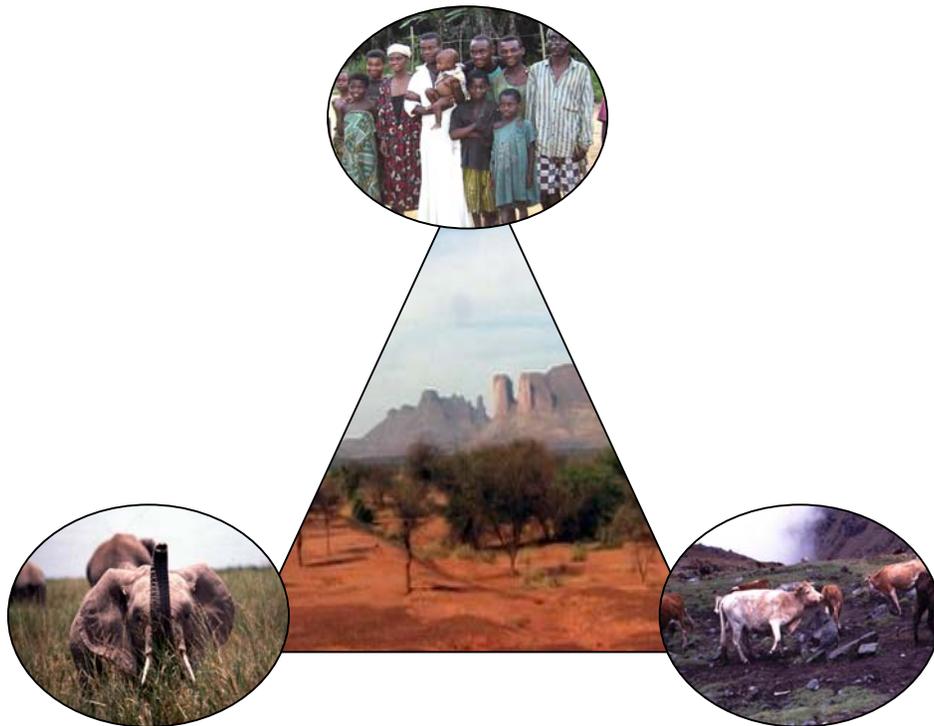


Animal Health Matters:

**Improving the Health of Wild and Domestic Animals to
Enhance Long-Term Development Success
in USAID-Assisted Countries**



Prepared as part of the RFA USAID/G/ENV/ENR 99-01 Technical Application- WCS
by the Field Veterinary Program, Wildlife Conservation Society



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Prepared for U.S.A.I.D. March 30, 2003

As part of the RFA USAID/G/ENV/ENR 99-01 Technical Application – WCS

By:

The Field Veterinary Program
Wildlife Health Sciences
Wildlife Conservation Society
2300 Southern Blvd.
Bronx, NY 10460

The Wildlife Conservation Society saves wildlife and wild lands. We do so through careful science, international conservation, education, and the management of the world's largest system of urban wildlife parks, led by the flagship Bronx Zoo. Together, these activities change individual attitudes toward nature and help people imagine wildlife and humans coexisting in a sustainable way on both a local and a global scale. WCS is committed to this work because we believe it essential to the integrity of life on earth.

Since 1895, WCS has worked from our Bronx Zoo headquarters to save wildlife and wild lands throughout the world. We uniquely combine the resources of wildlife parks in New York with field projects around the globe to inspire care for nature, provide leadership in environmental education, and help sustain our planet's biological diversity.

Today WCS is at work in 53 nations across Africa, Asia, Latin America and North America, protecting wild landscapes that are home to a vast variety of species from butterflies to tigers. Our pioneering environmental education programs reach millions locally, nationally and internationally.



On the Value of Wildlife Health Surveillance

The globalization cliché that we are all connected should not be dismissed. Scientists warn that vast clouds of dust and pathogens transported across continents may link the future of the Sahel to such costly problems as citrus canker and red tide in Florida. Phytophthora, a family of pathogens responsible for the nineteenth-century Irish potato famine, is reappearing in California as Sudden Oak Death Syndrome thanks to international trade in nursery plants. Other invasive plants and animals transported through trade threaten the \$8 billion restoration of the Everglades ecosystem. Cruise ships around the world flush ballast water with unknown ‘hitchhiker’ organisms that can cross national borders without approval or known impact.

Field conservationists today provide a biodiversity surveillance system essential to protecting a changing and highly connected Earth and its inhabitants. If it had not been for the scientific wildlife surveillance capability at the Bronx Zoo, for example, the recent outbreak of the West Nile virus in the United States would have escaped early detection and correct diagnosis. The same conservation surveillance capability will likely provide any signals that chronic wasting disease among elk and deer or brucellosis in bison might jump to beef cattle, and in general provide an early warning system to catch future crossings of the wildlife-human disease frontier.

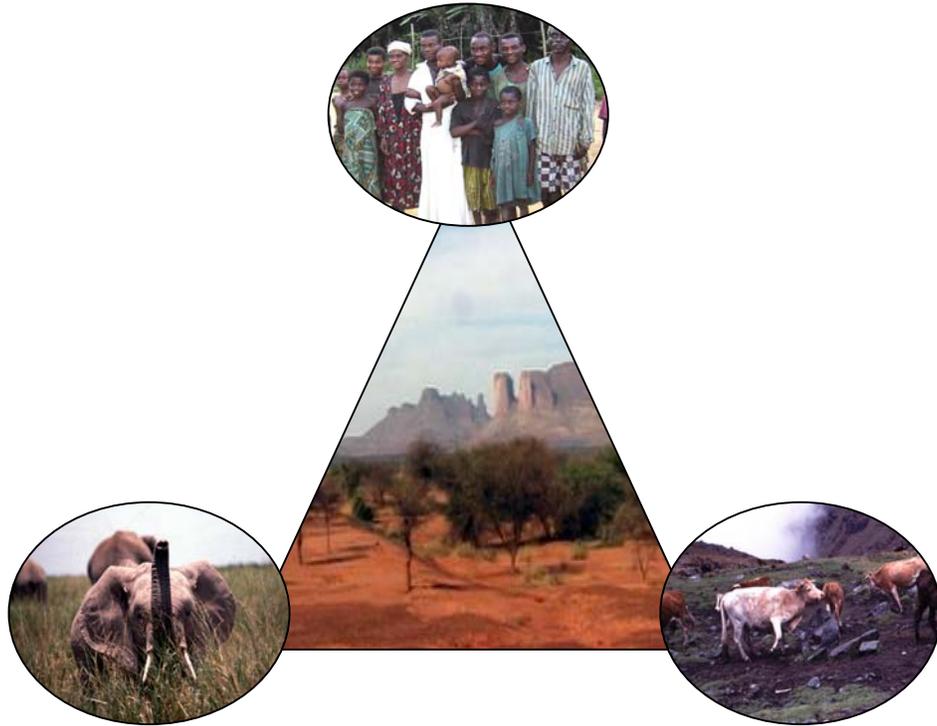
-Dr. Steven Sanderson, President and CEO, the Wildlife Conservation Society. “The Future of Conservation,” *Foreign Affairs*, vol. 81 (5), September / October 2002.



Different Land Uses, Common Ground

Despite the contrasting perspectives of animal agriculture and wildlife conservation groups on some health issues, it must be stressed here that there is substantial common ground. To a great extent, many of the same people are involved in both activities and have understanding from both sides of controversial issues. Animal agriculturists and wildlife managers understand the concept and value of population health management as opposed to individual animal treatment, and the concern for foreign animal disease introduction is mutual. Additionally, both groups are competing against a ‘tide of humanity’ as human populations increase demand for land and water resources, and there is concern regarding the animal rights movement directed against consumptive use of either wild or domestic animals. Lastly, because the land base for much of wildlife production is private land, and much of private land is used for animal agriculture, saving farming enterprises is beneficial to wildlife.... it is important for all to view the transmission of diseases between domestic animals and wildlife as a “two-way street” where organisms have the potential to move in either direction. Thus, the goal should be to develop programs and policies that can protect and sustain all interests.

-Dr. Victor F. Nettles, Director Emeritus- Southeastern Cooperative Wildlife Disease Study, The University of Georgia. “Wildlife-Livestock Disease Interactions,” *United States Animal Health Association Newsletter*, vol. 28 (5), October 2001.



Animal Health Matters:

Improving the Health of Wild and Domestic Animals to Enhance Long-Term Development Success in USAID-Assisted Countries

Executive Synopsis

1. Domestic animals, wild animals, and humans share many diseases. Landscape fragmentation, unsustainable land-use choices, pollution, and other types of ecosystem disruption affect all three groups, often in similar ways.
2. Animal diseases that don't directly affect people can still have extraordinary impacts on human societies and economies.
3. Animal health security is critical to protecting the US economy domestically and necessary for maintaining international trade, with billions of dollars at risk annually in the agricultural and wildlife-related sectors (e.g.- tourism, bird-watching, fishing, hunting, hospitality, ranching, etc.).
4. Developing countries are as, if not more, dependent upon healthy domestic and wild animals at local as well as national levels in terms of food security and self-sufficiency, fiber needs, micronutrients, cultural norms, sustainable livelihoods, economic growth, and trade.
5. With advanced planning and the involvement of multidisciplinary teams *that include animal health experts*, foreign assistance projects can avoid many of the mistakes and problems often experienced by developed countries at the livestock / wildlife interface, while also decreasing the likelihood that projects will inadvertently have negative impacts on human health and/or economic growth.
6. Many developing countries lack functional strategies and the infrastructure needed to protect their domestic agricultural and wildlife interests from endemic (native to an area) or introduced (akin to alien invasive species) diseases. Without sound vigilance systems in-place at local and national levels, the risk of diseases being accidentally exported globally through trade is also increased.

7. It is in the United States' strategic interest to help developing countries improve their animal health-related programs, policies, and infrastructure given ongoing globalization trends and the constant threat of new and emerging as well as resurgent diseases to animal and human health worldwide.
8. Projects that incorporate animal health objectives lend themselves to quantitative short- and long-term monitoring, since disease status within and across species can be objectively measured over time. Indicators derived from an epidemiological approach can point to project success or failure.
9. By following the basic tenets of the Pilanesburg Resolution (**p. 41**), development agencies can improve the success and sustainability of their development interventions, particularly those that involve the agricultural and natural resource management sectors.
10. By using a simple pre-implementation project checklist (**p. 44**), development agencies can help set projects off in a direction that avoids negative impacts on animal health and ultimately the human condition over time.

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Introduction:

Healthy Landscapes, Healthy Lives

In 1933, Aldo Leopold stated that the “role of disease in wildlife conservation has probably been radically underestimated.” Today, infectious and noninfectious diseases of humans, domestic animals, and wildlife are finally being recognized as an increasing challenge to efforts aimed at improving the human condition as well as to programs aimed at conservation and sustainable management of natural resources. As human populations and global demand for resources continue to expand, wild landscapes are lost, fragmented and degraded, pushing wildlife into smaller and smaller remnants- mere islands in a sea of humanity. With people spreading into wilderness areas in search of land, food, and other resources, as well as for recreation, the needs of people and the needs of wildlife are increasingly in conflict. Often overlooked, one of the most significant consequences of people and their domestic animals coming into increasingly close contact with wildlife is a significant increase in disease transmission amongst people, livestock, and wildlife.

Foreign Assistance and Unforeseen Impacts on Health

Some well-intentioned development initiatives as well as conservation projects have unwittingly introduced diseases into wildlife populations. Others have been unsuccessful because they failed to take disease factors into consideration. Domestic dogs have spread fatal distemper to lions and other predators in the Serengeti ecosystem, and disease has helped extirpate African wild dogs throughout much of their range. Chickens used to feed eco-tourists may have infected wild parrots with *Salmonella*, known to cause avian infertility. Ill tourists, project staff, and local people have been incriminated in transmitting fatal respiratory infections, measles, and polio to gorillas and chimpanzees in Africa with devastating consequences. In fact, examples of the importance of paying attention to wildlife health issues in conservation and development projects abound (Box 1).

Box 1: Wildlife Health and Development Efforts: An Ounce of Prevention is Worth a Pound of Cure

- Throughout tropical and sub-tropical South America, peccaries provide a significant source of protein for indigenous hunting communities. Studies to elucidate population dynamics that could help establish sustainable harvest rates have depended on theoretical assessments of reproductive capacity due to a lack of information on the actual variation in reproductive success. Infectious diseases can have significant effects on reproductive success; initial studies on one population of peccaries in Bolivia have shown that 25% of the population has been infected with leptospirosis. This disease is known to cause stillbirths and abortions in other mammal species, including domestic swine. Integrating further health evaluations in other populations could provide data needed for more accurate modeling of reproductive rates and population dynamics. Models lacking this information could inadvertently over-estimate the levels of sustainable harvesting.
- The use of ecotourism to support conservation efforts raises concerns about the impact of human proximity on wildlife in some of these projects, but little has been done to quantify the effects. In a project where tourists were allowed to visit and participate in an endangered macaw breeding and restocking program, *Salmonella* bacteria were found to be infecting the hand-reared, released birds. This bacterium is known to cause infertility and poor hatching success in other bird species. Releasing infected birds provides a route of contamination for wild macaw populations. The source of the *Salmonella* bacteria was most likely either the domestic poultry brought in to the remote site to feed the tourists and staff, or rodents that infest the lodge facilities. Without health evaluations, the threat to wild populations would never have been identified and management changes would not have been made to correct the problem.
- Chlorinated pesticides (agents such as DDT and its metabolites) are being found in colonies of endangered sea birds, seals, and seal lions in remote protected areas of Argentina and Peru. These chemicals have been shown to affect reproductive success in many species. Sources of these toxins have not been identified, but agricultural run-off and contamination of fish stocks (and thus the food chain) from areas of agricultural development hundreds of miles away are highly likely. To date, no studies have been conducted to identify the sources of pesticide contamination, nor have studies been instituted to assess the effects on wildlife populations. While environmental contaminants have traditionally been thought of as a more urban or “brown” issue, both ocean currents and animal migrations can result in population effects occurring in the most remote protected areas.
- Integrated Conservation and Development Projects, community-based conservation efforts, buffer zone management programs, and other multiple-use strategies are often correlated with the presence of an interface between wild and domestic animals. Increasingly, disease transmission between these groups of animals has had a negative impact on wildlife (i.e., lions and wild dogs in Tanzania, rinderpest outbreaks in Kenya). Wildlife is often erroneously implicated as the source of infections in domestic animals. Free-ranging guanaco in Argentina have long been thought to be the source of diseases for domestic sheep, while the only study conducted to date found just the opposite to be true. Typically, wildlife health information is gathered only after major mortality events (an approach providing no baseline for facilitating a complete epidemiological picture). To be successful, proactive health assessments are required to more completely assess and address disease threats to conservation and development projects.
- Land-use choices are often driven by government incentives or subsidies that can favor unsustainable agriculture over more ecologically sound natural resource management schemes, particularly in marginal semi-arid lands. With better understanding of disease epidemiology and the true costs associated with disease control and environmental degradation, land-use decisions might more often favor a return to natural production systems. For example, in some parts of southern Africa, foot and mouth disease control programs to support beef production for an export market may not be as profitable or as environmentally sustainable as a return to multi-use natural production systems emphasizing endemic wildlife species.

Selected Examples of Animal Health Issues of Importance in North America:

One doesn't have to look to the international arena to find examples of the huge economic, ecological, and political dimensions of animal health and disease. Wildlife and domestic animal health issues pervade the North American landscape. Both agricultural and wildlife conservation interests have concerns as to how diseases may impact animals, and each group fears disease transmission from the other. *In the world's most industrialized economy, the agriculture and natural resource sectors remain at the heart of productivity. Why would we expect these sectors deserve any less attention in the developing world (Box 2)?*

Today's headlines are full of examples of the inextricable links between animal and human health, and the state of health of our environment. Brucellosis continues to cause conflict between cattle and conservation interests in and around Yellowstone; Chronic Wasting Disease seriously threatens deer and elk as it moves across the United States **while federal compensation for elk farmers in Saskatchewan who've been mandated to have their animals destroyed and farms condemned (even for grain production) has now surpassed the US \$ 24,000,000 mark**; West Nile Virus' toll on wildlife is only beginning to be understood as we continue to grapple with the loss of human lives; tuberculosis threatens the multi-million dollar deer hunting and livestock industries due to human health concerns in states like Michigan, and so on. These examples represent **millions and millions of dollars of ongoing research and attempted remediation costs in addition to revenues lost by commercial agriculture, wildlife ranching interests, hunting and associated tourism and hospitality-related industries**, etc. Could greater awareness and better vigilance have prevented some of these problems? Can we preclude similar scenarios in countries receiving U. S. foreign assistance?

Box 2: A Perspective from the Home Front:

From the livestock/poultry producer's perspective, there are multiple concerns about the perceived or actual presence of diseases in wildlife. A recent United States Animal Health Association (USAHA) news release gave the cost to producers at **\$1 billion annually**, so there is much to be feared. When a disease moves from wildlife to domestic animals, there is the direct threat due to morbidity and mortality, and the accompanying economic losses. Additional financial losses occur through quarantines, special husbandry practices (fencing, closed housing) required to segregate wildlife from domestic animals, surveillance programs, vaccination, etc. Also, there may be loss of export markets due to endemic infections in wildlife, even when domestic animals are not infected. A reverse economic threat also can occur when public grazing is denied to livestock owners because of a real or perceived threat to wildlife from domestic stock.

Wildlife conservationists, including professional wildlife managers, hunters, many landowners, and the numerous private citizens who enjoy wildlife in a non-consumptive manner, also worry about diseases. As with domestic animals, there is the direct risk to wildlife due to the pathogenicity of the disease agent, and there are a few examples where wild populations were decimated by disease. Perhaps a greater threat is for wildlife to become involved in the epidemiology of a disease of significance to animal agriculture. When a wild species is identified as reservoir host, amplifying host, main or alternate host for the disease (or for its vector), or as a transport mechanism for disseminating a disease, it can lead to trouble and conflict for wildlife conservationists. Preserving our agricultural economy may call for harsh control measures such as the depopulation of thousands of animals, intolerance of wildlife on farms, and destruction of habitat. Even perceived health threats from wildlife have led poultry industries to lobby forcefully against waterfowl refuges in poultry-producing areas. Given these circumstances, it is not unusual for agriculture and wildlife interests to collide over health issues.

One special area of health concern for wildlife conservationists is the private ownership of wildlife species as "alternative livestock." Wildlife managers fear the introduction of diseases or undesirable genetic material into wildlife populations from animals that are being rapidly moved throughout the country. In addition to fence-line contact, escapes are particularly worrisome because recovery of the privately owned animals can be difficult, particularly when indistinguishable wild animals are present.

Before progressing further, it is important to recognize that fish-and-wildlife –associated recreation is big business. Outdoor activities associated with wildlife have a huge public constituency and the economics of wildlife generally are under-recognized. The latest National Survey of Hunting, Fishing and Wildlife-Associated Recreation revealed that 77 million Americans participate in fishing, hunting, or non-consumptive wildlife enjoyment. And they spend \$104 billion annually in the process. Thirty-five million people fish and spend \$38.1 billion, and 14 million people hunt and spend \$20.6 billion. Non-consumptive wildlife activities (observation, feeding, etc.) are enjoyed by 63 million people who spend \$25.7 billion. Hunting, which is the smallest of the wildlife industries, is huge. Hunting activities provide for \$16.1 billion in household income, \$3.1 billion in state and federal tax revenue, 704,000 jobs, and an economic multiplier effect of \$61 billion. Many of the economic benefits from hunting and fishing impact rural areas.

One comparative example is the value for the cattle industry provided by the National Cattlemen's Beef Association. The farm gate value of all cattle, calves, and dairy products was \$44 billion in 1996. There were approximately 1 million cattle farmers and ranchers, which means for every vote the cattlemen had that year, fish and wildlife enthusiasts had 76. Cattlemen have the largest percentage of private land, some 525 million acres, but they also are dependent upon much of the 516 million acres of public land. Both private and public lands are teeming with wild animals that are held in public trust and, thus, there are multiple scenarios where disease interaction between wildlife and livestock can become contentious issues....

Nettles, V. F. "Wildlife-Livestock Disease Interactions," United States Animal Health Association Newsletter, vol. 28 (5), October 2001.

The Washington Post December 27, 2002

Ecological Impact of West Nile Virus -by Rick Weiss

First there was the silence of the crows. Then the horses fell ill – more than 14 000 this past summer [2002] alone -- along with squirrels, chipmunks, and mountain goats. Even mighty raptors -- eagles, hawks, and great horned owls -- dropped from the sky. Now scientists are beginning to take stock of West Nile virus's North American invasion, and they are taken aback by the scale and sweep of its ecological impact. While the human toll dominated the nation's attention this year [2002] -- the virus killed at least 241 people and infected thousands more -- the effects on wildlife were far worse.

The virus swept westward with alarming rapidity, appearing in almost every state in the nation -- an astonishing expansion for a [virus] that had never been seen in the Western Hemisphere until 3 years ago. Equally unexpected, nearly 200 species of birds, reptiles and mammals fell ill as a result of West Nile virus infection this year [2002], including rabbits and reindeer, pelicans and bats, even a few dogs and cats. The virus also slammed dozens of exotic species in about 100 U.S. zoos, killing cockatiels, emus, seals, flamingos, and penguins. Florida alligator farms lost more than 200 of the reptiles....

...In North American wildlife, the virus has proven to be unusually aggressive and capable of infecting a surprisingly diverse array of animals. "Most viruses tend to be rather host-specific, but that's not the case with what we were seeing," said Tracey McNamara, chief of pathology for the Wildlife Conservation Society, which has its headquarters at the Bronx Zoo [NY], where the first infected crow was found. It is still unclear how many of the 200 or so species struck by West Nile virus infection have suffered significant population declines.... Still, researchers this year found more than 140 bird species sickened or dead.... [Researchers] point to the experience of Hawaii, where the arrival of an avian poxvirus in the 1890s and avian malaria in the 1930s drove dozens of species to extinction or close to it. "Those [microbes] just hammered Hawaiian forest birds," [Princeton Professor of Ecology David] Wilcove said. "That illustrates the potential for harm when a disease organism encounters a naive population."

Still, some scientists fear that the nation may soon become less able to prevent outbreaks such as that of West Nile virus -- whether accidental or intentional. They say the U.S. system for screening incoming animal, plant and microbial life -- a patchwork of more than 20 agencies -- has long been undervalued and underfunded. Now the largest component, the Agriculture Department's Animal and Plant Health Inspection Service, is to become part of the new Homeland Security Department. That's leading many ecologists to fear that it will narrow its focus to classical bioterrorism pathogens such as anthrax, leaving the nation more vulnerable to [agents] such as West Nile virus.The epidemic should be a wake-up call to beef up the nation's surveillance and quarantine network, said Princeton's Wilcove.

<http://www.washingtonpost.com/wp-dyn/articles/A45800-2002Dec27.html>

Chronic Wasting Disease (CWD) is a transmissible neurological disease of deer and elk that produces small lesions in brains of infected animals. It is characterized by loss of body condition, behavioral abnormalities and death. CWD is classified as a transmissible spongiform encephalopathy (TSE), and is similar to mad cow disease in cattle and scrapie in sheep.

Infectious agents of CWD are neither bacteria nor viruses, but are hypothesized to be prions. Prions are infectious proteins without associated nucleic acids.

Although CWD is a contagious fatal disease among deer and elk, research suggests that humans, cattle and other domestic livestock are resistant to natural transmission. While the possibility of human infection remains a concern, it is important to note there have been no verified cases of humans contracting CWD.

CWD can reduce the growth and size of wild deer and elk populations in areas where the prevalence is high, and is of increasing concern for wildlife managers across North America. The disease was long thought to be limited **in the wild** to a relatively small endemic area in northeastern **Colorado, southeastern Wyoming and southwestern Nebraska, but it has recently been found in new areas of Colorado and Nebraska, as well as in wild deer in Illinois, New Mexico, South Dakota, Wisconsin and Saskatchewan.**

The disease also has been diagnosed in commercial game farms in Colorado, Nebraska, South Dakota, Minnesota, Montana, Oklahoma, Kansas, Wisconsin, Saskatchewan and Alberta.

© Chronic Wasting Disease Alliance

<http://www.cwd-info.org/index.php/fuseaction/about.main>

Greater Yellowstone's Bison: Brucellosis and the Unraveling of an Early American Wildlife Conservation Achievement

The Greater Yellowstone region's bison-brucellosis controversy has triggered troublesome proposals giving federal and state agriculture agencies jurisdiction over wildlife to eradicate a domestic livestock disease. Many of the region's bison (*Bos bison*) and elk (*Cervus elaphus*) carry the bacterium *Brucella abortus*, which can cause brucellosis. Local livestock officials fear bison and elk could transmit brucellosis to domestic livestock, jeopardizing state brucellosis class-free status. However, no cases of such transmission in an open range setting have been verified scientifically. Various federal and state agencies have jurisdiction over the region's wildlife and livestock; these agencies are having real difficulty reaching consensus on how to address brucellosis in the wildlife populations. Montana and Idaho recently vested livestock officials with jurisdiction over bison leaving Yellowstone National Park (YNP), and the U.S. Department of Agriculture's Animal, Plant and Health Inspection Service (APHIS) has indicated it may propose regulations asserting jurisdiction over bison. An interim bison management plan, the result of a recent court settlement, provides for the National Park Service (NPS) to participate in capturing, testing, and slaughtering Yellowstone's bison, but makes no provision for addressing brucellosis in elk. The region's brucellosis problem could be adequately addressed through a risk management disease control policy rather than a costly and perhaps fruitless eradication effort. Such an approach can be implemented without the unwelcome precedent of livestock officials taking jurisdiction over wildlife.

Abstract from: Keiter, R. B. 1997. Greater Yellowstone's Bison: The Unraveling of an Early American Wildlife Conservation Achievement, *Journal of Wildlife Management* 61 (1): 1-11.

The New York Times April 19, 2002

Farm Bill Could Mean Killing of Sick Bison in Yellowstone

National Park Service officials and environmentalists say a provision in the farm bill could lead to the slaughter of bison and elk in Yellowstone and other national parks. The provision, the Animal Health Protection Act, was added to the bill in the Senate by Senator Tom Harkin, Democrat of Iowa, to consolidate and broaden the Department of Agriculture's authority to manage animal disease. The purpose was to make it easier for agricultural officials to respond to livestock diseases like mad cow and foot-and-mouth and to counter possible food contamination by terrorists.

The contention comes down to the word "animal" in the definition of the "pests" that would be subject to the department's new authority. That addition, critics say, would give that department control over any animals that threaten livestock. Among those that could be affected, the critics say, would be elk and bison in Yellowstone, which have brucellosis in large numbers. Ranchers in Montana and Wyoming fear that the disease could be passed on to their cattle. The Interior Department, which oversees national parks and has authority over wildlife, has opposed efforts to kill infected elk and bison under a philosophy that nature should be allowed to take its course. Even though there have been no documented cases of brucellosis transmission to domestic cows in the wild, Montana has a zero-tolerance policy and shoots any buffalo that leave Yellowstone.

"For 60 years, the state veterinarians and Department of Agriculture have wanted to come into the park, round up elk and bison, test them and slaughter the ones that have brucellosis," the chief scientist at Yellowstone, John Varley, said. "My guess is that would be their first priority." A spokeswoman for the Agriculture Department said the bill was not intended to grant the agency authority over other jurisdictions. "Any action we would take that involves another government agency, we would consult with them very closely," the spokeswoman, Alisa Harrison, said. "We work closely with the National Park Service."

A spokesman for Mr. Harkin's office said the language in a small but critical section of the bill that transferred authority was an oversight. "It wasn't Senator Harkin's intent to infringe on the Department of Interior's jurisdiction," the spokesman, Seth Boffeli, said. "We are working with wildlife groups and are hopeful a compromise can be reached." **Based on past studies of the 3,000 or so bison in Yellowstone, Mr. Varley said, up to 80 percent of the animals could test positive for brucellosis and could, under the proposed legislation, be shipped to slaughter.** Yellowstone bison are descendants of the few animals that survived the slaughter in the late 19th century. They are the last free-roaming herd in the West. Steve Torbit, senior scientist for the National Wildlife Federation in Denver and a former wildlife biologist for Colorado and Wyoming and the United States Fish and Wildlife Service, said the proposed legislation would also usurp a state's authority to manage its own wildlife. "It would," Mr. Torbit said, "give authority to kill wildlife to a single special interest, the livestock industry."

www.nytimes.com

“Based on past studies of the 3,000 or so bison in Yellowstone, Mr. Varley said, up to 80 percent of the animals could test positive for brucellosis and could, under the proposed legislation, be shipped to slaughter.”



Wood Bison National Park and Disease

The presence of reportable cattle diseases in bison in the Greater Wood Buffalo National Park area is the most difficult issue facing management and recovery of wood bison in Alberta, Canada. There are three prevalent diseases that affect the bison populations, particularly those in and around Wood Buffalo National Park: bovine tuberculosis, bovine brucellosis, and anthrax.

Bovine tuberculosis and brucellosis occur only in bison in and around Wood Buffalo National Park. Infected herds within the Park appear to be negatively impacted by the presence of the two cattle diseases (Joly and Messier 2001). In addition to being a concern for recovery of healthy wood bison herds in wild populations, these diseases are of concern to the commercial bison and cattle industry. **One estimate of the economic consequences of an outbreak in cattle in Canada reported a potential cumulative loss of \$1 billion** over a 20-year period (FEARO 1990).

Mycobacterium bovis and *Brucella abortus* are the causative agents of bovine tuberculosis and bovine brucellosis, respectively. The role of the diseases in the population ecology of free-ranging bison is the subject of current research programs in Wood Buffalo National Park (Joly and Messier 2001) and Yellowstone National Park (National Parks Service 1999). The course of each disease is considered similar in bison and cattle (Tessaro 1989). The main clinical features of brucellosis are a high incidence (approximately 90%) of abortion during the first pregnancy, following infection the second pregnancy exhibits a 20% abortion rate, and subsequent pregnancies result in less than a 1% abortion rate because of naturally acquired immunity (Davis et al. 1991). The symptoms of the disease also include a low incidence of bursitis leading to arthritis and reduced joint mobility. Transmission occurs through contact with aborted fetuses and infected placentas (FEARO 1990).

Tuberculosis in bison and cattle is primarily a lung disease, although any organ system may be affected. Advanced tuberculosis is generally fatal and is transmitted through infected secretions and excretions (FEARO 1990). **Owing to the importance of brucellosis and tuberculosis as diseases communicable from animals to humans, they have been the subject of intensive, long-term eradication programs in livestock populations in Canada and the United States.** Bison in the Greater Wood Buffalo National Park area represent the last known reservoir of the diseases in Canada.

Aboriginal peoples in the Canadian northwest have a long tradition of association with bison, both having inhabited the region for millennia. Traditionally, these people hunted wood bison for food, clothing, and for use in spiritual ceremonies (Guthrie 1980, Bigstone Cree Nation and Metis People of Kituskeenow 1999). Because of the threatened status of wood bison and the cultural and spiritual significance of the animal, some aboriginal groups have voluntarily refrained from hunting bison. The First Nations have expressed a desire to hunt disease-free, free-ranging bison herds in the Caribou Lower Peace Region in the long-term. A management plan has not been developed to achieve this objective however. . . the objective was identified in the National Wood Bison Recovery Plan (Gates et al. 2001).

<http://www3.gov.ab.ca/srd/fw/status/reports/bison/lim.html>

“Owing to the importance of brucellosis and tuberculosis as diseases communicable from animals to humans, they have been the subject of intensive, long-term eradication programs in livestock populations in Canada and the United States.... One estimate of the economic consequences of an outbreak in cattle in Canada reported a potential cumulative loss of \$1 billion....”



Tuberculosis at the Wildlife / Human Interface

Michigan fights bovine TB- but not soon enough...

03/13/1998 JUSTIN HYDE Associated Press Writer

EAST LANSING, Mich. (AP) Concerned about the spread of disease to cattle, two Michigan state commissions approved measures meant to eradicate an outbreak of bovine tuberculosis among whitetail deer in parts of the Lower Peninsula. The state Agriculture Commission approved a ban Thursday on feeding deer in the area. The Natural Resources Commission prohibited baiting deer in the five affected counties and parts of six others. Under the bait ban, hunters could use bait only from Sept. 1 until the last day of the open deer-hunting season in the affected area. Farmers say the steps are needed - and might not be enough to stop the deer from spreading the disease to cattle. Some hunters consider the limits too severe.

``There's plenty of bitter medicine to go around," Bob Bender, the state's TB coordinator, told a joint meeting of the Natural Resources and Agriculture commissions Wednesday. ``We're not going to solve this problem overnight."... **The infection threatens the state's cattle industry, which has been certified as tuberculosis-free. Preliminary tests show that four cattle herds in the area might have been infected. If those tests are confirmed, the whole state would lose its certification for at least five years, and all cattle shipped out of Michigan would have to be tested....**

Just a few years later...

Department of Community Health Confirms Human Case of Bovine TB

Michigan Department of Community Health officials today announced that an elderly individual was **diagnosed with bovine Tuberculosis (TB)**, but died from unrelated causes in February. DNA fingerprinting conducted by the Department of Community Health laboratory has determined **the strain of Mycobacterium bovis found in the individual is the same found in cattle and deer in Northern Lower Michigan....**

Bovine tuberculosis is a serious bacterial disease that affects primarily the lungs and sometimes the digestive tract of livestock, deer and other wildlife," said Michigan Department of Community Health Director James K. Haveman, Jr. "Due to the fact that it is slow growing, it has taken some time to culture the bacterium and conduct the appropriate DNA testing." The individual lived in a rural area within the Northeast Lower Peninsula. The patient was not coughing and was not likely to transmit disease, Haveman said....

The Michigan Department of Community Health, in conjunction with the state's Bovine TB Eradication Project, continues to emphasize standard bovine TB prevention practices. Because the bacterium is most often found in lung tissues the disease is primarily spread through breathing or coughing but can also be spread by drinking unpasteurized milk or eating improperly cooked meats from infected animals.... All meats, including hunter-harvested deer, should be thoroughly cooked to an internal temperature of 165 degrees F for 15 seconds to kill bacteria. If the lungs, ribcage or internal organs from wild deer look abnormal (multiple tan or yellow lumps), the meat should not be eaten and the deer should be taken to a Michigan Department of Natural Resources check station....

Since bovine TB was re-discovered in Michigan in the mid-1990's, the state has moved aggressively to develop and implement a comprehensive and stringent TB testing strategy and protocol. Since 1995 more than 760,000 TB tests have been conducted on Michigan cattle, bison and goats and 16,500 privately owned cervids have been tested or are under a herd surveillance plan. In 1997, one privately owned cervid herd was identified with TB and was depopulated. **To date, 19 cattle herds have been diagnosed with bovine TB. Two dairy herds are under plans that remove animals responding to TB skin tests, and 17 beef herds have been depopulated.**

In addition, over 88,373 TB tests have been conducted on wild white-tailed deer and elk, with 397 deer and two elk confirmed with the disease. Carnivore tests for 2001 revealed two TB positive coyotes, two bobcats and three probe-positive bear, bringing the total number of carnivores that have tested positive for bovine TB to 30.

www.bovinetb.com

The 'livestock / wildlife' interface is not just terrestrial. *Aquaculture presents a similar set of challenges in the developed and developing world.*

A North American Perspective on Salmon Farming: Few Benefits and Many Risks?

"In the 1970s and early 1980s, shrimp and salmon farming were small-scale industries that appeared to be more of a solution than a problem for protection of marine resources. The increasingly large scale of these industries, combined with other human activities, now places substantial demands on ocean ecosystems, which in turn result in the demise of fisheries and biological diversity. These ecological impacts are not reflected in either local or international prices for aquaculture inputs or outputs. So long as the full environmental costs of feed and stock inputs, effluent assimilation, and coastal land conversion are not recognized in the market, ocean resources - including fisheries - will deteriorate further."

Rosamund Naylor, et. al., Science, Vol. 282, October 1998.

- Disease is very prevalent in the crowded netcages of farmed salmon. Epidemics in wild fish stocks could be transmitted by fish farm wastes and escaped farm fish. Millions of tax dollars have been spent, fish destroyed and many rivers poisoned in unsuccessful attempts to eradicate diseases that have decimated native salmon stocks from Canada to Europe.
- In an attempt to control disease and parasites among farmed salmon, powerful antibiotics and other drugs are dumped directly into open netcages. Salmon aquaculture uses more antibiotic per pound of "livestock" than any other form of farming. This largely unregulated use of antibiotics - the same drugs used to treat human infections - has already led to the development of drug-resistant "super-bugs." This poses grave risks not only to the wider marine ecosystem, but also to fish farm workers and to consumers of farmed salmon who may be affected by antibiotic-resistant bacteria.
- Over a million Atlantic salmon have escaped in British Columbia's waters. DNA tests have confirmed they are now reproducing in the wild - something salmon farmers and government officials said could never happen. As well as spreading disease, these exotic species may threaten some Pacific stocks by competing for food and breeding space.
- Every day British Columbia's aquaculture industry dumps the same amount of raw sewage into the ocean as a city of half a million people. High concentrations of fish waste and drugs, along with drug-resistant microbes, pass through netcages to settle and destroy life on the ocean floor, contaminating shellfish beds and other habitats while spreading disease up the food chain.
- Farmed salmon represent a 'net loss' of protein worldwide. Three to five kilograms of other fish are used to make the feed to produce every kilogram of farmed salmon.
- Marine life, like whales, seals, sea lions and birds, are killed by net entanglements and by salmon farmers using guns and acoustic deterrent devices to protect their stock.

http://www.davidsuzuki.org/Salmon_Aquaculture/Benefits_and_Risks/

Shrimp Aquaculture May Be Fishing for Trouble

Environmental News Service

By Cat Lazaroff

SAN FRANCISCO, California, February 21, 2001 (ENS) - New studies released this week reveal that farmed fish and shellfish, which form a growing percentage of the seafood consumed around the globe, may pose unexpected risks to wild species, as well as to the environments in which they are raised. At the American Association for the Advancement of Science (AAAS) meeting in San Francisco this week, an international group of scientists presented new findings on the unintended impacts of fish farming that put both oceans and the aquaculture industry at risk. Aquaculture, the fastest growing sector of the world food economy, is increasing by 11 percent a year.... "A lot of countries could use more protein, and aquaculture is a good way to get there," said Rosamond Naylor, an economist at the Stanford Institute for International Studies. The problem, Naylor pointed out, is that farmed salmon, shrimp and other carnivorous species often take more out of the oceans than they keep in. At the AAAS meetings, a panel of seven international scientists presented data showing that aquaculture is necessary to the world's future food security. But they also warned that the growing demands of the world's food production systems upon a finite quantity of resources means that all aquatic and terrestrial farming systems must become more efficient.

Shrimp farming now produces half of all internationally traded shrimp. Raising 800,000 metric tonnes world wide each year, for a total value of U.S. \$6 billion, the industry was predicted to generate benefits for cash strapped countries. **Instead, disease-induced "boom and bust" shrimp farming has resulted in increasing poverty and landlessness, declining food security, and the breakdown of traditional livelihood systems.** Impacts have included the destruction of mangroves and wetlands, the large scale capture of wild larvae and brood stock, pollution, use of chemicals and antibiotics, intensive fish meal demands and the privatization of public resources. Fish farms can have negative impacts on surrounding ecosystems as well. Nils Kautsky from the University of Stockholm in Sweden demonstrated how fish farms can affect surrounding areas by discarding excess fishmeal, transferring parasites to wild populations and introducing exotic fish into native ecosystems. **Kautsky showed that the so called footprint of a farm - its influence on the local environment - can be up to 50,000 times larger than the physical farm itself.**

"There are now identifiable ways to improve shrimp aquaculture," said Stanford's Dr. Naylor, who chaired the AAAS session. These may include reducing food input and developing closed water systems that prevent waste and parasites from escaping. "Aquaculture is at a critical crossroads," said Dr. Albert Tacon, head of the Oceanic Institute's Aquatic Feeds and Nutrition Program in Hawaii. "Fish farming could decrease pressure on fisheries and feed the world's growing population. That's why it is so important to proceed on a sustainable path." More information on sustainable fisheries is available at: <http://www.fao.org/fi/default.asp> . More information on health risks from wild fish is available at: <http://ens.lycos.com/ens/feb2001/2001L-02-20-06.html> .

Applying the Lessons Learned at Home to Foreign Assistance Programs:

Development agencies can promote *health* as “the ultimate ecosystem service,” an indicator of development initiatives that *a priori* acknowledge that their sustained success depends on environmental stability. If we are to successfully reconcile the needs of people with the challenges of saving wild species and natural spaces in an increasingly human-dominated world, we must develop a keen understanding of how disease interactions influence human, domestic animal, and wildlife health. Although we often hear media reports about the transmission of wildlife diseases to people, the reverse has received little attention while devastating wildlife populations. Improving the health of people and their domestic animals is not only key to raising living standards and enhancing food security, it is the single most effective way to reduce the incidence of disease transmission to highly susceptible wildlife populations. Qualified human and animal health experts should ideally be involved at all levels of development and conservation project planning, implementation, and monitoring to ensure that people, domestic animals, wildlife, and the environment are not negatively affected by new activities. To that end, the Wildlife Conservation Society is working towards integrating the health sciences into its landscape-based conservation approach. What follows are snapshots of key landscapes around the world that WCS feels are true “wildlife health hotspots,” places where investments at the livestock / wildlife interface are likely to pay significant development as well as conservation dividends.

Wildlife Health Hotspots- a WCS perspective:

The Wildlife Conservation Society’s portfolio of animal and human health-related projects spans the globe, and has clearly identified common problems that nevertheless merit context-specific solutions. Demand for a “one health” perspective continues to grow, as socioeconomic progress demands sustained improvements in health for humans, their domestic animals, and the environment.

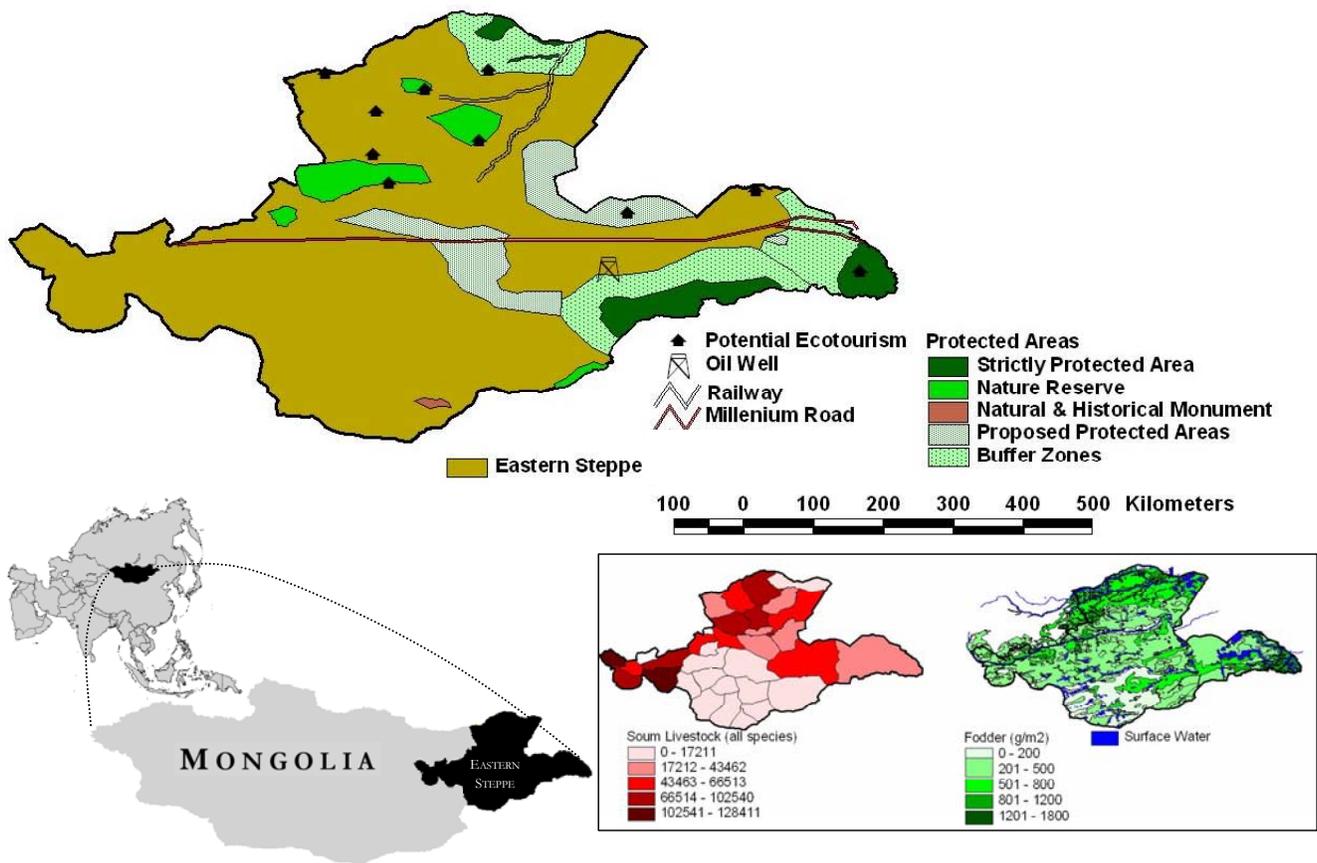


Where is the nexus of conservation, development, and health most obvious? While scenarios vary across the globe, themes emerge that guide our ‘diagnostic’ as well as ‘therapeutic’ approaches. The following landscape-based portraits illustrate the value of a truly multidisciplinary approach that includes the health sciences.

Mongolia's Eastern Steppe

Roughly the size of the state of Oregon, the approximately 250,000 km² Eastern Steppe landscape of Mongolia is perhaps the planet's last and largest example of an essentially intact temperate grassland ecosystem. It is home to *Asia's largest remaining population of wild ungulate*, with the Mongolian gazelle migrating almost unhindered in numbers approaching one million or more. The Eastern Steppe landscape provides breathtakingly vast wilderness scenes with equally amazing wildlife populations and numbers. Lack of surface water has kept human and livestock populations relatively low, with the result that one can travel for kilometer after kilometer through lush rangelands that have not been degraded, rangelands without fences, buildings, or herds of livestock except at long intervals.

The steppe is of international importance, a Global 200 ecoregion, and stands in stark contrast to the degraded habitats in neighboring Russia and China. At the same time, only 1 % of Mongolia is considered arable land, while about 34 % of Mongolia's people are directly dependent on livestock production, with another 26% indirectly so. These figures are probably substantially higher within the Eastern Steppe area. Clearly, conservation plans must integrate



Top: Protected areas and infrastructure in the Eastern Steppe. **Lower right:** total livestock numbers in each *soum* in 2001 and rangeland resources in the Eastern Steppe; **Lower left:** location of the Eastern Steppe in Mongolia and Asia

the social and economic needs of the approximately 300,000 people who inhabit the Eastern Steppe and depend on its resources for their survival. Closure of factories has left subsistence herders without a market for the wool, hides and other products they glean from their livestock. Overgrazing, particularly around county (*soum*) centers, human-caused fires, and limited access to water for livestock further imperil traditional livelihoods. The success of a conservation strategy for the steppe will be determined in part by its ability to foster a multi-use landscape in which traditional nomadic pastoralists can preserve their lifestyle. The reality is that impoverished inhabitants of this remote area are in search of ways to improve their standards of living, with exploitation of natural resources such as oil and coal providing one obvious route. Road building, financed largely by nearby Chinese interests, threatens to fragment the Eastern Steppe (and thus essential gazelle migrations), without consideration of irreversible environmental impacts.

The Mongolian gazelle is the flagship species of the steppe: they define the ecosystem by their numbers and extensive migrations. With an estimated one million or more gazelles persisting, the sight of migrating herds remains the greatest Asian wildlife spectacle left in what is essentially *Asia's Serengeti*. The gazelles and the ecology of the steppe are wholly linked, interdependent: a conservation plan for one must involve the other. Because gazelles travel so extensively, reserves by themselves are not enough for this species: the whole landscape has to be managed in an environmentally sound way. Other large mammals on the steppe include wolves and Corsac foxes, and there are many birds- some of them rare, such as the great bustard, swan goose, and several crane species. Mongolia and the world are fortunate that the steppe still persists relatively undamaged.



W. B. Karesh, D.V.M.

Economic development scenarios include the leasing or privatization of rangelands to increase livestock and fodder production. This would be predicted to lead to the drilling of wells every few square kilometers, fencing-in of properties to keep one's livestock in and others' out, a sedentary lifestyle, many new roads, and so forth. From what we already know about the ecology of the steppe, the guaranteed result would be the cessation of gazelle migrations and a crash in the population, as well as serious overgrazing of the rangelands as livestock could not be shifted elsewhere on the open range. This has already been observed nearby in China. The effects of fencing prairies and the subsequent impacts of livestock on habitat and on wildlife have been well illustrated in the American west.

Foot and mouth disease and other pathogens are endemic in livestock on the steppe. Danger exists that such diseases could be transmitted to gazelles with catastrophic results to the population, and recent evidence points to at least exposure of some gazelles to the foot and mouth disease virus. Already gazelle have been blamed for spreading foot and mouth, and some officials have even called for the elimination of the large herds, but this would be extremely counter-productive. There is no question that sound science needs to be brought to bear to

elucidate potential disease relationships between livestock and gazelles. Without science-based livestock and wildlife health policies and programs, outbreaks are certain to happen and plans must be in place to reduce their impacts on all sectors and to pinpoint underlying factors contributing to health problems. Interestingly, preliminary gazelle research has identified pathological changes in microscopically examined tissues that are compatible with exposure to radiation. This could be due to grassland contamination from open pit uranium mining: more thorough analysis needs to be conducted to identify areas that may be unsafe for livestock grazing or gazelle harvesting- in the interest of animal as well as human health. In short, with disease an ever-present danger to gazelles and livestock (several epidemics having occurred in the past decade), it is essential that a health monitoring program be initiated. Timely measures can prevent widespread animal death, and only good epidemiological monitoring of sentinel species like gazelles can help determine the factors contributing to disease outbreaks or other ecological disturbances- including those with potential ramifications for people.

As in southern Africa, for example, well-managed sustainable use of the steppe's resources could tip the scales in favor of conservation. Gazelles could be an important economic resource for the government and local people *if properly managed*. An economically and biologically viable gazelle harvesting program is currently of interest to the Mongolian authorities, and the success of such an initiative will depend on: a) reducing the size of the ongoing illegal off-take by increasing anti-poaching efforts; b) training local teams in the proper way to harvest



gazelle and hygienically process the carcasses so that they can find a ready market; c) developing a strategy for disease eradication / control that meets international food safety and animal health code (Office International des Epizooties) standards to allow for expanded market options; d) establishing a marketing program for high-value (“luxury”) gazelle meat in Europe, Japan and elsewhere; e) establishing a tannery for gazelle hides and handicraft centers to make leather products for sale to tourists (at present the hides are discarded); and f) working with the government to design and implement the proper policies and procedures for all aspects of a sustainable (consumptive and non-consumptive) gazelle use program. Transboundary natural resource management among Mongolia, China, and Russia remains a challenge. Given the similarity in terms of the threat of diseases like foot and mouth here to the situation in transboundary landscapes of southern Africa (see ahead), an interesting opportunity exists to cross-pollinate conservation and development interventions in Mongolia with expertise from southern Africa, given the latter region's significant experience with trans-frontier wildlife and animal health management. W. B. Karesh, D.V.M.

It is not too late for Mongolia to learn from mistakes made elsewhere so that development here does not spoil the natural wealth these grasslands represent. Given that so many people here support themselves by keeping livestock, and that diseases such as tuberculosis, brucellosis, foot and mouth disease, and Johnes remain serious problems for animals and humans (directly and/or indirectly), this biologically unique landscape is indeed a *Wildlife Health Hotspot*.

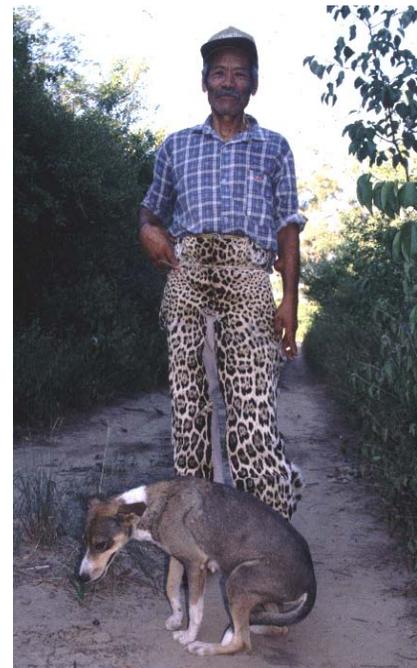
Bolivia

Bolivia is a land of incredible contrasts and extraordinary biological diversity. From stark, snow-covered Andean peaks to tropical Amazonian forest, moist cloud forest to tropical dry forests and savannas, Bolivia harbors an amazing array of environments for its equally amazing wildlife. The Northwestern Bolivian Andes Landscape is considered a Global 200 Ecoregion, and is believed to contain a stunning 10% of the world's bird species. The Gran Chaco, stretching across southeastern Bolivia and neighboring countries, is the largest tropical dry forest in the world, and encompasses pampa, forest, and wetland habitats that are home to numerous endemic species. Despite the range of habitats in this country, however, the threats to its wildlife are surprisingly similar. Expanding human population and invasion of wildlife habitat by humans and their domestic animals (and their pathogens), wildfires from agriculture, uncontrolled tourism development, unsustainable land use, selective logging, overhunting, overgrazing by livestock, and livestock/wildlife conflicts all contribute to habitat degradation and wildlife depletion.

The Northwestern Bolivian Andes includes Madidi National Park and Integrated Management Area, a 40,000 km² region acknowledged as **the most biologically diverse park in the world** – over 1,000 of the world's 9,000 species of birds are estimated to occur in the area, with 880 already confirmed, and preliminary surveys have shown high diversity in mammals (more than 200 species expected and 170 confirmed), reptiles, amphibians, fish, butterflies, orchids, palms, and other flowering plants. This landscape also holds a very high number of endemic (30% of all flowering plants) and threatened species. The area contains charismatic animals such as the spectacled bear, Andean condor, white-lipped peccary, jaguar, vicuña and surubí catfish – all landscape species that are vital to the maintenance of the ecological integrity of the region while also representing economic opportunities and/or threats to the people of the landscape.

The Gran Chaco, although it receives less attention, represents an even more endangered habitat. Kaa-Iya del Gran Chaco National Park and Integrated Management Area, a 34,000 km² region, is a newly (1995) established protected region. Although large, it represents less than 25% of the Bolivian Chaco. Three groups of indigenous people live in the Chaco: the Izoceño-Guaraní, Chiquitanos, and Ayoreos. Because many of these people survive through subsistence hunting and agriculture, the future of this landscape depends on sustainable use and resource extraction.

Large mammals such as jaguars, pumas, giant anteaters, brocket deer, tapirs, giant armadillos, and peccaries call this landscape home, as do a tremendous number and variety of small armadillos. The critically endangered Chacoan guanaco, of which there may be as few as 50 individuals, occurs here, as does the giant Chacoan peccary, perhaps the Chaco's most famous endemic mammal. Many



W. B. Karesh, D.V.M.

migratory birds, an endemic toad, red and black tegu lizards, caiman, and red-footed tortoises are also found in this dry, somewhat forbidding environment.

Infrastructure development and pollution associated with petroleum exploration and exploitation are present and imminent threats to the lowland portion of the landscape, directly affecting the Tuichi, Hondo and Quiquibey valleys in the Madidi and Pilon Lajas protected areas and the northern third of Kaa-Iya National Park. Though plans for the Bala Dam now seem less likely to be implemented, there remain several proposed road construction projects that would facilitate spontaneous and directed colonization of the lowlands as well as allow for the spread and introduction of livestock and wildlife diseases into previously unexposed populations. Foot and mouth disease

(FMD) is present in domestic livestock in Bolivia and the movement of cattle poses a serious threat of infecting native wildlife populations and making needed eradication programs more complicated and expensive. Significant gold mining in the

Infectious Disease	Affects Wildlife	Affects Domestic Animals	Affects Humans Directly	Affects Human Livelihoods Indirectly
Brucellosis	X	X	X	X
Canine Parvovirus	X	X		
Chagas	X	X	X	
Distemper	X	X		
Foot and Mouth Disease	X	X		X
Leishmania	X		X	
Leptospirosis	X	X	X	
Rabies	X	X	X	X
Scabies	X	X	X	
Toxoplasmosis	X	X	X	

highlands, along with urban source pollution, also pose a significant threat to aquatic systems due to habitat destruction and contamination with toxic minerals and heavy metals. Population resettlement is a major concern for the Madidi area. Recent political and social developments in the country have increased the pressure on the Bolivian government to support colonization of lowland areas such as the northern Ixiamas area. This largely unregulated increase in smallholder land-clearing will have major adverse effects on pristine lowland forests. Colonization outside of the Chaco may still have an impact there if the watershed is affected.

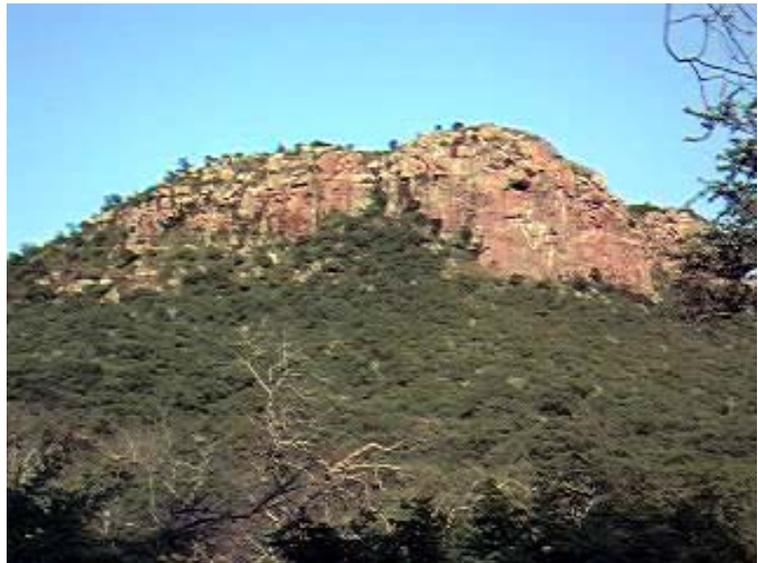
Forest clearing for agriculture, and savanna degradation as a result of overstocking of domestic livestock, are both serious problems in the Madidi and Chaco landscapes. Well noted in developed countries, overstocking leads not only to degraded habitats, but significantly increases the risk of infectious disease outbreaks and spread. An increase in mechanized agriculture in the Chaco is driving the conversion of forest at a very rapid rate. Irrigation for crops and livestock may also divert water from the main source of the principal river of the area, thus negatively impacting the wetland habitats and the subsistence agricultural practices of the Izoceños.

The threat of transmission of disease from domestic animals to wildlife is often underestimated, but may represent a serious problem for mammalian biodiversity in this landscape. Both livestock and pets can be a source of disease for susceptible wildlife species, and with so many threatened ungulates and carnivores in Bolivia, an epidemic could be catastrophic. The presence of foot and mouth disease (FMD) in Bolivian cattle is just one of the more obvious threats to people's livelihoods. In addition, many of the disease agents that affect

domestic carnivores, livestock, and wildlife are zoonotic (transmissible between animals and people).

Rabies, trypanosomiasis, leishmaniasis, and toxoplasmosis are examples of common diseases that cause fatalities in humans and animals in Bolivia. Maintaining healthy human communities and healthy ecosystems requires an integrated approach. A narrow view to health, one that pays attention only to human disease issues or only to wildlife disease issues is doomed to failure. On the other hand, community-based conservation will only work if the people in the community are motivated to protect their environment—and given the knowledge and simple tools to protect their own health and that of their domestic animals and the wildlife on which they depend for food security and ecosystem maintenance.

The connections among wildlife health, livestock health, and human well-being are intimate and complex. In a region like the Chaco, where the indigenous people survive largely through subsistence hunting, the health of their prey populations is, at the simplest level, critical for food security. Obviously if game species are diseased and humans are eating them, disease transmission is possible. The situation in Central Africa with Ebola virus is a tragic example of this. Initial surveys in Bolivia have found more than half of the brocket deer tested and roughly



one-fourth of peccaries had previously been infected with the bacteria W. B. Karesh, D.V.M. causing leptospirosis, a disease which can lead to fetal death, infertility, kidney problems, fever and sometimes death in all mammals, including humans. It is not only an individual diseased animal that is the problem, however -- if the game animal population declines, the people may have a difficult time meeting their protein requirements. Disease presence and effects on wildlife must be determined in order to accurately calculate sustainable harvesting rates. Additionally, because domestic dogs participate extensively in human hunting activities, their health matters too. Sick hunting dogs can both introduce disease into wildlife populations, and bring disease from wildlife to their human handlers and other villagers.

Zoonotic diseases abound in Bolivia, as wildlife and domestic carnivore surveys have shown. Chagas' disease, caused by *Trypanosoma cruzi*, is a serious problem in Bolivia, especially in the southeast. Fifty percent of dogs tested for antibodies to this organism are positive, indicating that domestic dogs may serve as a reservoir for the infection, which is one of the most serious human health problems in Latin America, with damage to the heart often leading to death in infected people. Toxoplasmosis is another zoonotic parasite, and 83% of cats and 37% of dogs in the Chaco have antibodies to the causative agent, and 92% of cats and 62% of dogs in Madidi have antibodies. Toxoplasmosis is a problem especially among children, so this high prevalence is a concern. Scabies, a highly contagious disease caused by the sarcoptic

mange mite, is another condition that affects children. In one small town on the border of Madidi National Park, every dog tested was found to be infected.

Preliminary research in the Chaco and Madidi has shown that 95% of domestic dogs have been exposed to canine distemper virus and canine parvovirus. Other serious pathogens are present in the dog population as well, such as canine herpesvirus, and the causative agents of toxoplasmosis and sarcoptic mange. Nearly one hundred percent of domestic cats have been exposed to feline calicivirus. More disturbing is the fact that antibodies to canine distemper, canine parvovirus, feline calicivirus, and toxoplasmosis have been found in ocelots, Geoffroy's cats, pampas foxes, and crab-eating foxes in the Chaco. In addition, several dead pampas foxes, and one living fox have been found with evidence of sarcoptic mange. Foxes and small felids are routinely found in villages, where dogs are extremely common, and in the Izoceño communities, where dogs are almost always used during subsistence hunting activities. This means that ample opportunities exist for contact between dogs and wildlife. While dogs in the Madidi area are often vaccinated against rabies, the Izoceños have no access to veterinary care in their communities, and neither group of dogs is vaccinated against common canine pathogens.



S. L. Deem, D.V.M., Ph.D.

Attempts to mitigate the threats outlined above are severely hampered by the persistence of a number of indirect factors that drive or facilitate the unsustainable use of natural resources. Abating these indirect threats is no less important than tackling the direct threats, because by doing so the underlying causes of unsustainable use or ineffective resource management will be removed. Indirect threats include: a lack of baseline biological and extractive-use information relevant to natural resource management across the landscape; weak national capacity for biodiversity research; a dearth of trained professionals conducting sustainable natural resource programs at the national, regional and local levels; inadequate communication among local, regional and national stakeholders; and limited capacity of local government and the protected area administration to design and implement resource management activities. Combined, these threats result in a lack of coherent regional and local land-use planning, and failure to address important biogeophysical, social and economic linkages across Bolivia. A related and important threat is a paucity of income-generating options that do not rely on the direct exploitation or extraction of wild resources, a situation that perpetuates unsustainable resource-use practices.

Argentina

Patagonia was once the domain of the Tehuelches, a nomadic hunter-gatherer people whose livelihood depended largely on the huge herds of guanacos and choiques (lesser rheas) that occupied the arid steppes and scrubland of this vast landscape. Since the “Conquista del Desierto” (Conquest of the Desert campaign) in the late 1800’s, this culture and the faunal assemblage on which it relied have to a large extent been replaced in the last one hundred years by European customs and European species. The dominant fauna of most Patagonian landscapes in the 21st century are now sheep, cows, goats, or European red deer, rather than guanacos, choiques (rheas), and huemuls (Andean deer). European hares are ubiquitous, and the native ecological equivalents- Patagonian maras and mountain vizcachas- are in severe decline. Native carnivores, including some of the rarest in the world such as the Andean cat, prey almost exclusively on introduced European species, while native herbivores are present at such low densities that they no longer play a significant role in their native ecosystems, and are thus considered ecologically extinct throughout large areas.

Conversion of the Patagonian Steppe to subsidized agricultural use, namely overgrazing by domestic sheep, has resulted in destruction of the native grasslands and more recently, the bankruptcy and abandonment of many farms in the region. Economic incentives for unsustainable agricultural development focused on maximizing short-term production and profits, steering efforts away from more natural, lower impact production systems utilizing the mammals and birds evolutionarily adapted to the native habitats. The future of Patagonia needs



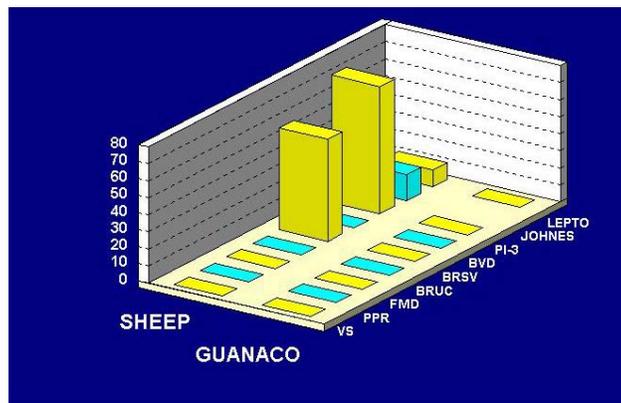
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a fresh look, one in which the unique Patagonian wild species and their ecosystems are valued, restored, and preserved, and land and natural resources are shared among the descendants of the Tehuelches, other indigenous groups, and European settlers. What is needed is a mosaic of land use in Patagonia that includes a series of protected areas with functioning assemblages of native wildlife, as in the days when the Tehuelches were the sole human inhabitants. The matrix in which these protected areas are embedded would include lands under varying intensities of human use, ranging from towns and cities where native wildlife is absent, to ranches or indigenous areas managed for the co-existence of native wildlife and livestock production or other economic activities. These different land uses would be distributed in such a way as to allow for a high degree of connectivity or permeability of the matrix for wildlife, ensuring that the protected areas do not become island refuges for isolated wildlife populations. Historical accounts indicate that the Tehuelches may have migrated seasonally to follow their prey, and a system of protected areas could provide the opportunity for the animals to migrate once again between the Andes and the coast.

The major threat to native wildlife and their habitats in Patagonia is overgrazing by livestock and other introduced herbivores. Grazing has resulted in severe desertification of approximately 30% of the steppe. Even sheep husbandry has declined in recent decades because large expanses of degraded land can no longer support the number of sheep they once did. Livestock and other domestic animals serve as sources of diseases that can have severe adverse effects on wildlife. The degree of this threat has not been thoroughly evaluated here, although preliminary studies have shown that domestic sheep and cattle carry a number of infectious diseases such as brucellosis, paratuberculosis, and a suite of respiratory and other viruses that have the potential to negatively impact wild ungulate populations, as they have in North America. In addition, some of these infectious agents can infect humans. While current research is lacking, it is also likely that ranchers' domestic dogs and cats harbor diseases to which native wild carnivores have no immunity. Human activities have disturbed habitats in the highlands and have reduced native predators, contributing to aberrant fluctuations in rodent populations and associated outbreaks of hantavirus infection- killing people and damaging efforts to develop ecotourism-based alternative revenue streams.

Guanaco, the Wild Camels of the New World

Guanaco are new-world camelids that currently range throughout much of southern Argentina and Chile. The dry grasslands and scrub, where the largest populations are found in southern Argentina, have been heavily utilized for sheep ranching for over a century. Sheep and guanaco are still commonly found on the same ranches and “protected areas.” Local lore in Patagonia holds that guanaco serve as the source of diseases for sheep and they are thus heavily hunted by ranchers. Field studies by WCS showed for the first time that some populations of free-ranging guanaco are, in fact, relatively disease-free, but are themselves susceptible to common diseases of domestic livestock (cattle, sheep, and horses). Infections such as brucellosis, paratuberculosis, and leptospirosis are common in sheep here, and pose a serious threat to the health of wild guanaco, and perhaps to native deer. Parasites of sheep may also be impacting guanaco sharing the same grazing areas. Alleviating poaching is not enough to save the guanaco: disease transmission from livestock must be reduced by managing interspecies contact and improving the health of domestic animals.



Infectious Disease Exposure- Preliminary Surveys

Another major threat to native herbivores, indigenous birds, and wild carnivores is intensive hunting. They are hunted commercially, for their skins or wool, to control predation on / competition with livestock, and for subsistence consumption. This widespread hunting is either

not managed at all, or is inadequately managed by most provincial wildlife agencies. Once again, human impacts on natural prey and the numbers of predators disrupt the fragile ecological balance in this harsh, dry environment and can lead to disease outbreaks and the emergence of diseases in species that have never been impacted by them before. In addition, oil exploration and drilling have destroyed and continue to destroy large areas of native habitat, serving as a source of pollution while also opening roads that provide increased access for hunters



M. M. Uhart, M.V.

Conservation in Patagonia largely depends on the will and initiative of large private landowners. Most public lands are occupied by small sheep or goat farmers, and are severely degraded. **Only about 1% of the steppe and scrub ecosystems are currently under strict protection.** If the current economic crisis in Argentina can be said to have a benefit, it may be



W. B. Karesh, D.V.M.

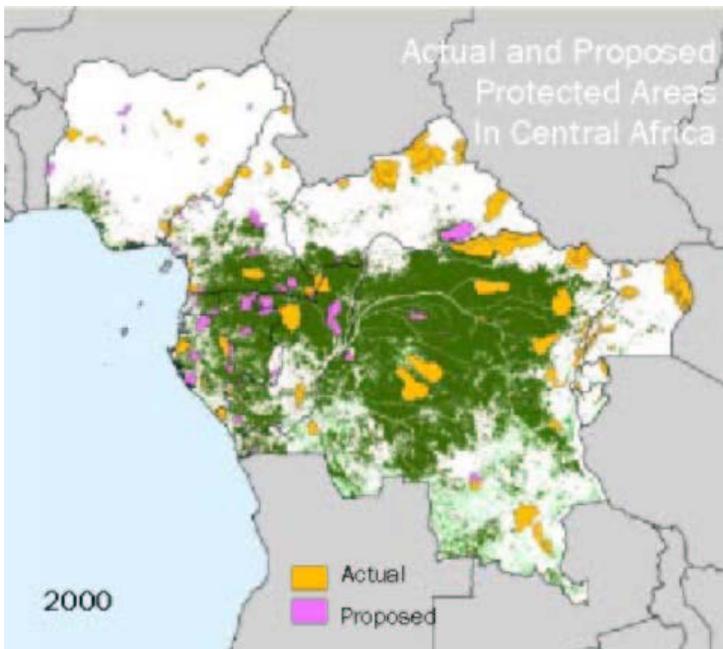
that landowners and the government are more motivated than ever to find alternative management systems to reduce costs and increase revenues and thus the value of their land. In Patagonia, wild and domestic animals and human livelihoods can clearly benefit from programs promoting better land-use zoning as well as improved livestock health to reduce the threats posed by disease.

The Congo Basin

Across all continents, the number of plant and animal species increases toward the equator, with tropical rainforests being the most biodiverse landscapes on the planet. A rainforest may contain over 300 tree species in a single hectare, 10 times that of the richest temperate forests. Covering close to 2,000,000 km², the equatorial forest of Central Africa is well recognized as one of the wildest and most diverse terrestrial ecosystems on earth. High biodiversity is complemented by an abundance of charismatic megafauna including forest elephants, gorillas, chimpanzees, leopard, buffalo and bongo antelopes, which contribute to the outstanding conservation value of these forests.



Central Africa contains the second largest area of contiguous moist tropical forest in the world. More than 60 million people live in the region, and these people depend on their rich forests and other biotic resources for their livelihoods and economic development. These forests form the catchment basin of the Congo River, a watershed of local, regional and global significance. They provide valuable ecological services by controlling and buffering climate at a



regional scale, and by absorbing and storing excess carbon dioxide released from the burning of fossil fuels, thereby helping to slow the rate of global warming. The livelihoods of people in the Central African forests are dependent on the continued future of this resource, not as a supplement to other sources of subsistence, but as the primary resource for the raising and gathering of food and other products, for clean water, and as a basis of their cultures.

Across the globe, a central component of successful conservation is effective management of networks of protected areas. In recognition of this fact, the recently formulated *Congo*

Basin Forest Partnership (CBFP)- a partnership comprised of 29 different entities including national

These forests support 50% of the plant and animal species in Africa, and the greatest diversity of primates on earth. Since disease knows no legal boundaries, health programs must span traditional geopolitical borders.

governments, a range of nongovernmental organizations, as well as business interests - has identified key protected areas and their buffer zones in 11 priority landscapes. The primary goals of the CBFP are *“protection, integrated development and land-use management to promote economic development, improved governance and natural resource conservation, through support for a network of national parks and protected areas, well-managed forestry concessions, and assistance to communities which depend upon the conservation of forest and wildlife resources”* <http://carpe.umd.edu/>.

Protection of these landscapes requires a combination of strong commitment and investment by host nations and the international community, collaboration among numerous stakeholders, intelligent land-use planning, and effective law enforcement. Linking biological and socioeconomic information is critical to developing appropriate management plans for these areas and also for monitoring the effectiveness of management strategies. Attention to the needs and impacts of local people is essential to working towards conservation and development success, and the Congo Basin serves as an obvious example of the importance of linkages between human and animal health.



A. M. Kilbourn, D.V.M.

Emergency Workshop in Brazzaville is first to develop a multidisciplinary approach to solving the continuing Ebola Virus crisis in Central Africa

A workshop was organized in March of 2003 to bring together regional government authorities, NGO's (both conservation and human medicine) and virology experts to address the current Ebola virus outbreak in northwest Congo. The workshop was sanctioned by the Congolese Ministry of Health and the Ministry of Forests, with additional participants from the Ministry of Agriculture. Experts and representatives from the Congo, DRC, and Gabon participated to provide insights from the previous outbreaks in those countries. Representatives from the U.S. Centers for Disease Control, the World Health Organization, Doctors without Borders, the Wildlife Conservation Society, and the World Wildlife Fund also participated. The workshop was organized by ECOFAC (a regional conservation initiative of the European Community and the Wildlife Conservation Society under the auspices of the Congolese government).

There are still significant knowledge gaps in understanding Ebola. The reservoir species for Ebola has not yet been identified, though this may change very soon based on samples collected over the last two months. The current evidence suggests that the Ebola virus is present over a wide range in equatorial Africa, and within sub-regions it has the property of spilling over from its reservoir (much like St. Louis encephalitis virus in North America, and rabies) into other species that are severely affected by the disease. Also, there is preliminary data correlating Ebola outbreaks with heavy rains following 2 years of drier than normal dry seasons.

- 1) The two lead Congolese ministers (Health and Forestry) opened and closed the workshop at public events which included local and international press. At these "ceremonies," their commitment to work collaboratively and invite external participation with the mutually reinforcing goals of protecting people and wildlife was clearly stated. This provides an essential framework of authority within which conservation efforts can legitimately help address health issues and formalizes the linkages among the disciplines that can contribute to the urgently needed actions.
- 2) Immediate needs agreed upon by all representatives at the workshop included:
 - (a) Community outreach programs among local villages to establish the linkages between conservation and health efforts. The virtual abandonment of rural communities over the last 10-20 years has resulted in isolation, mistrust, and few or no education or health care programs. The resulting lack of trust and hostilities at the local level has resulted in both the rejection of human health care efforts as well as disruption of all ongoing conservation activities whenever an Ebola outbreak occurs. Contact with villages must be established immediately and an assessment of their health and education needs must be performed as soon as possible to begin intervention programs to protect the health of people and of wildlife.
 - (b) Educational components used by conservation teams in Congo have already shown that disease risk education in villages can reduce primate hunting and consumption. This needs to be expanded into areas threatened by Ebola.
 - (c) Research needs to be supported in the area of current outbreak to understand the disease process, to help identify great ape populations at greatest risk, and to assess intervention strategies. Needs include 1) finding the reservoir and possible vectors; 2) delineating transmission rates and modes among gorillas; 3) mapping of other factors (fruiting trees, weather, etc.) to help identify correlations. Surviving gorillas in the center of the current outbreak will be examined to determine their exposure status and the extent of mortalities and survivorship of exposed great apes.
- 3) This meeting represented the first multidisciplinary experts forum to address Ebola and the relationships between human and wildlife health. In itself, this was a groundbreaking step, shifting from the old paradigm of competition for resources toward building the collaborative teams essential for tackling these complex issues of common concern.

As the human population rises exponentially, especially in rural areas, the risks posed by emerging diseases to wildlife, people and domestic animals are significant. In the Congo Basin, human population growth and poverty are forcing people to penetrate deeper into once pristine wilderness in search of animal protein and other natural resources. As a result, rare diseases such as Ebola are emerging with greater frequency. In addition, other easily preventable infections such as polio, measles and typhoid are still commonly seen. These diseases can spread among humans and primates. Common diseases of animals (such as salmonellosis, brucellosis, leptospirosis, and rabies) can infect humans but have drawn little attention. Equally little attention has been paid to the risk of domestic animals introducing diseases such as rinderpest, foot and mouth disease, or distemper into wildlife populations as programs to provide alternative protein sources are developed to reduce dependence on bushmeat.

As people and their domestic animals encroach on wildlife habitat, disease transmission has deleterious consequences for both human livelihoods and fragile wildlife populations. Besides the obvious toll from death itself, there are economic consequences—the loss of a wage earner, the loss of marketable livestock, or the loss of ecotourism dollars. Economic losses to those living in poverty affect their general health and nutrition, resulting in greater susceptibility to disease and thus an increase in disease transmission- establishing a vicious cycle of illness, suffering, and poverty.

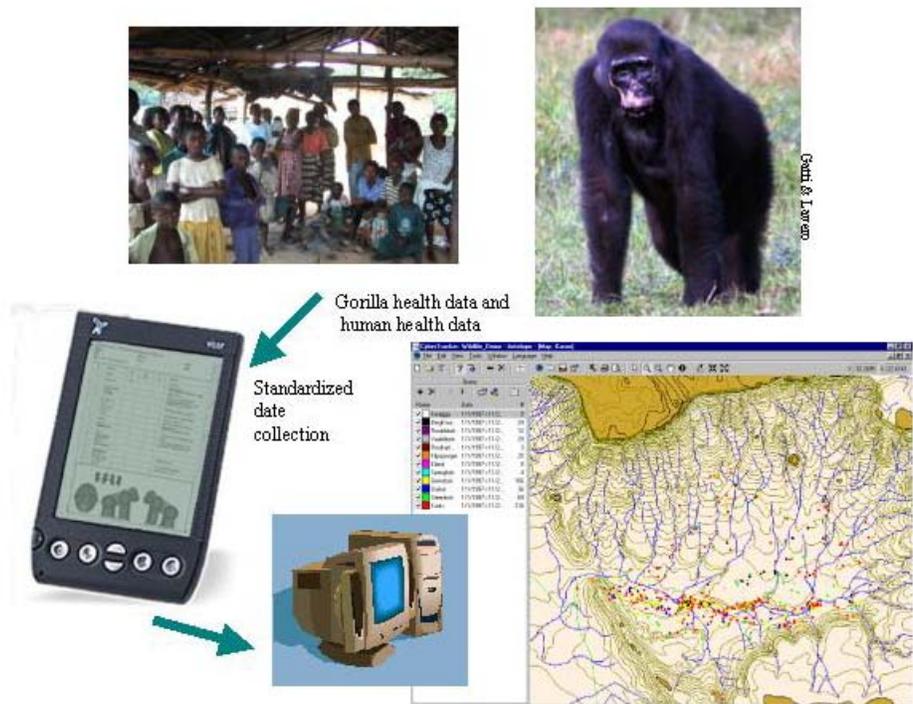
Even beyond the impacts of disease, wildlife populations can collapse from over-harvesting, degradation of wilderness habitats, and pollution. This can easily translate into problems of malnutrition, illness, and lost income. Usually those most at risk are the people who, by definition, live on the fringe of society, at the edge of wilderness areas, out of reach of even the most basic healthcare and sanitation systems.

By taking a holistic approach to health care and poverty alleviation, by bringing communities in as partners in wildlife management, by managing interspecies contact and by improving the health of people, domestic animals and wildlife, societies can improve their prospects for better health and economic opportunities.

Gorillas and Human Health

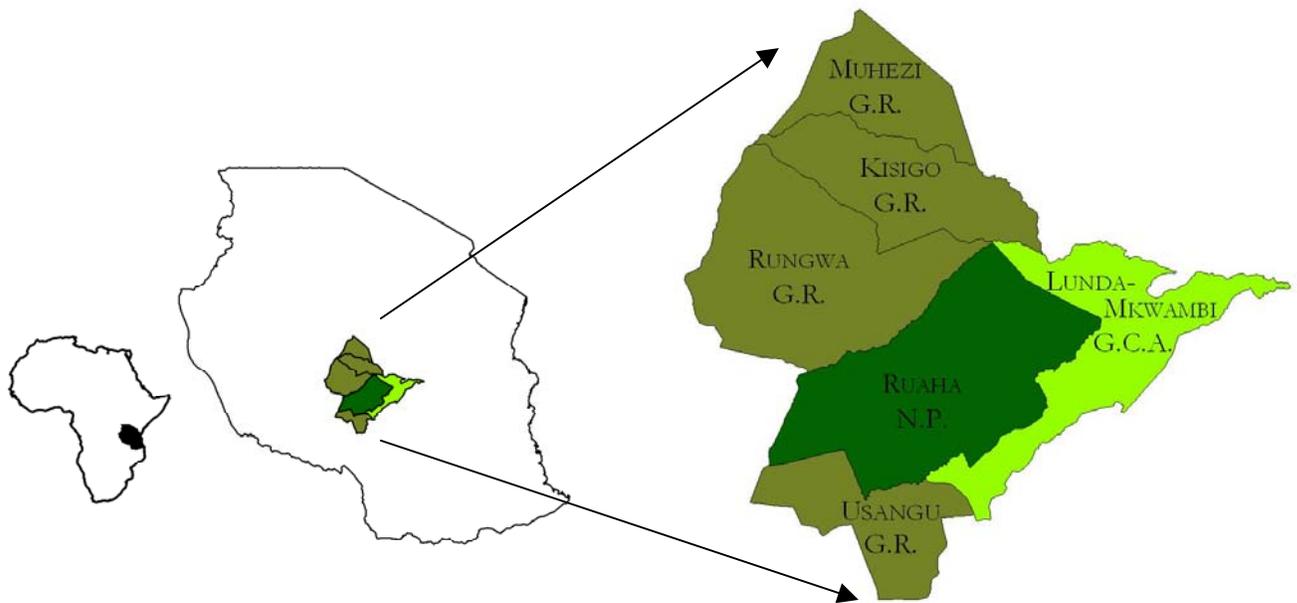
In Central Africa, humans and gorillas share not only their land but also more than 140 diseases. The impact of these pathogens can be devastating if not monitored, managed, and most importantly- prevented. Both humans and gorillas suffer terribly from rare diseases such as Ebola hemorrhagic fever, as well as easily preventable but deadly infections such as polio and measles. People living in rural areas of central Africa are plagued by the lack of the most basic health care. These rural peoples live on the fringes, the exact same areas that still hold the world's richest biodiversity. While conservation efforts in these areas offer the hope of well-managed natural resources as well as revenue streams through ecotourism, the lives of local people will not significantly improve if steps are not taken to improve their health. Living in remote areas, far from capital cities, these people have been left off of the "map" of developing country health care programs.

Simultaneously, humans pose the greatest disease threats to great apes. Human tuberculosis causes a rapidly fatal disease in primates. Measles and influenza infect apes with deadly effects. In contrast to the safety of using injectable polio vaccine, the shedding of virus following oral polio vaccines can cause deadly infections in wild apes that come in contact with water or soil contaminated by recently vaccinated people. Ironically, one of the biggest threats to ecotourism's significant revenue potential for local people and protected areas is disease spread by local people, their domestic animals, and even tourists. These diseases can devastate the wildlife resources upon which tourism is based, and other animals upon which local people depend for food.



Tanzania's Rungwa-Ruaha Landscape

At over 45,000 km², the Rungwa-Ruaha Landscape is one of Tanzania's largest wild areas. It sits within a global hotspot of mammal species richness, including the continent's third largest population of the critically endangered African wild dog, and is biogeographically important within Tanzania. The area contains two Important Bird Areas, two potential Ramsar sites, and is recognized in the "Global 200" and as a "Last Wild Place." Not surprisingly, Rungwa-Ruaha and its spectacular wildlife communities are also under threat. Grazing, land transformation, unregulated and illegal hunting, and uncontrolled fires threaten the integrity of this wild landscape. Covering an area larger than Denmark, this sprawling ecosystem reaches from the Rift Valley and the alluvial plain of the Great Ruaha River, up the Rift Valley escarpment to higher elevation miombo woodlands and relict forests of the Isinkuviola Plateau, which form the headwaters of the critically important Rungwa River. Nearly 90% (over 40,000km²) of the Rungwa-Ruaha landscape lies within six protected areas: Ruaha National Park, Rungwa, Kisigo, Muhezi and Usangu Game Reserves, and the Lunda-Mkwabi Game Controlled Area. In short, the Rungwa-Ruaha landscape is a critical link between Tanzania's Maasai Steppe and the western wildlife corridor.



Livestock represent a critical component of rural livelihoods in this landscape, and disease is a critical yet not fully examined threat to the ecosystem's integrity. Competition between wildlife and livestock for grazing resources is an issue that must be addressed if a balance between agricultural and conservation interests is to be attained. The dramatic effects of livestock on Usangu Game Reserve's vegetation resources, for example, have been evaluated. However, disease interactions remain an incompletely understood management concern for both pastoralists and wildlife managers. The intensity of disease threats and of resource competition will only increase as wildlife numbers recover under improved management regimes and/or as livestock densities rise. The key stakeholders in this landscape include pastoralists, government officials, tour operators and employees, and subsistence as well as sport hunters.

The conservation significance of this landscape is extraordinary. First, the ecosystem harbors a nearly intact fauna, including as many as 12,000 elephants, and Africa's 3rd largest population of wild dogs, a critically endangered large carnivore that has disappeared from more than 95% of its original range. The forests of the Isinkuviola Plateau are largely unsurveyed, and like the Eastern Arc Forests to the east and the Albertine Rift forests to the west, probably contain high levels of biodiversity and endemism. Equally important are the ecosystem's sheer size and level of intactness. At the core of the ecosystem is Ruaha National Park (RNP). Even though it is somewhat smaller than Serengeti, which endures heavy illegal hunting in its western corridor, Ruaha NP represents one of the Tanzanian landscapes least impacted by hunting, largely because managed areas surround RNP, and it faces far lower human population pressure. Ruaha NP is of course *influenced* by hunting. Rungwa, Kisigo, Muhezi and Usangu Game Reserves are all hunted, as is the Lunda-Mkwambi Game Controlled Area. Hunting in these areas varies from low-volume sport hunting for trophy animals, to higher-volume subsistence hunting, to uncontrolled illegal exploitation.

The area is also potentially important as a precedent-setter for the rest of Tanzania including in the realm of animal health policy. The Lunda-Mkwambi Game Controlled Area will likely become one of Tanzania's first Wildlife Management Areas (WMA), where management authority and benefits from wildlife will be devolved to local communities. This will set a powerful precedent for Tanzania by establishing a new mechanism for conservation outside protected areas.

Conflicts between wildlife and livestock over grazing lands are most acute in the Usangu Game Reserve and adjacent areas, but livestock are also kept in Lunda-Mkwambi and adjacent to Rungwa, Kisigo and Muhezi Game Reserves. Currently, over 300,000 cattle - an order of magnitude more than the number of buffalo in RNP - and 81,000 sheep and goats graze the Usangu wetlands, which are less than half the size of Ruaha N.P. This translates to a density of 73 individuals / km², more than 20 times the density of RNP buffalo, and more than double the estimated carrying capacity of a cattle-only rangeland in this ecosystem. Over 90% of the wet season grazing area used by livestock lies within the Usangu Game Reserve, where such use is illegal. Heavy livestock grazing has led to serious degradation in some areas and, by decreasing the water-holding capacity of the wetlands, has contributed to the hydrological problems accompanying irrigation and land transformation. However, because the ecosystem historically supported high densities of wild herbivores, the effects of grazing are not ecologically unprecedented, and recovery is realistic over time if the lands can be managed collaboratively.

Hydrological disruptions serve neither the people nor the wildlife of Rungwa-Ruaha well. For the last nine years, the Ruaha has dried up completely and for longer periods during every dry season. Not surprisingly, this has had profound effects on water-dependent wildlife as well as livestock herding and small-scale fisheries. Some wide-ranging wildlife species have shifted their habitat use to elsewhere, but other species' numbers have declined precipitously (most notably hippopotamus, crocodiles, and waterbuck). These population declines and changes in dry season distributions have had, and if unchecked will continue to have, significant negative effects on tourism (in Ruaha N.P.), subsistence hunting (in Lunda-Mkwambi GCA), and on sport hunting (in Usangu GR).

Livestock depredation, whether real or perceived, also precipitates direct persecution of some large carnivores (lions and wild dogs), adding another dimension of threat to the grazing

system. Diseases among domestic animals may also affect both wild herbivores and carnivores, but the significance of disease interactions at the wild-domestic animal interface is in urgent need of evaluation in this landscape. For comparative purposes, it's worth noting that in 1999 more wild buffalo died in Kenya as a result of a livestock-introduced disease (rinderpest) than had been killed by illegal poaching during the entire previous twenty years. Tanzania National Parks (TANAPA) has been investigating a wide range of disease issues across the country, including recent work on canine distemper, tuberculosis, rabies, trypanosomiasis, foot and mouth disease, rinderpest, mange, and anthrax- just to name a few examples.

Solutions to conflicts over fodder resources must avoid simply exporting the problem elsewhere in Tanzania. Coexistence of livestock and wildlife must be explored wherever possible for several reasons. First, complete exclusion of cattle from Usangu GR, for example, may simply concentrate livestock on alluvial fans and lead to more serious local degradation. Second, reductions in livestock numbers could also have serious economic consequences for Mbarali District, which generates approximately half of its tax revenue from livestock. Third, a mass exodus of livestock could also contribute to the spread, for example, of contagious bovine pleuropneumonia (CBPP), a disease of significant economic importance to livestock, and one which has forced intermittent quarantines and bans on livestock movements for over ten years. Developing acceptable solutions to challenges at the livestock / wildlife interface will of course require close collaboration with local people and with relevant local as well as national authorities. With sound veterinary science, adequate technical and financial resources, and approaches like community-based animal health care (for example), diseases like contagious bovine pleuropneumonia, tuberculosis, brucellosis, and a range of other maladies of significance to domestic animal health and (directly or indirectly) to human health can start to be addressed on the ground and in the policy arena- in ways that secure a future for healthy wildlife as well.

Southern Africa

The Southern African Development Community (SADC) has a population of about 200 million people and a combined Gross Domestic Product (GDP) of about US\$190 billion. Nevertheless, an estimated 40 percent of the total regional population still lives in poverty (<http://www.sadc.int/>). According to the International Fund for Agricultural Development (<http://www.ifad.org>), southern Africans maintain approximately 40 million livestock units (1 cow = 0.8 LSU, sheep or goat = 0.1 LSU, camel = 1.1 LSU). Domestic animals share the landscape with, for example, the more than 70 species of antelopes in sub-Saharan Africa, representing a much greater diversity than any other group of medium to large mammals. Up to 75 % of these antelope species are in decline (East, 1998).

The SADC region received some 13.4 million tourists in the year 2000, accounting for more than 46% of the total arrivals in Africa. With regard to growth in tourist arrivals, Southern Africa recorded an 8.3% growth rate compared to world's 7.4%. Tourism receipts in SADC countries increased from US\$ 3.6 billion in 1995 to US\$ 5 billion in 1999 (<http://www.sadc.int/>). Southern Africa's remaining wildlife areas continue to anchor growth in tourist revenues.

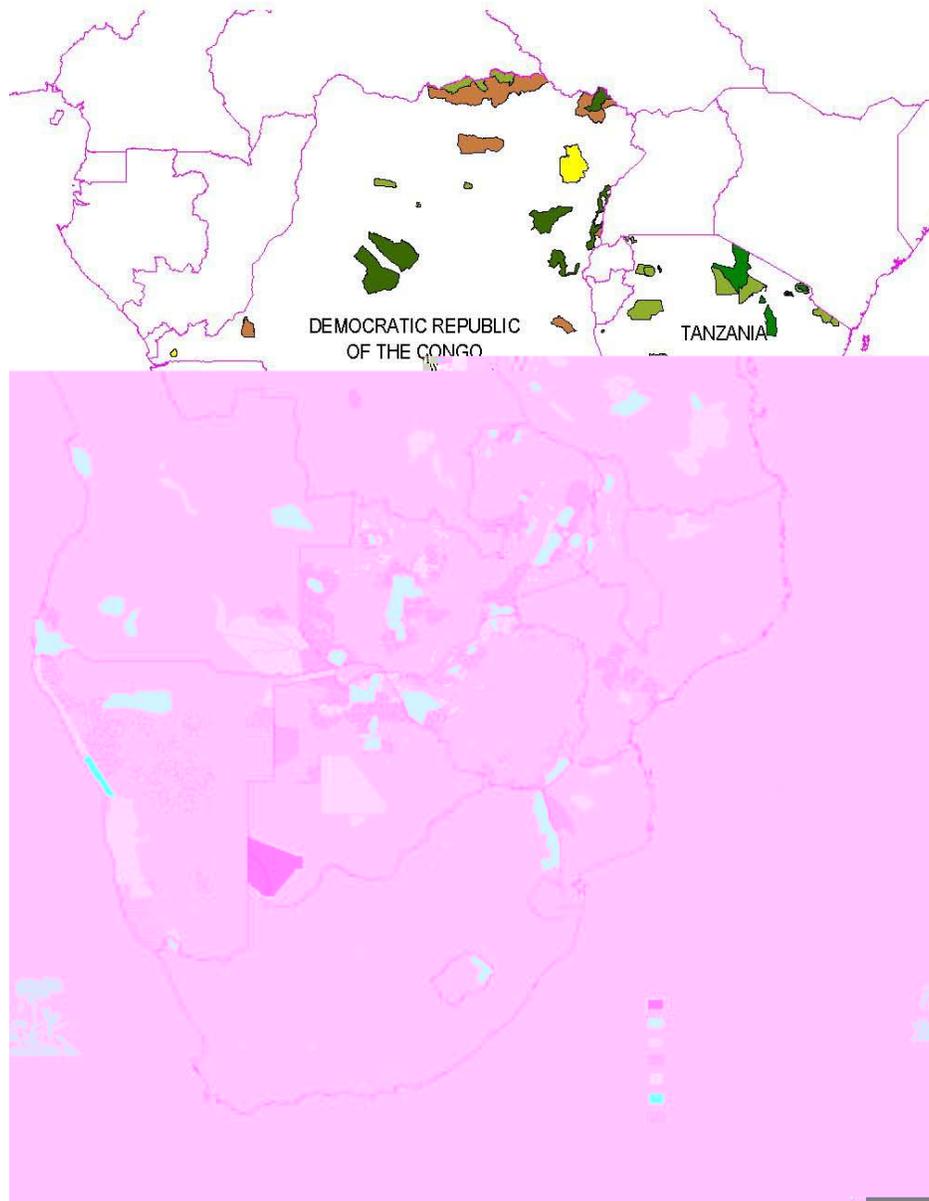
There is probably no region on earth where animal health policies have had as tangible an effect upon the biotic landscape as in southern Africa. And in terms of human livelihoods, the subregion's dependence on agriculture becomes all too obvious in times of drought. In many parts of the world, land-use choices are often driven by government (domestic and/or foreign) incentives or subsidies that can favor unsustainable agricultural practices over more ecologically sound natural resource management schemes.



Steve Osofsky, DVM

With a better understanding of disease epidemiology and the true costs associated with disease control as well as the true costs of environmental degradation related to livestock management practices not well-suited to a particular ecosystem, land-use decisions might more often favor a return to natural production systems. For example, in semi-arid parts of southern Africa that characterize much of the Kalahari semi-desert as well as southeastern Zimbabwe's lowveldt, foot and mouth disease (FMD) control programs to support beef production for an export market may not actually be as profitable or as environmentally sustainable as a return to multi-use natural systems emphasizing endemic wildlife species (consumptively and non-consumptively).

*Protected Areas and Wildlife Management Areas
of the Southern African Development Community*



Of course one cannot generalize across the entire mosaic of southern African landscapes- livestock will remain critically important both culturally and economically in much of the region. "Getting it right" when it comes to animal health programs and policies becomes even more critical in transboundary land-use planning, as domestic as well as wild animals have opportunities to cross international borders. The future of the new Great Limpopo Transfrontier Park and surrounds may in large part be decided by the animal health policies agreed upon by the countries involved. The choices surrounding which areas will be zoned for wildlife and which for foot-and-mouth disease-free beef production will dictate where fences are placed- which will in turn dictate whether a functional transboundary landscape exists in reality- or just on paper.

South Africa Bans Imports from Botswana over Foot-and-Mouth

SABC News January 15, 2003

South Africa has imposed a ban on the importation of all cloven-hooved animals and their products from Botswana, following a suspected outbreak of foot-and-mouth disease in that country, the agriculture department said today.

Products banned included live cloven-hooved animals, including elephants, dairy products, meat products, hides and skins, hunting trophies, horns, hooves, bones, wool, hair, grass and pet food, it said in a statement in Pretoria.

South Africa recently regained its international foot-and-mouth disease free zone status. "It is therefore very imperative that precautionary measures are taken in order to ensure that the suspected outbreak does not endanger the health of livestock in South Africa," the statement said.

Botswana: Foot and mouth disease outbreak stalls exports to EU and South Africa

A ProMED-mail post January 17, 2003

The European Union (EU) followed South Africa's lead on Thursday and banned imports of deboned meat from Botswana following an outbreak of foot and mouth disease (FMD) in the country. "The standing committee on food chain and animal health agreed to temporarily suspend the importation into the EU of de-boned fresh meat of these species [bovine, ovine, and caprine species and farmed and wild game animals] from the whole territory of Botswana," an EU statement said. [As for] speculation that Botswana's outbreak may have originated in Zimbabwe, ...this had not been confirmed. However... there was some cattle smuggling across the border by Zimbabweans taking advantage of the favorable exchange rate of the Botswana Pula, the strongest currency in the region, on the parallel market....

[Zimbabwe's unstable conditions seem to be contributing to the deteriorating animal-health situation in the entire region. There is an obvious common interest of all countries in the region that FMD outbreak(s), in any of southern Africa's countries, be speedily put under control. Hence the need to urgently support the Veterinary Services of Zimbabwe in their great efforts to control FMD, including supplying suitable (polyvalent?) vaccines. - Mod.AS]

Whether we are talking about foot and mouth disease (FMD) or contagious bovine pleuropneumonia (CBPP) (a disease that directly affects only domestic stock- but common mitigation measures like fencing have significant impacts on wildlife), malignant catarrhal fever (MCF) or diseases like tuberculosis and brucellosis which are transmissible between animals/animal products and people, animal health issues (and their implications for human health, livelihoods, and the economies of nations) must be addressed by any truly regional agricultural or natural resources management strategies if they are to succeed. How can agricultural and conservation interests work together for the common good? The next section of this guide reviews the Pilanesburg Resolution, a series of recommendations for development agencies on just this very question.

The Pilanesburg Resolution:

First, Do No Harm... But How? Animal Health Scientists from Around the Globe Provide Suggestions to the Development Community Through the Pilanesburg Resolution

In July, 2001, at a meeting of animal health science professionals from more than 30 countries held in South Africa's Pilanesburg National Park, the Wildlife Disease Association and the Society for Tropical Veterinary Medicine jointly prepared and released a resolution calling for the recognition of animal health sciences as critical to the design and management of sustainable wildlife and/or livestock-based programs. This resolution, targeted at the international donor community, encourages agencies to consider potential wild and domestic animal health impacts when development projects (particularly those related to livestock development) are being planned or implemented. The two professional societies, representing thousands of scientists and meeting together to address the issue of diseases transmitted between domestic and wild animals, wished to emphasize the interrelatedness of development actions and the environment, the potential for adverse consequences in projects that neglect to consider animal disease issues, and the importance of considering the true and overall costs and benefits of attempting to address animal health issues to natural as well as human-made production systems when evaluating or trying to define project sustainability. The resulting **Pilanesburg Resolution** reads as follows:

Resolution by the Wildlife Disease Association and the Society for Tropical Veterinary Medicine calling for international donor community recognition of animal health sciences as critical to the design and management of sustainable wildlife and/or livestock-based programs:

* Whereas, contact and resource competition between wildlife and livestock continuously expand as more and more land comes under some form of human use;

* whereas, wild and domestic animals have many diseases in common and both groups can and do play different roles in disease epidemiology, and recognizing that these interrelationships can have significant implications for disease prevention or control schemes;

* whereas, livestock-based and wildlife-based activities are undertaken separately as well as jointly as primary modes of sustenance, economic betterment and support of rural livelihoods, with the sustainability thereof inextricably linked to ecologically appropriate land-use choices;

*whereas, the sustainable management of livestock as well as the conservation of wildlife require ground-level stewardship, including disease surveillance, by those communities closest to and most dependent on these resources;

*whereas, numerous governmental and nongovernmental organizations worldwide provide financial resources, incentives, leadership, and advice targeted at boosting productivity and sustainability of the livestock and/or natural resource management sectors without always recognizing concomitant disease implications, which can be significant and complex;

*whereas, limited funding streams for wildlife and/or livestock initiatives require prudent use;

*whereas, donor organizations seldom possess sufficient internal expertise regarding the myriad disease issues implicit in ensuring the success of wildlife and/or livestock-based programs; and

*whereas, the Wildlife Disease Association and the Society for Tropical Veterinary Medicine, along with other local, national, and international organizations, represent professionals who possess unique skills, knowledge, and experience with wild and domestic animal diseases and their underlying causes, ecological relationships, and economic implications.

Now, therefore, be it resolved that the Wildlife Disease Association and the Society for Tropical Veterinary Medicine urge those organizations contemplating the funding and implementation of programs involving wildlife or livestock resources to:

**encourage projects that foster integrative approaches to livestock production, food security, human health, economic growth, democracy and governance, biodiversity conservation, and natural resource management in order to build upon synergies among these sectors while precluding conflicting policies and/or negative impacts on either livestock or wildlife health;*

**formalize steps in their project design, environmental impact assessment, and implementation processes which address wildlife, livestock, and rangeland health issues and their implications for sustainability and thus success, recognizing that these projects may alter fundamental*

relationships between animal hosts and potential pathogens and parasites;

**when contemplating projects involving domestic and/or wild animals, establish relationships with appropriate wildlife and domestic animal health-oriented organizations and recognized local, national, regional, and international experts, thereby identifying an appropriate pool of professionals who can assist in ensuring the inclusion of timely, science-based advice in planning, implementation, and monitoring processes; and*

**put a premium on local human capacity-building to address the long-term technical needs of development activities that require expertise in domestic animal health and wildlife health by building adequate support into project design and implementation so as to engage local expertise and to foster capacity-building at professional as well as community levels as a first-tier priority within and beyond the life-spans of such programs.*

The resolution was unanimously adopted by both professional groups, and has since been distributed to more than 30 international aid organizations including the United Nations Development Program, the World Bank, and the US Agency for International Development. It is the hope of the Wildlife Disease Association and the Society for Tropical Veterinary Medicine that the ideas conveyed in this way will influence development projects that have historically had profound impacts, good and bad, on land-use planning and practices in developing nations.

Checklist for Mitigating Wildlife Health Impacts in USAID-Assisted Projects

We believe that if USAID staff seek answers to the following questions when reviewing project proposals (*regardless of sector*, regardless of whether the project is classified as research or not) before deciding whether or not to fund them, and routinely include these questions as part of project monitoring and evaluation procedures, then many potentially unforeseen negative impacts on wildlife health can be precluded. Some of the questions relate inherently to animal welfare issues, which of course overlap with conservation issues when one is dealing with endangered species. Many proposals/projects will be easy to apply this protocol to, as they will not involve many activities relevant to the questions. But running through this brief “checklist” will likely reveal potentially significant environmental issues that otherwise would likely have been overlooked. These types of issues are perhaps not thoroughly addressed through Federal Regulation 216 Agency Environmental Procedures.

It should also be clear that *judging the answers* to some of the following questions might in some cases be beyond the purview of USAID expertise, and beyond what can be reasonably articulated in a primer such as this. *We strongly suggest that USAID develop a peer review process when proposals related to the management / handling of wild and domestic animals are being considered. Ad hoc* or more permanent committees that include relevant USAID staff as well as outside expertise on domestic and wild animal health may be needed from time to time. One obvious source of such outside scientific expertise to consider is the IUCN Species Survival Commission (SSC) Veterinary Specialist Group (VSG). More information on this and other expert groups can be found in the appendices.

In the interest of efficiency, USAID might consider including these questions in its Requests for Proposals (RFPs) so candidates seeking development assistance actually have the opportunity to answer these questions directly themselves as part of the application process.

Project Checklist for Mitigating Wildlife Health Impacts (not all questions are applicable to all proposals from all sectors of USAID assistance):

1) Does the proposed work comply with relevant local, national, and international laws, regulations, treaties, agreements, and conventions as related to biosafety, animal health, human health, endangered species, trade, phytosanitation, property rights, etc.?

(a) Are the handling, transport, and chain of custody procedures for biological samples clearly articulated by the proponent?

(b) Are all permits in order (CITES, USDA, host country)?

2) Does the applicant describe precautions that will be taken to ensure the protection of human health during this project and address issues related to biosafety, occupational safety, tourism, and zoonotic diseases (diseases transmissible between animals and people)? Are project staff adequately protected from project-related health risks (e.g.- abattoir workers exposed to potentially infected animal carcasses), and are animals adequately protected from human diseases (e.g.- are game guards patrolling a gorilla reserve trained in basic hygiene / sanitary procedures and screened / vaccinated for diseases common to people and great apes)?

3) Does the applicant describe precautions that will be taken to ensure the protection of wildlife and livestock health during (and after) the project? Have potential disease transmission risks been adequately addressed in the planning phase of the project? (This question also pertains to any pets or livestock project staff may wish to have on-site!) What type of risk assessment analysis has been applied?

4) Does the applicant describe appropriate steps for safely moving animals, animal products, and/or animal waste to prevent disease transmission and / or 'downstream' impacts?

5) Has the proponent evaluated the potential environmental impact of any project-related animal or other wastes / run-off, pharmaceutical agents, biologics, drug residues, food additives, or pesticides through toxicity or pathogenicity for non-target species (including soil and water invertebrates and microbes) or through bioaccumulation through the food chain? Has the proponent listed all such materials that will be utilized within the context of the project?

Lobster Decline- USA (NY)- www.promedmail.org
New Agriculturalist [edited] 15 January 2003

Pesticides are the suspected cause of a **devastating decline in the lobster population off the coast of New York**. Preliminary tests on lobsters from Long Island Sound have found traces of pyrethroid, and researchers believe this may be linked to [the management of] an outbreak of West Nile virus [infection] in New York last year. In an attempt to prevent another outbreak of the virus, which is spread by mosquitoes, several eastern coastal states sprayed large quantities of insecticide. Although the US Environmental Protection Agency restricts spraying to land, scientists have surmised that heavy storms caused by Hurricane Floyd at the time of spraying may have washed large amounts of the pyrethroid chemicals into the sewers that flow into the Sound....

6) If habitat modifications such as barrier fences, roads, dams, or other water diversions are part of the project plan, has the proponent considered the adverse impacts on wildlife such as a loss of access to water, shifts in prey base, changes in disease vector ecology (e.g.- altering flowing into standing water), or interruption in migratory routes? Evaluating potential human health impacts is also obviously critical here.

7) Does the project include the lethal control of disease reservoir or vector species (e.g.- killing of bison that leave Yellowstone National Park because of concerns related to possible brucellosis transmission to cattle), and if so have environmental impacts been minimized and justified? Have non-lethal alternative approaches been considered?

8) When elimination of disease vector species is part of the proposed project (eg- tsetse fly eradication to eliminate trypanosomiasis), have follow-on changes in land-use patterns been adequately anticipated and evaluated for sustainability?

Clearing tsetse flies and creating the infrastructure (roads, bridges, etc.) for people to move into fundamentally unsuitable areas is, unfortunately, a subsidy for the settlement of often marginal, semi-arid lands. People migrate into these 'frontiers,' displacing existing traditional land uses and cultures- and may initially thrive on the accumulated soil nutrient stocks. Once these soils have been exhausted, the increased population will likely become dependent on urban subsidies and food aid to survive. Globally, many of the most severe impacts on the conservation of biodiversity probably result from subsidies to agriculture on marginal lands (David Cumming, pers. comm.).

- 9)** If the project uses domestic or wild animals, does the applicant describe the role of the principal investigator and each co-investigator involved in the project and list their animal-related experience and training? Does the applicant describe the level of experience obtained by project personnel with the species and/or techniques specifically involved in the project? [**Note:** Specific experience should be required, particularly for work with capture, chemical restraint, and surgery of animals. Listing of coursework, certificates, or degrees is not in itself sufficient.]
- 10)** If the project involves wild animals, does the applicant describe the capture and handling methods used? If the movement of live animals is involved, does the applicant provide detailed descriptions of protocols and equipment to be used, and of transport plans?
- 11)** Are biological samples being collected / analyzed from the animals in the project, particularly those animals that are members of an endangered species?
- (a) If so, the applicant must explain why and describe collection, storage and biosafety techniques to be utilized.
- (b) If not, the applicant must explain why not. It is an honor and a privilege, for example, to handle a member of an endangered species. Every opportunity to safely take samples and learn from a wild animal being handled for other research or management purposes should be considered and evaluated within the context of USAID's conservation objectives.
- 12)** Has the proponent addressed other project scenarios with disease transmission risks between humans, domestic animals, and/or wildlife? Risks can accompany projects that involve, for example, ecotourism, effluent discharge, waste management, road-building, construction, forest conversion, logging, water diversion, sustainable use, and contact between species through fences. What type of risk assessment analysis has been applied?
- 13)** If hunting or culling are occurring, has the proponent considered the adverse effects of artificial selection (e.g.- tusklessness trait on the rise in elephants in Uganda, Tanzania-populations with significant historical poaching pressures).
- 14)** If the project proposes the collection of animal products or biological samples through lethal means, have non-lethal alternative approaches been explored?

15) If non-lethal methods are not available and the collection of animal products or biological samples is deemed justified / necessary, does the applicant describe methods of euthanasia to be used and demonstrate that project personnel are qualified to implement them?

16) Where appropriate, does the proposal outline protocols and demonstrate that capabilities are in place for postmortem (necropsy) examination procedures of animals that die due to project-related activities? If an animal's death relates directly or indirectly to project activities, it is important to determine exactly what went wrong in order to avoid repetition of mistakes.

17) If animals are being moved as part of the project:

- (a) Has the applicant identified the health risks to source and recipient populations?
- (b) Has the applicant addressed relevant precautionary criteria as published by the IUCN Species Survival Commission Re-Introduction Specialist Group, Invasive Species Specialist Group, Conservation Breeding Specialist Group, and Veterinary Specialist Group? (See Appendices).
- (c) Has the applicant considered potential adverse effects of introducing non-endemic genetic stock (effects of genetic dilution, hybridization, potential declines in disease resistance) or of genetically modified organisms (GMOs) [intermixing with native gene pools, beyond-site (non-target) impacts]? That is, how has it been determined that the proposed benefits of such introductions exceed the potential risks?
- (d) Does the project meet the "IUCN Guidelines for Re-introductions"? These guidelines were developed specifically to provide practical recommendations to those planning, advising, carrying out, or monitoring reintroduction exercises. Any project that does not meet the basic criteria outlined in this document should be subjected to further scrutiny, including direct discussion with the proponents as to why the project fails to address IUCN-recommended best practices.
- (e) In line with the above, does the proponent compare the alleged benefits of releasing an animal into a particular habitat to the potential risks related to the introduction of disease or deleterious genes?
- (f) Does the proposal demonstrate that protocols/facilities to be used for confining animals meet minimum requirements for humane confinement? Some basic information on animal welfare / confinement standards can be found in the appendices.
- (g) Has the applicant included an evaluation of the potential for animal escape? Risks (beyond the obvious ones to the animal itself) depend on the species and situation, but could include physical danger to humans, animal and human disease risks, as well as danger to ecosystems if the project involves a non-native wildlife species (i.e.- a potential alien invasive species: projects involving non-native wildlife species should certainly be discouraged, as per point 18). Does the proponent described

plans for emergency response / mitigation if escape occurs?

18) Is the introduction of non-endemic species proposed as part of the project? If so, does the applicant:

- (a) Justify why the project must use non-endemic species and address the potential risk of the species becoming invasive?
- (b) Demonstrate that they have researched the inherent potential of the species for invasiveness (see Appendix for “IUCN Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species” and other references)?

19) Is the proponent prepared to deal with the potential injury of animals through project-related activities? For example, if a capture procedure is to be undertaken for research or management purposes, how are injuries to be dealt with? Are provisions in place to deal with irreparably harmed animals in terms of humane euthanasia? Particularly for projects involving threatened or endangered species, it is important to determine exactly what went wrong, in order to avoid repetition of mistakes. Projects that have demonstrated sound conservation reasons for handling threatened or endangered animals should also be prepared to carry-out post-mortem examinations of any animals that die in the process. Such examinations include the collection of appropriate tissues and other samples to maximize what is learned from the animal when an unfortunate post-mortem exam opportunity does arise. Such situations are best avoided by using ‘best practices’ at all times, as implied by this checklist.

Appendices

Species Survival Commission (SSC)

IUCN/SSC GUIDELINES FOR RE-INTRODUCTIONS

Prepared by the SSC Re-introduction Specialist Group *

Approved by the 41st Meeting of the IUCN Council, Gland Switzerland, May 1995

INTRODUCTION

These policy guidelines have been drafted by the Re-introduction Specialist Group of the IUCN's Species Survival Commission (1), in response to the increasing occurrence of re-introduction projects worldwide, and consequently, to the growing need for specific policy guidelines to help ensure that the re-introductions achieve their intended conservation benefit, and do not cause adverse side-effects of greater impact. Although IUCN developed a Position Statement on the Translocation of Living Organisms in 1987, more detailed guidelines were felt to be essential in providing more comprehensive coverage of the various factors involved in re-introduction exercises.

These guidelines are intended to act as a guide for procedures useful to re-introduction programmes and do not represent an inflexible code of conduct. Many of the points are more relevant to re-introductions using captive-bred individuals than to translocations of wild species. Others are especially relevant to globally endangered species with limited numbers of founders. Each re-introduction proposal should be rigorously reviewed on its individual merits. It should be noted that re-introduction is always a very lengthy, complex and expensive process.

Re-introductions or translocations of species for short-term, sporting or commercial purposes - where there is no intention to establish a viable population - are a different issue and beyond the scope of these guidelines. These include fishing and hunting activities.

This document has been written to encompass the full range of plant and animal taxa and is therefore general. It will be regularly revised. Handbooks

for re-introducing individual groups of animals and plants will be developed in future.

CONTEXT

The increasing number of re-introductions and translocations led to the establishment of the IUCN/SSC Species Survival Commission's Re-introduction Specialist Group. A priority of the Group has been to update IUCN's 1987 Position Statement on the Translocation of Living Organisms, in consultation with IUCN's other commissions.

It is important that the Guidelines are implemented in the context of IUCN's broader policies pertaining to biodiversity conservation and sustainable management of natural resources. The philosophy for environmental conservation and management of IUCN and other conservation bodies is stated in key documents such as "Caring for the Earth" and "Global Biodiversity Strategy" which cover the broad themes of the need for approaches with community involvement and participation in sustainable natural resource conservation, an overall enhanced quality of human life and the need to conserve and, where necessary, restore ecosystems. With regards to the latter, the re-introduction of a species is one specific instance of restoration where, in general, only this species is missing. Full restoration of an array of plant and animal species has rarely been tried to date.

Restoration of single species of plants and animals is becoming more frequent around the world. Some succeed, many fail. As this form of ecological management is increasingly common, it is a priority for the Species Survival Commission's Re-introduction Specialist Group to develop guidelines so that re-introductions are both justifiable and likely to succeed, and that the conservation world can learn from each initiative, whether successful or not. It is hoped that these Guidelines, based on extensive review of case - histories and wide consultation across a range of disciplines will introduce more rigour into the concepts, design, feasibility and implementation of re-introductions despite the wide diversity of species and conditions involved.

Thus the priority has been to develop guidelines that are of direct, practical assistance to those planning, approving or carrying out re-introductions. The primary audience of these guidelines is, therefore, the practitioners (usually managers or scientists), rather than decision makers in governments. Guidelines directed towards the latter group would inevitably have to go into greater depth on legal and policy issues.

1. DEFINITION OF TERMS

"Re-introduction": an attempt to establish a species(2) in an area which was once part of its historical range, but from which it has been extirpated or become extinct (3) ("Re-establishment" is a synonym, but implies that the re-introduction has been successful).

"Translocation": deliberate and mediated movement of wild individuals or populations from one part of their range to another.

"Re-reinforcement/Supplementation": addition of individuals to an existing population of conspecifics.

"Conservation/Benign Introductions": an attempt to establish a species, for the purpose of conservation, outside its recorded distribution but within an appropriate habitat and eco-geographical area. This is a feasible conservation tool only when there is no remaining area left within a species' historic range.

2. AIMS AND OBJECTIVES OF RE-INTRODUCTION

a. Aims:

The principle aim of any re-introduction should be to establish a viable, free-ranging population in the wild, of a species, subspecies or race, which has become globally or locally extinct, or extirpated, in the wild. It should be re-introduced within the species' former natural habitat and range and should require minimal long-term management.

b. Objectives:

The objectives of a re-introduction may include: to enhance the long-term survival of a species; to re-establish a keystone species (in the ecological or cultural sense) in an ecosystem; to maintain and/or restore natural biodiversity; to provide long-term economic benefits to the local and/or national economy; to promote conservation awareness; or a combination of these.

3. MULTIDISCIPLINARY APPROACH

A re-introduction requires a multidisciplinary approach involving a team of persons drawn from a variety of backgrounds. As well as government personnel, they may include persons from governmental natural resource management agencies; non-governmental organisations; funding bodies;

universities; veterinary institutions; zoos (and private animal breeders) and/or botanic gardens, with a full range of suitable expertise. Team leaders should be responsible for coordination between the various bodies and provision should be made for publicity and public education about the project.

4. PRE-PROJECT ACTIVITIES

4a. BIOLOGICAL

(i) Feasibility study and background research

* An assessment should be made of the taxonomic status of individuals to be re-introduced. They should preferably be of the same subspecies or race as those which were extirpated, unless adequate numbers are not available. An investigation of historical information about the loss and fate of individuals from the re-introduction area, as well as molecular genetic studies, should be undertaken in case of doubt as to individuals' taxonomic status. A study of genetic variation within and between populations of this and related taxa can also be helpful. Special care is needed when the population has long been extinct.

* Detailed studies should be made of the status and biology of wild populations (if they exist) to determine the species' critical needs. For animals, this would include descriptions of habitat preferences, intraspecific variation and adaptations to local ecological conditions, social behaviour, group composition, home range size, shelter and food requirements, foraging and feeding behaviour, predators and diseases. For migratory species, studies should include the potential migratory areas. For plants, it would include biotic and abiotic habitat requirements, dispersal mechanisms, reproductive biology, symbiotic relationships (e.g. with mycorrhizae, pollinators), insect pests and diseases. Overall, a firm knowledge of the natural history of the species in question is crucial to the entire re-introduction scheme.

* The species, if any, that has filled the void created by the loss of the species concerned, should be determined; an understanding of the effect the re-introduced species will have on the ecosystem is important for ascertaining the success of the re-introduced population.

* The build-up of the released population should be modelled under various sets of conditions, in order to specify the optimal number and composition of individuals to be released per year and the numbers of years necessary to promote establishment of a viable population.

* A Population and Habitat Viability Analysis will aid in identifying significant environmental and population variables and assessing their potential interactions, which would guide long-term population management.

(ii) Previous Re-introductions

* Thorough research into previous re-introductions of the same or similar species and wide-ranging contacts with persons having relevant expertise should be conducted prior to and while developing re-introduction protocol.

(iii) Choice of release site and type

* Site should be within the historic range of the species. For an initial re-inforcement there should be few remnant wild individuals. For a re-introduction, there should be no remnant population to prevent disease spread, social disruption and introduction of alien genes. In some circumstances, a re-introduction or re-inforcement may have to be made into an area which is fenced or otherwise delimited, but it should be within the species' former natural habitat and range.

* A conservation/ benign introduction should be undertaken only as a last resort when no opportunities for re-introduction into the original site or range exist and only when a significant contribution to the conservation of the species will result.

* The re-introduction area should have assured, long-term protection (whether formal or otherwise).

(iv) Evaluation of re-introduction site

* Availability of suitable habitat: re-introductions should only take place where the habitat and landscape requirements of the species are satisfied, and likely to be sustained for the foreseeable future. The possibility of natural habitat change since extirpation must be considered. Likewise, a change in the legal/ political or cultural environment since species extirpation needs to be ascertained and evaluated as a possible constraint. The area should have sufficient carrying capacity to sustain growth of the re-introduced population and support a viable (self-sustaining) population in the long run.

* Identification and elimination, or reduction to a sufficient level, of previous causes of decline: could include disease; over-hunting; over-collection; pollution; poisoning; competition with or predation by introduced species; habitat loss; adverse effects of earlier research or management programmes; competition with domestic livestock, which may be seasonal. Where the release site has undergone substantial degradation caused by human activity, a habitat restoration programme should be initiated before the re-introduction is carried out.

(v) Availability of suitable release stock

* It is desirable that source animals come from wild populations. If there is a choice of wild populations to supply founder stock for translocation, the source population should ideally be closely related genetically to the original native stock and show similar ecological characteristics (morphology, physiology, behaviour, habitat preference) to the original sub-population.

* Removal of individuals for re-introduction must not endanger the captive stock population or the wild source population. Stock must be guaranteed available on a regular and predictable basis, meeting specifications of the project protocol.

* Individuals should only be removed from a wild population after the effects of translocation on the donor population have been assessed, and after it is guaranteed that these effects will not be negative.

* If captive or artificially propagated stock is to be used, it must be from a population which has been soundly managed both demographically and genetically, according to the principles of contemporary conservation biology.

* Re-introductions should not be carried out merely because captive stocks exist, nor solely as a means of disposing of surplus stock.

* Prospective release stock, including stock that is a gift between governments, must be subjected to a thorough veterinary screening process before shipment from original source. Any animals found to be infected or which test positive for non-endemic or contagious pathogens with a potential impact on population levels, must be removed from the consignment, and the uninfected, negative remainder must be placed in strict quarantine for a suitable period before retest. If clear after retesting, the animals may be placed for shipment.

* Since infection with serious disease can be acquired during shipment, especially if this is intercontinental, great care must be taken to minimize this risk.

* Stock must meet all health regulations prescribed by the veterinary authorities of the recipient country and adequate provisions must be made for quarantine if necessary.

(vi) Release of captive stock

* Most species of mammal and birds rely heavily on individual experience and learning as juveniles for their survival; they should be given the opportunity to acquire the necessary information to enable survival in the wild, through training in their captive environment; a captive bred individual's probability of survival should approximate that of a wild counterpart.

* Care should be taken to ensure that potentially dangerous captive bred animals (such as large carnivores or primates) are not so confident in the presence of humans that they might be a danger to local inhabitants and/or their livestock.

4b. SOCIO-ECONOMIC AND LEGAL REQUIREMENTS

* Re-introductions are generally long-term projects that require the commitment of long-term financial and political support.

* Socio-economic studies should be made to assess impacts, costs and benefits of the re-introduction programme to local human populations.

* A thorough assessment of attitudes of local people to the proposed project is necessary to ensure long term protection of the re-introduced population, especially if the cause of species' decline was due to human factors (e.g. over-hunting, over-collection, loss or alteration of habitat). The programme should be fully understood, accepted and supported by local communities.

* Where the security of the re-introduced population is at risk from human activities, measures should be taken to minimise these in the re-introduction area. If these measures are inadequate, the re-introduction should be abandoned or alternative release areas sought.

* The policy of the country to re-introductions and to the species concerned should be assessed. This might include checking existing provincial, national and international legislation and regulations, and provision of new measures and required permits as necessary.

* Re-introduction must take place with the full permission and involvement of all relevant government agencies of the recipient or host country. This is particularly important in re-introductions in border areas, or involving more than one state or when a re-introduced population can expand into other states, provinces or territories.

* If the species poses potential risk to life or property, these risks should be minimised and adequate provision made for compensation where necessary; where all other solutions fail, removal or destruction of the released individual should be considered. In the case of migratory/mobile species, provisions should be made for crossing of international/state boundaries.

5. PLANNING, PREPARATION AND RELEASE STAGES

* Approval of relevant government agencies and land owners, and coordination with national and international conservation organizations.

* Construction of a multidisciplinary team with access to expert technical advice for all phases of the programme.

* Identification of short- and long-term success indicators and prediction of programme duration, in context of agreed aims and objectives.

- * Securing adequate funding for all programme phases.
- * Design of pre- and post- release monitoring programme so that each re-introduction is a carefully designed experiment, with the capability to test methodology with scientifically collected data. Monitoring the health of individuals, as well as the survival, is important; intervention may be necessary if the situation proves unforeseeably unfavourable.
- * Appropriate health and genetic screening of release stock, including stock that is a gift between governments. Health screening of closely related species in the re-introduction area.
- * If release stock is wild-caught, care must be taken to ensure that: a) the stock is free from infectious or contagious pathogens and parasites before shipment and b) the stock will not be exposed to vectors of disease agents which may be present at the release site (and absent at the source site) and to which it may have no acquired immunity.
- * If vaccination prior to release, against local endemic or epidemic diseases of wild stock or domestic livestock at the release site, is deemed appropriate, this must be carried out during the "Preparation Stage" so as to allow sufficient time for the development of the required immunity.
- * Appropriate veterinary or horticultural measures as required to ensure health of released stock throughout the programme. This is to include adequate quarantine arrangements, especially where founder stock travels far or crosses international boundaries to the release site.
- * Development of transport plans for delivery of stock to the country and site of re-introduction, with special emphasis on ways to minimize stress on the individuals during transport.
- * Determination of release strategy (acclimatization of release stock to release area; behavioural training - including hunting and feeding; group composition, number, release patterns and techniques; timing).
- * Establishment of policies on interventions (see below).
- * Development of conservation education for long-term support; professional training of individuals involved in the long-term programme; public relations through the mass media and in local community; involvement where possible of local people in the programme.
- * The welfare of animals for release is of paramount concern through all these stages.

6. POST-RELEASE ACTIVITIES

- * Post release monitoring is required of all (or sample of) individuals. This most vital aspect may be by direct (e.g. tagging, telemetry) or indirect (e.g. spoor, informants) methods as suitable.
- * Demographic, ecological and behavioural studies of released stock must be undertaken.

- * Study of processes of long-term adaptation by individuals and the population.
- * Collection and investigation of mortalities.
- * Interventions (e.g. supplemental feeding; veterinary aid; horticultural aid) when necessary.
- * Decisions for revision, rescheduling, or discontinuation of programme where necessary.
- * Habitat protection or restoration to continue where necessary.
- * Continuing public relations activities, including education and mass media coverage.
- * Evaluation of cost-effectiveness and success of re- introduction techniques.
- * Regular publications in scientific and popular literature.

Footnotes:

1 Guidelines for determining procedures for disposal of species confiscated in trade are being developed separately by IUCN.

2 The taxonomic unit referred to throughout the document is species; it may be a lower taxonomic unit (e.g. subspecies or race) as long as it can be unambiguously defined.

3 A taxon is extinct when there is no reasonable doubt that the last individual has died

The IUCN/SSC Re-introduction Specialist Group (RSG) is a disciplinary group (as opposed to most SSC Specialist Groups which deal with single taxonomic groups), covering a wide range of plant and animal species. The RSG has an extensive international network, a re-introduction projects database and re-introduction library. The RSG publishes a bi-annual newsletter RE-INTRODUCTION NEWS.

If you are a re-introduction practitioner or interested in re-introductions please contact:

Mr. Pritpal S.Soorae
 Senior Conservation Officer
 IUCN/SSC Re-introduction Specialist Group (RSG)
 Environmental Research & Wildlife Development Agency (ERWDA)
 P.O. Box 45553
 Abu Dhabi
 United Arab Emirates (UAE)

Tel: (D/L) 971-2-693-4650 or general line: 693-4628

Fax: 971-2-681-7361

E-mail: PSoorae@erwda.gov.ae

Species Survival Commission, IUCN - The World Conservation Union, Rue
Mauverney 28, CH-1196, Gland, Switzerland

Tel: +41/22/999-0152 | Fax: +41/22/999-0015 | E-mail: ssc@iucn.org

<http://www.iucn.org/themes/ssc/pubs/policy/reinte.htm>

Species Survival Commission (SSC)

IUCN GUIDELINES FOR THE PREVENTION OF BIODIVERSITY LOSS CAUSED BY ALIEN INVASIVE SPECIES

Prepared by the SSC Invasive Species Specialist Group

Approved by the 51st Meeting of the IUCN Council, Gland Switzerland,
February 2000

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1. BACKGROUND(1)

Biological diversity faces many threats throughout the world. One of the major threats to native biological diversity is now acknowledged by scientists and governments to be biological invasions caused by alien invasive species. The impacts of alien invasive species are immense, insidious, and usually irreversible. They may be as damaging to native species and ecosystems on a global scale as the loss and degradation of habitats.

For millennia, the natural barriers of oceans, mountains, rivers and deserts provided the isolation essential for unique species and ecosystems to evolve. In just a few hundred years these barriers have been rendered ineffective by major global forces that combined to help alien species travel vast distances to new habitats and become alien invasive species. The globalisation and growth in the volume of trade and tourism, coupled with the emphasis on free trade, provide more opportunities than ever before for species to be spread accidentally or deliberately. Customs and quarantine practices,

developed in an earlier time to guard against human and economic diseases and pests, are often inadequate safeguards against species that threaten native biodiversity. Thus the inadvertent ending of millions of years of biological isolation has created major ongoing problems that affect developed and developing countries.

The scope and cost of biological alien invasions is global and enormous, in both ecological and economic terms. Alien invasive species are found in all taxonomic groups: they include introduced viruses, fungi, algae, mosses, ferns, higher plants, invertebrates, fish, amphibians, reptiles, birds and mammals. They have invaded and affected native biota in virtually every ecosystem type on Earth. Hundreds of extinctions have been caused by alien invasives. The ecological cost is the irretrievable loss of native species and ecosystems.

In addition, the direct economic costs of alien invasive species run into many billions of dollars annually. Arable weeds reduce crop yields and increase costs; weeds degrade catchment areas and freshwater ecosystems; tourists and homeowners unwittingly introduce alien plants into wilderness and natural areas; pests and pathogens of crops, livestock and forests reduce yields and increase control costs. The discharge of ballast water together with hull fouling has led to unplanned and unwanted introductions of harmful aquatic organisms, including diseases, bacteria and viruses, in marine and freshwater systems. Ballast water is now regarded as the most important vector for trans-oceanic and inter-oceanic movements of shallow-water coastal organisms. Factors like environmental pollution and habitat destruction can provide conditions that favour alien invasive species.

The degradation of natural habitats, ecosystems and agricultural lands (e.g. loss of cover and soil, pollution of land and waterways) that has occurred throughout the world has made it easier for alien species to establish and become invasive. Many alien invasives are "colonising" species that benefit from the reduced competition that follows habitat degradation. Global climate change is also a significant factor assisting the spread and establishment of alien invasive species. For example, increased temperatures may enable alien, disease-carrying mosquitoes to extend their range.

Sometimes the information that could alert management agencies to the potential dangers of new introductions is not known. Frequently, however, useful information is not widely shared or available in an appropriate format for many countries to take prompt action, assuming they have the resources, necessary infrastructure, commitment and trained staff to do so.

Few countries have developed the comprehensive legal and institutional systems that are capable of responding effectively to these new flows of goods, visitors and 'hitchhiker' species. Many citizens, key sector groups and governments have a poor appreciation of the magnitude and economic costs of the problem. As a consequence, responses are too often piecemeal, late and ineffective. It is in this context that IUCN has identified the problem of alien invasive species as one of its major initiatives at the global level.

While all continental areas have suffered from biological alien invasions, and lost biological diversity as a result, the problem is especially acute on islands in general, and for small island countries in particular. Problems also arise in other isolated habitats and ecosystems, such as in Antarctica. The physical isolation of islands over millions of years has favored the evolution of unique species and ecosystems. As a consequence, islands and other isolated areas (e.g. mountains and lakes) usually have a high proportion of endemic species (those found nowhere else) and are centres of significant biological diversity. The evolutionary processes associated with isolation have also meant island species are especially vulnerable to competitors, predators, pathogens and parasites from other areas. It is important to turn this isolation of islands into an advantage by improving the capacity of governments to prevent the arrival of alien invasive species with better knowledge, improved laws and greater management capacity, backed by quarantine and customs systems that are capable of identifying and intercepting alien invasive species.

2. GOALS AND OBJECTIVES

The goal of these guidelines is to prevent further losses of biological diversity due to the deleterious effects of alien invasive species. The intention is to assist governments and management agencies to give effect to Article 8 (h) of the Convention on Biological Diversity, which states that:

"Each Contracting Party shall, as far as possible and as appropriate:
...(h) Prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species."

These guidelines draw on and incorporate relevant parts of the 1987 IUCN Position Statement on Translocation of Living Organisms although they are more comprehensive in scope than the 1987 Translocation Statement. The relationship to another relevant guideline, the IUCN Guidelines for Re-introductions, is elaborated in Section 7.

These guidelines are concerned with preventing loss of biological diversity caused by biological invasions of alien invasive species. They do not address

the issue of genetically modified organisms, although many of the issues and principles stated here could apply. Neither do these guidelines address the economic (agricultural, forestry, aquaculture), human health and cultural impacts caused by biological invasions of alien invasive species.

These guidelines address four substantive concerns of the biological alien invasion problem that can be identified from this background context. These are:

- * improving understanding and awareness;
- * strengthening the management response;
- * providing appropriate legal and institutional mechanisms;
- * enhancing knowledge and research efforts.

While addressing all four concerns is important, these particular guidelines focus most strongly on aspects of strengthening the management response. This focus reflects the urgent need to spread information on management that can quickly be put into place to prevent alien invasions and eradicate or control established alien invasives. Addressing the other concerns, particularly the legal and research ones, may require longer-term strategies to achieve the necessary changes.

These guidelines have the following seven objectives.

1. To increase awareness of alien invasive species as a major issue affecting native biodiversity in developed and developing countries and in all regions of the world.
2. To encourage prevention of alien invasive species introductions as a priority issue requiring national and international action.
3. To minimise the number of unintentional introductions and to prevent unauthorised introductions of alien species.
4. To ensure that intentional introductions, including those for biological control purposes, are properly evaluated in advance, with full regard to potential impacts on biodiversity.
5. To encourage the development and implementation of eradication and control campaigns and programmes for alien invasive species, and to increase the effectiveness of those campaigns and programmes.
6. To encourage the development of a comprehensive framework for national legislation and international cooperation to regulate the introduction

of alien species as well as the eradication and control of alien invasive species.

7. To encourage necessary research and the development and sharing of an adequate knowledge base to address the problem of alien invasive species worldwide

3. DEFINITION OF TERMS(2)

"Alien invasive species" means an alien species which becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity.

"Alien species" (non-native, non-indigenous, foreign, exotic) means a species, subspecies, or lower taxon occurring outside of its natural range (past or present) and dispersal potential (i.e. outside the range it occupies naturally or could not occupy without direct or indirect introduction or care by humans) and includes any part, gametes or propagule of such species that might survive and subsequently reproduce.

"Biological diversity" (biodiversity) means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems.

"Biosecurity threats" means those matters or activities which, individually or collectively, may constitute a biological risk to the ecological welfare or to the well-being of humans, animals or plants of a country.

"Government" includes regional co-operating groupings of governments for matters falling within their areas of competence.

"Intentional introduction" means an introduction made deliberately by humans, involving the purposeful movement of a species outside of its natural range and dispersal potential. (Such introductions may be authorised or unauthorised.)

"Introduction" means the movement, by human agency, of a species, subspecies, or lower taxon (including any part, gametes or propagule that might survive and subsequently reproduce) outside its natural range (past or present). This movement can be either within a country or between countries.

"Native species"(indigenous) means a species, subspecies, or lower taxon, occurring within its natural range (past or present) and dispersal potential (i.e. within the range it occupies naturally or could occupy without direct or indirect introduction or care by humans.)

"Natural ecosystem" means an ecosystem not perceptibly altered by humans.

"Re-introduction" means an attempt to establish a species in an area which was once part of its historical range, but from which it has been extirpated or become extinct. (From IUCN Guidelines for Re-Introductions)

"Semi-natural ecosystem" means an ecosystem which has been altered by human actions, but which retains significant native elements.

"Unintentional introduction" means an unintended introduction made as a result of a species utilising humans or human delivery systems as vectors for dispersal outside its natural range.

4. UNDERSTANDING AND AWARENESS

4.1 Guiding Principles

* Understanding and awareness, based on information and knowledge, are essential for establishing alien invasive species as a priority issue which can and must be addressed.

* Better information and education, and improved public awareness of alien invasive issues by all sectors of society, is fundamental to preventing or reducing the risk of unintentional or unauthorised introductions, and to establishing evaluation and authorisation procedures for proposed intentional introductions.

* Control and eradication of alien invasive species is more likely to be successful if supported by informed and cooperating local communities, appropriate sectors and groups.

* Information and research findings which are well communicated are vital prerequisites to education, understanding and awareness. (See Section 8.)

4.2 Recommended Actions

1. Identify the specific interests and roles of relevant sectors and communities with respect to alien invasive species issues and target them

with appropriate information and recommended actions. Specific communication strategies for each target group will be required to help reduce the risks posed by alien invasive species. The general public is an important target group to be considered.

2. Make easily accessible, current and accurate information widely available as a key component of awareness raising. Target different audiences with information in electronic form, manuals, databases, scientific journals and popular publications. (See also Section 8.)

3. Target importers and exporters of goods, as well as of living organisms as key target groups for information/education efforts leading to better awareness and understanding of the issues, and their role in prevention and possible solutions.

4. Encourage the private sector to develop and follow best practice guidelines and monitor adherence to guidelines. (Refer 5.2 and 5.3.)

5. As an important priority, provide information and recommended actions to travellers, both within country and between countries, preferably prior to the start of journeys. Raising awareness of how much human travel contributes to alien invasive problems can improve behaviour and be cost-effective.

6. Encourage operators in eco-tourism businesses to raise awareness on the problems caused by alien invasive species. Work with such operators to develop industry guidelines to prevent the unintentional transport or unauthorised introduction of alien plants (especially seeds) and animals into ecologically vulnerable island habitats and ecosystems (e.g. lakes, mountain areas, nature reserves, wilderness areas, isolated forests and inshore marine ecosystems).

7. Train staff for quarantine, border control, or other relevant facilities to be aware of the larger context and threats to biological diversity, in addition to practical training for aspects like identification and regulation. (See Section 5.2.)

8. Build communication strategies into the planning phase of all prevention, eradication and control programmes. By ensuring that effective consultation takes place with local communities and all affected parties, most potential misunderstandings and disagreements can be resolved or accommodated in advance.

9. Include alien invasive species issues, and actions that can be taken to address them, in appropriate places in educational programmes and schools.

10. Ensure that national legislation applicable to introductions of alien species, both intentional and unintentional, is known and understood, not only by the citizens and institutions of the country concerned, but also by foreigners importing goods and services as well as by tourists.

5. PREVENTION AND INTRODUCTIONS

5.1 Guiding Principles

* Preventing the introduction of alien invasive species is the cheapest, most effective and most preferred option and warrants the highest priority.

* Rapid action to prevent the introduction of potential alien invasives is appropriate, even if there is scientific uncertainty about the long-term outcomes of the potential alien invasion.

* Vulnerable ecosystems should be accorded the highest priority for action, especially for prevention initiatives, and particularly when significant biodiversity values are at risk. Vulnerable ecosystems include islands and isolated ecosystems such as lakes and other freshwater ecosystems, cloud forests, coastal habitats and mountain ecosystems.

* Since the impacts on biological diversity of many alien species are unpredictable, any intentional introductions and efforts to identify and prevent unintentional introductions should be based on the precautionary principle.

* In the context of alien species, unless there is a reasonable likelihood that an introduction will be harmless, it should be treated as likely to be harmful.

* Alien invasives act as "biological pollution" agents that can negatively affect development and quality of life. Hence, part of the regulatory response to the introduction of alien invasive species should be the principle that "the polluter pays" where "pollution" represents the damage to native biological diversity.

* Biosecurity threats justify the development and implementation of comprehensive legal and institutional frameworks.

* The risk of unintentional introductions should be minimised.

* Intentional introductions should only take place with authorisation from the relevant agency or authority. Authorisation should require

comprehensive evaluations based on biodiversity considerations (ecosystem, species, genome). Unauthorised introductions should be prevented.

* The intentional introduction of an alien species should only be permitted if the positive effects on the environment outweigh the actual and potential adverse effects. This principle is particularly important when applied to isolated habitats and ecosystems, such as islands, fresh water systems or centres of endemism.

* The intentional introduction of an alien species should not be permitted if experience elsewhere indicates that the probable result will be the extinction or significant loss of biological diversity.

* The intentional introduction of an alien species should only be considered if no native species is considered suitable for the purposes for which the introduction is being made.

5.2 Unintentional Introductions - Recommended Actions

Unfortunately, it can be very difficult to control unintentional introductions that occur through a wide variety of ways and means. They include the most difficult types of movement to identify, control and prevent. By their very nature the most practical means of minimising unintentional introductions is by identifying, regulating and monitoring the major pathways. While pathways vary between countries and regions, the best known are international and national trade and tourism routes, through which the unintentional movement and establishment of many alien species occurs.

Recommended actions to reduce the likelihood of unintentional introductions are:

1. Identify and manage pathways leading to unintentional introductions. Important pathways of unintentional introductions include: national and international trade, tourism, shipping, ballast water, fisheries, agriculture, construction projects, ground and air transport, forestry, horticulture, landscaping, pet trade and aquaculture.

2. Contracting parties to the Convention on Biological Diversity, and other affected countries, should work with the wide range of relevant international trade authorities and industry associations, with the goal of significantly reducing the risk that trade will facilitate the introduction and spread of alien invasive species.

3. Develop collaborative industry guidelines and codes of conduct, which minimise or eliminate unintentional introductions.

4. Examine regional trade organisations and agreements to minimise or eliminate unintentional introductions that are caused by their actions.

5. Explore measures such as: elimination of economic incentives that assist the introduction of alien invasive species; legislative sanctions for introductions of alien species unless no fault can be proved; internationally available information on alien invasive species, by country or region, for use in border and quarantine control, as well as for prevention, eradication and control activities. (See also Section 8.)

6. Implement the appropriate initiatives to reduce the problems of alien invasives arising from ballast water discharges and hull fouling. These include: better ballast water management practices; improved ship design; development of national ballast water programmes; research, sampling and monitoring regimes; information to port authorities and ships' crews on ballast water hazards. Make available existing national guidelines and legislation on ballast water (for example Australia, New Zealand, USA). At the national, regional and international level, disseminate international guidelines and recommendations, such as the International Maritime Organisation's guidelines on ballast water and sediment discharges. (See also Section 9.2.2.)

7. Put in place quarantine and border control regulations and facilities and train staff to intercept the unintentional introduction of alien species. Quarantine and border control regulations should not be premised only on narrow economic grounds that primarily relate to agriculture and human health, but, in addition, on the unique biosecurity threats each country is exposed to. 7. Improved performance at intercepting unintentional introductions that arrive via major pathways may require an expansion of the responsibilities and resourcing of border control and quarantine services. (Also see 9.2)

8. Address the risks of unintentional introductions associated with certain types of goods or packaging through border control legislation and procedures.

9. Put in place appropriate fines, penalties or other sanctions to apply to those responsible for unintentional introductions through negligence and bad practice.

10. Ensure compliance by companies dealing with transport or movement of living organisms with the biosecurity regimes established by governments in the exporting and importing countries. Provide for their activities to be subjected to appropriate levels of monitoring and control.

11. For island countries with high risks and high vulnerabilities to alien invasive species, develop the most cost-effective options for governments wanting to avoid the high costs of controlling alien invasive species. These include more holistic approaches to biosecurity threats and better resourcing of quarantine and border control operations, including greater inspection and interception capabilities.

12. Assess large engineering projects, such as canals, tunnels and roads that cross biogeographical zones, that might mix previously separated flora and fauna and disturb local biological diversity. Legislation requiring environmental impact assessment of such projects should require an assessment of the risks associated with unintentional introductions of alien invasive species.

13. Have in place the necessary provisions for taking rapid and effective action, including public consultation, should unintentional introductions occur.

5.3 Intentional Introductions - Recommended Actions

1. Establish an appropriate institutional mechanism such as a 'biosecurity' agency or authority as part of legislative reforms on invasives. (Refer to Section 9.) This is a very high priority, since at present the legislative framework of most countries rarely treats intentional introductions in a holistic manner, that is, considers all organisms likely to be introduced and their effect on all environments. The usual orientation is towards sectors, e.g. agriculture. Consequently the administrative and structural arrangements are usually inadequate to deal with the entire range of incoming organisms, the implication for the environments into which they are being introduced, or with the need for rapid responses to emergency situations.

2. Empower the biosecurity agency, or other institutional mechanism, to reach decisions on whether proposed introductions should be authorised, to develop import and release guidelines and to set specific conditions, where appropriate. (Operational functions should reside with other agencies. See 9.2.1)

3. Give utmost importance to effective evaluation and decision-making processes. Carry out an environment impact assessment and risk assessment as part of the evaluation process before coming to a decision on introducing an alien species. (See Appendix)
4. Require the intending importer to provide the burden of proof that a proposed introduction will not adversely affect biological diversity.
5. Include consultation with relevant organisations within government, with NGOs and, in appropriate circumstances, with neighbouring countries, in the evaluation process.
6. Where relevant, require that specific experimental trials (e.g. to test the food preferences or infectivity of alien species) be conducted as part of the assessment process. Such trials are often required for biological control proposals and appropriate protocols for such trials should be developed and followed.
7. Ensure that the evaluation process allows for the likely environmental impacts, risks, costs (direct and indirect, monetary and non-monetary) benefits, and alternatives, to have been identified and assessed by the biosecurity authority in the importing country. This authority is then in a position to decide if the likely benefits outweigh the possible disadvantages. The public release of an interim decision, along with related information, should be made with time for submissions from interested parties before the biosecurity agency makes a final decision.
8. Impose containment conditions on an introduction if and where appropriate. In addition, monitoring requirements are often necessary following release as part of management.
9. Regardless of legal provisions, encourage exporters and importers to meet best practice standards to minimise any invasive risks associated with trade, as well as containing any accidental escapes that may occur.
10. Put in place quarantine and border control regulations and facilities and train staff to intercept unauthorised intentional introductions.
11. Develop criminal penalties and civil liability for the consequent eradication or control costs of unauthorised intentional introductions.
12. Ensure that provisions are in place, including the ability to take rapid and effective action to eradicate or control, in the event that an unauthorised introduction occurs, or that an authorised introduction of an alien species

unexpectedly or accidentally results in a potential threat of biological invasion. (See Sections 6 and 9.)

13. As well as taking the efforts that are required at global and regional levels to reduce the risk that trade will facilitate unintentional introductions (Section 5.2), utilise opportunities to improve international instruments and practices relating to trade that affect intentional introductions. For example, the Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) are addressing the implications alien invasive species may have on the operation of the Convention. Similar initiatives should be made with respect to relevant international trade authorities and industry associations.

6. ERADICATION AND CONTROL

When a potential or actual alien invasive species has been detected, in other words, when prevention has not been successful, steps to mitigate adverse impacts include eradication, containment and control. Eradication aims to completely remove the alien invasive species. Control aims for the long term reduction in abundance or density of the alien invasive species. A special case of control is containment, where the aim is to limit the spread of the alien invasive species and to contain its presence within defined geographical boundaries.

6.1 Guiding Principles

- * Preventing the introduction of alien invasive species should be the first goal.
- * Early detection of new introductions of potential or known alien invasive species, together with the capacity to take rapid action, is often the key to successful and cost-effective eradications.
- * Lack of scientific or economic certainty about the implications of a potential biological alien invasion should not be used as a reason for postponing eradication, containment or other control measures.
- * The ability to take appropriate measures against intentionally or unintentionally introduced alien invasive species should be provided for in legislation.
- * The best opportunities for eradicating or containing an alien invasive species are in the early stages of invasion, when populations are small and

localised. (These opportunities may persist for a short or long time, depending on the species involved and other local factors.)

* Eradication of new or existing alien invasive species is preferable and is more cost effective than long-term control, particularly for new cases.

* Eradication should not be attempted unless it is ecologically feasible and has the necessary financial and political commitment to be completed.

* A strategically important focus for eradication is to identify points of vulnerability in the major invasive pathways, such as international ports and airports, for monitoring and eradication activities.

6.2 Eradication - Recommended Actions

1. Where it is achievable, promote eradication as the best management option for dealing with alien invasive species where prevention has failed. It is much more cost effective financially than ongoing control, and better for the environment. Technological improvements are increasing the number of situations where eradication is possible, especially on islands. Eradication is likely to be more difficult in the marine environment. The criteria that need to be met for eradication to succeed are given in the Appendix.

2. When a potentially alien invasive species is first detected, mobilise and activate sufficient resources and expertise quickly. Procrastination markedly reduces the chances of success. Local knowledge and community awareness can be used to detect new alien invasions. Depending on the situation, a country's response might be within the country, or may require a cooperative effort with other countries.

3. Give priority to eradication at sites where a new alien invasion has occurred and is not yet well established.

4. Ensure eradication methods are as specific as possible with the objective of having no long-term effects on non-target native species. Some incidental loss to non-target species may be an inevitable cost of eradication and should be balanced against the long-term benefits to native species.

5. Ensure that persistence of toxins in the environment does not occur as a result of eradication. However, the use of toxins that are unacceptable for long-term control may be justified in brief and intensive eradication campaigns. The costs and benefits of the use of toxins need to be carefully assessed in these situations.

6. Ensure that methods for removing animals are as ethical and humane as possible, but consistent with the aim of permanently eliminating the alien invasive species concerned.

7. Given that interest groups may oppose eradication for ethical or self-interest reasons, include a comprehensive consultation strategy and develop community support for any proposed eradication as an integral part of the project.

8. Give priority to the eradication of alien invasive species on islands and other isolated areas that have highly distinctive biodiversity or contain threatened endemics.

9. Where relevant, achieve significant benefits for biological diversity by eradicating key alien mammalian predators (e.g. rats, cats, mustelids, dogs) from islands and other isolated areas with important native species. Similarly, target key feral and alien mammalian herbivores (e.g. rabbits, sheep, goats, pigs) for eradication to achieve significant benefits for threatened native plant and animal species.

10. Seek expert advice where appropriate. Eradication problems involving several species are often complex, such as determining the best order in which to eradicate species. A multidisciplinary approach might be best, as recommended in the IUCN Guidelines for Re-introductions.

6.3 Defining the Desired Outcomes of Control

The relevant measure of success of control is the response in the species, habitat, ecosystem or landscape that the control aims to benefit. It is important to concentrate on quantifying and reducing the damage caused by alien invasives, not concentrating on merely reducing numbers of alien invasives. Rarely is the relationship between pest numbers and their impacts a simple one. Hence estimating the reduction in the density of the alien invasive species will not necessarily indicate an improvement in the wellbeing of the native species, habitat or ecosystem that is under threat. It can be quite difficult to identify and adequately monitor the appropriate measures of success. It is important to do so, however, if the main goal, namely preventing the loss of biodiversity, is to be achieved.

6.4 Choosing Control Methods

Control methods should be socially, culturally and ethically acceptable, efficient, non-polluting, and should not adversely affect native flora and fauna, human health and well-being, domestic animals, or crops. While

meeting all of these criteria can be difficult to achieve they can be seen as appropriate goals, within the need to balance the costs and benefits of control against the preferred outcomes.

Specific circumstances are so variable it is only possible to give broad guidelines of generally favoured methods: specific methods are better than broad spectrum ones. Biological control agents may sometimes be the preferred choice compared to physical or chemical methods, but require rigorous screening prior to introduction and subsequent monitoring. Physical removal can be an effective option for clearing areas of alien invasive plants. Chemicals should be as specific as possible, non-persistent, and non-accumulative in the food chain. Persistent organic pollutants, including organochlorine compounds should not be used. Control methods for animals should be as humane as possible, consistent with the aims of the control.

6.5 Control Strategies - Recommended Actions

Unlike eradication, control is an ongoing activity that has different aims and objectives. While there are several different strategic approaches that can be adopted they should have two factors in common. First, the outcomes that are sought need to achieve gains for native species, be clearly articulated, and widely supported. Second, there needs to be management and political commitment to spend the resources required over time to achieve the outcomes. Badly focused and half-hearted control efforts can waste resources which might be better spent elsewhere.

Recommended actions are as follows:

1. Prioritise the alien invasive species problems according to desired outcomes. This should include identifying the areas of highest value for native biological diversity and those most at risk from alien invasives. This analysis should take into account advances in control technology and should be reviewed from time to time.

2. Draw up a formal control strategy that includes identifying and agreeing to the prime target species, areas for control, methodology and timing. The strategy may apply to parts of, or to a whole country, and should have appropriate standing as, for example, the requirements of Article 6 of the Convention on Biological Diversity ("General Measures for Conservation and Sustainable Use"). Such strategies should be publicly available, be open for public input, and be regularly reviewed.

3. Consider stopping further spread as an appropriate strategy when eradication is not feasible, but only where the range of the alien invasive is limited and containment within defined boundaries is possible. Regular

monitoring outside the containment boundaries is essential, with quick action to eradicate any new outbreaks.

4. Evaluate whether long-term reduction of alien invasive numbers is more likely to be achieved by adopting one action or set of linked actions (multiple action control). The best examples of single actions come from the successful introduction of biological control agent(s). These are the 'classical' biological control programs. Any intentional introductions of this nature should be subject to appropriate controls and monitoring. (See also Sections 5.3, 9 and Appendix.) Exclusion fencing can be an effective single action control measure in some circumstances. An example of multiple action control is integrated pest management which uses biological control agents coupled with various physical and chemical methods at the same time.

5. Increase the exchange of information between scientists and management agencies, not only about alien invasive species, but also about control methods. As techniques are continuously changing and improving it is important to pass this information on to management agencies for use.

6.6 Game and Feral Species as Alien Invasives - Recommended Actions

Feral animals can be some of the most aggressive and damaging alien species to the natural environment, especially on islands. Despite any economic or genetic value they may have, the conservation of native flora and fauna should always take precedence where it is threatened by feral species. Yet some alien invasive species that cause severe damage to native biodiversity have acquired positive cultural values, often for hunting and fishing opportunities. The result can be conflict between management objectives, interest groups and communities. In these circumstances it takes longer to work through the issues, but resolution can often be achieved through public awareness and information campaigns about the damaging impacts of the alien invasives, coupled with consultation and adaptive management approaches that have community support. Risk analysis and environmental impact assessment may also help to develop appropriate courses of action and solutions.

Recommended actions are as follows:

1. Consider managing hunting conflicts on public land by designating particular areas for hunting while carrying out more stringent control to protect biodiversity values elsewhere. This option is limited in its application to situations where there is high value attached to the alien species and yet biological diversity values can still be protected through localised action.

2. Evaluate the option of removal of a representative number of the feral animals to captivity or domestication where eradication in the wild is planned.
3. Strongly encourage owners and farmers to take due care to prevent the release or escape of domestic animals that are known to cause damage as feral animals, e.g. cats, goats.
4. Develop legal penalties to deter such releases and escapes in circumstances where costly economic or damaging ecological consequences are likely to follow.

7. LINKS TO RE-INTRODUCTION OF SPECIES

7.1 Guiding Principle

* Successful eradications and some control programmes can significantly improve the likely success of re-introductions of native species, and thereby provide opportunities to reverse earlier losses of native biological diversity.

7.2 Links Between Eradication and Control Operations and Re-introductions

An eradication operation that successfully removes an alien invasive species, or a control operation that lowers it to insignificant levels, usually improves the conditions for native species that occupy or previously occupied that habitat. This is especially true on many oceanic islands. Eradications are often undertaken as part of the preparation for re-introduction(s).

The IUCN Guidelines for Re-introductions (May 1995) were developed to provide "...direct, practical assistance to those planning, approving or carrying out re-introductions." These guidelines elaborate requirements and conditions, including feasibility studies, criteria for site selection, socio-economic and legal requirements, health and genetic screening of individuals, and issues surrounding the proposed release of animals from captivity or rehabilitation centres. They should be referred to as part of the planning of eradication or control operations where re-introductions might be an appropriate and related objective. They should also be referred to if reviewing any re-introduction proposal.

The socio-economic considerations that apply to eradication and control operations largely apply to re-introductions as well, namely the importance of community and political support, financial commitment and public

awareness. This makes it cost-effective to combine consultation over the eradication objective with proposals to re-introduce native species. It has the added advantage of offsetting the negative aspects of some eradications (killing valued animals) with the positive benefits of re-introducing native species (restoring heritage, recreation or economic values).

8. KNOWLEDGE AND RESEARCH ISSUES

8.1 Guiding Principle

* An essential element in the campaigns against alien invasive species at all levels (global, national, local) is the effective and timely collection and sharing of relevant information and experiences, which, in turn, assist advances in research and better management of alien invasive species.

8.2 Recommended Actions

1. Give urgency to the development of an adequate knowledge base as a primary requirement to address the problems of alien invasive species worldwide. Although a great deal is known about many such species and their control, this knowledge remains incomplete and is difficult to access for many countries and management agencies.

2. Contribute to the development of an easily accessible global database (or linked databases) of all known alien invasive species, including information on their status, distribution, biology, invasive characteristics, impacts and control options. It is important that Governments, management agencies and other stakeholders should all participate in this.

3. Develop "Black Lists " of alien invasive species at national, regional and global levels that are easily accessible to all interested parties. While "Black Lists" are a useful tool for focusing attention on known alien invasive species, they should not be taken to imply that unlisted alien species are not potentially harmful.

4. Through national and international research initiatives, improve knowledge of the following: ecology of the invasion process, including lag effects; ecological relationships between invasive species; prediction of which species and groups of species are likely to become invasive and under what conditions; characteristics of alien invasive species; impacts of global climate change on alien invasive species; existing and possible future vectors; ecological and economic losses and costs associated with introductions of alien invasive species; sources and pathways caused by human activity.

5. Develop and disseminate better methods for excluding or removing alien species from traded goods, packaging material, ballast water, personal luggage, aircraft and ships.

6. Encourage and support further management research on: effective, target-specific, humane and socially acceptable methods for eradication or control of alien invasive species; early detection and rapid response systems; development of monitoring techniques; methods to gather and effectively disseminate information for specific audiences.

7. Encourage monitoring, recording and reporting so that any lessons learned from practical experiences in management of alien invasive species can contribute to the knowledge base.

8. Make better use of existing information and experiences to promote wider understanding and awareness of alien invasive species issues. There need to be strong linkages between the actions taken under Sections 4 and 8.

9. LAW AND INSTITUTIONS

9.1 Guiding Principles

* A holistic policy, legal and institutional approach by each country to threats from alien invasive species is a prerequisite to conserving biological diversity at national, regional and global levels.

* Effective response measures depend on the availability of national legislation that provides for preventative as well as remedial action. Such legislation should also establish clear institutional accountabilities, comprehensive operational mandates, and the effective integration of responsibilities regarding actual and potential threats from alien invasive species.

* Cooperation between countries is needed to secure the conditions necessary to prevent or minimise the risks from introductions of potentially alien invasive species. Such cooperation is to be based on the responsibility that countries have to ensure that activities within their jurisdiction or control do not cause damage to the environment of other countries.

9.2 Recommended Actions

9.2.1 National level

1. Give high priority to developing national strategies and plans for responding to actual or potential threats from alien invasive species, within the context of national strategies and plans for the conservation of biological diversity and the sustainable use of its components.

2. Ensure that appropriate national legislation is in place, and provides for the necessary controls of intentional and non-intentional introductions of alien species, as well as for remedial action in case such species become invasive. Major elements of such legislation are identified in previous sections, particularly sections 5 and 6.

3. Ensure that such legislation provides for the necessary administrative powers to respond rapidly to emergency situations, such as border detection of potential alien invasive species as well as to address threats to biological diversity caused by intentional or non-intentional introductions of alien species across biogeographical boundaries within one country.

4. Ensure, wherever possible, for the designation of a single authority or agency responsible for the implementation and enforcement of national legislation, with clear powers and functions. In cases where this proves impossible, ensure there is a mechanism to coordinate administrative action in this field, and set up clear powers and responsibilities between the administrations concerned. (Note : these operational roles regarding implementation and enforcement are different from, and in addition to the specific function of the 'biosecurity' agency that was recommended in Section 5.3.)

5. Review national legislation periodically, including institutional and administrative structures, in order to ensure that all aspects of alien invasive species issues are dealt with according to the state of the art, and that the legislation is implemented and enforced.

9.2.2 International level

1. Implement the provisions of international treaties, whether global or regional, that deal with alien invasive species issues and constitute a compulsory mandate for respective Parties. Most prominent among these treaties is the Convention on Biological Diversity, and a number of regional accords.

2. Implement decisions taken by Parties to specific global and regional conventions, such as resolutions, codes of conduct or guidelines related to introductions of alien species, for example the International Maritime Organisation's guidance on ballast water.

3. Consider the desirability, or as the case may be, necessity, of conducting further agreements, on a bilateral or multilateral basis, or adapting existing ones, with respect to the prevention or control of introduction of alien species. This includes, in particular, consideration of international agreements related to trade, such as those under the auspices of the World Trade Organisation.
4. For neighbouring countries, consider the desirability of cooperative action to prevent potential alien invasive species from migrating across borders, including agreements to share information, through, for example, information alerts, as well as to consult and develop rapid responses in the event of such border crossings.
5. Generally develop international cooperation to prevent and combat damage caused by alien invasive species, and provide assistance and technology transfer as well as capacity building related to risk assessment as well as management techniques.

10. ROLE OF IUCN

1. IUCN will continue to contribute to the Global Invasive Species Programme (GISP)(3), together with CAB International, the United Nations Environment Programme (UNEP) and the Scientific Committee on Problems of the Environment (SCOPE).
2. IUCN will actively participate in the processes and meetings of the Convention on Biological Diversity (CBD) to implement article 8(h) by providing scientific, technical and policy advice.
3. The components of IUCN (including its Commissions, Programmes and Regional Offices) will act together to support the IUCN Global Initiative on Invasive Species.
4. IUCN will maintain and develop links and cooperative programmes with other organisations involved in this issue, including international organisations such as the United Nations Environment Programme, Food and Agricultural Organisation, Scientific Committee on Problems of the Environment, World Trade Organisation and international NGOs. IUCN will work with work with Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Parties to the Convention on Biological Diversity (CBD), Parties to the RAMSAR Convention, and with regional programmes such as the South Pacific Regional Environment Programme (SPREP).

5. IUCN regional networks will play a significant role in raising public awareness at all levels on the issues of alien invasive species, the various threats to native biological diversity and the economic implications, as well as options for control.

6. The IUCN Invasive Species Specialist Group (ISSG) of the Species Survival Commission (SSC) will, through its international network, continue to collect, organise and disseminate information on alien invasive species, on prevention and control methods, and on ecosystems that are particularly vulnerable to alien invasion.

7. The separate work of IUCN/SSC on identifying species threatened with extinction and areas with high levels of endemism and biodiversity will be supported. This work is valuable when assessing alien invasion risks, priority areas for action, and for practical implementation of these guidelines.

8. The ongoing work of the ISSG will be supported, including the following actions: the development and maintenance of a list of expert advisors on control and eradication of alien invasive species; expansion of the alien invasive species network; production and distribution of newsletters and other publications.

9. IUCN, in association with other cooperating organisations, will take a lead in the development and transfer of capacity building programmes (e.g. infrastructure, administration, risk and environmental assessment, policy, legislation), in support of any country requesting such assistance or wishing to review its existing or proposed alien invasive species programmes.

10. IUCN will take an active role in working with countries, trade organisations and financial institutions (e.g. World Trade Organisation, World Bank, International Monetary Fund, International Maritime Organisation) to ensure that international trade and financial agreements, codes of practice, treaties and conventions take into account the threats posed to biological diversity and the financial costs and economic losses associated with alien invasive species.

11. The ISSG will support the work of the IUCN Environmental Law Programme in assisting countries to review and improve their legal and institutional frameworks concerning alien invasive species issues.

12. The ISSG will develop regional databases and early warning systems on alien invasive species and work with other cooperating organisations to ensure efficient and timely dissemination of relevant information to requesting parties.

11. BIBLIOGRAPHY AND RELATED INFORMATION

The guiding principles and text of these guidelines are partially based on, or sourced from the following important documents:

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12. ACKNOWLEDGEMENTS

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APPENDIX

1. Environmental Impact Assessment (EIA)

Generic questions in the EIA process concerning impacts a proposed introduced species may have on the environment should include the following:

- * Does the proposed introduction have a history of becoming invasive in other places? If yes, it is likely to do so again and should not be considered for introduction.
- * What is the probability of the alien species increasing in numbers and causing damage, especially to the ecosystem into which it would be introduced?
- * Given its mode of dispersal, what is the probability the alien species would spread and invade other habitats?
- * What are the likely impacts of natural cycles of biological and climatic variability on the proposed introduction? (Fire, drought and flood can substantially affect the behaviour of alien plants.)
- * What is the potential for the alien species to genetically swamp or pollute the gene pool of native species through interbreeding?
- * Could the alien species interbreed with a native species to produce a new species of aggressive polyploid invasive?
- * Is the alien species host to diseases or parasites communicable to native flora or fauna, humans, crops, or domestic animals in the proposed area for introduction?
- * What is the probability that the proposed introduction could threaten the continued existence or stability of populations of native species, whether as a predator, as a competitor for food, cover, or in any other way?
- * If the proposed introduction is into a contained area(s) with no intention of release, what is the probability of a release happening accidentally?
- * What are the possible negative impacts of any of the above outcomes on human welfare, health or economic activity?

2. Risk Assessment

This refers to an approach that seeks to identify the relevant risks associated with a proposed introduction and to assess each of those risks. Assessing risk means looking at the size and nature of the potential adverse effects of a proposed introduction as well as the likelihood of them happening. It should identify effective means to reduce the risks and examine alternatives to the proposed introduction. The proposed importer often does a risk assessment as a requirement by the decision-making authority.

3. Criteria to be Satisfied to Achieve Eradication

- * The rate of population increase should be negative at all densities. At very low densities it becomes progressively more difficult and costly to locate and remove the last few individuals.
- * Immigration must be zero. This is usually only possible for offshore or oceanic islands, or for very new alien invasions.

* All individuals in the population must be at risk to the eradication technique(s) in use. If animals become bait- or trap-shy, then a sub-set of individuals may no longer be at risk to those techniques.

* Monitoring of the species at very low densities must be achievable. If this is not possible survivors may not be detected. In the case of plants, the survival of seed banks in the soil should be checked.

* Adequate funds and commitment must continuously exist to complete the eradication over the time required. Monitoring must be funded after eradication is believed to have been achieved until there is no reasonable doubt of the outcome.

* The socio-political environment must be supportive throughout the eradication effort. Objections should be discussed and resolved, as far as practicable, before the eradication is begun.

Footnotes

1 Definition of Terms in section 3

2 At the time of adoption of these Guidelines by IUCN, standard terminology relating to alien invasive species has not been developed in the CBD context. Definitions used in this document were developed by IUCN in the specific context of native biodiversity loss caused by alien invasive species.

3 SCOPE, UNEP, IUCN and CABI have embarked on a programme on invasive species, with the objective of providing new tools for understanding as well as dealing with invasive species. This initiative is called the Global Invasive Species Programme (GISP). GISP engages the many constituencies involved in the issue, including scientists, lawyers, educators, resource managers and people from industry and government. GISP maintains close cooperation with the CBD Secretariat on the issue of alien species.

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