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Attwater's Prairie Chicken: The Conservation Challenge and Recommendations

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Abstract

*The Attwater's prairie chicken (*Tympanuchus cupido attwateri*) is an endangered bird native to the Texas Gulf Coast Prairie. Populations have declined from historic levels of over one million individuals to 56 birds in 1998. The recovery plan lists several management efforts–increased habitat management and acquisition, captive breeding and reintroduction, and establishment of public-private partnerships for species recovery. Although many of these efforts have been implemented, the species continues to decline and is in imminent danger of extinction. To supplement the programs, we have four suggestions. First, continue and increase research into causes for continued species decline. Second, expand public outreach and focus on the benefits of the safe harbor agreement to build future partnerships between diverse groups. Third, an independent team of experts should be formed to evaluate all problem-solving and organizational aspects of the recovery program. Fourth, the program needs to continue celebrating small successes and break the recovery process into a series of more attainable efforts. This species' recovery effort illustrates the complexities of endangered species management–even effective partnerships and successful programs must be organized to advance the goal of species recovery.*

Foreword

On a windy morning in mid-March, vans of birdwatchers, townspeople, and tourists traveled along the winding 'vehicle loop' at the Attwater Prairie Chicken National Wildlife Refuge. In the middle of the tour, each van stopped and people piled out, hoping to see one of the most endangered birds in North America. Five years ago, they might have been successful; now, there were fewer than 30 Attwater's prairie chickens (*Tympanuchus cupido attwateri*) on the refuge and the current males had not established the 'booming grounds' essential for natural reproduction. No prairie chickens were seen all day, and the only bird heard was one that was captive-bred and in an acclimation pen. On a 3000-hectare refuge, with a recently enacted safe harbor agreement and four centers captive breeding centers, the Attwater's prairie chicken seemed closer than ever to extinction as a wild species.

Introduction

In many ways, the story of the Attwater's prairie chicken is similar to that of dozens of prairie species. Historically, nearly one-million Attwater's prairie chickens (APC) were distributed throughout 2.4-million hectares of coastal prairie habitat in Texas and Louisiana (Lehmann 1941). As settlers converted the coastal prairie for grazing, agriculture, and urbanization, the APC declined sharply in both range and abundance. In the original ecosystem, occasional wildfires and large grazers such as bison maintained open prairie. Many range-lands, however, have been overgrazed, leading to soil compaction and the spread of invasive plant species. Fire suppression throughout the prairie has encouraged further brush encroachment. The combination of fire suppression and improper grazing techniques has helped reduce suitable APC habitat by over 97% from historic levels (FWS 1995a). The development of cities such as Houston further fragmented the remaining APC prairie habitat, precluding movement across urban and agricultural barriers. Today, only 56 individuals remain in three geographically isolated populations. At low population numbers, the deleterious impacts of habitat loss and fragmentation intensify (Seal 1994). While there is limited evidence of disease in wild APCs (Peterson et al. 1998), epidemics spread by captive-bred individuals could decimate the remaining birds. Since the APC is confined to three small areas, stochastic events such as fires, storms, or inbreeding could extirpate the populations and cause extinction.

This paper reviews current efforts to restore the APC, examines the re-

covery program as a 'model' partnership, and offers recommendations to improve prospects for this species. We first became involved with this issue in 1997 as part of a habitat conservation plan analysis conducted simultaneously at nine universities. Specifically, we focused our attention on the APC safe harbor agreement (SHA) and associated conservation efforts. We initially researched the scientific basis for the SHA using primary source literature and government documents. In addition, we interviewed many personnel responsible for APC conservation and reintroduction. During the spring of 1998 we visited the Attwater Prairie Chicken National Wildlife Refuge (APCNWR) and met with FWS biologists, refuge employees, SHA coordinators, and local landowners. All participants are dedicated to their mission; each is working hard to achieve the program's goal of habitat restoration or species conservation. Despite their efforts, however, the APC has continued to decline in the wild and would be extinct were it not for continual infusions of captive-bred birds. Although useful partnerships have been formed in APC recovery efforts, progress toward the overarching goal of species recovery needs to be the first and major criterion by which any program is evaluated.

Current efforts at species recovery

Because of the massive loss of its native prairie habitat, the APC has been recognized as a threatened species since the early 1960s and was listed as endangered in 1967 (FWS 1993). With the population declining by approximately 50% every fourteen years (FWS 1995b), it was one of the first species to be listed under the Endangered Species Act. Conservation efforts have focused on five areas: habitat management on the refuge system, the SHA for the Gulf Coast Prairie ecosystem, captive breeding and release programs to supplement wild populations, increased public awareness of the APC, and the development of management-oriented research (FWS 1993; Terry Rossignol pers. com.).

Shortly after the APC was listed, the APCNWR was established near Eagle Lake, Texas to ensure long-term protection. The site, a combination of native prairie and former agricultural land, had historically been inhabited by the APC and was surrounded by land containing healthy populations of the bird. As late as the mid-1980s, flocks of 25-30 prairie chickens were commonly observed on land adjoining the refuge (Frank Reznicek pers. com.). Although the refuge covers nearly 3,300 ha, most sightings occur in an 1,100 ha 'core' area where public access is restricted (Seal 1994). The smaller Galveston Bay Prairie Reserve was established by the Nature Conservancy of Texas to provide protection for a population on private land. These two refugia and an additional patch of private land hold the remaining APC populations. These areas are separated by urbanization, precluding movement between parcels.

Historically, habitat loss has been the principal cause of APC decline. Theoretically, existing reserves could be buffered by obtaining massive tracts of land. Because 97% of the state is privately owned, however, the amount of land that would have to be purchased makes this alternative impractical. Given this fact, a SHA was created to supplement existing refugia. By providing financial support, coupled with a 'safe harbor' from the Endangered Species Act, the plan encourages landowners to engage in range management, replicating the natural prairie landscape and benefiting the APC. The SHA is a subset of a larger restoration effort, the Native

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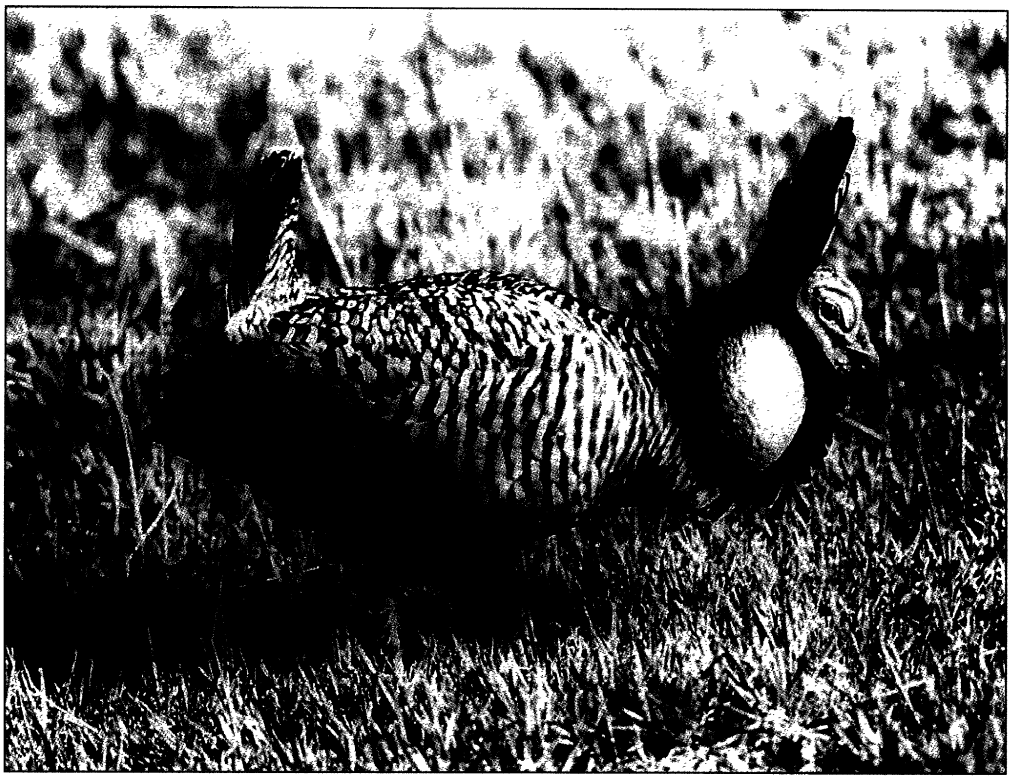

Attwater's prairie chicken (*Tympanuchus cupido attwateri*) Photograph courtesy of George Levandoski

Gulf Coast Prairie Restoration Program (Sam Houston Resource Conservation and Development Area Inc.1995). Thus, although the SHA targets the APC, the overall goal is prairie habitat restoration. The SHA promotes range management through a cost-share agreement with landowners. The cost-share enables landowners to enhance their property at a reduced rate. Interest in the program has been high, in part because of this financial benefit. There are currently nine agreements, selected from over 50 applications. The genuine interest of landowners will hopefully contribute to the SHA's effectiveness. While official management responsibilities only last ten years, it is anticipated that participant's range improvements will continue for a longer period.

In addition to the refuges and the SHA program, captive breeding of the APC has quickly become a vital part of the recovery effort. Although grouse are difficult to rear in captivity (Toepfer et al. 1990) and there have been problems with disease (Terry Rossignol pers. com.), the APC breeding centers have successfully produced over three hundred chicks since 1992. Unfortunately, releases have been less successful–survival rates of individuals released into the wild have averaged 36% per year over the last two years (Terry Rossignol pers. com.). In addition, it has proven difficult to maintain the communal breeding habits among released birds. Despite these difficulties, the captive breeding program is essential for maintaining extant wild populations–50 chicks were released in 1997, supplementing a wild population of about 58 birds (FWS 1997b). In addition to captive breeding efforts, the centers engage in disease and pathogen research and are investigating the feasibility of hybridizing the APC with the closely related greater prairie chicken (*Tympanuchus cupido*).

Efforts toward public outreach and management-oriented research have also received attention. In exchange for a financial contribution, participants in the 'Adopt-A-Prairie-Chicken' program receive quarterly updates on breeding and reintroduction efforts and may be invited to attend special events such as captive releases. The APCNWR and SHA coordinators also participate in the annual 'Attwater's Prairie Chicken Festival' that raises awareness of the APC while providing guided tours of the APCNWR and a forum for promotion of the SHA. Research on habitat requirements of the APC and more effective methods of captive reintroduction are also occurring, although the question of why the birds continue to decline on land managed for the prairie chicken has not yet been answered. Research is mainly coordinated through academic institutions, and there is no systematic program of refuge-based research.

The APC recovery process as a model partnership

Partnerships for endangered species recovery have flourished in recent years. The recent surge in habitat conservation plans (HCPs) and safe harbor agreements is but one aspect of this regulatory shift from confrontation to cooperation. The use of HCPs and 'incidental take' permits has increased greatly in recent years; as of 1997, 212 HCPs had been approved and over 200 were being developed (FWS 1997). The current trend is toward larger programs involving increasing numbers of participants. By joining financial and educational resources across agencies, partnerships can help maximize possibilities for species recovery (Clark and Brunner 1996).

In many ways, the APC recovery team represents a well-executed and

effective partnership. Biologists, refuge personnel, captive breeding specialists, private land-owners, and other constituents form the APC recovery team. This team has effectively coordinated efforts between groups, and no single participant appears to exert undue influence on the planning process. This spirit of cooperation between refuge personnel and captive-breeding centers is evident in the creation of the 'Adopt-A-Prairie-Chicken' program that funds captive-breeding efforts. By promoting this effort through the APCNWR visitor's center, refuge personnel increase the program's visibility to tourists. At the same time, the captive-breeding centers' promotion of the yearly APC re-introductions increases the number of people involved with refuge activities. The captive-breeding centers, three of which are located at zoos or private wildlife preserves, further enhance public awareness of APC conservation through displays and interpretive exhibits.

The ability of the APC recovery team to work together is especially noteworthy given the track record of other recovery efforts. Since these efforts bring together so many different kinds of organizations, often with widely varying cultures and levels of expertise, there exists a strong tendency for one or a few participants to dominate the proceedings. This problem is especially acute in recovery efforts, since the recovery team determines priorities (and thus, indirectly, funding and work) for each of the participating agencies. In addition, jurisdictional disputes and conflicting organizational 'personalities' (for instance, between environmental groups and government agencies) can often sidetrack the recovery process (Clark and Brunner 1996). Recovery programs like that for the black-footed ferret (*Mustela nigripes*) vividly illustrate what happens when agencies engage in 'goal substitution' of their own interests for that of the species recovery process (for a review, see Reading and Miller 1994). In this context, the ability of governmental, scientific, environmental, and citizens groups to coordinate their efforts and support each other's initiatives towards APC recovery is quite impressive. Even without formal guidelines defining their roles vis-a-vis each other, APC participants have avoided time- and energy-wasting disputes and exemplify a successful inter-agency partnership.

The APC safe harbor agreement is another element of the effective partnership. The plan aims to enlist landowners as partners in a community where distrust of 'big government' and endangered species legislation is pervasive. Local Natural Resource Conservation Service (NRCS) conservationists work with landowners to implement a management plan consistent with NRCS technical guidelines, fostering a supportive relationship between technicians and landowners. Because landowners already have a working relationship with their NRCS conservationist, they are confident that their best interests are being considered in the plan's design. The local resource conservation and development agency and the FWS in turn approve the plans. Thus, the final plan represents a process that has involved local landowners, the NRCS, and the FWS. The level of trust and cooperation that characterizes the recovery effort is remarkable, especially given the historic antipathy toward regulatory initiatives.

Recommendations for recovery

The APC recovery program has many virtues: valuable partnerships are being formed between the NRCS, FWS and local landowners, captive breeding efforts are steadily improving, and additional land is being protected for the APC through the SHA. Despite these successes, the population continues to precipitously decline (Figure 1). While we do not suggest terminating these ongoing efforts, the APC's declining status suggests that the existing programs and their strategies may be inadequate. To improve the prognosis for species recovery, we suggest focusing intensive research on the reasons for species decline, increasing education among stakeholders and the public, and celebrating small successes. We also recommend that a genuinely interdisciplinary, external appraisal team be formed to better determine specific recovery strategies, including program organization and basic problem-solving approaches. Such a team is necessary to facilitate introspective and adaptive evaluation of existing efforts.

Although much has been published about the APC, including speculations for its decline, many uncertainties remain. Although captive-bred birds are annually released to both the Galveston and Colorado County populations, only the Galveston population has increased (from 22 birds in 1997 to 36 birds in 1998). Despite annual infusions, the APCNWR population is not using former booming grounds and mortality rates are high. While population supplementation may be practical in the short term, chances for recovery continue to decline as the existing birds abandon traditional breeding behavior and decrease the social stimulation needed for the males to 'perform' (Terry Rossignol pers. comm.). Interestingly, booming and associated behavior continues in the Galveston population–this may be attributable to the smaller size of the refuge forcing birds into closer proximity. Research must examine ways to promote natural breeding and to reduce the high mortality among captive-bred birds.

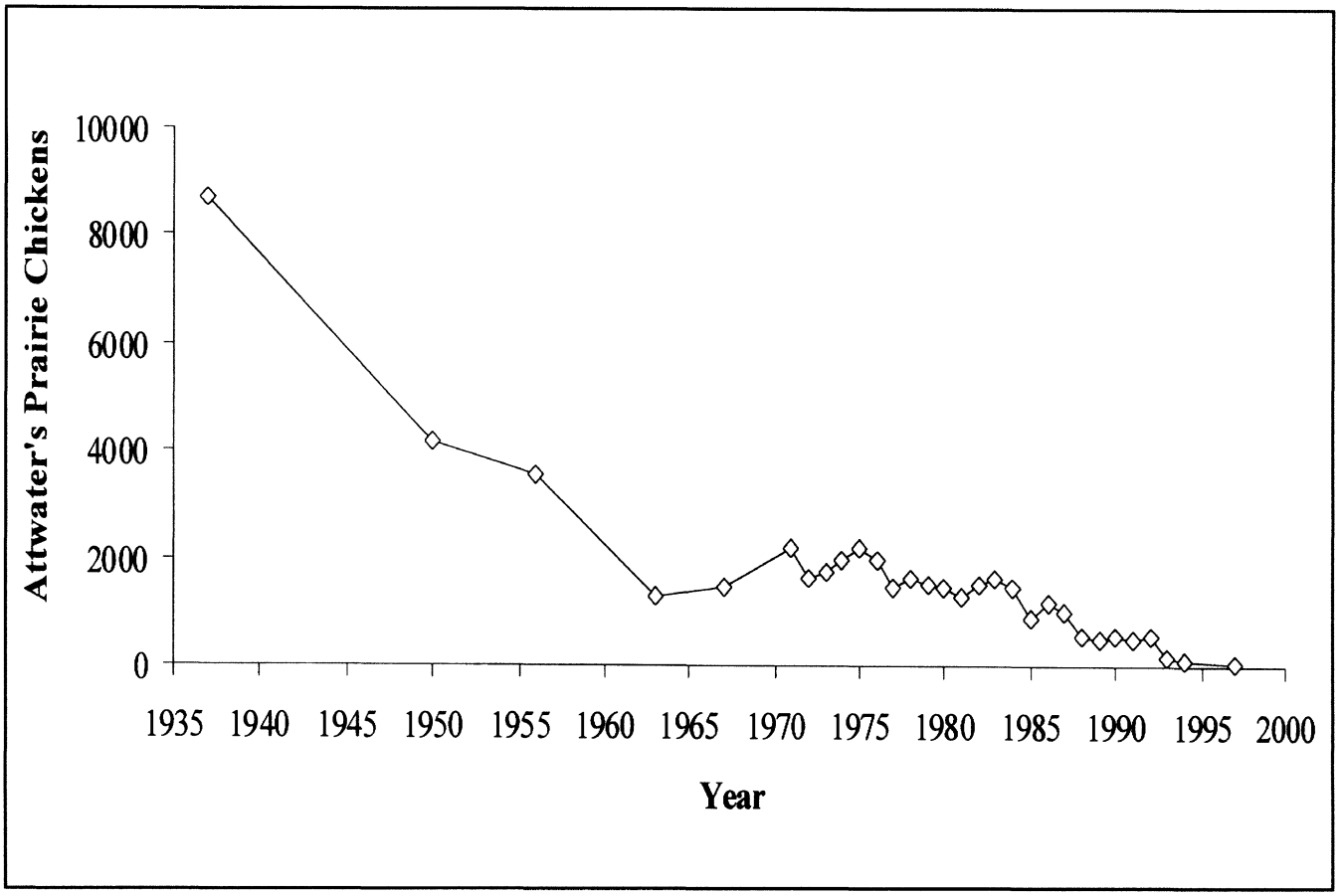

Figure 1. Estimated number of Attwater's prairie chickens throughout their range, 1937 – 1997 (after Peterson and Silvy 1996).

The recovery plan maintains that habitat loss and degradation are the chief causes of APC decline. The SHA addresses these threats; however, APC reproductive success continues to fall on protected reserves that are already managed for the prairie chicken. In addition, suitable habitat for the APC exists that is not being used by existing populations. Thus, habitat loss alone cannot explain the continued decline of APC populations. Fragmentation of APC habitat may be one factor contributing to population decline. The "crash" of the APCNWR population in the mid-1980s correlates with the loss of prairie connectivity in the vicinity of the refuge (McKinney 1996). It is also possible that factors such as fire ants (*Solenopsis invicta*), disease, and adverse weather (e.g., floods and droughts) may have contributed to the reduction in APC numbers. The SHA addresses fragmentation by targeting parcels within five miles of existing populations; however, it does not commit to a research program to actually determine the cause of decline. While the focus on connectivity is important, planners should follow the recovery plan's mandate and engage in a focused research effort to conclusively determine the cause of extirpations within protected areas.

APC recovery depends upon cooperation between the FWS, NRCS, Texas Parks and Wildlife Department, landowners, captive breeders, research institutions, and the general public. Improved education about the APC and recovery efforts will help strengthen the commitment of these diverse groups. Although programs like 'Adopt-a-Prairie-Chicken' and the APC Festival are a good start, they primarily affect people with a pre-existing interest in APC recovery. Presently, the public outreach efforts at the APCNWR are inadequate. Experiential education programs for school children will help foster greater interest in prairie chicken recovery. Classes should be taken to the refuge to see the bird's habitat first-hand. Viewing the expansive range that was once populated with prairie chickens may evoke heightened public interest in protection. In addition, the public profile of the APC should be enhanced, and both print and broadcast media sources should be additionally encouraged to cover APC reintroductions and habitat restoration efforts. Increasing education about the ecosystem-level focus of the SHA might be particularly beneficial: it may be easier to secure public commitment to system recovery, rather than focusing on one particular species. In the case of the APC, interest in protecting this 'flagship' species coupled with general concern for protecting prairie habitat seems to be an effective combination. Education efforts might focus on the other prairie species that will also benefit

from the APC recovery effort, and the avoidance of the future expense and regulations inherent in future endangered species listings. Similar educational outreach efforts should be made with neighboring landowners and SHA participants. This will strengthen existing partnerships and encourage the formation of others.

Although the ultimate objective of any recovery effort is to restore viable populations, this may be difficult for species like the APC that are literally on the brink of extinction. Rather, planners should identify short term, tractable goals so that participants remain enthusiastic and optimistic. While both the APC Recovery Plan (FWS 1993) and a population and habitat viability assessment (Seal 1994) conclude that a minimum of 24 to 28,000 hectares of additional prairie habitat is needed for APC persistence, smaller acquisitions may still be beneficial to the species. Similarly, while the recovery plan aims to protect 5,000 birds, short-term successes must still be recognized and celebrated. Participants should continue to establish annual goals for captive breeding, predator management, and outreach. Success at these small-scale goals will encourage constituents to work together to achieve larger objectives.

One of the hardest things for groups to do is to evaluate their own problem-solving performance. Personal biases, disciplinary views, and professional loyalties can get in the way of even the most well-intentioned efforts. Accordingly, an independent working group, formed of outside experts with no professional affiliation to members of the recovery team, should appraise all aspects of the APC recovery process. The entry of such a group into the process will encourage a top-to-bottom appraisal of the program, while allowing an explicit formulation of the common interest in species recovery. Since the APC is so close to extinction in the wild, an especially important part of the appraisal group's responsibilities would be to encourage debate about the program and its future (Clark and Brunner 1996). Often, popular and socially successful programs may not contribute to the ultimate goal of species recovery as effectively as more technical efforts (such as varied grazing regimes to increase habitat heterogeneity). While the conventional view of the APC recovery process is that successful partnerships have been developed, a basic and more functional view must consider how the structure and operation of the partnerships might be hindering attainment of the overall goal. An outside appraisal team would help develop a more reflective social and decision process that encourages self-evaluation against short- and long-term goals (Clark 1996). In a situation where much is going right, the appraisal team may be able to identify holes or limitations in existing efforts, ultimately suggesting ways of re-focusing current programs for maximum progress towards species recovery. Such a team may help recovery efforts to become more reflective and responsive to new information. Continuous appraisal is needed to help identify flaws in current strategies and determine areas for improvement (see Lasswell 1971). Planners must constantly examine their actions, reframe the conservation problem, and determine appropriate alternatives–reflective learning of this sort leads to policy that is more responsive to changing conditions (Clark 1996).

Conclusion

The suite of activities associated with APC conservation are well organized and impressive. The recovery team and other interest groups seem to work well together, allowing for coordination with a minimum of wasted effort. In addition, the safe harbor agreement is an excellent example of a successful partnership, building connections between the historically antagonistic groups of land-owners and the government. At the same time, however, these successful efforts have not reversed the APC species decline. To supplement the existing program, an increased research effort to determine why species decline continues and the most effective way to stop this reduction seems imperative. Better use of the APCNWR as an educational resource and a focus on the benefits of ecosystem-level protection are also important. In addition, setting short-term goals and celebrating small successes could encourage and re-invigorate refuge personnel and others who face the difficult task of species recovery. A genuinely interdisciplinary, independent review team, appraising all of the existing efforts, could make recommendations on how to allocate scarce resources–knowledge, problem-solving, and organizational–in a way that best advances APC conservation. A primary concern of refuge personnel was a lack of sufficient funding for additional programs–a comment echoed by many recovery teams. While this is a valid and important issue, many of the recommendations can be addressed either with a shift in existing programs' focus or a re-allocated and more efficient use of current funding. By combining increased self-assessment with a refinement of current program foci, the Attwater's prairie chicken stands its best chance of regaining its status as a wild species.

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The Professional in Endangered Species Conservation: An Introduction to Standpoint Clarification

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Abstract

As society itself changes, the work and role of professionals who carry out endangered species conservation are changing. Knowing about the range of standpoints a professional can assume in conservation is one way to enhance effectiveness. Professionals may assume a variety of standpoints, depending on how they see the recovery process and their own role in it. Recovery may be viewed as a biological-technical task or a multifaceted task with biological-technical and *social dimensions. An endangered species case illustrates how one professional changed her standpoint from a "conventional" one to "policy oriented" professionalism. These two forms of professionalism are compared.*

Introduction

Most endangered species conservation work is carried out by professional biologists and land managers. Professionals labor to meet goals as laid out in the Endangered Species Act and in other public policies. For our purposes, a professional is a person with specialized education who participates in a community with standards of practice and shows a commitment to public service (Clark 1997a). The work of a professional and their role in society have changed dramatically in recent years, and both are expected to change even more in the foreseeable future. Today's work settings are as diverse as the species and habitat conservation challenges faced by a professional. The days when professional biologists could go to the field and work in solitude at their own pace are long gone. Among recent changes are partnerships of various kinds that aid the work of professionals and make it more difficult. As a result, professionals should always be on the lookout to improve their performance. Being explicitly aware of the standpoint a professional assumes in endangered species work or in other conservation efforts is one way to improve performance, and it can significantly aid in the recovery of a species. In this paper we (1) examine the notion of standpoint clarification for a professional, (2) look at two ways to conceptualize the recovery process and examine models of professionalism, (3) give an example of these issues, and (4) offer recommendations for improving professional standpoint clarification and performance.

Standpoint clarification and the professional

Regardless of the professional work to be done in endangered species conservation or any other conservation effort, managing oneself constructively is important. Two dramatically different professional standpoints are well-illustrated in companion articles on the controversy over elk management in Yellowstone National Park (see Bugle 1998). Many endangered species cases show diverse standpoints among participants, why it happened, its significance, and what should happen in the future. Knowing about one's own behavior and role in endangered species recovery requires knowing about the biological challenge (e.g., the species requirements) and the organizational environment (e.g., what the boss wants and will permit), and it also requires knowing about oneself. All too often professionals assume, perhaps unconsciously, that they know what they are doing and why and that other people will see and appreciate their good works. Clarifying one's standpoint relative to the endangered species recovery challenge *and* other participants is just as important to achieving conservation goals as knowing that the population status of a threatened species is an important variable. Being clear about one's standpoint can aid successful teamwork and successful conservation. Being unclear can lead to conflict and disaster.

Professionals must clarify their standpoints to themselves and those with whom they share working relationships so they can most effectively participate in recovery efforts. They can be either participants in or observers of the recovery process, depending on their level of involvement and

how they perceive themselves in the process. They can be more or less aware of both themselves and others, depending on how self-reflective and observant they are (Schon 1983). To be as effective as possible in endangered species recovery, professionals must be clear in their standpoint–how they fit into the process–and seek to avoid biases. This is possible only by being self-aware and using that knowledge of self in professional judgment and interpersonal relations. Most individuals have at one time or another analyzed their actions and role in interpersonal relationships, whether with a spouse, partner, parent, sibling, or friend. We do this in order to know where we stand with someone concerning expectations, demands, trust, and many other aspects of relationships. This self-analysis is at the heart of clarifying one's standpoint, and the process is no different in a professional setting than in a personal relationship. All people have biases as a result of experience, personality, interest, and education, among other things. Learning about one's own standpoint and the perspectives of others is not easy, but it is essential to effective professional practice. Over time, as professionals gain experience, they improve understanding of self and others. To reach their potential for effectiveness in either technical work or in leadership, they must be able to look at and understand themselves and others involved in or interested in the species and its conservation.

Two views of the recovery process

One aspect of professional standpoint is viewing or conceptualizing just what the recovery process is. There are many different ways to understand the endangered species recovery process. Depending on how the process is understood determines how a professional might act, as well as how other people involved may respond. Clark (1996) describes two views that professionals may take of the recovery process.

The first view sees the recovery process largely as a technical task requiring that a professional be given a relatively free hand to formulate the challenge and address it. The professional is guided by the scientific method and adheres to the view of technical rationality (Schon 1983). The major constraint perceived by a traditional professional is the lack of scientific information about the species and its habitat, lack of funding, and political obstacles (e.g., public opinion, politicians, developers), all outside the program. Examples of this standpoint abound, and it is perhaps the dominant view in endangered species recovery (e.g., McFarlane 1992; Butler and Merton 1992). In accordance with this view, species recovery is achieved by carrying out appropriate studies, filling in the missing biological knowledge, ascertaining the species' management implications, implementing the chosen management actions, and otherwise maximizing money flows into the program and minimizing external political interference. Professionals who subscribe to this view tend to see themselves as scientists carrying out "good science." They believe they are agents of objective, value-neutral science and are often relatively unaware or inattentive of the social matrix within which they work. Despite their skills in scientific methods, these professionals are little skilled in social processes, decision process analysis, or team participation. This view is called a "science-based" approach to species recovery.

The second view sees recovery as a multifaceted task with biological-technical and social dimensions. The professional is guided by a problem-oriented, contextual outlook and diverse methods, including traditional biological scientific approaches, as well as diverse social science methods and qualitative and integrative methods. This view is partly described by Schon (1983) and called "reflective practice" and more fully described by Lasswell (1971), Clark et al. (1992), and Clark (1992) and labeled "policy-oriented" professionalism. This conceptualization requires a broader, genuinely interdisciplinary approach and professional skills that the technical rationalist does not know about or use. In this view, the major constraint perceived is lack of effective social processes that would integrate values and knowledge for successful conservation. Examples of this view are less evident in the literature (e.g., Kellert 1985, Clark 1989, Miller et al. 1996). From this view, the way to achieve recovery is to simultaneously and explicitly address socioeconomic, organizational, and political as well as biological dimensions of recovery. This is both a methodological challenge and a challenge to the ability of professionals to integrate often disparate fields of knowledge. This approach explicitly requires that professionals develop awareness of their roles in the social process of endangered species recovery. This "practice-based" approach encourages people to observe what actually works, both technically and socially, and apply experience and lessons successfully.

We believe the second view is the more practical of the two. Professionals, other participants, and observers may use one or the other without being fully aware of the assumptions and approaches that they bring to the recovery process. In turn, these lead to differences in expectations, demands, and actions by professionals and others involved in the conservation effort, which may lead to miscommunication, conflict, and possibly failure if these viewpoints are not

Table 1. Two models or standpoints of professional problem solving in endangered species (from Pimbert and Pretty 1995; Clark 1997a).

Conventional Professionalism	Policy-Oriented Professionalism
Technological rationality	Reflective practice
Scientific method is singular, reduction istic, and positivistic (cause and effect, prediction)	Scientific method is holistic and post-positivistic (human freedom, empirical, systematic)
Strong natural science biases	Mix of natural and social sciences
Professional categories and perceptions are central	Local categories or contextuality is central to problem solving
Professionals know what they want and follow a pre-specified plan or project design	Professionals do not know where projects will lead so work is an open learning process
Information and results are extracted from controlled situations	Understanding and focus emerge from interaction with context
Problem solving is like a blueprint	Problem solving is like a process
Use problem-blind, acontextual outlook, and disciplinary methods	Use problem-oriented, contextual outlook, and integrative methods
Assumption of single, tangible reality reality	Assumption of multiple realities that are partially socially constructed
Professionals control problem solving and clients	Professionals enable and empower people in close dialogue about problem solving in context
Often work alone with single disciplinary focus	Work in groups with an interdisciplinary focus
Careers are inward and upward	Careers are outward and downward
High-level professionals loose touch with changing local realities	Professionals stay in touch with action at all levels

clarified and differences addressed. These two views of endangered species conservation are based on two very different models of professionalism, as contrasted in Table 1. These show dramatically different assumptions, approaches, and consequences.

A case: An endangered species biologists "situates" herself

This case is about a professional who started off with the first view of species conservation and rapidly shifted to the second conceptualization as a result of her direct experiences (see Bentrupperbaumer 1998). This professional studied the endangered cassowary (*Casuarius casuarius*). This large, forest-dwelling, flightless bird inhabits wet tropical regions of northern Queensland, Australia. In a section called "situating the author," Bentrupperbaumer (1998) explains why she changed her standpoint in her Ph.D. thesis. Her story is an interesting one, but not atypical of endangered species professionals. At the heart of her standpoint was that she hoped to contribute to preventing the extinction of a species even in a modest way. And as a result of her experiences, she indicated that she left "normal" biology behind and came to have a broad interest in ecology, environmental psychology, and environmental management.

Over several years she collected data on the bird and its habitat. Even though her work began as a biological study, it soon progressed into conservation and management when the bird's forest habitat began to be logged. She came to realize that conserving this magnificent bird would require overcoming the "ineffectual" way in which the recovery effort at the time was unfolding. Several incidents propelled her into a fuller appreciation of the second view described above. She soon found that "despite the harsh and demanding physical and climatic conditions of the field, the actual biological component of the field work presented the least difficulties. Cassowary 'politics' inevitably came to the fore, on many occasions threatening to terminate the project." Denials of access by private landowners halfway through her study and attempts by local community conservation organization to terminate the "human population study" component of the research are two examples of these politics.

The first incident resulting in a significant change in her standpoint was a response by the major landowner, who became concerned about the possible implications her results would have on his property's future. The state government was at the time preparing nature conservation legislation. This private property completely land-locked the northern boundary of the study site, a 319 ha World Heritage area listed as a National Park. The other boundaries included the sea and a mangrove river. This property had been described as critical habitat for cassowaries previously. In addition to

Table 2. Questions professionals should ask themselves to clarify their standpoints (after Willard 1998, personal communication).

(1) What roles are you and other people engaged in while working in the recovery effort: scientist, technician, manager, student, teacher, advocate, advisor, reporter, decision maker, scholar, facilitator, concerned citizen, or others?
(2) What problem solving tasks do you carry out when performing your roles: clarifying goals, determining historical trends, analyzing conditions, projecting trends, and inventing and evaluating alternatives? [These tasks are described by Wallace and Clark (In press), forthcoming in Endangered Species Update.]
(3) What factors shape how you carry out your tasks and roles: culture, class, interest, personality, and previous experience?
(4) What conditioning factors shape your personal and professional "approach" in general and in reference to any particular conservation case? Which approaches or roles are you predisposed toward or against, and how are you predisposed to conduct your professional work from each?
(5) How does your approach shape how you carry out the intellectual tasks associated with your roles? For example, what is the impact of your "reflective approach" on the goals you clarify and how you specify them? the trends you identify and describe? the conditions you analyze and how you analyze them? the projections you make and how you make them? the alternatives you invent, evaluate, and select?

denying her access to the study site, the landowner cleared extensive areas of his property, preempting the potential restrictive status of a formal critical cassowary habitat classification. The second incident that resulted in a significant change in her standpoint was the negative response of the local conservation organization when she "disengaged" herself from it. She worked with this group at the request of the then State Minister of the Environment and left the organization to begin her Ph.D. work.

Because of these two incidents and others, she decided to expand her thesis beyond cassowary biology to include the human dimension. Issues about who dominated the cassowary conservation issue arose, and there was a perceived loss of control by "locals" over a study being undertaken under the auspices of a distant university and a federal government management agency. It was perceived as a threat to the expertise and credibility of the conservation organization. One of the most important issues was the local conservation organization's efforts to "undermine the credibility of myself and the value and relevance of the research project were both instructive and sobering, as well as personally very difficult to accept." This history, especially with the community conservation group, highlighted the complex and dynamic role of the professional in endangered species conservation and the need to clarify just what standpoint a professional like herself should take in such a situation. She concluded by noting that the "emotionally charged and politically volatile community environment underscores the difficulties of 'field work' with human communities."

These incidents and others motivated her to move on to other knowledge areas beyond biology and survey social science literature for guidance. As she noted, this "presented many challenges for an ordinary biologist like myself." The social sciences gave her important concepts and methods to understand the hard conservation experience she had gained and how to tackle future work practically. She reported that there were "continuous tensions between my proceeding, being fully aware of the limitations and dangers of simplification, and not proceeding, thereby giving in to this conflict and continuing on 'as normal' with a biological perspective only." She expanded her research and gathered social science data on the human community in the region and interrelated them with the biological data set. She said she sought to "heed the current call for multidisciplinary research ... and have taken courage from the knowledge that more biologists, ecologists, psychologists, and other environmental scientists seem willing to cross disciplinary boundaries and levels of organization in an endeavor to contribute to solving the extinction crises." Through all of this, she sought a "coherent, holistic picture relevant to endangered species recovery." But it was not without difficulties. Her work evolved into a professional approach that integrated a number of disciplines, focused on understanding and aiding endangered species conservation. Not only did she add to cassowary conservation, but ultimately this effort significantly clarified her standpoint to herself.

This professional career is developing toward a fully mature, policy-oriented standpoint. The evolution of a traditional professional career into a policy-oriented one was first described by Lasswell (1971), and Bentrupperbaumer's account fits the profile. The conservation literature now contains similar descriptions of policy-oriented professionals and benefits (e.g., see "Conserving biodiversity in the real world: Professional practice using a policy orientation," (Clark et al. 1992) and "Practicing natural resource management with a policy orientation" (Clark 1992). More recently, a policy-ori-

ented approach to conservation biology was described by Clark (1977a). Bentrupperbaumer's professional transformation is one example of the kind of change needed broadly in conservation professionalism (see Schon 1983, Sullivan 1995).

Conventional professionalism and the policy-oriented professional

Bentrupperbaumer shifted her view of endangered species recovery from a conventional to a more holistic one (Table 1). As a result, she changed from understanding her role and herself in a 'conventional' sense toward a more comprehensive, policy-oriented understanding. Clarifying standpoint means finding out which kind of professional you are, which kind you want to be, and why. The conceptual tools a professional possesses include a way of seeing oneself, other people, the conservation challenge, and communication styles (see Clark and Reading 1994).

To clarify standpoint, we recommend that professionals start by asking themselves questions about their own professional roles, tasks, shaping factors, and orientation that they take or assume. Table 2 offers questions about these variables that professionals should ask themselves continuously over a career . Asking and answering these questions lead to "reflective" practice and can lead to policy-oriented professionalism, when combined with skilled use of a genuine interdisciplinary problem solving method (see Clark 1997b). Restructuring professionalism toward policy-oriented practice requires a substantial commitment to learning by professionals, universities, and other organizations (Clark 1997a). Training and updating training can take place in universities and professional schools, agency workshops, and at the individual level. If organized policy-oriented education is not available, then the individual is left to his or her own devices to improve problem solving.

Conclusion

Clarifying one's standpoint is a necessary first step toward gaining a better understanding of the human social process associated with endangered species conservation (Clark and Wallace 1998). Understanding of personal values and interests in the context of a larger social and organizational whole, in this case endangered species recovery programs, only helps a professional to raise awareness and eventually master many of the problems inherent in complex programs that transcend social and technical-biological realms.

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Marine Matters

How Global Warming Caused Cooling: Dynamic Effects of Thermohaline Circulation

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Abstract

The currents of the world's oceans form an interconnected conveyor belt known as thermohaline circulation (THC). This belt has its beginnings in the North Atlantic where highly salinized deep-water is formed. This process has been proven to be highly sensitive to temperature changes and fresh-water influxes. THC has a direct impact on the world's climate, and any alteration of North Atlantic deep-water formation can bring about rapid changes in the Earth's mean atmospheric temperatures, and vice versa. Increasing atmospheric carbon dioxide (CO_2) (from anthropogenic sources) is highly correlated to greater mean global temperatures, as the Intergovernmental Panel on Climate Change (IPCC) states an increase of 1°C over the past 90 years. Studies have shown increases in CO_2 will lead to increases in global temperature and a breakdown of THC. This, in turn, will result in both the decreased ability of the ocean to naturally cycle CO_2 and rapid localized climate changes. Findings of these recent studies include abrupt cooling over northwestern Europe, and implicate a positive feedback between increasing CO_2 and global climate change. These alterations to the current system will inevitably affects all forms of life on the planet, and could mean disaster for a variety of plant and animal species, both terrestrial and aquatic.

Introduction

The currents of the ocean function as one interconnected conveyor belt, known as thermohaline circulation (THC). Currently, this belt finds it beginnings in the cold waters of the North Atlantic Ocean. THC is governed by a balance of temperature, and, more importantly, salinity. The North Atlantic is unique because this is where warm currents, carried across from North America on the Gulf Stream, become subjected to much colder air temperature. When this warm water of intermediate salinity comes in contact with cold, high latitude air masses, two crucial processes take place that drive THC. First, large amounts of evaporation occur, sending warm, moist air over Northwestern Europe (Broecker 1997). The result is colder, denser, and more highly saline water at the sea surface. As temperature decreases, the second process begins. Surface waters reach a temperature of maximum density (high salinity and low temperature), and the entire mass of water sinks down (Winton 1997). When this water does sink, it travels south, beginning the worldwide conveyor belt, and establishes the thermocline; cold, dense waters flowing like a river under the warmer, less dense surface waters. These cold waters cycle around the globe, and well to the surface in the Northern Pacific.

Studies have shown that the current pattern of THC is not static. In fact, the system has been found to be very sensitive to perturbations (Stocker and Wright 1991). More freshwater influx, from increased river runoff and/or more glacial melting, decreases sea surface salinity causing surface waters to be less dense. This significantly disrupts formation of North Atlantic Deep Water (NADW). The role of evaporation on sea surface salinity is so small, that it can be neglected when determining salinity variations in the open oceans (Mikolajewicz and Maier-Reimer 1994)–thus illustrating that temperature and salinity are the key driving forces in NADW formation. If the surface density of the North Atlantic is reduced to such an extent that maximum density can not be achieved, the water no longer has the ability to sink. THC is a process driven by convection, so if a break in the chain occurs (i.e. lack of NADW formation), THC collapse becomes not only possible, but likely (Broecker 1997).

Ocean circulation and water influx are measured in units of Sverdups (Sv), one of which is equal

to $1x10^6$ m^3/s. The circulation of today's THC averages around 20 Sv– compared to all of the world's rivers, which collectively represent 1 Sv. Stocker and Wright (1991) used a computer model that tested two hypothetical scenarios of a net Atlantic-to-Pacific fresh water flux (F) (the present estimate for F lies in the range of +0.1 to +0.45 Sv). Scenario A introduced an additional freshwater influx of 0.3 Sv, resulting in the shutdown of THC. An addition of 0.3 Sv would be similar to a large input from glacial melting. Scenario B reconstructed ocean conditions during the last global glacial maximum. Freshwater influx also was increased to 0.3 Sv without significant change of THC. Since the amount of freshwater input was the same in both cases, questions arose over how two opposite outcomes could be achieved. These conflicting results were significant enough to conclude that two stable modes of THC can in fact exist, given identical boundary conditions (Stocker and Wright 1991).

This paper will explore past behavior of THC and the accompanying effects on climate. From there, I will illuminate connections between CO_2 concentrations and glacial cycles and temperature change. I will then look through the lens of three recent studies to explore possible climatic outcomes of the future, and how THC plays a role therein. Following this analysis, I will speculate how these potential changes might affect various species around the globe, both terrestrial and aquatic.

Past examples of varying thermohaline circulation

The above study by Stocker and Wright (1991) looked at various modes of THC as a result of fresh water flux. Broecker et al. (1985) were among the first to hypothesize that glacial cycles were caused by fluctuations in the formation rate of NADW. Continental glaciers have advanced and retreated on an observed timescale of the past 100,000 years. Such oscillation cycles are characterized by long periods of glacial buildup that end abruptly with rapid warming periods. These cycles were found by Broecker et al. (1985) to be closely timed with the variations in seasonal contrast produced by changes in the Earth's orbital cycles. They posed the idea that the process of orbital cycles alone was not sufficient to cause these cycles of glaciation.

The primary evidence supporting this idea arose from the difference in atmospheric CO_2 concentrations between glacial and interglacial times, rooted in ocean chemistry (Broecker et al. 1985). Ice cores from glacial periods were found to contain 2/3 less CO_2 than those from interglacial times (i.e., atmospheric CO_2 concentrations were greater in warmer periods). Broecker et al. concluded that in order for this difference in CO_2 concentrations to have occurred, the carbon to nitrogen and/ or carbon to phosphorous ratio in organic residues falling to the sea floor had to have decreased by 30% at the end of glacial times. Furthermore, biological 'pumping' of carbon by organisms from the surface ocean to the deep ocean is compensated partly by a flow of CO_2 through the atmosphere from cold-to-warm water areas (i.e. evaporation over cold water, into precipitation over warm water). A change in these locales of warm and cold water dramatically alters the balance between these two competing effects. All of these factors correspond to a decrease in THC. From this, Broecker et al. (1985) conclude that production of NADW was likely greatly reduced during peak glacial times. This conclusion supports the concept of reduced natural CO_2 cycling by the ocean during times of NADW reduction.

The theory that ocean circulation controls major climate change has been supported by various other studies (Broecker 1987; Mikolajewicz and Maier-Reimer 1994; Rahmstorf 1995; Broecker 1997). Another major finding of these studies is the speed at which climate change itself has taken place between glacial and interglacial cycles. Rather than responding smoothly to any type of forcing, the ocean-atmosphere system simply changes the way it works (Broecker 1987). The most dramatic fluctuation in temperature since the termination of the ice age and the recorded history of Earth was the Younger Dryas event, an abrupt reversion to glacial conditions. This event affected Western Europe ~13,000 years BP (Before Present), and lasted for ~1,300 years (Mikolajewicz and Maier-Reimer 1994). The Younger Dryas has been conclusively linked to the termination of NADW formation, most likely caused by a heavy influx of freshwater flows from the then-retreating glaciers. The fast change in temperature was most likely a result of a rapid halt in NADW formation, and the subsequent breakdown of THC. Shutdowns of this type would inevitably cool the North Atlantic and adjacent lands by 6-8° C (Broecker 1987), resulting in abrupt change, as the onset of this cold spell could take only 20 years (Mikolajewicz and Maier-Reimer 1994).

Further research supports the concept of localized cooling. A study by Rahmstorf (1995) modeled a total shutdown of NADW circulation, and observed maximum cooling of 6° C near Greenland, with widespread cooling of over 4° C across the North Atlantic. These basic examples demonstrate how easily climate is affected by ocean currents, and how sensitive these currents are to natural forces (i.e. freshwater influx and temperature). Yet, we find ourselves poten-

tially perpetuating the increase in mean global temperature, which is occurring at an unprecedented rate. As long as human society continues to add large amounts of CO_2 to the atmosphere, there is an increased possibility that severe consequences will manifest themselves. The essential question becomes, how might increasing CO_2 concentrations affect THC, and how is THC going to affect the climate of the next century? Moreover, how will these climate changes affect the species that inhabit the planet?

Recent research modeling climate change

The burning of fossil fuels, the production of cement, and changes in land use (including deforestation) are the three primary contributors of CO_2 emissions—all from anthropogenic sources. These practices have led to an increase in atmospheric CO_2 concentrations of almost 30% over the pre-industrial level of 280 ppm (parts per million) (Stocker and Schmitter 1997). A recent study by the Intergovernmental Panel on Climate Change (IPCC) provided climate stabilization scenarios for the future, stating that the two primary sinks for CO_2 are the ocean and the terrestrial biosphere. Believing that the ocean will continue to serve as a sink for CO_2 assumes that ocean circulation and temperature will remain constant over the next few centuries (Sarmiento and LeQuere 1996). With the influence of an increasing atmospheric CO_2 concentration, the assumption that these conditions will remain static is unrealistic. The following three studies yield sometimes interrelated and striking results to support these dynamic conditions.

Study one

Manabe and Stouffer (1991) used a coupled ocean-atmosphere model to predict the changing climate over the next few centuries. This model excluded biological processes, and three different scenarios were tested. One scenario used a standard integration (S) in which atmospheric CO_2 was held constant. The second scenario increased CO_2 concentrations by 1% (similar to today's rate of increase), compounded annually until the CO_2 level reached 4 times that of today (4XC), taking 140 years, and then leveled off. The concentrations of CO_2 in the last scenario also increased at 1%, but halts at 2 times today's level (2XC), reached after 70 years, and then leveled off. Atmospheric and oceanic components of the model were at equilibrium when the simulation began.

After 140 years in the 4XC scenario, global mean surface temperature increased by 5° C at a rate of ~3.5° C per century. Afterwards, mean surface air temperature increased by another 1.5° C, due to the thermal inertia contained within the ocean. By that point, sea levels had risen by 1.8 meters (m). For the 2XC scenario, the same rate of temperature increase occurs, resulted in an increase of 2.2° C after 70 years, and a corresponding 1 m rise in sea level. THC almost disappeared in the modeled oceans of the 4XC scenario, and was reduced to 1/2 its original intensity in the 2XC scenario. Gradual recovery of THC in the North Atlantic does not occur until the 500th year of the simulation (for the 4XC scenario), largely due to the greater inputs of freshwater to high-latitude oceans. An important point here is that input due to melting of the continental ice sheets was not incorporated into the model, which might have induced total THC breakdown in the 2XC simulation (Manabe and Stouffer 1991).

The 4XC treatment, in which THC is almost non-existent, results in excessive warm and salt-rich waters over the North Atlantic. This produces temperature increases over the Arctic Ocean of 11-16° C, and 5-8° C over both the North Atlantic and circumpolar ocean of the Southern Hemisphere. These changes would cause warming over the continents of 7-10° C, similar to the climate of the Late Cretaceous of 65-90 million BP (Manabe and Stouffer 1991).

Study two

A study by Sarmiento and LeQuere (1996) ran the exact same coupled ocean-atmosphere global warming model. This study, however, looked at THC shutdown as a function of the ocean's ability to take up atmospheric CO_2. All parameters, controls, and treatments were the same as those in Manabe and Stouffer (1991). Similar numbers were found for temperature increases for both 2XC and 4XC simulations. In the Sarmiento and LeQuere (1996) model, the peak value of the THC collapsed in the North Atlantic, with a flow rate dropping from 18.5 Sv to about 2.5 Sv in the 4XC scenario. They found a weakening or collapse of the global-scale THC as climate warms was the result of all model simulations (1996). However, they also concluded that, at slower increase rates of temperature THC decreased but did not collapse, even in the 4XC scenario.

Sarmineto and LeQuere (1996) then applied their models to simulate CO_2 uptake. These simulations are equivalent to the IPCC stabilization scenarios, which assume ocean circulation and temperature remain roughly constant. After 350 years of cumulative CO_2, there were reductions in uptake in the 2XC and 4XC scenarios of 38 and 48%, respectively. After 150 additional years, that number surpassed 50% in the 4XC simulation. In the 4XC simulation, the researchers were able to determine what percentages of the lack of uptake were due to heating, or due to

decreased THC. They found heating only responsible for 15%, while decreased THC was responsible for 85% of the lack of CO_2 uptake.

The authors then added to the model the effects of biological processes of production of biogenic organic matter, calcium carbonate ($CaCO_3$), and nutrients at the surface; transport of biogenic material to the deep ocean; and remineralization of biogenic material. The CO_2 uptake simulations with this model, known as an ocean biogeochemical model (OBM), produced very different results. Here, the uptake reduction after 350 years were 17 and 19% for the 4XC and 2XC simulations, respectively. This drop is due to the combined effects of $CaCO_3$ and nitrate cycling, which together lower surface alkalinity. Lower surface alkalinity diminishes the buffering capacity of the ocean, and thus its ability to dissolve excess CO_2 (Sarmineto and LeQuere 1996). The study also discovered a constant flux of biogenic material into the deep ocean. The return flow of inorganic carbon decreases dramatically, however, due to the reduction in circulation. An important conclusion from their study is that the magnitude of future atmospheric CO_2 responses to these changes will be greatly magnified due to this decreased buffering capacity of the ocean.

Study three

The most recent and final study, done by Rahmstorf and Ganopolski (1998, in press), produced innovative and surprising results. Simulations were run using an intermediate-complexity atmosphere-ocean-sea-ice model, projected out to the year 3000. These researchers discovered a strong decline in THC over the next 50 years. The study concluded that a substantial multi-century cooling would occur over the North Atlantic, resulting in a subsequent drying over Europe—reminiscent of the effects of the Younger Dryas. Rahmstorf and Ganopolski (1998, in press) cited several other studies in which researchers ran models that have elucidated this concept. Until now, the hypothesis that global warming is going to lead to both a new mode of THC and an accompanying cooling over Europe has not been supported by model simulations (Rahmstorf and Ganopolski 1998). Their model suggested the climate system will recover from a temporary peak in greenhouse gas concentrations, but may then be forced into a new, stable mode of operation, without NADW.

The Rahmstorf and Ganopolski (1998, in press) model projected until 2100, following the IPCC IS92c scenario, one with the fastest rate of CO_2 release based on unchecked fossil fuel consumption. After 2100, CO_2 concentrations peaked at about 1200 ppm (~3.3 times the present level) in 2150, and then declined to zero emissions in 2200. Temperature increased 4.3° C by 2100, at which point the mean Arctic Sea ice had decreased by half. The North Atlantic warmed less than other areas of similar latitude, due to deep mixing and a reduction in THC. This study found a reduction of NADW formation from 20 Sv today to 12 Sv by the end of the next century. The model concluded that reduced salinity contributed just as much as warming to the weakening of the density gradient and circulation, implying that neither force has a greater impact than the other.

Regional terrestrial temperature differences were especially large over the high latitude North Atlantic. One scenario showed near-surface winter air temperatures around the North Atlantic rose by 3° C until 2100, but then dropped 3° C within 40 years following the shutdown. The cooling continued until the end of the next millennium, when the temperature stabilized at over 6° C colder than pre-industrial times. Any climatic cooling would directly impact northwestern parts of Europe. All other scenarios (in the North Atlantic) using this model resulted in temperatures warmer than those at present. In their conclusion, Rahmstorf and Ganopolski (1998) stated that a cooling has never been predicted because simulations have not extended far enough into the future to reach a point of collapse. In fact, they cited Manabe and Stouffer (1993;1994) who, in two studies not included in this paper, did reach a collapse of the THC. This collapse, however, was achieved under idealistic—not realistic—conditions; rate of CO_2 emission and cumulative release were both highly exaggerated.

Discussion

A study of THC by Broecker (1997) states that the failure of general circulation models to reproduce the abrupt and spontaneous changes in temperature and rainfall patterns clearly recorded in the geologic record for the last glaciation sends a strong message that these models are somehow deficient. This assertion may have been true for relatively simple, coupled ocean-atmosphere models used before 1997. The most recent study by Rahmstorf and Ganopolski uses a much more complex model that considers twice as many variables as both studies one and two included in this paper. Moreover, this model does predict a rapid and spontaneous climate change, as well as a new and fixed mode of THC operation. Broecker's (1997) statement may have actually caused Rahmstorf and Ganopolski to consider these variables and therefore come up with a new, more reliable formula to predict change. Whether Broecker's conclusion played a role or not is unknown, yet what is certain is that this most recent model

most likely provides the most accurate results.

The question is then, if we were gaining unreliable results with previous modeling techniques, does this mean that Northwestern Europe should be bracing for a major cold spell? Some predictions call for incredible rates of temperature increase (study one), while some have predicted grand scale cooling (study three). Rahmstorf and Ganopolski (1998) assert that if Northwestern Europe does experience this cooling, the effects will be mostly offset by broader global warming. Whatever the definite results, the likelihood remains that the Earth is going to experience very drastic climate change over the next five-hundred years, and the function of THC is going to play a very large role in the outcome.

The lack of consensus among these studies discussed leaves a great deal of room for argument about the accuracy and precision of all of these models. In the event that THC does experience a weakened ability to circulate as it always has, the resulting decreased ability of the ocean to absorb atmospheric CO_2 could be potentially life threatening. As CO_2 concentrations continue to increase, so does the likelihood of THC shutdown. And when the oceans cannot absorb as they are normally able, in a time when concentrations of CO_2 are already very high, a positive feedback occurs. The existing atmospheric CO_2 will continue to accumulate at an even faster rate, reinforcing the conditions necessary to suppress THC. This complex linkage is still unexplored in-depth, and, considering the possible implications, is sorely in need of further research.

Shifting climates are going to affect life around the globe. In a time when human population numbers are exploding, climate variability could mean serious catastrophe for millions of individuals; humans, animals, and plants. Humans are resilient and will be able to alter their surroundings in order to deal with the problems global warming will bring. Whether the strategies we employ will be effective or not remains to be seen, and is simply a matter of subjective opinion. Animal and plant species will suffer the most. Forced to deal with an increase of 3.3° C per century, many plants will simply not be able to expand their range fast enough to keep up with the shifting climates. Considering then the vast number of mutualistic relationships between plants and various mammal, bird, and insect species, many animal species will be excluded from the ranges of their necessary food source, breeding ground, or seasonal habitat. Taking into account the numerous endangered species currently suffering from habitat loss and/or destruction of their food sources, the potential threat to these species is enormous.

Arguably most devastating of all, researchers in the field of global climate change argue that the damage is already done (Sarmiento and LeQuere 1996). Even if the United States alone could bring its own CO_2 emissions rates down to a reasonable level, many developing countries of the world are just beginning to generate CO_2 emissions, using technology that is comparable to that used in the 1940's in this country. As truly devastating and nonsensical as it sounds, environmental policy has yet to take appropriate steps to mitigate this impending ecological disaster.

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Teaming With Wildlife: Legislation Offers Hope for Preventing More Listings

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Abstract

The 3,000 groups and organizations supporting the Teaming With Wildlife (TWW) initiative have succeeded in bringing Congressional attention to the serious declines facing wildlife not hunted, fished or yet endangered. In early 1999, both House and Senate will reintroduce bills that address TWW funding needs for nongame wildlife, recreation and education as part of a larger package allocating offshore oil and gas revenues.

The U.S. Congress will soon take up significant wildlife conservation legislation that was first introduced in October, 1998. The Reinvestment and Environmental Restoration Act of 1998 (RERA, S. 2566, Senate version) and Conservation and Reinvestment Act of 1998 (CARA, H.R. 4717, House version) would dedicate from $321 to $459 million of annual federal revenue from offshore oil and gas leases to meet most goals of a national initiative dubbed "Teaming With Wildlife." The bills allocate funding in three areas: Title 1 for coastal impact assistance; Title II for the Land and Water Conservation Fund and urban parks; and Title III for Teaming With Wildlife.

Once known as the Fish and Wildlife Diversity Funding Initiative (as described in Vol. 12 No. 9 1995 of the *Endangered Species UPDATE*), Teaming With Wildlife (TWW) has drawn national attention to the plight of nongame fish and wildlife–more than 2,000 species that are not hunted, fished or listed as endangered.

The coalition supporting the proposal grew from 100 groups and businesses in 1995 to 3,000 in 1998. The thousands of letters, calls and state-level organization made a tremendous difference.

According to Naomi Edelson, TWW director for the International Association of Fish and Wildlife Agencies,"Without the hard work of the coalition, nongame wildlife would still be without a voice. For the first time, Congress is taking seriously the importance of preventing species from becoming endangered."

TWW specifically aims to remedy state nongame wildlife funding shortfalls, while securing dollars for wildlife-related outdoor recreation (trails, viewing areas, etc.) and conservation education.

Originally, TWW proposed raising $350 million annually for state wildlife agencies via a small user fee on equipment connected with enjoying wildlife and the outdoors, such as binoculars, bird feeders and camping gear. Currently, hunters and anglers pay similar user fees on hunting and fishing gear. The result of more than a half century of reliable, annual funding for game species is demonstrated in the restoration of the white-tailed deer, wood duck and striped bass.

Despite the grassroots support for a user-pay, user-benefit system, the proposal encountered serious resistance from several major outdoor companies and in Congress. No matter how clearly coalition members made the case that the proposal simply expanded a successful user fee to a wider group of outdoor enthusiasts, the negative "tax" word haunted the initiative. The tax issue has made it difficult to find the broad bipartisan support needed to introduce the user fee legislation. The climate appears to be very different from the era when the Sport Fish and Wildlife Restoration Acts passed Congress (dating back to the 1930s).

Although the user fee proposal remains an option, the TWW Steering Committee views the new legislation with optimism. As more nongame species join the US Fish and Wildlife candidate list for threatened or endangered status, the urgency of solving the crisis in conservation becomes apparent. Currently, 26 animal and 36 plant species are proposed for listing. Another 159 species (76 animals and 83 plants) are on the docket as candidate species. Recently, Partners in Flight, an international consortium of wildlife agencies and conservation groups, published a "Watch List" of 107 bird species (not listed as threatened or endangered) that are in need of immediate conservation attention.

A high priority for the TWW Steering Committee is to shape the House and Senate bills into a form that is as beneficial as possible for wildlife conservation. The TWW Steering Committee is composed of the American Birding Association,

A CLOSER LOOK AT THE NEW LEGISLATION

Where do Outer Continental Shelf oil and gas leases go now?
The approximately $4 billion in annual revenues goes to the Federal Treasury and is then available for Congressional appropriation, including up to $900 million for the Land and Water Conservation Fund.

How would the new bills change the current system?
Instead of all oil and gas revenues heading to the Federal Treasury, about half of the funds would be directed to the three program titles outlined in the bill. These funds would be available each year without the need for annual congressional approval.

How do the House and Senate versions differ?
The House Version offers the stronger package for wildlife conservation funding at this point.

HR 4717-CARA
40% Federal Treasury
27% Title I: Coastal impact assistance — approx. $1.24 billion
23% Title II: Land-based conservation and recreation (LWCF and urban parks)—approx. $1.06 billion
10% Title III: Wildlife-based conservation and education (Teaming With Wildlife) —approx. $459 million

S 2566-RERA
50% Federal Treasury
27% Title I: Coastal impact assistance–approx. $1.24 billion
16% Title II: Land-based conservation and recreation–approx. $734 million
7% Title III: Wildlife-based conservation and education–approx. $321 million

Who's backing the legislation?
In 1998, co-sponsors included the following members. When the bills are introduced in 1999, the co-sponsor list is expected to be even larger.

House co-sponsors include Congressmen Don Young (R - Alaska), John Dingell (D-MI), Billy Tauzin (R-LA), Chris John (D-LA), Richard Baker (R-LA), Bob Schaeffer (R-CO), Nicholas Lampson (D-TX), Saxby Chambliss (R-GA) and James Barcia (D-MI).

Senate co-sponsors include Mary Landrieu (D-LA), Frank Murkowski (R-AK), Trent Lott(R-MS), John Breaux (D-LA), Thad Cochran (R-MS), Tim Johnson (D-SD), Barbara Mikulski (D-MD), Jeff Sessions(R-AL), Alfonse D'Amato (R-NY) and Max Cleland (D-GA).

American Fisheries Society, International Association of Fish and Wildlife Agencies, Izaak Walton League of America, National Audubon Society, National Wildlife Federation, National Wild Turkey Federation, National Association of State Park Directors, The Wildlife Society and Wildlife Management Institute.

Not every committee member has the same concern with different aspects of such major legislation, but they are united in their priorities for improving Title III, pertaining to TWW.

Under Title III, the legislation recognizes that species not hunted, fished or listed as threatened or endangered fail to receive the attention needed for conservation. It directs funds to states to help conserve a wide variety of wildlife populations and their habitats and to provide more opportunities for wildlife education and recreation. The language does not, at this point, specifically emphasize nongame species.

Both House and Senate versions in their Title III sections dedicate a percentage of federal offshore oil and gas revenues to states for wildlife programs. The House bill dedicates 10% (about $459 million) and the Senate bill dedicates 7% (about $329 million). The two most important changes the TWW Steering Committee wants to see are raising the 7% of the Senate bill to match the House bill's 10% allocation, and assuring that nongame species receive emphasis in both bills.

The success of bringing TWW to the table as part of a major piece of legislation is good news for supporters of the Endangered Species Act. As soon as states have funding for endangered species prevention, they can take a flexible, nonregulatory approach with landowners to protect habitats and prevent losses of species. They can begin the necessary steps they've lacked the funding to do as

well, such as conducting inventories to find out species numbers and habitat preferences.

As much as states have tried to conserve nongame wildlife through funds from tax checkoffs, vehicle license plate fees and lottery dollars, the dollars raised have proved to be inconsistent and far from adequate.

A look at a few statistics indicates an impending train wreck if the status quo for nongame continues. Long-term bird surveys such as the Breeding Bird Survey, Christmas Bird Count and migrations counts are making it clear that in every part of the continent and in most every habitat there are wild bird species suffering significant losses. In the last 30 years, painted buntings have declined by 60%, American goldfinches by 20%, cerulean warblers by 75%, olive-sided flycatchers by 70%, American bitterns by 50%, loggerhead shrikes by 65% and black terns by 60 %.

Beyond birds, a host of other species face similar crises. However, lack of funding has prevented biologists from finding out what's happening on the ground. For example, beyond cataloguing 230 species of amphibians in the continental US, researchers have only piecemeal information on declines and disappearances.

Additionally, dwindling fish and wildlife species and habitats directly affect some of the fastest growing forms of outdoor recreation. Wildlife viewing is the number one outdoor activity in the United States and has become a billion-dollar industry. Nature-based tourism is growing at a higher rate than any other segment of tourism worldwide.

A closer look at three states—New Jersey, Minnesota and Oregon—illustrate how lack of funding is limiting proactive action on behalf of scores of unprotected species and habitats.

New Jersey's Delaware Bay Shore and Cape May Peninsula attract thousands of tourists each fall and spring who come to see bird migrations of 200 songbird and 20 shorebird species, 16 raptor species and four species of owls stopping over to refuel before continuing their arduous journeys. Birders spend over $40 million annually to witness this phenomena, yet, the state has lost 40% of the migratory bird habitat on the lower Cape May Peninsula since 1972. Two years ago, an oil spill threatened beach nester habitat and jeopardized the ability of thousands of shorebirds to reach their Arctic destination in time to reproduce. The ongoing overharvesting of horseshoe crabs along the Delaware Bay continues to threaten this annual migration. Shorebirds en route from South America rely on horseshoe crab eggs to double their weight before continuing to their northern breeding grounds. New Jersey needs TWW dollars to avoid more habitat loss and to protect the migrations that drive the growing tourism industry. State biologists would be able to carry out habitat protection plans that are supported by a diverse coalition of partners, as well as actions developed through the Delaware Bay Shorebird Plan and the state Partners in Flight Plan.

Despite Minnesota's long-standing reputation as a leader in generating voluntary funds for nongame wildlife, the $1.1 million of annual funding falls far short of identified conservation needs. Meanwhile, shallow wetlands and marshes of Minnesota have dwindled by 90% since the state was settled. The remaining 10% harbor a breathtaking assemblage of waterbirds, yet even those wetlands are being lost to drainage, contamination and introduction of exotic species. As the habitat fails, wildlife species head toward the endangered species list. So far, Minnesota has just 7 federally listed species, but its state endangered species list is an alarming 197, with another 242 listed as state species of special concern. By acting now to provide crucial funds, Minnesota has a chance to protect vital habitats and prevent more species from becoming endangered.

In Oregon, conservation funding needs tally more than $11 million when the state has had at the most $1.5 million annually available for nongame wildlife. Oregon Department of Fish and Wildlife can do little to solve problems such as taking action on behalf of the approximately 26% of neotropical migratory birds showing long-term declines, according to Breeding Bird Survey data. The state agency has identified priority habitats requiring conservation plans for their protection, but has lacked funding to complete any of them. The high priority habitats for neotropical migrants include: oak woodlands, steppe grasslands, western Oregon mature forests, and eastern Oregon coniferous forests and riparian areas.

Overall, funding for state wildlife diversity programs add up to approximately $100 million. The International Association of Fish and Wildlife Agencies estimates $1 billion in funding needs, based on state projections. However, an increase of $459 million dispersed among the states would go a long way toward establishing the other half of the endangered species equation—keeping species off the list in the first place.

For more information on the new legislation, the original TWW proposal and a complete coalition list that includes your state's coalition leader, visit the web site www.teaming.com, *email teaming @sso.org or call (202)624-7890.*

Legislative News

New Mexico Legislation to Remove State Protection of Endangered Species

According to an alert by the Southwest Center for Biological Diversity (Dec. 15, 1998), New Mexico State Senator Tim Jennings has announced that he will introduce legislation this session that would kill all state protection for endangered species. Jennings has proposed the elimination of the state's Wildlife Conservation Act that provides protection for 119 endangered or threatened species. He also proposes to eliminate the state's Conservation Services Division that oversees all non-game programs.

Clinton Conservation Plan to Purchase Land

Pres. Clinton asked Congress to spend $1 billion in FY '00 to buy more land for national parks and other conservation projects, such as purchasing private holdings within national forests and wildlife refuges (Greenwire, 1/12). In addition to expanding federal land purchases by $442 million, the initiative would give $588 million to state and local governments, private land trusts and other nonprofit groups to buy land and save endangered species and their habitat. And the proposal would create an automatic financing mechanism that would help guarantee a "steady flow" of funds for conservation.

Oregon Executive Order to Save Salmon

Oregon Gov. John Kitzhaber signed an executive order committing all state agencies to helping save every salmon species in the state (Greenwire, 1/5). Although directly ordering government agencies to protect the state's dwindling salmon species is outside of Kitzhaber's legal authority, he can establish goals for agency directors to embrace. And department heads and legislative leaders say they will support the first-of-its-kind plan. (Jonathan Brinckman, Portland Oregonian, 1/10).

NMFS Decides on Separate Listing of Columbia River Cutthroat Trout

Fishery managers are asking the National Marine Fisheries Service (NMFS) to separate Twin Harbor cutthroat trout from their lower Columbia River counterparts in an attempt to avoid a possible endangered species listing. The managers say the two species are separated geographically to the point that an interchange between stocks is "unlikely." And they note that there is not enough genetic information to conclude the stocks are similar. The NMFS is expected to make a decision on the proposal this month (Neil Pascale, Aberdeen [WA] Daily World, 1/9).

Information for Legislative News is collected from Greenline, Greenwire and Wildlines

The *Endangered Species UPDATE* is interested in your work!

The *UPDATE* is looking for quality papers on the science and policy of endangered species recovery.
We are specifically interested in papers focused on marine conservation.

If you would like to submit a paper to the *Endangered Species UPDATE,* please call (734) 763-3243 or e-mail esupdate@umich.edu.

News From Zoos

Rhino and tiger labeling law signed

Since 1970, more than 90% of the world's rhinos have disappeared, leaving fewer than 14,000 in the wild today. Likewise, the wild tiger population has declined from around 100,000 at the turn of the century to fewer than 6,000. This fall, President Bill Clinton signed the Rhinoceros and Tiger Product Labeling Act which bans the sale of products labeled as containing tiger or rhino parts. The act, an amendment to the Rhinoceros and Tiger Conservation Act of 1994, closes a loophole in the Endangered Species Act, and gives the U.S. Fish and Wildlife Service (FWS) authority to take any product that claims to contain rhino or tiger parts off store shelves. Before the amendment was passed, the FWS had to prove that any product claiming to have rhino or tiger parts actually did—and the only way to prove it was through costly and inaccurate forensic tests.

Although the United States has listed tigers and rhinos for more than 20 years under the ESA and is a member of CITES, a significant trade of traditional Chinese medicine products labeled as containing tiger and rhino parts has continued. A study released earlier this year by the World Wildlife Fund's wildlife trade monitoring program found that many products are more openly available on store shelves in the United States than in China.

880-pound sunfish back in the ocean

Last November, a chopper airlifted a sunfish from the Monterey Bay Aquarium in California, and took it out to sea in a special sling. The Aquarium had to return the sunfish to the Pacific Ocean because it had gotten too big for its million-gallon tank. When the creature arrived at the aquarium last year, it weighed just 57 pounds and measured 41 inches. In just 14 months, it grew to 880 pounds and more than six feet long—on a diet of squid, shrimp, fish puree and a nutrient-enriched gelatin. In the wild, sunfish reach 3,300 pounds.

Christmas in the hot tub

Two years ago, the Detroit Zoo installed a natural looking tub that simulates hot springs used by wild snow monkeys. Snow monkeys are the only primates besides humans willing to live in snowy climates. Bathing, however, is not an instinctive trait. In the wild, each generation learns from its elders, and even then not all members of the population partake of the warm waters. At the Detroit Zoo, it was the younger monkeys who were the bravest and decided to test the waters. So far, only the 1-3 year olds have taken a dip, but their elders might learn from them. Japanese macaques are a threatened species. The growing human population is encroaching on their territory, and the macaques are losing precious habitat on their islands north of Japan.

Web site lets students track Cameroon elephants

A new Web site developed by the North Carolina Zoo uses maps, daily diaries, photos and sound bites to let Web users follow an elephant tracking expedition in Cameroon in February. Bankrolled with $30,000 in private contributions, the Web site is part of a new involvement by the N.C. Zoo in preserving animals in their natural habitats and educating people about the conflict over dwindling space and resources.

Lesson plans linked to the elephant project appear on the Web site courtesy of seventh-grade public school teachers in Chatham County. Math lessons ask students to calculate the economic incentives for elephant poachers. Language-arts lessons get students to respond to an elephant poem. Science lessons focus on the ecosystem, and social-studies lessons look at Cameroon society. The culminating assignment will be to design an elephant management plan.

North Carolina's Department of Public Instruction will provide a link from its Web site, as will the American Zoo and Aquarium Association and at least seven zoos throughout North America, zoo officials said. The site is up and running but will allow more interaction during the expedition, Feb. 19 through March 5. *www.nczooeletrack.org*

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

Bulletin Board

Conference Announcement

The International Symposium on Society and Resource Management will be an interdisciplinary forum focussed on the interactions between society and natural resources for researchers and practitioners to discuss research and management strategies. The symposium will be held 7 - 10 July 1999 at the University of Queensland and Griffith University, Brisbane Australia. For further information, browse their web site at *www.geosp.uq.edu.au/issrm99* , or write to Sally Brown Conference Connections, PO Box 108 Kenmore, Brisbane , Australia 4069.

American Peregrine Falcon Celebration

The Peregrine Fund, the Santa Cruz Predatory Bird Research Group, The Raptor Center, and Canadian friends announce the North American Peregrine Falcon celebration to be held at the Peregrine Fund's World Center for Birds of Prey, Boise, Idaho on 20 and 21 August 1999. Everyone who has participated in the species' recovery in North America is invited. This is a celebration, not a scientific conference, and families are invited. The Peregrine Fund is trying to contact, and seeking names and addresses of, those who may wish to attend. Please write, call, or e-mail names and addresses to Peregrine Celebration, 566 W. Flying Hawk Lane, Boise, Idaho 83709, telephone (208) 362-3716, fax (208) 362-2376, or e-mail tpf@peregrinefund.org. Information will be sent to you. Please pass the information on to others you know who helped with the Peregrine Falcon restoration.

HCP Research

The National Center for Environmental Decision-Making Research (NCEDR) has embarked upon a study of decision-making processes used in developing conservation plans under the Endangered Species Act. These plans—habitat conservation plans, safe harbor agreements, and Non-section 10 conservation agreements—are a relatively new and novel collaborative approach to natural-resource decision making. For more information visit their web site at *www.ncedr.org*.

Announcements for the Bulletin Board are welcomed.

Endangered Species UPDATE

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