans Reserved Forest has an integrated resource development plan which includes a wildlife chapter. Specific management plans for the three Wildlife Sanctuaries are now being prepared. The Bangladesh Government has recently upgraded the management of all three of the Sanctuaries. Each sanctuary now has three field stations, each with nine staff equipped with patrol boats. There is no contact with colleagues working in the Sundarbans National Park in India.

5. ADDITIONAL COMMENTS

The SWS is directly adjacent to the National Park on the Indian side which was inscribed on the World Heritage List in 1987. The Sundarbans are one ecological unit and indeed were managed as a single forest

block prior to national partitioning in 1947. As recommended in IUCN's 1987 evaluation of the Indian portion, a transfrontier site is again suggested. This is clearly consistent with the ecological realities of the area, the spirit of the Convention and Operational Guideline 16. The Governments of India and Bangladesh will need to be approached through official channels to consent to the possibility that, for purposes of the World Heritage List, a Sundarbans protected area transfrontier site would be acceptable. In light of the recent cooperative agreement on equitable sharing of water resources between the two countries such a gesture of cooperation would seem timely.

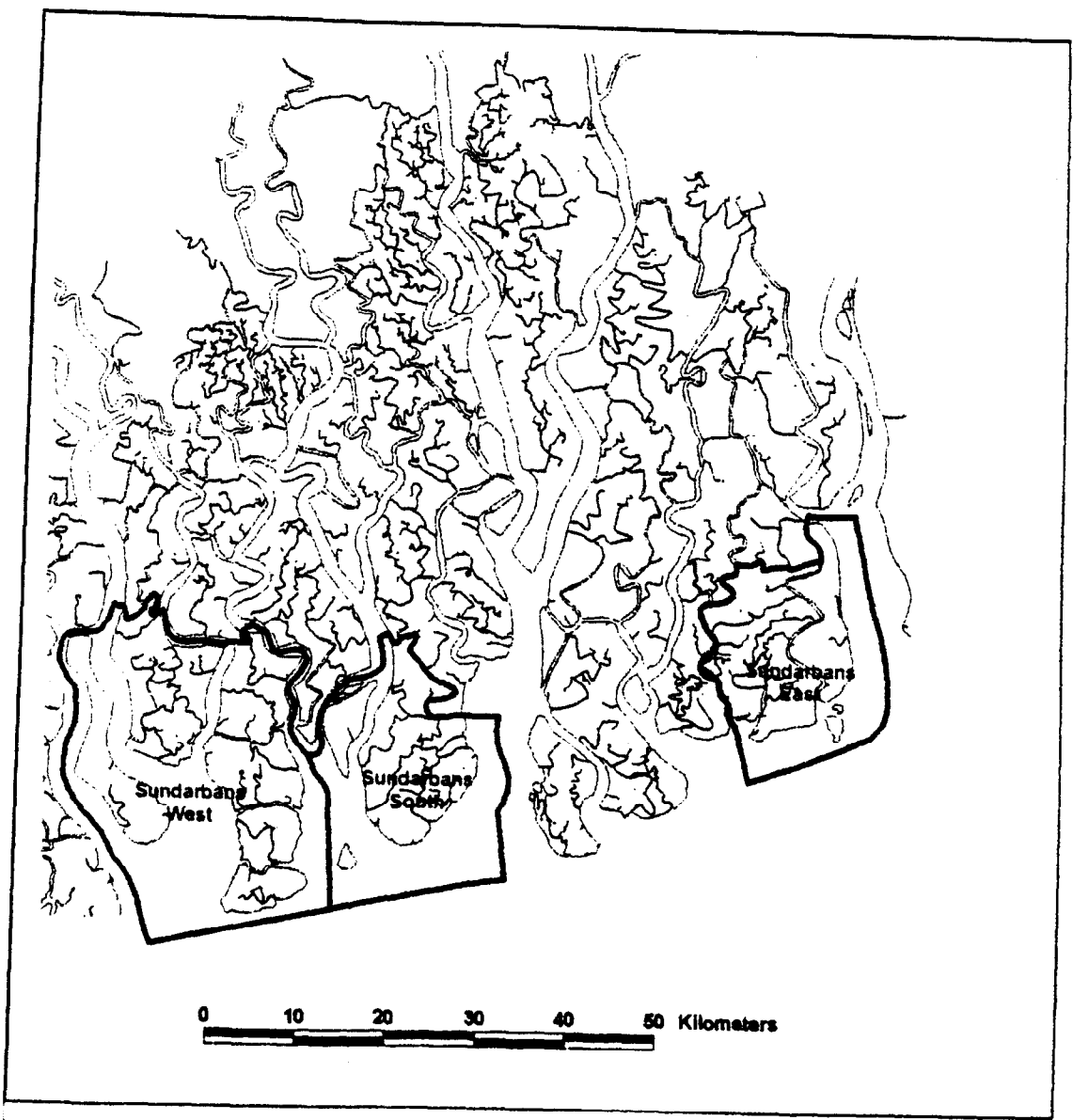
Until there is bilateral agreement on a transfrontier site the name of the Bangladesh portion should be "Sundarbans Wildlife Sanctuaries".

6. APPLICABILITY OF WORLD HERITAGE NATURAL CRITERIA

The SWS includes three protected areas in one of the largest remaining areas of mangroves in the world. It is adjacent to the existing Sundarbans World Heritage Site in India and supports a wide range of fauna including the Bengal Tiger and other threatened species. SWS meets criterion (ii) as a significant example of an on-going ecological process with its exceptional display of the effects of monsoonal rains, flooding, delta formation, tidal influence and plant colonisation. It also meets criterion iv for its exceptional biodiversity and as a haven for many threatened species, especially Bengal tigers.

7. RECOMMENDATIONS

That the Sundarbans Wild Sanctuaries be inscribed on the World Heritage List under criteria ii and iv. The Government of Bangladesh should be commended for responding to the Bureau's request to extend the boundary of the site to include all three of the sanctuaries on the Bangladesh side. As the adjacent Sundarbans National Park in India is already inscribed on the World Heritage List, the authorities in both countries should be encouraged to agree to the joint listing of the site as a transfrontier World Heritage property.



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COUNTRY Bangladesh

NAME The Sundarbans

IUCN MANAGEMENT CATEGORY
Sundarbans East, West and South Wildlife Sanctuaries IV (Managed Nature Reserve)

Natural World Heritage Site (proposed) - Criteria ii, iii, iv

BIOGEOGRAPHICAL PROVINCE 4.03.01 (Bengalian Rainforest)

GEOGRAPHICAL LOCATION The Sundarbans consist of three wildlife sanctuaries (Sundarbans West, East and South) lying on disjunct deltaic islands in the Sundarbans Forest Division of Khulna District, close to the border with India and just west of the main outflow of the Ganges, Brahmaputra and Meghna rivers. 21°30'-22°30'N, 89°12'-90°18'E.

DATE AND HISTORY OF ESTABLISHMENT All three wildlife sanctuaries were established in 1977 under the Bangladesh Wildlife (Preservation) (Amendment) Act, 1974, having first been gazetted as forest reserves in 1878. The total area of wildlife sanctuaries was extended in 1996. The entire Sundarbans is reserved forest, established under the Indian Forest Act, 1878.

AREA Total area of Bangladesh section of Sundarbans is 595,000ha of which 139,699ha are protected as follows: Sundarbans West Wildlife Sanctuary with 71,502ha; Sundarbans East Wildlife Sanctuary with 31,226ha; and Sundarbans South Wildlife Sanctuary with 36,970ha. Sundarbans National Park (133,010ha), a World Heritage Site, lies to the west in India.

LAND TENURE State owned

ALTITUDE Ranges from sea level to three metres.

PHYSICAL FEATURES The Sundarbans, covering some 10,000sq.km of land and water, is part of the world's largest delta (80,000sq.km) formed from sediments deposited by three great rivers, the Ganges, Brahmaputra and Meghna, which converge on the Bengal Basin (Seidensticker and Hai, 1983). The total area of the Bangladesh Sundarbans is 5,771sq.km (almost 62 percent of the total), of which 4,071sq.km is land and the rest water (Christensen, 1984). This area is approximately half the size of the area of mangrove that existed 200 years ago, the other half being cleared and converted to agricultural land (Hussain and Archarya 1994).

The land is moulded by tidal action, resulting in a distinctive physiography. An intricate network of interconnecting waterways, of which the larger channels of often a mile or more in width run in a generally north-south direction, intersects the whole area. Innumerable small khals drain the land at each ebb. Rivers tend to be long and straight, a consequence of the strong tidal forces and the clay and silt deposits which resist erosion. Easily eroded sands collect at the river mouths and form banks and chars, which are blown into dunes above the high-water mark by the strong south-west monsoon. Finer silts are washed out into the Bay of Bengal but, where they are protected from wave action, mud flats form in the lee of the dunes. These become overlain with sand from the dunes, and develop into grassy middens. This process of island building continues for as long as the area on the windward side is exposed to wave action. With the formation of the next island further out, silt begins to accumulate along the shore of the island and sand is blown or washed away (Seidensticker and Hai, 1983). Apart from Baleswar River the waterways carry little freshwater as they are cut off from the Ganges, the outflow of which has shifted from the Hooghly-Bhagirathi channels in India progressively eastwards since the 17th century. They are kept open largely by the diurnal tidal flow (Seidensticker and Hai, 1983).

Alluvial deposits are geologically very recent and deep. The soil is a silty clay loam with alternate layers of clay, silt and sand. The surface is clay except on the seaward side of islands in the coastal limits, where sandy beaches occur. In the eastern part of the Sundarbans the surface soil is soft and fertile, whereas it is harder and less suitable for tree growth in the west (Choudhury, 1968). The pH averages 8.0 (Christensen, 1984).

CLIMATE Rainfall is heavy and humidity high (80%) due to the proximity of the Bay of Bengal. About 80% of the rain fall in the monsoon, which lasts from June to October. Mean annual rainfall varies from about 1,800mm at Khulna, north of the Sundarbans, to 2,790mm on the coast. There is a six-month dry season during which evapotranspiration exceeds precipitation. Conditions are most saline in February-April, the depletion of soil moisture being coupled with reduced freshwater flow from upstream. Temperatures rise from daily minima of 2-4°C in winter to a maximum of about 43°C in March and may exceed 32°C in the monsoon. Storms are common in May and October-November and may develop into cyclones, usually accompanied by tidal waves of up to 7.5m high (Seidensticker and Hai, 1983). Climatic data for Khulna are summarised by Christensen (1984).

VEGETATION The mangroves of the Sundarbans are unique when compared to non-deltaic coastal mangrove forest. Unlike the latter, the Rhizophoraceae are of only minor importance and the dominant species are sundri *Heritiera fomes*, from which the Sundarbans takes its name, and gewa *Excoecaria agallocha*. The reason for this difference is the large freshwater influence in the north-eastern part and the elevated level of the ground surface. The Sundarbans can be classified as moist tropical seral forest, comprising a mosaic of beach forest and tidal forest (Champion, 1936). Of the latter, there are four types: low mangrove forests, tree mangrove forests, salt-water *Heritiera* forests and freshwater *Heritiera* forests. Sundarbans West occurs within the salt-water zone, which supports sparse *Ecoecaria agallocha*, a dense understory of *Ceriops*, and dense patches of hantal palm *Phoenix paludosa* on drier soils. Dhundal and passur *Xylocarpus* spp., and *Bruguiera* occur sporadically throughout the area. Sundri and gewa cover most of the Sundarbans but *Oryza coarctata*, *Nypa fruticans* and *Imperata cylindrica* are prevalent on mud flats (Khan, 1986). Large stands of keora *Sonneratia apetala* are found on newly accreted mudbanks and provide important wildlife habitat (R.E. Salter, pers. comm., 1987).

Prain (1903) gives an account of the flora of the mangrove forest of the Ganges-Brahmaputra delta. Seidensticker and Hai (1983) report a total of 334 plant species, representing 245 genera, present in the Bangladesh portion of the delta, and list principal woody and herbaceous species. Chaffey and Sandom (1985) provide a detailed list of trees and shrubs in the Bangladesh portion. Islam (1973) provides an account of the algal flora of the mangroves.

FAUNA The Sundarbans is the only remaining habitat in the lower Bengal Basin for a variety of faunal species. The presence of 49 mammal species has been documented. Of these, no less than five spectacular species, namely Javan rhinoceros *Rhinoceros sondaicus* (CR), water buffalo *Bubalus bubalis* (EN), swamp deer *Cervus duvauceli* (VU), gaur *Bos frontalis* (VU) and probably hog deer *Axis porcinus* (LR) have become locally extirpated since the beginning of this century (Salter, 1984). The only primate is rhesus macaque *Macaca mulatta*, considered by Blower (1985) to number in the region of 40,000 to 68,200, based on surveys by Hendrichs (1975) and Khan (1986), respectively, as compared to the much higher estimate of 126,220 derived by Gittins (1981).

The Sundarbans of Bangladesh and India support one of the largest populations of tiger *Panthera tigris* (EN), with an estimated 350 in that of the former (Hendrichs, 1975). Again, Gittins' estimate of 430-450 tigers may be overoptimistic (see Blower, 1985). Spotted deer *Cervus axis*, estimates of which vary between 52,600 (Khan, 1986) and 80,000 (Hendrichs, 1975), and wild boar *Sus scrofa*, estimated at 20,000 (Hendrichs, 1975), are the principal

prey of the tiger, which also has a notorious reputation for man-eating. Of the three species of otter, smooth-coated otter *Lutra perspicillata* (VU), estimated to number 20,000 (Hendrichs, 1975), is domesticated by fishermen and used to drive fish into their nets (Seidensticker and Hai, 1983). Other mammals include three species of wild cat, *Felis bengalensis*, *F. chaus* and *F. viverrina*, and Ganges River dolphin *Platanista gangetica* (EN), which occurs in some of the larger waterways. Species accounts and a check-list are given by Salter (1984).

The varied and colourful bird-life to be seen along its waterways is one of the Sundarbans' greatest attractions. A total 315 species have been recorded (Hussain and Acharya, 1994), including about 95 species of waterfowl (Scott, 1989) and 38 species of raptors (Sarker, 1985b). Among the many which may be readily seen by the visitor are no less than nine species of kingfisher, including brown-winged and stork-billed kingfishers, *Pelargopsis amauropterus* (NT) and *P. capensis*, respectively; the magnificent white-bellied sea-eagle *Haliaeetus leucogaster* which, at a density of one individual per 53.1km of waterways (Sarker, 1985), is quite common; also the much rarer grey-headed fish eagle *Ichthyophaga ichthyaetus* (NT), Pallas's fish-eagle *Haliaeetus leucoryphus* and several other raptors. Herons, egrets, storks, sandpipers, whimbrel, curlew and numerous other waders are to be seen along the muddy banks and on the chars or sandbanks which become exposed during the dry season. There are many species of gulls and terns, especially along the coast and the larger waterways. Apart from those species particularly associated with the sea and wetlands, there is also a considerable variety of forest birds such as woodpeckers, barbets, shrikes, drongos, mynahs, minivets, babblers and many others (Salter, 1984). Scott (1989) gives further details of the avifauna.

Some 53 reptile species and eight of amphibians have been recorded (Hussain and Acharya, 1994). Of these mugger *Crocodylus palustris* (VU) is now extinct, probably as a result of past over-exploitation, although it still occurs in at least one location nearby (R.E. Salter, pers. comm., 1987). Estuarine crocodile *C porosus* still survives but its numbers have been greatly depleted through hunting and trapping for skins. There are also three species of monitor, *Varanus bengalensis*, *V. flavescens* and *V. salvator*, and Indian python *Python molurus* (NT). Four species of marine turtle have been recorded from the area, olive ridley *Lepidochelys olivacea* (EN) being the most abundant. Green turtle *Chelonia mydas* (EN) is rare due to excessive fishing, while loggerhead *Caretta caretta* (EN) and hawksbill *Eretmochelys imbricata* (CR) are not common although there have been some reported on the beaches (Hussain and Acharya, 1994). River terrapin *Batagur baska* (EN) is also present. The eighteen recorded snake species include king cobra *Ophiophagus hannah* and spectacled cobra *Naja naja*, three vipers and six sea-snakes (Salter, 1984).

Over 120 species of fish are reported to be commonly caught by commercial fishermen in the Sundarbans (Seidensticker and Hai, 1983). According to Mukherjee (1975) only brackish water species and marine forms are found in the Indian Sundarbans, freshwater species being totally absent. This may be assumed to apply also to the Bangladesh Sundarbans, except possibly in the eastern portion where there is freshwater in Baleswar River. Mention should also be made of mud-skippers or gobys which occur in large numbers and are a characteristic feature of mangrove swamps.

Crustacea account for by far the largest proportion of animal biomass, with an estimated 40 million kilograms of fiddler crabs and 100 million kilograms of mud crabs (Hendrichs, 1975). The nutrient-rich waters of the Sundarbans also yield a considerable harvest of shrimps, prawns and lobsters. The area supports a varied insect population including large numbers of honey-bees, honey and beeswax being among the economically important products. The insect life of the Sundarbans has been little studied.

CULTURAL HERITAGE There is archaeological evidence of earlier human occupation on

the deltaic islands. The human settlements are indicative of the former presence of abundant freshwater, both from the Ganges and from non-saline ground water. Human occupation ceased in the 17th century, reportedly due to pirate attacks (Christensen, 1984).

LOCAL HUMAN POPULATION Approximately 2.5 million people live in small villages surrounding the Sundarbans. The area provides a livelihood at certain seasons of the year for an estimated 300,000 people, working variously as wood-cutters, fishermen, and gatherers of honey, golpatta leaves (*Nipa fruticans*) and grass. Fishermen come in their boats from as far away as Chittagong and establish temporary encampments at various sites along the coast, where they remain until the approach of the monsoon season in April before returning to their homes. Apart from the large numbers of people employed by contractors in the commercial exploitation of sundri and other tree species, the local people are themselves dependent on the forest and waterways for such necessities as firewood, timber for boats, poles for house-posts and rafters, golpatta leaf for roofing, grass for matting, reeds for fencing and fish for their own consumption. The season for collecting honey and wax is limited to two and a half months commencing annually on 1 April. Thousands of people, having first obtained their permits from the Forest Department, enter the forest in search of bee nests which are collected and then crushed to extract the honey and wax.

VISITORS AND VISITOR FACILITIES Few tourists visit the Sundarbans due to the difficulty and cost of arranging transport and to the lack of suitable accommodation and other facilities. The area has no potential for mass tourism but it does offer obvious possibilities for limited special-interest tourism from October to April or May. The use of launches equipped with catering and sleeping facilities is considered more practicable than permanent land-based facilities and would provide greater flexibility. There is, however, a large well-equipped rest house belonging to the Port Authority at Hiron Point, Sundarbans South Wildlife Sanctuary, and a smaller one belonging to the Forest Department at Katka in Sundarbans East Wildlife Sanctuary (Blower, 1985).

SCIENTIFIC RESEARCH AND FACILITIES Considerable research has been carried out on the Sundarbans ecosystem and its wildlife. Hendrichs (1975) undertook a three-month field study of tiger, concentrating on the problem of man-eating, and other vertebrates and invertebrates, in 1971. Other faunal surveys include those of Gittins (1981) and Khan (1986) for rhesus macaque, Khan (1986) for spotted deer, Sarker and Sarker (1986) for birds, and Sarker (1985a, 1985b) and Sarker and Sarker (1985) for birds of prey. About 500 foreign tourists visited the area in 1996 plus 5000 domestic tourists, the majority at the South Wildlife Sanctuary.

CONSERVATION VALUE The mangrove forests of the Sundarbans are among the richest and most extensive in the world. The Bangladesh portion, covering six percent of total land area, represents over half of the country's remaining natural forest. The forests and waterways support a wide range of fauna, including a number of species threatened with extinction. As one of the most biologically productive of all natural ecosystems, it is of great economic importance as a source of timber, fish and numerous other products (Blower, 1985).

CONSERVATION MANAGEMENT Three field stations have been established within Sundarbans West. There are no recognised local rights within the reserved forest, entry and collection of forest produce being subject to permits issued by the Forest Department. The Department may issue hunting licences under the Bangladesh Wildlife (Preservation) (Amendment) Act, 1974, but in practice none is issued and the whole Sundarbans is thus effectively closed to legal hunting. Under the provision of this Act, various activities are prohibited within the wildlife sanctuaries, including *inter alia* residence, cultivation of land, damage to vegetation, hunting, introduction of domestic animals and setting of fires. Any of these prohibitions may be relaxed, however, for scientific purposes, aesthetic enjoyment or "improvement" of scenery (Blower, 1985).

The Sundarbans is the only sizeable mangrove forest in the world managed for commercial timber production and it has been under some sort of management since 1879. Early management consisted on revenue collection by enforcing simple felling rules. Subsequently, the progressive enforcement of felling rules reduced the amount of over-cutting of the four species for which felling rules were established. Bangladesh part of Sundarbans is managed as a continuous block of mangrove forest with no permanent human habitation inside.

The Sundarbans has been the subject of a series of successively more comprehensive working plans since its declaration as reserved forest, the most recent of which points out the importance of the tiger in controlling the spotted deer population, and also mentions the intention of establishing compartments 3-7 as a 'game sanctuary', a total area of some 52,320ha (Choudhury, 1968). A plan relating specifically to wildlife conservation was prepared under the joint sponsorship of the World Wildlife Fund and the National Zoological Park, Smithsonian Institution (Seidensticker and Hai, 1983). Emphasis is directed towards managing the tiger, together with all wildlife, as an integral part of forest management that assures the sustainable harvesting of forest products and maintains this coastal zone in a way that meets the needs of the local human population. The Sundarbans Forest Development Planning Mission, carried out by FAO in conjunction with the Bangladesh Forest Department in February-May 1984, collected all available data related to the use and management of forest products, wildlife and fisheries, assessed development potential and prepared proposals for further integrated development and conservation of the natural resources of the area (Christensen, 1984; Salter, 1984). More recently, Blower (1985) reviewed wildlife conservation in the Sundarbans Reserved Forest as part of the Sundarbans Forest Inventory Project, carried out by the Bangladesh Forest Department and the Land Resources Development Centre of the UK Overseas Development Administration. The main purpose of the project is to provide the necessary data on which to base future exploitation of the forest for sustainable use of timber, fuelwood and other forest produce, with due consideration to wildlife conservation and the social amenity value of the area. It has been recommended that the Sundarbans be managed as a single unit with full protection afforded to both wildlife and habitat in the wildlife sanctuaries, and with forest resources exploited at sustainable levels but wildlife protected elsewhere in the reserved forest. The establishment of intermediate buffer zones, in which disturbance is kept to a minimum through restriction of access, is recommended in areas peripheral to sanctuary boundaries. A new management plan is due to be prepared, based on data collected in 1995, and is expected to include detailed prescriptions concerning the conservation and management of the sanctuaries.

MANAGEMENT CONSTRAINTS A long-term ecological change is taking place in the Sundarbans, due to the eastward migration of the Ganges, abandonment of some distributaries, diversion of water and withdrawals for irrigation. (Up to 40% of the dry season flow of the Ganges has been diverted upstream, following the completion of the Farraka Barrage in India in 1974.) Decreased freshwater flushing of the Sundarbans results in increased saline intrusion, particularly in the dry season. Concern has been expressed about recent indications of apparent deterioration in the flora, including localised die-back of sundri, commercially the most valuable of tree species. Top-dying of sundri is most likely associated with the decrease in freshwater flow, either as a direct effect of increasing salinity or other associated edaphic changes. A gradual replacement of *Heritiera* with *Excoecaria*, therefore, is a likely long-term effect (Christensen, 1984). While deterioration in the vegetation is already well-documented (International Engineering Company, 1977 and 1980) and is the subject of continuing study, no attention has yet been given to the possible effects which these changes might have on the fauna. It is perhaps significant, however, that the stocking of spotted deer appears lower in western areas, where salinity is highest, than in the east where it is lowest. Oil spills are another potential threat and could cause immense damage, especially to aquatic fauna and seabirds and probably also to the forest itself (Blower, 1985). There have been several spillages from tanks passing nearby. The most recent incidence due to ship wreckage occurred in August 1994 when a Panamanian cargo ship capsized near Dangmari Forest

Station. Oil from the fuel tank spread about 15km downstream from the ship and affected a considerable part of the Sundarbans mangrove area. It was found to cause instant mortality of seedlings of *Heritiera* and *Excoecaria* while patches of grass which were covered by oil also died. Mortality of fishes, shrimps and other aquatic animals from the Sundarbans has been reported to due the incidence (Hussain and Acharya, 1994).

Cyclones and tidal waves cause some damage to the forest along the sea-face, and are reported to result occasionally in considerable mortality among spotted deer. The most immediate threat is over-exploitation, both of timber resources, which may have already taken place, and also of the fauna. Agricultural encroachment has already occurred to a limited extent on the eastern and western boundaries and, with increasing population pressure in surrounding settled areas, could reach serious proportions unless checked. Fishermen's camps are a major source of disturbance. There is extensive illegal hunting and trapping, not only by fishermen and woodcutters but also reportedly by naval and military personnel from Hiron Point in Sundarbans South Wildlife Sanctuary (Blower, 1985). A total of 118 offences was recorded and over 3,300m of deer nets removed between 1981/82 and 1986/87 (Habib, 1989) but this poaching is now rare. The capture of adult marine turtles and *Batagur* in fishing nets and their subsequent killing and marketing for food is a potentially serious problem (R.E. Salter, pers. comm., 1987). Smugglers moving to and from India with contraband goods also use the area.

The Sundarbans has been notorious for its man-eating tigers since the 17th century. Numbers of reported deaths has varied from 0 to 47 (mean = 22.1) per annum during the period 1947-1983 (R.E. Salter, pers. comm., 1987). In 1988, 65 deaths were reported during a four-month period (*The Guardian*, 28 December 1988). Noting that tigers that hunt man like any other prey occurred only in the south and west, Hendrichs (1975) hypothesised on a possible linkage between high salinity levels, due to the absence of freshwater, and man-killing. This is not substantiated by more recent analyses, which suggest that man-killing may be at least partly correlated with the availability of easy prey (humans) and the frequency of man-tiger interactions (Salter, 1984; Siddiqi and Choudhury, 1987).

STAFF There is 3 field stations in Sundarbans West Wildlife Sanctuary each with 95 staff (2 officers and 7 forest guards). There are respectively 2 station in South Wildlife Sanctuary and 3 in South East Wildlife Sanctuary.

BUDGET No information available

LOCAL ADDRESSES

Bangladesh Forest Department, Bana Bhaban, Gulshan Road, Mohakhaldi, Dhaka-1212, Bangladesh

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