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1-1-1983

Cranes of the World: 7. Endangered Species and Conservation

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7 Endangered Species and Conservation

Few families of birds, other than some associated with small island archipelagos, have such a large proportion of their species in danger of extinction as does the crane family. Of the 14 extant species of cranes, King (1979) regards two full species (whooping crane and Siberian crane) as endangered, three more (Japanese, hooded, and white-naped) as vulnerable, and the black-necked crane as of indeterminate status. Additionally, one race (the Mississippi) of the sandhill crane is classified as endangered, and the Cuban race is regarded as rare and local. Thus, more than a third of the world's crane species are currently considered vulnerable or endangered.

There is also good reason to believe that the wattled crane is rapidly declining and should perhaps be placed in the "vulnerable" category. The eastern sarus crane is probably also in a vulnerable situation. It is thus worth considering the current populations of each of these forms, and their prospects for survival in the future. A general summary of their estimated current population sizes is presented in table 28, and in the following discussion the endangered species are organized in a sequence reflecting their apparent relative rarity. The rare or endangered subspecies are discussed after the accounts of the full species.

RARE OR ENDANGERED SPECIES

Whooping Crane

The history of the endangered whooping crane is now so well known, as a result of the monograph by Allen (1952) and several more recent popular books (McNulty, 1966; McCoy, 1966; Zimmerman, 1975), that a detailed discussion seems unwarranted. Derrickson (1980) has summarized much of the population data for the species up to the late 1970s, and Johnsgard (1982) has also provided an analysis of the trends of the mortality and natality rates that are becoming evident.

The lowest known wild population size of the whooping crane was in 1945, when only 17 birds appeared at Aransas National Wildlife Refuge in Texas, and when only 2 more were known to be existing in Louisiana. The Louisiana population had disappeared by 1949, and in 1952 only 21 birds arrived and wintered at Aransas National Wildlife Refuge. The same number was present in the fall and winter of 1954, but the mid-1950s marked the beginning of a gradual increase in numbers that is still continuing. In the fall of 1975, the first fledged offspring resulting from the egg transplantation experiments at Gray's Lake, Idaho, reached the Rio Grande Valley of New Mexico, providing a secondary wintering population site (table 29). Numerical information on the success of this experiment through 1980 was provided earlier (table 20).

At present, the whooping crane population is slowly increasing, reaching nearly 100 birds by 1982, although the species' actual natality rates are the lowest in history (Johnsgard, 1982). Thus, there is little reason to feel secure about its long-term status, and more intensive efforts must be made to find ways of increasing the actual number and success of wild breeding pairs. These remain remarkably few, and perhaps have not significantly changed in the past 20 years, judging from the total numbers of fledged young reaching the wintering grounds annually (table 29).

Siberian Crane

In his summary of the status of this species in the USSR, Flint (1978a) suggested that the eastern Siberian breeding population then numbered no more than some 300 birds, and the western Siberian population

TABLE 28

Estimated Population Sizes of Endangered Populations of Cranes

Species or Race	*Estimated Number in Wild*	*Number in Captivity, 1979 & 1980**	*References*
Wattled Crane	Endangered in Transvaal & Natal.	69	West, 1976
	Local in Zambia & Botswana, 1970s.		Konrad, 1981
	Few in Namibia, Zimbabwe, Malawi, Ethiopia, Angola, Zaire, and Mozambique, 1970s.		Konrad, 1981
Siberian Crane	ca. 24 breeding in western Siberia, 1980 (9 wintering in Iran, 15 in India).	12	Archibald, 1981c
	ca. 300 breeding in eastern Siberia, 60 in eastern Siberia, mid-1970s.		Flint, 1978a
White-naped Crane	2,700 in late 1970s.	154	Yamashina, 1978
Cuban Sandhill Crane	ca. 100-150 in late 1970s.	—	King, 1979
Mississippi Sandhill Crane	ca. 40-50 in 1980.	24	Valentine, 1981
Whooping Crane	78 wintering in Texas, 1980-81.	26	U.S.F.W.S. data
	16 wintering in New Mexico, 1981-82.		
Japanese Crane	80 in Amur and Ussuri basins, late 1970s.	139	Yamashina, 1978
	ca. 200 in Hokkaido, late 1970s.		
	Total world population ca. 300-400, late 1970s.		
Hooded Crane	2,800 in late 1970s.	92	Yamashina, 1978
Black-necked Crane	ca. 600 on Tsaidam breeding grounds	8	Tso-hsin Cheng, pers. comm.

*Data from *International Zoo Yearbook*, vols. 20 and 21 (1980 and 1981); Chinese zoo data from 1979, remainder from 1980.

consisted of perhaps 60 individuals. There had been no noticeable reduction in numbers for the past 10 years, although in the past 100 to 150 years the population had exhibited a catastrophic reduction in numbers. This was especially true of the western population, and Flint suggested that as industrial development is built up in that area the entire population might disappear. Flint considered the major causes of population declines to be human encroachment on the breeding areas, poaching, unsatisfactory remaining habitat, mortality during migration and wintering, and general disturbance of the population structure.

King (1979) provided a population estimate of the eastern (Yakutia) component as numbering 300 birds as of 1974. He also noted that Afghanistan and India support transient or wintering populations of up to 200 birds, while a remnant wintering population of 9 birds was discovered in 1978 in the south Caspian coastlands at Feredookenar. In 1981 about 100 birds from the Yakutia population were found wintering along the Yangtze River, in eastern China.

Archibald (1981c) has reviewed this species' status, and suggested that the 1979-80 population was 250 to 300 individuals, with an eastern component of about 200 birds and the remainder in the western Siberian group. The western group actually consists of two subpopulations. One of these winters in the Caspian lowlands and, as already noted, included only 9 birds in 1978. The other winters in the Keoladeo Ghana Sanctuary of north-central India, with a stopover in the Ab-i-Estada saline lake of Afghanistan. This flock declined from 77 birds in 1970 to only 15 in the winter of 1980-81, probably because of hunting on their stopover point in Afghanistan. The most recent population estimates are a 1980 estimate of 200 birds in the Yakutia population by Vladimir Flint, and 1981 counts of 16 birds in Iran and 34 in India (Ronald Sauey, pers. comm.).

Japanese Crane

King (1979) considered this species "vulnerable," and it is included in the Japanese *Red Data Book of Japanese Birds* (no date). Flint (1978a) considered it

TABLE 29

Whooping Crane Wintering Populations

Year (fall)	*TEXAS Adults*	*TEXAS Juveniles*	*Sub-total*	*LOUISIANA Total*	*NEW MEXICO Adults*	*NEW MEXICO Juveniles*	*NEW MEXICO Subtotal*	*Grand Total*
1938	14	4	18	11				29
1939	15	7	22	13				35
1940	21	5	26	6				32
1941	13	2	15	6				21
1942	15	4	19	5				24
1943	16	5	21	4				25
1944	15	3	18	3				21
1945	14	3	17*	2				19
1946	22	3	25	2				27
1947	25	6	31	1				32
1948	27	3	30	1				31
1949	30	4	34					34
1950	26	5	31					31
1951	20	5	25					25
1952	19	2	21					21
1953	21	3	24					24
1954	21	0	21					21
1955	20	8	28					28
1956	22	2	24					24
1957	22	4	26					26
1958	23	9	32					32
1959	31	2	33					33
1960	30	6	36					36
1961	34	5	39					39
1962	32	0	32					32
1963	26	7	33					33
1964	32	10	42					42
1965	36	8	44					44
1966	38	5	43					43
1967	39	9	48					48
1968	44	6	50					50
1969	48	8	56					56
1970	51	6	57					57
1971	54	5	59					57
1972	46	5	51					51
1973	47	2	49					49
1974	47	2	49					49
1975	49	8	57			4		61
1976	57	12	69		3	3	6	75
1977	62	10	72		6	2	8	80
1978	68	7	75		6	3	9	84
1979	70	6	76		8	7	15	91
1980	72	6	78		14	4	18	96
1981	71	2	73		16	0	16	89
1982†	66	6	72		—	—	14	86

NB: "Adult" category includes all birds in nonjuvenile plumage (at least 1 year old).
*Incomplete count (based on counts during previous and following falls, 18 adults and 4 juveniles were probably alive in 1945).
†Based on December information.

TABLE 30

Japanese Crane Populations on Hokkaido*

Year	*Adults*	*Juveniles*	*Total*
1952	—	—	33
1953	—	—	42
1954	—	—	52
1955	—	—	61
1956	—	—	76
1957	—	—	92
1958	—	—	125
1959	—	—	139
1960	—	—	172
1961	—	—	175
1962	164	20	184
1963	128	19	147
1964	137	17	154
1965	148	24	172
1966	144	26	170
1967	171	34	205
1968	147	24	171
1969	188	24	212
1970	146	33	179
1971	129	18	147
1972	195	27	222
1973	204	29	233
1974	221	32	253
1975	180	14	194
1976	180	40	220
1977	229	28	257
1978	195	19	214
1979	215	34	249

*After Masatomi (1979, 1981b)

"very rare, and disappearing" in the *Red Data Book* of the USSR. In 1964, the USSR breeding population was some 200 to 300 birds, including 30 to 35 breeding on the southeastern shores of Lake Khanka (Fisher, Simon, and Vincent, 1969). However, Flint estimated that in the late 1970s there were no more than 25 to 30 breeding pairs in all of the USSR, and a known total world population of 282 birds, based on winter census data. Similarly, Yamashina (1978) estimated that about 80 birds occur on the known USSR breeding grounds (the east shore of Lake Khanka and the middle courses of the Amur and Ussuri rivers), and that there are some as yet unknown breeding numbers along the River Sungari in northern Manchuria, and in extreme northeastern Mongolia.

Although population sizes are unknown, the Japanese crane certainly once bred on both Hokkaido and Honshu, and perhaps also on Shikoku and Kyushu, but by the late 1800s it may have been confined to a single area in eastern Hokkaido. When this population was discovered in 1924 it was found to have less than 20 birds and only three known active nests. The area was made a sanctuary in 1925 and was then believed to include 20 to 30 birds. By 1934 there were about 30 resident birds, and by 1949 about 35 were present. Since 1952 fairly complete counts have been made on a yearly basis (table 30). The large buildup of birds during the late 1950s and early 1960s is remarkable and seems too rapid to have been accounted for by normal reproductive potentials. It thus must in part have resulted from the attraction of cranes from elsewhere, presumably from the continent. Yet this population is essentially sedentary, although a few Japanese cranes turn up in the winter with other cranes in a crane sanctuary at Arasaki, Kagoshima Prefecture, Kyushu. Since the early 1970s the Hokkaido population has remained essentially stable at between 147 and 257 birds (table 30).

Compared to this Japanese population, the mainland population (which Archibald, 1975, 1976, considers a distinct race) is much more difficult to estimate accurately. The USSR breeding ground estimates have already been mentioned, and these birds now winter largely or entirely in Korea. Previously, wintering also occurred south to central China and on Taiwan.

Besides a few birds that winter each year in South Korea, there is also a small colony that both winters and apparently also breeds near Pyonguang Zoo, North Korea (King, 1979). The wintering population in China is unknown but may number in the hundreds. In Japan the species has been considered a National Monument since 1935, and a Special National Monument since 1952. It was designated as a National Monument in South Korea in 1968, and is also protected in North Korea and in the USSR. A history of its conservation in Japan was provided by Masatomi (1981a).

Hooded Crane

This species was reported as "vulnerable" by King (1979) and was included in the *Red Data Book* of the USSR (Flint, 1978a) and in that of Japan. Flint classified it "rare, little-studied," and considered it an endemic breeding species in the USSR.

Almost nothing can be said of the breeding population, as very few nests have been found. An estimated 12 to 15 pairs breed in the Bikin River marshes, Ussuri basin. Winter counts suggest a population of about 2,800 birds in the late 1970s. Of these, about 1,500 to 2,200 winter on Kyushu Island and about 75 to 100 on Honshu, and there are few if any still present in Korea (Flint, 1978a). There is no recent information as to numbers wintering in China. In Japan, the wintering population dropped from 3,435 in 1939 to only about 250 after the Second World War. However, by 1973 there were 2,793 reported in Kagoshima Prefecture and 137 more in Yamaguchi Prefecture. Thus, nearly all the hooded cranes of the world now winter in Japan, so far as can presently be judged (Yamashina, 1978). A listing of numbers observed at Arasaki, Kagoshima Prefecture, and in Yamaguchi Prefecture is provided in table 31. These two areas are the only significant wintering areas in Japan, and provide the best available estimates of the species' numbers. The Japanese wintering population has been protected since 1955, and the hooded crane has been considered a National Monument in South Korea since 1970 (King, 1979). Kawamura (1981) has summarized population data for Yamaguchi Prefecture, and Nishida (1981) has done the same for Kagoshima Prefecture.

White-naped Crane

This species is regarded by King (1979) as "vulnerable," and was classified by Flint (1978a) as "very rare, numbers decreasing" in the *Red Data Book* of the USSR. Although it formerly wintered throughout Japan, the species now is limited to the area of Sendai, Kyushu. It was formerly much more abundant in Japan, and 469 were counted in 1939. However, by 1947 the number was down to 25. By 1974 the species had increased to approximately 600 birds. Nearly 1,500 birds were counted in Japan in the winter of 1977-78 (table 32).

Flint (1978a) estimated the world population as 2,632 birds, based on winter counts. Numbers on the breeding grounds are still unknown, but it is believed that breeding occurs primarily in Mongolia and Manchuria, with possibly some breeding in the Tuvinskaya ASSR. No breeding is known to occur in the USSR (Flint, 1978a).

Certainly Korea is the most important single wintering area for this species, and in November 1961 a flock of at least 2,300 birds was found at the confluence of the Han and Imjin rivers. There were 1,500 birds in the same area in 1974, and 2,000 in 1977. A considerable number of these birds evidently continue on to Japan; as noted above, many were observed in Japan that same winter (King, 1979). At present, about 1,500 to 2,000 white-naped cranes are in the Han River estuary, and many of them scatter through the DMZ for the winter. About 1,000 now continue on to Kyushu, Japan (Won, 1981). The species has been protected in South Korea since 1970, and the Han River estuary was made a sanctuary in 1975, with additional areas (Gimpogun, Inchon) so designated in 1977. It is also given special protection at Sendai, Kyushu. Although the species has been recently reported from the lower Yangtze of China, there is no indication of the actual number of birds. The total number of wintering birds is far greater than the known breeding populations for this species, indicating that there are still unknown breeding areas to be found. These perhaps occur around the east shore of Lake Baikal, or around the Kerulen River and the Onon River basin in Mongolia (Yamashina, 1978). Their status in Korea has recently been summarized by Won (1981), Archibald (1981a), and Kyu and Oesting (1981).

Wattled Crane

Although not included in King's (1979) list, there is little doubt that the wattled crane is now suffering a substantial range retraction and has been locally eliminated from much of its originally widespread range in Africa. The species exists as two surprisingly widely disjunctive populations, which are not considered racially distinct. The northern population, restricted to a relatively small range in the Ethiopian highlands, is either small or declining (Konrad, 1981). The southern population has been reported from as far north and as low as the mouth of the Congo River, and south to the Cape of Good Hope. Actual breeding records seem to be almost entirely confined to areas east of 25° east longitude and south of 10° south latitude (Snow, 1978), although a small area of local breeding

TABLE 31

Wintering Hooded Crane Populations in Honshu and Kyushu*

Year	*Yamaguchi Prefecture (Honshu)*	*Kagoshima Prefecture (Kyushu)*	*Total*
1897	34	—	—
1907	55	—	—
1912	65	—	—
1921	100	—	—
1927	—	400	—
1929	—	600	—
1933	140	—	—
1936	—	2,381	—
1939	—	3,435	—
1940	355	—	—
1947	200	250	450
1950	160	265	425
1955	150	274	424
1960	132	376	508
1961	108	723	831
1962	111	811	922
1963	110	1,053	1,163
1964	109	1,127	1,136
1965	101	1,442	1,543
1966	125	1,447	1,572
1967	90	1,450	1,540
1968	78	1,452	1,530
1969	78	1,562	1,640
1970	91	2,072	2,163
1971	108	2,023	2,131
1972	106	2,286	2,392
1973	137	2,793	2,930
1974	90	2,158	2,248
1975	108	2,867	2,975
1976	110	2,813	2,923
1977	105	3,296	3,401
1978	87	3,179	3,266
1979	73	3,889	3,962

*After Koga (1974) and Nishida (1981)

also occurs in Ovamboland, South-West Africa (Namibia) (Winterbottom, 1971). Probably the largest part of its southern population now occurs in Zambia, Zimbabwe, the Transvaal, and Natal, according to West (1976). However, it now is extirpated from Cape Province and Swaziland and no longer occurs in western Transvaal (David Skead, pers. comm.). It is considered endangered in both Natal and Transvaal (Konrad, 1981). According to Konrad, it is also declining or present only in small numbers in Zimbabwe, Malawi, Namibia (South-West Africa), Angola, Zaire, and Mozambique. This would suggest that only Zambia and Botswana still support good wattled crane populations. In these two areas, six large wetlands provide feeding and nesting habitats for the species, with individual wetlands supporting between 250 and 3,000 birds. They include the Kafue Flats, Bangweulu, Busanga, and Liuwa in Zambia, and the Okavango and Magadigadi in Botswana. Three of these areas (Kafue Flats, Okavango, Bangweulu) are targeted for damming or wetland reclamation, and in another (Luiwa) the human population pressures are affecting reproduction of a supposedly protected crane population (Konrad, 1981). Douthwaite (1974) reported that the Kafue Flats area supports less than 1,000 birds during flood periods, but some 3,000 birds in the latter half of the dry season. Breeding occurs during the rainy season in small wetland habitats, and toward the end of the wet season in larger wetlands, as floodwaters recede (Konrad, 1981). All told, it seems quite possible that the total wild population of this species is likely to be under 10,000 individuals. Konrad (1981) has made research and conservation recommendations for this rare species.

TABLE 32

Wintering White-naped Crane Populations in Kyushu, Japan*

Year	*Total Cranes*	*Year*	*Total Cranes*
1939	467	1961	71
1940	25	1962	96
1941	50	1963	45
1942	50	1964	121
1943	30	1965	129
1944-46	?	1966	181
1947	25	1967	221
1948	50	1968	203
1949	30	1969	233
1950	28	1970	257
1951	23	1971	287
1952	20	1972	401
1953	20	1973	449
1954	22	1974	582
1955	25	1975	781
1956	27	1976	1,021
1957	31	1977	1,220
1958	34	1978	1,448
1959	45	1979	670
1960	60		

*After Walkinshaw (1973), Archibald (1978), and Nishida (1981).

Black-necked Crane

Of all the crane species, this is certainly the least known, and any attempt to estimate its numbers can be little more than sheer guesswork. King (1979) considered it of "indeterminate" status, although he noted that during the 1930s it was still apparently fairly common on the wintering grounds of Yunnan, China (Schäfer, 1938). King noted that 15 had been seen during the winter in Bhutan in 1974, and a few adults plus one chick had been observed in Ladakh in 1976 (Ali, 1976). A nest was observed in the same area in 1978 (Gole, 1981), but the species is certainly extremely rare in Ladakh. Most recently, an estimate of about 600 birds seen during October 1979 in the Tsaidam Basin of China now provides a crude indication of its abundance (Cheng, 1981).

RARE OR ENDANGERED SUBSPECIES

Cuban and Mississippi Sandhill Cranes

The Cuban race of the sandhill crane is considered "rare and local" by King (1979), while the Mississippi race is considered an endangered population by King as well as by the U.S. Fish and Wildlife Service.

King estimated the Cuban population to total probably some 100 to 150 birds. These include about 30 on the Isle of Pines, about 30 in the Zapata Swamp area, and smaller numbers in the Pinar del Rio pine barrens. There are probably also some still present in the Camaguey prairie area. However, no hard information is available on any of these areas at present. Walkinshaw (1949) estimated that in the mid-1940s only 15 to 20 pairs occurred on the Isle of Pines, but no earlier good estimates are available for this race.

The Mississippi sandhill crane was first reported in 1928 and was believed at that time to number approximately 50 to 100 individuals. In 1940 Walkinshaw (1949) estimated that 25 pairs of birds might be then breeding in Jackson County. In 1972 it was recognized as a distinct race, and in 1973 it was designated as an endangered form. Valentine and Noble (1970) estimated that the population consisted of less than 40 birds in the late 1960s. The most recent available estimate is that of Valentine (1979, 1981), who suggested that as of 1978 there were 12 to 15 breeding pairs, and the total 1980 wild population was 40 to 50 birds. An area of some 6,070 hectares in Jackson County was declared a national wildlife refuge in 1974, and in 1977 an area of 10,552 hectares (26,000 acres) also was designated as critical habitat. Valentine has also outlined the recovery plan for this population, which includes the raising of 10 captive pairs to provide stock for supplementing the wild population and for translocating to other parts of

the original range of this race. Such releases began in 1981 with apparent success (Valentine, 1982).

Recently Walkinshaw (1981a) has estimated the Cuban sandhill crane to number about 200 birds, the Mississippi population to be 40 to 50, and the Florida race to be about 4,800 individuals.

Burmese Sarus Crane

Although this subspecies is not included in King's (1979) listing, Archibald et al. (1981) reported that the eastern or Burmese sarus crane is now considered extirpated from Burma, Thailand, Malaysia, and the Philippines and is of undetermined status in Cambodia and Vietnam. On the other hand, it has recently colonized Queensland, Australia, and seems to be increasing there. Madsen (1981) was unable to locate any cranes on Luzon, of the Philippines, during searches in 1979, but believed that a few isolated individuals might still survive in the Tabuk area of Kalinga-Apayao Province. The Philippine government may begin a restocking program by releasing hand-raised birds (Archibald et al., 1981).

Major Sources of Mortality in Wild and Captive Cranes

If rare and endangered cranes are to be preserved effectively, then a few words on the probable major sources of crane mortality, both in the wild and in captivity, are warranted. There are few good summaries of actual sources of mortality in wild crane populations, since most deaths obviously go unobserved and unreported. Allen (1952) judged that of the 39 estimated whooping crane mortalities (of birds that had survived to reach Aransas at least once) between 1939 and 1949, 14 birds (representing 36 percent of the total) were known to have been killed, while the fate of the remainder was unknown. During this entire period the species was federally protected and its status was well publicized; thus illegal killing was a surprisingly high source of mortality.

A more complete documentation of losses in wild cranes is available for the Japanese crane on Hokkaido, for the period 1950-1979 (table 33). During this period a total of 245 cranes were known to have died. These deaths occurred during the total of 2,168 "crane years,"

TABLE 33

Mortality Sources in Various Crane Populations

	Captive Populations			
	*Chicks**	*Immatures and Adults†*	*All Ages†*	*Wild Japanese Cranes‡*
Diseases				7.7%
Herpes	—	—	36.1%	—
Erysipelas	—	—	3.2%	—
Pneumonia	11.8%	—	3.2%	—
Staphylococcus	—	—	3.2%	—
Enteritis	8.8%	7.0%	—	—
Omphalitis	8.8%	—	—	—
Septicemia	5.9%	—	—	—
Miscellaneous	2.9%	1.8%	6.5%	—
Parasites	5.9%	3.5%	—	—
Traumatic Effects				
Fighting	4.4%	26.3%	16.4%	—
Collision with wires	—	—	—	70.9%
Injury or accident	7.3%	15.7%	6.5%	—
Shooting	—	—	—	2.0%
Cold stress	7.3%	—	6.5%	—
Unspecified trauma	—	—	3.2%	—
Age	—	—	3.2%	—
Anatomical Abnormality	20.6%	—	—	—
Predator	2.9%	1.7%	3.2%	—
Miscellaneous	19.4%	—	—	—
Unknown	2.9%	8.8%	8.2%	21.2%

*Based on 68 chicks and 57 immature or adult sandhill cranes at Patuxent Wildlife Research Center (Carpenter, Locke, and Miller, 1976).
†Based on 61 deaths of 13 crane species at the International Crane Foundation (Archibald and Viess, 1979).
‡Based on deaths of 245 cranes in Hokkaido (Akiyama, 1981).

judging from table 30, and thus represent a known mortality of about 1 percent per year. Of these deaths, much the largest single mortality source was trauma caused by collision with electric wires. It remains to be seen whether other crane populations are as vulnerable to wire collisions as these figures indicate, but there is evidence that utility highlines pose a potentially serious threat to sandhill cranes as well (Tacha, Martin, and Endicott, 1979). The presence or installation of utility lines through areas of critical habitat for endangered cranes should certainly be avoided if possible.

By comparison, mortality sources for captive crane populations seem to consist primarily of traumatic factors or disease pathogens, with accidental deaths being relatively insignificant (table 33). During the period from the establishment of the International Crane Foundation in 1973 to 1978, 61 of 195 captive cranes died, or roughly 6 percent per year. Of these losses, much the largest resulted from a herpes outbreak in 1978, emphasizing the danger of keeping captive birds on areas of continually used soil. Another important mortality source was "aggressive trauma" or "cranicide," caused when one crane attacked another, usually because of territorial intrusion. A few deaths of small or young cranes have been caused by avian predators such as great horned owls (*Bubo virginianus*), although probably most cranes, once they attain fledging, are relatively safe from such predators. Nonetheless, one juvenile crane on its fall migration between Gray's Lake and New Mexico was observed to be attacked in flight and killed by a golden eagle (*Aquila chrysaetos*).

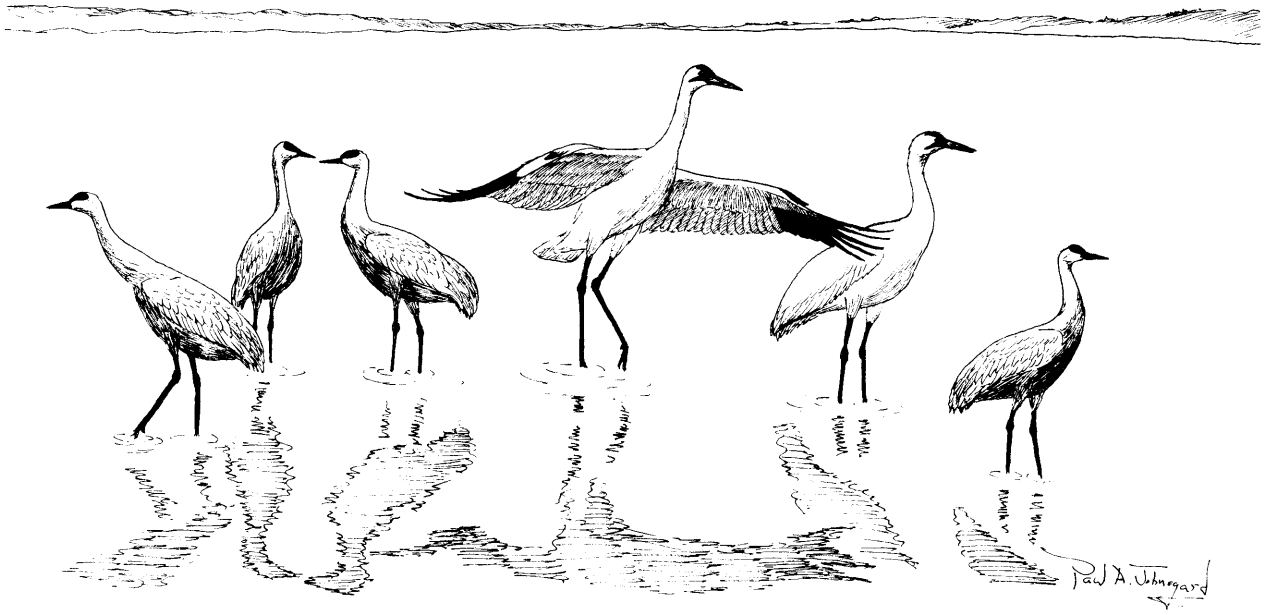
Parasitic infections occasionally pose serious problems in both wild and captive bird populations. Thus, parasites contributed to 7 percent of the 135 sandhill crane mortalities at the Patuxent Wildlife Research Center between 1966 and 1975 (Carpenter, Locke, and Miller, 1976). Treatment methods for major parasitic infections of captive cranes have been outlined by Carpenter (1979). These included gapeworms, coccidiosis, and idiopathic protozoan infections, primarily of young birds. However, only gapeworms seem to cause significant adult mortality in cranes. In this combined sample of adults and young birds, trauma from aggression, injury, or accident was responsible for 30 percent of the deaths, infectious diseases 18 percent, anatomical abnormalities 13 percent, and nutritional problems 4 percent. Additionally, miscellaneous factors were responsible for 20 percent, 4 percent of the birds were subjected to euthanasia, and the deaths of 6 percent were from undetermined causes. Unlike the tabulations shown in table 33, these mortality figures include all age-groups from downy young (which accounted for half of the total deaths) to adults. The largest category (36 percent) of mortality factors of downy young consisted of diseases such as pneumonia, omphalitis, and septicemia, while for immatures and adults various traumatic factors caused the largest single source of mortality.

Summary of Distributional Status of Endangered Cranes

Archibald et al. (1981) recently summarized the distribution patterns and population trends of the endangered populations of cranes, and analyzed the present and past distributions of all crane species by countries. An abbreviated summary of their information is presented in table 34. It is apparent from this table that a multinational effort will be required for virtually all of the endangered cranes for effective conservation, since all of the endangered cranes depend on habitats in several countries for part or all of their life cycles. Of the threatened species, only the wattled crane is entirely nonmigratory, and thus only it is likely to be effectively managed by the actions of any single nation. The black-necked and Japanese cranes also have resident populations in China and Japan respectively, while the hooded and white-naped cranes must depend on the cooperative efforts of the several countries that encompass their breeding, migrational, and wintering areas. The future of the whooping crane is likewise essentially dependent upon the bilateral cooperation of the United States and Canada, although efforts are being made to establish a new breeding population confined within the limits of the United States and having a shorter and more fully protected migration route. Similarly, the Soviets and Iranians may cooperate in establishing a new and more secure population of Siberian cranes by substituting Siberian crane eggs into the nests of Eurasian cranes that breed in Siberia and winter in the Arjan National Park of Iran. A less likely possibility would be to place the eggs of Siberian cranes in nests of lesser sandhill cranes, which breed in Siberia but winter in the western United States. However, this latter population is now subjected to considerable hunting pressure, and thus there are many serious conservation problems associated with this option (Archibald, et al., 1981).

TABLE 34

Countries Represented in Current Distributions of Cranes of the World*

	Permanent Resident	*Summer*	*Transient*	*Winter*
Black-necked Crowned Crane	12	—	(2)	—
Gray-necked Crowned Crane	15	—	—	—
Demoiselle Crane	—	6	25 (3)	13
Blue Crane	4	1 (1)	—	—
Wattled Crane (Vulnerable?)	10	—	—	—
Siberian Crane (Endangered)	—	1	7	3 (2)
Australian Crane	3	—	—	—
Sarus Crane	5	—	—	—
White-naped Crane (Vulnerable)	—	3	6	4 (1)
Sandhill Crane (all races)	2	4	4	2 (1)
Mississippi Sandhill (Endangered)	1	—	—	—
Cuban Sandhill (Endangered)	1	—	—	—
Whooping Crane (Endangered)	—	2	2	1
Japanese Crane (Vulnerable)	1	2 (1)	2	3 (2)
Hooded Crane (Vulnerable)	—	2	6	2 (2)
Black-necked Crane (Vulnerable?)	1	2	5	5
Eurasian Crane	—	11	47 (1)	27 (4)

*Numbers indicate countries in which species currently is regularly present; additional irregular presence indicated by parentheses. Modified from Archibald et al. (1981).