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In this Issue

Status of Anadromous Atlantic Salmon, *Salmo salar*, in the United States

Mary Colligan and Paul Nickerson

Anadromous Atlantic salmon (*Salmo salar*) migrate from the mouths of U.S. rivers to the Northwest Atlantic Ocean, overwintering in the southern Labrador Sea and the Bay of Fundy. Atlantic salmon begin their lives in rivers where they stay for two to three years before beginning the process of smoltification to prepare for migration to the ocean. During smoltification, biochemical and physiological changes prepare the Atlantic salmon for the transition from fresh to salt water. The ocean portion of the species life history typically lasts from one to three years (adults that return after only one year at sea are called grilse), during which they undertake feeding migrations over thousands of miles. Atlantic salmon feed on capelin, herring, sand eels and large zooplankton (Reddin 1988), and appear to be opportunistic feeders as their numbers are not correlated with the availability of a particular prey species. After returning to spawn, kelts (spawned-out salmon) either return to the ocean or overwinter in the river.

Mature adults show a strong affinity for their native river (a straying rate of 2% for hatchery fish over 22 years according to Baum and Spencer 1990), and appear to use olfactory stimuli to return to their native streams (Stasko *et al.* 1973) between April and November. This strong homing ability has resulted in the evolution of unique characteristics for each river population, for example in the timing of smolt migration. Historically, there were significant differences in the timing of outmigrating smolts. Each river population appeared to be timing its outmigration during the period when the river and estuary were the most suitable in terms of water flow and temperature. However, many of these differences have been lost or at least reduced as genetic diversity has been affected by decreasing run size.

Insight into the marine life stage of U.S. Atlantic salmon has been gained from marking and tagging studies of fish stocked in the Connecticut, Merrimack, and Penobscot Rivers. Over the history of the U.S. program, marking has progressed from fin clipping (1942-1962) to Carlin tags (1962-1992) and, finally, to coded-wire tags (CWT) in use since 1985 (Meister 1984; NASCO 1993). A diagram of the life cycle of an anadromous Atlantic salmon is presented in Figure 1.

History and Present Status

As depicted in Figure 2, the original range of Atlantic salmon in the U.S. was from the Housatonic River (Connecticut) to the St. Croix River (Maine) (Kendall 1935; Scott and Crossman 1973). Historic runs have been estimated at 500,000 fish annually. Atlantic salmon populations were present in at least 34 rivers in Maine alone (Rounsefell and Bond, 1948). By the early 1800's the Atlantic salmon runs in the U.S. were severely depleted due to sport fishing, water quality degradation, excessive commercial netting, and barriers to migration caused by development accompanying the Industrial Revolution.

The presence and abundance of Atlantic salmon in a river has traditionally been viewed as a gauge of a river's health. In the late 1960's and early 1970's there was a great deal of energy and effort directed at improving the water quality and habitat in the rivers to a condition that could support Atlantic salmon. Improvements in water quality, installation of fish passage facili-

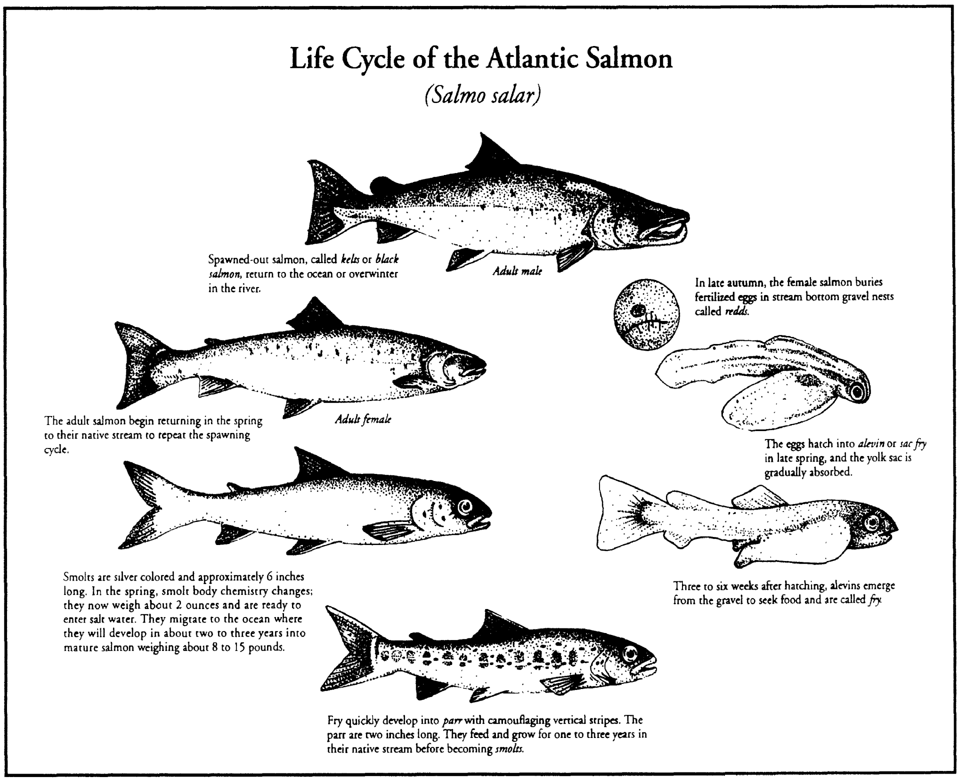

Figure 1

ties, movement from harvest to catch and release, and increased public awareness all contributed to an atmosphere of hope for successful Atlantic salmon restoration throughout New England, thereby encouraging more partners to join the effort. During the 1970's and early 1980's, returns increased and recreational fishing success in Maine was high. However, Atlantic salmon were being heavily fished at sea by Canadian and West Greenland commercial fisheries. This reduced the number of adults that returned to spawn in rivers of the eastern U.S. In addition, the recreational fishery harvested 15-25% of the returning spawners. Those factors, coupled with worsening natural conditions at sea, have drastically reduced Atlantic salmon abundance in many U.S. rivers during the past decade.

Currently the Atlantic salmon populations in New England consist primarily of river runs restored or enhanced by fish of hatchery origin. Adult fish are captured upon returning to the river, spawned in hatcheries, and their offspring are used to maintain the runs. In addition, juvenile offspring of sea-run stock are reared in captivity to sexual maturity and their offspring are then released into the wild as fry. Major populations, notably the Penobscot, Connecticut, and Merrimack River populations, have been partially restored during the past 10 to 25 years after virtually disappearing, and in 1994 a total of 1,634 Atlantic salmon were documented to have returned to a total of 19 rivers in New England.

For the purposes of review under the Endangered Species Act (ESA), it is important to analyze the status of the Atlantic salmon populations in those rivers that have had persistent returns of *naturally* spawning Atlantic salmon and thus qualify as species under the ESA. Currently the National Marine Fisheries Service and Fish and Wildlife Service (collectively "the Services") believe that the only remaining populations that consist at least in part of native fish in the U.S. occur in seven Maine Rivers: the Dennys, Machias, East Machias, Narraguagus, Pleasant, Ducktrap and Sheepscot Rivers. In 1991 the FWS listed 5 of those populations as category 2 candidate species under the ESA. In 1994, only an estimated 79 Atlantic salmon returned to these rivers. Recent downward trends in abundance have put most of these rivers at less than 10 percent of escapement goal (the number of adults needed to produce enough eggs to fully seed the river). The combination of low adult returns and low numbers relative to spawning requirements indicates that these river populations are in peril.

Consideration for Listing Under the Endangered Species Act

In October and November of 1993, the Services received petitions from Restore: The North Woods; Biodiversity Legal Foundation; and Jeffrey Elliot, to list the Atlantic salmon throughout its historic range in the contiguous United States under the ESA. The Services decided to respond to the petition jointly as they had worked cooperatively for the conservation, rehabilitation and restoration of the species in the Northeast Region for years. The Services published a notice on January 20, 1994, that the petition presented substantial scientific information indicating that a listing may be warranted and requested input from the public.

The Services had been working individually and cooperatively for decades to further the scientific knowledge of Atlantic salmon, to manage the species throughout its migratory route, to restore the species to its historic range, and to address threats to the species. In March of 1994 the FWS and NMFS signed a Regional Memorandum of Agreement to pledge greater coordination and cooperation between the FWS and NMFS, as well as with the states and the international community, to avoid duplication of effort and concentrate efforts on priority issues with the greatest potential to benefit anadromous Atlantic salmon. The Regional Directors of the NMFS and FWS appointed a team to conduct a status review pursuant to Section 4 of the ESA.

The ESA defines species as "any subspecies of fish or wildlife or plants, and any *distinct population segment*

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Cover: Snow Leopard (*Panthera uncia*). Photo Courtesy of New York Zoological Society.

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of any species of vertebrate fish or wildlife that interbreeds when mature" (emphasis added). Distinct population segments (DPS) are particularly important to anadromous salmonines because their strong homing capability fosters the formation of discrete populations exhibiting important adaptations to local riverine ecosystems (Utter et al. 1993). Guidance on defining species under the ESA has been provided by the NMFS in the context of listing decisions involving Pacific salmon (Waples 1991). This guidance introduces a more precise definition called the Evolutionarily Significant Unit (ESU). Because the structure of Atlantic salmon populations is similar to Pacific salmonines, the ESU approach provides a practical framework for delineating DPSs of Atlantic salmon under the ESA. To qualify as a DPS a population (or group of populations) *1)* must be reproductively isolated from conspecific populations and *2)* must be evolutionarily significant (i.e. contribute substantially to the ecological/genetic diversity of the species).

Regarding the first of the necessary DPS criteria, tagging studies indicate that U.S. Atlantic salmon stocks do not stray far from their natal streams. In addition, there has been a lack of recolonization by Atlantic salmon in U.S. rivers where they have been extirpated. Given available information, the Atlantic Salmon Biological Review Team (Team) concluded that wild river-specific populations of Atlantic salmon in the U.S. are substantially reproductively isolated from Canadian stocks.

In examining the second criteria for a DPS, evolutionary significance, the Team considered the following three factors: phenotypic traits, life history traits, and habitat characteristics. Historic records indicate that distinct, locally-adapted Atlantic salmon stocks existed in river systems in the U.S. Genetic analyses and life history traits demonstrate that U.S. stocks of Atlantic salmon are distinct from stocks in Canada and Europe. Historically, adult spawners in U.S. rivers have been predominately those that spend two winters at sea, whereas many Canadian and European stocks return after one year at sea. The riverine habitat occupied by U.S. Atlantic salmon is distinctive in that it is located at the southern extent of the range of the species in North America. The continuous presence of U.S. Atlantic salmon in indigenous habitat provides evidence that important local adaptations have persisted, although at present differences are subtle and difficult to assess due to low abundance. The populations of anadromous Atlantic salmon present in the Sheepscot, Ducktrap, Narraguagus, Pleasant, Machias, East Machias and Dennys Rivers represent the last wild remnant of U.S. Atlantic salmon. All of these factors indicate that the DPS is evolutionarily significant.

Candidate status is recommended for Atlantic salmon in the Kennebec River, Penobscot River, Tunk Stream and St. Croix River, rivers where the link to native stocks and degree of persistence is not well understood. Atlantic salmon populations have been extirpated from many other rivers in the United States. Some of these rivers are currently the focus of restoration efforts using nonindigenous stocks. Restoration of Atlantic salmon in these watersheds will contribute to the biodiversity of these ecosystems.

The Team evaluated the status of the seven river stocks that comprise the DPS of Atlantic salmon by analyzing trends in historic and current relative abundance and spawner escape-

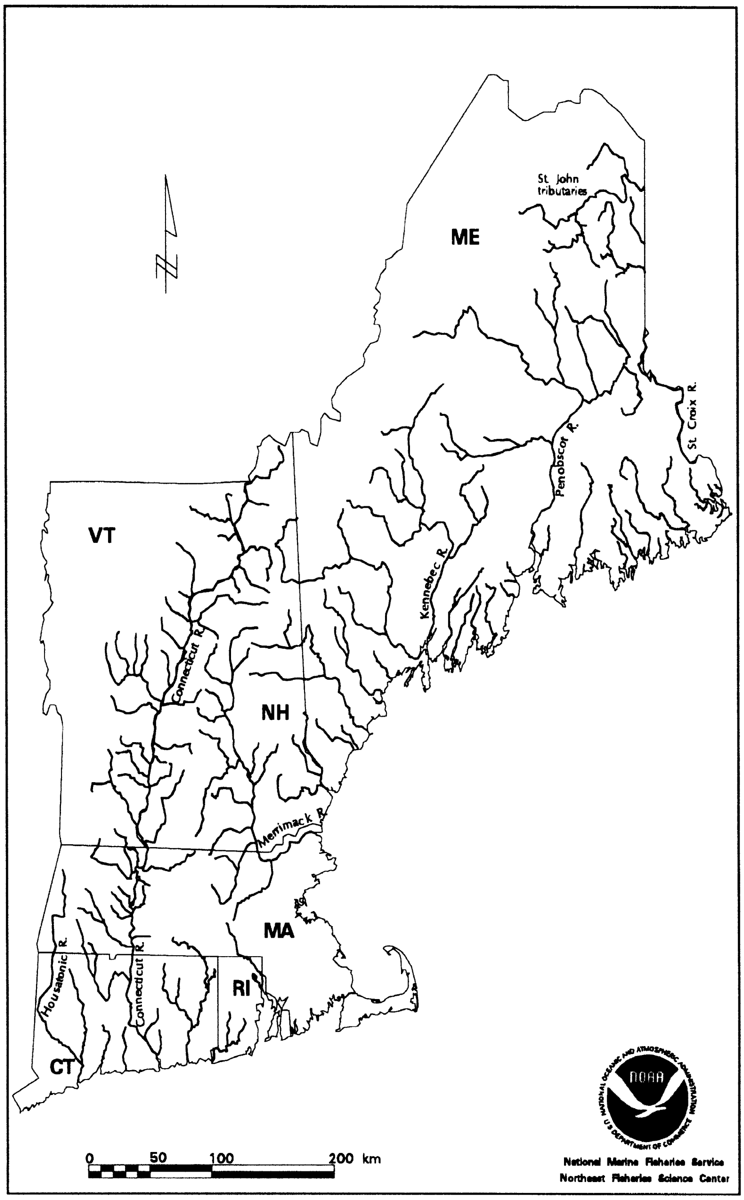

Figure 2

ment goal. The status of these populations was then examined in relation to the ESA which defines an endangered species as one in danger of extinction throughout all or a significant portion of its range, and a threatened species as one likely to become endangered in the foreseeable future. Species may be determined to be threatened or endangered due to any one or more of the following factors: (1) the present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) the inadequacy of existing regulatory mechanisms; and (5) other natural or manmade factors affecting its continued existence (Section 4(a)(a)(1)).

1) Habitat Impacts

The construction of dams with either inefficient or non-existent fishways was a major cause of the decline of U.S. Atlantic salmon. In the late 1800's Atkins stated: "The disappearance of salmon from so many rivers appears to have been entirely the result of artificial causes, chief among which is the obstruction of the way to the breeding grounds by impassable dams (1874)."

In the Strategic Plan for Management of Atlantic Salmon in the State of Maine (1984), Beland reported that: "As colonization and development accelerated during the 17th and 18th centuries, the salmon habitat was degraded, destroyed, and/or made inaccessible. By 1947, less than 10% of the original habitat remained accessible to Atlantic salmon." The substrate and water quality of a river or stream must meet certain criteria in order for it to be suitable as Atlantic salmon spawning and nursery habitat. The egg, alevin, fry and parr stages of Atlantic salmon are especially sensitive to impacts associated with watershed development. Potential impacts to habitat quality include alterations in water temperature, reductions in dissolved oxygen, the introduction of pollutants and sediment, and other factors that may alter substrate or river discharge. Water temperature can be impacted by introductions of heated effluent, reductions in riparian vegetation, or by impounding water. Water quality can also be affected by the introduction of chemicals such as chlorine added during sewage treatment, metals discharged with industrial effluent, herbicides and pesticides used in agriculture, and nutrients in treated wastewater which increase the level of biological activity, decreasing the level of dissolved oxygen in the water.

2) Overutilization for commercial, recreational, scientific, or educational purposes

Atlantic salmon are vulnerable to exploitation throughout their entire range, in both marine and freshwater and in both recreational and commercial fisheries. Many countries are moving toward eliminating commercial fisheries to preserve sports fisheries. This is based in part on an economic evaluation of commercial versus recreational fishing. The issue is made complex in that it is a mixed stock fishery where nations can intercept fish originating from another country even if they have no anadramous stocks themselves.

Historically, the marine exploitation of U.S.-origin Atlantic salmon occurred primarily in foreign fisheries. U.S.-origin Atlantic salmon have been documented in the harvests of West Greenland, New Brunswick, Nova Scotia, Newfoundland, and Labrador fisheries, with the Newfoundland and Labrador fisheries constituting the majority of the harvest. In the absence of West Greenland and Canadian interception fisheries, returns of U.S. Atlantic salmon could potentially increase two-fold. In Canada, a 5-year moratorium is in place in Newfoundland and licenses are being purchased by the government. The Labrador fishery is now managed by quotas, and the 1993 quota represents a reduction of 92 percent from that of the 1990 quota level. In 1982, the North Atlantic Salmon Conservation Organization was formed for the purpose of managing salmon through a cooperative program of conservation, restoration and enhancement of North Atlantic stocks. NASCO accepted an agreement in 1993 that set quotas on the harvest off West Greenland with the goal of reaching target spawning escapements for North American stocks. During the next three years of the management plan, the number of spawners needed to sustain North American stocks of Atlantic salmon (194,000) will be protected by adjusting the West Greenland quota.

In 1987 the New England Fishery Management Council prepared a Fishery Management Plan (FMP) to establish explicit U.S. management authority over all Atlantic salmon of U.S. origin in Federal waters. The FMP prohibits the possession of Atlantic salmon in the exclusive economic zone, the area between 3 and 200 miles off the U.S. coastline. During the 1970s, recreational fishermen were harvesting as much as 15 to 25 percent of the Atlantic salmon returning annually to home waters. Currently state law allows only a catch and release fishery for Atlantic salmon, and no salmon fishing is authorized on the Pleasant River. Multi-sea-winter salmon could incur some mortality from catch-and-release fishing and parr are vulnerable to incidental hooking mortality or illegal harvest by trout anglers. Poaching may also pose a serious threat to depressed populations of Atlantic salmon in New England rivers.

3)Disease or predation

During their various life stages, Atlantic salmon are preyed upon by numerous species of fish, birds, and mammals and also compete with other species of fish. Major freshwater predators on Atlantic salmon include brook trout, brown trout, eel, burbot, northern pike, chain pickerel, smallmouth bass, belted kingfisher, heron, common and red-breasted merganser, osprey, herring and greater black-backed gull, otter and mink. Documented predators in the estuarine and marine environments include striped bass, shark, skate, ling and Atlantic cod, pollock, whiting, garfish, double-crested cormorant, European

(continued on p. 24)

Learning as a Strategy for Improving Endangered Species Conservation

Tim W. Clark

Justification for the Endangered Species Act of 1973 (ESA) is largely based on recognition that if the biotic enterprise is damaged by the extinction of too many species, the current functioning of ecosystems will be lost or diminished, and the consequences for humans will be unpredictable, but most definitely harmful. It is vital that the ESA policy be refined, administered, and applied well to conserve species and their habitats. Improving the learning capability of professionals and organizations is the strategy most likely to be successful in this regard. This paper examines learning at multiple levels to improve species and ecosystem recovery and conservation.

Learning at Individual and Organizational Levels

Learning is the process of using information to adjust one's responses to the environment, or the process of detecting and correcting "errors," i.e., mismatches between expectations and outcomes (Argyris and Schön 1978). Learning to meet practical conservation goals successfully involves more than refining scientific methods. We must focus on learning capabilities and processes at both individual and societal levels in pragmatic ways. Fundamentally, we must learn how to learn more effectively—an approach that improves performance by explicitly seeking information about our own past performance, the dynamic status of the problems we face, and the contexts of these problems (Clark 1993). This focus on learning brings four targets to attention—individual, professional, organizational, and policy. Learning in any one of these four may affect learning in all the others. An explicit learning strategy requires that inquiry and redirection are common, new ideas welcomed, bridging rewarded, and responsibility for outcomes shared.

There has been considerable experience with endangered species conservation since passage of the ESA, but it is debatable how much of this has been explicitly and systematically converted to organizational or societal learning or how much improvement has actually occurred in species survival (see Yaffee 1982, 1994, Tobin 1990, Kohm 1991, Alvarez 1993). The sad fact is that, as Argyris and Schon (1978:9) noted, "there are too many cases in which organizations know less than their members." Organizational learning capability, in both government, business, and NGOs, has been shown to affect important organizational outcomes and policy implementation (Glynn et al. 1992). In this case, the level of performance in restoring endangered species is largely a function of the ability of organizations to learn from past experience and apply the lessons to new situations.

Learning Theory

Exactly how individuals, professionals, organizations, and policy systems learn is not known. Parson and Clark (1995) provide a good overview, in the context of sustainable development, of numerous theories that explain the phenomenon of individual learning. Some theories focus on people's behavior and what factors (e.g., social, cognitive, symbolic) motivate it. Others emphasize people's rationality, and its "boundedness," as they make decisions, learn, or solve problems. Other theories look at information processing, i.e., the need to filter and structure vast amounts of incoming information. Parson and Clark (1995:436) also summarized the cognitive sciences' definition of learning: "Learning is an experience-driven change in the internal cognitive structures used to represent information. People respond to disparity between their cognitive structures and feedback from their behavior by revising their cognitions." There is also a body of learning theory dealing with the joint development, or "codetermination," of individual thought/learning and social/cultural contexts. Learning by individuals is prerequisite to organizational or policy learning.

For significant improvements to occur in endangered species conservation, organizations must learn. Such a statement seems obvious, but few organizations set explicit learning goals or track their learning performance. No recovery or management plan that I am aware of specifically lists learning as a goal. Leeuw et al. (1994:2) point out that "organizational learning is usually not a deliberate enterprise, but an ad hoc endeavor used for problem solving." In part, the concept of organizational learning is relatively new; many key advances were made beginning in the 1970s building on theories about individual learning (e.g, Argyris and Schön 1978). Recent interest in organizational learning (see Senge 1990) stems from the fact that it has a vast array of practical implications. But despite its potential uses in improving endangered species conservation, these ideas and techniques are little known in species restoration circles.

Organizational learning depends on individual learning, probably in one of two ways. It has been theorized that organizational learning is the sum of its individual members' learning, which is not as simple as it sounds. According to Parson and Clark (1995:439): "What each individual learns may be complexly contingent on the choices and learning of other group members (e.g., in the pursuit of high-level coordinated performance by a group such as a basketball team, a string quartet, or a recovery team). Or the means of individual learning might be through activities that depend on the participation of other group members, such as discourse, imitation, or shared activity." Alternatively, group learning may be analogous to individual learning except that it takes place at a more complex level of society, i.e., it may be "autonomous, determined by group-level causal processes that correspond to the processes shaping individual learning" (p. 439). Thus, one could speak of organizational perception, memory, or changes in behavior and beliefs.

Etheredge and Short (1983:42), in their study of learning in government agencies, proposed that learning ought to result in "increased intelligence and sophistication of thought and, linked to it, increased effectiveness of behavior." Etheredge (1985:66) drew on three criteria to measure increase in intelligence: "1) growth of 'realism,' recognizing the different elements and processes actually operating in the world; 2) growth of 'intellectual integration' in which these different elements and processes are integrated with one another in thought; 3) growth of reflective **perspective** about the conduct of the first two processes, the conception of the problem, and the results which the decision maker desires to achieve" (emphasis in original).

Similarly, Argyris and Schön (1978) emphasize the change in "reflective perspective" in their distinction between "single-loop learning" and "double-loop learning." In single-loop learning, organizations develop skills to scan their environment, set goals, gather better information, use it in planning, and monitor their own performance in relation to their goals. The entire process is conducted within the context of the organization's central cultural norms and traditions, i.e., its understanding of how to do business and the adequacy and reasonableness of its strategies. Many organizations become good at changing organizational strategies to meet unchanging norms.

But some "errors" are not easily corrected within that framework (Argyris 1992). Sometimes the error or conflict challenges the norms themselves. A program selected to achieve certain goals may be implemented successfully, for instance, yet not be adequate to achieve the goals. It may be that, in the words of Leeuw et al. (1994:9), "evaluations precipitate debate on core organizational issues when they not only ask the question 'how well are we doing,' but also, 'does it make sense to do it, even if it is being done well?'" Organizational learning in these cases requires more than a single feedback loop of changing strategies: it requires a double feedback loop that also reexamines the standards by which the organization operates. The process must start with recognizing the unexpected outcomes, acknowledging that they cannot be "corrected" by doing the same thing better, and developing a new and different perspective on the problem. Double-loop learning must institutionalize systems that "review and challenge basic norms, policies, and operating procedures in relation to changes occurring in the environment" (Morgan 1986:89).

Many of the people and organizations engaged in endangered species conservation could benefit from these concepts and criteria. Appraisal of restoration efforts, for instance, would be improved by a willingness to examine both personal and organizational norms as well as the success of particular programmatic elements. As Senge (1990) suggests, organizational learning depends on developing new values and assumptions, new "action rules," new capacities in both cognition and language, and new practices. Many of the supposedly intractable and recurring problems of recovery programs could be overcome by adopting new approaches to learning. The practical benefits in terms of improving efficiency, developing operational process, and saving species would be enormous.

Barriers to Learning

There are inherent limitations on learning both by individuals and groups. These limitations are at play in endangered species conservation as in many other settings. Michael (1995) notes that three barriers to learning may be largely unconscious at the individual level, but nonetheless real. First, sociocultural constraints against learning are part of every human myth system and its "shared set of tacit assumptions" (p. 469). "Our belief that we are independent agents deters us from recognizing how very much our beliefs and behavior, our ways of evaluating persons and events, are shaped by our myths and our habits" (p. 469). Second, emotional factors also weigh against learning. New ways of understanding the world may create uncertainty, risk, threat, a sense of vulnerability, and anxiety. Third, there are cognitive constraints on how our minds perceive, collect, understand, and analyze information, assess its reliability, and comprehend its massive quantities and complexity. "Learning to perceive and to evaluate the 'facts' differently, including experiencing them from the 'rationality' of other interests, and then learning to act differently with regard to them" (p. 473) may be an overwhelming task.

A number of intrinsic limitations on learning have been recognized within organizations, too, particularly bureaucratic ones. Morgan (1986) cites three such barriers. First, organizations impose fragmented structures of thought on their employees and discourage them from thinking for themselves. Organizationally-set goals, structures, roles, and routines sharply define patterns of attention and responsibility for people within the group. Even successful single-loop learning may inhibit asking deeper questions about the organization's underlying assumptions, norms, and learning capabilities (Argyris 1992). Second is the system of bureaucratic accountability that fosters defensiveness. The organization and its employees may make excuses, deflect responsibility, or obscure issues and problems that might make them look bad. This may be manifest as "cover ups," manipulation of images and impressions, or telling superiors or the public what employees think they want to hear. Third is the difference between what people say and what they actually do. Employees "develop espoused theories that effectively prevent them from understanding and dealing with their problems" (Morgan 1986:90). "Groupthink" pressures may reinforce these tendencies (Janis 1972).

Etheredge (1985) identified several barriers to governmental learning (see also Osborne and Gaebler 1993). First, agencies tend to adopt similar policies and programs across all circumstances. Second, decision processes in agencies tend to be closed, relying primarily on information sources that confirm agency tendencies. Third, government agencies commonly demonstrate errors in judgment and perception: they underappreciate valuable data, dismiss outsiders' suggestions, and base judgments on wishful thinking. Fourth, early appointments of people

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Zoos, Aquariums, and Endangered Species Conservation

Beth Stevens, Michael Hutchins, and Terry L. Maple

The following articles, provided by Beth Stevens, Director of the Conservation Action Resource Center at Zoo Atlanta, Terry Maple, President and CEO of Zoo Atlanta, and Michael Hutchins, Director of Conservation and Science for the American Zoo and Aquarium Association (AZA), represent the start of a collaboration between the Endangered Species UPDATE and the AZA. In this issue the authors explore the role of zoos in the larger context of species protection efforts throughout the world. Future issues will highlight specific conservation efforts, such as individual Species Survival Plans, and include information of interest to professionals working in zoos and non-professionals interested in wildlife conservation.

Zoos and aquariums have evolved rapidly: from mere menageries, where people went to marvel at the spectacle of fierce and unusual animals behind bars or glass, to institutions dedicated to the conservation of wildlife and natural habitats. Vanishing from zoos are images of animals in hard confinement, and increasing are animals exhibited in conditions which accurately and effectively simulate their native environments (Norton, et. al, 1995). Today each of the 172 zoos and aquariums in the United States and Canada accredited by the American Zoo and Aquarium Association (AZA) has four main goals: conservation, education, science and recreation.

How zoos and aquariums contribute to conservation has also evolved rapidly: from the approach that zoos are modern Noah's Arks, protecting wildlife from the approaching "flood" of species extinctions, to a much broader, multifaceted approach that has zoos contributing to the conservation of wildlife in nature through a combination of programs including public education, scientific research, technology development and transfer, fund-raising, and captive breeding for reintroduction (Hutchins, et. al., in press; Wiese and Hutchins, 1994; Sunquist, 1995). While it is unfortunately true that for some species zoos and aquariums may be their last refuge, it is unrealistic to view captivity as the "safety net" for all endangered species, because there simply is not enough space. However, zoos and aquariums and their living collections can, and do, play a much broader role in the preservation of wildlife in nature.

Public education is perhaps the greatest role that zoos and aquariums can play in conservation. Collectively, AZA zoos and aquariums form the only conservation organization large enough to reach more than 116 million visitors annually. Supporting zoological societies have a combined membership of 4.9 million people. For many people, urban dwellers in particular, zoos and aquariums may be the only place where they have any significant contact with animals. Zoos and aquariums can provide people with personal wildlife experiences, experiences that often evoke an emotional connection with animals. A close encounter with a gorilla or a flamingo, an alligator or a leaf-cutting ant, can inspire a visitor to want to learn more about these animals and the many threats to their existence. According to a recent Roper Organization poll, nine out of ten Americans believe professionally-managed zoos and aquariums are essential to educating the urban public about wildlife. Ultimately, zoos and aquariums strive to inspire each and every visitor to take some kind of action to help preserve wildlife and wildlife habitat. Zoos and aquariums promote many actions that people can take, from recycling and planting backyard habitats, to taking citizen action through writing to Congress in support of the Endangered Species Act, to making financial contributions to conservation organizations.

Scientifically-managed captive breeding programs are critical to responsible zoo animal management. Over ninety percent of all mammals and seventy percent of all birds in North American zoos today

Left
Natural habitats, like this gorilla habitat at Zoo Atlanta, provide appropriate environments for the animals as well as representative learning environments for zoo visitors. Photograph by J. Sebo, Zoo Atlanta.

were bred in captivity (Wiese & Hutchins, 1994). Sophisticated computer analyses are employed to maintain healthy, self-sustaining captive populations of animals. Captive breeding for reintroduction is appropriate for some species, particularly those that are extinct in the wild or those whose populations have become so fragmented that they are destined for extinction.

Scientific research contributes directly to conservation through providing greater knowledge on which to base critical management decisions. Zoos conduct research in a wide variety of disciplines: biology, ecology, reproductive biology, genetics, behavior, nutrition, and wildlife medicine. Both applied and basic research are supported by zoos. According to Hutchins et. al. (in press), scientists working at, or in collaboration with, AZA member institutions produced over 1,350 peer-reviewed technical and semi-technical articles, and conference proceedings, in the last four years (1991-1994).

Many of the technologies developed or tested by zoo and aquarium biologists are directly relevant to field conservation (Hutchins & Conway, 1995). Examples include advances in reproductive technology (e.g. methods of wildlife contraception), safe chemical immobilization of wild animals, high-tech methods for tracking free-ranging animals, and individual animal identification (Hutchins, et.al, in press; Wiese and Hutchins, 1994). Through various programs sponsored by individual zoos and AZA Conservation and Science committees (see articles on AZA's conservation programs), wildlife biologists in developing countries receive training in applications of all of these technologies.

Finally, in addition to supporting field research, several AZA institutions provide direct financial assistance to national parks and

Right
The goal of providing close encounters with zoo animals is to inspire visitors to learn more about wildlife issues and take action for conservation. Photograph by J. Sebo, Zoo Atlanta.

reserves through "adopt-a-park" programs or "adopt-an-acre" programs. For example, the Minnesota Zoological Garden has adopted Ujung Kulon National Park on the island of Java in Indonesia. An international biosphere reserve, the park is one of the last strongholds of the Java rhinoceros, perhaps the most endangered large mammal in the world. The zoo provides financial assistance to park personnel to purchase equipment and to make improvements to park facilities. Furthermore, a growing number of institutions have field biologists on staff. Zoo and aquarium based ecotourism is another method by which zoos and aquariums make financial contributions to developing countries. Both the AZA and many of its member institutions have developed various funds to support field conservation programs, with each fund having a very specific initiative.

Through regular features in the Endangered Species Update, we intend to highlight examples of those programs that demonstrate how AZA-accredited zoos and aquariums are active players in the conservation of endangered species. Our ultimate goal is to foster increased communication and collaboration among our many dedicated colleagues who share our commitment to endangered species throughout the world.

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The AZA's Conservation Programs: How Are They Organized?

In 1981, the American Zoo and Aquarium Association (AZA), formerly the American Association of Zoological Parks and Aquariums (AAZPA), made its first significant commitment to conservation by establishing the Species Survival Plan (SSP). The SSP is the cornerstone of the AZA's efforts to preserve endangered species and their habitats. This is accomplished through public education, scientific research, field conservation, and the maintenance of healthy captive populations as a hedge against extinction. Subsequently, Taxon Advisory Groups (TAGs), Faunal Interest Groups (FIGs) and Scientific Advisory Groups (SAGs) were formed to further enhance the AZA's conservation mission. Below are explanations of each of these programs, with excerpts taken directly from the AZA Fact Sheets on each program. The complete Fact Sheets are available from the AZA Excutive Office/Conservation Center, 7970-D Old Georgetown Road, Bethesda, MD 20814. Descriptions of the program are also available in Hutchins and Wiese (1991) and Wiese and Hutchins (1994).

SPECIES SURVIVAL PLAN (SSP)

The mission of the AZA's Species Survival Plan (SSP) is to help ensure the survival of selected wildlife species. The mission is implemented using a combination of the following strategies:

- Organize scientifically-managed captive breeding programs for selected wildlife as a hedge against extinction.
- Cooperate with other institutions and agencies to ensure integrated conservation strategies.
- Increase public awareness of wildlife conservation issues, including development and implementation of education strategies at our member institutions and in the field, as appropriate.
- Conduct basic and applied research to contribute to our knowledge of various species.
- Train wildlife and zoo professionals.
- Develop and test various technologies relevant to field conservation.
- Reintroduce captive-bred wildlife into restored or secure habitat, as appropriate and necessary.


Photograph by Neal Johnston, Los Angeles Zoo

A species must satisfy a number of criteria to be selected for an SSP. Most SSP species are endangered or threatened in the wild and have the interest of qualified professionals with time to dedicate toward the species' conservation. SSP species are often "flagship species," well-known animals which arouse strong feelings in the public for their preservation and the protection of their habitats. Examples include the giant panda, Sumatran tiger and lowland gorilla. New SSPs are approved by the AZA Wildlife Conservation and Management Committee, with input from the appropriate Taxon Advisory Group (TAG), which manages conservation programs for related groups of species (e.g. great apes, bears, freshwater fish, etc.).

Each SSP has a qualified species coordinator who is responsible for managing its day-to-day activities. Management committees composed of various experts assist the coordinator with conservation efforts for the particular species, including aspects of population management, research, education, field conservation and reintroduction when feasible. The species coordinator is responsible for developing the SSP Master Plan, which outlines the goals for the population. It designs the "family tree" of a particular captive population in order to maximize genetic diversity and demographic stability. A computer database, called a "studbook," is developed; it contains the vital records of an entire managed population of a species, including births, deaths, transfers and family lineage. With appropriate computer analysis, the studbook enables the species coordinator and management group to make sound breeding and other management recommendations based on genetics, demographics, and the species' biology. Consideration is also given to the logistics and feasibility of transfers between institutions, as well as maintenance of natural social groupings. Often, recommendations not to breed animals are made, so as to avoid having the population outgrow the available holding space.

Several SSPs support reintroduction projects, though reintroduction of animals to the wild is not the goal of every SSP. For native species, SSPs are typically linked to U.S. Fish and Wildlife Service Endangered Species Recovery Plans; examples include the black-footed ferret, California condor, Mexican wolf, and Puerto Rican crested toad. SSPs for which reintroduction is not appropriate have a positive impact on assisting the wild population through fund-raising to support field projects and habitat protection, development of new technologies, public and professional education programs, and basic and applied research.

As of January 1, 1996 there are 76 SSPs representing 125 species: 62 mammals, 18 birds, 7 reptiles and amphibians, 34 fish, and 4 invertebrates. A complete list of SSPs is available from the AZA Executive Office/Conservation Center.

TAXON ADVISORY GROUPS (TAGs)

Established by the AZA in 1990, Taxon Advisory Groups (TAGs) examine the conservation needs of entire taxa, or groups of related species. There are currently over 40 TAGs covering groups of invertebrates, fish, birds, mammals, reptiles and amphibians. Each TAG consists of SSP coordinators, studbook keepers, scientists, and other individuals with expertise on one or more of the species covered by the TAG.

TAGs assist in the selection of appropriate species for AZA conservation programs and provide a forum for discussing husbandry, veterinary, ethical and other issues that apply to entire taxa. Through a strategic planning process, one of the TAGs' primary responsibilities is to evaluate the present North American captive carrying capacity for a given taxonomic group and recommend how this space should be allocated. This results in the development of Regional Collection Plans that allow the TAG to recommend species for new AZA studbooks, SSPs and other zoo and aquarium-based programs; establish priorities for management, research and conservation; and recruit qualified individuals to carry out these activities. A number of criteria are involved in the regional collection planning process, and, depending on the particular taxon in question, various factors will carry different weights. The following criteria are often used as a starting point:

- current and anticipated captive space available;
- current captive population size and composition;
- ability to maintain and successfully breed in captivity;
- status in the wild;
- sufficient number of founders available;
- usefulness of the taxon to save habitat and other taxa (i.e., is the taxon a "flagship" species?)
- research potential;
- educational potential;
- public appeal and ability to assist in fund-raising to support field conservation;
- ability to survive in human altered ecosystems that are now ubiquitous; and
- probability of successful reintroduction to the wild, if appropriate and necessary.

Purposely organized along the same lines as the specialist groups of IUCN-The World Conservation Union's Species Survival Commission's (SSC's) and Bird Life International's Taxonomic Specialist Groups, AZA TAGs also promote cooperation and sharing of information between AZA and other regional and international conservation programs.

FAUNA INTEREST GROUPS (FIGs)

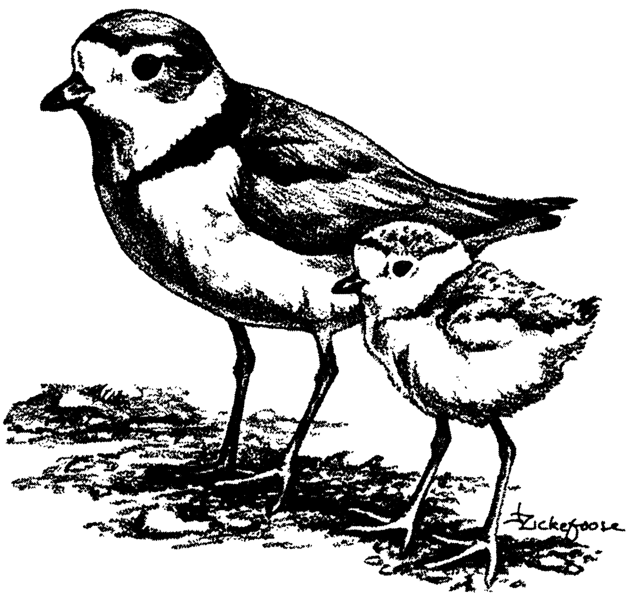
In recognition of the importance of conserving assemblages of species in their natural habitats, AZA established Fauna Interest Groups (FIGs) in 1991 to focus attention on the conservation needs of regions rich in biodiversity (Hutchins and Wiese, 1991; Wiese and Hutchins, 1994). Attention is being focused on regions abundant in unique wildlife and habitat, "hot spots" of biodiversity. FIG members include zoo and aquarium directors and curators, university scientists, field researchers, and representatives from conservation organizations and agencies with special expertise or interest in a particular region and its wildlife.

For AZA to address the special needs of such biologically diverse regions on a species-by-species basis would be both difficult and inadequate. FIGs allow AZA member institutions and individuals to network more broadly, allowing the development and coordination of multiple conservation projects both within and between given regions. To date, FIGs have been succesful in coordinating some of the international conservation activities of SSPs; establishing working relationships and agreements with government wildlife agencies, aiding in the renovation of buildings and animal enclosures; providing training to zoo and national park personnel in animal management and husbandry; and supplying essential equipment for use by park rangers. There are currently seven FIGs: Brazil, Madagascar, Meso-America, Paraguay, Southeast Asia, West Indies, and Zaire. Efforts are currently underway to establish a North American FIG. The intent is to better organize AZA's cooperative efforts for endangered native wildlife and to provide a forum to increase communication between AZA and appropriate state and federal wildlife agencies. In particular, it is important that the AZA and government wildlife agencies strengthen cooperative efforts on behalf of native wildlife and their habitats.

SCIENTIFIC ADVISORY GROUPS (SAGs)

Established in 1991, AZA Scientific Advisory Groups (SAG's) facilitate, support, network, and coordinate the relevant research activities of member institutions. Because resources are limited, zoos and aquariums must work together to expand their scientific programs, collaborate with the greater academic community, increase the use of science in the management of captive populations, and collectively contribute to the long-term conservation of biodiversity around the world.

There are currently eight SAGs: behavior and husbandry, contraception, genome banking, nutrition, reintroduction, small population management, systematics, and veterinary science. Each of the SAGs is made up of experts in a particular field of wildlife science, such as veterinary medicine or behavior. SAG members include zoo- and aquarium-based curators with appropriate scientific training, veterinarians and researchers, as well as university, government, and other outside scientists with a commitment to sharing their particular expertise. From outlining priorities for future research to consulting at meetings focused on individual species or habitat conservation, Scientific Advisory Groups serve the AZA membership in a variety of ways.



Zoo and aquarium based research is of increasing relevance to field conservation and has already made many unique contributions. For example:

- detailed information on courtship, mating, parental and aggressive behavior, and behavioral ontogeny derived from captive studies is critical for the propogation of endangered species and their eventual reintroduction;
- contraceptive research which involves collaborators from the zoo and academic communities has the potential to offer alternative methods of reducing and eventually eliminating populations of ecologically-destructive exotic species or for controlling overabundant populations of indigenous animals;
- various reintroduction, translocation, and post-release monitoring techniques developed through zoo and aquarium based research have been invaluable to a variety of endangered species recovery efforts; and
- genetic and demographic management strategies developed for captive populations are increasingly applicable to management of isolated populations in parks and reserves.

Scientific publications by zoo and aquarium employees and university affiliates have appeared in 218 different journals, 61 books and the proceedings of 39 different conferences over the past four years (Hutchins et. al., in press). AZA Scientific Advisory Groups provide the support, guidance, and networking critical to the further advancement of conservation science at accredited zoos and aquariums throughout North America.

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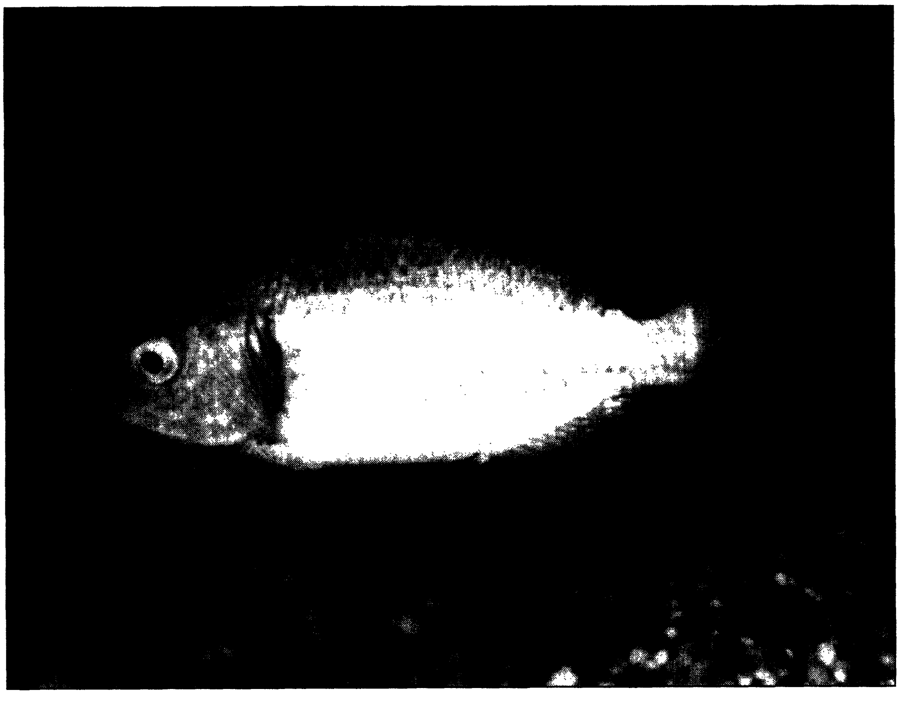
SSP Profile: Lake Victoria Cichlids

Species Survival Plan Profile
Since Species Survival Plans form the cornerstone of AZA's conservation programs, the "SSP Profile" will become a regular feature of the AZA's contributions to the Endangered Species UPDATE. The purpose of this feature is to highlight the diversity of approaches and programs that SSPs employ to help ensure the survival of endangered species.

Lake Victoria touches the shores of Kenya, Uganda, and Tanzania in East Africa. The lake was once home to one of the most spectacular concentrations of fish species in the world. Numerous unique species were found in its waters, providing an important food resource for the 30 million people who inhabit the region. One of the most devastating human impacts on the Lake Victoria ecosystem was the introduction of the non-native Nile perch beginning in 1954. The perch experienced a population explosion in the 1980s, which directly coincided with a decrease in native fish populations preyed upon by the perch. As native species disappeared, the lake's ecology was disrupted, resulting in algal blooms and low oxygen levels. The haplochromine cichlids were the hardest hit by these changes.

A Species Survival Plan for the Lake Victoria Cichlid was established by AZA in 1993 to focus the support of the North American zoo and aquarium community on the conservation of this lake's unique ecosystem and fishes. The goal of the SSP is to conserve and ultimately restore representative remnants of the native fish fauna. Organized captive breeding programs are now in place for over 30 cichlid species. Working closely with the Lake Victoria Research and Conservation Program of the New England Aquarium and with the fisheries research institutes of the host countries, the SSP is helping to lay scientific and political foundations for the development of a comprehensive restoration plan. This program is of particular importance because it is AZA's first fish SSP.

Excerpts from Wiese and Hutchins, 1994, Species Survival Plans, Strategies for Wildlife Conservation, AZA, 1994.



Right
A sexually active male ngege, *Oreochromis esculentus*, one of the two tilapia species native to the Lake Victoria basin. Formerly the basis of a major commercial fishery, the *ngege* is extinct in Lake Victoria proper, although relict populations persist in small satellite lakes in Kenya and Uganda. A keystone species in the Lake's pre-Nile perch ecosystem as well as a favored food fish, its eventual restoration is keenly desired by the people and governments of Lake Victoria's three riparian states. Photograph by Paul V. Loiselle.

Conservation Spotlight: Piping Plovers Plucked from Perilous Predicament

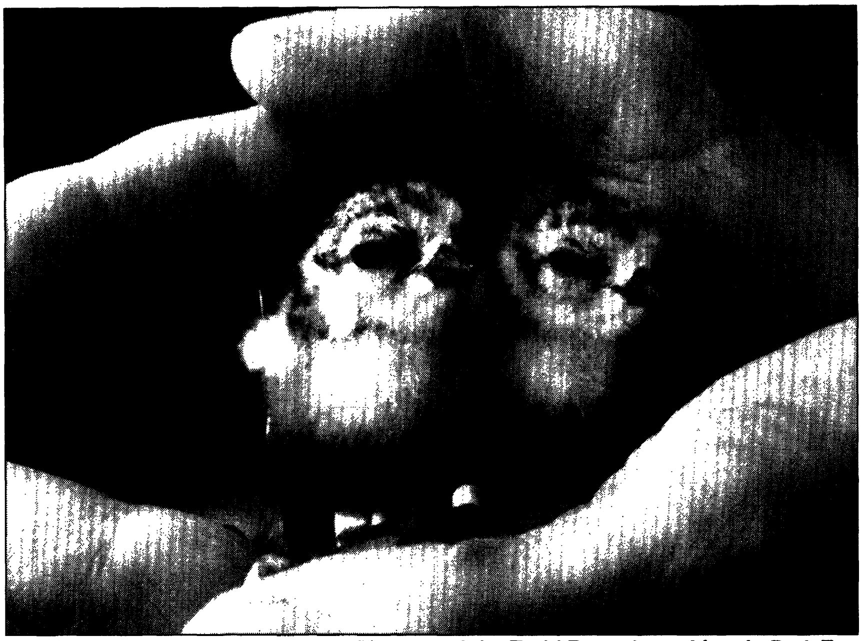
AZA Conservation Spotlight
AZA zoos and aquariums participate with state and federal wildlife agencies in a variety of cooperative programs that are not always part of an SSP. There are over 100 cooperative programs between the AZA and the United States Fish and Wildlife Service already in place. The purpose of the *Conservation Spotlight* is to highlight the role of zoos and aquariums in some of these cooperative programs.

In June 1995 the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service faced a difficult situation. Due to near record precipitation and above average snow packs, the runoff in the upper Missouri River Basin had already filled storage reservoirs to capacity. To prevent the situation from getting worse, the Corps of Engineers planned to open the dams in the area, which would wash away the nests of piping plovers, a North American shorebird threatened due to habitat loss from the impact of river dams and off-road vehicles.

The Corps of Engineers and USFWS decided to attempt a rescue of some of the plover eggs before the dams were opened. They consulted with Bruce Bohmke of the Phoenix Zoo, who chairs the AZA Charadriiformes Taxon Advisory Group (TAG). Subsequently the Milwaukee County Zoological Gardens and the Lincoln Park Zoological Gardens were also asked to help develop a rescue plan, and to participate in the rescue itself.

A patron of the Milwaukee County Zoological Gardens donated a jet and pilot for the rescue, and portable incubators were borrowed from the International Crane Foundation. Zoo staff and government personnel initially collected a total of 30 eggs from Yankton, S.D., Pierre, S.D., and Williston, N.D., and on a later trip the Corps of Engineers collected an additional 114 eggs. The eggs were evenly divided between the Milwaukee County Zoological Gardens, which hatched 12 eggs, and Lincoln Park Zoological Gardens, which hatched 14 eggs.

The zoos' role in the recovery plan extends far beyond the actual rescue and hatching; they are also undertaking to learn as much as possible about the husbandry and management of this species in captivity. For many other endangered species, such as the California condor, captive breeding efforts have been started only after the species is close to extinction, and there has been no opportunity to develop the needed expertise and husbandry protocols. In these cases it has been necessary to test methodology on the last few remaining individuals. With the piping plover, the staffs of the participating zoos will continue to assist with establishing these protocols now, a strategy more likely to achieve success.



Photograph by Todd Rosenberg, Lincoln Park Zoo

For now, efforts to save the piping plover will continue to focus on maintaining the species in its natural habitat. However, this impromptu captive breeding effort will provide invaluable information in the event that captive breeding becomes incorporated formally into the recovery plan.

For more information about the piping plover egg rescue, please contact:

Nell McPhillips
Fish and Wildlife Biologist
Fish and Wildlife Service
Pierre, South Dakota
(605) 224-8693

Anita Cramm
Curator of Birds
Lincoln Park Zoological Gardens
(312)742-2000; or

Bruce Beehler
Deputy Director
Animal Health and Management
Milwaukee County Zoological Gardens
(414)771-3040.

Excerpts from Swaringen, K. 1995. AZA Communique, December 1995.

NEWS FROM ZOOS

AZA Conservation and Science Office Organizes Planning Process for Black-Footed Ferret Recovery Program


Photo by Jessie Cohen, National Zoo

The Black-Footed Ferret Recovery Management Team, including representatives from the U.S. Fish and Wildlife Service, U.S. Forest Service, Bureau of Land Management, and various state wildlife agencies, selected the AZA Conservation and Science Office to organize and facilitate a program analysis and action planning process for the Black-Footed Ferret Recovery Program at their meeting in Big Sky, Montana from July 15-18, 1995. The analysis will be conducted during a series of three meetings focused on captive breeding; reintroduction and field conservation; and support activities (i.e. program administration, marketing and development, public relations, and public education). The first two meetings have been held and planning for the third meeting is currently underway. It is hoped that this process will result in a model for public/private partnerships in endangered species recovery. Funding was provided by the National Fish and Wildlife Foundation. (*From AZA Conservation and Science Office.*)

Reintroduced Guam Rail Breeds on Rota Island


Photo by Jessie Cohen, National Zoo

Guam Department of Aquatic and Wildlife Resources (GDAWR) biologists have documented reproduction in reintroduced, captive-bred Guam rails on Rota Island. This represents the first documentation of successful reproduction in released birds. The Guam rail became extinct on Guam as a result of the introduction of an exotic predator, the brown tree snake. Efforts are underway to eradicate or control the snake on Guam so that repatriation may be possible. Additional releases of rails are planned on Rota in the near future. The Guam rail Species Survival Plan is a cooperative program of the GDAWR, U.S. Fish and Wildlife Service, and the AZA. (*From Scott Derrickson, Coordinator, AZA Guam Rail SSP*)

Dian Fossey Gorilla Fund Relocates to Zoo Atlanta from Denver, Colorado

The Dian Fossey Gorilla Fund

The Dian Fossey Gorilla Fund (Fossey Fund) is a non-profit organization founded by Dr. Dian Fossey in 1978 to preserve and protect the few remaining mountain gorillas (*Gorilla gorilla berengei*) living in the Virunga Volcano ecosystem along the border between Rwanda and Zaire. Originally named "Digit Fund" in memory of Dr. Fossey's favorite gorilla, who was killed by poachers in 1977, the fund was renamed in 1992 to focus on the organization's commitment to carry out the research and conservation programs established by Dr. Fossey.

Advances in Reproductive Technology: Test Tube Gorilla and Cheetah From Artificial Insemination


Photo by Ron Austing
Cincinnati Zoo And Botanical Garden

Advanced reproductive technology is a potentially useful tool in the effort to preserve endangered species. It may, for example, someday be possible to move the genetic material of an endangered animal from one population to another to maintain genetic diversity. This might be particularly important when populations have become physically or genetically isolated as a result of habitat fragmentation. Two recent breakthroughs by zoo-based scientists at the National Zoological Park's New Opportunities in Animal Health Science (NOAHS) program and the Cincinnati Zoo and Botanical Garden's Center for the Reproduction of Endangered Wildlife (CREW) illustrate the progress being made: the birth of a cheetah from cyropreserved sperm collected in Namibia at the Rio Grande Zoo in Albequerque, NM, and the birth of the world's first test tube gorilla at Omaha's Henry Doorley Zoo, respectively. (*From AZA Communique.*)

Possible New Subspecies of Gorilla Identified


Photo by Jane T. R. Dewar

Drs. Sarmiento, Butynski and Kalina, scientists from the American Museum of Natural History and Zoo Atlanta recently compared the habitat, ecology, behavior and morphology of gorillas of the Bwindi-Impenetrable Forest National Park and Virunga Volcanoes and determined that the animals in the Impenetrable Forest are not mountain gorillas. These results indicate that the mountain gorilla is far more endangered than researchers thought: the total number of mountain gorillas is now estimated at 320, not 620.

AZA conferences in 1996

April 10-13, 1996
The AZA Eastern Regional Conference will be held in Greenville, South Carolina. For further information, contact Bob Wilson, Greenville Zoo, 150 Cleveland Park Drive, Greenville, SC 29601 (803)467-4300.

May 15-18, 1996
The AZA Western Regional Conference will be held in Denver, Colorado. For further information, contact Angela Baier, Denver Zoological Garden, 2300 Steele Street, Denver, CO 80205 (303) 331-5805.

February 28 - March 2, 1996
The AZA Central Regional Conference will be held in New Orleans, Louisiana. For further information, contact Craig Dinsmore, Audubon Park and Zoological Garden, P.O. Box 4327, New Orleans, LA 70178 (504)861-5112.

September 17-21, 1996 - The AZA Annual Conference will be held in Honolulu, Hawaii. Further information will be provided in a future issue.

For information on becoming a member of AZA, please contact:
AZA Office of Membership Services, Oglebay Park, Wheeling, WV 26003-1698
Phone (304) 242-2160 Fax (304) 242-2283

Report from the Field

Understanding Proposed Changes to the Endangered Species Act: The Case of the Marbled Murrelet

By Kate Irvine

In its current attempt to reauthorize the Endangered Species Act (ESA), Congress is heatedly debating the Act's merits and introducing a flurry of bills and amendments to modify its scope. The number of proposed modifications and the often subtle differences among them make it easy to lose sight of the implications of these changes. This article takes a step back from the specifics of each bill or amendment and discusses the proposed changes in terms of three underlying issues driving the current debate: private property rights, the scope of protection, and the role of science. To better understand how changes to the ESA could impact the conservation of biodiversity, this article analyzes possible consequences for one species of seabird, the marbled murrelet (*Brachyramphus marmoratus*). The first part of the article describes the natural history of this murrelet while the second discusses proposed changes to the ESA and potential effects on marbled murrelet populations.

The marbled murrelet was selected for two reasons. The bird is scientifically fascinating because of its unusual life history; it depends on two very different ecosystems for survival, marine coastal waters for feeding and ancient forests for nesting. Also, the bird presents a management and conservation challenge because human resource use often conflicts with this murrelet's resource needs, particularly for breeding.

Natural History of the Marbled Murrelet

Despite many years of research, the natural history of the marbled murrelet is still not well understood. Its unique and secretive nesting habits and cryptic coloration make it difficult to observe, or even locate, particularly on land. Much of our knowledge about the bird is based on at-sea surveys, behavioral observations and chance discoveries of nests (Ralph et al. 1995).

Species Description

The marbled murrelet is a dove-sized seabird, described by ornithologists as a "football with wings" when in flight (Dietsch pers. comm.). It is one of 22 species of the alcid family (Alcidae), which also includes puffins, murres, and guillemots. Alcids spend most of their lives bobbing up and down on the surface of the sea and diving under water in pursuit of prey. The short neck and tail, stubby wings, and rear-placed feet enable the marbled murrelet to propel itself beneath the ocean's surface to feed on schools of small fish, such as Pacific herring (*Clupea harengus*) and Northern anchovies (*Engraulis mordax*). Its compact body and thick layers of down conserve heat and keep the bird warm when in the cold, watery environment.

Distribution

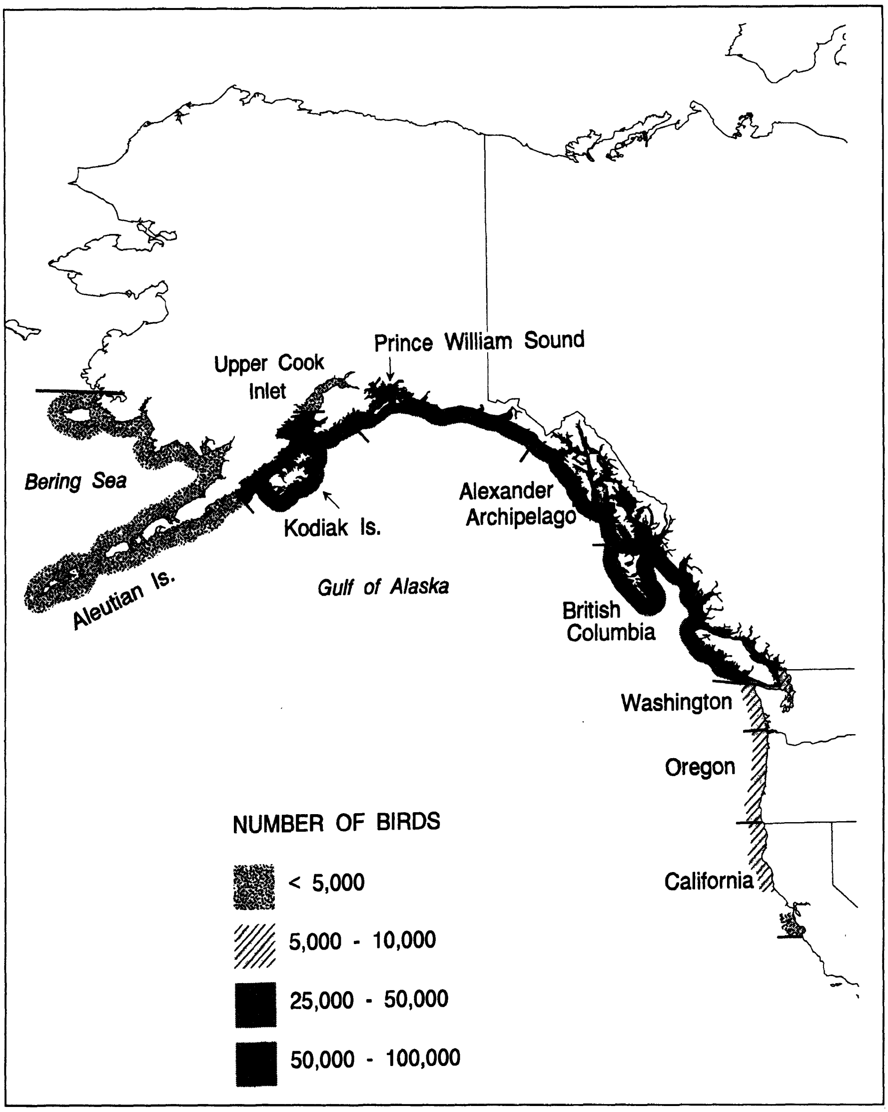
Most species of alcids are found in northern Pacific waters. In North America, the marbled murrelet frequents inner-coastal waters, ranging along approximately 4,000 km of coastline from the Aleutian islands in southern Alaska to south-central California. At-sea surveys estimate the population at around 300,000 individuals of which approximately 85% are located between the Gulf of Alaska and Prince William Sound (Ralph et al. 1995). Unlike most seabirds, which are found primarily in large flocks, marbled murrelets usually occur as widely dispersed pairs within 300 to 2000 meters of the coastline (Strachan et al. 1995). Recent evidence indicates a slight seasonal migration, particularly in the Washington and British Columbia area; individuals are widely dispersed offshore in summertime and congregated into groups of three or more birds in sheltered inlets and bays during the winter (Speich and Wahl 1995; Strachan et al. 1995; Burger 1993). Carter and Sealy (1990) suggest that marbled murrelets form small flocks during the nesting season, when the distribution along the coastline is heavily dependent on location of suitable nesting habitat.

Nesting Habits

The marbled murrelet's choice of nesting habitat is unique among seabirds. Most seabirds nest on rocky substrates, such as cliffs or rock crevices, in groups of ten to several thousand pairs. This murrelet nests in coastal late-successional and ancient forests. While many details about its nesting behavior remain a mystery, such as whether pairs nest alone or in loose colonies, patterns have been pieced together from observations of flight behavior, comparative deductions from life histories of other alcids, and monitoring of known nesting sites.

The marbled murrelet nests between April and September, with the length of the nesting season depending on how far north the bird lives (Hamer and Nelson 1995a). A breeding female lays a single egg in a breeding season. Incubation of the egg and feeding of the nestling are shared equally between the parents. Behavioral observations indicate that the male and female change places once a day, during the early morning hours around sunrise (Nelson and Hamer 1995a). Incubation lasts from twenty-seven to thirty days and fledging occurs between twenty-seven and forty days after hatching (Hamer and Nelson 1995a). Utilizing studies of other alcids of similar size and range, researchers estimate marbled murrelets start breeding between two and four years of age (De Santo and Nelson 1995).

It is known that many alcids mate for life and use the same nest year after year, and researchers speculate, based on life histories of other alcids and observations of marbled murrelet pairs in at-sea surveys, that these birds do form pair bonds for life (De Santo and Nelson 1995). Behavioral observations in terrestrial ecosystems suggest this bird at least exhibits loyalty to a particular type of nest site if not to a specific nest itself (Divoky and Horton 1995). The challenge of finding nests has made it difficult for researchers



Range of the marbled murrelet, which stretches from central California to southern Alaska. Courtesy of U.S. Forest Service.

to quantify empirically these intriguing and biologically important aspects.

Nesting in trees is one of many characteristics that enables the marbled murrelet to avoid predators. Additionally, the bird limits its activity to periods of low light, such as dawn and dusk, remaining motionless and flattened against the nest at other times (Nelson and Hamer 1995a). The breeding plumage, a chocolate-brown coloration on its back with mottled brown underparts, as compared to brown coloration on top with white plumage below during the winter, is the same for male and female and camouflages the bird in its arboreal surroundings. The bird rarely calls when on or approaching its nest, and it "freezes" for a period of minutes after landing on the nest for feeding or incubation (Nelson and Hamer 1995a). Despite these adaptations, survival rates are relatively low compared to other alcids. Observations at thirty nests indicated that only 67% of the eggs hatched and fledging success is estimated to be 45% (De Santo and Nelson 1995). Mortality of eggs and young in the nests is due primarily to predation by owls and a variety of corvids, such as Stellar's jays (*Cyanocitta stelleri*) and common ravens (*Corvus corax*) (Nelson and Hamer 1995b). Death of newly fledged young can occur on their trip from land to water, either due to predation or exhaustion (De Santo and Nelson 1995; Nelson and Hamer 1995b).

Nest Site Suitability

Understanding the characteristics of appropriate nesting habitat has been hindered by this murrelet's secretive behavior on land. Although ground nests have been located in areas lacking trees, such as islands off the coast of Alaska, the majority of nests have been found in late-successional and ancient trees (Mendenhall 1992). Until 1974, no tree-nest had ever been found in North America. Since then, a mere 65 tree-nests have been located. Nests in the Pacific Northwest are usually located at heights of 30-60 meters and studies suggest that large limbs that form a platform and have thick mats of moss on which the egg can be laid and incubated are preferred (Hamer and Nelson 1995b).

Observations of birds flying in and around ancient forests suggest the forest structure is an important quality for suitable habitat (Nelson and Hamer 1995b; Paton 1995). Occasional openings in the forest canopy and medium-dense forest stands may be necessary to facilitate movement in and out of the forest (Grenier and Nelson 1995). Also, modified forests with a higher proportion of edges due to timber harvesting, windthrow or fire may have larger populations of predators (Ralph et al. 1995). Ancient forests are also ideal nesting habitat because the cool understory keeps the well-insulated bird from overheating (Ralph et al. 1995).

Population Status

Over the past ten to twenty years numbers of marbled murrelets from California to Alaska have decreased (Ralph et al. 1995). In 1991, the bird was listed as endangered by the California Department of Fish and Game and in September 1992 the U.S. Fish and Wildlife Service listed it as threatened in California, Washington and Oregon under the auspices of the Endangered Species Act. Washington and Oregon have since listed the bird as threatened. The main threat to the species is loss of suitable nesting habitat due to logging, and secondary threats include oil spills, predation, and fishing nets in which the birds may become entangled when diving for food (Federal Register 1992).

Recovery of marbled murrelet populations will likely take decades (USFWS 1995). The low reproductive rate of only one egg per breeding season, low survival rates for eggs and fledglings, and deferred sexual maturity suggest that population numbers will not increase rapidly. The marbled murrelet's need for two distinct ecosystems for survival further complicates opportunities for recovery. Restoration of appropriate nesting habitat could take between 100-200 years to grow (USFWS 1995). Taken as a whole, the marbled murrelet's habitat requirements and life-history strategy present significant challenges to wildlife managers.

The Marbled Murrelet and the Endangered Species Act

The Endangered Species Act (ESA) mandates a set of behaviors designed to protect biodiversity at two levels: the individual species of plant or animal and the organism's habitat (Yaffee pers. comm.). Protection begins once a species is listed as endangered or threatened. Once listed, the law prevents anyone from engaging in activities that might adversely effect protected species. It also requires identification and protection of habitat critical for species' survival and development of a recovery plan.

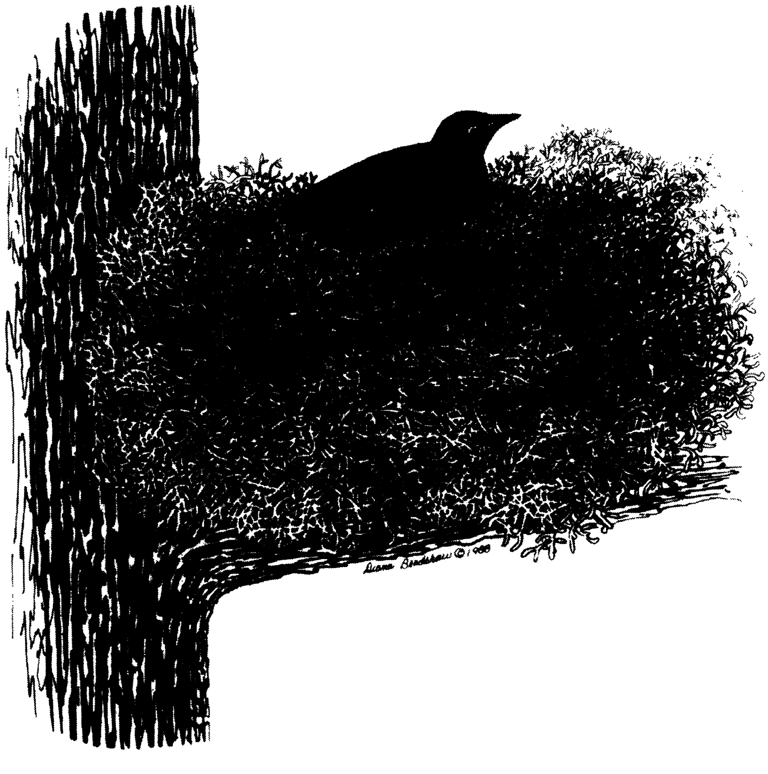
A series of bills and amendments introduced in the 104th Congress aim to modify the scope of the ESA and make regulation of actions on public and private lands more difficult. The proposed changes can be more easily understood if one views them as driven by three underlying issues: private property rights, the scale of protection provided to a listed species, and the role of science in the listing process. These issues are addressed in relationship to their effect on the marbled murrelet.

Private Property Rights

There are two components to the issue involving private property rights, a concern over the loss of economic value of private property and a question of uncertainty as to what kinds of activities are allowable under the Act. The former involves the issue of "takings." Under the Fifth Amendment of the Constitution, the government is required to compensate a property owner whose land has been taken for a public purpose. ESA opponents claim regulations imposed by the Act can, in some cases, greatly reduce the value of the property, essentially akin to a taking of economic use. Proposed legislation could require compensation by the government if property values or profits are diminished for any, not just all, portions of the property (Jones 1995). In the case of the marbled murrelet this could be quite costly. For example, this species has been sighted in the Headwaters Forest in northern California, a 3,000 acre tract of virgin, ancient redwood forest owned by Pacific Lumber. According to a 1993 Forest Service appraisal, the value of 4,488 acres, which includes the 3,000 acre stand of redwood forest and a surrounding buffer of secondary growth, is approximately $500 million, a figure that includes the value of the standing timber (Leonard 1993). Under proposed takings legislation, if Pacific Lumber had to reduce their timber harvest, the government would have to compensate the company for the amount of their economic loss.

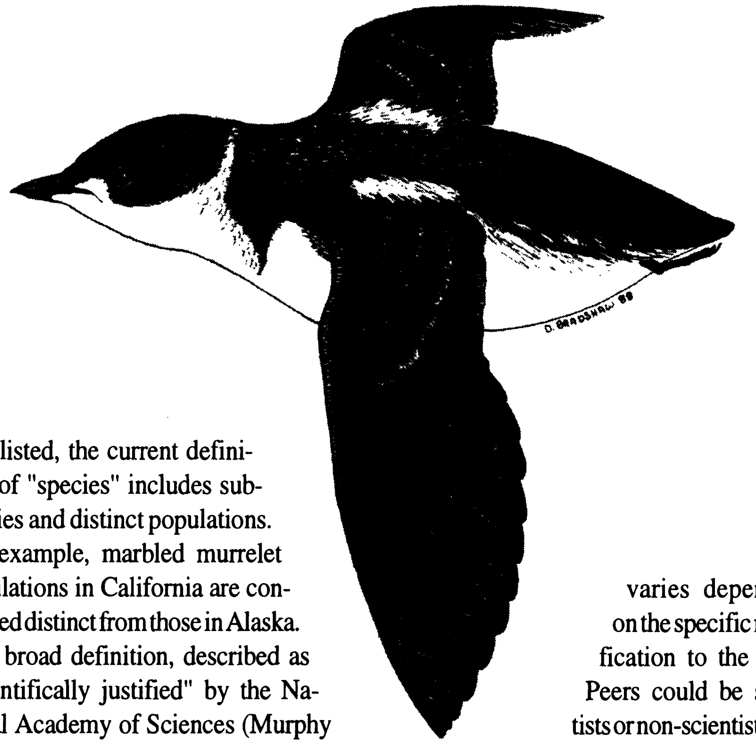
What is at stake is a question of who and what should be primarily protected by the law. The existing ESA protects the marbled murrelet by placing the general public's interests ahead of the interests of private property owners. The proposed takings legislation raises the cost of protection. Large sums of public money will have to be paid to private landowners for the conservation of marbled murrelet habitat. From a managerial standpoint, a greater burden is placed on implementing agencies that, already short of resources, may not be able to monitor property owner's actions adequately or could expend resources in court with regulatory takings cases.

The second issue concerning property rights is a desire for economic certainty. Property owners wishing to build on or otherwise modify land on which a listed species is located must develop a Habitat Conservation Plan (HCP). This plan must detail how their actions will affect the species, how these effects will be mitigated, and how the species will benefit (Lehman 1995). HCPs have traditionally covered only a single listed species. Thus, should another species be listed in the future, a landowner may need to develop a new HCP to address impacts on this newly listed species. Each new or revised HCP could further restrict the landowner's use of his or her land. Recent implementation of the HCP concept attempts to provide greater economic certainty to landowners by guaranteeing that no additional land or financial demands will be made once an HCP is approved and operative (Department of the Interior 1994). For example, HCPs are increasingly being written to cover multiple spe-



Nests of marbled murrelets can be extremely hard to find, causing problems for scientists trying to determine critical habitat. Drawing courtesy of Diana Bradshaw.

cies, both listed and candidate species. In the rush to provide certainty for landowners, it is important to ensure species protection is not unduly jeopardized. Given the lack of biological information about the marbled murrelet's use of ancient forests, it may be difficult to develop HCPs that truly meet the protection needs of this species.



Scale of Protection: The Definition of Harm

The ESA defines "take" (a term that is different from "takings") as harassing, harming, pursuing, hunting, killing, trapping, capturing or collecting protected species. How much protection a species has depends on the scale at which one interprets the term "harm." At the species scale, protection involves preventing direct harm (e.g., injuring or killing) to the organism. At the ecosystem scale, however, protection includes the habitat critical to the survival of the species; damage to the ecosystem could be deemed indirect harm to the species. Current interpretation of the ESA, upheld by the 1995 U.S. Supreme Court decision in Babbitt v. Sweet Home Chapter of Communities, states that a property owner may neither directly nor indirectly harm a protected species (Irvin 1995). Proposed changes would define the intent of the Act as concerned only with direct harm to a species. For the marbled murrelet these changes could be disastrous. This species uses ancient forest for only five to six months of the year, during its breeding season. Thus, during the months in which the bird is absent, a property owner could do anything they wanted to the area. Clearcutting the forest, for example, would not be prohibited because removal of habitat would not be considered as causing direct physical harm to the bird. Even during the nesting season an area could be logged as long as known nesting trees, with marbled murrelets in them, are left standing. Such activity will likely precipitate the extinction of the species.

The Listing Process: The Role of Science

The third issue is the role of science in the listing process, focused primarily on the questions of what is listed and how this is determined. With respect to what gets listed, the current definition of "species" includes subspecies and distinct populations. For example, marbled murrelet populations in California are considered distinct from those in Alaska. This broad definition, described as "scientifically justified" by the National Academy of Sciences (Murphy 1995), affords protection to smaller segments of species, which helps conserve genetic as well as organismic diversity. Proposed legislation narrows this definition making it basically impossible to protect species doing poorly in only part of their range. Had the narrow definition of species been in place in 1992 when the U.S. Fish and Wildlife Service was petitioned to list the marbled murrelet, the bird never would have been listed because Alaskan populations were, and still are, doing well. Senator Kempthorne (R-ID) has introduced a bill that proposes delisting any species currently listed as distinct populations; this change would result in no further protection for marbled murrelet populations in California, Washington and Oregon.

The second matter of concern is the decision-making process leading up to a listing. Listing is based solely on the best scientific and commercial data available. The language of the ESA does not require an official peer review of scientific information. Listing agencies do, however, utilize scientific experts, both internal and external to the agency, to review data and make recommendations, particularly when disagreements occur over whether a species should be listed (USFWS undated; Bartell, pers. comm.). Proposed new language requires an official peer review process for all listing decisions, regardless of whether disagreement exists. The actual make-up of the panel varies depending on the specific modification to the ESA. Peers could be scientists or non-scientists, and they could be appointed by the Secretary of the Interior or governors of the states in which the species is located or selected from a list of experts submitted by the National Academy of Sciences. This new requirement suggests a desire to strengthen the scientific basis of the listing decision. However, it could severely lengthen the listing process, leaving potentially imperiled species unprotected for a longer period of time. For a species such as the marbled murrelet, which has a low reproductive rate, lengthening the process could bring populations closer to a point where they would not be able to recover.

Species Protection: What Can We Conclude

The Endangered Species Act promotes protection of biodiversity through preventing harm at both a species and ecosystem level. A fundamental premise is that these species are somehow beneficial to the health, safety and well-being of the American public. This tenet stands behind the idea of restricting property owners' actions on their land and provides a framework for a broad, multi-scale implementation of the law. If indeed our goal is to take a long-term approach to protecting biodiversity for the public good (Yaffee pers. comm.), the case of the marbled murrelet illustrates the shortsightedness of some of the changes proposed by the 104th Congress. This bird's use of two different ecosystems nicely depicts the impact a narrow definition of harm would have on habitat critical for a species' survival; while the bird is in its marine environment, breeding habitat could be legally modified or removed. The paucity of biological information about this species illustrates the importance of designing flexible HCPs that provide long-term certainty for private landowners and species protection. Additionally, the fact that this species has been defined as consisting of several subpopulations portrays the implications for redefining the term species; currently protected populations in California, Oregon, and Washington could no longer be protected. Lastly, the case of the marbled murrelet demonstrates the cost that could be involved in species protection should takings legislation become law.

Is the marbled murrelet a representative example of a threatened or endangered species? It is likely that there is no one, single species that represents all the protection needs of listed species. The marbled murrelet, however, is a perfect example to help us identify what we want to accomplish with the ESA. Do we want legislation that protects biodiversity as being in the public interest, or legislation that places a higher value on the right of private property owners to pursue economic gain? One would hope, for the sake of present and future generation's enjoyment of species such as the marbled murrelet, that we would choose a long-term approach to conserving biodiversity.

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to important positions tend to determine later outcomes. Fifth, there is a tendency within bureaucracies for no one to accept complete responsibility. Sixth, policy meetings are usually highly ritualized, which reinforces patterns of collective decision making and bypasses "intellectual integrity" (p. 98). Seventh, group decision processes are generally "designed to affect choices rather than to clarify them" (p. 99). Finally, organizational learning is inhibited when decision makers underuse or penalize information from subordinates.

Many of these "self-blocked learning" patterns appear over and over again within organizations, and the same strategies for organized behavior are repeated—despite continuing incongruities between people's expectations of how their actions and decisions will affect matters and the actual outcomes and effects.

Improving Conservation by Improving Learning

The constraints on achieving a more learning-based approach to endangered species conservation are fundamental cultural, biological, and organizational factors. Yet, the necessity of change is widely recognized. To put it simply, we need to learn how to learn explicitly and systematically at all levels—individual, professional, organizational, and policy. A number of suggestions have been put forward to implement and facilitate improved learning and reorientation of our approach to conservation.

Michael (1995:475-484) offers nine recommendations for improving learning in the context of the renewal of ecosystems: (1) "Use the metaphoric power of language." Michael points out that war (and its derivative sports) is a pervasive metaphor used to describe many of our society's activities: "These metaphors tacitly emphasize we/they, before/after, winner/loser, beginning/ending, fixed boundaries in time and space, and relationships that map poorly onto the amorphous information world . . . and onto the fluid ecological environment. . . . [And] it is usually by these metaphors (data never stand alone) that activists and policy makers present their proposals" (p. 476). He suggests building an alternative vocabulary of metaphors that more accurately reflect the realities of "an amorphous, problematic, information-rich world of multiple myths described by such words as reciprocal, resilient, circular, emergent, development, ebb and flow, cultivate, seed, harvest, potential, fittingness, both/and" (p. 477). Such metaphors might come from the fields of biology, ecology, music, storytelling, and learning itself. (2) "Use myth reinforcement to encourage learning." Traditions that esteem learning have long existed within Western culture —science, exploration, art, athletics, "American ingenuity"—and these should be highlighted and strengthened. (3) "Acknowledge uncertainty and embrace errors." Learning requires recognition of many future uncertainties: "When uncertainties in the outcomes of proposed policy and action are acknowledged, perceived risks and vulnerabilities increase. However, options and the opportunities for resilience also increase" (p. 479). (4) "Minimize the learner's sense of vulnerability." Michael notes that learning groups are more successful when they acknowledge that there are other significant issues besides "the facts," including individual fears and "protecting organizational turf or political expediency." (5) "Use facilitators rather than chairpersons." Training in the skills of group facilitation can be extremely beneficial to a group's learning. (6) "Introduce training of group process skills." Special training can also help group members overcome predispositions toward poor listening, interrupting, "withdrawal from active participation, resistance to every suggestion, long-windedness, putting down other participants, and scapegoating" (p. 481). (7) "Provide short-term reinforcements/rewards." To help counteract the inherently long time frames of environmental management, Michael calls for the invention of rituals that regularly recognize and reward learning and acknowledge the many risks taken. (8) "Reinforce the learning mode by becoming educators." Educators at all levels can practice modeling this new kind of learning, including using more appropriate metaphors and thus changing the social context. (9) "Use disasters and crises as learning occasions." Sudden, even violent, disruptions in the world provide a potent and unique opportunity for learning that could be anticipated and capitalized through scenario construction or gaming simulation. These nine can be applied to endangered species recovery, as can the following suggestions.

Other authors have offered useful suggestions for upgrading the learning performance of organizations, although they have not specifically addressed the conservation arena. Morgan (1986:91-95) summarized four general principles: (1) "Encourage and value an openness and reflectivity that accepts error and uncertainty as an inevitable feature of life in complex and changing environments." (2) "Encourage an approach to the analysis and solution of complex problems that recognizes the importance of exploring different viewpoints. . . . This is best facilitated by managerial philosophies that recognize the importance of probing the various dimensions of a situation, and allow constructive conflict and debate between advocates of competing perspectives. In this way issues can be fully explored, and perhaps redefined so that they can be approached and resolved in new ways. The kind of inquiry helps an organization absorb and deal with the uncertainty of its environment rather than trying to avoid or eliminate it." (3) "Avoid imposing structures of action upon organized settings. . . . When goals and objectives have a predetermined character they tend to provide a framework for single-loop learning but discourage double-loop learning. . . . More double-loop learning can be generated by encouraging a 'bottom-up' or participative approach to the planning process." And finally, (4) "Make interventions and create organizational structures and processes that help implement the above principles."

Westrum (1986) provided seven principles for developing "generative" rationality within organizations, i.e., a strategy of creative problem solving: (1) "Encourage system-wide awareness for all members of the system. No one can be expected to help solve the system's problems if they do not understand what those problems are. An empowered periphery must be one aware of overall goals and approaches." (2) "Encourage creative and critical thought for all organization

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("Learning" continued from previous page)
members. Although some members of the organization will contribute disproportionately, it is vital to realize that some important ideas may come from unlikely sources." (3) "Link the parts of the system whose work is interdependent. The members of a task system must understand each other's work if they are to co-operate in solving the system's problem—not just their own. It is not enough to identify with the system as a whole. Without seeing integration as an important task, organization members will perform their contributions often in blissful ignorance of what the rest of the organization requires." (4) "Scan the system's parts for relevant solutions or contributions. Use the best solutions regardless of their origins. Every organization should examine the ability of its intratelligence system [what an organization knows about itself] to do this. It may be useful to develop formal exercises to generate alternatives. The fruits of these exercises should be formally transmitted and acknowledged." (5) "Reward communications and activities that show a desire to contribute to the entire system's thought processes. Although today's contribution may not be the answer sought, tomorrow's contribution will never come unless today's is recognized. 'Good try' is always superior to 'No good.'" (6) "Avoid over-structuring. Most of the organization's resources should be used in coping with problems, not in building up the private domains of its leaders. It is a natural tendency for parts of systems to entrench themselves. It is equally certain that resisting this tendency is necessary to maintain generativity." (7) "Examine mistakes honestly. Generative systems characteristically deal with mistakes as system problems rather than as person problems. While genuine negligence should be punished, oversights and inadequacies are human. The important issue is to identify the source of the mistake, not punish the person who made it. The ability of the system to repair its problems is strongly related to the willingness of people in it to open themselves to criticism. This willingness is greatest when criticism is dispassionate and impersonal."

The myriad ideas and approaches covered here can be boiled down to a single notion, best expressed by Morgan (1986:91): "In essence, a new philosophy of management is required, to root the process of organizing in a process of open-ended inquiry. . . . The whole process of learning to learn hinges on an ability to remain open to changes occurring in the environment, and on an ability to challenge operating assumptions in a most fundamental way." Institutions that deal with the conservation of endangered species in America, including the professions, science, government management agencies, and the non-profit sector, are currently not organized this way.

Conclusions

It is widely perceived that current endangered species conservation is not working as expected. Extinction rates are high and accelerating; few endangered species have been returned to healthy, viable populations. ESA reauthorization efforts provide an opportunity to improve conservation significantly at the legislative level. Numerous other practical opportunities for improvement exist at the individual and organizational levels in many field efforts (Clark et al. 1994). Learning is an approach that could be widely applied. Active, explicit, and systematic learning about human systems (organizations, professions, policy making, etc.), as well as endangered species and ecological systems, would ground conservation efforts in realism and enlarge their scope significantly.

In recent years, new responses to biodiversity conservation have come forward. Ecosystem management proposes to conserve biodiversity in large regional biotic systems with protected core areas, buffer zones, and interlinking corridors. This would be accomplished by coordinating management on large spatial and temporal scales based on watersheds and natural biotic communities, thus protecting more species and habitats than previously and, it is hoped, preventing species declines. Comprehensive regional planning has also been suggested as a way to integrate planning and management for wildlife (including endangered species), natural resource use, land use, air and water quality, development, and transportation at local, regional, state, and federal levels (e.g., California Governor Wilson's "Strategic Growth Plan"). These two initiatives to "scale up" conservation efforts contain the seeds of a learning approach at multiple levels, but neither one embodies a fully-recognized focus on learning as a significant tool to improve conservation.

Michael (1995) concludes that "there are two kinds of learning: one for a stable world and one for a world of uncertainty. Learning appropriate for the former world has to do with learning the right answers and learning how to adapt and settle into another mode of being and doing. Learning appropriate for our world has to do with learning what are the useful questions to ask and learning how to keep on learning since the questions keep changing" (p. 484). The future health of the nation and the planet is directly linked to the maintenance of the biotic enterprise on which all human activity ultimately depends. The opportunity for significant improvement in biological conservation exists in the cultivation and expansion of our learning abilities, i.e., in learning how to learn and applying the lessons of our experience.

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("Atlantic Salmon" continued from p. 4)

cormorant, harbor seal, gray seal, harp seal, and ringed seal.

The Atlantic salmon compete with other fish species for food and habitat and are a source of prey for some predators. Those interactions become more complex as new species are introduced, naturally or artificially, to rivers where they were not historically present and did not co-evolve with Atlantic salmon. Introduced species such as smallmouth bass, chain pickerel and brown trout have been documented to prey upon juvenile Atlantic salmon (Baum et al. 1995). Species assemblages and abundances have also changed in estuaries utilized by Atlantic salmon with the recent increase in populations of striped bass, seals and birds.

Atlantic salmon are susceptible to a number of diseases and parasites that can result in high mortality. Parasites of Atlantic salmon are the gill maggot, freshwater louse, leach, flukes, tapeworms, spiny-headed worms, roundworms, the skin parasite *Gyrodactylus salaris*, sea louse, and sea lamprey. Atlantic salmon are susceptible to numerous bacterial, viral and fungal diseases, including furunculosis, bacterial kidney disease and vibriosis. Disease-related mortality is primarily documented for hatcheries and aquaculture facilities. Disease epizootics in wild salmon are uncommon. In New England, furunculosis is the only known source of disease-related mortality in wild Atlantic salmon.

4) Inadequacy of existing regulatory mechanisms

Management of anadromous fish, such as Atlantic salmon, is a complex issue. There are a variety of demands being placed on the riverine, estuarine and marine habitats utilized by the Atlantic salmon. The challenge is to manage these multiple uses in a way that allows the various needs to be met without compromising the health and natural resources of the river.

Management of Atlantic salmon in the State of Maine is conducted by the Maine Atlantic Sea Run Salmon Commission (ASRSC) which was created in 1947 to focus efforts on recovering stocks of Atlantic salmon in Maine. Over the years the ASRSC has monitored river population studies, evaluated the relative success of stocking methods, and participated in tagging studies. The Atlantic salmon restoration program focuses on sixteen river systems in the state ranging from the Aroostook River in the north to the Saco River in the south. The goals of the ASRSC are to restore river specific stocks of Atlantic salmon through the following means: preserving existing populations and habitat; restocking of fry; reducing removals; and eliminating or minimizing threats. Recently the state of Maine replaced the ASRSC with a new management entity called the Maine Salmon Authority.

In 1990 the Atlantic Sea Run Salmon Commission and the U.S. Fish and Wildlife Service signed a Cooperative Agreement and established a Technical Advisory Committee (TAC). The purpose of the TAC is to advise the ASRSC and the FWS on technical matters related to the Atlantic salmon restoration program in Maine, to review and comment on proposals for cooperative research, and to provide assistance in developing and updating restoration plans.

Many federal and state laws and programs have affected the abundance, health and survival of anadromous Atlantic salmon populations in the United States. However, they have not prevented the decline of the species. The effectiveness of certain existing laws and regulations could be strengthened by more stringent implementation and enforcement. Aquaculture facilities are located within 20 kilometers (km) (12 miles) of the mouths of five of the rivers within the DPS. Atlantic salmon that have been released or that have escaped from aquaculture pens are known to have entered some of these rivers. Released aquaculture Atlantic salmon can impact wild populations through competition, genetic dilution or the introduction of diseases (Kapuscinski and Jacobson 1987; Utter et al. 1993).

5) Other natural or manmade factors affecting the species continued existence

Scientific evidence suggests that

(Continued next page)

("Atlantic Salmon" continued from previous page)

low natural survival in the marine environment is a major factor contributing to the decline of Atlantic salmon throughout North America. Recent research indicates that major seasonal events influence post-smolt survival of Atlantic salmon. It appears that survival of the North American stock complex of Atlantic salmon is at least partly explained by sea surface water temperature, during the period when Atlantic salmon concentrate in winter months in habitat at the mouth of the Labrador Sea and east of Greenland. Until more direct observation can be made on the marine ecology of post-smolts during the winter, the exact mode of mortality will be unknown. Currently, researchers speculate that a combination of factors related to slow growth and increased predation contribute to marine mortality.

Potential genetic impacts of hatchery practices include inbreeding depression, outbreeding depression and domestication. Potential ecological impacts of hatchery practices include competition and predation, displacement of wild fish, altered migratory and spawning behavior, and disease transfer. The practice of stocking fry transferred from other rivers may have exacerbated the decline of the wild population by possibly displacing wild fish. For six of the seven rivers, the average percentage of the run that was of natural origin (wild) was higher during years not influenced by the stocking of fry transferred from other rivers. However, the Services do not believe that stock transfers in the DPS rivers have eliminated all historic characteristics of wild Atlantic salmon. Although past stocking practices may have contributed to the decline of Atlantic salmon in the DPS rivers, the Services are committed to ensuring that future hatchery practices contribute to recovery of each river population. Use of river-specific fry stocking on the Penobscot River has boosted the percentage of natural origin fish and is a tool for recovery of the DPS rivers.

The Future

The product of the Team's efforts, a Status Review for Anadromous Atlantic Salmon in the United States, was distributed in draft form in January of 1995. The notification that the Services would be recommending a listing for these seven river populations elicited a response from the state of Maine and other potentially affected parties. There are numerous measures underway to prevent the loss of any of the river populations of Atlantic salmon within the DPS. Collectively, these measures have the potential to reduce the likelihood of extinction and enabled the Services to propose listing the DPS for threatened rather than endangered status, as was recommended by the Team. The proposed rule was published in the Federal Register on September 29, 1995. The Services have up to one year to publish a final rule as proposed or modified, or withdraw their proposal.

The threatened designation provides the Services with more flexibility in implementation of the ESA, should the proposal be finalized. The Services proposed to adopt joint regulations for the protection of the DPS which apply all the standard prohibitions of the ESA and allow exceptions for incidental take under sections 4(d) and 10 of the ESA. Section 4(d) of the ESA allows the Services to define the conditions under which the incidental "take" (take, as defined in the ESA, includes the following: harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt any of these) of Atlantic salmon resulting from activities regulated by State and local governments would not violate section 9 of the ESA. Under the special rule, incidental take of Atlantic salmon when conducting otherwise lawful activities addressed in an Atlantic salmon conservation plan prepared by the State of Maine and approved by the Services, would not be considered a violation of section 9 of the ESA. The intent of the special rule is to provide the State of Maine an opportunity to maintain the lead role in the management of activities that could impact Atlantic salmon in the DPS. The State has convened a task force with subgroups addressing recreational fishing, aquaculture and habitat alteration to begin the development of a conservation plan. The Services believe that a state plan provides a more comprehensive, less bureaucratic procedure for addressing the potential incidental take of Atlantic salmon than the traditional Section 10 permitting route.

In addition to the state-led effort to develop a conservation plan, a number of federal and private initiatives have been launched in recent years. The Maine Wild Atlantic Salmon Stewardship Program was initiated by the FWS in 1994. Program activities include angler and habitat surveys and weir and trap installation and maintenance. Project S.H.A.R.E (Salmon Habitat and River Enhancement) formed in 1994 to "conserve and enhance Atlantic salmon habitat in the Downeast region of Maine through voluntary and mutual cooperation of area landowners and businesses; local, state and federal agencies; academia; and conservation organizations." Projects conducted to date include replacement of a dam gate on the Dennys River, removal of a major obstruction on the Machias River, provision of material support for the Pleasant River Hatchery, and fabrication of parts for a floating weir.

The restoration and rehabilitation of Atlantic salmon to their native habitat in New England has challenged federal and state resource agencies and private conservation groups for decades. Recently there has been interest in critically evaluating past efforts to refine those management practices that have had success and to try to evaluate new strategies. The introduction of a potential listing of some Atlantic salmon populations under the ESA has introduced a new variable into the equation. The key challenge has been, and will continue to be, to bring together interested and affected parties in a cooperative rather than a confrontational manner.

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Report from the Field

Colorado Endangered Species Protection Bill Introduced

By Michael Robinson

As Congress prepares to reauthorize the federal Endangered Species Act with an eye towards increasing states' rights, a state senator has introduced a bill to strengthen Colorado's laws on threatened and endangered species. Political observers say the bill by Senator Dorothy Rupert, a Democrat in the Republican-dominated Colorado General Assembly, will not likely pass without significant amendments. But its introduction alone has sharpened the debate over endangered species, and will define part of the political landscape awaiting John Mumma, the new director of the embattled Colorado Division of Wildlife (DOW).

Senator Rupert's legislation, the Colorado Native Species Conservation Act (SB 108), would do several things. First, it would codify elements of a recent Memorandum of Understanding (MOU), signed jointly by Governor Roy Romer and Secretary of the Interior Bruce Babbitt, that would create conservation agreements for species declining to the point where they might need to be listed as threatened or endangered. Such conservation agreements would be based upon a collaborative decision-making framework comprised of private land owners and local, state and federal officials, among others. Currently, the DOW has no legal authority to enter into such conservation agreements for plants and most invertebrate species. Rupert's legislation would provide such authority.

For both federal and state listed species, Rupert's bill would mandate state recovery plans and the designation of critical habitat, based primarily on the best available scientific information. Decisions on listing species would also require a scientific basis. The DOW would be tasked to advocate protection and restoration of critical habitat with federal land management agencies, potentially reversing the more familiar dynamic of state officials inveighing against protective federal edicts.

Finally, the bill would increase the fines for poaching of threatened and endangered species from $2,000 to $5,000, and for sale of a listed species from $100,000 to $500,000. Although for most species the increased penalties for poaching may be less significant than the requirement to write recovery plans, the poaching provisions have garnered far more attention throughout Colorado than the other provisions. Conservationists in the legislature and throughout the state must continually grapple with the challenge of explaining to the public that threats to species come in many forms, and while poaching is dramatic and visible, alterations of critical habitat through resource use or development often have a greater impact on species.

Michael Robinson is Executive Director of Sinapu, a group working to reintroduce wolves to Colorado and restore habitat for a wide variety of species; P.O. Box 3243, Boulder, CO 80307.

Bulletin Board

International Symposium on Human Dimensions of Natural Resource Management in the Americas: Call for Papers

The Symposium, which is being hosted by the Human Dimensions in Natural Resources Unit at Colorado State University, the Ministry of Natural Resources in Belize, and the University College of Belize, will be held February 25 to March 1, 1997, in Belize City, Belize. The Symposium will embrace a wide variety of topics, but its main focus is on the importance of a global perspective and on the human element of natural resource management. Symposium activities include concurrent paper and poster sessions, panel sessions, plenary theme addresses, and extensive field trips.

For more information, including a call for proposals, contact Jennifer Pate, Symposium Coordinator, Human Dimensions in Natural Resources Unit, Colorado State University, Fort Collins, CO 80523; phone (970) 491-7729; fax (970) 491-2255; email jpate@cnr.colostate.edu; or visit the Symposium Homepage at http://www.cnr.colostate.edu/~hdnru/hdsympo.html.

Natural History and Environmental Writing Workshop Offered

Sterling College, in beautiful Craftsbury Common, Vermont, will be offering the Ninth Annual Wildbranch Workshop in Outdoor, Natural History, and Environmental Writing, to be held June 16-22, 1996. The Workshop is a combination of classes, lectures, discussion groups and readings in the craft and techniques of fine writing about the outdoor world, and is designed for both professionals and non-professionals. Program include environmental journalism, natural history writing, conservation writing, problems in outdoor writing, writing as a business, and sessions from a publisher's and editor's perspective. Tuition and room and board costs are $775 (combined), and some $200 scholarships are available. Applications are due May 15, and enrollment is limited to 30. For an application or for more information contact David Brown, Director, Wildbranch Workshop, Sterling College, Craftsbury Common, VT 05827; phone (802) 586-7711 or 800-648-3591.

Sophie Danforth Conservation Biology Fund

The Sophie Danforth Conservation Biology Fund, established by the Roger Williams Park Zoo and the Rhode Island Zoological Society, will be awarding grants of up to $1000 to individuals and institutions working in conservation biology. Projects and programs that enhance biodiversity and maintain ecosystems receive highest priority. Field studies, environmental education programs, development of techniques that can be used in a natural environment, and captive propagation programs that stress an integrative and/or multi-disciplinary approach to conservation are also appropriate. Proposals for single species preservation, initial surveys, or seed money for technique development are not appropriate. Application forms, which must be submitted by May 1, can be obtained from Dr. Anne Savage, Director of Research, Roger Williams Park Zoo, Elmwood Avenue, Providence, RI 02905, (401) 785-3510 ext. 335.

Announcements for the Bulletin Board are welcomed. Some items from the Bulletin Board have been provided by Jane Villa-Lobos, Smithsonian Institution.

Endangered Species UPDATE

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