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Cover: Jaguar (*Panthera onca).*
Photograph by Ron Singer.
Courtesy of the U.S. Fish and Wildlife Service.

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The Jaguar in the Southwest: Borderland or Borderline Conservation?

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Abstract
*In 1997, the domestic listing of the jaguar (*Panthera onca*) under the Endangered Species Act (ESA) made the killing of wild jaguars in the U.S. a federal crime and helped protect the animals against accidental harm from government predator control activities. Since then, a multi-agency Jaguar Conservation Team (JAGCT) has promoted education and research on the jaguar, but has not fulfilled its promise to address habitat conservation. JAGCT's ambivalence is traced to political ideology and to uncertainty as to whether a recovery effort for the jaguar along the northern periphery of its geographic range is warranted. I argue that the American Southwest is significant to the jaguar from a conservation standpoint. A jaguar restoration strategy should include ESA recovery planning and critical habitat designation; professionally mediated workshops to address locally perceived conflicts between ESA protection, property rights, and ranching interests; and a bi-national campaign to protect a core reserve for the jaguar in northern Mexico, secure habitat corridors leading to the Southwest, and promote predator-friendly management of livestock.*

El Jaguar en el Suroeste Norteamericano: ¿Conservación de la Tierra en la Frontera o de la Línea Fronteriza?
*Resumen. En 1997, el listado local del jaguar (*Panthera onca*) dentro del 'Endangered Species Act' [Acta de las Especies en Peligro de Extinción (ESA, por sus siglas en inglés)], convirtió en un crimen federal matar jaguares silvestres en los Estados Unidos y ayudó a protegerlos en contra de daño accidental ocasionado por las actividades gubernamentales de control de depredadores. Desde entonces, un equipo de conservación del jaguar conformado por varias agencias (JAGCT por sus siglas en inglés) ha promovido educación e investigación sobre el jaguar, pero no ha cumplido su promesa de dirigir sus esfuerzos al problema de la conservación del habitat. La ambivalencia del JAGCT es debida a ideología política y a la incertidumbre de si la recuperación del jaguar en la periferia norte de su rango geográfico está garantizada. Arguyo que el suroeste norteamericano es significativo para el jaguar desde el punto de vista de la conservación. Una estrategia de la restauración del jaguar debe incluir planeación de recuperación y designación de habitats críticos por el ESA; talleres de mediación llevados a cabo profesionalmente para tratar localmente los conflictos que se perciben entre la protección hecha por ESA, los derechos de la propiedad y los intereses de los ganaderos; una campaña binacional para proteger una reserva central para el jaguar en el norte de México, para asegurar corredores de habitats que conduzcan al suroeste norteamericano y para promover un manejo del ganado que sea amigable hacia los depredadores.*

Le Jaguar dans la Conservation du Sud-ouest: quelle Frontière?
*Résumé: En 1997, le jaguar (*Panthera onca*) a été nationalement repertorié comme espèce menacée sous le 'Endangered Species Act' (ESA), et rend ainsi criminel le fait de tuer des jaguars sauvages aux Etats-Unis et contribue également à les protéger du mal accidentel causé par des activités prédatrices contrôlées par le gouvernement. Depuis lors, un groupement d'agences en faveur de la conservation du jaguar – Jaguar Conservation Team (JAGCT) – a encouragé*

l'éducation et la recherche sur le jaguar, mais n'a pas accompli sa promesse de traiter du problème de l'habitat et de la conservation. L'ambivalence de la JAGCT remonte à l'origine de l'idéologie politique et de l'incertitude de savoir si le rétablissement du jaguar le long de la périphérie nordique de son étendue géographique est justifié. Je soutiens que le sud-ouest américain est essentiel pour le jaguar pour ce qui concerne la conservation. Une stratégie de restauration du jaguar devrait inclure la planification de rétablissement de l'ESA et la designation critique d'habitat; des ateliers de négociations professionnels pour gérer les tensions locales entre la protection de l'ESA, les droits de propriétés et les intérêts du ranching; ainsi qu'une campagne bi-nationale afin de protéger une réserve centrale pour le jaguar au nord du Mexique, fixer des couloirs d'habitat menant au sud-ouest, et favorisant une gestion naturelle du bétail.

Introduction

In 1996 rancher Warner Glenn photographed a jaguar (*Panthera onca*) after his lion hounds chased and cornered it in southwestern New Mexico. "It will take all of our efforts to protect this animal and the wide open country it needs," Glenn said in a vivid photographic essay recalling the event (Glenn 1996).

Glenn's jaguar was one of three distinct individuals recently photographed in the Southwest, the others in 1996 and 2001, both south of Tucson, Arizona. State wildlife officials have been able to confirm only about a dozen additional reports of jaguar in the region over the past 50 years (FWS 1993; Hatten et al. 2002). Most observers believe jaguars that have been recently seen are dispersing individuals or temporary visitors from a population centered some 200 miles south of the Mexico-U.S. Border (Rabinowitz 1999; Johnson and Van Pelt 2000; Brown and López 2001; Sanderson et al. 2002). Nevertheless, jaguars have historically ranged into Arizona, New Mexico, and Texas, and perhaps southern California and Louisiana (Hall 1981; Swank and Teer 1989). Their pattern of decline, based on kill records from 1900-1970, suggests an over-exploited, resident population that once included females and cubs (Brown 1983).

The year 1948 marked the last record of a wild jaguar in Texas (Nowak 1975). With habitat in that state reportedly too fragmented to help with species recovery, Arizona and New Mexico today are the logical choice for jaguar conservation in the U.S. (Johnson and Van Pelt 1997).

Threats

Shooting, trapping, and poisoning have taken a heavy toll on the jaguar, with 62 kills recorded for Arizona and New Mexico since 1900 (Brown and López 2001). Today loss of habitat represents an additional threat (Johnson and Van Pelt 1997). Land development, vegetation clearing, road construction, depletion of springs and surface waters, and increased human presence can result in diminished security for jaguars, heightened risk of disturbance and displacement, blockage of movement corridors, and loss of suitable acreage sufficient to contain individual home ranges. In Arizona and New Mexico, the most favorable habitat for the jaguar involves mountain ranges and canyons interconnected by riparian areas, wash complexes, and shrub-grasslands (Sierra Institute 2000).

Over the past 5 years, the human population of Arizona counties where jaguars have recently been recorded (Cochise, Pima, and Santa Cruz) has risen by over 100,000 people (from

Loss of habitat caused by human disturbance such as land development is one of the main threats to jaguar survival. Photograph by Claire Dobert. Courtesy of U.S. Fish and Wildlife Service.

951,964 to 1,055,166; Arizona Department of Economic Security 2002). Areas east and south of Tucson, from Sierra Vista to Benson, and in Sulfur Springs Valley are experiencing urban and exurban sprawl. Heightened land development affecting the San Pedro River corridor, an upsurge in human activity and habitat modification along the Mexico-U.S. border, and heavy night traffic on interstate highways, aggravated by a dearth of wildlife underpasses, are among other specific concerns.

The jaguar is also threatened by a prevailing ideology in government that opposes conservation that may affect hunting, livestock interests, and economic development. Reflective of this view, the Arizona Game and Fish Department has assured its wildlife commissioners, who set wildlife policy for the state, that it does not support reintroduction of the jaguar or designation of critical habitat for the species (Arizona Game and Fish Commission 1999).

Endangered Species Act protection

In 1992, after learning about the recent killing of a jaguar, the Sierra Institute field studies program in the Southwest petitioned the U.S. Fish and Wildlife Service (FWS) to list the species in the U.S. under the Endangered Species Act of 1972 (United States Congress 1972). FWS had listed the jaguar 20 years earlier, but only for Mexico southward (FWS 1972). In 1979 FWS acknowledged the oversight and its intention to rectify the matter as quickly as possible (FWS 1979). Two years after receiving the petition, FWS issued a proposed rule, and, upon legal prodding by the Center for Biodiversity and a subsequent U.S. district court order, completed the listing in 1997 (FWS 1997a). Seeing that FWS did not designate critical habitat (ESA Section 4) for the jaguar at that time, the Sierra Institute group asked the agency for a determination that would include sizable blocks of mountainous terrain and connecting open space in Arizona and New Mexico (Sierra Institute 1999). The group believed that critical habitat coverage would help ensure measures to protect and restore habitat (Houck 1993). FWS turned down its request, stating that the U.S. cannot be considered "essential to the conservation of the species" as "the key to the species conservation in the northern part of its [global] range lies closer to the core of the species range in Mexico" (FWS 1999a). Moreover, it argued that critical habitat is unnecessary since Section 7 of ESA prohibits agencies from taking actions likely to jeopardize the continued existence of a listed species, including activities which impact habitat. The Sierra Institute group reasoned that this "jeopardy" standard alone would not lead to proactive conservation of habitat in the Southwest given the jaguar's sparse presence, great mobility, and, from a narrow species survival perspective, its "non-essential" status.

Subsequent FWS consultations (ESA Section 7) with other federal agencies seem to validate the group's concerns. FWS "biological opinions" on livestock grazing, prescribed vegetation burning, and campground development on public lands in southeastern Arizona have uniformly stated that these activities are "not likely to jeopardize the continued existence of the jaguar" (FWS 2002). Related agency guidelines have been essentially limited to maintaining vegetation cover for jaguar in some livestock grazing areas (FWS 1997b, USFS 1998) without herd reductions (Harlow 1999; Drennen 2002).

In 1999, FWS issued a biological opinion on predator control activities of the U.S. Department of Agriculture's Wildlife Services program in southern Arizona and Hildago County, New Mexico (FWS 1999b). The outcome included some restrictions on the use of leghold traps, snares, and M-44 coyote poisoning devices. In addition, the U.S. Bureau of Land Management and the U.S. Forest Service informed public land ranchers in southeastern Arizona that the jaguar is federally protected and that measures are needed to avoid killing or harassing the animals (Drennen 2002; Skinner 2002).

In sum, the 1997 ESA listing made it a federal crime to kill jaguars in the U.S. and helped protect them against harm from federal predator control activities. However, it failed to address the range of threats to jaguar habitat. That task would presumably go to the Jaguar Conservation Team (JAGCT), a new intergovernmental, public involvement group for Arizona and New Mexico.

Jaguar Conservation Team (JAGCT)

Led by the Arizona Game and Fish Department, JAGCT stems from a formal agreement by federal and state agencies and four counties in southern Arizona and New Mexico to adopt the department's jaguar "conservation assessment and strategy" (Johnson and Van Pelt 1997). The agreement was advanced initially in an attempt to convince FWS that ESA protection for the jaguar was not needed (Shroufe 1997; Brown and López 2001). JAGCT was to address threats to the jaguar by providing for conservation "consistent with the intent of the Act" (Johnson and Van Pelt 1997). Member agencies and county governments direct JAGCT activities, while rancher associations, conservation organizations, and private citizens help fill out its "work group" by contributing information and opinions.

JAGCT's accomplishments include education and outreach activities involving, for example, a jaguar

Jaguar (*Panthera onca*). Photograph by John and Karen Hollingsworth. Courtesy of the U.S. Fish and Wildlife Service.

identification brochure for the public and a curriculum for school children. JAGCT also backs a compensation fund for ranchers who might lose livestock to a jaguar (financed through the private Malpai Borderlands Group), and promotes efforts to study jaguars. JAGCT has also conducted a literature review and compilation of jaguar distribution and occurrence data for the Southwest.

JAGCT's promise to tackle habitat conservation has not been fulfilled. Under its conservation agreement, the team was to provide "land management cooperators with guidelines for assessing impacts of current and planned actions on the jaguar and its currently known or suspected habitat" (Johnson and Van Pelt 1997). Cooperators, in turn, were to "evaluate the potential impact on jaguars and jaguar habitat of each new project" while JAGCT would recommend how to address impacts and concerns.

JAGCT would also "encourage public and private land managers to conserve or enhance suitable or potentially suitable jaguar habitat, including corridors connecting those habitat blocks, to ensure that the jaguar's current and future habitat needs (including natural dispersal and habitat expansion) are appropriately addressed." State wildlife agencies would pursue formal agreements with public land agencies and private landowners to get the job done. These and other habitat objectives, most slated for completion by 1999, have not been met.

JAGCT's failure to carry out its habitat conservation protocol has been blamed on a lack of clarity as to "what is or is not jaguar habitat" (Johnson and Van Pelt 2000). Soon after its inception in 1997, JAGCT had planned to develop a habitat suitability map for the jaguar in the Southwest (Johnson and Van Pelt 1997). Ironically, three and a half years passed before a list of habitat criteria could be finalized, and, as of mid-2002, JAGCT's map remained in draft form (Hatten et al. 2002; Menke and Hayes 2002). From my observations, JAGCT's neglect of its habitat work has been largely in deference to participants who fear that this will ultimately infringe on property rights and ranching interests.

Conservation science

Is habitat in the U.S. too marginal to support the jaguar? (Rabinowitz 1999; JAGCT 1999). Might conservation resources be better devoted elsewhere? (Peterson 2001). Doubts raised by these questions have dampened interest among conservationists in jaguar recovery for the Southwest. Clearly, the region lies at the northern boundary of the jaguar's geographic range in the Americas (Sanderson et al. 2002). However, peripheral or marginal habitat, while expected to have fewer animals than optimal habitat, does not necessarily mean poor habitat, i.e. habitat not able to support healthy, reproducing individuals. There is no evidence that jaguars in the Southwest are physically disadvantaged or in ill health. In fact, reported body sizes may suggest otherwise. Arizona jaguars, both females and males, tend to be as large or larger than individuals from Mexico (Brown and López 2001). For example, two females, one killed in central Arizona in 1963 and the other in southern Arizona in 1949, were 25-30 lbs (11-14 kg) heavier than an average estimate for females from northwestern Mexico.

Conservation entails saving wild animals and plants in different ecological settings (Povilitis 2001; Sanderson et al. 2002), including along the margins of their geographic ranges (Lesica and Allendorf 1995; Nielsen et al. 2001). It means ensuring evolutionary potential as well as species maintenance. While evolutionary tendencies in the jaguar are unknown, its larger size in the Southwest and in northern Mexico (as compared to Central America but not tropical South America; Brown and López 2001) may hint at re-adaptation to a more open environment. During the Pleistocene, a larger, lankier jaguar was widespread over much of what is now the contiguous U.S. (Kurtén and Anderson 1980).

One thing is certain: jaguars can, if humans allow, inhabit landscapes of comparatively open habitat, as indicated by their presence not only in the American Southwest but in the pampas and llanos of South America (Sanderson et al. 2002). A favorable conservation scenario would see jaguar reproduction in the Southwest as well as in northern Mexico, with regular movement of breeding individuals between the two areas. At the very least, the Southwest should serve as supplemental habitat for what would hopefully be a secure jaguar population in northern Mexico.

Successful conservation of the jaguar in Mexico will not guarantee its presence in the U.S. On the other hand, the jaguar could, despite efforts to the contrary, disappear from northern Mexico making the Southwest potentially the sole northern refugium for the species. As Channel and Lomolino (2000) point out, population persistence depends far more on the intensity of human impacts locally than on geographic location. In fact, endangered species often do better in peripheral areas than elsewhere within their historic ranges. With global climate change and continued deforestation in tropical South America, the American Southwest, inclusive of its heavily timbered central Arizona-New Mexico Mountains, could become vital to the jaguar as a species.

In large measure, conservation resources that might be mustered for the jaguar in the U.S., through state, local, and many national organizations, are not transferable to priority areas for the jaguar elsewhere in the Americas (for a listing, see Sanderson et al. 2002). In the face of increasing development pressures, the U.S. can play an exemplary role by demonstrating its commitment at home to the complex task of ecoregional conservation that is required for large carnivores.

A frequent comment at JAGCT meetings is that jaguars should be studied in northern Mexico before habitat protection measures are undertaken in the U.S. For example, study of territorial jaguars in Sonora, Mexico might suggest specific aspects of habitat (e.g. cover types, topography) important to the species in the Southwest (Miller et al. 2000). On the other hand, such study may not advance knowledge beyond what we already know: jaguars need escape terrain, concealing vegetation, water sources, a prey base, sizable habitat areas, and habitat connectivity. For example, data from northern Mexico suggesting that jaguars prefer thornscrub (a vegetation type that does not occur in the U.S.; Brown and López 2001) might only reveal that, where fearful of humans, the animals select the densest cover available. While encouraging jaguar studies in Mexico, JAGCT's Scientific Advisory Group has recommended broadly identifying habitat in the Southwest that could be occupied by jaguars, and protecting that habitat through a combination of legal and informal means (Miller et al. 2000).

The future

Our evolving relationship with wildlife and the land will determine the jaguar's future in the U.S. Progress has been made: less killing and less harassment signals a possible comeback for the jaguar. Conversely, habitat loss and fragmentation continue largely unabated. A way must be found to retain "wide open country" for the jaguar and biodiversity in general, and for a host of other reasons related to the quality and meaning of human life (Povilitis 2000).

I suggest several measures to save the borderland jaguar:

1. *Utilize the full power of ESA.* Implement its critical habitat and recovery plan (Section 4) provisions for the jaguar. The Act's purpose is "to provide a means whereby the ecosystems upon which endangered and threatened species depend may be conserved" (ESA Section 2). JAGCT cannot substitute for strong ESA protection (Arizona Daily Star 1997). It is right and just that ranching and hunting traditions, which led the charge to remove the jaguar from the Southwest (FWS 1993; Brown and López 2001), now play a pivotal role in restoring it. In theory, JAGCT affords this opportunity by shifting power and responsibility for conservation to people closest to jaguar habitat. On the other hand, the proximal motivating force behind JAGCT continues to be ESA and its powers of enforcement.

2. *Confront the "fear factor."* Communication workshops led by professional facilitators could help JAGCT address, in a reasoned manner, what ESA protection for the jaguar can and cannot do. Simply allowing participants at meetings to vent their anger about hypothetical land use restrictions, without an improved understanding of ESA, perpetuates misconceptions and diminishes prospects for conservation. Frank discussions on what constitutes "take" (ESA Section 9) would show, for example, that activities such as building a horse corral or an extra house on one's land would not be restricted under ESA because they do not degrade habitat to the point of actually killing or injuring the jaguar "by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering"(Stanford Environmental Law Society 2001). Conversely, the clearing of large acreage for a housing development could be in violation of ESA. In that case, a developer could prepare a Habitat Conservation Plan in order to minimize, monitor, and mitigate adverse effects, and consider alternatives (Hood 1998).

3. *Advance comprehensive con-*

servation planning for the Borderland region. At stake are the jaguar and a plethora of other species in a region whose biodiversity is "globally outstanding" (Ricketts et al. 1999). What is needed is a broad conservation vision and campaign that can be endorsed by U.S. and Mexican governments and attract substantial private investment. Options include the creation of a large Borderlands Conservation Area, drawing on the experience of California's Mojave Desert Conservation Area and Mexico's Biosphere Reserves.

Another model to consider would be Pima County's Sonoran Desert Protection Plan, which addresses multiple-species protection, cultural and ranch land conservation, and other community needs (Pima County Administration 1998).

For the time being at least, jaguar presence in the Southwest is inextricably linked to jaguar survival in northern Mexico. Brown and López (2001) write: "With the translocation of jaguars to the United States off the table…the fate of borderland jaguars depends entirely upon what happens to the Huasabas-Sahuaripa population in Sonora, Mexico. Should this population disappear, there won't be any more jaguars found in the American Southwest."

Jaguars in northern Sonora are the only ones within reasonable dispersal range of the U.S. Border. Ongoing removal of jaguars by local ranchers is compromising the population's future (Brown and López 2001). Additionally, the jaguars in the area may soon be jeopardized by new dams, mines, roads, and other efforts to exploit the region's natural resources.

U.S. and Mexican conservationists must work quickly to protect a core reserve for jaguars in Sonora, secure habitat corridors leading to the Southwest, and help local ranchers adjust livestock practices to reduce conflict with the jaguar.

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Opinion

Mexican Wolf Reintroduction Vital to the American Southwest

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Abstract
*Despite the fact that reintroduction of the grey wolf (*Canis lupus*) in Yellowstone National Park has produced positive economic and biological effects, the reintroduction of the Mexican wolf* (C.l. baileyi) *in New Mexico has met opposition from powerful interest groups. Limitations imposed on the reintroduction program such as relocation of individuals trespassing the recovery area, have reduced the possibilities for wolf establishment. As of September 30, 2002, there are still no wolves in New Mexico. There is a need for political and social changes in the state to save a species truly unique to the American Southwest.*

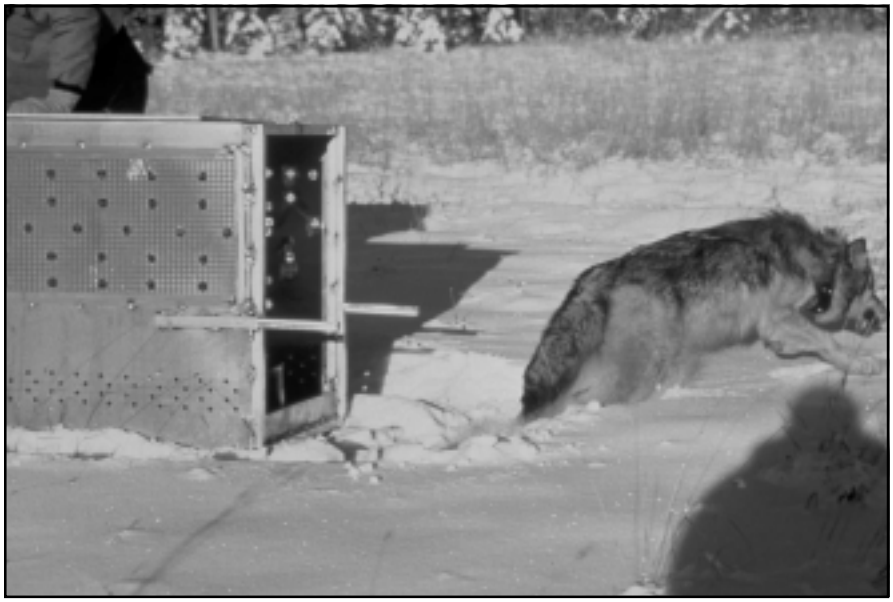
La Reintroducción del Lobo Mexicano, Vital para el Suroeste Norteamericano
*Resumen. A pesar de que la reintroducción del lobo gris (*Canis lupus*) en el parque nacional de Yellowstone ha producido efectos económicos y biológicos positivos, la reintroducción del lobo mexicano* (C. l. baileyi) *en Nuevo Mexico ha encontrado oposición de grupos de interés poderosos. Las limitaciones impuestas al programa de reintroducción tales como la reubicación de individuos que traspasan el área de recuperación, han reducido las posibilidades del establecimiento de individuos. Hasta el 30 de Septiembre del 2002, aún no hay lobos en Nuevo México. Existe la necesidad de cambios políticos y sociales en el estado para salvar esta especie verdaderamente única del suroeste norteamericano.*

La Réintroduction du Loup Mexicain est Essentielle au Sud-ouest Américain
Résumé. Malgré le fait que la réintroduction du loup gris (Canis lupus) *dans le Parc National du Yellowstone a produit des effets économiques et biologiques positifs, la réintroduction du loup mexicain* (C. l. baileyi) *au Nouveau Mexique s'est heurtée à l'opposition de groupes d'intérêts puissants. Les limitations imposées au programme de réintroduction, telle que la relocalisation des individus enfreignant le secteur de rétablissement, a réduit les possibilités d'établissement de loups. En date du 30 septembre 2002, il n'y a toujours pas de loups au Nouveau Mexique. Il y a un réel besoin de changements politiques et sociaux dans cet Etat afin de sauver cette espèce*

Eco-tourism needs to be promoted in many parts of the world, both as a way of saving endangered wildlife as well as an incentive for economic growth. The reintroduction of the grey wolf (*Canis lupus*) in the United States Yellowstone National Park has produced positive results for both man and wolf. Since reintroduction in 1995, an estimated 20,000 visitors have observed wolves. Moreover, the grey wolf reintroduction program in Yellowstone has provided not only economic benefits to the area, but also many opportunities for education, including the importance of maintaining intact ecosystems. In 1976, New Mexico signed a cooperative agreement with the U.S. Fish and Wildlife Service declaring the state would aid the Federal government with reintroduction of the Mexican gray wolf (*C. l. baileyi*). The Mexican wolf reintroduction program in the Southwest has encountered enormous biological and political challenges.

The recovery area (Figure 1) comprises 4.4 million acres, split between the Apache National Forest in Arizona and the Gila National Forest in New Mexico (Center for Biological Diversity 2002). Unlike Yellowstone and central Idaho, more than two-thirds of the Mexican wolf recovery area is grazed by cattle. The Gila contains the largest chunk of ungrazed terrain and three-fourths of the recovery area.

There are now approximately



Radio collared gray wolf (*Canis lupus*) released. Photograph by LuRay Park. Courtesy of the U.S. Fish and Wildlife Service.

200 Mexican wolves in captivity. In 1998, Arizona released wolves directly from the captive population. There are now five packs with approximately 25 wolves established and several litters of pups were born in 2001. In Spring 2002, two pairs were released in New Mexico, but they have subsequently been recaptured. As of September 30, 2002, there are still no wolves in New Mexico and none have reproduced successfully here. Poor results since the Gila National Forest contains three-fourths of the recovery area.

There is some evidence that pair bonding disruption is one of the causes of breeding failure. A case of wolf reintroduction exemplifies this issue. The first time "Rio" and his partner were released, the female was killed by a mountain lion. His next two mates were recaptured for not showing enough fear of humans. His fourth mate displayed suitable wild behavior by avoiding people and domestic animals, but the pair crossed the recovery area limits and they had to be recaptured. After four months, the pair was re-released in the Gila Forest, but they did not establish permanent bonds. Three other pairs have been released in Arizona but re-captured, and only two of those pairs have been re-released. Both pairs split apart after being re-released. It is currently unknown exactly why this occurs, but the evidence suggests that repeated re-captures and re-releases stress pair bonding.

The political turmoil caused by the reintroduction of a predator complicates prospects for wolf survival. The reintroduction in New Mexico of this species has met with considerable resistance from the ranching industry. According to the U.S. Fish and Wildlife Service (2002), livestock grazing is permitted on 66 percent of the Blue Range Wolf Recovery Area. The ranchers who graze their cattle on these lands have fought against reintroduction. Their claims have run the gamut from uninformed ("What will the government do when children are eaten?") to self-indulgent ("What will happen to my cattle grazing?").

The National Public Lands Grazing Campaign (2002) states that ranchers pay $1.43 per animal unit month (AUM) to the federal government for grazing. In contrast, the cost for a private rancher is nearly $11.00 per AUM. This "welfare ranching" costs the taxpayer by subsidizing the 31,000 ranchers who lease these permits. Therefore, the government subsidizes a marginal economic activity that costs $500 million each year and produces less than 5% of the U.S. beef. In addition, the grazing also drastically reduces the health of the highly arid western landscape and jeopardizes a variety of wildlife species such as the endangered black-footed ferret.

Only one percent of livestock losses throughout the West are due to predators such as cougars, lynx, and bears. This means that 99 percent of livestock losses are due to other causes (e.g. bad weather, illness, starvation, dehydration and deaths at birth). However, the New Mexico Game Commission, whose membership is dominated by the livestock lobby, strongly and unequivocally opposes any wolf reintroduction. Because of their political pressure, wolves were only released within the Arizona portion of the recovery area, with allowance for translocating animals into New Mexico following their recapture from the wild.

The reintroduction program as it is currently practiced in New Mexico is unprecedented in two respects. First, wolves that establish territories outside of the recovery area, even on other public lands, and even if they are not killing livestock, must be removed. Second, there are no provisions requiring livestock operators to assume any responsibility whatsoever for cleaning up the carcasses of cattle that die from any cause. Allotments are grazed year-round in New Mexico; thus, unattended cattle succumb to starvation, disease and other factors. It is entirely natural for wolves to feast upon these stinking, rotting carcasses that the ranchers do not remove. Punishing the wolves for cleaning up wild lands and doing what is natural for them is unethical and irrational.

Public opinion in New Mexico strongly supports wolf reintroduction.

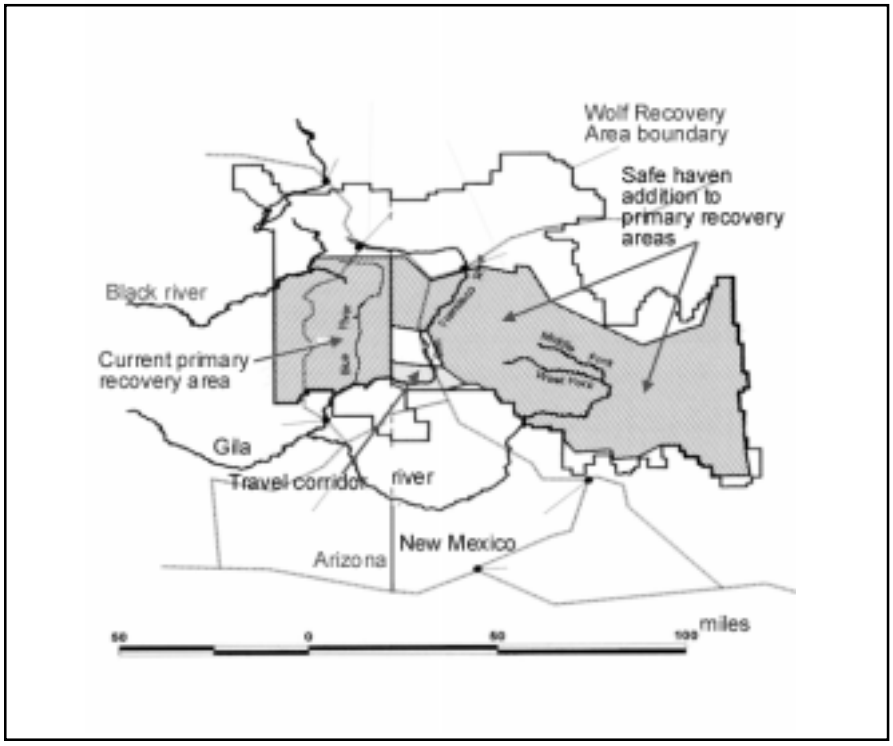


Figure 1. Wolf Safe Haven Recovery Plan in Arizona and New Mexico. Map by Shane Jimerfield. Courtesy of the Center for Biological Diversity

In 1995, the League of Women Voters sponsored a statewide telephone survey. Nearly 50% of the population said they would feel a positive benefit "knowing that Mexican wolves roamed the wilderness areas." Only 28% were opposed to any reintroduction at all, citing among other reasons for their opposition, erroneous wolf mythology such as children being attacked by wolves.

The positive benefits of reintroduction far outweigh the negative. These benefits include restoration of natural balance to the land, eco-tourism dollars and even spiritual fulfillment that some people feel by "knowing" that the wolf has returned. New Mexico's policies are alienating many individuals who strongly believe in biodiversity, and any financial benefits this state could reap from eco-tourism remain untapped.

Cattle losses attributed to wolf predation are one of the negative outcomes of the reintroduction. However, ranchers are reimbursed through programs sponsored by non-governmental organizations such as Defenders of Wildlife.

Predators play an important role in preserving the balance of all species. If humans continue to permit species to be eliminated, this world could become a barren desert. As Henry David Thoreau wrote, "In Wildness is the preservation of the World."

Let us not permit the Mexican wolf nor any other living creature to go extinct for political reasons. The decimation of our natural world cannot continue under the guise of economic imperative. Hopefully, New Mexico will soon open its eyes, both politically and socially. Every living thing we allow to become extinct takes us all closer to extinction. If we believe that all life is sacred, we may manage to save our world and our own souls. In learning how to peacefully coexist with other species, we might also find peace within ourselves. The Mexican wolf, a species truly unique to the American Southwest, has had its nose in the wind for over 20,000 years, and it should continue roaming this world.

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Mexican gray wolf (*Canis lupus baileyi).* Photograph by Jim Clark. Courtesy of the U.S. Fish and Wildlife Service.

Marine Matters

Extinction of Ocean Fish: A Growing Threat

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Abstract

Scientists have changed their views in recent years and now recognize that over 80 marine fish species face a serious risk of extinction. Many of these endangered fish species are actively managed, raising serious questions about the limitations of our fishery management system. This article traces the problem of marine extinctions to a management system that has been slow to keep up with reforms in fisheries law and incautious in the face of uncertainty, paid too little attention to the effects of fishing on ecosystems, and favored short-term economic interests over conservation. New approaches are needed to address extinction risk, including prohibition of bottom trawling and other fishing in the habitat of vulnerable species, and creation of fully protected marine areas that allow the whole web of ocean life to regenerate. Spurred by pressure from diverse interests, California and the Pacific Fishery Management Council are taking halting but potentially significant steps in this direction.

La Extinción de Peces Marinos: Una Amenaza Creciente

Resumen. Los científicos han cambiado sus puntos de vista en los años recientes y actualmente reconocen que más de 80 especies de peces marinos enfrentan un riesgo serio de extinción. Muchos de estos peces que se encuentran en riesgo son manejados activamente, provocando serios cuestionamientos sobre las limitantes de nuestro sistema de manejo de la pesca. El artículo rastrea los orígenes del problema de extinciones marinas hasta un sistema de manejo que ha sido lento para actualizarse de acuerdo con las reformas en las leyes de la pesca, además de ser un sistema desprecavido al enfrentarse a la incertidumbre, de poner muy poca atención a los efectos que pescar tiene sobre los ecosistemas, asi como favorecer los intereses a corto plazo en vez de la conservación. Nuevos planteamientos son necesarios para atender el riesgo de extinción, incluyendo prohibiciones de arrastres de fondo y otro tipo de pesca en el habitat de especies vulnerables y la creación de áreas marinas con protección completa, que permitan la regeneración de la cadena de la vida marina en su totalidad. Forzados por la presión ejercida por diversos grupos de interés, el estado de California y el Consejo para el Manejo de la Pesca en el Pacífico están tomando pasos lentos pero potencialmente significativos en esta dirección.

Extinction des Poissons d'Océan: Une Menace Croissante

Résumé. La communauté scientifique a changé ses vues ces dernières années et reconnaît maintenant que plus de 80 espèces de poissons de mer font face à un risque sérieux d'extinction. Plusieurs de ces poissons mis en danger sont activement contrôlés et soulèvent des questions sérieuses quant aux limitations de notre système de gestion de pêche. Cet article met en evidence le problème des extinctions marines par rapport à un système de gestion qui a été très lent à s'aligner sur les réformes concernant les régulations pour la pêche et imprudent face à l'incertitude, a accordé trop peu d'attention aux conséquences de la pêche sur les écosystemes, a préféré les intérêts immédiats à la conservation. De nouvelles approches sont nécessaries pour aborder le risque d'extinction, y compris la prohibition de la pêche de fond au chalut et toute autre pêche dans l'habitat d'espèces vulnérables, et la création de secteurs marins entièrement protégégés qui permettent à l'ensemble de la vie sous-marine de se régénérer. Stimulés par la pression d'intérêts divers, la Californie et le Conseil Pacifique de Gestion de Pêche prennent des mesures timides mais essentielles dans cette direction.

A new perspective emerging on marine fish

Scientific views about marine fish and their risk of extinction are undergoing a sea of change. Experts have long recognized that the restricted habitats of freshwater and anadromous fish make them vulnerable to extinction when human activities degrade or destroy those habitats. In contrast, scientists believed that the extensive habitat range of many marine fish populations, combined with their fertility, buffer them from the fate of their freshwater cousins. Most ocean fish are "broadcast spawners," producing thousands of larvae that hitchhike on ocean currents before settling into a spot where they can grow into young fish,

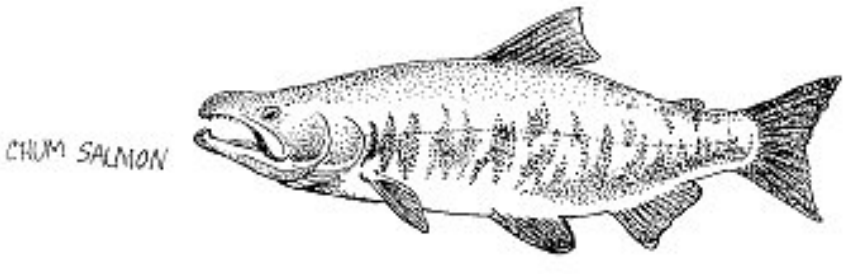
Resilience to depletion has proved to be an elusive trait; numerous marine fish populations have not recovered even under rebuilding plans (Hutchings 2000). Many fish species have declined to tiny fractions of their historic abundance, providing evidence of an unfolding tragedy in our oceans. Bocaccio (*Sebastes paucispinis*), a once-abundant Pacific rockfish, has plummeted to less than 5% of its unfished level, and scientists believe it has little chance of recovering anytime in the next century. Cod populations off Newfoundland show no signs of a rebound despite a concerted effort to restore the fishery. A number of other Pacific rockfish, along with sturgeon, grouper, and shark species hover at deeply depleted levels. Fishing is the main human impact on many of these species, yet efforts to rein in its effects have often failed to reverse the declines. As a result, concerned individuals and groups in the U.S. have, for the first time, begun filing petitions to list saltwater fish under the federal Endangered Species Act (ESA).

A reevaluation of scientific views on extinction and marine fish has paralleled the legal changes and growing public awareness. One important sign of the shift was the November 2000 publication of the findings of a scientific panel of the American Fisheries Society (AFS), the nation's oldest and most prestigious organization of fishery biologists. The AFS panel developed criteria for extinction risk and conducted a careful review of the status of the nation's ocean fish. The panel came to the startling conclusion that 82 marine fish species in U.S. waters now face a risk of extinction (Musick et al. 2000).

Limitations of conventional management

Conventional fishery management has failed these extinction-bound species—and allowed many more to become overfished—for several reasons. First, fishery management councils (regional bodies representing the fishing industry and government) have often failed to follow scientific advice in setting catch levels or management measures. Second, managers rarely take adequate precaution when information is uncertain, and uncertainty is par for the course in all aspects of fishery management, from estimating population size to accounting for fishing mortality. For example, most fisheries still lack enough observers to obtain reliable estimates of bycatch—nontarget species that are tossed overboard, often dead or dying. In the Pacific, as groundfish populations declined, managers ratcheted down their catch quotas but continued to allow fishing for other species in the habitat of depleted ones, most likely increasing the bycatch mortality of depleted species. Failure to track this collateral damage, or adequately account for the resulting uncertainty, undermines the ability to stop overfishing or meet rebuilding targets (Parker et al. 2000). Third, the scientific model prevalent in fishery management has severe shortcomings. It focuses on setting catch levels of one species at a time, without looking at the impacts of fishing on the ocean ecosystem and on

The endangered shortnose sturgeon (*Acipenser brevirostrum*). Courtesy of U.S. Fish and Wildlife Service.



Chum salmon by Robert Savannah, USFWS.

habitat. Scientists now recognize that the disruption fishing causes to ecosystems, including the removal of large predators (often referred to as "fishing down the food web"), may subvert recovery of depleted species. While fishery managers recognize this concern, few have yet taken action to address it. The typical management model has also been a poor predictor of how fish populations behave at very low abundance levels (Pauly et al. 2002).

Underlying and driving these problems is the economic pressure to keep fishing as well as the legacy of an era when the oceans were considered inexhaustible. The nation's main fishery law, the Magnuson Act, dates from the 1970s. Its primary goal was to kick foreign fleets out of U.S. waters (3 to 200 miles from shore) and develop an American fishing industry. The law was so successful that it spawned a new set of problems—bloated fleets and depleted fish populations. In 1996, spurred by the collapse of a New England groundfish fishery that until then had persisted for centuries, Congress amended the law to create the Sustainable Fisheries Act (SFA). The SFA addresses some of the weaknesses of fishery management discussed above: it strengthens prohibitions on overfishing and adds requirements to rebuild depleted species, assess and minimize bycatch, and protect essential fish habitat. However, the legacy of the original act remains—too many boats, industry-dominated fishery management councils with a prominent role in decision-making, a federal agency accustomed to rubber-stamping council decisions, and a burden of proof that favors fishing over conservation. This legacy has helped thwart implementation of the new law. Many fish populations have continued their downward slide, and lawsuits challenging the failure to carry out the SFA have proliferated.

The case of bocaccio rockfish

In many fisheries, the various problems of conventional fishery management described above—failure to follow scientific advice, lack of precaution, failure to take ecosystem impacts into account—intertwine, as they have in the plight of bocaccio rockfish, better known by its market names of Pacific red snapper or rock cod. As salmon populations dropped, groundfish became the most valuable ocean fishery on the U.S. Pacific coast, and bocaccio were among the most economically important groundfish. In 1990, a stock assessment showed that to sustain the population, the catch needed to be cut sharply from previous levels. What followed graphically illustrates the failure to follow scientific advice. The fishery management council set the quota almost 40% higher than scientists recommended. In practice, fishermen exceeded the quota levels by another 40 to 60% (MacCall 1999). This pattern persisted until 1996, when the trawl fleet landings began to plummet, simply for lack of fish.

In 1998, while working for the conservation group Natural Resources Defense Council (NRDC), the threat to bocaccio came to my attention. A scientific survey showed a drop in the California population to 2-4% of its historic abundance. Bocaccio school with other, more abundant species like chilipepper rockfish (*Sebastes goodie*), thus reducing mortality of bocaccio would require reducing fishing for associated species like chilipepper, as well. Fully aware of the reduction in the boccacio population, fishery managers raised the chilipepper catch for 1999, instead of lowering it, putting bocaccio at greater risk. Since the region had no program of onboard observers and hence no data on the amount of bocaccio caught and killed as bycatch, the council chose to ignore that problem, rather than assessing the risk and taking a cautious approach in the face of uncertainty. The more we looked, the more fisheries we found with uncontrolled bocaccio bycatch that no one was counting or attempting to control. A petition by NRDC and other organizations in February 1999 for emergency protection of bocaccio helped propel observer programs forward in the groundfish fishery and reversed the increase in chilipepper, but failed to win reductions in catches.

Scientists now know that bocaccio are far less productive than previously assumed. They recruit successfully only once a decade or so. Rockfish compensate for sporadic recruitment with long lives. For example, bocaccio live 40 or 50 years, while cowcod (*Sebastes levis*) and yelloweye (*Sebastes ruberrimus*) rockfish live to be over 100. Great reserves of fertility are stored in big old fish, which are exponentially more productive than younger fish half their size. Fishing has largely

removed old-growth fish, impairing the productivity of the population and its ability to weather periods of poor recruitment.

To help restore fish productivity and create a hedge against uncertainty, scientists have recommended closing parts of fish habitat to fishing. NRDC petitioned for such closures for bocaccio in 1999, but the council and the National Marine Fisheries Service (NMFS) took no action, falling back on their own failure to identify such habitats as an excuse for inaction rather than a reason for being cautious. As a consequence of the inadequacy of protective measures, bocaccio remain in dire shape.

A belated shift in management strategy?

Bocaccio are now so deeply overfished that they have constrained fishing for all groundfish off California. Under pressure of litigation by conservation groups and deep declines in fish populations, fishery managers in the Pacific have begun to depart from past practice. Off California, the Fishery Management Council has recommended establishing a rockfish conservation zone encompassing the area from 36.6 m (120 ft) deep to the edge of the continental slope at 182.9 m (600 ft) from the Mexican border to Point Reyes. Point Reyes to Cape Mendocino, conservation zone goes from 36.6 m to 457 m (1500 ft) deep. Cape Mendo to Oregon border, 182.9 m to 457 m, and even deeper in Northern California. Within that zone, bottom fishing is prohibited unless specifically exempted. Just as land zoning laws prevent a chemical plant from building next to a nursery school, the idea behind this plan is to confine human activities in the ocean to appropriate places. This concept could be the first step toward recognizing that indiscriminate bottom trawling gear does not belong in the fragile rocky places where rockfish live, and that such gear should be allowed only in places where it can be shown to have low impacts on overfished species. That step shifts the incentives; it takes away the pressure to constantly expand capacity, and instead encourages fishermen to develop and test more selective and less damaging gear.

New England made a similar move several years ago; it closed large areas to bottom fishing and reduced effort in the remaining fleet. Most groundfish populations in the area are beginning to recover. This initial success needs to be sustained and replicated elsewhere. Taking similar steps before the point of complete fishery collapse could make recovery quicker and less painful.

The reality of zonal management off California is still far from ideal. The number and scope of broad exceptions proposed for 2003 (particularly trawling for flat fish and halibut) could undermine the value of the management strategy. A key question is whether government agencies will resist the intense pressure to keep fishing at all costs.

Protecting the web of ocean life: a proactive approach

While fishery managers have largely stayed in reactive mode, the number and variety of individuals and organized groups that care about the oceans has multiplied. These constituencies include divers, kayakers, surfers, conservationists, beachgoers, whale and birdwatchers, scientists and educators. They have a stake in keeping oceans healthy, yet they are poorly represented in decisions about the activity with the most widespread impacts on ocean health today—fishing. Whether following common sense or heeding the recommendations of a growing consensus of scientists, members of the public are asking for fully protected marine areas—much like parks and wilderness areas on land—as part of the solution to the pervasive problems in the oceans today.

Dozens of scientific studies from all over the world confirm that fully protected marine reserves have more and bigger fish, greater capacity to produce baby fish, and more biological diversity than fished areas (Halpern and Warner 2002). By allowing the full size range of a species to thrive, they increase the productivity of a population. By protecting habitat from disturbing activities and allowing a full range of species to thrive, they help restore the resilience of ecosystems. A network design makes it possible to encompass both nursery habitat and spawning habitat. Marine reserves are not a panacea; they work best in conjunction with constraints on fishing effort outside the reserves. Examples clearly show that such areas show a promising ability to rebuild depleted sea life populations and, in the future, to prevent the risk of extinction in the first place.

The California Department of Fish and Game (DFG) is developing such a network under a new law, the Marine Life Protection Act (MLPA). Enacted in late 1999, the MLPA is designed to improve the protection of California's coastal and ocean waters. Two key components of the MLPA process are scientific input and public input. Under the Act, a team of scientists called the "Master Plan Team" examined the status of marine protected areas (MPAs) statewide, identifying gaps and duplication in the existing system, developing an initial draft proposal for a new network, and documented the reasons for those recommendations. The release of that report in large public meetings drew fire from fishermen and set the process back by months. However, DFG has regrouped, convening local groups representing a range of parties in seven different sections of the

state's coast. These groups are meeting to take the process the next step, reviewing data, collecting local knowledge, and making recommendations for MPAs in their regions.

The MLPA sets broad goals and guidelines for the process. Fully protected areas must encompass a representative variety of habitats and species, replicate those habitats in each region, and have a network design. State agencies led by the Department of Fish and Game will incorporate scientific and public advice into a Master Plan that includes information on habitat and species, a preferred siting option for MPAs, and guidelines for managing the network. The process has been extended from its original 2-year process to a total of about six years to map habitat and gather information, conduct public working groups and hearings, perform scientific review, adopt a final Master Plan, and develop regulations.

Currently far less than 1% of the nation's ocean waters are fully protected. Over the past half-century, many MPAs have been established off California's coast, but most of that area is protected in name only. Marine sanctuaries, for example, prohibit oil drilling but allow activities like dredging and fishing. The current fragmented system leaves most marine habitats and communities without real protection. The MLPA is being designed to revamp the array of MPAs and create safe havens in nearshore waters that serve as nurseries for marine life.

Polls show that public support for fully protected areas runs at levels over 70% in California and other states (Edge Research 2002). While opposition runs high among fishermen, some support the concept. Three types of designations available under the MLPA reflect the legislature's desire to balance public access and protection: marine reserves, where all fishing and resource extraction is prohibited; marine parks, where recreational fishing is allowed; and marine conservation areas, where a mix of recreational and commercial activities are permitted. The ability to restrict public access to protect fragile resources is not new, but this may be the first time a state has adopted a policy of protecting marine biodiversity and natural ecosystem processes with a set of affirmative requirements to create networks of marine reserves. Success will depend in part on ensuring a fair process, active engagement by the public, and the Department of Fish and Game's resolve to craft a coherent plan from diverse recommendations.

Next steps

Reversing the course of extinction threat for marine fish will require fundamental changes of direction for fishery managers, and a stronger voice for the public in decisions that affect ocean life. Two ocean commissions have been formed to conduct the first thorough review of ocean policy since the Stratton Commission proposed the formation of our existing ocean agencies and laws 30 years ago. In 2000, the Pew Charitable Trusts formed the Pew Ocean Commission as an independent, multi-interest entity, and later in 2000 Congress formed the U.S. Commission on Ocean Policy, a group of representatives of industry, academia and government. These commissions will release reports in 2003 that could encourage the trend toward more conservation-oriented fishery management and a greater emphasis on protecting ecosystems. What the future recommendations include and how much difference they will make depends to a large extent on whether there is concerted pressure from citizens to do something about the condition of our oceans.

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Report from the Field

The Chicago Botanic Garden's Center for Integrated Conservation Science

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Abstract
For many years, the Chicago Botanic Garden has supported a research program focusing on the restoration of native plant communities. In the mid-1990s, steps were taken to extend the impact of the Garden's science and broaden its scope, resulting in the creation of the Center for Integrated Conservation Science in 2001. The Center is unique among other conservation organizations because our research is applied, it focuses on plants, and it uses integrated, multi-disciplinary approaches. Areas of research include restoration genetics, population biology, and community and soil ecology. Much of our work focuses on endangered and threatened plant species, but we also study several invasive plants and use common native plants as models in experiments that could not be done on rare taxa.

El Centro para la Ciencia de la Conservación Integrada del Jardín Botánico de Chicago
Resumen. Por muchos años, el Jardín Botánico de Chicago ha apoyado un programa de investigación enfocado a la restauración de comunidades de plantas nativas. A mediados de los años 90 se tomaron varios pasos para extender el impacto científico del Jardín botánico y extender el ámbito de trabajo, que dieron como resultado la creación en el año 2001 del Centro para la Ciencia de la Conservación Integrada. El Centro es único entre otras organizaciones de conservación debido a que su investigación aplicada se enfoca a plantas y sus plantamientos son multidisciplinarios. Las áreas de investigación incluyen genética de la restauración, biología de poblaciones y ecología de comunidades y del suelo. Mucho de nuestro trabajo se enfoca a especies en peligro de extinción o amenazadas, pero también estudiamos varias plantas exóticas y plantas nativas comunes como modelos en experimentos que no podrían llevarse a cabo con grupos taxonómicos no comunes.

L'Institut Botanique de Chicago pour la Science de Conservation Intégrée
Résumé. Pendant plusieurs années, le Jardin botanique de Chicago a soutenu un programme de recherche centré sur la restauration de communautés de plantes indigènes. Au milieu des années 90, des mesures ont été prises pour étendre l'influence de la science du Jardin et élargir sa portée. Ceci donna lieu à la création de l'Institut pour la Science intégrée de conservation en 2001. L'Institut est unique entre d'autres organismes de conservation car notre recherche est appliquée; elle se concentre sur les plantes et emploie des approches intégrées et multidisciplinaires. Les domaines de recherche incluent la génétique de restauration, la biologie de population, et l'écologie de la communauté et de sol. La plupart de notre travail se concentre sur les espèces de plantes mises en danger et menacées. Mais nous étudions également plusieurs espèces de plantes envahissantes et employons des plantes indigènes communes comme modèles, dans des expériences qui ne pourraient être menées sur des espèces plus rares.

The Chicago Botanic Garden's Center for Integrated Conservation Science is a unique research and education center focusing on the conservation of plants and their communities. The Center was a natural outgrowth of the Garden's long standing community restoration program and its endangered plant research program which began in the mid-1990s. In the last five years, six scientists and several support staff have been hired creating the multi-disciplinary research team that comprises the Center for Integrated Conservation Science. Scientists with the Center conduct applied research on plant rarity, plant ecology and restoration, and plant-soil interactions. We investigate many of the biotic and abiotic factors affecting the conservation of plants, including population genetics and demography, invasive species, habitat fragmentation, disturbance and land-use change. Our projects fall under three main programmatic areas: ex situ (off site) plant conservation, restoration research, and regional floristics.

Our *Ex Situ* Conservation program focuses on flora of the Midwest. As members of the Center for Plant Conservation, a network of 33 gardens and arboreta, we seed bank nine globally rare plant species. Our core collections of these species serve as an insurance policy against extinction in the wild and some of the species are used in reintroduction projects. For example, we are partnering with The Morton Arboretum to reintroduce Pitcher's thistle (*Cirsium pitcheri*) to Illinois Beach State Park. The species had not been seen in Illinois since the early 1900s but is now reproducing on its own at the park. We are also partnering with the Millennium Seed Bank at Royal Botanic Gardens, Kew to preserve seed from native tallgrass prairie species. Research in the *ex situ* program focuses on minimizing genetic change during "captivity" and developing propagation protocols for species slated for reintroduction.

In the Restoration Research program, we are taking an experimental approach to answer questions about plant rarity, restoration, the effects of management on plants and their communities, and soil ecology. For instance, through a partnership with the Bureau of Land Management (BLM) we are using molecular and quantitative techniques to study the restoration genetics of six *Penstemon* and *Eriogonum* species. These taxa, native to the Intermountain West, will be used in post-wildfire restoration projects. In similar studies, we are looking at inbreeding and outbreeding depression in two Illinois *Lobelia* species that have different pollination syndromes.

One of our conservation scientists, Pati Vitt, is interested in how management practices affect populations of rare plants. She is studying the effect of prescribed fire and invasive plant removal on the demography, population genetic structure, and breeding system of *Viola conspersa*, a state-listed violet that produces both chasmogamous (open) and cleistogamous (closed) flowers. She also works with the federally threatened *Platanthera leucophaea* (eastern prairie fringed orchid). In this orchid, hand-pollination is used to increase fruit set to provide seed for reintroduction projects. She is testing if increased fruit set affects individual longevity. Her work will allow us to recommend levels of hand-pollination that provide seed for restoration without negatively impacting popu-

Eastern prairie fringed orchid (*Platanthera leucophaea*). Photograph by Pati Vitt

lation viability.

Stuart Wagenius is looking at the effects of habitat fragmentation on *Echinacea angustifolia* (purple coneflower). He is tracking reproductive success, population demography, and genetic structure in small and large prairie fragments. His work will enable us to evaluate how much increasing the size of a restoration area will enhance the long-term sustainability of plant populations. Stuart also investigates how quantitative seed and seedling traits in individual plants are related to their lifetime fitness. In particular, he is testing the hypothesis that asymmetry of cotyledons in seedlings is a predictor of poor health in adult plants.

Our community ecologists, Louise Egerton-Warburton and Lara Jefferson, are investigating how below-ground processes influence the structure of the above-ground plant community. They are currently evaluating how mycorrhizal (symbiotic) fungi and soil nutrients influence the boundary between oak woodlands and prairies. Louise is also working on the role of mycorrhizae in minimizing drought stress and how anthropogenic impacts, such as nitrogen deposition, affect the diversity and functioning of soil fungi. In a recently completed study in California grasslands, Louise found that the interaction of fire, smoke, length of soil burial and temperature were important determinants of seed germination. The variation in germination requirements among species indicated the ways in which seeds may be pre-treated prior to sowing to enhance restoration success, while the timing of fires provide information for site management.

In the Regional Floristics program, we primarily study the flora of the greater Chicago region and are particularly interested in the rare species. Through our Plants of Concern project, we are coordinating a group of volunteers who monitor occurrences of many federally and state listed endangered and threatened plants. The volunteers receive training on monitoring methods and are gathering census and demographic data on plant populations, as well as site management history, for analysis by Garden staff. Our results are shared with the landowners and the Illinois Natural Heritage database. Next year, we will expand the project to include invasive plant species and monitoring their response to management. Volunteers for the invasive project will include student groups from a variety of Chicago area high schools.

Offering educational opportunities for the next generation of conservation botanists is one of our most important goals. The Garden's Institute for Plant Conservation Biology offers one of the most comprehensive suites of educational programs in the United States focusing on applied plant conservation. The Institute gives students the theoretical background and the practical stewardship experience necessary to conserve plants and their communities. The Institute offers a Plant Conservation Biology Certificate, accredited by Loyola University of Chicago. Students must pass 14 credit hours of conservation courses to earn a certificate. Courses include Conservation Biology, Plant Biology, Conservation Genetics, Plant Reproductive Biology, Plant Ecology, and others. We offer a variety of public programs aimed at conservation professionals and students, including the annual Janet Meakin Poor Research Symposium, short courses, and a seminar series. For students wanting hands-on experience after graduation, we offer two types of internships. The Garden's Conservation Science interns spend 12 months working with one of our scientists. They typically assist with ongoing research, design and carry out their own project, and take Garden classes appropriate for

Chicago Botanic Garden intern Jen Taylor pollinating *Platanthera leucophaea*. Photograph by Pati Vitt.

their area of interest. We also partner with the BLM to offer the Conservation and Land Management Mentoring Program. Students come to the Garden for a 40-hour training course and then work with a mentor in one of the BLM state or field offices. These five-month internships focus on endangered species management.

Making research tools available to the larger conservation community is also one of our goals. Toward that end, we are working on two websites that will be available in January 2003. The first site will provide information, images, and bibliographies of nearly 600 of the nation's rarest plants held in the Center for Plant Conservation's National Collection. The second site, "vPlants: a Virtual Herbarium", is being developed in partnership with The Morton Arboretum and the Field Museum of Natural History. The site will contain records of all the Chicago region herbarium specimens held by the three institutions, as well as digital images of many of the sheets. It is our hope that through research, education and public outreach, the Center for Integrated Conservation Science will contribute in a significant way to the international effort to conserve plant diversity.

FOCUS ON NATURE ™ *by Rochelle Mason*

Insight into the lives of animals

The GRAY WOLF (*Canis lupus*), also known as "timber wolf", is the largest member of the dog family measuring 5-8 feet in length (nose to tail) and weighing 57-130 pounds. Males are larger than females. Each wolf pack generally consists of 3-8 related individuals and is dominated by an alpha male. All members of the pack help raise the young and hunt together. This monogamous and gregarious carnivore travels great distances and adapts to a wide variety of climates and habitats in North America supporting large prey species such as bison, elk and moose. Small mammals and rodents are also consumed. Reintroduction programs into areas such as Yellowstone National Park are helping to recover U.S. populations of this endangered species. Please donate your time or money to a nature conservation organization to help preserve wild habitats.

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News from Zoos

The Baltimore Zoo teams up with local schools to promote bog turtle conservation

Through collaborations with Maryland's Department of Natural Resources and the Department of the Environment, the Baltimore Zoo bog turtle exhibit, a restored wetland habitat, is providing valuable education and conservation opportunities for both the endangered bog turtle and the human inhabitants of its native state. Through various partnerships, The Baltimore Zoo has been able to use data collected by Towson University students to track the turtles' movements and body temperatures. Due to an increase in rainfall this spring, the Zoo has been able to return some bog turtles to their homes. These turtles were removed from the bogs during drought conditions in order to ensure their safety. Local middle-school student Jessica Huber lent a helping hand in the restoration project and was recognized as one of 50 national essay winners in the Mutual of Omaha 'Wild Kingdom Kids' Summit on Conservation. Huber's essay, which focuses on the bog turtle conservation efforts, encouraged the Zoo to seek her input in the creation of new conservation education materials to be used at the Zoo. The Baltimore Zoo Herpetology Department has received an award from the U.S. Fish and Wildlife Service for their contribution to the conservation and recovery efforts for this threatened species. [Source: Communiqué]

Aquarium lends helping hand to otters

At the Monterey Bay Aquarium, the sea otter exhibit is prominently located near the main entrance. That is no surprise; these furry animals, who enjoy eating shellfish while floating on their back, are one of the Bay's selling points for nature lovers.

But what most Aquarium viewers fail to see is what is taking place just off the coast. A kayaker and a diver swim slowly back toward the aquarium. With them is an abandoned sea otter pup. The sea otter cannot see the diver's face or hands because they are completely covered in a black wetsuit. The diver goes down to the ocean floor and picks up prospective food. The otters are expected to emulate. Once back ashore, the otter is hustled into an enclosed tank with no view in or out. There is no human contact; a lone camera is aimed 24 hours a day at the animal.

"We are trying to help them return to the wild," says Ken Peterson of the aquarium. Positive interaction with humans may interfere with the otters' behavior in the wild.

These efforts are part of the Sea Otter Research Center, operated by the Aquarium and the Hopkins Marine Institute, which is part of Stanford University. Since 1984, the Center has rescued more than 200 adult otters and stranded pups. It has returned about 25 percent of its captures back to the wild.

The Center also helped re-establish a population of otters at San Nicholas Island in the Channel Islands and two weeks ago did its first magnetic resonance image (MRI) to establish a baseline for the species. The otter used for the MRI is suffering from domoic acid poisoning - a frequent problem among rescued otters - will eventually have to be euthanized.

The population is improving, Peterson said, and the center's effort is slow-growing. More otters die from complications caused by biotoxins and domoic acid poisoning than are returned to the wild. Rescue animals are usually too sick to recover or it is too late for them to respond to antibiotics. But the Sea Otter Research Center staff members are still hopeful. "Our typical day is nothing happens," Hawkins said. "That is what we are hoping for. But then, we got 13 otters in one month once." [Source: Keith Lair, San Gabriel Valley Tribune]

Zoo scientist wins national award for tree kangaroo conservation work

Dr. Lisa Dabek, Director of Conservation and Research at Roger Williams Park Zoo, works village by village in Papua New Guinea, persuading landowners to set aside parts of the hunting lands for conservation so that the endangered Matchie's tree kangaroo can survive. For those grassroots efforts, Dabek was one of eight recipients of the 48th annual ChevronTexaco Conservation Awards, presented at the Houston Museum of Natural Science. Dabek also serves as the chair for the American Zoo and Aquarium Association's (AZA) Marsupial and Monotreme Taxon Advisory Group, a vice-chair for AZA's Wildlife Conservation and Management Committee and a member of AZA's Field Conservation Committee.

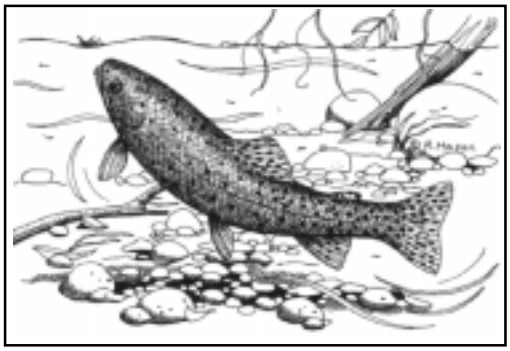
Honorees "provide stellar examples of what can be accomplished when people and organizations put these values into action. Their passion, ingenuity, and vision to conserve natural resources are examples for all of us to emulate," said Warner Williams, vice president of health, environment and safety for ChevronTexaco.

Dabek's efforts to save habitat in order to protect species are part of her successful Tree Kangaroo Conservation program, based at Roger Williams Park Zoo. Last December, the Zoo announced the formation of a 50,000-acre wildlife conservation area in the Huon Peninsula - credited to Dabek's efforts - where no animals can be hunted, including the shy marsupials.

Dabek hopes to help expand the protected area to 150,000 acres, encompassing a conservation corridor in Papua New Guinea, from coral reefs to 13,000-foot mountains. The Tree Kangaroo Conservation program also includes a strong education focus. Children in Rhode Island and Papua New Guinea are involved in an art and ideas exchange program, and the Tree Kangaroo Conservation program supports literacy programs, teacher training and curriculum development at two Papua New Guinea schools. [Source: The Providence Journal]

FOCUS ON NATURE ™ *by Rochelle Mason*

Insight into the lives of animals



The **GREENBACK CUTTHROAT TROUT** *(Onchorynchus clarki stomias)* measures 12-18 inches in length and has larger black spots and more brilliant spawning colors than other cutthroat species. This native subspecies inhabits cold, clear, upper-elevation streams in the headwaters of the South Platte and Arkansas Rivers in Colorado and feeds on zooplankton, aquatic insects, worms and crustaceans. During spawning season in spring and early summer, the female digs redds in the gravel streambed and deposits her eggs. After fertilization by the dominant male she covers them and parental care ends. Establishment of new greenback populations, tightened fishing regulations, removal of non-native competing trout, and protection of aquatic habitats can be furthered by a donation of your time or money to a trout or nature conservation organization.

Information for News from Zoos *is provided by the American Zoo and Aquarium Association*