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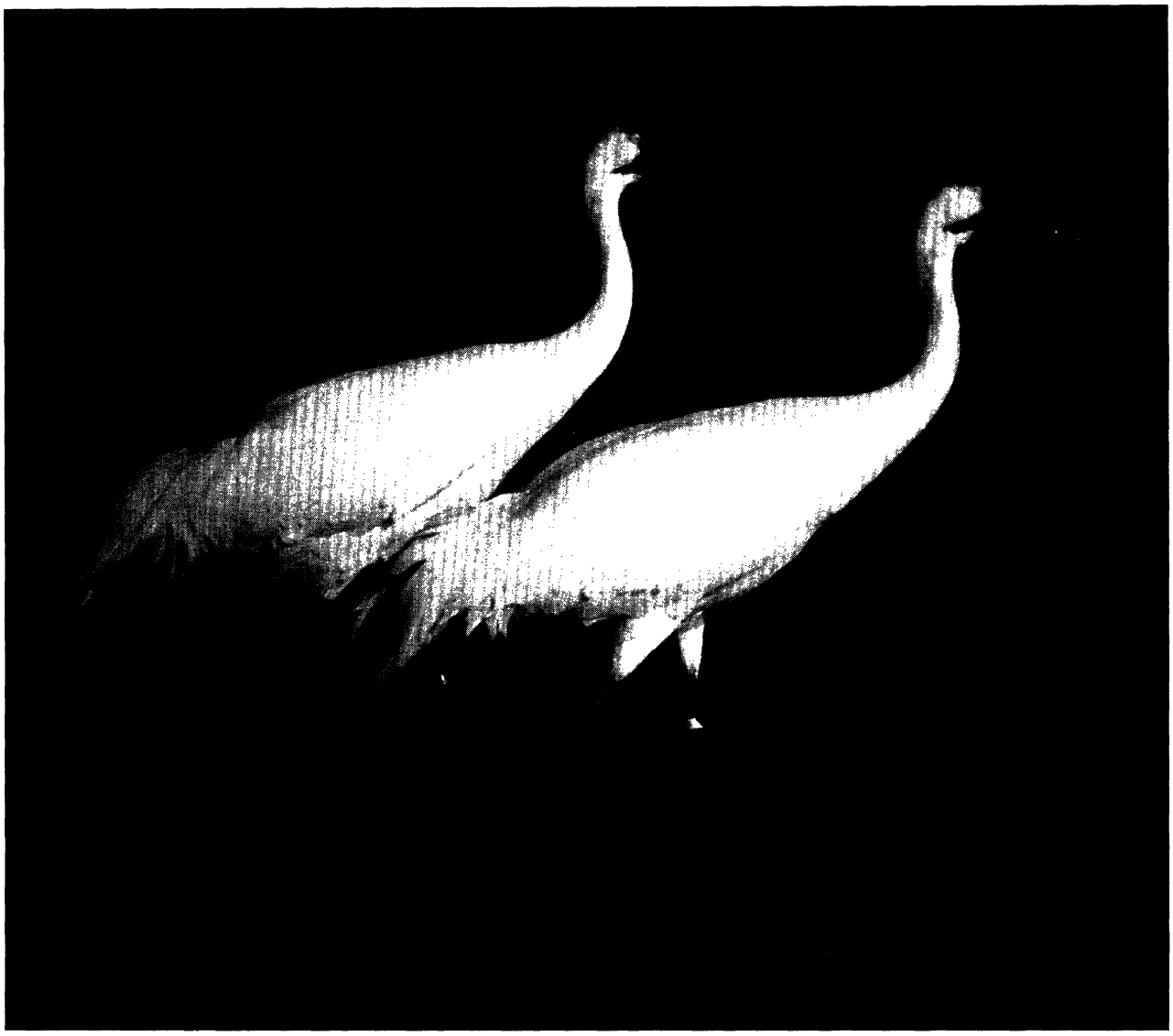

In this Issue

A Whooping Crane Reintroduction Project on the Canadian Prairies: Identifying Relevant Issues Using Expert Consultation

by

Peter L. May and
J. David Henry

Introduction

The whooping crane (*Grus americana)* is an internationally recognized symbol of wildlife conservation, classified as an endangered species in both Canada and the United States. Currently, the only wild breeding population of whooping cranes migrates between Wood Buffalo National Park in the Northwest Territories and Aransas National Wildlife Refuge (NWR) in Texas (Kuyt 1987). Aided by the efforts of dedicated professionals and volunteers, this population has increased in number from a low of 16 in 1941 to 145 in 1991, with a reduction in number to 131 in the fall of 1994 (Doughty 1989; WCCA 1992, 1993; Stehn 1994). While the slow growth in the numbers of the Wood Buffalo-Aransas flock is encouraging, these birds lead a precarious existence. Of constant concern is the possibility that adverse environmental conditions, such as a major storm or oil spill, could seriously reduce the existing population.

One way to potentially increase and stabilize the viability prospects of the species would be to establish a second breeding migrating flock with different summering and wintering areas than the Wood Buffalo-Aransas population, as recommended by the Canadian Whooping Crane Recovery Plan (Cooch et al. 1988). The Plan recommends changing the status of the whooping crane from "endangered" to "threatened" upon establishment of breeding populations of 40 pairs in the Wood Buffalo-Aransas flock and 25 nesting pairs in each of two other wild populations in North America (Kuyt 1987). The U.S. Whooping Crane Recovery Plan similarly recommends establishing two additional populations but does not specify Canada as being one of those locations (Smith et al. 1986).

Canada's prairie provinces are possible sites for the establishment of an additional migratory population. They contain critical whooping crane staging habitat used by birds migrating to and from Wood Buffalo National Park each year. In addition, based on historic breeding records of the species in prairie wetlands, the prairies may be a logical location for the establishment of a second Canadian breeding flock (Hjertaas 1989). Canada's prairies have distinct advantages as a release area as compared to other areas in Canada. Despite the fact that over a quarter of the wetlands on the Canadian prairies have been drained (World Wildlife Fund 1988), many of the wetlands in the historic breeding range of the whooping crane remain in existence, and some of these are carefully managed and have protected status.

Because the Canadian prairies are a potential location for a second migratory flock of whooping cranes, this study was undertaken to identify potential problems and possible solutions related to establishing such a population. Through a synthesis of literature and expert opinion, strategies to overcome the problems were developed. The study became an instrument through which interested management agencies and members of the public could discuss whether to pursue such an initiative.

Methodology

During the summer and fall of 1991, contact was made with 36 individuals considered to have expertise in whooping crane management or a related field. Twenty-five persons contributed either by letter, telephone interview, or meeting. This study analyzed these opinions and together with the findings of published research, identified ten problems and possible solutions in establishing a second migratory flock of whooping cranes on the Canadian prairies.

The study built on results of previous experiments done with whooping cranes in Idaho and Florida. The first attempt was an innovative experiment initiated in 1975 at Grays Lake NWR, Idaho, in which the eggs of some resident greater sandhill cranes (*Grus canadensis tabida*) were replaced with whooping crane eggs in the hopes that the foster parents would hatch and rear the endangered whooping cranes (Smith et al. 1986). Unfortunately, the experiment was discontinued in 1991 due to the failure of the whooping cranes to breed successfully (USFWS 1989). The second experiment is currently attempting to establish a non-migratory flock on the Kissimmee Prairie in central Florida, using chicks from captive flocks. As of fall 1994, thirty-three captive-bred whooping cranes have been moved from the International Crane Foundation in Wisconsin and Patuxent Wildlife Research Center in Maryland to the Kissimmee Prairie. However, 70% of the releases in 1994 were lost due to bobcat predation (Nesbitt 1994).

Because many endangered species recovery efforts are characterized by a multi-agency, multi-interest group team project, many of the issues raised in this study apply to other endangered species programs as well.

Results

The previous experiments in Idaho and Florida were used to identify some of the problems that may be encountered in the creation of a sec-

A juvenile whooping crane in flight. Photo by Rod C. Drewien.

ond Canadian migratory flock. Potential solutions to some of the problems, or parts thereof, were developed whenever possible. Additionally, gaps in knowledge that need to be filled were identified so that more informed decisions can be made. The problems identified and potential solutions or information needed are briefly presented here but are not listed in order of priority. The issues are grouped into two broad areas of focus: (i) Protection of the Wood Buffalo-Aransas migratory population; (ii) Establishment of a new population. For a more detailed examination of the specific issues, refer to May (1992).

Protection of the Wood Buffalo-Aransas migratory population

Since the Wood Buffalo-Aransas population is the only existing breeding population, it must not be detrimentally affected by a new flock. Both the Canadian and United States Whooping Crane Recovery Plans reflect this concern by stating that additional wild flocks must be "separate" from the existing flock (Smith et al. 1986; Cooch et al. 1988), implying no contact between flocks. It should be noted, however, that some responses from experts interviewed as part of this study did not agree with this concept.

Introduction of Disease into the Existing Flock

The primary area of concern with respect to protecting the Wood Buffalo-Aransas flock was the introduction of disease into the existing flock. Whooping cranes are known to be susceptible to a number of avian diseases including avian tuberculosis, avian cholera, eastern equine encephalitis, and disseminated visceral coccidiosis. Due to the close interaction between whooping cranes, sandhill cranes and waterfowl, some other diseases known to affect these birds are also of concern in whooping crane management, including avian botulism (Type C), inclusion body disease, and mycotoxicosis (Brand 1991; Carpenter 1991).

At this time the disease risk to whooping cranes of the Wood Buffalo-Aransas flock is not fully understood. These birds may be presently exposed to many or all of these dis-

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Cover: Whooping Crane (*Grus americana*). Photo by John Jefferson.

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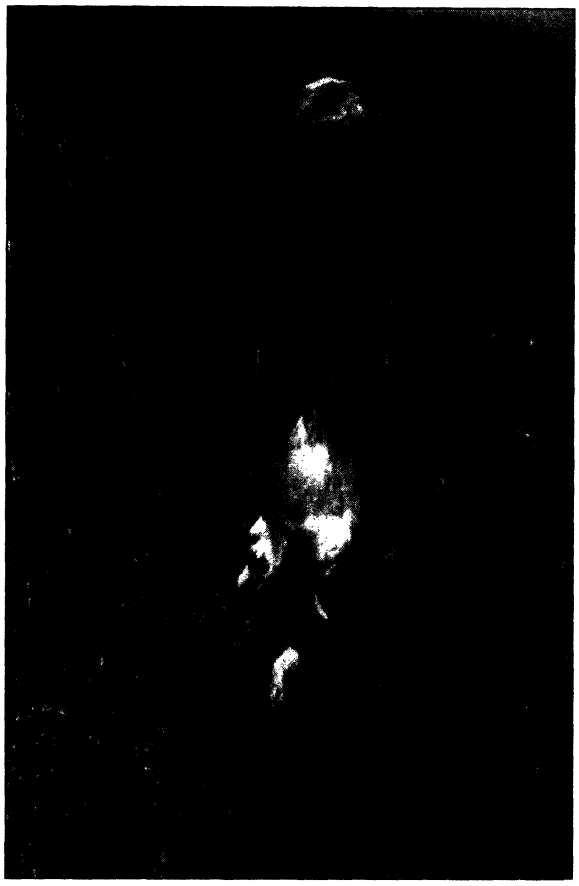

A 52 day old whooping crane chick raised by sandhill parents in Grays Lake National Wildlife Refuge. Photo by Rod C. Drewien.

eases through contact with other avian species and other organisms. If this is true, the "disease risk" factor of establishing a migratory flock of whooping cranes on the Canadian prairies may be less of an issue. Immunological research is needed to establish what diseases the Wood Buffalo-Aransas cranes are exposed to, and to assess the disease risk factors that are at stake in establishing an introduced population of cranes on the Canadian prairies.

In addition, there will remain the problem of keeping a new flock as free from disease as possible. One of the first steps is to manage the health risks to the whooping cranes in the captive propagation facilities prior to release. Such a program must ensure that introduced individuals are vaccinated and certified as being disease-free (B. Johns, pers. comm.). Inoculating the birds in the wild against potential diseases may be another option (J. Lewis, pers. comm.). However, there are not vaccines for all of the key diseases affecting whooping cranes. Once the birds have been released, there is little that can be done except to monitor potential use areas for outbreaks and to manage those situations as they arise.

Analyses of other responses suggested that this issue may be manageable. Two strategies were proposed: (i) reintroduce birds only in areas that are geographically separate from the Wood Buffalo-Aransas population or, (ii) reintroduce in the flyway but manage the problem by finding different wintering and staging areas than those used by the Wood Buffalo-Aransas flock. A release experiment with sandhill cranes at Seney NWR in northern Michigan has shown that the majority of reintroduced sandhill cranes return to their natal area each summer (Urbanek 1990). More data is necessary to determine if a similar experiment with whooping cranes will provide similar results; if so there may be no overlap of birds on breeding grounds between a new flock and the Wood Buffalo-Aransas flock.

Behavioral Changes in the Existing Flock

The second concern related to protecting the Wood Buffalo-Aransas population was the potential for reintroduced cranes to exhibit different behaviors than those in the existing population. Some potential contributing factors include:

- the effects of dominant males influencing movement patterns of females should the two flocks come into contact
- the potential effects of differences in vocalizations between captive-reared birds and wild birds
- the effects on the movement patterns (i.e., migratory patterns, use of summering and wintering areas, choice of breeding areas) and timing of migration should there be associations between released, captive-reared whooping cranes and those in the existing flock. Changes in timing of migration could result in conflicts related to different weather conditions or increased hunting pressures.

The potential significance of these scenarios is unknown. The issues were not developed in detail for this study (refer to May 1992).

Establishment of a New Population

Along with concerns related to protection of the existing migratory flock, the second major area of focus relates to factors involved in establishing a new population.

Location of the Reintroduction Program

For both the Idaho and Florida whooping crane reintroduction experiments, the specific reintroduction areas were carefully chosen (Smith et al. 1986; Bishop 1988). Without suitable habitat, translocations historically have a low chance of success (Scott and Carpenter 1987; Griffith et al. 1989; Kleiman 1989). A thorough review of studies concerning prairie areas historically used by wild whooping cranes for breeding as well as those currently used during migration is needed (Didiuk 1976; Gollop 1978; Stephen 1979; Johns 1986, 1987; Hjertaas 1989). This effort should provide a good initial search model for suitable habitat as well as expand our understanding of what constitutes productive whooping crane breeding habitat. Substantial protected wetland areas exist in parts of Saskatchewan (D. Hjertaas, pers. comm.). Once areas with suitably protected habitat are identified, thorough habitat evaluations using objective criteria will be required (R. Drewien, pers. comm.).

Sources of eggs or birds for reintroduction

There are currently three poten-

tial sources of whooping crane eggs or chicks: Wood Buffalo National Park in the Northwest Territories, the International Crane Foundation (ICF) in Wisconsin, and Patuxent Wildlife Research Center in Maryland. A fourth institution, the Calgary Zoo's Devonian Research Conservation Centre, holds 21 young whooping cranes with the goal of establishing a whooping crane breeding facility (Barnett 1993; Olsen 1994). The hope is to use birds born in Calgary to establish a second flock migrating between a yet-to-be-determined site on the Canadian prairies and a U.S. wintering ground (Barnett 1993). The low supply of whooping cranes and their eggs will continue to be a major obstacle in limiting experimentation to determine the best reintroduction sites and develop the best reintroduction methods (R. Urbanek, pers. comm.). Actions suggested by some respondents are to: (i) continue egg pickup at Wood Buffalo National Park; (ii) stabilize the captive populations and maintain healthy birds for release; (iii) maintain adequate funding for captive propagation; (iv) supply eggs for the Florida release; and, (v) supply eggs for the next release (J. Lewis, C. Mirande, pers. comm.). However, eggs will likely not be made available until the combined surplus of eggs from the captive breeding centres, beyond what is needed to sustain a safe growth rate for the captive population, is enough to support a reintroduction (S. Swengel, pers. comm.).

A radio transmitter being applied to a young whooping crane. This and other similar experiments provided data on whooping crane migration, food, and habitat. Photo by Rod C. Drewien.

Method of Inducing Migration

In 1991, the decision was made to stop sending eggs to Idaho for that reintroduction experiment because of the inability of those whooping cranes to breed (USFWS 1989). The demise of cross-fostering as a method for establishing a migratory population led respondents to indicate that the development of a technique that enables whooping cranes to breed in new areas and migrate successfully is a priority. A technique currently in development is the use of the isolation-rearing gentle release technique at Seney NWR in northern Michigan (Urbanek 1990). This method involves rearing the birds such that their habituation to humans is minimized. Through the use of hand puppets which simulate crane heads, the young cranes are taught not to depend on humans for protection or provision of food. In addition, this reduces the likelihood that the cranes will imprint sexually on species other than their own (Urbanek 1990). Early work was conducted using sandhill cranes. The hope is to transfer the technique first for use with red-crowned cranes (*Grus japonensis*), a species morphologically similar to the whooping crane, and then eventually to whooping cranes. The applicability of this technique for use with whooping cranes is not known.

Size of the Reintroduced Population

Both the Canadian and U.S. Recovery Plans have established the target population for new flocks at 25 breeding pairs (Smith et al. 1986; Cooch et al. 1988). Using the survival rates in the experimental flock in Idaho, Garton et al. (1989) determined that if 30 eggs were transferred into the population each year, in the best case scenario the flock would reach 25 breeding pairs in 30 years; the worst case scenario projected 6 pairs in 50 years. The survival rates in the Idaho population are poorer than those in the Wood Buffalo-Aransas population and a new flock in a different area may have different survival rates again. A minimum of 10-20 birds may need to be released per year for at least five years in an area where the survival rates are high (R. Drewien, pers. comm.). As discussed earlier, these are more birds than can currently be supplied.

Project Funding

The Grays Lake experiment, which ran from 1975 to 1989, cost Canada and the United States over two million dollars (USFWS 1989). As well, substantial funds are required to finance captive propagation facilities ($200,000 per year as suggested

in Smith et al. 1986). Three major financial issues arise at the pre-planning phase of a reintroduction: (i) how much money is needed to launch a reintroduction? (ii) how long will the reintroduction project need funds? and, (iii) what are some possible sources of this funding? Due to the preliminary nature of this study, these questions were largely unanswerable. However, some basic information is presented here to address these questions. Using information from Urbanek's study, a reintroduction could be performed for approximately $50,000 (U.S.) per year (R. Urbanek, pers. comm.). This figure does not account for all preliminary studies leading up to a release, nor does it include any costs associated with captive propagation facilities or transporting wild birds or eggs from Wood Buffalo National Park or captive flocks. The cost of feasibility studies must also be factored into the equation. Smith et al. (1986) estimated that in 1987 pre-release banding and migration studies with sandhill cranes and habitat evaluations in potential release areas would cost $150,000 (U.S.). Because a successful release program may last many years (the Grays Lake experiment lasted 13 years), a long-term financial commitment and strategy will be needed. With the large amount of funds required, it is likely that a number of organizations will need to fund cooperatively a reintroduction project on the Canadian prairies.

A regiment of swimming enables captive born whooper chicks to exercise and grow normally. Photo by Robin Doughty.

Impact of the Project on Flyway Management

Another potential problem identified in this study was the impact of a new flock of whooping cranes on the management of the Central Flyway. It was suggested that to meet the requirements of the U.S. Endangered Species Act and gain support of the Central Flyway states for the proposed release, the following should be done: (i) complete the required environmental assessment; (ii) designate the release as "experimental non-essential" and publish the selected designation in the Federal Register; and, (iii) work with the Technical Committee of the Central Flyway to gain their support for releases and to minimize the impact on hunting of snow geese and sandhill cranes, the primary "look-alike" species (J. Lewis, pers. comm.). Hunting considerations are very important in whooping crane management, because hunting has been a recognized cause of whooping crane mortality (Smith et al. 1986). To alleviate this concern, several initiatives need to be undertaken: hunter and public education, the designation of "critical habitat" along the migratory path of the Wood Buffalo/Aransas population, and detailed Contingency Plans to reduce the threat of hunting on whooping cranes.

Conclusions

A number of significant gaps in knowledge (briefly identified in this paper) have become evident and need to be filled before a reintroduction can be attempted. In the meantime, whooping cranes must be managed despite the fact that these information gaps exist. However, the gaps are significant enough to warrant further research before options as to the suitability of different reintroduction sites can be assessed.

As a result of this literature review and survey of expert opinion, there are two recommendations that we put forward regarding future whooping crane management and research efforts. We believe that these recommendations apply to other endangered species recovery programs as well. The recommendations are:

(1) Recovery Teams must determine and articulate the degree of risk they are willing to consider in future management and research programs. Once this has been accomplished, the risks of various management options should be empirically determined and evaluated against the stated degrees of risk tolerance, and then the Teams can decide accordingly and present decisions for public review. This study showed that the risks of some options, such as creating another flock of whooping cranes on the Canadian prairies, are uncritically assumed to be large. These assumptions may or may not be true. In addition, Teams must not assume that the status quo is a no-risk situation. Lack of empirical evidence should not be grounds for a management option to be dismissed;

it should dictate that more empirical evidence needs to be collected. If the Recovery Teams are committed to establishing new flocks of whooping cranes, then efforts in these directions should be carried out. The lack of evidence that a release on the Canadian prairies would be a risk to the Wood Buffalo-Aransas flock is not logical grounds for dismissing this as a potential management option. This is particularly true given the length of time normally required to prepare release programs, and to evaluate them once they start.

(2) The deliberations of the Recovery Teams should become the focus of more public interest and involvement. We believe there are three reasons for this: (i) opening up the process to public review may provide a significant amount of useful input; (ii) it may serve as a useful avenue for addressing problems that are politically charged because internal issues will have to be resolved before the public becomes involved; and, (iii) Recovery Teams use public funds. As a result, more people in the scientific community and general public may wish to constructively contribute ideas or review proposals by the Recovery Teams. Despite some potential problems caused by increased openness to the public, it may provide untold benefits to both aiding whooping crane recovery efforts and providing effective public education with respect to whooping cranes specifically and endangered species in general.

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For more information on John Jefferson's photography see page 10.

Report from Washington

Supreme Court Rules Habitat is Home *Sweet Home* for Endangered Species

By Wm. Robert Irvin

In a closely-watched decision, the U.S. Supreme Court handed supporters of endangered species conservation a much-needed victory on June 29, 1995 when the Court upheld regulations under the Endangered Species Act (ESA) prohibiting significant habitat destruction. The high court ruling set the stage for a heated battle in Congress where opponents of endangered species protection immediately declared their intent to seek amendments to the ESA limiting its reach.

The Timber Industry's Challenge

The Court's decision came in *Babbitt v. Sweet Home Chapter of Communities for a Great Oregon*, a suit brought by the timber industry. At issue in the case was a Department of the Interior regulation defining prohibited "harm" to endangered species. Section 9(a)(1)(B) of the ESA makes it unlawful for anyone to "take" endangered species. The ESA defines "take" in Section 3(18) as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." In 1975, the Department of the Interior issued a regulation, set forth at 50 C.F.R. § 17.3, further defining "harm" as:

an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering.

In the midst of controversies over conservation of old-growth forest habitat for the threatened northern spotted owl in the Pacific Northwest and the endangered red-cockaded woodpecker in the Southeast, a coalition of timber industry groups filed suit in U.S. District Court in Washington, D.C. challenging the regulation. Timber industry lawyers argued that the Interior Department exceeded its statutory authority under the ESA by defining harm in the regulation to include significant habitat modification or destruction.

The timber industry's challenge was rejected in 1992 by the U.S. District Court for the District of Columbia. On appeal, the District Court's decision was initially upheld by the U.S. Court of Appeals for the District of Columbia Circuit in 1993. On rehearing in 1994, however, the Court of Appeals reversed itself, ruling that Congress intended "harm" to be narrowly construed, applying only to actions involving the direct application of force to an individual of an endangered species. In other words, cutting down a Douglas-fir tree in which a spotted owl is actually roosting at the time the tree falls would constitute prohibited harm, while clearcutting the surrounding ancient forest habitat on which the owl depends for feeding and reproducing would not be prohibited.

The D.C. Circuit's opinion contradicted an earlier decision by the U.S. Court of Appeals for the Ninth Circuit, *Palila v. Hawaii Dept. of Land and Natural Resources*, 852 F. 2d 1106 (1988). In that case, the Ninth Circuit ruled that the State of Hawaii's maintenance of an exotic mouflon sheep herd for sport hunting was destroying the forest habitat of the Palila, an endangered bird, harming the species and constituting a prohibited take under the ESA. To resolve the conflict between the Circuits, the Supreme Court agreed to hear the *Sweet Home* case.

The Supreme Court's Opinion

By a vote of 6 to 3, the Supreme Court upheld the Interior Department regulation, reversing the D.C. Circuit. The majority opinion, written by Justice Stevens and joined by Justices Kennedy, O'Connor, Souter, Ginsburg, and Breyer, upheld the regulations on three grounds.

First, the Court found that the regulation is consistent with the plain meaning of "harm," which is to cause hurt or damage, to injure. The majority concluded that the plain meaning of harm, like the regulatory definition, encompasses habitat destruction which results in actual injury or death to members of an endangered species.

Second, the Court found that the regulation is supported by the broad purposes set forth in Section 2(b) of the ESA, to protect endangered species and the ecosystems upon which they depend. The Court reiterated its landmark decision in *Tennessee Valley Authority v. Hill*, 437 U.S. 153 (1978), the famous snail darter case, that Congress intended to provide comprehensive protection to endangered species under the ESA.

Third, the Court found support for the regulation in reauthorizations by Congress of the ESA after its original enactment in 1973. In particular, the Court found that Congress's 1982 amendment of the ESA adding Section 10(a)(1)(B) authorizing incidental take permits indicated that Congress understood the ESA to prohibit indirect as well as deliberate take of endangered species, in accordance with the challenged regulation.

Justice O'Connor wrote a concurring opinion emphasizing that, while the harm regulation may be overbroad in some instances, in general, the regulation's protection of habitat is a valid interpretation of the ESA's purposes. Recognizing the importance of habitat protection to endangered species conservation, Justice O'Connor wrote: "One need not subscribe to theories of 'psychic harm,'. . . to recognize that to make it impossible for an animal to reproduce is to impair its most essential physical functions and to render that animal, and its genetic material, biologically obsolete. This, in my view, is actual injury." Justice O'Connor noted,

however, that Congress may revisit the issue and the Interior Department may choose to narrow the regulation of its own accord.

Justice Scalia, joined by Chief Justice Rehnquist and Justice Thomas, penned a sharply worded dissent, arguing that the ESA only prohibits hunting and killing of endangered animals and provides federal lands for endangered species conservation and federal funds to acquire private lands for that purpose. By extending the ESA's reach beyond those protections, the regulation "imposes unfairness to the point of financial ruin—not just upon the rich, but upon the simplest farmer who finds his land conscripted to national zoological use."

Winning the Battle But Losing the War?

Far from settling the debate over the ESA, the Supreme Court's *Sweet Home* decision has fanned the flames of controversy which threaten to engulf the ESA in the Congress. Reacting to the decision, Congressional opponents of the ESA vowed to include a narrow definition of harm in any reauthorization of the law. Senator Dirk Kempthorne (R-ID), Chairman of the Environment and Public Works Committee's Subcommittee on Drinking Water, Fisheries and Wildlife, said, "The court's decision confirms my contention that the Endangered Species Act must be reformed and that Congress must get it done this year." Similarly, Representative Richard Pombo, Chairman of a House Resources Committee Task Force on the ESA, said that the Court's decision "demonstrates the need for reform of the Endangered Species Act."

Even before *Sweet Home* was decided, Senators Slade Gorton (R-WA) and Bennett Johnston (D-LA) introduced the Endangered Species Act Reform Act of 1995 (S. 768), which would define harm under the ESA to prohibit only "direct action against any member of an endangered species of fish or wildlife that actually injures or kills a member of the species." Thus, under the Gorton-Johnston bill, which was drafted for the Senators by some of the same timber industry lawyer-lobbyists who filed the *Sweet Home* case, one could chop down every tree in the forest except the one in which a spotted owl is sitting without violating the ESA.

Conservationists have vowed to fight the Gorton-Johnston bill and any other attempts to weaken habitat protection under the ESA. In their view, Congress exhibited remarkable foresight in 1973 when it recognized in the ESA that protecting ecosystems is essential to endangered species conservation, and the Supreme Court's decision in *Sweet Home* supports that view. Adding further weight to the importance of protecting habitat is the recently announced conclusion of the National Research Council in its report, *Science and the Endangered Species Act*, released on May 24, 1995, that "habitat protection is a prerequisite for conservation of biological diversity and protection of endangered and threatened species."

A huge battle over the ESA's ability to protect endangered species habitat appears to be looming. The battle will be hard-fought, with the outcome uncertain. For the time being, however, the Supreme Court's *Sweet Home* decision has provided endangered species with a safe haven.

Wm. Robert Irvin is an attorney and Deputy Vice President for Marine Wildlife and Fisheries Conservation at the Center for Marine Conservation in Washington, D.C. Along with Patrick A. Parenteau of the Vermont Law School's Environmental Law Center and Timothy Eichenberg, Program Counsel at the Center for Marine Conservation, Irvin filed a friend of the court brief in the Supreme Court in the *Sweet Home* case. The brief, filed on behalf of 14 prominent scientists, argued that habitat protection is essential to endangered species conservation.

Report from the Field

Howler Monkeys Appear to be Preadapted to Cope With Habitat Fragmentation

By Clara B. Jones

Howler monkeys (*Alouatta*), "arboreal folivores," deserve their descriptive name. The early naturalists who studied them were understandably impressed by the howling male vocalizations employed in the assignation and defense of space. Howls may also be attractive to females and may be heard by conspecifics as far as 5 km away. The genus *Alouatta*, which is distributed throughout an area of approximately 11.5 million square kilometers from southern Mexico to the eastern coast of Brazil, includes several threatened and endangered species (Groves 1993). Although howlers disappear where deforestation removes habitat patches completely, they are known to be exceptionally competent in coping with habitat fragmentation (Robinson and Ramirez 1982), perhaps more so than any other Neotropical primate species. This report proposes to explain howlers' success in coping with environmental disturbance and suggests that the hypothesized factors may facilitate viability analyses of other primate taxa.

Studies of the genus *Alouatta* have identified several features of howler monkeys which would contribute to success under heterogeneous conditions. Habitat disturbance and subsequent fragmentation create a spatially varying landscape which may stress a species' capacities to balance reproduction and mortality. Certain authors (e.g., Glander 1980; Jones unpublished) have determined that the reproductive rate (r) of mantled howler monkeys (*A. palliata* Gray) living in disturbed habitat is greater than zero, suggesting a flexible response to forest fragmentation and the ability to recover from periods of population decline.

Similarly, several students of howlers have shown that these monkeys have highly effective mechanisms of dispersal (e.g., Jones 1980) which may compensate for spatial discontinuity by minimizing the consequences of fragmentation. Colonization effects which are

An adult female howler monkey holding a leaf in her hand. Leaves may provide howlers with a stable food resource that facilitates resistance to habitat disturbance and fragmentation. Photo by Clara Jones.

thought to control processes of metapopulations appear to be highly efficient mechanismsof survival and reproductive success in howlers.

Malmgran (1979) found that mantled howlers exhibit high levels of genetic monomorphism, and James (1992) reached the same conclusion for other species of howlers. Low levels of genetic variance suggest that howler populations have passed through a historical "bottleneck", indicating that howlers or ancestors of howlers, perhaps during the Pleistocene, have experienced fluctuating populations or habitat fragmentation in the past. This trait may "buffer" howlers from environmental disturbance and contribute to their defense against extinction.

Another trait of *Alouatta* behavior which may preadapt them to disturbed conditions is their habit of eating leaves (folivority). Leaves are an abundant and stable resource relative to flowers, fruit, and insects. Indeed, just as Terborgh (1986) has called frugivores "extinction prone," one may label most folivores "survival prone." *Alouatta* reproductive rate, colonization capacities, and genetic systems may combine with folivorous habits to produce significant resistance to the detrimental effects of forest fragmentation. For instance, the varying abundance and dispersion of leaves in time and space may explain the labile system of subgrouping in howlers in which subgroup size is negatively and significantly correlated with the frequency of subgroups of a given size ($r_S = -0.99$, $P \leq 0.01$). Thus, subgroups of 3 individuals, the size of a typical colonizing propagule, are much more likely to occur than subgroups of 12 individuals. This flexible organization of social structure appears to be related to the folivorous behavior of howlers and may facilitate the exploitation of patchy resources such as those found in disturbed conditions.

The traits of howler monkeys that I have discussed may be employed as an assay in the study of other primate species to estimate the resilience to environmental regimes that render taxa "extinction prone." Thus, species with high reproductive rate, high genetic monomorphism, good colonizing abilities, and high levels of folivority are expected to be inherently good survivors. Some combination or all of these four variables may predict which primate taxa will prove most resistant to the deleterious effects of habitat fragmentation. Although no arboreal species can be expected to survive in the face of complete deforestation, howlers exhibit behavioral, physiological, and genetic coping mechanisms that facilitate their survival in the current biodiversity crisis.

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Bulletin Board

Third International Large Brachiopod Symposium

After meeting in Europe in 1989 and 1993, the third meeting of workers interested in all aspects of the biology and conservation of the large brachiopod Crustacea (Anostraca, Conchostraca, and Notostraca) will be held in San Diego, CA, July 14-18, 1996. The theme of the meeting is "Understanding and Conserving Large Brachiopod Biodiversity." This is an especially appropriate theme for this meeting because five large brachiopods endemic to California are listed under the Endangered Species Act and a sixth is a candidate species. The Anostracan Working Group of the Inland Water Crustacean Specialist Group of the Species Survival Commission of IUCN will hold its first formal meeting during the symposium. For more information contact Dr. Marie Simovich, Department of Biology, University of San Diego, San Diego, CA 92110-2492; phone (619) 260-4729.

Rainforest Education

Save the Rainforest, Inc., is a non-profit network of over 20,000 primary and secondary school teachers that seeks to contribute to rainforest preservation through education, activism, and fundraising. Educational programs include publication of a teacher's guide for environmental action, an array of teaching aids from curriculum guides to videos and posters, and the coordination of low-cost educational trips to temperate and neotropical rainforests for teachers and high school students. The two week courses are taught by local conservationists, guides, and field scientists, and are designed to broaden mulit-disciplinary understanding of the rainforest and forces behind its destruction. The average price for a course is $650 plus airfare, and graduate credits are available.

Save the Rainforest also involves students in letter writing to government and international agencies, and fund raising campaigns to finance the purchase of forest preserves. For further information contact Bruce Calhoun, Save the Rainforest, 604 Jamie St., Dodgeville, WI, 53533

Endangered Plant Conference

The Second Southwestern Rare and Endangered Plant Conference will be held in Flagstaff, Arizona, September 11-14, 1995. Authors with topics concerning rare plants in Arizona, Colorado, New Mexico, Texas, and Utah are invited to submit abstracts; proceedings will be published. For more information contact Dr. Joyce Maschinski, The Arboretum at Flagstaff, PO Box 670, Flagstaff, AZ 86002; phone (602) 774-1441; email <jmm@nauvax.ucc.nau.edu>.

New Amphibian and Reptile Publication

Amphibian and Reptile Conservation (ARC) is a new publication that will serve as a forum for exchange of information within the herpetological conservation community and will foster a closer union between the private sector and academia in the worldwide conservation of amphibians and reptiles. For more information or to receive an information packet contact Amphibian and Reptile Conservation, 2255 N. University Pkwy., Suite 15, Provo, UT 84604-7506; phone (801) 379-8900; email <arc@yvax.byu.edu>.

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

Endangered Species UPDATE

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