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James Harris

*International Crane Foundation*

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# MANAGING NATURE RESERVES FOR CRANES IN CHINA

JAMES HARRIS, International Crane Foundation, E-11376 Shady Lane Road, Baraboo, WI 53913

**Abstract:** During the past 15 years, China has established more than 300 nature reserves. Many of the wetland reserves have been created primarily to protect endangered cranes. This paper summarizes the status of 22 nature reserves, 13 for breeding cranes and 9 for wintering cranes. The nature reserves have often been established in areas heavily populated or intensively used for economic purposes. Many reserves have been effective in stopping hunting of cranes. Taking of eggs or young has also been greatly reduced, but general human disturbances threaten successful nesting. Reserve authorities have also taken steps to prevent destruction or degradation of habitats, with mixed results. Nature reserve managers still cannot control most economic activities within reserve boundaries. North American conservationists have played an important role in assisting development of nature reserves. This paper suggests how North American approaches must be modified for China. In China, protective measures for reserves should be linked with compatible programs for local economic development. Preliminary efforts are described.

**Key Words:** China, conservation, cranes, management, nature reserves, wetlands

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China is the third largest nation on earth, and has great ecological diversity. China's western regions are dominated by vast mountain ranges and arid plateaus, while deserts and grasslands span the northcentral regions. Forests, drained by some of earth's greatest rivers, range from stunted conifers in the far northeast to tropical rainforests in the far southwest. From a global conservation perspective, China has extraordinary importance. Aside from the sheer number of species represented (for example, China has 1,186 species of birds [Cheng 1987:xi]), some of its plants and animals have worldwide fame, including the dawn redwood (*Metasequoia glyptostroboides*), ginkgo (*Ginkgo biloba*), giant panda (*Ailuropoda melanoleuca*), Chinese river dolphin (*Lipotes vexillifer*), Przewalski's horse (*Equus caballus przewalskii*), and red-crowned (*Grus japonensis*) and black-necked cranes (*G. nigricollis*). China has special interest for crane enthusiasts. Eight of the world's 15 crane species reside here, more than in any other country.

China's current human population of 1.2 billion has put great pressure on natural resources and wildlife. Even with a slowing in growth of the human population, the country's economic development will threaten wildlife and natural ecosystems without carefully planned, effective conservation programs. For example, 6 of China's 8 crane species are threatened or endangered (King 1981, Yang 1991).

While the Chinese have long loved nature, conservation has a very recent history. The development of a system of nature reserves has been the primary undertaking for Chinese conservation. The first reserve, Dinghu Mountain Nature Reserve in Guangdong Province, was established in 1956. Through 1965, a total of 19 nature reserves were established, covering an area of 648,874 ha (Li and Zhao 1989:12).

China's Cultural Revolution intervened. From 1966 to 1976, the country underwent continuous social and political upheavals. Scientific undertakings and conservation in particular came to a halt. The reserves ceased to function and some of them were damaged irreparably. Since 1976, however, a more stable government has recognized the dangers of uncontrolled population growth and resource exploitation. The establishment of nature reserves again became a priority. By 1981, 76 nature reserves existed in China. By the end of 1986, China had 333 nature reserves covering 19,330,000 ha. To protect the nation's biological diversity, the provinces have outlined plans for future nature reserves; by the year 2000, 500 should exist (Li and Zhao 1989:12-14).

Creation of these nature reserves has been remarkably rapid. Creation is but the first step, however, and severe problems remain regarding human activities within the reserves. A future for cranes and other wildlife will be assured only when effective management programs are in place.

This paper examines the successes and difficulties to date in developing functional nature reserves for cranes. As China lacks a practical tradition of wildlife protection, wildlife officials have looked to other countries for technical advice, inspiration, and financial support. North American conservation has provided a model for protection programs. This paper aims to assist North American conservationists who become involved in Chinese conservation, either through visits to China or through hosting Chinese delegations in America. North American approaches must be greatly modified to suit Chinese conditions. Thus cooperation should be a 2-way learning process. As we study with our Chinese colleagues, North Americans will gain a wider perspective that will benefit our own efforts close to home.

This paper is possible only because of the great kindness of my Chinese colleagues and hosts at the nature reserves, many of whom generously gave of their knowledge and insights. I also thank my numerous interpreters who worked so hard to translate ideas new to them and difficult to understand even in the original language. Differences in culture and language undoubtedly have led to errors or misconceptions which are my own responsibility. I also wish to thank G. Archibald, J. Barzen, S. Bouffard, and T. Clark for reviewing this manuscript. My travels to China were supported by grants from the Pew Charitable Trusts, the Lynde and Harry Bradley Foundation, the Francis R. Dewing Foundation, contributions from members of the International Crane Foundation (ICF), and the Forestry and Environmental Protection Bureaus responsible for the nature reserves.

## METHODS

This paper is based on 10 visits I made to China between 1986 and 1991, where I worked with management staff at 13 wetland reserves in 9 provinces. Information about the reserves is based on my field visits and on interviews with reserve, local government, and provincial officials. I also discussed conservation with numerous Chinese scientists, especially at the 1987 International Crane Workshop held in Heilongjiang Province, China. Since 1984, ICF has hosted 11 delegations of scientists and officials involved in Chinese nature reserves, another opportunity for discussions. I have also drawn on the experiences of G. Archibald and other ICF staff visiting China since 1979.

## WETLAND RESERVES FOR CRANES

Cranes have great symbolic and cultural significance for the Chinese (Zhou 1986, Ma 1991), much more so than any North American bird. Accordingly, most of China's wetland nature reserves have been established primarily to protect nesting or wintering populations of cranes. Table 1 lists 22 nature reserves for cranes in China; locations are shown in Fig. 1. These reserves include 13 reserves for breeding cranes and 9 reserves for wintering cranes. Although some reserves, such as Zhalong and Shengjin Lake, also have importance as migratory stopovers, no reserves explicitly for migrating cranes have been established. Thus cranes receive little or no protection while migrating between the northern nesting areas and wintering areas primarily in the Yangtze River basin.

Conservation needs for breeding and wintering cranes are significantly different. Accordingly, the status of 1 breeding area reserve, Zhalong Nature Reserve in Hei-

longjiang Province, and 1 wintering reserve, Cao Hai Nature Reserve in Guizhou Province, will be briefly summarized as examples.

### Zhalong Nature Reserve

Zhalong Nature Reserve (ZNR), covering an area of 210,000 ha, provides nesting habitats for vast numbers of waterfowl, herons, rails, and other wetland and grassland birds. Four crane species nest here, and 2 other species pause on migration. ZNR is a major staging area for the Siberian crane (*G. leucogeranus*) in spring, when as many as 800 individuals are present for up to 3–4 weeks (Li Fangman and Li Peixun 1991).

A headquarters complex has been established on the western edge of the reserve, only 30 km from the city of Qiqihar, which has more than 1 million people. Accordingly, a public education program now hosts more than 100,000 visitors each year, and visitors see a large exhibit hall, climb an observation tower, and have a close look at a collection of captive cranes. A guest house and dining hall serve mainly foreign visitors.

The research staff of 7 persons has been active since 1982, primarily focusing their efforts on cranes. In addition, numerous scientists from elsewhere in the province have conducted studies at ZNR (see, for example, 7 papers from Zhalong in Harris [1991b]). Collaborative studies have been undertaken with North American and Japanese scientists (Archibald 1983, Dombrowski 1988).

A protection staff of 3 wardens (6–7 in summer) works with researchers and educators in enforcing regulations designed to stop hunting, nest robbing, and disturbing of wildlife. As a result, by 1987–88 illegal hunting had become uncommon within the reserve, although it still occurred in areas closely bordering the reserve. Formerly, taking of eggs substantially reduced success of breeding birds; this practice had greatly subsided also (ZNR staff, pers. commun.).

Human disturbance is much more difficult to control. Twenty-five villages with 24,000 people lie within the boundaries of the reserve (Ma and Su 1991). These people rely on the marsh for 70–80% of their production activities (fish; reeds for fuel, roof thatching, and sale to a paper factory; and grasses for livestock) and cross the marsh daily to farm isolated pieces of high ground. These disturbances make sizable portions of the marsh uninhabitable by the more wary wildlife such as cranes. In the mid-1980's, the red-crowned population at ZNR raised few young, and eastern white storks (*Ciconia boyciana*) and whooper swans (*Cygnus cygnus*) had disappeared from the marsh as nesting birds (Ma and Su 1984).

Another serious problem was the alteration of habitats



Fig. 1. Locations of crane reserves in China. Numbers identify nature reserves listed in Table 1.

due to human economic activities (see Harris 1989, Ma and Su 1991). Zhalong lies at the inland delta of the Wuyuer River; irrigation and industrial uses diverted major portions of the water formerly flowing into the marsh, and a large reservoir held water in the upper part of the marsh. During periods of high rainfall, large amounts of water were released into the marsh, and during drought times, flow was dramatically reduced. The long period of water storage in the reservoir, during which water evaporated, resulted in increasing salt concentrations. Coupled with reduced flows and flushing, portions of the marsh in 1987 experienced salinization and changes in vegetation.

During the early years of ZNR, villages cooperatively managed artificial fish ponds. Changing economic policies encouraged villagers to fish on their own in the marsh. Policies rewarding individual initiative resulted in striking increases in productivity on farmlands, where resources were controlled by a single family, but resulted in overexploitation of common resources, such as fish in public

waters of the marsh. Fish of all sizes were taken with all types of traps and nets, and closed seasons to protect spawning fish were ignored. Fish production dropped, yet disturbance to nesting wildlife continued (ZNR staff, pers. commun.).

By 1987, managers at ZNR recognized (1) that control of hunting, nest robbing, and harassment of wildlife were not sufficient to safeguard bird populations, and that habitat protection had to be the primary focus of management efforts, and (2) that human economic activities threatening wildlife habitats also were causing decreases in harvests of marsh resources such as fish and reeds. Reserve managers therefore expanded their conservation strategies to include management of all resources in the marsh. Rather than argue that economic sacrifices were necessary to safeguard the birds, they advocated to local governments that ecological functions of Zhalong marsh needed protection from overexploitation. By safeguarding the marsh itself, human harvests could be sustained at a

Table 1. Nature reserves for cranes in China.<sup>a</sup>

Reserve	Province	Year estab.	Size (1,000 ha)	Species <sup>b</sup>	Status <sup>c</sup>	Number <sup>d</sup>	Year	Source
1 Zhalong	Heilongjiang	1979	210.0	Red-crowned	Breeding	230	1990	Zhalong staff
				White-naped	Breeding	40	1990	Zhalong staff
				Demoiselle	Breeding			
				Common	Breeding	Occ.		
				Siberian	Migrant	600	1991	Su Liying
2 Honghe	Heilongjiang	1984	16.3	Hooded	Migrant	300	1991	Su Liying
				Red-crowned	Breeding	51	1987	Ma Yiqing
3 Xingkai Hu	Heilongjiang	1985	131.0	White-naped	Breeding	Occ.	1987	Ma Yiqing
				Red-crowned	Breeding	59	1984	Ma and Li (1991)
4 Momoge	Jilin	1981	144.0	White-naped	Breeding	6	1989	Mishan Forest Bureau
				Red-crowned	Breeding			
5 Xianghai	Jilin	1981	105.5	Demoiselle	Breeding	5	1984	Yang and Tong (1991)
				Siberian	Migrant	350+	1983-6	Wu Zhigang et al. (1991)
				Red-crowned	Breeding	50	1984	Ma and Li (1991)
				White-naped	Breeding	40	1990	Xianghai staff
				Demoiselle	Breeding	674	1986	Tong Junchang (1986)
6 Keerqin	Inner Mongolia	1986	134.0	Common	Migrant			
				Siberian	Migrant			
				Red-crowned	Breeding	40	1987	Inner Mongolia EPB
				White-naped	Breeding	20	1987	Inner Mongolia EPB
				Demoiselle	Breeding	Com.	1987	Inner Mongolia EPB
7 Dalainor	Inner Mongolia	1986	400.0	Common	Migrant			
				Siberian	Migrant	4	1987	Inner Mongolia EPB
				Hooded	Migrant	3	1987	Inner Mongolia EPB
				Red-crowned	Breeding	5	1988	Dalainor staff
				Demoiselle	Breeding	Com.		Dalainor staff
8 Dalinor	Inner Mongolia			Siberian	Summer res.	23	1987	Dalainor staff
				Common	Migrant			
				Red-crowned	Breeding	3	1984	Duan Wenrui
				White-naped	Breeding	15	1984	Duan Wenrui
9 Shuangtaizi	Liaoning	1987	10.0	White-naped	Migrant	208	1987	Fen Lingfei
				Demoiselle	Breeding			
				Common	Migrant			
				White-naped	Migrant	76	1987	Chen Tieshan
				Red-crowned	Breeding			
10 Big Suga Lake	Ganzu	1982	3.5	Black-necked	Breeding			
11 Small Suga Lake	Ganzu		0.85	Black-necked	Breeding			
12 Ganhaizht	Gansu		0.3	Black-necked	Breeding			
13 Gahai	Gansu		10.0	Black-necked	Breeding			
14 Longbaotan	Qinghai	1985	4.5	Black-necked	Breeding	19	1986	Liao (1987)
15 Yancheng	Jiangsu	1984	243.4	Red-crowned	Wintering	533	1990-1	Yancheng staff
				Common	Wintering	9		
16 Shengjin Lake	Anhui	1986	33.3	White-naped	Migrant	3	1990	Shengjin staff
				Siberian	Migrant	1	1990	Shengjin staff
				Hooded	Wintering	358	1990-1	Author
				Common	Wintering	1	1990-1	Author

Table 1. Continued.<sup>a</sup>

Reserve	Province	Year estab.	Size (1,000 ha)	Species <sup>b</sup>	Status <sup>c</sup>	Number <sup>d</sup>	Year	Source
17 Poyang Lake	Jiangxi	1984	22.4	White-naped	Wintering	1950	1990-1	Poyang Lake staff
				Siberian	Wintering	1500	1990-1	Poyang Lake staff
				Hooded	Wintering	150	1990-1	Poyang Lake staff
				Common	Wintering	190	1990-1	Poyang Lake staff
18 East Dongting Lake	Hunan	1984	190.0	White-naped	Wintering	12	1991	Dongting staff
				Siberian	Wintering	31	1991	Dongting staff
				Hooded	Wintering	7	1991	Dongting staff
				Common	Wintering	27	1991	Dongting staff
19 Cao Hai	Guizhou	1986	12.0	Black-necked	Wintering	231	1990-1	Cao Hai staff
				Common	Wintering	300	1991	Cao Hai staff
20 Luguahu	Yunnan	1987	8.1	Black-necked	Wintering	10	1985	Yunnan Forest Bureau
				Common	Wintering	80	1985	Yunnan Forest Bureau
21 Napahai	Yunnan	1984	2.1	Black-necked	Wintering	76	1989	Author
22 Bitahai	Yunnan	1984	4.1	Black-necked	Wintering	22	1989	Li Zhixin

<sup>a</sup> Information obtained from nature reserve staffs, provincial bureaus, Wang (1988), and Ma (1991).

<sup>b</sup> Scientific names of cranes: red-crowned (*Grus japonensis*), white-naped (*G. vipio*), demoiselle (*Anthropoides virgo*), common (*G. grus*), Siberian (*G. leucogeranus*), hooded (*G. monachus*), black-necked (*G. nigricollis*).

<sup>c</sup> Many breeding species are present in larger numbers during migration.

<sup>d</sup> The most recent counts available to the author are provided; numbers in some reserves, particularly in winter, vary considerably from year to year.

higher level over the long term and the wildlife would benefit as well—i.e., economic and wildlife needs were not conflicting demands on the marsh; both were dependent on proper management of the resource base (Harris 1989).

The reserve has met some limited success with this approach. For example, fishing is more carefully controlled during the spawning period, which coincides with the nesting period for cranes. Limited areas of reeds were left unharvested in winter 1989–90, providing nesting cover for cranes and other birds (Zhang Chen, ZNR, pers. commun.).

Four obstacles limit habitat management efforts. First, the reserve does not have authority over the marsh resources, only over the wildlife. Second, control over the water, fish, reeds, and other components of the marsh are fragmented among numerous agencies unaccustomed to cooperation. Third, ecological concepts underpinning proper wetland management are poorly understood by the villagers or local officials. Fourth, individuals greatly prefer short-term gain over long-term benefits, an understandable priority given the poverty in the area.

Nevertheless, reserve efforts have benefitted nesting cranes. Aerial surveys in 1990 revealed 230 red-crowned

cranes and 40 white-naped cranes (*G. vipio*) during the nesting season, both increases over survey results from 8 years earlier (Xu Jie, ZNR, pers. commun.; Feng and Li 1985).

### Cao Hai Nature Reserve

In winter most cranes feed and roost in flocks, a strong contrast to their territorial behavior during the breeding season. Substantial numbers concentrate in relatively small areas. Furthermore, the wintering flocks are less sensitive to disturbance than breeding birds, if they have alternative feeding and roosting areas where they can temporarily move in response to local disturbances.

Cao Hai Nature Reserve (CNR) takes its name from the lake "Cao Hai," but includes only 870 ha of wetlands and 2,488 ha of lake surface (Li Fengshan and Li Mingjing 1991); it has far less aquatic habitat than ZNR. Yet, in recent years, about 200–300 black-necked cranes have wintered here annually (Wu Zhikang et al. 1991). Until 1991, CNR was believed to hold the largest winter concentration of the species, almost a third of the known world population (in early 1991, Mary Bishop [ICF, pers.

commun.] and staff of the Tibet Plateau Institute of Biology found 2,850 black-necked cranes in Tibet). In addition, common cranes (*G. grus*) winter at CNR, as many as 2,178 in 1983 (Wang 1991), as well as bar-headed geese (*Anser indicus*) and a large variety of ducks, herons, shorebirds, and birds of prey.

Visitors to CNR are immediately impressed by the tameness of the birds. During my early 1991 visit, I openly approached within 9 m of a feeding flock of black-necked cranes before they flew. The tolerance of the birds for people contrasts greatly with all other crane reserves in China, and is due in part to local Buddhist traditions that forbid killing cranes. In addition, the reserve headquarters, a 5-story building, has been erected close to one of the main feeding areas for cranes, at the edge of the city of Weining. The no-hunting regulations are explained and enforced by a network of 21 local farmers living in villages around the periphery of the lake. Reserve staff claim the cranes have grown more tame since protection measures were implemented. Nevertheless, in 1991 I found several snares that had been erected in the wetland, and remains of 1 bar-headed goose illegally taken. A family of black-necked cranes included a young bird carrying a wooden stake hanging from a noose tight around the bird's neck.

It is fortunate that the birds are highly tolerant of humans at CNR, because the location has had and continues to feel severe impacts from human activities. The lake was much larger before 1958, when 700 ha of farmland were created by partial drainage of the lake. The lake was entirely drained in 1971, during the Cultural Revolution when many destructive projects were implemented throughout China by hand labor. But the project had disappointing results. Most of the lake bottom was unsuitable for farming, and much of the remainder was either too dry or too wet; only about 100 ha of land yielded good crops despite drought or high rainfall (Li Fengshan and Li Mingjing 1991).

In 1982, Guizhou Province decided to restore the lake "Cao Hai" and built a dam. The purpose was not to assist cranes, but as the lake expanded, wetlands formed about the edges. The black-necked cranes, which had numbered as few as 35 birds during the period Cao Hai had been drained (Wu and Li 1985), quickly increased.

The nature reserve staff monitors numbers of cranes and other rare birds annually, but none of the staff have advanced training in wildlife. The Guizhou Academy of Sciences, however, has a research station at Weining, and Academy researchers have intensively studied many aspects of the ecology of cranes and of CNR (see Institute of Biology, Guizhou Academy of Sciences 1986). The reserve has a fine exhibit hall designed by Nayna Jhaveri representing World Wildlife Fund-Hong Kong, and the

reserve has actively promoted public education in the area.

The primary problems at CNR, as at ZNR, involve human use of the habitats required by the cranes. Most severe has been the continued encroachment of farming around the edges of the lake. In recent years, the local people have developed a technique of hand digging wide, deep ditches and placing the spoil on the land between the ditches, thus artificially raising the surface level of the soil (Hong Shouli, Guizhou Environmental Protection Bureau [EPB], pers. commun.). Crops can then be grown here during the summer rainy season. Such a practice has obvious short-term benefits but probably cannot be sustained for long periods because of erosion. The ditches must be dug out every winter before planting, and the practice has hastened the runoff of soils and nutrients into the lake proper.

Both species of cranes and particularly the bar-headed geese visit croplands. The cranes can be seen daily foraging in fallow fields and eating potatoes left after the previous harvest. Unfortunately, the cranes and geese also eat unharvested vegetables (Wang 1991). Occasional cold weather freezes the shallow waters, forcing all the birds to feed on uplands. But the conflict between birds and farmers has intensified because of wetland destruction and will get much worse.

The CNR staff have correctly understood the need to control the habitats and not just the birds of the reserve, and have worked closely with the local government. As a result, fishing regulations have been tightened, and no fishing is allowed in CNR during the winter period of heavy bird use. The reserve boundaries encompass the lake and wetland habitats as the core area for intensive management for wildlife; a buffer zone is also included in the reserve, comprising the entire watershed of Cao Hai (Hong Shouli, Guizhou EPB, pers. commun.). CNR is thus unusual among wetland reserves in China, in that management of the wetland itself is linked to land uses throughout the watershed. This link was recognized at CNR after much damage had already been done. Between 1956 and 1982, forested land area surrounding Cao Hai decreased from 35.8% to 13.7% (Li Fengshan and Li Mingjing 1991). In 1991, I could see only 1 small forest fragment. Weining County and Guizhou Province are cooperating, however, on extensive reforestation, both to reduce soil erosion and to provide income through timber and apple harvests for local people as an alternative to converting wetlands to farmlands.

A complicated legal disagreement exists over whether the local people have the right to convert the wetland edges of the lake to private farmland (Hong Shouli, Guizhou EPB, pers. commun.). As is typical of land-use disagreements in China, foreigners have an almost impos-

sible task of understanding the discrepancy between legalities and what really happens on the land. The Weining County government agrees with the nature reserve that the local people do not have the right to reclaim wetlands, but will not evict the people unless some other way can be found for them to improve their incomes.

The reserve managers have focused on economic development for the CNR area, as the only means whereby remaining wetlands can be protected and former wetlands restored. In the meantime, the reserve has attempted to gain control over the dam at the outlet to Cao Hai so that, among other purposes, water levels can be kept high in winter to prevent land reclamation. The local water bureau has resisted reserve efforts, slowly allowing Cao Hai's water to flow out during winter to power a small hydroelectric plant downstream and to provide water for irrigation. The Guizhou EPB, which manages the reserve, has supported construction of a new power plant near Weining and raised funds to increase the size of the dam and gain control over water levels. The new dam would enlarge the lake in summer, thereby improving fish yields and drowning illegal farmlands; in winter, falling water levels would create conditions suitable for cranes. Again, the reserve must develop alternative economic activities before implementing this project (Hong Shouli, Guizhou EPB, pers. commun.). At CNR, management of the reserve has become increasingly integrated with economic planning and development for the watershed area, so that the reserve is as much concerned with wise use of resources as with wildlife protection. The future of CNR depends on the future of Weining County, the poorest county in one of the poorest provinces in China.

## IMPORTANT ISSUES FOR NATURE RESERVES

The 2 examples of Chinese wetland reserves, discussed above, suggest a number of important issues for reserve management.

### Hunting and Taking of Birds

For the most part, the nature reserves have greatly reduced hunting and other direct persecution of wildlife. Firearms are easily detected and the poachers apprehended, so local people have experimented with other methods of taking birds, including snares, nets, traps, and poisons. The last named practice has become common at Poyang Lake Nature Reserve, where drugs are spread for the birds to eat, and the drugged birds are captured and taken alive to market. The price for wild ducks is so high

that the sale of 10 birds will compensate the poacher if he is caught and fined. Reserve staff apprehended 50 poachers in winter 1989–90, but the punishment has been an insufficient deterrent (Xie Xuexian and Song Xiangjin, Jiangxi Nature Reserve Management Office, pers. commun.). At East Dongting Lake Nature Reserve, poachers are imprisoned for 2 years, and poisoning is much less of a problem (Gui Xiaojie, Hunan Forestry Bureau, pers. commun.).

Initial gains in efforts to control hunting can easily be lost. At ZNR, poaching at Lindian, an area far removed from the reserve headquarters, is now once again a major problem. Hunting involves local officials and their friends, whom the reserve wardens feel powerless to stop. Cranes and their nests are not disturbed, but many other birds and eggs are taken (Su Liying, University of Missouri, pers. commun.).

### Disturbance

Disturbance is much more difficult to control than hunting. For nesting birds, unintentional disturbance has become a more serious problem than hunting at some reserves. At winter reserves, occasional poaching has made the birds extremely shy of people; even moderate human activities will prevent cranes from using otherwise suitable wetland habitat. At Napahai Nature Reserve, hunting during the Cultural Revolution caused the birds to stop using fallow fields for feeding, and to abandon use of major portions of the wetland near villages (Li Zhixin, Zhongdian Forest Bureau, pers. commun.). By 1989, reserve protection efforts appeared to be resulting in slightly tamer black-necked cranes that were gradually expanding their feeding areas.

### Habitat Protection and Economic Development

China's rapid expansion of its nature reserve system has been both surprising and inspiring, but the quick development of education and research programs will not lead to a stable and secure future for cranes and other wildlife. Increasingly, the reserves are confronted with the limitations of managing wildlife without any real control over the habitats on which they depend. This central conflict of the reserve system is likely to intensify if solutions are not found. At Poyang Lake Nature Reserve, for example, Dahu Chi is the most important wetland for wintering Siberian and white-naped cranes—at times 99% and 50% of the world populations of Siberian and white-naped cranes, respectively, gather here. But since about 1975, a small fishing village of 100 people has drained much of this shallow lake through a ditch passing through

a sluice gate into the Xiu river; fish are harvested as they pass through the gate. The village has drained the lake more slowly and less completely than they might for strictly economic reasons, so that extensive shallows remain as essential habitat for the cranes during most or all of the winter. But the village has demanded that the nature reserve provide reimbursement for the lost fish. The reserve has not made payments, leading to increasingly bitter feelings among the villagers. During the winter of 1990–91, the village drained the wetland quickly in the autumn before the cranes arrived. The remaining wetland was so small that the wintering cranes did not use it but foraged elsewhere (Xie Xuexian, Jiangxi Nature Reserve Management Office, pers. commun.).

Some reserves in China may fail while others succeed in providing long term protection. But it is likely that successful habitat programs in 1 or more reserves will lead the way for the system as a whole. Growing awareness of the problem is a good sign—ZNR and CNR are good examples. The earliest wetland reserve to achieve a measure of control over its wetland habitats has been Yancheng Nature Reserve, along the coast of Jiangsu Province. By 1986, the reserve had designated a core area where no economic activities would be allowed and a secondary zone (much larger) where limited activities could occur if compatible with needs of the red-crowned cranes and other wildlife (Yang Ji, Jiangsu EPB, pers. commun.). Five years later, the system still appears to be holding, despite some minor encroachments. The reserve, however, lies outside the outermost sea walls, where high tides in summer render the land unsuitable for farming or buildings. Furthermore, silt carried by the Yangtze and Yellow rivers is deposited along the coast here, adding about 100 m of new land each year. The land has no past history of use and no occupants (Harris 1986, 1991a).

Poyang Lake, with its 17,000 human residents inside the reserve boundaries (Harris 1986), is a more typical wetland reserve. In 1990, the Governor of Jiangxi Province visited Dahu Chi and the nearby wetland Sha Hu to discuss water levels, fish, and habitat needs of the cranes. He later signed a document changing authority over the water levels. The change cannot occur until the province provides a large payment so that the villagers can start a small factory in a nearby town. Depending on the amount of funds available, Poyang Lake Nature Reserve will gain partial or complete control over water levels and fishing on these 2 lakes and thus can begin active management of the wetlands (Xie Xuexian, Jiangxi Nature Reserve Management Office, pers. commun.).

East Dongting Lake Nature Reserve in nearby Hunan Province has an even greater human population, since its boundaries include the second largest city in the province,

Yueyang; 2 million people live within the reserve. Fortunately, the area attracts large numbers of tourists from China and abroad, and the city pays special attention to its aquatic resources. The city therefore enabled the nature reserve to receive a document in 1990 giving it control over the resources in 16,000 ha of its best crane and waterfowl habitat. Within the Chinese context, such control is heavily limited by prior rights and claims of the local people, and successful implementation must be gradual and sensitive to local concerns. As a first step, the reserve reduced the number of fishermen in the core area in winter from about 1,000 boats to 100. Most of the other 900 boats probably moved into the secondary zone of the reserve. The reserve has a total of 3 zones, and the secondary zone of 61,000 ha is designated to allow birds and economic activities to coexist. The third zone, including Yueyang City itself, is a non-hunting area (Gui Xiaojie, Hunan Forest Bureau, pers. commun.).

The North American-style nature reserve, strictly for the birds without any economic activity, is impossible in China, given the numbers of people, their poverty, and the limited funds of the government. Successful reserves will be those that guide development rather than resist it, and that consider not just the wetland but the watershed and surrounding region. As the reserves work to increase public sensitivity to wildlife both inside and outside their boundaries, they may take on another role, as models for ecologically sound development that will sustain people and wildlife over the long term. A major concern of the successful reserves will thus be the needs of the local people.

Population growth within or surrounding the nature reserves is a critical issue for the long term. China's population control policies have been effective in the cities but not in the countryside, where individual families benefit from the labor available to larger families. Of equal concern, economic development within reserves must be accompanied by strict procedures to prevent immigration of people attracted by economic opportunities. ZNR has addressed this problem (Ma and Su 1991), and other reserves need to do the same.

Aside from local economic development to benefit local people, regional development plans can have a major impact on nature reserves. Wetlands are particularly vulnerable because projects far distant from the nature reserves can significantly alter quality and quantity of inflowing water. To date, reserve management agencies have had little influence on such projects. A good example is the proposed Three Gorges Dam on the Yangtze River, an immense project that could alter waterbird habitats throughout the lower basin (Ryder 1990). In particular, Yancheng Nature Reserve on the coast of Jiangsu could

be impacted, because the reserve lands are built from sediments washing into the Yellow Sea from the Yangtze. The dam would greatly reduce sediment loads and might result in the gradual erosion of the nature reserve into the sea.

### Public Education

A number of China's wetland reserves quickly established education programs centered around displays of captive cranes or expensive exhibit halls. The content of these displays included general natural history, and the education staff preached the beauty and value of the cranes. ZNR's captive crane management, with many of the cranes flying freely, nesting in the wetland close to visitors, and even returning to the wild (Xu et al. 1991) had great impact on the general public.

Education programs have tended to emphasize facilities and displays rather than actual communication between reserve staff and local people, and they have also ignored the fact that successful education depends on 2-way communication. Educators need to know the perceptions and needs of the local people very well, so that the content of education programs can be designed to support specific management needs for wildlife (Wood and Wood [1987] provide excellent guidelines for developing conservation education programs). Education programs, for example, are essential in teaching local people what types of disturbance are detrimental to endangered wildlife and how the people can conduct their necessary activities with minimal impact.

Nature reserves have often established captive bird collections as part of their education programming. For officials or government leaders with limited understanding of field ecology, captive breeding programs can provide a false sense of conservation progress even if the more important field work is being neglected. Moreover, captive programs can divert scarce funds or trained staff away from field efforts. But among the Chinese public, unlike the American public, very few people have binoculars. Captive birds may be the only way for reserves to show the general public rare wildlife up close and to stimulate support for conservation. If captive programs are established, they should clearly support habitat conservation. Equally important, facilities must be healthy and the staff well trained in aviculture. For this latter need, some of China's zoos (such as Beijing and Shengyang zoos) have excellent crane management programs and might provide instruction at low cost. Captive birds that are poorly housed, and without veterinary care, can pose a serious disease threat to wild birds nearby.

Yancheng Nature Reserve has recently begun artificial

feeding of red-crowned cranes so that the wild birds are lured close to an observation tower each morning. Artificial feeding is carefully limited to ensure that the cranes continue to obtain natural foods as well. Artificial feeding must never be a substitute for strong habitat protection. On Kyushu in Japan, where natural wetlands have been destroyed, artificial feeding supports large numbers of cranes (Ohsako 1987), but the concentrated birds threaten local farming and are vulnerable to disease (G. Archibald, ICF, pers. commun.).

Only recently have nature reserves such as CNR or ZNR begun to emphasize wise use of the wetland resources. The extension education programs of some North American universities, where extension agents give practical instruction to farmers and businessmen on how to use and conserve soils, waters, forests, or fish, might provide a good model for Chinese reserves. Vaguely focused education programs, without specific conservation goals, are often hardly worth their share of the scarce funds available to the reserves.

### Staff and Training

Given the rapid growth of a large reserve system in just 15 years, it is not surprising that reserves suffer from a lack of trained staff. Chinese universities have only 1 wildlife department, at the Northeast Forestry University in Harbin. A further problem is that the reserves tend to lie in remote areas with difficult living conditions. Unlike the American love for rural life, few educated Chinese want to live in such places; everyone tries to move to the larger cities with reasonable amenities. As a general rule, the reserves near cities, such as East Dongting Lake Nature Reserve near Yueyang City in Hunan, have the best qualified staff.

Training opportunities are essential. ICF has therefore invited and received numerous delegations from the reserves and the relevant provincial agencies. The chance for Chinese colleagues to see the varied approaches to conservation long established in North America can be invaluable, as China lacks such examples. There is a tendency for everyone to want training trips to the United States, however, and careful selection of training goals and individuals to be trained is necessary.

At least as important can be the visits of North American specialists to the nature reserves in China. Even brief visits from foreigners can cause provincial and local authorities to attend more closely to conservation efforts.

Foreigners consulting in Chinese reserves are handicapped by their own ignorance of Chinese conditions and culture. This handicap can be partially overcome if we spend most of the time listening and asking innumerable

questions. Only then can we provide information useful to our hosts. If possible, look at the world (or at least the marsh and cranes) through the eyes of the local farmer, the fisherman, and the reserve manager. Almost always their view has a strong consistency and rationality, even if greatly contrasting with our North American perspective.

We can especially offer ecological perspectives for species and habitat management, and descriptions of what we have learned over the last half century in North America. These descriptions cannot be taken as literal recipes for Chinese conservation, but as stimulants for how to approach similar problems with Chinese solutions. For example, managed hunting, as practiced in North America, could not be controlled in China and would not provide significant income for conservation from the local people. We can emphasize, however, the needs for control and for a sound research base before legal hunting is considered.

Conservationists familiar with standards of North American reserves can become depressed or angry about conditions in Chinese reserves. The reserves must still overcome extraordinary challenges if they are to be effective, but they have come a long way in a very short time. I think one has a choice about whether to be optimistic or pessimistic. Optimism is much more fun, and will encourage better efforts among everyone involved.

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