CASE STUDY 12.3

Putting the Pieces Together

Conserving Cranes and Their Habitats Around the World

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The cranes (family Gruidae) belong to an ancient family of birds, with fossil records dating back more than 50 million years. The family's 15 extant species (Figure A) are widely distributed, occurring in more than 110 countries on five continents; only South America and Antarctica lack cranes (Johnsgard 1983). Primarily birds of open wetlands, grasslands, and savannas, cranes have in some regions been able to adapt to, and even thrive within, humanized landscapes. Over the last 150 years however, cranes have had to cope with accelerated loss and degradation of habitat, overexploitation, and other new and intensified threats. As a result many crane populations, subspecies, and entire species are regarded as threatened.

Cranes have long commanded the respect and admiration of their human neighbors, a cultural value that has been critical in drawing attention to their biological plight. Even as cranes have declined in numbers, their beauty, dramatic migrations, and striking calls and behavior have inspired widespread conservation efforts. They have often served as flagship and umbrella species in broader ecosystem conservation programs. They have also provided a focal point for community-based projects that strive to meet the needs of both local wildlife and people. Since the early 1970s, a global campaign has been underway to develop and coordinate conservation programs focused on cranes and the ecosystems that serve as crane habitat.

This unusual effort, centered on a single family of birds, yet international in scope and integrated in its approach, offers lessons of broad relevance to conservation biologists. In contrast to management efforts involving particular species in a particular place, crane conservation offers an example of what might be called "meta-management"—the coordination of efforts to conserve an entire group of species throughout the world.

Conservation Status of Cranes

Although cranes are subject to a wide array of direct and indirect threats, the most significant long-term conservation issues worldwide involve the loss and degradation of wetlands. This issue affects crane distribution, movement, and breeding success, and involves habitats used by both migratory and nonmigratory species throughout the year (Harris 1994; Meine and Archibald 1996). Species that use upland grasslands and savannahs have also been heavily affected by the conversion and degradation of these ecosystems.

Because of the cranes' low reproductive potential—in most species, pairs do not breed until 3–5 years of age, and raise less

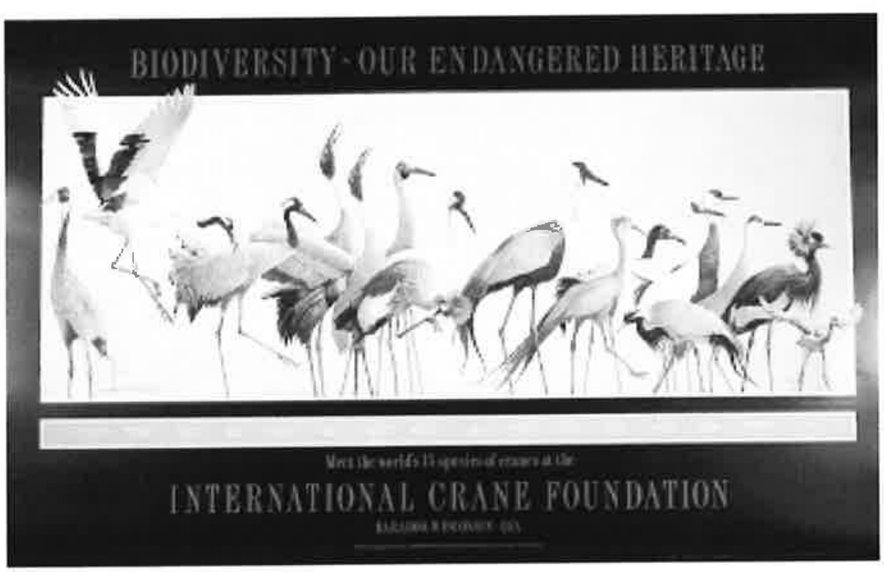

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Figure A The world's 15 species of cranes are here depicted in a wall poster that has also been used as an attractive educational tool. (Original artwork by David Rankin; photograph courtesy of International Crane Foundation.)

TABLE A *Conservation Status of Cranes under the IUCN Red List Criteria*

Species	Conservation status
Black-crowned Crane (*Balearica pavonina*)	Lower risk / near threatened
Grey Crowned Crane (*Balearica regulorum*)	Least concern
Blue Crane (*Anthropoides paradiseus*)	Vulnerable
Demoiselle Crane (*Anthropoides virgo*)	Least concern
Wattled Crane (*Bugeranus carunculatus*)	Vulnerable
Siberian Crane (*Grus leucogeranus*)	Critically endangered
Sandhill Crane (*Grus canadensis*)	Least concern
Sarus Crane (*Grus antigone*)	Vulnerable
Brolga (*Grus rubicundus*)	Least concern
White-naped Crane (*Grus vipio*)	Vulnerable
Hooded Crane (*Grus monacha*)	Vulnerable
Eurasian Crane (*Grus grus*)	Least concern
Whooping Crane (*Grus americana*)	Endangered
Black-necked Crane (*Grus nigricollis*)	Vulnerable
Red-crowned Crane (*Grus japonensis*)	Endangered

Note: This table includes only the conservation status of cranes at the species level. Crane conservationists are also concerned with the status of several subspecies, including the West African, Sudan, South African, and East African Crowned Cranes; Mississippi and Cuban Sandhill Cranes; and Indian and Eastern Sarus Cranes. (From Meine and Archibald 1996).
Source: From IUCN 2003.

than one chick per year on average—increases in mortality caused by hunting, poisons, and powerline collisions can easily depress crane populations. Other important threats to cranes include overexploitation, dam construction, water diversions, urban expansion, invasive plant species, genetic and demographic problems associated with small populations, commercial trade in cranes, lack of effective environmental law enforcement, and political instability. As a result of these multiple threats, 10 of the 15 crane species are now included on the IUCN Red List of Threatened Animals (IUCN 2003a) (Table A). Several crane species, subspecies, and populations, including North America's Greater Sandhill Cranes and western Europe's Eurasian Cranes, are now recovering from past declines. These success stories pose new and different conservation challenges and opportunities.

Effective crane conservation depends on the ability to identify the combination of actions that are available and needed to respond to the highly varied circumstances on the ground. Such actions include stronger legal protections; use of international agreements and cooperative international programs (such as the Ramsar Convention for wetlands protection and the Convention on the Conservation of Migratory Species of Wild Animals); development of community-based conservation projects; establishment and management of protected areas; ecosystem protection and restoration; long-term monitoring and research; support for non-governmental organizations active in key crane locations; public education and professional training; and captive propagation and reintroduction. In some cases, as with the Whooping Crane, necessity has often been the mother of invention, dictating critical responses to immediate needs. In other cases, as with the endangered cranes of East Asia, conservationists have taken steps incrementally and opportunistically amid complicated sociopolitical circumstances.

Three cases from around the world illustrate how cranes have served as catalysts for innovative approaches to conservation.

Cranes and Conservation in the Amur River Basin

The Amur River along the Russia–China border is the world's eighth longest river, and the longest without a dam on its main stem. Its basin is rich in species diversity, a reflection of its unique mix of elements from the northern coniferous forests, southern deciduous forests, and Eurasian steppes. For migratory birds, the Amur Basin is an important link between arctic breeding grounds and temperate to subtropical wintering areas. It is also a center of diversity for cranes, with six species (four of which are threatened) occurring in the region (Halvorson et al. 1995).

International tensions have for decades prevented intensive development of the Amur Basin; however, in recent years development pressures have been growing. A series of dams has been proposed for the Amur River, threatening the river itself and adjacent wetlands. Rapid agricultural conversion of wetlands in the associated Sanjiang Plain in China has deprived Red-crowned and White-naped Cranes and other wetland species of critical breeding habitat. In Russia, economic uncertainty has contributed to inefficient agriculture and exploitative forestry.

Since 1980 cranes have played a key role in stimulating regional conservation initiatives. Important wetlands in Russia and China have been protected, including international reserves at Lake Khanka on the Russia–China border, and in the China-Mongolia-Russia border region. A Russian NGO, the Socio-Ecological Union (SEU), has established Muraviovka Park (Figure B), the first private conservation area created in Russia since 1917, by leasing prime crane habitat (Pryde 1999). Muraviovka is located amid farmlands; crucial community support has been fostered through an exchange program involving schoolteachers and student conservationists from the area and from the United States. Russian and American teachers are now involving Chinese colleagues from the south side of the Amur River in environmental education activities. The park has developed a model farm to demonstrate agricultural practices that safeguard soil, water, and other natural resources while enhancing production. In 2004 the park celebrated its tenth anniversary by bringing together conservationists from northeast Asia, Europe, and North America to review successes and the challenges of local, regional, and international collaboration in conserving wildlife and wetlands.

Cranes and Community-Based Conservation at Cao Hai

In the karst mountains of western Guizhou and northeastern Yunnan Province, China, lie scattered, high plateau wetlands

Figure B Entrance to a crane refuge in the Amur Basin. (Photograph courtesy of International Crane Foundation.)

that are unique in Asia. These wetlands, dominated by slightly alkaline water, produce abundant submerged aquatic plants that in turn support a wide variety of wintering waterbirds, including the threatened Black-necked Crane and the much more common Eurasian Crane. Crane conservationists have worked at the Cao Hai Nature Reserve in western Guizhou Province since the early 1980s. Cao Hai's 20 km^2 wetland rests within a 98 km^2 watershed (Figure C). Early conservation efforts focused primarily on protecting the cranes and their wetland home. With time however, Cao Hai's wetlands diminished as the shallows were converted to agriculture.

By 1994 it was clear that the initial approach was failing to address the conservation needs of this watershed and the more than 20,000 people living within it. More tangible links between conservation activities and the gripping poverty of the region were needed. The biologists and managers working at Cao Hai were ill-prepared to address these larger social issues. In response, conservationists entered into a collaboration with the Yunnan Institute of Geography and the New York-based Trickle Up Program, organizations with extensive experience in poverty alleviation. Together the partners developed a process to link poverty alleviation and wetland conservation at Cao Hai (Shouli et al. 2001).

The Trickle Up Program has worked in many countries, providing conditional $100 grants and business training to very poor people, enabling them to start their own businesses. At Cao Hai, farmers agreed to use their grants only for businesses compatible with protecting the natural resources on which cranes and people depend. The goals of the program were clear on paper. It took time however, for these goals to be shared among those involved and for attitudes to evolve—a reflection of the divergent views of what poverty alleviation and resource protection entailed. As one example, the first grants were given to relatively wealthy farmers because some people felt that people who are poor don't know how to spend money.

Eventually, poor farmers did receive grants, enabling them to reduce their demands upon local natural resources. Relations between local communities and the reserve staff, which had deteriorated to the point of physical conflict before the program began, improved dramatically. Agriculture encroachment upon the Cao Hai wetland ceased. As management within the reserve became more effective, numbers of Black-necked Cranes doubled. The success of the process developed at Cao Hai has led to its being adapted to other nature reserves in China and other parts of Asia. The basic lessons from Cao Hai have proven to be broadly applicable: Act on common interest, build trust through shaping a shared vision, and leave outcomes open.

Figure C Black-necked Cranes at the Cao Hai Nature Reserve, Yunnan Province, China. (Photograph courtesy of International Crane Foundation.)

Wattled Cranes, Wetlands, and People in the Zambezi Basin

The lower Zambezi River valley is the lifeline of Mozambique, ancient home to more than a million people and one of the most productive and biologically diverse river floodplain systems in Africa. Over the millennia, the annual spread of Zambezi floodwaters nourished the fertile floodplains and its human and nonhuman inhabitants. The floodplain once provided spawning grounds for fish and critical dry season grazing lands for both livestock and wildlife. The Zambezi Delta's vast, seasonally flooded grasslands were home to a rich array of wildlife, including an important population of the world's endangered

Wattled Cranes. Extensive coastal mangroves and estuaries supported a productive prawn fishery.

Since the 1960s, however, large upstream dams have disrupted the hydrological cycle of the lower Zambezi, eliminating natural flooding and greatly increasing dry-season flows (Beilfuss and Davies 1999). These changes have affected the availability of water supplies, fuel wood, building materials, and medicinal plants, while weakening the cultural relationship between local people and the river. With the loss of the annual flood, subsistence fishing, farming, livestock grazing, and the commercial prawn fishery collapsed. The dams have also altered conditions in the delta. Saltwater has intruded, the area of wetland and open water has declined, and exotic vegetation has taken over stagnant waterways. Upland plant communities have replaced wetland vegetation, while grassland fires have degraded fire-sensitive communities (Beilfuss et al. 2000). Desiccation of the floodplain has also opened the area to widespread poaching. Populations of Cape buffalo, waterbuck, reedbuck, zebra, and hippopotamus plummeted in the 1980s and 1990s. Wattled Cranes, which serve as an important flagship species for the conservation of many flood-dependent waterbird species of the Zambezi system, have ceased to breed across most of the delta (Bento 2002).

In the 1990s, conservation biologists began to collaborate closely with social scientists, dam operators, government officials, and local communities to promote sustainable management of the lower Zambezi. The immediate goal of this work has been to develop and implement a practical and equitable plan for managing water releases from the upstream Cahora Bassa Dam. An interdisciplinary team is working with a wide variety of users to assess the environmental, social, and economic benefits and drawbacks of different river management scenarios. The broader goal is to implement releases as part of a comprehensive program for poverty alleviation, natural resource conservation, and ecological restoration in the lower Zambezi. Although it is only one of many species that will benefit from these efforts, the Wattled Crane has already proven to be a valuable symbol of the potential rebirth of this endangered system.

Coordinating Crane Conservation Response

As these examples illustrate, cranes provide important opportunities to build conservation programs that combine varied goals, activities, and techniques. With limited time, money, and personnel, crane conservationists have had to develop ways to coordinate efforts effectively at local, regional, and international levels. A number of mechanisms and organizations have emerged to help integrate the various components of a balanced and comprehensive conservation program.

At international levels of the International Crane Foundation (ICF), the IUCN/SSC Crane Specialist Group, the Global Captive Crane Working Groups and additional working groups all serve to coordinate efforts and to share techniques and guidelines. National working groups, such as the U.S. Whooping Crane Recovery Team or the China Crane and Waterbird Working Group focus attention on national efforts, but also collaborate with other national groups.

Recovery teams and recovery plans

The U.S. Endangered Species Act of 1973 provided for development and implementation of recovery plans for endangered species. These plans are prepared and periodically updated by recovery teams appointed by the U.S. Secretary of the Interior. For example, the U.S. Whooping Crane Recovery Team was appointed in 1976 and the USFWS published its first Whooping Crane Recovery Plan in 1980. The Canadian Whooping Crane Recovery Team was established in 1987 to coordinate recovery activities within Canada.

Recovery activities have been closely coordinated between the two nations. In 1995, a Memorandum of Understanding on Conservation of the Whooping Crane was signed, calling for the preparation of a combined plan and the formation of a single recovery team comprising five U.S. and five Canadian members. These steps are especially important as precedents for other nations that share endangered migratory crane populations. For example, in 1995 representatives of the range nations of the rare central and western populations of the Siberian Crane met for the first time in Moscow, laying the foundation for establishing a Siberian Crane Recovery Team. In 2001 the Siberian team met in Wisconsin, and for the first time included representatives from the species' eastern flyway.

International Crane Foundation (ICF)

Since 1973 the International Crane Foundation (located in Baraboo, Wisconsin) has carried out conservation programs around the world. ICF's programs in ecosystem restoration and management, aviculture, research, education, and training have helped to strengthen the global network of crane conservationists. Its website (www.savingcranes.org) and publications provide communication links for tthe network.

ICF works actively with other local, national, and international organizations in developing community-based conservation programs that address the interrelated needs of cranes and human communities. ICF also maintains a "species bank" of threatened cranes at its headquarters, and is one of the three primary breeding facilities for the Whooping Crane. ICF has successfully bred all 15 crane species in captivity, developing new techniques that have been used in propagation of other endangered birds. ICF also provides training opportunities for biologists, managers, and educators, and supports a wide range of public education and outreach projects at its headquarters and around the world.

IUCN/SSC crane specialist group

IUCN Crane Specialist Group serves as a vital hub of communications for crane researchers and conservationists worldwide In 1996 the group published its first comprehensive action plan (Meine and Archibald 1996).

Crane working groups

Crane working groups have played a key role in supporting research, information exchange, and development of conservation programs. Crane working groups have been organized at the regional, national, and local levels. At the regional level, working groups are active in North America, Europe, and Northeast Asia. National-level working groups are best developed in Europe. In the late 1990s several local working groups in South Africa joined together under the umbrella of the South African Crane Working Group.

Global captive crane working group

The appropriate integration of ex situ conservation techniques and ecosystem restoration programs is a critical challenge for crane conservationists. Most crane species can now be reliably bred in captivity. Based on this success, the emphasis in captive programs has shifted from management of individual birds to management of healthy populations to meet conservation needs. A Global Captive Crane Working Group sets regional target populations, defines genetic and demographic objectives, allocates limited space among species, and coordinates work with field conservation projects. In addition, captive management techniques have been summarized in a crane propagation and husbandry manual (Ellis et al. 1996).

Crane workshops and meetings

Since 1975, more than 40 national, regional, international, and species-specific crane workshops and meetings have been held. These gatherings serve as important forums for information exchange, and allow scientists and conservationists from throughout the world to meet and learn from one another. Proceedings from most of the workshops have been published, making this information available to even broader audiences.

Lessons for Conservation Biologists

Each of the 15 crane species requires a different suite of conservation actions to ensure a secure future, and crane conservationists have had to integrate conservation programs under varied circumstances. Several basic guiding principles can be derived from this collective experience:

- Conservation mesures must be solidly grounded in the natural sciences, but should also involve the social sciences, humanities, law, education, economics, and other fields. Fortunately, cranes are among the best-studied groups of organisms on Earth. Effective conservation however, requires that scientific knowledge be linked with an understanding of the human dimensions of the challenge—the social forces and trends that affect crane populations and habitats. Consequently, in situ conservation programs must be broadly conceived and combine research with legal protection, habitat protection and management, education, community participation, and other components. All of these features can and must contribute to balanced programs that sustain crane populations, crane habitats, and local human communities.
- Conservation measures should be envisioned at multiple scales of time and space. Conservation programs for cranes have spanned broad temporal and spatial scales, from highly localized and immediate efforts to save threatened habitats and populations, to longer-term programs in, for example, ecosystem restoration, watershed-scale planning, and maintenance of viable populations in captivity.
- Conservation measures should seek to harmonize species-oriented and ecosystem-oriented approaches. As well-known birds that serve as umbrella and flagship species, cranes have drawn attention to, and provided protection for, a broad array of other species as well as the processes that maintain ecosystem health. In the long run, cranes must be viewed within the larger landscapes, watersheds, and ecosystems that support them, and conservation activities must be coordinated at these scales. In particular, managers must appreciate the role of flooding, fire, vegetation change, and other processes in these dynamic systems.
- Conservation measures should take into account biological attributes and processes at all levels of the biological hierarchy. Crane conservation has required attention to problems at the genetic, individual, population, subspecies, species, and family levels. Especially in the case of the Whooping Crane and the other endangered species, these problems need to be considered simultaneously to minimize risk.
- Conservation measures should work across national, cultural, and ecological boundaries. Because most cranes are migratory, and all the species occur in more than one country, successful conservation requires clear consensus on goals and responsibilities among parties from different parts of the species' range, constant communication of reliable scientific information, and support from various governments, international institutions, and nongovernmental organizations.
- Conservation measures should seek to address local community development and conservation needs in an integrated fashion. Efforts to conserve cranes—especially the 13 species occurring in Asia and Africa—are interwoven with the challenges of local sustainable development. Wild resources of wetlands and their watersheds cannot be conserved without the active involvement and leadership of local resource users. Invariably, local people provide essential insights into the best response to the threats that cranes face.
- The relationship between in situ and ex situ conservation measures should be well defined. Captive propagation and reintroduction programs should be under-

taken only as a last resort, and not as a substitute for in situ programs. Should ex situ programs become necessary, they should be developed based on clear goals and management guidelines. Priority should be placed on maintenance and enhancement of genetic diversity within populations, on safe and effective methods for reintroduction, and on assurance of high quality care.

- Conservation biologists should be prepared for success. The work of conservation biology does not stop once a species or population has recovered, or a critical habitat has been protected. In particular, the involvement of local people in species recovery and ecosystem management programs must continue after the initial challenges are met. Failure to do so risks undermining success in the long run.
- Education should be integrated into all conservation programs. Throughout the world, crane conservation programs have taken advantage of cranes as a special vehicle for communicating basic information about wetlands and endangered species management. Ultimately the conservation of cranes requires an informed public understanding, involvement, and support for activities that sustain the ecosystems where cranes occur.

Cranes, along with much of the world's biodiversity, will face difficult circumstances in the coming decades. History provides somber lessons about the speed with which even abundant species can become threatened. History, however, also shows that recovery is possible when species are provided with the necessary environmental conditions. Although the survival and recovery of the world's cranes cannot be assured, many steps are being taken to enhance their chances. Compared to the prospects 50 years ago—when most crane species and populations were dwindling, scientific knowledge was scarce, and conservation efforts were essentially nonexistent—there is reason for cautious optimism. And in safeguarding cranes, we may ensure a more secure future for other members of the ecosystems—including people—where cranes occur.

Summary

1. An understanding of the fluctuations in numbers of natural populations and the application of this understanding to the conservation of species must be based firmly on an understanding of the factors influencing spatial and temporal variability in population demography.
2. All populations exist in heterogeneous landscapes, and different individuals experience different conditions depending on when and where they are located. Some locations (termed "sources") are highly productive and produce an excess of individuals that often populate less productive locations ("sinks"), where local mortality exceeds reproduction. In some cases, sink populations may be larger than the source populations that support them. Accordingly, great care must be exercised in the design of nature reserves to identify and protect source habitats.
3. Population viability depends not just on the quality of local patches of habitat, but also on the number and location of patches and the amount of movement between them. The dispersal mode of a population is a key factor in determining its viability. In many cases population dynamics must be studied at the level of many local patches of habitat, and population models must incorporate immigration and emigration explicitly.
4. Metapopulation models that consider the dynamics of many interacting subpopulations in a habitat mosaic demonstrate that the fraction of a landscape suitable for a given species and the magnitude of dispersal between suitable patches are critical components of population viability.
5. Unlike metapopulation models, spatially explicit population models consider the exact location of habitat patches and can incorporate detailed behavioral information about how dispersing individuals locate suitable habitat. Spatially explicit models can be useful tools for testing specific conservation strategies in a given region, while metapopulation models are more useful for testing general landscape influences using hypothetical populations.
6. A number of theoretical models are now available for quantitative analysis of population viability and extinction probability. These models should be viewed as useful additions to the collection of tools available for understanding the dynamics of natural populations. The more realistic models are, however, very data hungry and are only as good as the natural history insights and field studies that support them.
7. Increasingly, efforts to track and predict changes across landscape scales are possible due to the use of GIS datasets coupled with spatial models. Although these models are certainly among the more data