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The Need for Predator Management in Conservation of Some Vulnerable Species

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Abstract

Predator management is often controversial, and public understanding of why it is a necessary component of protection for some threatened, endangered, and other rare species is generally poor. Habitat fragmentation and other landscape-level changes have increased rates of predation of some species far above natural levels. Small or reduced populations may also be unable to withstand natural fluctuations in survival and productivity, including those caused by predation. Some critics of predator management advocate restricting its use to situations in which all other protection strategies have failed, but this approach may carry severe risks for many imperiled species. The best predator management strategy is often an adaptive approach that monitors as many factors as possible, considers a full range of management techniques, continually appraises their effectiveness, and makes appropriate adjustments. There is an important need for natural resource managers and interpreters to educate the public about this complex issue that affects conservation efforts for many vulnerable species.

Introduction

Implementing predator management is sometimes unpleasant, especially compared to unambiguously positive management activities such as habitat restoration. Opponents of predator management often sensationalize it. For many wildlife biologists and wildlands managers, especially those working in proximity to urban and suburban communities, predator management frequently alienates customary supporters. The fact remains, however, that predation is a critical threat to many threatened, endangered and locally rare species. Willingness of land managers to implement predator management, sometimes including lethal removal, may be the make-or-break factor that determines whether all other protection efforts for some vulnerable species will ultimately succeed or fail.

In discussions with concerned citizens, the media, and public officials, it is becoming increasingly clear that, beyond an understandable dis-

taste for "harming one species to help another," there often exists a fundamental lack of understanding of why such activities might ever be needed. The most basic life science curriculum and countless park visitor center exhibits teach us the concept of the food chain: herbivores eat plants and are then eaten by carnivores. So, isn't predation natural? Isn't predator management just another example of misguided people tinkering with nature and a system that would do fine if we would only stop interfering? Unfortunately, this simplistic philosophy overlooks several common problems in the dynamics of so-called "natural communities" and, especially, their effects on small populations.

Predation is natural; that human activities have altered the types, numbers, and activity patterns of many native predator species, is not. Increased populations of those predator species that are well suited to exploit human-induced environmental changes are especially problematic.

Highly mobile and adaptable predators such as the striped skunk (*Mephitis mephitis*), raccoon (*Procyon lotor*), and red fox (*Vulpes vulpes*) thrive on the contents of garbage cans and dumpsters. The areas under buildings and other structures furnish ready-made dens. Conversely, many threatened and endangered species have highly-specialized habitat requirements. These species become progressively restricted in range and reduced in numbers as their essential habitats are lost or degraded through development, conversion to agriculture, timber harvesting, spread of invasive non-native plants, exclusion of fire, or other mechanisms.

The bottom line is that, while predation is a natural phenomenon that cannot and should not be eliminated, many species suffer from excessive rates of predation. Elevated predation pressure reduces the natural biodiversity of many areas designated for conservation and threatens the survival of some species. A mandate

to protect the natural character of an area should no more preclude measures needed to curtail unnatural predation pressure than it should rule out re-introduction of previously extirpated species or controlling land uses such as livestock grazing or off-road vehicle traffic.

The role of habitat fragmentation and other landscape-level changes

While anthropogenic environmental changes are rapidly reducing habitat availability for some species and favoring more adaptable species, the impacts of habitat loss are often magnified due to fragmentation of the remaining native habitats. For example, a number of studies (e.g., Andren and Angelstam 1988; Yahner and Scott 1988; Johnson and Temple 1990; Robinson et al. 1995; Hoover et al. 1995; Keyser et al. 1998) document an inverse relationship between rates of nest predation (of real and artificial nests) and size of forest or prairie habitat patch. The smaller the habitat area, the greater the incidence of predation. Possible explanations include:

- The greater proportion of edge compared to total area in smaller habitat patches. This exposes a larger proportion of nests to forays by predators that inhabit the surrounding altered habitat.
- Loss of large predators that regulate numbers of small predators in small habitat patches. This results in expanded populations of small predators that, in turn, increase predation of bird nests.
- Increased density of prey species attempting to breed in remnant habitats, some of which are forced to nest in sub-optimal locations. This may facilitate greater predator efficiency.
- Other changes in landscape structure that affect behavior of predators and/or prey species.

The problems posed by habitat fragmentation are often compounded by other human-induced conditions. Many predator species, such as opossum (*Didelphis virginiana*) and coyote (*Canis latrans*) greatly increased their range during the 20th century (Godin 1977; Gardner 1982; Nowak and Paradiso 1983). A 15-fold increase in the number of common ravens (*Corvus corax*) in the Mohave Desert between 1968-1988 was largely driven by human-supplied water and food (landfills, garbage dumps, agricultural developments), perches, and nest sites (fence posts, power poles and towers, signs, etc.). While these habitat changes are relatively localized, ravens are highly mobile predators causing substantially elevated mortality of the threatened Mohave desert tortoise (*Gopherus agassizii*) across a very extensive area (USFWS 1994). Without compensatory management to reduce effects of the outside influences that increase the numbers of such predators, the overall effect of habitat loss is often much greater than the raw percentage of lost habitat. The hard reality is that, without the intervention of management to identify and reduce the effects of deleterious human influence, we may be deluding ourselves that we are conserving natural communities when we are merely preserving open space.

One solution to the problems caused by habitat fragmentation is to place priority on conservation strategies that maintain species on larger habitat areas. Certainly there are many good biological reasons why large, relatively intact habitats should be targeted for conservation and why habitat restoration efforts should seek to reconnect and reconstruct larger habitats. Unfortunately, many threatened and endangered species owe their precarious status to drastic reductions in habitat, and opportunities to reverse these situations may be lim-

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ited and difficult to achieve. A poignant example is the endangered Northeastern roseate tern (*Sterna dougallii*) population. By the late 1980s, 85 percent of these colonial nesting birds were confined to only two island breeding sites. Though protected from development and human disturbance, these sites remain extremely vulnerable to nocturnal predatory birds, especially the great horned owl (*Bubo virginianus*) and the black-crowned night heron (*Nycticorax nycticorax*). Threats include not only direct depredation, but also mortality of chicks and eggs due to chilling and other problems that occur when adult terns desert their nests in response to predators. Furthermore, human disturbance, erosion, and encroachment by herring and great black-backed gulls (*Larus argentatus* and *L. marinus*, respectively) contributed to displacement or drastic reductions in numbers of nesting roseate terns at 30 or more historic nesting locations between 1920 and 1979. This, in turn, has foiled one of the terns' natural defenses against predation, that of changing nest sites. Early detection and selective removal of predators in major breeding colonies is a cornerstone of protection and recovery efforts for this species (USFWS 1998) and is being judiciously and successfully implemented at virtually all remaining large colonies.

Added vulnerability of small populations

Another commonly overlooked concern with predation is its potential effect on the unique dynamics of small populations. Just as some predation is "natural," so are fluctuations in the size of populations that are due in turn to variation in productivity and survival rates. Figure 1 presents a stylized illustration of this concept, including the occurrence of a major dip due to a large natural perturba-

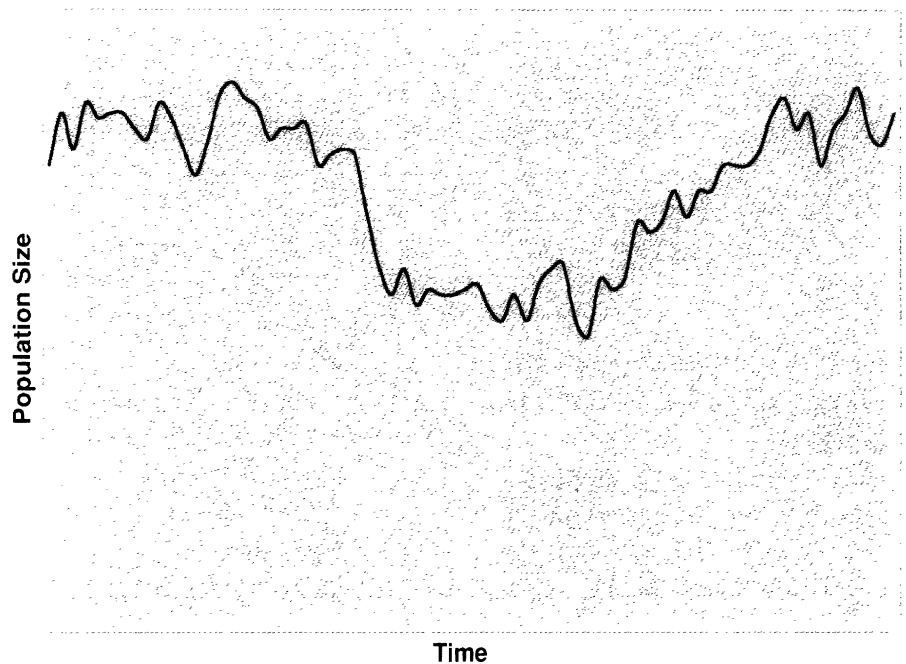


Figure 1. Size of a natural population will vary with fluctuations in survival and productivity.

tion such as fire, flood, or hurricane. However, a population that is already severely depleted due to habitat loss, over-harvesting, competition with non-native species, etc. may no longer be able to withstand such "natural" variations in productivity and survival (Figure 2). Fluctuations that typically cause no long-term ill effects for a large healthy population may help drive a small population to a threshold below which the probability of survival and recovery becomes extremely low.

In some cases, even a species whose gross numbers remain relatively high can be vulnerable to extinction if it is comprised of small, fragmented populations. This is especially true for species that experience large fluctuations in survival and productivity rates. Since isolation impedes recolonization of habitats that might otherwise only "wink out" temporarily, each successive extirpation will serve to widen gaps in the species' range, further increasing its precarious status. Management efforts to bolster survival and productivity of isolated populations can play a key role in forestalling extirpations in areas where it will be difficult if

not impossible to restore the species.

For precariously small populations, the best hedge against extinction is to increase numbers as rapidly as possible and to dampen variability in productivity and survival rates. If population numbers can be increased sufficiently, the species' cushion against natural variation will be improved and the need for predator management may be lessened. Failure to recognize the extreme vulnerability of imperiled populations and protect them with all available tools, however, may unwittingly contribute to avoidable extinctions.

"Last resort" fallacy

Some critics of predator management advocate limiting its use to the most acute situations, when all other threats have been neutralized and the species remains at risk of imminent extinction. Certainly predator management should not be implemented without good evidence that predation is substantially affecting reproductive and/or mortality rates of the species of concern. Limiting predator management to "last resort" situations, however, risks further deterioration in the species' numbers. This approach also

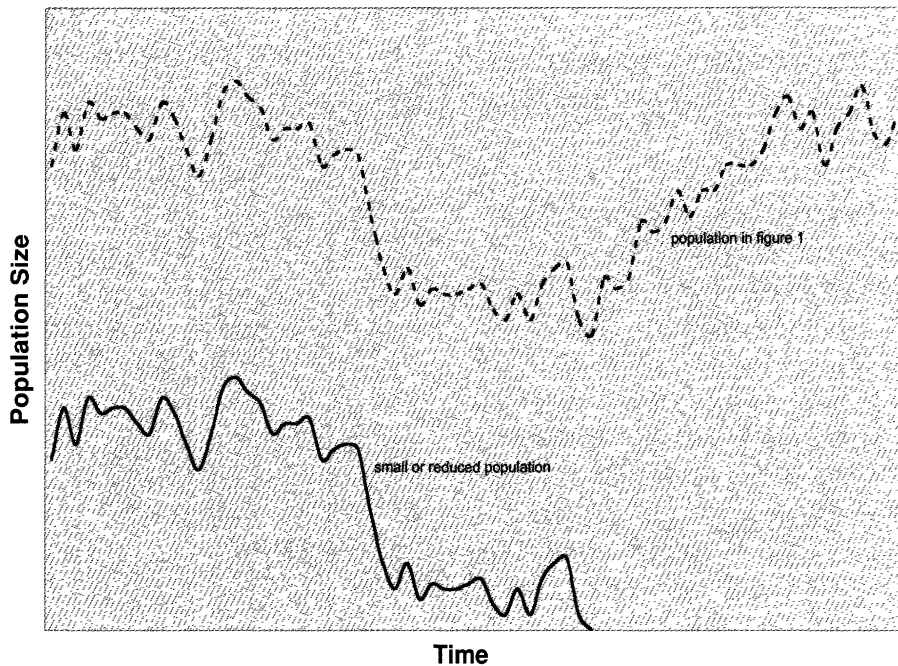


Figure 2. A small population may be vulnerable to extinction due to "natural" fluctuations easily withstood by a larger population.

fails to recognize that many imperiled species face multiple concurrent threats, and that gains are unlikely unless major threats are addressed simultaneously. The piping plover (*Charadrius melodus*), a threatened beach nesting bird, benefits from restricting off-road vehicles from nesting areas. Gains will be extremely limited, however, if predators consume almost all the plovers' eggs and chicks. The converse is also true: predator management efforts will be futile if flightless chicks are crushed by unregulated beach driving.

In addition to the direct biological risk that piecemeal protection will fail to stem a species' decline, failure to implement needed predator management poses sociopolitical risks for recovery efforts. The vast majority of Americans say they support the protection and recovery of rare species (see, for example, Kempton et al. 1995, Czech and Krausman 1999). When it comes time to implement specific protection actions, however, affected parties from abutting landowners to animal rights groups assume a defensive posture to protect their specific interests. On the other hand, when sacrifices are made, af-

ected citizens expect to see improvements in the status of the species in question. Any grudging support for the recovery program will quickly erode if it is perceived that managers are unwilling to implement other scientifically sound, but unpopular, protection measures. Thus, a strategy that reserves predator control only for "last resort" situations creates a likelihood that advocates for other interests will make similar demands, while the species suffers the consequences of overall inaction.

Choosing the best predator management technique

If we accept that management of predator populations for the benefit of other rare species is needed, then we face the task of selecting appropriate management techniques. Predator management does not necessarily equate to lethal predator removal. Nonlethal alternatives may include making habitat less attractive to the predator species, predator exclusion devices (such as fences), predator aversion techniques, live-trapping and translocation of predators, and other strategies. Each method, including lethal predator re-

moval, has strengths and weaknesses that vary not only with the technique, but with the specific application situation. Managers should approach predator management with an open mind, always remembering that the ultimate goal is conservation of the rare species, and reducing predation is sometimes a necessary component of efforts to attain that end.

Like almost any aspect of rare species conservation, predator management is part science and part art. Past successes or failures of a particular technique do not guarantee similar future outcomes, even at the same location or in situations that share many attributes. Effective predator management requires constant monitoring of the rare species (target) population, predator populations, and other salient environmental factors, both biotic and physical. The inherent dynamism of the natural environment makes it virtually impossible to evolve a perfect formula that predicts precisely the outcome of any management action, including predator management.

For example, predator exclosures (wire cages placed around nests) have been used with demonstrated success to reduce predation on piping plover eggs (Rimmer and Deblinger 1990; Melvin et al. 1992) and have contributed to population increases in some parts of their range. These same devices, however, have also caused serious problems. Plovers have died when they became entangled in exclosure tops. At some locations, exclosures have attracted "smart" predators that learned that they contain prey (USFWS 1996). Hazards associated with exclosures include not only predation or abandonment of nests at increased rates, but also induced mortality of adult birds. Since population modeling for this species shows that even modest reductions in survival of breeding adults pose grave risks for the persistence of small populations (Ryan

et al. 1993; Melvin and Gibbs 1994), exclosures carry very real potential for harm.

Predator exclosures remain a valuable tool for increasing piping plover productivity. Biologists deploying them, however, must exercise constant vigilance and regularly evaluate the relative benefits and risks of exclosures and alternative techniques. Such alternatives might include aversive conditioning of predators attracted to the exclosures, selective removal of predators attracted to these devices, and broader efforts to remove predators. If predation pressure is mild and plover populations are large and productive, then no predator management may be a viable option. The best overall predator management strategy is an adaptive approach that monitors many factors, considers a full range of management techniques, continually appraises their potential and actual effectiveness, and makes appropriate adjustments.

Conclusion: Need for public outreach and education

Predator management will likely remain controversial, even for rare species. While some wildlife managers seek to avoid controversy at all costs, debate may create opportunities to focus public attention and discussion on wider threats to biodiversity. If the ensuing dialogue is to encompass the real benefits and costs of predator management, however, public understanding of environmental changes affecting predation rates and the effects of predation on the dynamics of small populations must be im-

proved. Herein lies a critical role for natural resource managers and interpreters—educating the public about this complex issue.

Just as efforts to educate the public about the relationship between habitat loss and species endangerment has been challenging, so the task of improving public understanding of predation threats will require both ingenuity and persistence. The subject is complicated and emotional. That the survival of many precarious species hangs on our actions, however, creates very high stakes. We owe it to future generations to assure that decisions that affect these species are made with the full comprehension of the issues involved.

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Marine Matters

The Oceans Act: Legislation to Review Federal Ocean Policy

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Abstract

Thirty years have passed since the U.S. first underwent a comprehensive review of ocean policy. That review by the "Stratton Commission," which published their findings in the 1969 report Our Nation and the Sea, led to the creation of National Oceanic and Atmospheric Administration and the Coastal Zone Management Act. Since then, the threats facing our oceans have increased tremendously, as technological improvements and population growth have demonstrated that our oceans are not unlimited sources of wealth and resources. On the other hand, many of the nation's foremost laws and regulations to protect the marine environment were passed during this period. Yet these laws have not sufficed to protect our oceans and their living inhabitants. From 1975 to 1999, the number of threatened or endangered marine species or stocks grew from 20 to 61, with another 42 candidates for listing; and in 1999 over one third of our marine fisheries are "overfished" (depleted) or "approaching an overfished condition." After 30 years, another assessment of our ocean management framework is in order. The Oceans Act (S. 959; H.R. 2425) has been introduced in both the 105th and 106th Congresses to review current ocean policy and recommend any changes to improve the efficiency and effectiveness of such a policy. This article reviews the need for this legislation, its historical significance, and the impact that it could have on U.S. ocean management.

Introduction and historical context

Thirty years have passed since our nation made its first, and only, comprehensive review of our oceans, our ocean resources, and their management. Up until that time, our oceans were primarily viewed as a limitless, bountiful resource to be exploited. Legislation to comprehensively manage our ocean resources was minimal. While some laws, such as that which created the U.S. Commission of Fish and Fisheries (1871) were passed, these were aimed at improving the nation's ability to utilize our oceanic resources, especially fisheries (Federal Fisheries Investment Task Force 1999).

The Commission on Marine Science, Engineering, and Resources was created by President Johnson's signature of the Marine Resources

and Engineering Development Act of 1966 into law (P.L. 89-454). Similar to its legislative predecessors, the intent of this legislation was, "To develop, encourage, and maintain a coordinated, comprehensive, and long-range national program in marine science for the benefit of mankind to assist in protection of health and property, enhancement of commerce, transportation, and national security, rehabilitation of our commercial fisheries, and increased utilization of these and other resources" (P.L. 89-454, Sec. 2(a), reprinted in Knecht et al. 1998).

P.L. 89-454 created the Commission on Marine Science, Engineering, and Resources (also known as "the Stratton Commission"), composed of 15 individuals with expertise in marine science. The Commission was

charged with reviewing the known and anticipated needs for ocean resources, examining the existing research and engineering projects necessary to obtain those resources, recommending a national marine science program, and recommending a governmental organizational plan to implement these recommendations.

This landmark legislation set in motion a three-year process that culminated in the publication of *Our Nation and the Sea* by the Stratton Commission in 1969. This four volume work contained 120 recommendations to improve U.S. ocean management. Although the majority of the report's recommendations were never implemented, the report did result in three principle changes. First and foremost was the creation of the National Oceanic and Atmospheric

Administration (NOAA) as part of President Nixon's Reorganization Plan #4. While the report suggested the creation of an independent agency to oversee oceanography and marine resource management, as part of the plan the President submitted to Congress in July 1970, NOAA was proposed to be a part of the Department of Commerce. In 1971, NOAA was officially established as an agency of the Department of Commerce. The second result was the subsequent enactment of the Coastal Zone Management Act (CZMA) in 1972. The report proposed the creation of a coastal zone management program to integrate state and federal efforts; the CZMA to this day is the primary law responsible for the coordination of state and federal coastal policy and the protection of the coastal zone. The third result of the report was the beginning of a decade of enhanced ocean exploration (Knecht et al. 1998).

The 1970s were an era of heightened public awareness for the environment and the oceans that translated into a number of landmark laws to protect the marine environment. The National Environmental Policy Act (NEPA, 1970), the aforementioned Coastal Zone Management Act (CZMA, 1972), the Clean Water Act (CWA, 1972), the Marine Mammal Protection Act (MMPA, 1972), the Marine Protection, Research and Sanctuaries Act (MPRSA, 1972), the Endangered Species Act (ESA, 1973), and the Fishery Conservation and Management Act (FCMA, 1976) were all passed into law during this decade. In addition, 1971 saw the formation of the Environmental Protection Agency (EPA).

The growing threats facing our oceans

Thus, in a very short period of time the legal and regulatory framework for ocean management changed drastically. These laws reflected the

public's awareness of the need to protect the environment and the oceans. The increased protection mandated by these laws, however, was offset by at least two major factors: population growth and technological improvements.

Our nation's population, especially in coastal regions, has grown with alarming speed. From 1970 to 1994, the population in coastal counties grew from 110 to 138 million, resulting in nearly 53 percent of the U.S. population living on the coasts in only 17 percent of the U.S.'s contiguous land area. By 2015, this number is expected to reach 165 million people (Knecht et al. 1998). The industrial, agricultural, and suburban growth necessary to feed, house, and employ all these people has resulted in a tremendous increase in coastal water pollution. Point source discharges from industrial plants, agricultural runoff containing harmful pesticides and sediments, and urban runoff from driveways—nonpoint source pollution—have degraded our nation's coastal waters and estuaries.

Moreover, our nation has lost a vast number of its wetland and estuary areas as a result of coastal development. Over 50 percent of the wetlands in the contiguous United States have been lost since European settlement (CMC 1998; Kier 1998). These areas naturally filter sediments and pollutants and protect coastal water quality. In addition, they serve as nurseries and important habitat for as many as 75 percent of all commercially important species during a portion of their lifespan (Kier 1998; NOAA 1999).

Federal legislation in the 1960s and 1970s subsidized and promoted fisheries vessel development and increased funding for research on fisheries enhancement and development; for instance, the 1964 Amendment to the Fishing Fleet Improvement Act financed up to 50 percent of vessel

construction costs (NMFS 1996). The number of fishing vessels increased by 40 percent and the number of commercial fishermen increased by 60 percent from 1976 to 1995, resulting in a 50 percent increase in catch during that period (Buck 1995). As noted by Lisa Speer of the Natural Resources Defense Council, "the U.S. fleet was built up with federal subsidies in the late 1970s and early 1980s" (Russell 1997).

At the same time, and partially as a result of these subsidies, technological improvements in the ability of fishermen to catch fish increased tremendously. New, bigger boats meant that fishermen could stay longer at sea and fish areas that were formerly inaccessible. Moreover, improvements in fishing gear enabled fishermen to fish areas that were historically unavailable and which served as *de facto* "no take" zones and served to regulate fishing effort. In addition, recent technological advances (such as geographic information systems and side scan sonar) have given the modern-day fisherman a dramatic edge in effectiveness over the fishermen of the past. The ability of the U.S. to exploit its fishery resources was immensely increased during this period.

Yet with the ability to feed a growing world came an unforeseen consequence of our heightened exploitation of the oceans' resources: the depletion of many of our nation's fisheries and the near-extinction of some of the ocean's most beloved wildlife. While laws were written expressly to prevent these dire consequences from occurring, the overall decline of many marine mammal, sea bird, sea turtle, and fish populations was significantly contributed to by (1) the effectiveness of the U.S. and international fishing and whaling fleets, (2) the impacts of a growing coastal population, with its attendant problems of the loss of wetlands and coastal habitat and increased coastal water pollution, and

(3) the entanglement and death of animals in marine debris.

Between 1975 to 1999, the number of marine stocks or species listed as threatened or endangered under the Endangered Species Act (ESA) grew from 20 to 61, with another 42 species considered "candidates" for listing under the ESA (NOAA 1999). This number of threatened and endangered species includes almost all of the large whale species, including the blue (*Balaenoptera musculus*), bowhead (*Balaena mysticetus*), fin (*Balaenoptera physalus*), humpback (*Megaptera novaeangliae*), northern right (*Eubalaena glacialis*), sei (*Balaenoptera borealis*), and sperm whales (*Physeter macrocephalus*), all six species of sea turtles that are native to the United States, several species of seals, sea lions, and porpoises, including the Hawaiian monk seal (*Monachus schauinslandi*), the Stellar sea lion (*Eumetopias jubatus*), and the Guadalupe fur seal (*Arctocephalus townsendi*), and many fish species, especially West Coast salmon and trout subpopulations or "Environmentally Significant Units" (ESUs). The white abalone (*Haliotis sorenseni*) was listed as a candidate species in 1999, the first marine invertebrate ever listed as a candidate species under the ESA.

The only marine mammal ever removed from a listing as an endangered species under the ESA is the Eastern Pacific gray whale (*Eschrichtius robusta*). The grey whale population appears to have recovered at or above historic levels and was delisted in 1993. Despite this one success story and all the funding, personnel, and time dedicated to the species' recovery, many (if not most) of the species listed under the ESA are still in significant danger of being driven to extinction.

The status of the nation's marine fisheries tells a very similar story. Although problems with fisheries

were not unknown at the turn of the century (for instance, the U.S. Commission of Fish and Fisheries was created by Congress in 1871 and charged with studying and recommending solutions to an apparent decline in New England's fishes (Curtis and Guinan 1971; Hobart 1996)), it was in the past decade that these problems become both more pronounced and better known. The Sustainable Fisheries Act, passed in 1996, mandated that the National Marine Fisheries Service (NMFS), a division of NOAA, report to Congress annually on the status of the nation's marine fisheries. In each year's report, the number of fish species listed as "overfished" (whose populations are depleted) has risen, from 84 species in 1997 to 90 species in 1998 (NMFS 1998) to 98 species in 1999 (NMFS 1999). In the 1999 report, 127 species are listed as "not overfished" and another 5 species are listed as "approaching an overfished condition." Thus nearly half (44 percent) of the marine fisheries that we have accurate assessments for are either "overfished" or approaching that condition.

Just as troubling as these numbers are the statistics announced each year for the number of fish and marine mammals species for which we do not have an accurate population assessment. According to the 1999 NMFS report to Congress, 647 species' status (relative to an overfishing condition) is unknown (NMFS 1999). Similarly, of the 163 marine mammal stocks, there is sufficient information on population trends for only approximately one third of the species (CMC 1998).

Why our current ocean management regime does not work

With a framework of relatively strong, conservation-minded laws, multiple agencies implementing those laws, and a public dedication to protecting our oceans and the crea-

tures that live there, why has U.S. ocean management been beset with so many failures? I would suggest the answer has at least three key components: (1) insufficient funding for these programs, (2) a legal framework that insufficiently addresses today's most significant threats to these resources, and (3) conflicting agency missions and a lack of federal coordination on ocean resource management.

Ocean resource management has historically been an underfunded mandate of the U.S. government. Investment in ocean science is critical for accurate stock assessments, oceanographic data, and monitoring of the status of ocean resources. As our scientific understanding of the oceans increases, we learn how to remedy our old mistakes and how to better manage our existing resources. Yet ocean science funding still represents but a fraction of total science spending in the U.S. And without an adequate investment in the science, our best management practices will be misguided and less efficient. Mismanagement of our ocean resources costs this nation thousands of jobs, billions of dollars, and impacts the quality of life of our nation's citizens. Currently, it is very difficult to assess exactly how much is spent on ocean science and ocean resource management because of the multiple agencies funding such work (including NOAA, EPA, and the National Science Foundation). In addition, there is no independent assessment of what would be an adequate investment by the federal government in order to sustainably manage these resources.

Moreover, our regulatory framework often does not respond to the most pressing challenges facing ocean resources today. Many of the laws that protect our ocean resources were written decades ago. The conditions of the resources these laws were meant to protect, our under-

standing of ocean science, and the threats affecting those resources have changed in the time since their enactment. Many of these laws have been successful in addressing some of the threats facing a resource, but they have ignored other problems that have become more significant today.

As an example, the Clean Water Act has been hailed as a success story for cleaning up many polluted water bodies and much more strictly regulating point sources of pollution, such as industrial plants. The Clean Water Act, however, has not adequately addressed nonpoint source pollution (urban and agricultural runoff), which has become the number one source of coastal water pollution nationwide as the impacts from point sources have been reduced. The law itself does not provide the EPA with strong tools to combat nonpoint source pollution because the problem was not clearly understood when it was written in 1972 and at that time, point sources of pollution were considered to be a more significant impact.

Perhaps most importantly, a lack of coordination of federal and joint state and federal efforts to protect and manage our oceans has contributed to the problem. Our existing ocean management is fragmented under the authority of many different agencies and cabinet-level departments, creating inefficient and sometimes conflicting management that poorly protects our ocean resources. As an example, the Minerals Management Service (MMS), which manages offshore mineral and oil and gas resources, has had Outer Continental Shelf oil lease sales administratively overturned because they failed to protect other marine resources. In a recent case in Alaska, the MMS had 5 tracts removed from a lease sale to protect the Cook Inlet beluga whale (*Delphinapterus leucas*) population. Even though NMFS had proposed that these tracts be removed from the

sale, it took an administrative appeal by outside parties to overturn the MMS decision (Reuters 1999; Hunter 1999).

In some cases, a single agency's mission may be internally in conflict. As an example, the NMFS strategic plan states, "Under the Magnuson-Stevens Act, as amended by the Sustainable Fisheries Act, [Fishery Management Plans] must contain conservation and management measures which prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery" (NMFS 1997). That NMFS has not succeeded in reconciling these dual mandates in the past is exemplified by the "overfished" status of over one-third of our marine fisheries.

The U.S. lacks a national ocean policy that would coordinate all of these efforts, and there is not a transparent, open framework for the resolution of agency conflicts, especially where there are clear conflicts between the mandates of two or more agencies or departments. The development of a comprehensive national ocean policy that coordinates federal ocean management would ensure the efficient and effective implementation of the regulations that are designed to manage and protect the oceans. As noted by the National Research Council, "Despite the many programs and regulations that affect coastal marine resources, areas and activities, there are no basic principles or processes for establishing authority and accountability in the management of marine resources and the uses of ocean space. In other words, there is no coherent national system" (NRC 1997).

The Oceans Act: A re-examination of U.S. ocean management

Legislation has been introduced to create a second Stratton Commission to re-examine our ocean management programs and address the underlying

reasons for these ongoing problems. Called the Oceans Act, the legislation has been introduced in the 105th and 106th Congresses. While it has not yet been passed and signed into law, ocean advocates are hopeful that this Congress' legislation (S. 959 and H.R. 2425) will be more successful in the coming year.

The Oceans Act's purpose is to develop and maintain a coordinated, comprehensive, and long-range national policy with respect to ocean and coastal activities. The Oceans Act will help to (1) improve and expand existing federal programs that work well, (2) increase the efficiency and effectiveness of its remaining programs, and (3) better coordinate ongoing federal, state, and local management activities. As Senator Ernest Hollings (D-SC), the sponsor of the Oceans Act in the Senate, stated upon introducing the legislation, "The bill calls for development and implementation of a coherent national ocean and coastal policy to conserve and sustainably use fisheries and other ocean and coastal resources, protect the marine environment and human safety, explore ocean frontiers, create marine technologies and economic opportunities, and preserve U.S. leadership on ocean and coastal issues" (Hollings 1999).

As introduced, the Oceans Act, like its predecessor which created the Stratton Commission (P.L. 89-454), would create a National Ocean Commission (hereafter, the Commission) and a National Ocean Council (hereafter, the Council). The Commission would be made up of 16 ocean experts, and it would report to Congress and the President on a comprehensive national ocean and coastal policy. Their eighteen month review, public hearings, and meetings would focus on the following: (1) an assessment of "the condition and adequacy of investment in existing and planned" ocean and coastal management facili-

ties, equipment, and future needs (S. 959 Sec. 6 (b) 2), (2) an examination of existing and planned federal activities, and recommendations to improve the efficiency and effectiveness of these programs and activities, (3) an evaluation of the relationships between federal, state, local governments and the private sector to plan for the most appropriate and efficient management of ocean and coastal activities, and (4) a review of and recommendations for changes to U.S. laws and regulations necessary to implement an effective national ocean policy.

The Council, composed of cabinet-level secretaries (e.g., the Secretary of Defense) and other relevant agency heads, would be responsible for developing an implementation plan for a national ocean policy, and for improving coordination and reduce duplication of existing federal ocean management efforts.

In addition, the bill requires the President to produce a biennial report on the status of federal ocean and coastal activities, including the budgets of those programs and their accomplishments over the past two years. This report would help to identify what programs are effective and where funding is being spent on ocean resource management. Similarly, the bill requires each federal agency, as part of its annual appropriations request, to identify ocean and coastal activities and how these contribute to the implementation of a national ocean policy.

The Oceans Act would address the three problems with the United States' existing ocean management regime highlighted above. The Commission could evaluate what an "adequate investment" or appropriation would be to implement our nation's laws to protect and manage the oceans. The bill also would strengthen the fiscal accountability of the programs that are funded. Second, the Oceans Act would not make

any changes to existing laws, but the National Ocean Commission created by the Act would recommend changes to existing laws in order to efficiently and effectively protect and manage our oceans. Finally, the bill would ensure that all agencies responsible for ocean management collaborate on ocean management. The development of a national ocean policy that sets forth a framework for decision-making and collaboration is arguably the most important aspect of the bill.

Conclusion

While no single agency can or should have authority over all of the nation's ocean management programs, there must be a coherent framework and policy to coordinate and guide decisions made "on the ground." It is critically important that we re-assess our infrastructure, legal framework, and planned needs for the oceans before the problems we face become even greater.

These challenges are only growing, and the repercussions are being felt not only by "environmentalists" but throughout entire communities. New England fishermen sought \$5 million in disaster relief funds for the economic catastrophe brought on by the collapse of the cod fishery (64 FR 48594); West Coast communities have received significant disaster aid as a result of the ESA listings of Pacific salmon ESUs (Read and Buck 1997); and Pacific groundfish fishermen recently requested relief from the Governors of California, Oregon, and Washington because of severe cuts in the allowable quota of several rockfish species necessary to rebuild the West Coast groundfish fishery (Martin 1999). Overfished and depleted fisheries were estimated to cost the economy \$25 billion and thousands of jobs in 1997 (CMC 1998).

In addition, the effects trickle down beyond the fishing communities. The health of our oceans affects

industries such as tourism (including recreational fishing) as well as the quality of life of our coastal citizens—over one half of our nation's population. Solutions to problems such as nonpoint source pollution will require small changes in the daily habits of citizens throughout the country, such as reducing the amount of oil spilled when individuals change their oil in their car. Similarly, a solution to the the problem of the "dead zone" (a 7,728 square mile hypoxic zone in the Gulf of Mexico where no living creatures are found) may require that farmers in the 31 states that feed into the Mississippi watershed change some of their current farming practices, such as reducing the use of nitrogen-based fertilizers by as much as 20 percent from current levels (Annin 1999).

And in order to enact meaningful reforms on a national level, Congress must be emboldened with the political will to make tough choices between restrictions now or even greater problems later. Without the vocal support of their constituents, members of Congress will lack the political will to make these changes. Passage of the Oceans Act will set in motion a two year process that will involve the public and again draw attention to our oceans' plight, as did the United Nations designation of 1998 as the International Year of the Ocean. If we do not engage the nation in the protection and management of our oceans, then it is unlikely that we will ever succeed in their protection.

Enactment of the Oceans Act would not be a panacea for the ills facing our oceans, but it would demonstrate a conscious decision to attempt to reverse decades of mismanagement and neglect. It would start a process to identify what needs to be changed and how best to accomplish those changes. It would also commit the U.S. to the protection of the ocean environment and the sus-

tainable use of the resources therein to ensure the economic, social, and environmental well-being of our nation's citizens. The U.S. must simultaneously achieve environmental protection, ensure national security, and protect the economic well-being of our nation. By failing to achieve even one of these aims we have failed to protect the nation as a whole. Yet today, we do not seem to be achieving all three of these aims. The Oceans Act would help to ensure that we do so in the future.

With the development of a national ocean policy, the financial resources to carry it out and the leadership to do so, we can better manage our oceans for the next millennium by learning from past mistakes. If we fail to do so, we may continue to see a further decline in the ecological health of our oceans and their resources. That is a risk not worth taking.

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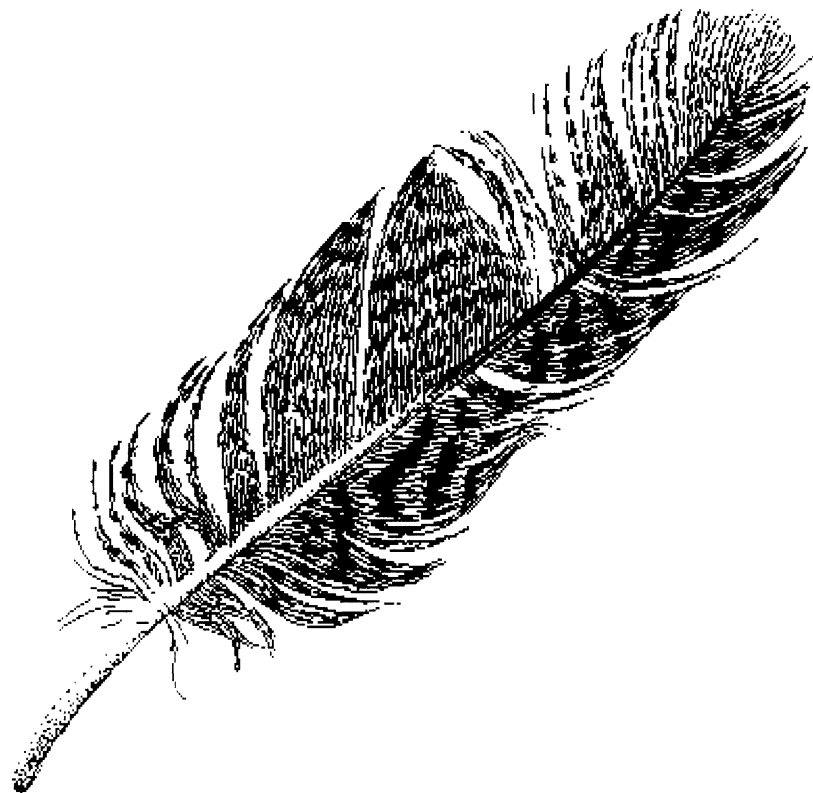
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Legislative News

Dam Agreement Clears Way for Salmon Habitat

Federal, state, and utility officials announced yesterday the largest dam removal effort in California history as Pacific Gas & Electric Company agreed to demolish five of its dams on Battle Creek. The dams currently block migration of three endangered fish species: steelhead, winter-run chinook salmon and spring run chinook. Utilities officials said the dams will come down in 2001 after environmental studies. Three other dams that make up the Battle Creek Hydroelectric Project will remain, but will be fitted with fish ladders and screens and will allow more water to flow downstream. (National Journal's GREENWIRE, 9 November 1999)

Freshwater Species Extinction Crisis

A new Canadian study published in *Conservation Biology* finds freshwater animals are disappearing from North American lakes and rivers at the same alarming rate as they are from tropical rainforests, says *ENS* (10/4). With some 123 species already extinct since 1900, freshwater snails, fishes and amphibians are dying out 5 times faster than land species and 3 times faster than marine mammals. Many of the endangered species are considered to be among the "most imperiled" species on Earth, including 49% of mussel species, 23% of snail species, 33% of crayfish species, 26% of amphibian species and 21% of fish species. (GREENLines, 6 October 1999)

DOD Takes Over Management of Key Habitat

The new Defense Authorization Act transfers management of more than 1.6 million acres of the Sonoran Desert in southern Arizona to the Defense Department, according to the *Arizona Republic* (10/8). The area is prime habitat for the critically endangered pronghorn antelope, pygmy owls, lesser long-nosed bats, and flat-tailed horned lizards under consideration for ESA listing. Environmentalists favor proposals for a Sonoran Desert National Park to take advantage of the National Park Services' greater experience in managing biologically sensitive areas. (GREENLines, 12 October 1999)

States Seek to Avoid Prairie Dog Listing

Eleven Great Plains states have drafted a region wide conservation plan to avoid possible listing of the black-

tailed prairie dog as a threatened species, says the *Omaha World Herald* 10/11. Conservation groups doubt whether the plan, which relies on voluntary compliance, will have the enforcement capacity that the ESA does. Prairie dog habitat has been reduced to less than 1 million acres. The FWS, which acknowledges that it "has been difficult to make such plans work," is reviewing the plan. (GREENLines, 14 October 1999)

Extinction Faces One in Eight Bird Species

A report released by BirdLife International found that 1,200 bird species could become extinct in the next century, according to *Reuters* (10/14). Some 185 species face a high risk of extinction in the coming decade. While many of the most imperiled species live in tropical forests, common bird populations, such as European swallows and skylarks, have declined by 50% in the last three decades. The greatest threats include "deforestation, burning of vegetation, commercial logging, subsistence farming, plantations, arable farming and mining." (GREENLines, 15 October 1999)

DNA Analysis to Determine Wildness

ENS reports (10/25) that a Sea Grant gene study could be critical in determining whether the wild Atlantic salmon should be listed as an endangered species. Maine Governor Angus King contends the wild salmon are really "descendants of stocking programs" and should not be listed. Until 1992, stocked salmon came from Penobscot River salmon and the DNA analysis seeks to find out to what extent the wild salmon can be genetically distinguished. (GREENLines, 26 October 1999)

High PCB Levels Found in Orcas

A new study found orcas in the Pacific Northwest had PCB levels 400 to 500 times that found in humans says the *Seattle Post Intelligencer* (10/25). The contamination weakens the immune system, hinders reproduction and makes them more susceptible to disease. Recent declines have led the Canadian government to list them as threatened, a path that researchers advocate the U.S. follow. (GREENLines, 27 October 1999)

You do interesting work! **Share it with the UPDATE.**

The *Endangered Species UPDATE* is designed and published as a forum for information exchange on endangered species issues. The *UPDATE* welcomes articles related to species protection in a wide range of areas including, but not limited to, research and management for specific endangered or threatened species, theoretical approaches to species conservation, policy and legislation related to species conservation, and strategies for habitat protection and preserve design. In addition, book reviews, editorial comments, and announcements of current events and publications are welcome.

The *Endangered Species UPDATE* accepts several kinds of manuscripts. These include:

1. Feature Article—on research, management activities and policy analyses for endangered species, theoretical approaches to species conservation, and habitat protection. Manuscripts should be approximately 3000-4000 words with abstract.
2. Opinion Article—a concise and focused argument on a specific endangered species issue; can be more speculative and less documented than the feature article. These are approximately 600-800 words with abstract.

Manuscript submissions and specifications

The manuscript should be submitted on a disk or by e-mail. Regardless of how you submit, please send us a hard copy and all of the appropriate contact information for all authors. If you are using Microsoft Word for Macintosh or WordPerfect, please save in the most recent version possible. For other programs, save the document in a rich text format (RTF). Send disks and hard copies to Editor, *Endangered Species UPDATE*, School of Natural Resources and Environment, University of Michigan, Ann Arbor 48109-1115. If submitting by e-mail, please send as an attachment to esupdate@umich.edu.

Photographs, illustrations, and other visuals

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Citations, acronyms, etc.

Literature citations in the text should be as follows: (Buckley and Buckley 1980b; Pacey 1983). The Literature cited section must be typed and follow the format used in the journal *Conservation Biology*. For example:

Balmford, A., N. Leader-Williams, and M. J. B. Green. 1995. Parks or arks: Where to conserve large threatened mammals? *Biodiversity and Conservation* 4:595-607.

For other abbreviations and details, consult the Editor.

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Authors will receive by fax a final version of their article, before it goes to press, for their review and proofing. The *Endangered Species UPDATE* and University of Michigan typically hold copyright for articles published, and authors will be asked to sign a contributors' agreement when the article is accepted. The vast majority of copyright requests are from educational institutions and non-profit organizations. The copyright agreement allows the author to reprint the article as long as credit is given to the *UPDATE*.

News From Zoos

Sedgwick County Zoo Teams with Nike to Help Jamaican Iguanas

Thanks to Nike, researchers will now be able to radio track the perilously endangered Jamaican Iguana in their habitat. Fewer than 100 Jamaican iguanas exist in a 38-square mile area. To boost their numbers, baby iguanas are collected, raised at a local zoo, and released when they are large enough to avoid predators. Researchers then fit the iguanas with vests containing battery-operated radio transmitters so they can track them. But with the rocky, thorny underbrush in the iguana's habitat, the home-made vests weren't holding up. So, Sedgwick County Zoo Reptile Curator Karen Graham wrote a letter to Nike asking for their help. The company produces an All Conditions Gear outdoor line and Graham was certain that similar technology could be used to design a durable vest that that wouldn't hinder thermoregulation and would stretch as the reptiles grew. After several prototypes, the final version has a elastic, breathable mesh upper, a polyurethane coated leather belly portion, and Nike's All Conditions Gear logo. The vests are now being road tested by iguanas at the Sedgwick County Zoo. If the vests pass the test, Nike will produce approximately 100 for the Jamaican iguana release program at no charge. [Adapted from an article by Jenny Upchurch, Wichita Eagle]

New Congo Gorilla Forest Opens at Bronx Zoo

The \$43 million Congo Gorilla Forest opened recently at the Wildlife Conservation Society's Bronx Zoo, allowing visitors to see animals in an amazing simulation of their natural habitat while earning money for conservation programs to help save animals in the wild. The new 6.5 acre exhibit features not only gorillas, but also okapi, red river hogs, mandrills, wolf monkeys, and 70 other exotic species. The exhibit, which contains over 10 miles of fake vines, 11 artificial waterfalls, and 45,000 square feet of sculpted-concrete terrain, makes visitors feel as if they've just entered an African rain forest. The exhibit directs visitors' attention to the plight of the animals' native habitat, an area that plagued by problems with loggers, poachers, and civil unrest. In addition to the zoo's normal entrance fee, there is a \$3 admission for the exhibit which will fund field conservation projects in the Congo, and 700,000 people are expected to visit the exhibit each year. According to retiring Wildlife Conservation Society President William Conway, the true mission of zoos should be to raise money and conduct research to save animals in the wild, and "serve the needs of the creatures they exhibit." [Adapted from an article by Eugene Linden, Time Magazine]

Louisville Zoo Spearheads *In Situ* Rattlesnake Study

The Louisville Zoo is in its second season of a long-term ecological study of the timber rattlesnake (*Crotalus horridus*) in our nation's central hardwood region. Snakes are monitored with radio transmitters and transponders inside a 6,000 hectare study site in Northcentral Kentucky. The Louisville Zoo is gathering baseline phenological data on this taxon in the geographic center of its range distribution to aid in the conservation of this misunderstood reptile. The project is funded by the Louisville Zoo and the Kentucky Department of Fish and Wildlife Resources.

Brevard Zoo Contributes to New National Park

The Brevard Zoo in Melbourne, FL, expanded its conservation mission to include *in situ* projects in the Caribbean and has contributed \$15,000 toward the creation of the new Morne Diablotin National Park on the Caribbean isle of Dominica. This project, led by the Rare Species Conservatory Foundation (RSCF) will leverage 1,300 acres of privately owned land into a 10,000 acre national park, preserving some of the last pristine rainforest in the region. The new park will be one of the most significant bioreserve areas in the Caribbean and is the only known nesting area for the island's critically endangered national symbol, the imperial Amazon parrot (*Amazona imperialis*). Field projects studying the imperial Amazon, as well as the red-necked Amazon parrot (*Amazona arausiaca*), will provide vital information so the Dominica Forestry Division can begin designing management strategies and recovery plans for these species.

Information for News From Zoos is provided by the American Zoo and Aquarium Association.

Bulletin Board

Sophie Danforth Conservation Biology Fund

The Sophie Danforth Conservation Biology Fund, established by the Roger Williams Park Zoo and the Rhode Island Zoological Society, supports conservation programs that protect threatened wildlife and habitats worldwide. For application guidelines and information, please write to the Sophie Danforth Conservation Biology Fund, Roger Williams Park Zoo, 1000 Elmwood Avenue, Providence, Rhode Island 02907, or e-mail ldabek@rwpzoo.org.

An Invitation to Participate in Shaping Forest Restoration in the U.S. Southwest

The Grand Canyon Forests Partnership invites all individuals and organizations with an interest in the development of forest restoration strat-

egies in the forests of the U.S. Southwest to participate in shaping forest restoration in the Southwest. If you would like to help develop an effective strategy to create a geographic framework outlining critical habitat concerns, contact Taylor McKinnon at the Grand Canyon Forests Foundation (520) 774-7488. If you would like to nominate a scientist with expertise in the fields of conservation biology, forest ecology, wildlife ecology, forestry, landscape ecology or others for a panel of scientists to consider forest restoration strategies, please contact Brett KenCairn at the Grand Canyon Forests Partnership, (520) 774-7488.

International Conference on Forest Restoration

The Grand Canyon Forests Partnership and the Ecological Restoration

Program at Northern Arizona University (NAU) are sponsoring an international conference on restoration in southwestern forest ecosystems. The conference, "Steps Towards Stewardship: A National Conference Joining Ecological Restoration and Conservation Sciences in Ponderosa Pine and Related Ecosystems," will take place April 25th through the 27th, 2000 on the campuses of NAU. Those interested in submitting papers or attending the conference can contact Gina Vance at the Ecological Restoration Program of NAU (520) 523-7187.

Announcements for the Bulletin Board are welcomed.

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