YELLOWSTONE NATIONAL PARK

(United States of America)

REPORT OF THE REACTIVE MONITORING MISSION

19 to 22 SEPTEMBER 2011

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1. EXECUTIVE SUMMARY

1.1 Introduction

From 19 to 22 September 2011, a joint IUCN/UNESCO monitoring mission visited the Yellowstone National Park World Heritage property, United States of America, in accordance with the World Heritage Committee decisions **32COM 7B.29** adopted at its 32nd session (Quebec City, 2008) and **34COM 7B.28** (Annex 1) adopted at its 34th session (Brasilia, 2010).

The mission team visited the property, situated in the States of Wyoming and Montana, travelling by vehicle on the park roads (Annex 2). Three days were spent in the field accompanied by specialist park staff. Briefing and de-briefing sessions were held with the park superintendent and senior staff. A technical session was held with representatives of the IUCN World Commission on Protected Areas (WCPA), and a two-hour public meeting.

In accordance with its terms of reference (Annex 3), the mission team assessed the factors affecting the Outstanding Universal value (OUV) of the property, and in particular reviewed action taken to ensure the conservation of populations of key species, including bison, cut-throat trout, grizzly bear and wolf, as well as the development of a long-term vision and action plan for the integrated management of the property and its surrounding areas.

1.2 Factors affecting the Outstanding Universal Value of the property

1.2.1 Mining restoration, water quality and roads

Concern about the impact of the proposed New World gold mine was among the main issues that led to Yellowstone NP being included on the list of World Heritage in Danger in 1995. Concerns included: the degrading of air and water quality; changes in water quantity; disturbance of habitat for grizzly, bighorn sheep, elk, bald eagle and fish, among others; loss of scenic and recreational values; and noise intrusion. Pollution from abandoned mine tailings on the floodplain of Soda Butte Creek, which flows into the park, has remained an on-going management problem.

Currently, the park is monitoring the effects of restoration relating to the New World Mine, where restoration is proceeding well and nearing completion[1]and the Cook City area (McLaren Mining Co.), which involves a major restoration program that is just beginning.

In the Soda Butte Creek discharge, the park is measuring arsenic, copper, iron and selenium, and sediment content. Results show that iron content exceeds the accepted standards for aquatic life in a few cases, but the creek scores high overall in supporting aquatic life.

Roading is one of the primary construction activities in the park.[2] The aim is to make roads wider and straighter, but to keep within prescribed corridors, and to balance convenience of

[1] Dan Reinhart, Yellowstone NP, pers. comm., September, 2011

travel with protection of natural and cultural resources. Resource values sometimes impose restrictions on construction, such as the requirement to protect rockwork on margins of the highways that are designated historic districts. The park collaborates with the US Fish & Wildlife Service to plan road construction and use in harmony with the needs of wildlife movement, feeding and other habitat requirements, especially to minimize wildlife encounters and deaths on roads. On average, there is one grizzly bear death on park roads each year.

1.2.2 Bison disease risk and migration

The Yellowstone National Park population of about 3,700 wild bison, which is largest free-ranging herd of plains bison in the world, is a significant component of the outstanding universal value of the property and a major attraction for visitors to the park. Following a moratorium on culling of bison in 1969, the population grew rapidly to a record high of more than 5,000 animals in 2005.

From the 1980s, increasing numbers of animals migrated during winter outside the park, leading to a series of conflicts with stock growers and the state of Montana, largely because of the perceived risk of transmission of the disease brucellosis to cattle.[3] Even if brucellosis transmission to cattle was eliminated from bison it is unlikely they would be generally tolerated outside the park because of social and political barriers such as concerns for safety of people (mainly motorists), property damage on private lands, depredation of agricultural crops, competition with livestock grazing, lack of local public support and absence of funding for state management. A further complication is that brucellosis is also found in elk (among other wildlife) and all recently reported brucellosis transmission to cattle has been attributed to elk. Eradication of brucellosis from elk is not feasible without ethically and politically unacceptable techniques such as mass testing and slaughter.

Conservation of Yellowstone bison, including their migratory tendencies, genetic diversity and role in the ecosystem, is of paramount importance for the survival of the species.

In 2000, the federal government and the state of Montana agreed to a court-ordered Intergovernmental Bison Management Plan (IBMP)[4] that established guidelines for co-operatively managing the risk of transmission of brucellosis from bison to cattle, while preserving the Yellowstone bison population and allowing some bison to occupy winter ranges on public lands in Montana. The IBMP provides for intensive management (hazing, hunting and culling) of bison migrating out of the park to maintain a spatial and temporal

[2] Dan Reinhart, 2011 ibid.

[3] Bovine brucellosis is a contagious bacterial disease caused by *Brucella abortus*, which may induce abortion or birth of non-viable calves in livestock and wildlife.

[4] Members of the IBMP are the National Park Service, US Forest Service, USDA Animal and Plant Health Inspection Service, Montana Department of Livestock, Montana Department of Fish, Wildlife and Parks, Intertribal Buffalo Council, Confederated Salish Kootenai Tribes and the Nez Perce Tribe.

separation between bison and cattle. To date this has proven successful for preventing the transmission of brucellosis to cattle.

Bison migrate out of the park when snowpack build-up on higher elevation summer ranges affects food availability, and return following a wave in the growth of spring vegetation from lower to higher elevations. Most bison exit the park through a northern route to the Gardiner Basin, and a secondary western route through West Yellowstone.

Park bison biologists are confident that these principal traditional migration routes are now secured in the Greater Yellowstone Area. By 2008-9, cattle grazing ceased on all public and private lands on the Horse Butte Peninsula adjacent to the Park's western boundary, opening this for seasonal occupancy for migratory bison. Under a 30-year agreement signed in 2008 with the Church Universal and Triumphant Inc., bison can access Gallatin National Forest through Royal Teton Ranch, north of Gardiner adjacent to the Park's northern boundary.

Based on research and population modelling, it is proposed that the Yellowstone bison population should be limited to 2,500 – 4,500 animals. This will satisfy the collective long-term interests of stakeholders, in providing balance between the park's forage base, the conservation of genetic integrity of the species, the protection of the migratory tendencies, brucellosis risk management and other societal constraints.

Bison migration to essential winter ranges in areas adjacent to the park should continue, while actively preventing the range expansion of bison to outlying private lands until there is tolerance for bison in these areas. One suggestion for increasing tolerance is to establish a local infection status zone for cattle in the Greater Yellowstone Area and test all cattle in this area for brucellosis. Another is to cease cattle grazing in areas where bison leave the Park in winter and compensate ranchers for the loss of earnings - conservation groups are exploring this idea with willing landowners. Further efforts include the need to: identify additional habitat and conservation areas for bison in Montana; develop fencing strategies with private landowners; identify opportunities for providing bison habitat in Montana in the April to early June period; and discourage bison movement on to private land with cattle. An innovative suggestion is to ship surplus Yellowstone bison to quarantine sites operated by Indian tribes, which would help preserve Indian culture and promote the establishment of wild herds from the only existing pure source of wild plains bison.

Large-scale conservation of bison over big landscapes will require partnerships and co-management among multiple landowners and land and wildlife management agencies. Forging such co-operative relationships remains perhaps the greatest challenge in successfully achieving conservation goals for bison.

1.2.3 Suppression of lake trout and protection of cutthroat trout

Eradication of the serious threat to native cutthroat trout from lake trout is an important and immediate problem for Yellowstone NP. Yellowstone cutthroat trout is an important food source for some 42 wildlife species and a major attraction for recreational fishers. However,

threats to the trout population make its future sustainability uncertain. The population of native cutthroat trout in the Yellowstone Lake ecosystem has declined substantially since the mid-1980s, primarily due to low-water in drought years, an exotic parasite causing whirling disease, and especially to predation by non-native lake trout.[5] Intentionally stocked brook, rainbow and brown trout have also taken their toll on cutthroat trout.

Lake trout, which were illegally introduced to the park some 20 years ago but were not discovered until 1994, have a significant impact by consuming cutthroat trout and competing with them for food sources. Potentially, they could decimate the cutthroat trout population in a generation.[6] Lake trout are not a substitute for cutthroat trout as they occupy a different ecological niche – they are a bottom-dwelling lake species (native to the Great Lakes and Canada) so are unavailable to some key predators.

Computer modelling suggests that currently there is a population of about 340,000 lake trout in Yellowstone Lake.[7] Control has primarily involved removal of fish, with some 550,000 having been removed since 1994. However, the catch per unit effort has been rising since 2002, suggesting that the population is increasing faster than fish are being removed.

Following recommendations from a 2008 scientific panel, the park stepped up control activities as follows: monitoring expertise was obtained from the University of Montana; more funding was obtained, especially with support from the Yellowstone NP Foundation, raising the budget to the current level of $2 million annually; and commercial fishers were engaged. In 2010, more than 100,000 lake trout were removed, of which 31,600 were caught in a 10 week period by commercial operators using gill nets.[8]

The Yellowstone Native Fish Conservation Plan, produced in 2010 and currently undergoing public consultation for environmental assessment, outlines a full conservation strategy for the three decades 2010-2031.[9] With respect to native cutthroat trout, the principal objectives of the plan are:

- maintaining access for spawning fish in at least 45 of 59 historical spawning territories in the Yellowstone Lake ecosystem;

[5] Yellowstone Resources Centre, 2011

[6] www.nps.gov/yell/nativescience/fisheries_issues.htm, 2011

[7] Pat Bigelow, Yellowstone NP, pers. comm., 2011

[8] Yellowstone Center for Resources, 2011. *Yellowstone National Park: natural resource vital signs, 2011.* Yellowstone National Park, Mammoth Hot Springs, Wyoming, 19pp.

[9] National Park Service, 2010. *Native fish conservation plan: environmental assessment.* Yellowstone National Park, National Park Service, 380pp.

- recovering fish abundance in the lake to that documented in the late 1990s; and
- maintaining or restoring genetically pure fish in streams currently occupied by pure or hybrid cutthroat trout.

Additionally, the plan aims at reducing the lake trout population by 25% annually until it collapses to an insignificant level. In rivers and streams beyond Yellowstone Lake, the plan provides for conservation of cutthroat trout using approved piscicides to remove non-native fish and re-stocking of native fish from genetically unaltered brood sources in the GYE. Future funding is secure – the Yellowstone NP Foundation has committed to providing $1 million for the next six years.

1.2.4 Grizzly bear connectivity and mortality

Grizzly bears once roamed widely throughout the western states of North America from Alaska to northern Mexico, but at the end of the 1950s they were largely confined to Yellowstone NP and some surrounding areas.[10] There was high mortality of bears in 1970-71 following the closure of open-pit garbage dumps in the park, and in 1975 grizzly were included on the federal List of Endangered and Threatened Wildlife due to unsustainable levels of human-caused mortality, habitat loss and significant habitat alteration. At that time the estimated population in the GYA was 136-312 individuals. Since then species numbers have made a notable recovery.,

Bears are well managed and protected in Yellowstone NP, where they are among the most popular visitor attractions. The park remains the principal core area for the grizzly bear today, and sustains an estimated population of around 600 bears. The number of females producing cubs has been relatively stable since 1996, suggesting that the bear population may be at or near the carrying capacity of the park.

In 1983, the Interagency Grizzly Bear Committee (IGBC) was formed from most federal and state agencies with authority over bears and their habitat, to co-ordinate research and management in implementing the adaptive Grizzly Bear Recovery Plan. The Committee bases its advice on the work of the Interagency Grizzly Bear Study Team (IGBST). A grizzly bear conservation strategy, finally released in 2007, documents the regulatory mechanisms, legal authorities, policies, and management and monitoring programs necessary to retain a recovered grizzly population for at least the next century. It sets an overall goal of maintaining the Yellowstone grizzly population at or above 500 animals, and provides for the protection of bear habitat in a 9,210 mile² core area (Primary Conservation Area), including all of Yellowstone NP and half of Grand Teton NP.

The conservation strategy recognises that environmental changes induced by a changing climate could detrimentally effect the survival of grizzlies. The greatest impact so far of

[10]Haroldson, M.A.; Schwartz, C.C. and Gunther, K.A. 2008. Garbage, controversy and decline to recovery. Yellowstone Science 16(2): 13-24.

climate change has been the periodic outbreak of mountain pine beetle and the consequent loss of whitebark pine. This high-altitude conifer is an important food source for bears, particularly as pine seeds are a rich source of dietary fat needed for hibernation and to support lactation. Beetle infestation and death of trees are increasing at unprecedented levels. Aerial surveys by the US Forest Service and the state of Montana reveal that 7% of the 281,700 acres of whitebark pine stands in the park were infested with beetles in 2010, and up to 80% of trees are affected in some areas.[11] The impact on bears is two-fold. First, low pine production leads to increased grizzly mortality from interactions with humans, especially outside the park, while bears are seeking other food, particularly meat.[12] Second, bears experience low fecundity in the year following low pine production due to poor nutrition.

A continual monitoring program is vital to ensuring that bears adapt successfully to climatic and environmental change. It is in their favour that grizzlies are a generalist and resourceful species adaptable to a wide variety of environments and food conditions. But they remain highly susceptible to human caused mortality, especially on lands beyond the protection of the park.

The grizzly population continues to grow and expand throughout the GYE as bears re-colonise habitats outside the park. Population modelling evidence suggests there is sufficient grizzly habitat for travel and residence outside the park. However, the suitable habitat is becoming increasingly fragmented, and high mortality curtails known dispersers. The greatest barriers to connectivity are the surrounding private lands at lower altitude. These areas are threatened by development of oil and gas industries, timber cutting and salvage activities, and housing in the ex-urban/wildland interface. Road construction has a major barrier effect – observations show that bears avoid an area within 500m of highways (though they will cross two-lane roads).

The vision of the IGBC is that grizzlies will be able to move freely between the park and all large blocks of grizzly habitat in the northern Rockies. To achieve this it is attempting the following: maintaining vegetation cover; limiting the increase in road density; improving the permeability of highways; limiting the size of new developments such as campgrounds; and making it more attractive for landowners to keep land open. There is a need for the park authorities to focus on working co-operatively with private landowners and with regulatory agencies, preferably at county level, to keep areas open for bears.

Management of grizzlies in Yellowstone NP will always require a major effort to control human-caused mortality. Some 80% of bear mortality is human caused, much of it by hunters, especially bow hunters who encounter grizzlies at short range. There is a need to mitigate bear-human conflict. Backcountry recreation continues to increase, though progress

[11] Yellowstone Center for Resources, 2011. Grizzly bears. p. 12, in *Yellowstone National Park, Natural Resources Vital Signs, 2011.* Mammoth Hot Springs, Wyoming.

[12] Lance Craighead, pers. comm., September, 2011

has been made with garbage containment and securing of camping and hunting sites. Conflict is most significant in connectivity areas outside the park, and these are bears that are most important in terms of long-term persistence of the species. Housing development continues to increase along fringes of bear habitat. The extension of forestry road networks gives greater backcountry access for hunters and hikers and increases encounters with bears.

Although some threats remain, the long-term future of Yellowstone grizzly conservation is good. The Yellowstone grizzly population is stable and is expanding its range. There is active co-operation and a firm commitment among agencies under the conservation strategy. Ultimately, it is the human factors and values that will determine where the grizzly can and cannot persist.

1.2.5 Hunting and protection of gray wolf

Wolf packs once roamed extensively on the continent, and by the end of the 19th century the population in the western USA and Mexico may have numbered 380,000 animals.[13] Wolves were regarded as dangerous predators and extermination programs led to their demise. In 1926, when the NPS ended its predator control efforts, there were no gray wolf packs in Yellowstone NP, and by 1978 the gray wolf was listed as an endangered species over most of its traditional range. The Greater Yellowstone Area (GYA) is one of three areas in North America where the recovery of wolves has good chance of succeeding. Wolf recovery began in 1995 under a multi-state recovery program and plan, overseen by the US Fish and Wildlife Service.

In 1995-96, 41 wolves from Alberta, British Columbia and northern Montana were released into the park. The animals thrived and their population reached a high of 174 in 2003, and by the end of 2010 there was a stable population of 97 wolves in the park, comprising 11 packs and 7 loners with a long-term average of 10 animals in each pack.

Protection of wolves is important both to the ecology and economy of Yellowstone NP. Studies show that wolf-watching activities by visitors earns revenue of about $30 million annually.[14] The park has a substantial on-going wolf research and management project, which in 2010 was conducted by three full-time and 19 part-time staff.[15] It includes monitoring of the wolf population, its dispersal, distribution, reproduction, mortality and predation on ungulates. The associated research covers population genetics, disease, hunting behaviour, territory use, leadership, scavenging interactions, breeding behaviour, dispersal and wolf-grizzly-bison interactions.

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[13] Whittlesey, L.; Schullery, P. 2011. How many wolves were in the Yellowstone area in the 1870s? *Yellowstone Science* 19(1):23-28.

[14] Douglas Smith, Yellowstone National Park, pers comm., September, 2011.

[15] Smith, Douglas et al. 2010. *Yellowstone Wolf Project, Annual Report 2010*. Centre for Resources, Yellowstone National Park, Wyoming. 32pp.

There is some movement of wolves into and out of the park. Illegal poaching and hunting of wolves accounts for about 20% of the total mortality. Testing for disease reveals that, while rabies and canine brucellosis are not a problem, wolves are commonly exposed to parvovirus, distemper and hepatitis.[16] Although the park's wolf population is derived from just seven breeding pairs, genetic diversity issues are not considered to be problematic.

Wolves are fully protected in the park. Outside the park, Yellowstone wolves were previously managed under special rules that permitted flexibility in addressing wolf conflicts with livestock and other wildlife management objectives. However, in May 2011 the gray wolf was removed from the endangered species list in Montana and Idaho, but not yet in Wyoming. This introduced the first public hunting of wolves in decades.

The mission team was informed that from an ecological viewpoint the conservation and survival of wolves is a relatively simple matter.[17] Wolves are omnivores, they have high reproduction rates with no genetic problems, and they have excellent dispersal abilities over distances as much as 800 km. However, politically the conservation of wolves is extremely difficult. The wolf population has grown rapidly and it is estimated that there are now 1,600-1,700 wolves in the states of Montana, Idaho and Wyoming.[18] Wolves have also established in areas not envisaged by the recovery plan.

The Yellowstone wolf population is not sustainable in the long term. For their survival, Yellowstone wolves need more land and habitat than is available in the Park, and are reliant on connection to populations in central Idaho and north-west Montana. This calls for co-operation between the park and neighbouring state agencies responsible for land and wildlife management. Among the key stakeholders in surrounding lands are ranchers and other private landowners, who are generally opposed to conservation of wolves as they prey on livestock and worry domestic dogs. Yet ranchers have a critical role to play as they keep land open, so they need to be partners with the park in conservation efforts. Housing and roading development pose major problems as they destroy natural habitat and act as barriers to wolf dispersal. The new issue of hunting of wolves outside the park remains a major conundrum. There is a need for further monitoring and research specifically targeted at determining the impact of hunting on wolves in general and Yellowstone wolves in particular.

1.2.6 Reducing pressure from park operations and high visitor use

<u>The interim winter use plan</u>

Sustained visitor pressure on the natural and cultural resources of Yellowstone NP has been of concern for many years, with more than 3 million visitors now entering the park annually.

[16] Smith, D.W & Almberg, E. 2007. Wolf diseases in Yellowstone National Park. *Yellowstone Science* 15(2):17-19.

[17] Dan Pletscher pers comm., September, 2011.

[18] Dan Pletscher, ibid.

Some 70% of visitors come in the June-August summer period, while fall visitation now accounts for about 21% of the total annual numbers. Winter use is much lower, and has never been more than 6% of the annual total, but the impacts and issues associated it are proportionately much higher.

Most of the debate over the past decade has centred on the use of motorized over-snow vehicles, particularly snowmobiles, which were first used in the park in 1963. Over-snow vehicle use was accompanied by unprecedented and unanticipated problems, including air and noise pollution, conflict with other users and wildlife harassment. Strict management of motorized use didn't begin until the early 2000s, with the progressive adoption of measures such as: daily limits on the number of machines; designation of speed zones; night-time closures; the required use of best-available-technology (BAT) machines (available from 2002) that are cleaner running and somewhat quieter than traditional machines; and mandatory commercial guiding of both snowmobiles and snow coaches that has reduced the incidence of wildlife disturbance.

The National Park Service instituted an interim winter use plan to guide management and use during the two seasons of the 2009-2011 period. Among the measures set by this plan is a daily limit for commercially guided operations of up to 318 BAT snowmobiles and 78 BAT snow coaches. Comprehensive monitoring reveals that implementation of the plan has produced many improvements and done much to reverse the unacceptable situation that existed previously. Air quality is very good; there are few known detrimental impacts on bison and elk; and sound levels and noise pollution concerns are much reduced. Winter visitor satisfaction surveys have revealed that visitor enjoyment rating is high, with 87% of respondents "very satisfied" with their overall experience and the remaining 13% "satisfied".[19] Favourable trends include an increase in use of multi-passenger coach travel, and decline in the demand for use of snowmobiles by more than 75% from historic levels.

The interim plan will remain for the present while the new long-tem plan is being prepared. This has been delayed due to some inconsistencies found in the model used for current analysis of winter use alternatives.[20] In re-instating the rules applying under the interim plan, the park authorities will supplement the current environmental analysis. This will allow examination of the reported possible decline in the environmental performance of newer snowmobiles. While the interim plan is satisfactory for current management needs, impacts arising from motorized winter use remain a challenge for the park.

Sustainable practices and the YES! program

While the "Greening of Yellowstone" program, launched in 1997, doesn't specifically address visitor impact pressures, much of it is intended to reduce the human imprint, both from visitors and park managers, on the outstanding universal values of the park. Among the

[19] Yellowstone NP, 2011, op. cit.

[20] Dan Wenk, Superintendent, Yellowstone NP, pers. comm., September 2011

innovative measures adopted to date are: replacement of some treated-timber boardwalks with recycled plastic boards; use of bio-diesel and ethanol blend fuels in park vehicles; conversion to hybrid gasoline/electric powered vehicles; use of sustainable building materials and techniques for heating, insulation and lighting; installation of renewable energy sources; a major recycling and composting initiative; and greening of concessionaire operations and practices involving food, paper, fuels and lighting.[21]

In 2008, in concert with the Yellowstone NP Foundation, the park launched the Yellowstone Environmental Sustainability Initiative (YES!). The ultimate goal of this multi-year program is to reduce the ecological footprint of park operations and decrease the consumptive use of natural resources by managers and users of the park, especially in confronting the challenges of climate change. Using 2003 figures as a baseline, by 2016 the YES! program aims to: reduce greenhouse gas emissions by 30%; electricity consumption by 15%; fossil fuel consumption by 18%; and water consumption by 15%; and divert 100% of solid waste from landfills. The Foundation is committed to raising the necessary funds and the park has comprehensive monitoring programs in place for measuring air and water quality, and regional climate trends, for example. The mission team was informed that already some 79% of waste is being diverted from landfills (it was only 20% in 2003), and transition to propane has reduced heating oil consumption by 23%.[22] The park sustainability and YES! programs, are well on course to meet their environmental targets, which will do much to relieve the human pressure on the outstanding universal natural values of the park.

1.2.7 Ecological and management integration with surrounding lands

Integrating Yellowstone NP with activities on lands outside the park is vital for maintaining the outstanding universal values of the property. Survival of some species, particularly bison, grizzly and wolf, depends on the use of habitat that extends beyond the park boundary, or seasonal migration to unprotected habitat. How land is used outside the park can disrupt ecological processes in the park. Minimizing human interference with ecological processes, requires careful monitoring of changes both within and outside the park. Many ecosystem drivers, such as climate, fire and geothermal activity are primarily the result of processes that operate on a distinctly larger scale that the park.

<u>The Greater Yellowstone Ecosystem</u>

Yellowstone NP is the core of a much larger Greater Yellowstone Ecosystem (GYE), which extends over an area of 18 million acres (or 28,000 sq. miles). The GYE encompasses state lands, two national parks, portions of six national forests, three national wildlife refuges and private and tribal lands. The park has exclusive jurisdiction over managing wildlife, but it chooses to collaborate on most issues with all other resource management federal and state agencies, and with private stakeholders.

[21] Yellowstone NP, 2011 *op. cit.*

[22] Jim Evanoff, Yellowstone NP, pers. comm., September 2011.

Collaborative oversight of management, monitoring and research in the GYE is provided by the Greater Yellowstone Co-ordinating Committee (GYCC). Its purpose is to pursue opportunities of mutual cooperation and coordination in the management of core federal lands in the GYA. The park participates in a series of many inter-active management sub-committees within the GYCC. Resource monitoring is conducted by park staff with the assistance of the Greater Yellowstone Inventory and Monitoring Network (GRYN).[23]

The major ecological and management challenges in the GYE are climate change and consequent environment change, and invasive species. The latest major collaboration in the GYE is development of a comprehensive climate action plan.[24] In 2009, each of the GYCC members pledged to reduce greenhouse gas emission by 20% by 2020, and subsequently established goals extend well beyond this. By the end of 2010, the program was well on target to meet its goals.

2. CONCLUSIONS AND RECOMMENDATIONS

2.1 CONCLUSIONS

Mining restoration, water quality and roads

Progress with implementation of mining restoration is well advanced, especially in respect of the New World Mine where it is nearing completion. Monitoring by the park shows that for the most part aquatic life in streams discharging from mine tailing sites is not endangered.

Roading construction is well planned and managed to minimise impact on park lands and wildlife. There are no outstanding problems or serious impacts on park natural resources from mining restoration and associated water pollution, or from roading construction and use.

Bison disease risk and migration

Conservation of Yellowstone bison, including their migratory tendencies, genetic diversity and role in the ecosystem, is of paramount importance for the survival of the species. Related to this is the vital need to mitigate the transmission of brucellosis to cattle.

Large-scale conservation of bison over big landscapes will require partnerships and co-management among multiple landowners and land and wildlife management agencies. Forging such co-operative relationships remains perhaps the greatest challenge in successfully achieving conservation goals for bison.

Collaboration on disease management in bison under the IBMP is proceeding well and according to plan, with development of measurable objectives, a monitoring program, and improvements in vaccines and testing for brucellosis. The IBMP program of intensive

[23] Yellowstone Center for Resources, 2011, op cit.

[24] Fiebig, M. 2011. Sustainability across boundaries: the Greater Yellowstone Area Climate Action Plan. Greater Yellowstone Coordinating Committee, May 2011.

management (hazing, hunting and culling) of bison migrating out of the park to maintain a spatial and temporal separation between bison and cattle is proving successful for preventing the transmission of brucellosis to cattle.

Several positive steps have been taken to provide more winter grazing habitat for bison on state and private land outside the park. Park bison biologists are confident that the principal traditional migration routes are now secured in the Greater Yellowstone Area.

Suppression of lake trout and protection of cutthroat trout

Eradication of the serious threat to native cutthroat trout from lake trout is an important and immediate problem for Yellowstone NP. The park authorities have responded quickly and positively to implement action from recommendations of a scientific and management review of the lake trout suppression program, and the 2010 Yellowstone Native Fish Conservation Plan. The signs to date are encouraging. Commitment to increased effort is strong and the medium-term budget is sufficient to give some real confidence of a successful outcome.

Grizzly bear connectivity and mortality

Grizzly are well managed and protected in Yellowstone NP and generally the species continues its recovery. The long-term prospects for Yellowstone grizzly conservation appear good. There is active co-operation and a firm commitment from the park and other federal and state agencies under the 2007 grizzly bear conservation strategy.

The conservation strategy recognises that environmental changes induced by a changing climate could detrimentally effect the survival of grizzlies. In its favour the grizzly is an omnivore generalist, capable of adapting to most of the current and envisaged threats from a changing environment. Threats remain, however.

Above all, management of grizzlies in Yellowstone NP will always require a major effort to control human-caused mortality. There is a need to mitigate bear-human conflict. Human tolerance, acceptance and willingness to co-exist with bears are essential if the grizzly is to survive long into the future. Ultimately, it is the human factors and values that will determine where the grizzly can and cannot persist.

Hunting and protection of gray wolf

Protection of wolves is important both to the ecology and economy of Yellowstone NP. From an ecological viewpoint, the conservation and survival of the discrete Yellowstone wolf population is relatively straightforward. Politically, however, it is a difficult, controversial and emotion-charged problem.

The Yellowstone wolf population, which is a very small subset of the historic population, is not sustainable in the long term. For their survival, Yellowstone wolves need more land and habitat than is available in the park, and are reliant on connection to populations in central Idaho and north-west Montana.

Among the key stakeholders in surrounding lands are ranchers and other private landowners, most of whom are opposed to conservation efforts because wolves prey on livestock and worry domestic dogs. Yet ranchers have a critical role to play outside the park as they keep land open, so they need to be partners with the park in conservation programs. Housing and roading development pose major problems as they destroy natural habitat and act as barriers to wolf dispersal.

Delisting of wolves as an endangered species in 2011 has ushered in a new era of hunting on public and private lands outside the park. Hunting and its impacts remain a major conundrum for the park.

Reducing pressure from park operations and high visitor use

Sustained visitor pressure on the natural and cultural resources of Yellowstone NP remains a challenge for the park. In particular, the impacts and issues associated with winter visitation exceed its relative contribution to overall visitor use of the park.

The interim winter use plan used to guide management and use during the two seasons of the 2009-2011 period has proven successful in meeting its objectives, and there has been marked improvement over the unsatisfactory situation that existed earlier.

The innovative sustainable resource use programs in the park, including the 1997 "Greening of Yellowstone" and the 2008 YES! initiatives, are laudable and proving successful in meeting their ambitious targets. They are contributing effectively in advancing the park's environmental stewardship ambitions, and in relieving human pressure on the outstanding universal natural values of the park.

Ecological and management integration with surrounding lands

Integrating Yellowstone NP with activities on lands outside the park is vital for maintaining the outstanding universal values of the property. Yellowstone NP forms the critical core of a much larger Greater Yellowstone Ecosystem (GYE), which extends over an area of 18 million acres (or 28,000 sq. miles) and is one of the largest intact temperate-zone ecosystems in the world.

The park has exclusive jurisdiction over managing wildlife, but it chooses to collaborate on most issues with all other federal and state resource management agencies, and with private stakeholders, through participation in the Greater Yellowstone Co-ordinating Committee (GYCC).

The latest major collaboration in the GYE is development of a comprehensive climate action plan. The NPS is participating actively and effectively in this program, which is an excellent example of cooperative integrated management of resources between the park and surrounding lands.

2.2 RECOMMENDATIONS

Mining restoration water quality and roads

Collaboration with relevant state agencies and the mining companies, and further monitoring of streams should be an on-going component of water quality management in the park.

Bison disease risk and migration

It is vital that park staff find ways to work more closely with their counterparts in State and federal agencies. To these ends the continued work of the IBMP partners is essential.

Management agencies should continue to allow bison migration to essential winter ranges in areas adjacent to the park, while actively preventing the dispersal and range expansion of bison to outlying private lands until there is tolerance for bison in these areas.

The park should carefully consider suggestions for increasing tolerance, such as establishing a local infection status zone for cattle in the Greater Yellowstone Area and testing all cattle in this area for brucellosis, or cessation of cattle grazing in areas where bison leave the Park in winter and compensating ranchers for the loss of earnings. The park should also engage with conservation groups that are examining these options.

Further efforts should be made to identify additional habitat and conservation areas for bison in Montana, develop fencing strategies with private landowners, identify opportunities for providing bison habitat in Montana in the April to early June period, and discourage bison movement on to private land with cattle. Consideration should be given to the innovative suggestion to ship surplus Yellowstone bison to quarantine sites operated by Indian tribes, to help preserve Indian culture and promote the further establishment of wild bison herds.

Suppression of lake trout and protection of cutthroat trout

The park authorities should continue to vigorously pursue the goals of the Yellowstone Native Fish Conservation Plan in eradicating the threat from lake trout to cutthroat trout in the park.

Grizzly bear connectivity and migration

A continuing monitoring program is vital to ensuring that bears adapt successfully to climatic and environmental change.

There is a need for the park authorities to focus on working co-operatively with private landowners and with regulatory agencies, preferably at county level, to keep areas open for bears.

The real challenge is to increase human tolerance and educate people to live around bears without conflict, and the park should strive to continue and intensify its public education program in this respect.

Hunting and protection of gray wolf

The very substantial on-going wolf research and management project in the park should continue at its current level and intensity, at least, and be expanded if possible.

There is a need for further monitoring and research specifically targeted at determining the impact of hunting on wolves in general, and Yellowstone wolves in particular. Ideally, this research should be conducted jointly by the park and state agencies, assisted by hunting organisations and other public bodies, and the results should be used to enlighten future conservation management strategies.

The park should work to build partnerships with ranchers and other private land holders in wolf conservation programs.

Providing better connectivity for wolves with habitat outside the parks calls for improved co-operation and collaboration between the park and neighbouring state agencies responsible for land and wildlife management. To date, relationships have been best in Montana but not as good in the others.

Park staff should interact with their counterparts in rural planning agencies to identify the impacts of housing and transport infrastructure development on wolf conservation, and construct solutions.

Reducing pressure from park operations and high visitor use

Continued use of the interim winter use plan is sufficient for guiding management intervention until the final long-term plan, scheduled for completion in mid-2012, comes into effect.

The park should continue its present commitment to the resource sustainability and YES! programs, and ensure that they fulfil their promise and meet their targets for improving environmental quality and reducing human pressure on the outstanding universal value of the property.

Ecological and management integration with surrounding lands

Efforts by the park to play a full and effective role in all available collaborative mechanisms for integrating management of the park and surrounding lands should continue, and be extended whenever the opportunity arises.

2. ACKNOWLEDGEMENTS

The mission was well organised and conducted. The mission team thanks in particular Stephen Morris, Chief of the Office of International Affairs, and Jonathan Putnam, International Cooperation Specialist of the U.S. National Park Service in Washington D.C., who accompanied the team throughout the mission. Thanks also to Dan Wenk, Superintendent of Yellowstone NP, and his senior and specialist staff who accompanied the mission team in the field and provided valuable information, including: Deputy Superintendent, Steven Lobst; David Hallac, Chief of Yellowstone Center for Resources;

Dan Reinhart, Acting Branch Chief of Integrated Resource Management; P.J. White, Acting Branch Chief of Aquatic and Wildlife Resources; Jim Evanoff, Environment Protection Specialist; Gerry Gunther, bear biologist; Doug Smith, wolf biologist; Roy Renkin, vegetation management specialist; Pat Bigelow, fisheries biologist; Rick Wallen, bison biologist; and Kyle McDowell, enforcement officer and boat captain. Special thanks also to Vance Martin, President of the WILD Foundation and Vice-Chair of the IUCN/WCPA Wilderness Specialist Group, who arranged and chaired a technical session of WCPA members, including: Dave Mihalic, consultant in natural and heritage resources management, Missoula, Montana; Lance Craighead, Executive Director of the Craighead Institute, Bozeman, Montana; Professor Daniel Pletscher, The University of Montana; Professor Cormak Gates, University of Calgary, Canada; and Jon Catton, Greater Yellowstone Management Organisation.

3. BACKGROUND TO THE MISSION

3.1. INSCRIPTION HISTORY AND COMMITTEE CONSIDERATION OF THREATS TO THE PROPERTY

Yellowstone National Park was inscribed on the World Heritage List in 1978 under criteria vii, viii, ix and x. It was one of the first four natural World Heritage properties to be inscribed.

In July 1995, the Bureau of the WH Committee discussed potential threats to the property and a joint World Heritage Centre/IUCN mission was conducted in September 1995. During that visit threats to the Park were ascertained in relation to endemic Yellowstone cut-throat trout, the leakage of sewage and waste contamination in certain areas, road construction and year-round visitor pressures. Potential threats identified included impacts on the quantity and quality of surface and ground-water especially from mining-related activities, and a threat to the bison population from proposed control measures to eradicate brucellosis in the herds. On the basis of both ascertained dangers and potential dangers, on 5 December 1995 the WH Committee decided that Yellowstone National Park should be placed on the List of World Heritage in Danger.

At the 27th session of the WH Committee in 2003, following consideration of several previous reports from the State Party, Yellowstone NP was removed from the List of World Heritage in Danger (Decision 27 COM 7A.12). In its decision, the WH Committee congratulated the State Party for its efforts to resolve the key issues and threats, and invited it to continue its commitment to address the issues of concern, and to provide further reports on this, and also to provide recovery plans setting out targets and indicators for the six remaining long-term management issues, *viz*: mining activities outside the park; threats to bison; threats to cutthroat trout; water quality issues; road impacts and visitor use impacts.

In 2008, in Decision 32 COM 7B.39, the WH Committee acknowledged progress in implementing the New World Mining District Response and restoration project, in restoring

the roads within the guidelines of the National Environment Policy Act and in implementing water quality improvement measures, and requested the State Party to continue to address these and all the identified threats.

In 2010 the WH Committee, having considered yet another State Party progress report, the fifth such report since removal of the property from the Danger List, welcomed the progress made in respect of improving the security of bison migration routes and the restoration of the native cut-throat trout population, and requested the State Party to seek ways of improving the connectivity of grizzly bear population inside and outside the park, and consider the impact on the park's wolf population of hunting on private and public lands around the park. The State Party was also encouraged to develop a long-term action plan for integrated management of the property and surrounding land, particularly in light of the ecological role such lands play in maintaining the OUV of the property. This decision was the basis of the mission reported here. The full decision (34 COM 7B.28) is copied in Annex 1.

3.2. THE MISSION TEAM AND ITINERARY

The monitoring mission team comprised Kishore Rao, Director of the World Heritage Centre, and Paul Dingwall, who was the IUCN representative. They began and ended their mission in Bozeman, Montana, which took place during the period 19 to 22 September 2011. The detailed itinerary and program is at Annex 2. The team spent three days in the field, touring the park by vehicle, boat and on foot in the company of park staff and specialists. Visits were made to key habitats for populations of bison, grizzly bear and wolves, to areas of high visitor concentration such as the Norris Geyser Basin, the Old Faithful geyser and Mammoth Hot Springs, and by boat on Yellowstone Lake for observation of the lake trout control operations. Several discussion sessions were held with the park superintendent and senior staff, including coverage of the park's sustainable resource conservation program and the comprehensive resource monitoring and data recording scheme. Additionally, a technical meeting was convened with North American members of the World Union for the Conservation of Nature (IUCN), including specialists on park management, visitor use, bison, grizzly bear and wolves. A public meeting was also convened with private citizens and representatives of business and conservation NGOs in the local community, which afforded an opportunity to discuss topics such as green tourism and mass transit systems, the economy of gateway communities, financial benefits of wildlands, and protection of the bison population genome and critical habitats.

4. LEGAL AND INSTITUTIONAL FRAMEWORK

Yellowstone National Park, ranked as an IUCN Category II Protected Area, was created in 1872. It is considered to be the world's first national park established in the modern era. The Park covers a total of nearly 9,000 km², 90% of which is in the State of Wyoming, 3% in Montana and 1% in Idaho. The National Park is surrounded by six National Forests, two National Wildlife Refuges and Grand Teton National Park located 12 km to the south. Along with Yellowstone National Park, these are within what is known as the Greater Yellowstone

area, which is four times the size of the park and is considered the largest intact ecosystem in the global temperate zone.

In 1976, an area of 898,349 ha, centered on the geothermal features, was designated as a UNESCO/MAB Biosphere Reserve. The park was inscribed as a natural property on the World Heritage List in 1978, being among the world's first four natural World Heritage properties. Between the years of 1995 and 2002 the property was inscribed on the List of World Heritage in Danger, primarily because of proposed adjacent mining, pollution of rivers, road construction and year-round visitor pressure.

The National Park is almost entirely Federal Land administered under various congressional Acts by the US Department of the Interior National Parks Service in Washington D.C., and is managed from headquarters in Mammoth Hot Springs, Montana. From 1886 protection was provided under an army administration, which was replaced in 1916 when a newly created National Parks Service assumed management authority. Today, the park employs some 355 permanent and 430 seasonal staff, and has an annual budget of approximately $70 million from federal government sources, fees and donations, supplemented by an equivalent amount through revenue generation and fundraising by the Yellowstone Park Foundation and others. There is an extensive interpretive program, and facilities and infrastructure to handle an annual influx of around 3.5 million visitors, in some one million private vehicles.

5. FACTORS AFFECTING THE OUTSTANDING UNIVERSAL VALUE OF THE PROPERTY

5.1. MINING RESTORATION, WATER QUALITY AND ROADS

Concern about the impact of the proposed New World gold mine, located 4.2 km outside the north-eastern boundary of the park, was among the main issues that led to Yellowstone NP being included on the list of World Heritage in Danger in 1995. The park was concerned in particular about the final deposition of the potentially toxic mill tailings on the floodplain of Soda Butte Creek, which flows into the park. Concerns included: the degrading of air and water quality; changes in water quantity; disturbance of habitat for grizzly, bighorn sheep, elk, bald eagle and fish among others; loss of scenic and recreational values; and noise intrusion. In 1998 the government compensated the mining company with a $65 million land trade, including the cost of clearing up the local mine contamination. Pollution from abandoned mine tailings in headwater catchments of the park has remained an on-going management problem. Currently, the park is monitoring the effects of two mining restoration programs, as follows.

The New World Mine restoration - the team was informed that this restoration, located on US Forest Service land, is proceeding well and nearing completion.[25]

[25] Dan Reinhart, Yellowstone NP, pers. comm., September, 2011

Cook City area (McLaren Mining Co.) – this is an old disturbance, also outside the park on state of Montana land. It involves a major restoration program that is just beginning. The park is a partner in this restoration along with state and other federal agencies. Restoration methods include installing catch basins and sediment traps for both physical and toxic chemical runoff, and re-vegetation of disturbed ground.

The park has monitored mine restoration activities and effects over a long period. In the Soda Butte Creek discharge, measurement is made of arsenic, copper, iron and selenium, and sediment content. Results show that iron content exceeds the accepted standards for aquatic life in a few cases. However, from sampling of aquatic invertebrates, the creek scores high in supporting aquatic life.

Roading is one of the primary construction activities in the park.[26] The park supervises roading activities but funding is provided from the Federal Highways Administration. The aim is to make roads wider and straighter, but to keep within prescribed corridors. The park is conscious of the need to balance convenience of travel with protection of natural and cultural resources. Roading teams link with scientists and archaeologists and resource values sometimes impose restrictions on construction, such as the requirement to protect rockwork on margins of the highways that are designated historic districts. The park collaborates with the US Fish & Wildlife Service to plan road construction and use in harmony with the needs of wildlife movement, feeding and other habitat requirements, especially to minimize wildlife encounters and deaths on roads. On average, there is one grizzly bear death on park roads each year.

The mission team concludes that there are no outstanding problems or serious impacts on park resources from mining restoration and associated water pollution, or from roading construction and use.

5.2. BISON DISEASE RISK AND MIGRATION

Bison play an important role in the wildlife ecology of North America and also have great social and cultural significance:

> *"No other wildlife species has exercised such a profound influence on the human history of a continent".*[27]

Yellowstone National Park currently has a population of about 3,700 wild bison. The largest free-ranging herd of plains bison in the world, it is a significant component of the outstanding universal value of the property and a major attraction for visitors to the park.

[26] Dan Reinhart, 2011 ibid.

[27] Gates, C.C.; Gogan, P.J.P. 2011. Introduction – the context. Chapter 1 in Gates, C.C et al. 2011. *American Bison: status survey and conservation guidelines 2010.* Gland, Switzerland. IUCN.

"One of the classic symbols of the American frontier is the image of vast herds of bison grazing on the western plains . . . Americans today still find inspiration in bison ranging freely on the landscape, as Yellowstone National Park demonstrates".[28]

Yellowstone bison were previously subject to some controls and to poaching, but in 1969 the National Park Service (NPS) instituted a moratorium on culling of bison and allowed bison numbers to fluctuate naturally in response to weather, predators and resource limitations. The population grew rapidly to a record high of more than 5,000 animals in 2005 – significantly above the low of 25 animals in 1902. [29]

From the 1980s, increasing numbers of animals migrated during winter outside the park, where some were hunted and culled by federal, state and tribal agencies. These migrations led to a series of conflicts with stock growers and the State of Montana, largely because of the perceived risk of transmission of the disease brucellosis to cattle.[30] Except for some designated parts of Wyoming near Grand Teton and Yellowstone National Parks, Yellowstone bison are considered to be livestock throughout the states of Montana, Idaho and Wyoming and can be removed or destroyed due to disease risk to cattle. Even if brucellosis transmission to cattle was eliminated from bison it is unlikely they would be generally tolerated outside the park because of social and political barriers such as concerns for safety of people (mainly motorists), property damage on private lands, depredation of agricultural crops, competition with livestock grazing, lack of local public support and absence of funding for state management.

A further complication for control programs is that brucellosis is a disease sustained by multiple hosts. It is also found in elk so there is potential for elk to transmit brucellosis in the absence of bison. All recently reported brucellosis transmission to cattle has been attributed to elk. Eradication of brucellosis from elk is not feasible without ethically and politically unacceptable techniques such as mass testing and slaughter.

In 2000, the federal government and the state of Montana agreed to a court-ordered Intergovernmental Bison Management Plan (IBMP)[31] that established guidelines for co-operatively managing the risk of transmission of brucellosis from bison to cattle, while preserving the Yellowstone bison population and allowing some bison to occupy winter

[28] U.S. Secretary of the Interior, 2008.

[29] White, P.J. et al. 2011. Carrying capacity and movements of Yellowstone bison. *Yellowstone Science* 19(1):8-14.

[30] Bovine brucellosis is a contagious bacterial disease caused by *Brucella abortus*, which may induce abortion or birth of non-viable calves in livestock and wildlife.

[31] Members of the IBMP are the National Park Service, US Forest Service, USDA Animal and Plant Health Inspection Service, Montana Department of Livestock, Montana Department of Fish, Wildlife and Parks, Intertribal Buffalo Council, Confederated Salish Kootenai Tribes and the Nez Perce Tribe.

ranges on public lands in Montana. In its 2010 report to the WH Committee[32], the State Party noted that the IBMP partners met several times in 2008 and 2009 to assess management outcomes, develop measurable objectives and a monitoring program, and report on improvements in vaccines and testing for brucellosis.

The IBMP is designed to progress through a series of adaptive management steps that initially tolerate only those bison testing negative for brucellosis exposure to occupy winter ranges outside the Park, but will eventually allow limited numbers of untested bison on key winter ranges adjacent to the Park when cattle are not present.[33] The IBMP provides for intensive management (hazing, hunting and culling) of bison migrating out of the park to maintain a spatial and temporal separation between bison and cattle. To date this has proven successful for preventing the transmission of brucellosis to cattle.

Migration

Modelling of the Yellowstone bison population, using multi-factor simulation techniques, has demonstrated that in general neither of the major herds exceeds the food-limited carrying capacity of the park.[34] However, the model predicts that bison would be under nutritional stress during winters with deep snowpacks that restrict access to forage, resulting in increased mortality from starvation.

Thus, bison migrate primarily in response to somewhat random variations in weather conditions that affect the abundance and availability of food. The outward migration relates to snowpack build-up on higher elevation summer ranges in the park, while the return migration follows a wave in the growth of spring vegetation from lower to higher elevations. The park's bison specialist informed the mission team that bison can travel up to 100 km in a few weeks. Lesser numbers of bison move out of the park without returning, to expand their range due to food limitations.

Research and modelling suggest that, assuming a population of some 4,500 animals, severe winters could induce large-scale movements of bison to lower elevation winter range country outside the park. Such large movements would jeopardise the brucellosis risk management objective of maintaining separation between bison and cattle. It is proposed that the Yellowstone bison population should be limited to 2,500 – 4,500 animals, thus satisfying the collective long-term interests of stakeholders, in providing balance between the park's forage

[32] U.S. State Party, State of Conservation Report for Yellowstone National Park (N28), 2010.

[33] White P.J. et al. 2011a. Balancing brucellosis risk management and wildlife conservation. *Yellowstone Science* 19(1):15-22.

[34] Plumb, G.E. et al. 2009. Carrying capacity, migration and dispersal in Yellowstone bison. *Biological Conservation* 14:2337-2387.

base, the conservation of genetic integrity of the species, the protection of the migratory tendencies, brucellosis risk management and other societal constraints.

Most bison exit the park in through two routes, a northern route to the Gardiner Basin, and a secondary western route through West Yellowstone. These modern migrations, which follow major river valleys, replicate historical patterns of movement that operated on much larger scales than the park lands alone. Park bison biologists are confident that the principal traditional migration routes are now secured in the Greater Yellowstone Area.

Several positive steps have been taken in this regard. By 2008-9, cattle grazing ceased on all public and private lands on the Horse Butte Peninsula adjacent to the Park's western boundary, opening this habitat for seasonal occupancy for migratory bison. Under a 30-year agreement signed in 2008 with the Church Universal and Triumphant Inc., bison can access Gallatin National Forest through Royal Teton Ranch, north of Gardiner adjacent to the Park's northern boundary. The National Park Service (NPS) provided half of the $3 million cost for this. In January 2011, and initial group of 25 bison bulls and cows that had been tested, marked and fitted with monitoring devices, was released to a 2,500 acre grazing area on Forest Service lands. A release of up to 100 untested bison may be allowed in future.

However, intensive management under policies of the IBMP is expensive, logistically demanding and controversial because in some winters culls of more than 1,000 animals have occurred. Since the late 1980s, considerable numbers of bison captured near the park boundary have been shipped to domestic slaughter facilities, but this serves more to reduce the population size than to prevent disease transmission. Removal of bison to slaughter houses has differentially affected the Yellowstone breeding herds, altered their gender structure, reduced the number of females in some years and temporarily dampened productivity. Effectively reducing brucellosis transmission in these ways in the long term would be very expensive and unacceptable to the public.

It is also inconsistent with the NPS policy of maintaining ecosystem integrity. Large-scale culls of more than 1,000 animals per year could diminish the vital ecological place and role of bison. With the exception of Yellowstone bison, the plains bison is now considered to be ecologically extinct across North America. Many thousands of animals are required to fully express their ecological role, which involves competing with other ungulates, providing prey for carnivores, habitat creation for grassland birds and stimulation of primary production.

Thus, conservation of Yellowstone bison, including their migratory tendencies, genetic diversity and role in the ecosystem, is of paramount importance for the survival of the species.

The IBMP initially provided for balancing a late spring pre-parturition population of 3,000 animals with the brucellosis risk management objectives. Since then the park has supported substantial research effort on genetic diversity and gene flow between the park's main herds, including modelling the effects of risk management removal of animals.

However the mission team heard one opposing expert view.[35] This view holds that in a herd of around 3,000 animals, genetic drift causes the loss of about 5% of genetic diversity annually, with rare genes, especially for disease resistance, being most at risk. Moreover, vaccination programs interfere with natural resistance to diseases and the park's selective culling is a form of artificial selection.

There are several other possible approaches that may be more acceptable, but each has undesirable side effects. One involves a program of consistent vaccination of female bison, but this has the potential to increase herd immunity and would ultimately require test-and-slaughter methods and fertility control. Another is the use of a reliable and safe contraceptive (not yet available), preferably combined with vaccination, but it could result in permanent sterility, altered reproductive behaviours and changes in the age and sex structure of the population.

The currently favoured approach for controlling the risk of brucellosis transmission is to maintain spatial and temporal separation between bison and cattle.[36] Thus, management agencies should continue to allow bison migration to essential winter ranges in areas adjacent to the park, while actively preventing the dispersal and range expansion of bison to outlying private lands until there is tolerance for bison in these areas. At present there is little support from the States of Montana, Idaho and Wyoming for resident, free-ranging wild bison. Bison conservation requires a paradigm shift whereby the public comes to recognise bison as wildlife, with much greater social tolerance, especially in the agricultural community.[37]

Suggestions for increasing tolerance include, either establishing a local infection status zone for cattle in the Greater Yellowstone Area and testing all cattle in this area for brucellosis, or cessation of cattle grazing in areas where bison leave the Park in winter and compensating ranchers for the loss of earnings - conservation groups are exploring this idea with willing landowners.

Further efforts include the need to: identify additional habitat and conservation areas for bison in Montana; develop fencing strategies with private landowners; identify opportunities for providing bison habitat in Montana in the April to early June period; and discourage bison movement on to private land with cattle. An innovative and potentially beneficial conservation technique suggested is to ship surplus Yellowstone bison to quarantine sites operated by Indian tribes or other conservation organisations, which would help preserve

[35] Jim Bailey (ex professor of Wildlife Biology, University of Montana), pers. comm. September. 2011

[36] White, P.J. et al. 2010. Management of Yellowstone bison and brucellosis transmission risk – implications for conservation and restoration. *Biological Conservation* 144:1322-1334.

[37] Aune, K. et al. 2011. Legal status, policy issues and listings. Chapter 8 in Gates, C.C. et al. 2011. op. cit.

Indian culture and promote the establishment of wild herds from the only existing pure source of wild plains bison.

Large-scale conservation of bison over big landscapes will require partnerships and co-management among multiple landowners and land and wildlife management agencies. Forging such co-operative relationships remains perhaps the greatest challenge in successfully achieving conservation goals for bison. It is also vital that park staff find ways to work closely with their counterparts in State and federal agencies. To these ends the continued work of the IBMP partners is essential, and they are actively promoting stakeholder involvement. IBMP website was made available to the public in September 2008, providing access to all its meeting reports and other documents. The IBMP partners are also actively examining options for increasing transparency and public involvement through public meetings, working groups, and roundtable sessions.

5.3. SUPPRESSION OF LAKE TROUT AND RESTORATION OF CUTTHROAT TROUT

Yellowstone NP is the type locality in North America for Yellowstone cutthroat trout, which is an important food source for some 42 wildlife species, including grizzly bear in the rivers and streams and osprey and bald eagle in lake waters. Trout are also a major attraction for recreational fishers. Yellowstone NP is, therefore, considered to have the most ecologically and economically important inland cutthroat trout fishery in North America. However, threats to the trout population make its future sustainability uncertain.

The population of native cutthroat trout in the Yellowstone Lake ecosystem has declined substantially since the mid-1980s. The decline is attributed to low-water in drought years, an exotic parasite causing whirling disease, and especially to predation by non-native lake trout.[38] Intentionally stocked brook, rainbow and brown trout have also taken their toll on cutthroat trout.

Lake trout were illegally introduced to the park some 20 years ago but were not discovered until 1994. They have a significant impact by consuming cutthroat trout and competing with them for food sources. Lake trout are about five times larger than cutthroat trout and each one can consume 40 cutthroat trout in a year, which potentially could decimate the cutthroat trout population in a generation.[39] Lake trout are not a substitute for cutthroat trout as they occupy a different ecological niche – they are a bottom-dwelling lake species (native to the Great Lakes and Canada) so are unavailable to some key predators.

Control and suppression of lake trout

[38] Yellowstone Resources Centre, 2011

[39] www.nps.gov/yell/nativescience/fisheries_issues.htm, 2011

Lake trout have been the subject of monitoring and research for about 10 years. Computer modelling suggests that currently there is a population of about 340,000 in Yellowstone Lake.[40] Control has primarily involved removal of fish, with some 550,000 having been removed since 1994. However, the catch per unit effort has been rising since 2002, suggesting that the population is increasing faster than fish are being removed.

In 2008 a scientific panel reviewed the lake trout suppression program and recommended intensification of removal using commercial fishers to augment park efforts, further monitoring and assessment of the cutthroat trout population, initiation of lake trout monitoring and an enhanced netting program, and increased agency commitment to control. In response, monitoring expertise was obtained from the University of Montana. More funding was obtained, especially with support from the Yellowstone NP Foundation, raising the budget to the current level of $2 million annually. Commercial fishers were engaged and in 2010 more than 100,000 lake trout were removed, of which 31,600 were caught in a 10 week period by commercial operators using gill nets.[41]

Yellowstone Native Fish Conservation Plan

The Yellowstone Native Fish Conservation Plan, produced in 2010 and currently undergoing public consultation for environmental assessment, outlines a full conservation strategy for the three decades 2010-2031.[42] It is based on the premise that, despite on-going conservation, native fish species continue to decline and could be lost from Yellowstone waters, and it calls for increased conservation efforts. With respect to native cutthroat trout, the principal objectives of the plan are:

- maintaining access for spawning fish in at least 45 of 59 historical spawning territories in the Yellowstone Lake ecosystem;
- recovering fish abundance in the lake to that documented in the late 1990s; and
- maintaining or restoring genetically pure fish in streams currently occupied by pure or hybrid cutthroat trout.

Additionally, the plan aims at reducing the lake trout population by 25% annually until it collapses to an insignificant level. Modelling suggests this is possible with the increased effort.

[40] Pat Bigelow, Yellowstone NP, pers. comm., 2011

[41] Yellowstone Center for Resources, 2011. *Yellowstone National Park: natural resource vital signs, 2011.* Yellowstone National Park, Mammoth Hot Springs, Wyoming, 19pp.

[42] National Park Service, 2010. *Native fish conservation plan: environmental assessment.* Yellowstone National Park, National Park Service, 380pp.

In rivers and streams beyond Yellowstone Lake, the plan provides for conservation of cutthroat trout using approved piscicides to remove non-native fish and re-stocking of native fish from genetically unaltered brood sources in the GYE.

The plan adopts an adaptive management approach, involving stakeholders and allowing adjustments when necessary based on experience and new knowledge. It is assessed that none of the proposed conservation practices would have more than a moderate impact on the natural environmental setting.

Future funding is secure – the Yellowstone NP Foundation has committed to providing $1 million for the next six years.

Eradication of the serious threat to native cutthroat trout from lake trout is an important and immediate problem for Yellowstone NP. The park authorities have responded quickly and positively to implement action from recommendations of a scientific and management review of the lake trout suppression program, and an associated native fish conservation plan. Commitment to increased effort is strong and the medium-term budget is sufficient to give some real confidence of a successful outcome.

5.4. GRIZZLY BEAR CONNECTIVITY AND MORTALITY

Historical background

Grizzly bears once roamed widely throughout the western states of North America from Alaska to northern Mexico. However, following the arrival of Europeans accompanying gold mining, the opening of the railroads and the cattle and sheep farming industries, the grizzly population steadily declined. By the 1930s grizzlies were all but extinct from 98% of their original range, and at the end of the 1950s they were largely confined to Yellowstone NP and some surrounding areas.[43] There was high mortality of bears in 1970-71 following the closure of open-pit garbage dumps in the park. Then in 1975 grizzly were included on the federal List of Endangered and Threatened Wildlife due to unsustainable levels of human-caused mortality, habitat loss and significant habitat alteration. At that time the estimated population in the GYA was 136-312 individuals. Since then the species has made a notable recovery – considered by some authors to be one of the greatest wildlife conservation successes in the USA.[44]

Bears are well managed and protected in Yellowstone NP, and they are among the most popular visitor attractions. The park remains the principal core area for the grizzly bear today, and sustains an estimated population of around 600 bears. The number of females producing

[43]Haroldson, M.A.; Schwartz, C.C. and Gunther, K.A. 2008. Garbage, controversy and decline to recovery. Yellowstone Science 16(2): 13-24.

[44] Gunther, K.A. 2008. Delisted but not forgotten: management, monitoring and conservation of grizzly bears in Yellowstone National Park after delisting. *Yellowstone Science* 16(2): 30-34.

cubs has been relatively stable since 1996, suggesting that the bear population may be at or near the carrying capacity of the park. However, there is no immediate threat from in-breeding, and no genetic problems are foreseen over the next few decades at least.[45]

Strategic planning and research for grizzly bear conservation and recovery

In 1983, the Interagency Grizzly Bear Committee (IGBC) was formed from representatives of most federal and state agencies with authority over bears and their habitat, to co-ordinate research and management in implementing the adaptive Grizzly Bear Recovery Plan. The Committee bases its advice on the work of the Interagency Grizzly Bear Study Team (IGBST), created in 1973. The team has one of the longest running and largest data sets of any grizzly population.

A grizzly bear conservation strategy, finally released in 2007, documents the regulatory mechanisms, legal authorities, policies, and management and monitoring programs necessary to retain a recovered grizzly population for at least the next century. It sets an overall goal of maintaining the Yellowstone grizzly population at or above 500 animals, and provides for the protection of bear habitat in a 9,210 mile² core area (Primary Conservation Area), including all of Yellowstone NP and half of Grand Teton NP.

The problem of climatic change and loss of whitebark pine

The conservation strategy recognises that environmental changes induced by a changing climate could detrimentally effect the survival of grizzlies. The predicted increase in atmospheric warming associated with climate change should be within the tolerance of grizzly bears. There is greater uncertainty about changes in precipitation, which could profoundly affect bear habitat and food sources.

The greatest impact so far of climate change has been the periodic outbreak of mountain pine beetle and the consequent loss of whitebark pine. This high-altitude conifer is an important food source for bears, particularly as pine seeds are a rich source of dietary fat needed for hibernation and to support lactation. The fundamental cause of pine death is the introduced pathogen blister rust that increases the tree's vulnerability to infestation by the endemic pine beetles. Beetle infestation and death of trees are increasing at unprecedented levels. Whitebark pine mortality is being tracked by monitoring and research programs. Aerial surveys by the US Forest Service and the State of Montana reveal that 7% of the 281,700 acres of whitebark pine stands in the park were infested with beetles in 2010, and up to 80% of trees are affected in some areas.[46] Whitebark pine is a slow maturing species, taking 50

[45] Miller, C.R. and Waits, L.P. 2003. The history of effective population size and genetic diversity in the Yellowstone grizzly: implications for conservation. *Proc. National Academy of Sciences* 100: 4334-4339.

[46] Yellowstone Center for Resources, 2011. Grizzly bears. p. 12, in *Yellowstone National Park, Natural Resources Vital Signs, 2011*. Mammoth Hot Springs, Wyoming.

years to reach cone-bearing stage. The impact on bears is two-fold. First, low pine production leads to increased grizzly mortality from interactions with humans while bears are seeking other food, particularly meat.[47] A higher incidence of bear-human conflict and human-caused mortality occurs particularly outside the park due to the higher density of people and availability of anthropogenic foods on private lands. Second, bears experience low fecundity in the year following low pine production due to poor nutrition.

A continual monitoring program is vital to ensuring that bears adapt successfully to climatic and environmental change. It is in their favour that grizzlies are a generalist and resourceful species adaptable to a wide variety of environments and food conditions. But they remain highly susceptible to human caused mortality, especially on lands beyond the protection of the park. Grizzlies are not as adaptable as humans. The real challenge is to increase human tolerance and educate people to live around bears without conflict.

Expansion of the grizzly range and connectivity outside Yellowstone NP

The grizzly population continues to grow and expand throughout the GYE as bears re-colonise habitats outside the park. Research shows that grizzlies expanded their range by some 11% in the 1980s and by a further 34% in the 1990s,[48] and it now covers some 14 million acres.

Bear movements are carefully monitored using data from encounters and the extensive deployment of radio collars. Unlike wolves, grizzly migration is short, with average dispersal distances of only 70km. Yellowstone grizzlies still form a population "island", and there is no evidence from DNA or other sources of connection with grizzly populations or key habitats outside the park.[49]

Population modelling evidence suggests there is sufficient grizzly habitat for travel and residence outside the park. However, the suitable habitat is becoming increasingly fragmented, and high mortality curtails known dispersers.

The greatest barriers to connectivity are the surrounding private lands at lower altitude. Suitable unoccupied habitat (below carrying capacity) that can be accessed from the park is primarily in private ownership. These areas are threatened by development of oil and gas industries, timber cutting and salvage activities, and housing in the ex-urban/wildland interface. Road construction accompanying these developments has a major barrier effect – observations show that bears avoid an area within 500m of highways (though they will cross two-lane roads).

[47] Lance Craighead, pers. comm., September, 2011

[48] Haroldson et al., 2008

[49] Craighead, L. 2011, ibid.

The vision of the IGBC is that grizzlies will be able to move freely between the park and all large blocks of grizzly habitat in the northern Rockies. To achieve this it is attempting the following: maintaining vegetation cover; limiting the increase in road density; improving the permeability of highways; limiting the size of new developments such as campgrounds; and making it more attractive for landowners to keep land open. The strategy recognises that successful management of grizzly-human conflict is critical for keeping bear mortality at sustainable levels. Central to this is management of nuisance bears, which involves promoting tolerance and minimising illegal killing through better information and public education, and the removal of attractants, especially garbage.

There is a need for the park authorities to focus on working co-operatively with private landowners and with regulatory agencies, preferably at county level, to keep areas open for bears.

Bear-human conflict and human-caused mortality

Management of grizzlies in Yellowstone NP will always require a major effort to control human-caused mortality.

Within the GYA during the period 2008-2011, bear mortality was at a rate of 4-8% of the population per year. There were 41 grizzly mortalities in 2010-11: three from natural causes; three from undetermined causes; and 35 human-induced causes, primarily from hunting and road accidents. Management actions resulted in the live removal of six animals and the death of 15 bears, including seven that had killed livestock and two that killed humans. The two human deaths in the summer of 2011 were the first in the GYE since 1986.

Some 80% of bear mortality is human caused, much of it by hunters. Mortalities are caused by hunters seeking other game species, and occur because hunters use firearms to defend against grizzlies rather than bear spray. Bow hunters also encounter grizzlies at short range. Should grizzlies be delisted as endangered and hunting be permitted, then bear mortalities, both planned and unplanned, from hunters will increase.

There is a need to mitigate bear-human conflict. The situation has improved considerably over the years. In the period 1939 – 1969, bears caused an annual average of 48 human injuries. During the period 1994 – 2009, on average there were seven bear-human conflict incidents per year in the Park. Backcountry recreation continues to increase, though progress has been made with garbage containment and securing of camping and hunting sites. Conflict is most significant in connectivity areas outside the park, and these are bears that are most important in terms of long-term persistence of the species. Housing development continues to increase along fringes of bear habitat. The extension of forestry road networks gives greater backcountry access for hunters and hikers and increases encounters with bears. Habituated, but not food-conditioned bears are also important because they have learned to live close to humans without conflict and females who do this can teach their offspring.

The future prospects

The long-term future of Yellowstone grizzly conservation is good. There is active co-operation and a firm commitment among agencies under the conservation strategy. The Yellowstone grizzly population is stable and is expanding its range. Threats remain, however, including the following:

- climatic change, altering habitats and food sources;
- introduced plant species, diseases and organisms that will influence food distribution and abundance;
- whirling disease and lake trout that have reduced the important food source of cutthroat trout in Yellowstone Lake and its tributary streams; and
- mountain pine beetle killing whitebark pine trees, which are a preferred food source and influence reproductive success.

The grizzly is an omnivore generalist, capable of adapting to most of the current and envisaged threats from environmental changes. Ultimately, it is the human factors and values that will determine where the grizzly can and cannot persist. Human tolerance, acceptance and willingness to co-exist with bears are essential if the grizzly is to survive long into the future.

5.5. HUNTING AND PROTECTION OF GRAY WOLF

Conservation of the gray wolf in North America is a controversial and very emotional subject. Wolf packs once roamed extensively on the continent, and by the end of the 19th century the population in the western USA and Mexico may have numbered 380,000 animals.[50] Wolves were regarded as dangerous predators and extermination programs led to their demise. In 1926, when the NPS ended its predator control efforts, there were no gray wolf packs in Yellowstone NP.

Gradually the ecological role of wolves became better recognised and by 1978 the gray wolf was listed as an endangered species over most of its traditional range. The Greater Yellowstone Area (GYA) is identified as one of three areas in North America where the recovery of wolves has good chance of succeeding. Wolf recovery began in 1995 under a multi-state recovery program and plan, overseen by the US Fish and Wildlife Service.

In 1995-96, 41 wolves from Alberta, British Columbia and northern Montana were released into the park. The animals thrived and their population reached a high of 174 in 2003. Between 2007 and 2010 the population declined by 43%, mostly in the northern packs, attributed primarily to the smaller elk population, which is their main food source. By the end of 2010 there was a stable population of 97 wolves in the park, comprising 11 packs and 7

[50] Whittlesey, L.; Schullery, P. 2011. How many wolves were in the Yellowstone area in the 1870s? *Yellowstone Science* 19(1):23-28.

loners with a long-term average of 10 animals in each pack. The Yellowstone population makes up 20% of the approximately 478 wolves in the GYA.

Protection of wolves is important both to the ecology and economy of Yellowstone NP. Studies show that wolf-watching activities by visitors earns revenue of about $30 million annually.[51] Research on wolves began in the park from the late 1970s, before wolves were present. Today, the park has a substantial on-going wolf research and management project, which in 2010 was conducted by three full-time and 19 part-time staff.[52] The project includes monitoring of the wolf population, its dispersal, distribution, reproduction, mortality and predation on ungulates. The associated research covers population genetics, disease, hunting behaviour, territory use, leadership, scavenging interactions, breeding behaviour, dispersal and wolf-grizzly-bison interactions.

There is some movement of wolves into and out of the park, and radio collars are maintained on about 30% of the park wolves, including animals in all packs. Illegal poaching and hunting of wolves accounts for about 20% of the total mortality. Testing for disease reveals that, while rabies and canine brucellosis are not a problem, wolves are commonly exposed to parvovirus, distemper and hepatitis.[53] The role of disease in the earlier sudden decline of the wolf population remains equivocal, but research on the importance of disease in population dynamics is continuing. Although the park's wolf population is derived from just seven breeding pairs, genetic diversity issues are not considered to be problematic.

Wolves are fully protected in the park. Outside the park, Yellowstone wolves were previously managed under special rules that permitted flexibility in addressing wolf conflicts with livestock and other wildlife management objectives. However, with the attainment of recovery goals, in May 2011 the gray wolf was removed from the endangered species list in Montana and Idaho, but not yet in Wyoming. This introduced the first public hunting of wolves in decades.

The mission team was informed that from an ecological viewpoint the conservation and survival of wolves is a relatively simple matter.[54] Wolves are omnivores, they have high reproduction rates with no genetic problems, and they have excellent dispersal abilities over distances as much as 800 km. However, politically the conservation of wolves is extremely difficult. The wolf population has grown rapidly and it is estimated that there are now 1,600-

[51] Douglas Smith, Yellowstone National Park, pers comm., September, 2011.

[52] Smith, Douglas et al. 2010. *Yellowstone Wolf Project, Annual Report 2010*. Centre for Resources, Yellowstone National Park, Wyoming. 32pp.

[53] Smith, D.W & Almberg, E. 2007. Wolf diseases in Yellowstone National Park. *Yellowstone Science* 15(2):17-19.

[54] Dan Pletscher pers comm., September, 2011.

1,700 wolves in the states of Montana, Idaho and Wyoming.[55] Wolves have also established in areas not envisaged by the recovery plan.

The Yellowstone wolf population, which is a very small subset of the historic population, is not sustainable in the long term. For their survival, Yellowstone wolves need more land and habitat than is available in the Park, and are reliant on connection to populations in central Idaho and north-west Montana. This calls for co-operation between the park and neighbouring state agencies responsible for land and wildlife management. To date, relationships have been best in Montana but not as good in the others.

Among the key stakeholders in surrounding lands are ranchers and other private landowners. For them wolves are a problem as they prey on livestock and worry domestic dogs, and the majority are opposed to conservation of wolves. Yet ranchers have a critical role to play outside the park as they keep land open, so they need to be partners with the park in conservation efforts. Housing and roading development pose major problems as they destroy natural habitat and act as barriers to wolf dispersal. Park staff should interact with their counterparts in rural planning agencies to identify the impacts of housing and transport infrastructure development on wolf conservation and construct solutions.

The new issue of hunting of wolves outside the park remains a major conundrum. There is a need for further monitoring and research specifically targeted at determining the impact of hunting on wolves in general and Yellowstone wolves in particular. Ideally, this research should be conducted jointly by the park and state agencies, assisted by hunting organisations and other public bodies, and the results should be used to enlighten future conservation management strategies.

5.6. REDUCING PRESSURE FROM PARK OPERATIONS AND HIGH VISITOR USE

The interim winter use plan

Sustained visitor pressure on the natural and cultural resources of Yellowstone NP has been of concern for many years. Since first exceeding 3 million in 1992, the annual number of visitors to the park has remained relatively stable, ranging from 2.8 – 3.6 million.[56] Some 70% of visitors come in the June-August summer period, while fall visitation, which began increasing from the 1990s, now accounts for about 21% of the total annual numbers. Winter use is much lower, and has never been more than 6% of the annual total. However, the

[55] Dan Pletscher, ibid.

[56] Yellowstone National Park, 2011. *Yellowstone resources & issues*. Division of Interpretation, Mammoth Hot Springs, Wyoming, 198pp.; Yellowstone Resources Center, 2011, op. cit.

impacts and issues associated with winter visitation exceed its relative contribution to overall visitor use of the park.

Winter visitation has been a controversial subject for a long time but especially over the past decade, during which several rounds of planning and lawsuits capitulated the issue into one of the most visible and enduring controversies confronted by the National Park Service. Most of the recent debate has centred on the use of motorized over-snow vehicles, particularly snowmobiles. Snowmobile use in the park began in 1963, boomed in the 1970s and reached a peak in the late 1990s when an average of 795 vehicles entered the park each day in winter. Over-snow vehicle use was accompanied by unprecedented and unanticipated problems, including air and noise pollution, conflict with other users and wildlife harassment. Strict management of motorized use didn't begin until the early 2000s, with the progressive adoption of measures such as: daily limits on the number of machines; designation of speed zones; night-time closures; the required use of best-available-technology (BAT) machines (available from 2002) that are cleaner running and somewhat quieter than traditional machines; and mandatory commercial guiding of both snowmobiles and snow coaches that has reduced the incidence of wildlife disturbance. Despite the marked improvements, as winter use steadily increased and motorized vehicles became the principal mode of touring the park in winter, so the conflicts grew.

The National Park Service instituted an interim winter use plan to guide management and use during the two seasons of the 2009-2011 period. Among the measures set by this plan is a daily limit for commercially guided operations of up to 318 BAT snowmobiles and 78 BAT snow coaches. Comprehensive monitoring reveals that implementation of the plan has produced many improvements and done much to reverse the unacceptable situation that existed previously, particularly in the 1990s. During its mission the team was advised that all key resource conditions in the park are favourable. Air quality is very good; there are few known detrimental impacts on bison and elk; and sound levels and noise pollution concerns are much reduced. Winter visitor satisfaction surveys conducted in collaboration with the University of Montana have revealed that visitor enjoyment rating is high, with 87% of respondents "very satisfied" with their overall experience and the remaining 13% "satisfied".[57] Favourable trends include an increase in use of multi-passenger coach travel, and decline in the demand for use of snowmobiles by more than 75% from historic levels (during 2003-2011, the use of snowmobiles was on average only 250 vehicles per day). [58]

The interim plan was intended to expire after two years but will remain for the present while the new long-tem plan is being prepared. This has been delayed due to some inconsistencies found in the model used for current analysis of winter use alternatives.[59] Specifically, the model employed outdated emission factors for snow coaches and under-stated the benefits for

[57] Yellowstone NP, 2011, op. cit.

[58] John Catton, IUCN member, pers. comm., based on park statistics, September 2011,

[59] Dan Wenk, Superintendent, Yellowstone NP, pers. comm., September 2011

air quality from BAT vehicles that will be required. In re-instating the rules applying under the interim plan, the park authorities will supplement the current environmental analysis. Among other things, this will allow examination of the reported possible decline in the environmental performance of newer snowmobiles, particularly the trend toward louder models with sound emission levels that may exceed the park noise standard.

The mission team recognises that impacts arising from motorized winter use remain a challenge for the park. However, it concludes that the continued use of the interim winter use plan is sufficient for guiding management intervention until the final long-term plan, scheduled for completion in mid-2012, comes into effect.

Sustainable practices and the YES! program

A "Greening of Yellowstone" program, launched in 1997, has the vision of sustaining the park values and improving environmental quality. While it doesn't specifically address visitor impact pressures, much of it is intended to reduce the human imprint, both from visitors and park managers, on the outstanding universal values of the park. Among the innovative measures adopted to date are: replacement of some treated-timber boardwalks with recycled plastic boards; use of bio-diesel and ethanol blend fuels in park vehicles; conversion to hybrid gasoline/electric powered vehicles; use of sustainable building materials and techniques for heating, insulation and lighting; installation of renewable energy sources; a major recycling and composting initiative; and greening of concessionaire operations and practices involving food, paper, fuels and lighting.[60]

In 2008, in concert with the Yellowstone NP Foundation, the park launched the Yellowstone Environmental Sustainability Initiative (YES!). This multi-year program is intended to elevate the park as a world leader in advancing environmental stewardship. The ultimate goal of the program is to reduce the ecological footprint of park operations and decrease the consumptive use of natural resources by managers and users of the park, especially in confronting the challenges of climate change. Using 2003 figures as a baseline, the YES! aims by 2016 to: reduce greenhouse gas emissions by 30%; reduce electricity consumption by 15%; reduce fossil fuel consumption by 18%; reduce water consumption by 15%; and divert 100% of solid waste from landfills. The Foundation is committed to raising the necessary funds and the park has comprehensive monitoring programs in place for measuring air and water quality, and regional climate trends, for example. The mission team was informed that already some 79% of waste is being diverted from landfills (it was only 20% in 2003), and transition to propane has reduced heating oil consumption by 23%.[61] Another YES! project will install a micro-hydropower system in the existing water supply infrastructure near Mammoth Hot Springs, which is estimated will result in an annual reduction of 695 tons of greenhouse gas emission.

[60] Yellowstone NP, 2011 *op. cit.*

[61] Jim Evanoff, Yellowstone NP, pers. comm., September 2011.

The mission team is impressed by the scope of the park sustainability and YES! programs, and the commitment to them, and is confident that they are well on course to meet their environmental targets, which will do much to relieve the human pressure on the outstanding universal natural values of the park.

5.7. ECOLOGICAL AND MANAGEMENT INTEGRATION WITH SURROUNDING LANDS

Integrating Yellowstone NP with activities on lands outside the park is vital for maintaining the outstanding universal values of the property. Survival of some species, particularly bison, grizzly and wolf, depends on the use of habitat that extends beyond the park boundary, or seasonal migration to unprotected habitat. How land is used outside the park can disrupt ecological processes in the park. The population in the GYA has grown steadily since the 1970s, especially in rural residential areas, and this influences the amount of land available as wildlife habitat. The GYA is also one of the most visited natural regions in the USA, with around four million visitors annually. One of the main goals for Yellowstone NP is to minimize human interference with ecological processes, which requires careful monitoring of changes both within and outside the park. Many ecosystem drivers, such as climate, fire and geothermal activity are primarily the result of processes that operate on a distinctly larger scale that the park. Environmental quality, as measured by air and water quality, can be affected by human activities both within and outside the park.

The Greater Yellowstone Ecosystem

Yellowstone NP is the core of a much larger Greater Yellowstone Ecosystem (GYE), which extends over an area of 18 million acres (or 28,000 sq. miles) and is one of the largest intact temperate-zone ecosystems in the world. The GYE encompasses state lands, two national parks, portions of six national forests, three national wildlife refuges and private and tribal lands. Lands in the GYE are managed by federal, state and tribal governments and private individuals.

Wildlife diversity in the GYE is as great as that found anywhere in the contiguous 48 states of America. However, this rich biodiversity is not guaranteed. Many plants and animals are rare, threatened and endangered, including more than 100 species of plants, at least 20 birds, 18 mammals, and six fish species, along with several amphibians and hundreds of invertebrates. The park has exclusive jurisdiction over managing wildlife, but it chooses to collaborate on most issues with all other resource management federal and state agencies, and with private stakeholders.

Collaborative oversight of management, monitoring and research in the GYE is provided by the Greater Yellowstone Co-ordinating Committee (GYCC). It was formed in 1964 by the National Park Service and the US Forest Service, who were joined by the US Fish & Wildlife Service in 1999. Its purpose is to pursue opportunities of mutual cooperation and coordination in the management of core federal lands in the GYA. The park participates in a series of many inter-active management sub-committees within the GYCC. Resource

monitoring is conducted by park staff with the assistance of the Greater Yellowstone Inventory and Monitoring Network (GRYN), which also includes Grand Teton NP and the Bighorn Canyon National Recreation Area.[62] This is just one of 32 networks established by the NPS for inventory and monitoring and to facilitate collaboration among natural resource agencies. The major ecological and management challenges in the GYE are climate change and consequent environment change, and invasive species.

The latest major collaboration in the GYE is development of a comprehensive climate action plan.[63] An inventory of greenhouse gas emissions from federal operations began in 2007, and planning for emissions reduction began in 2009. Each of the GYCC members pledged to reduce greenhouse gas emission by 20% by 2020 and subsequently established goals extend well beyond this. By the end of 2010, the program was well on target to meet its goals. The NPS is participating actively and effectively in this program. This is an excellent example of the on-going collaborative integrated management of resources between the park and surrounding lands.

6. STATE OF CONSERVATION

Yellowstone National Park, created in 1872 as the first national park in the western world, is widely considered to be the global model of its kind and the standard by which other parks may be measured. A prominent World Heritage property since 1978, Yellowstone has outstanding universal value as one of the world's foremost sites for study of the earth's geological evolution; one of the few remaining large contiguous ecosystem in the world's northern temperate zone; a globally significant refuge for biota, including grizzly bear, bison and wolf; and a scenic wonderland that contains one of the world's largest assemblage of hydrothermal features, especially geysers.

Management of the park has not been without its problems, and between 1995 and 2002 Yellowstone was inscribed on the World Heritage in Danger List due to multiple ascertained and potential threats including proposed mining in surrounding lands, pollution of rivers, road construction and year-round visitor pressure. Since then, management intervention by the park authorities has systematically and progressively reduced or removed these threats. Some problems requiring further attention, which were the subject of this monitoring mission, are all judged to be making satisfactory progress toward a solution. Although the park is extensive, intact and well protected, many of its most important animals including grizzly, bison and wolf, require land and habitat outside the park for their survival. Thus, integrated management of biota and habitat between Yellowstone and surrounding state and private lands remains a principal on-going concern for the park authorities. The park's environmental

[62] Yellowstone Center for Resources, 2011, op cit.

[63] Fiebig, M. 2011. Sustainability across boundaries: the Greater Yellowstone Area Climate Action Plan. Greater Yellowstone Coordinating Committee, May 2011.

stewardship and natural resource monitoring programs are world leaders. Yellowstone National Park is well led, has an excellent complement of permanent, part-time and voluntary operational staff, supported by an impressive group of professional and technical specialists, and is abundantly funded from federal and other sources including grants from foundations and public support organizations. It is recommended that the current round of state of conservation reporting on Yellowstone be phased out and replaced by periodic progress reports to the Committee.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS

Mining restoration, water quality and roads

Progress with implementation of mining restoration is well advanced, especially in respect of the New World Mine where it is nearing completion. Monitoring by the park shows that for the most part aquatic life in streams discharging from mine tailing sites is not endangered.

Roading construction is well planned and managed to minimise impact on park lands and wildlife. There are no outstanding problems or serious impacts on park natural resources from mining restoration and associated water pollution, or from roading construction and use.

Bison disease risk and migration

Conservation of Yellowstone bison, including their migratory tendencies, genetic diversity and role in the ecosystem, is of paramount importance for the survival of the species. Related to this is the vital need to mitigate the transmission of brucellosis to cattle.

Large-scale conservation of bison over big landscapes will require partnerships and co-management among multiple landowners and land and wildlife management agencies. Forging such co-operative relationships remains perhaps the greatest challenge in successfully achieving conservation goals for bison.

Collaboration on disease management in bison under the IBMP is proceeding well and according to plan, with development of measurable objectives, a monitoring program, and improvements in vaccines and testing for brucellosis. The IBMP program of intensive management (hazing, hunting and culling) of bison migrating out of the park to maintain a spatial and temporal separation between bison and cattle is proving successful for preventing the transmission of brucellosis to cattle.

Several positive steps have been taken to provide more winter grazing habitat for bison on state and private land outside the park. Park bison biologists are confident that the principal traditional migration routes are now secured in the Greater Yellowstone Area.

Suppression of lake trout and protection of cutthroat trout

Eradication of the serious threat to native cutthroat trout from lake trout is an important and immediate problem for Yellowstone NP. The park authorities have responded quickly and positively to implement action from recommendations of a scientific and management review of the lake trout suppression program, and the 2010 Yellowstone Native Fish Conservation Plan. The signs to date are encouraging. Commitment to increased effort is strong and the medium-term budget is sufficient to give some real confidence of a successful outcome.

Grizzly bear connectivity and mortality

Grizzly are well managed and protected in Yellowstone NP and generally the species continues recovery. The long-term prospects for Yellowstone grizzly conservation appear good. There is active co-operation and a firm commitment from the park and other federal and state agencies under the 2007 grizzly bear conservation strategy.

The conservation strategy recognises that environmental changes induced by a changing climate could detrimentally effect the survival of grizzlies. In its favour the grizzly is an omnivore generalist, capable of adapting to most of the current and envisaged threats from a changing environment. Threats remain, however.

Above all, management of grizzlies in Yellowstone NP will always require a major effort to control human-caused mortality. There is a need to mitigate bear-human conflict. Human tolerance, acceptance and willingness to co-exist with bears are essential if the grizzly is to survive long into the future. Ultimately, it is the human factors and values that will determine where the grizzly can and cannot persist.

Hunting and protection of gray wolf

Protection of wolves is important both to the ecology and economy of Yellowstone NP. From an ecological viewpoint, the conservation and survival of the discrete Yellowstone wolf population is relatively straightforward. Politically, however, it is a difficult, controversial and emotion-charged problem.

The Yellowstone wolf population, which is a very small subset of the historic population, is not sustainable in the long term. For their survival, Yellowstone wolves need more land and habitat than is available in the park, and are reliant on connection to populations in central Idaho and north-west Montana.

Among the key stakeholders in surrounding lands are ranchers and other private landowners, most of whom are opposed to conservation efforts because wolves prey on livestock and worry domestic dogs. Yet ranchers have a critical role to play outside the park as they keep land open, so they need to be partners with the park in conservation programs. Housing and roading development pose major problems as they destroy natural habitat and act as barriers to wolf dispersal.

Delisting of wolves as an endangered species in 2011 has ushered in a new era of hunting on public and private lands outside the park. Hunting and its impacts remain a major conundrum for the park.

Reducing pressure from park operations and high visitor use

Sustained visitor pressure on the natural and cultural resources of Yellowstone NP remains a challenge for the park. In particular, the impacts and issues associated with winter visitation exceed its relative contribution to overall visitor use of the park.

The interim winter use plan used to guide management and use during the two seasons of the 2009-2011 period has proven successful in meeting its objectives, and there has been marked improvement over the unsatisfactory situation that existed earlier.

The innovative sustainable resource use programs in the park, including the 1997 "Greening of Yellowstone" and the 2008 YES! initiatives, are laudable and proving successful in meeting their ambitious targets. They are contributing effectively in advancing the park's environmental stewardship ambitions, and in relieving human pressure on the outstanding universal natural values of the park.

Ecological and management integration with surrounding lands

Integrating Yellowstone NP with activities on lands outside the park is vital for maintaining the outstanding universal values of the property. Yellowstone NP forms the critical core of a much larger Greater Yellowstone Ecosystem (GYE), which extends over an area of 18 million acres (or 28,000 sq. miles) and is one of the largest intact temperate-zone ecosystems in the world.

The park has exclusive jurisdiction over managing wildlife, but it chooses to collaborate on most issues with all other federal and state resource management agencies, and with private stakeholders, through participation in the Greater Yellowstone Co-ordinating Committee (GYCC).

The latest major collaboration in the GYE is development of a comprehensive climate action plan. The NPS is participating actively and effectively in this program, which is an excellent example of cooperative integrated management of resources between the park and surrounding lands.

7.2 RECOMMENDATIONS

Mining restoration water quality and roads

Collaboration with relevant state agencies and the mining companies, and further monitoring of streams should be an on-going component of water quality management in the park.

Bison disease risk and migration

It is vital that park staff find ways to work more closely with their counterparts in State and federal agencies. To these ends the continued work of the IBMP partners is essential.

Management agencies should continue to allow bison migration to essential winter ranges in areas adjacent to the park, while actively preventing the dispersal and range expansion of bison to outlying private lands until there is tolerance for bison in these areas.

The park should carefully consider suggestions for increasing tolerance, such as establishing a local infection status zone for cattle in the Greater Yellowstone Area and testing all cattle in this area for brucellosis, or cessation of cattle grazing in areas where bison leave the Park in winter and compensating ranchers for the loss of earnings. The park should also engage with conservation groups that are examining these options.

Further efforts should be made to identify additional habitat and conservation areas for bison in Montana, develop fencing strategies with private landowners, identify opportunities for providing bison habitat in Montana in the April to early June period, and discourage bison movement on to private land with cattle. Consideration should be given to the innovative suggestion to ship surplus Yellowstone bison to quarantine sites operated by Indian tribes, to help preserve Indian culture and promote the further establishment of wild bison herds.

Suppression of lake trout and protection of cutthroat trout

The park authorities should continue to vigorously pursue the goals of the Yellowstone Native Fish Conservation Plan in eradicating the threat from lake trout to cutthroat trout in the park.

Grizzly bear connectivity and migration

A continuing monitoring program is vital to ensuring that bears adapt successfully to climatic and environmental change.

There is a need for the park authorities to focus on working co-operatively with private landowners and with regulatory agencies, preferably at county level, to keep areas open for bears.

The real challenge is to increase human tolerance and educate people to live around bears without conflict, and the park should strive to continue and intensify its public education program in this respect.

Hunting and protection of gray wolf

The very substantial on-going wolf research and management project in the park should continue at its current level and intensity, at least, and be expanded if possible.

There is a need for further monitoring and research specifically targeted at determining the impact of hunting on wolves in general, and Yellowstone wolves in particular. Ideally, this research should be conducted jointly by the park and state agencies, assisted by hunting

organisations and other public bodies, and the results should be used to enlighten future conservation management strategies.

The park should work to build partnerships with ranchers and other private land holders in wolf conservation programs.

Providing better connectivity for wolves with habitat outside the parks calls for improved co-operation and collaboration between the park and neighbouring state agencies responsible for land and wildlife management. To date, relationships have been best in Montana but not as good in the others.

Park staff should interact with their counterparts in rural planning agencies to identify the impacts of housing and transport infrastructure development on wolf conservation, and construct solutions.

Reducing pressure from park operations and high visitor use

Continued use of the interim winter use plan is sufficient for guiding management intervention until the final long-term plan, scheduled for completion in mid-2012, comes into effect.

The park should continue its present commitment to the resource sustainability and YES! programs, and ensure that they fulfil their promise and meet their targets for improving environmental quality and reducing human pressure on the outstanding universal value of the property.

Ecological and management integration with surrounding lands

Efforts by the park to play a full and effective role in all available collaborative mechanisms for integrating management of the park and surrounding lands should continue, and be extended whenever the opportunity arises.

8. ANNEX 1

8.1. DECISION OF THE WORLD HERITAGE COMMITTEE

Decision – 34 COM 7B.28 - Yellowstone National Park (United States of America) (N 28)

The World Heritage Committee,

Having examined Document WHC-10/34.COM/7B,

Recalling Decision **32 COM 7B.29**, adopted at its 32nd session (Quebec City, 2008),

Welcomes the State Party's progress towards opening some areas to bison migration and enhancing stakeholder involvement in the Interagency Bison Management Plan;

Encourages the State Party to continue its efforts to secure bison migration routes, and to increase its engagement with ranchers surrounding the property in order to keep landscapes open to bison movements in order to ensure the effective conservation of this key species of the property;

Also welcomes the State Party's efforts to rapidly implement the recommendations of the scientific expert panel concerning the restoration of the property's native cut-throat trout population, and urges the State Party to ensure that adequate funding is secured to intensify lake trout suppression efforts over the next six years;

Requests that given the small size of Yellowstone's grizzly bear's population, the State Party seek to increase the population's connectivity with the larger population of bears in the region, and consider the need to further mitigate human-bear conflict;

Strongly urges the State Party to consider how recent delisting of wolves as a protected species in Idaho and Montana and hunting of wolves in neighbouring public and private land may impact the wolf population within the property ;

Also encourages the State Party to develop a more detailed understanding of the ecological role that the surrounding lands play in maintaining the property's values, and a long-term vision and action plan for integrated management of the property and its surrounding areas;

Also requests the State Party to submit to the World Heritage Centre, by **1 February 2012**, a detailed report on the state of conservation of the property and the progress made in addressing the different issues above, for examination by the World Heritage Committee at its 36th session in 2012.

9. ANNEX 2

9.1. ITINERARY AND DAILY PROGRAMS OF THE MISSION

Monday 19 September

9:00 – 11 am: Meet in Superintendent's Conference Room in Mammoth Hot Springs.

General briefing on Yellowstone National Park in Superintendent's Conference Room (Park staff: Supt. Dan Wenk, Yellowstone Center for Resources Chief Dave Hallac, Deputy Supt. Steve Iobst, Tim Reid, Chief Ranger).

Discussion points:

- Objectives of the mission.
- Outstanding Universal Value (OUV) of the property.
- Current state of conservation of the OUV of the property.

11:00 am – 3.00 pm: Take yellow bus out into park.

Driving/hiking tour of Yellowstone's northern range habitats (just past Tower Junction): discussion of whitebark pine, beetles, climate change, wolves, New World Mine, grizzly bears (Park staff: Bear Biologist Kerry Gunther, Vegetation Management Specialist Roy Renkin, Wolf Biologist Doug Smith, Acting Branch Chief of Integrated Resource Management Dan Reinhart).

6.00 pm: Mission team has presentation on park resource monitoring and data recording from David Hallac.

Lodging: Lake Hotel

Tuesday 20 September

8.00 am: Mission team has breakfast discussion on sustainability program with Jim Ekoff, Environment Protection Specialist.

9am - 11am: Boat (Robert E. Mahn) tour on Yellowstone Lake to discuss Yellowstone cutthroat trout and the lake trout eradication effort as well as climate change (Park staff: Fisheries Biologist Pat Bigelow), Dave H.-Drive to Marina with Pat Bigelow, Captain: Kyle McDowell.

Noon: Lunch at Lake Lodge Cafeteria.

1:30 pm: Meet at Dragon's Cauldron parking area. Driving tour of Hayden Valley to discuss bison management (Park staff: Acting Branch Chief of Aquatic and Wildlife Resources PJ White, Bison Biologist Rick Wallen).

Lodging: Canyon

Wednesday 21 September

8:00am: Drive to Old Faithful on Yellow Bus to discuss winter and visitor use, restoration of park roads within the guidelines of NEPA, water quality improvement measures, and implementation of a sustainability program to reduce the impacts of visitation and park operations.

pm: Lunch at Old Faithful Snow Lodge Deli

2.00 pm: Drive Yellow Bus to West Yellowstone, arrive by 3.00 pm and check into Holiday Inn.

3.30 - 5.30 pm: Mission team meets with WCPA members, chaired by Vance Martin, in conference room.

6:30 - 8:30 pm: Public Meeting, chaired by Dan Wenk, in conference room.

8.30 pm: Dinner

Lodging: West Yellowstone Holiday Inn.

Thursday 22 September

Morning: Take bus back to Mammoth Hot Springs, check into hotel and have lunch.

2.00 pm: Review and discussion in the Superintendent's Conference Room and follow up with staff as needed. Discuss the ecological role that surrounding lands play in maintaining the property's values, and ongoing integrated management efforts (Park staff: Dan Wenk, Dave Hallac, other staff as requested).

5:30 - 8.00 pm: Reception at Superintendent Dan Wenk's residence.

Lodging: Mammoth Hot Springs Hotel.

10. ANNEX 3

10.1. TERMS OF REFERENCE FOR THE MISSION

Terms of Reference

Joint World Heritage Centre / IUCN Reactive Monitoring Mission

World Heritage property "Yellowstone National Park "United States of America

19 - 22 September 2011

The objective of the monitoring mission is to review progress in implementing the recommendations of the World Heritage Committee, as requested by the Committee at its 32nd session (**Decision 32COM 7B.29**). The mission will assess the factors affecting the Outstanding Universal Value (OUV) of the Yellowstone National Park World Heritage property and in particular will review action taken to ensure the conservation of populations of key species, including bison, cut-throat trout, grizzly bear and wolf, as well as the development of a long-term vision and action plan for the integrated management of the property and its surrounding areas. The mission team will be composed of Kishore Rao for the World Heritage Centre and Dr. Paul Dingwall representing IUCN.

In particular, the mission should address the following key issues:

Assess progress made in the implementation of the New World Mining District Response and Restoration project, restoring the roads within the guidelines of the National Environment Policy Act, and implementing water quality improvement measures;
Review the outcomes of the risk analysis for the transmission of brucellosis from unconfined bison to cattle, and assess progress in the implementation of the recommendations that resulted from this risk analysis;
Assess progress made in further securing bison migration routes and in further increasing engagement with ranchers surrounding the property to keep landscapes open to bison movement;
Assess progress made in securing adequate funding to intensify suppression efforts of invasive lake trout over the next six years, and in implementing the recommendations from the scientific expert panel concerning the restoration of the property's native cut-throat trout population;
Assess progress made in increasing the connectivity of Yellowstone's grizzly bear population with the larger population of bears in the region, and review the need for increased efforts to mitigate human-bear conflict, which is one of the main causes of bear mortality;
Assess how the recent delisting of wolves as a protected species in Idaho and Montana and hunting of wolves in neighbouring public and private land may impact the wolf population within the property;
Assess whether the implementation of the Yellowstone Environmental Stewardship (YES) programme and the interim winter use plan for the 2009-2010 and 2010-2011 seasons have been effective in reducing the pressure from high visitor use;

Assess progress made in the development of a long-term vision and action plan for integrated management of the property and its surrounding areas, in view of the ecological role that these surrounding lands may play in maintaining the property's values.

The mission team should be able to conduct the necessary field visits to the property to make these assessments, and be provided with final or draft copies of the studies, recommendations and plans mentioned above. The mission team should further hold consultations with the United States authorities at federal and state levels, in particular the Yellowstone National Park management authority as well as all relevant other stakeholders, including representatives of local communities, ranchers, local and national NGOs, and members of WCPA North America.

Based on the results of the above-mentioned assessment and discussion with the State Party representatives, the mission team will develop recommendations to the World Heritage Committee for review at its 36th session (June – July 2012).

The mission team will prepare a concise mission report in English on the findings and recommendations of this reactive monitoring mission following the standard format (IUCN to lead).