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Cranes of the World: White-naped Crane (*Grus vipio*)

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White-naped Crane

Grus vipio Pallas 1811

Other Vernacular Names. Japanese white-necked crane;

Ts-ang-kua (Chinese); Grue à cour blanc (French); Weissnacken-Kranich (German); Mana-zuru (Japanese); Dachkai zhuravl (Russian); Grulla de cuello blanco (Spanish).

Range. Breeds on the Transbaikalian steppes probably from the Onon and Argun rivers eastward through northwestern and central Manchuria to the southern Ussuri Valley, the basin of Lake Khanka, and in southwestern Ussuriland. Known recent breeding areas (Yamashina, 1978) include the marshlands around the central part of the Primorskiy Krai (Maritime Territory), the middle drainage of the Amur River (from the upper Zeya to the Bureya and the Archara), and in northwestern Manchuria (Jaranton). Also breeds in eastern Mongolia to headwaters of the Kerulin River (Bold, 1981). Migratory, wintering in Korea, in southern Japan (Arasaki, Kyushu), and (formerly) on the lower Hwang and Yangtze rivers of eastern China, with vagrants sometimes reaching Fukien and Taiwan.

Subspecies. None recognized.

Measurements. Wing, males 510-585 mm (average of 9, 562.9 mm); females 521-560 mm (average of 6, 546.8 mm). Exposed culmen, males 128-155 mm (average of 9, 145.1 mm); females 128-148 mm (average of 6, 137.8 mm). Tarsus, 242-262 mm (average of 9, 253.7 mm); females 230-263 mm (average of 6, 242.3 mm). Eggs, average 99.3 × 61.5 mm (92.7-103.0 × 58.5-62.7 mm) (Walkinshaw, 1973).

Weights. Adults of both sexes range from 4,750 to 6,500 grams (Tso-hsin Cheng, pers. comm.). Four hand-reared young averaged 3,294 grams at 70 days of age (Archibald and Viess, 1979), and five hand-reared birds averaged 3,405 grams at 73-78 days (Christine Sheppard, pers. comm.). The estimated average egg weight is 207 grams.

Description

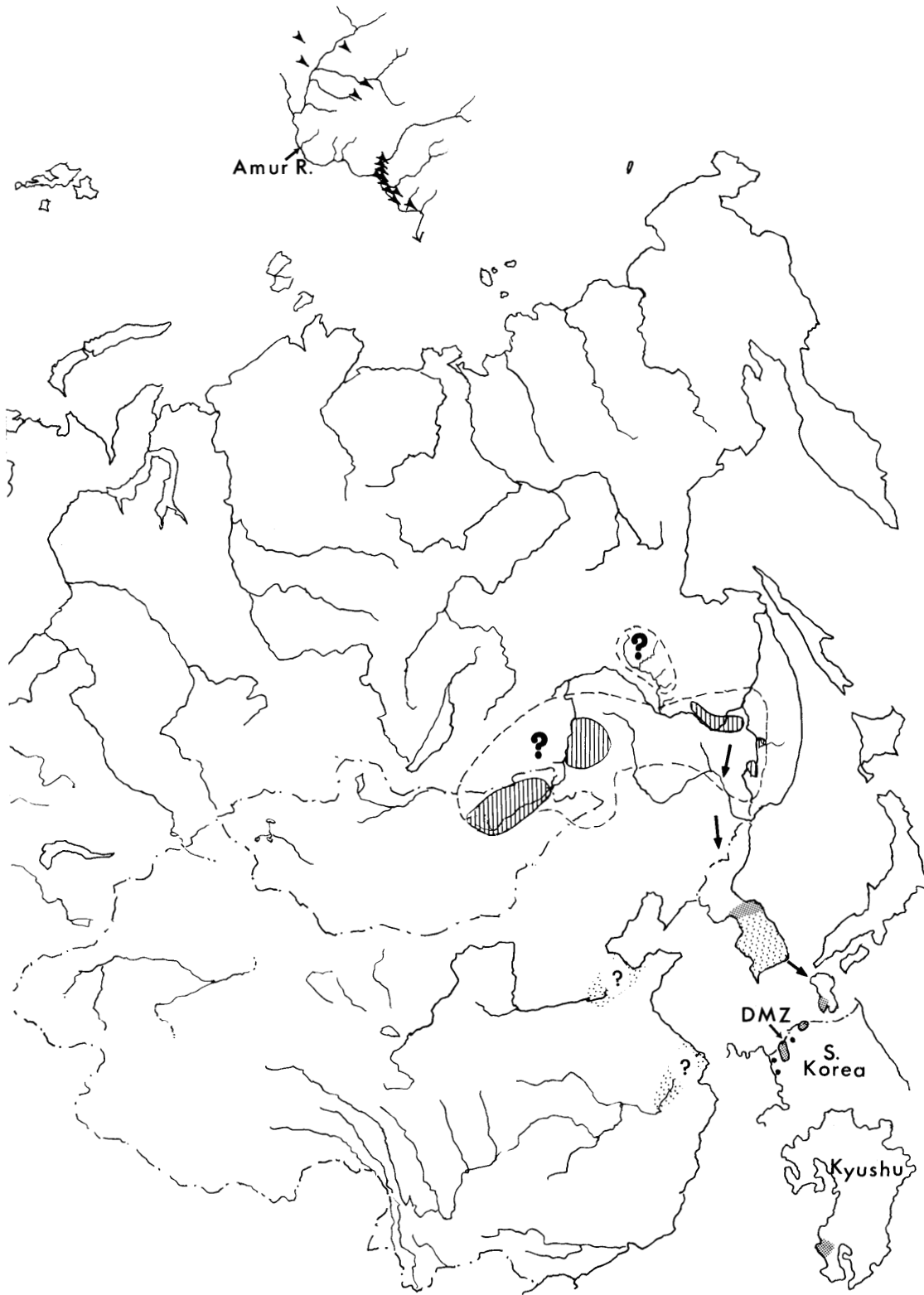
Adults of both sexes are alike, with the face and forehead mostly bare of feathers to about 25-30 mm behind the eye, and reddish, with dark bristly hairlike feathers scattered on the cheeks and forehead, and with a small oval-shaped area of light gray feathers around the ear opening. The rear portion of the head, the entire hindneck, and the throat are white. The front of the neck is dark grayish, the grayish area extending up the sides of the neck and terminating in a point close to the bare facial patch. The primaries are black, with white shafts, and the basal portions of the inner webs are also white. The secondaries are blackish, with whitish bases that are mottled from about the fourth secondary inward, while the innermost secondaries are white, decurved, lengthened, and pointed. The wing coverts are light gray, and the greater coverts are white terminally. The lower portion of the body and the breast are dark slaty gray and continuous with the dark gray of the neck. The tail is dark gray, tipped with black. The iris is orange yellow, the bill is greenish yellow, and the legs and toes are pinkish.

Juveniles have the head entirely covered with cinnamon brown feathers, which also occur on the neck. The throat is yellowish white, and the breast and underparts are gray, the feathers with slightly yellowish margins. The tail and wings are blackish gray.

Downy chicks are tawny yellow, becoming somewhat white below and more brownish above, with darker spots on the upper parts of the wings, the rump, and the lower back (Walkinshaw, 1973).

Identification

In the field, the dark grayish body, becoming silvery gray on the wings and wing coverts, and the white



Breeding (hatched) and wintering (dark shading) distributions of the white-naped crane. Broken lines enclose regions of possible but unproven breeding, and arrows indicate known migration routes. Light stippling indicates region of prior or uncertain wintering. Insets show locations of breeding season occurrence in the Amur Valley (above), and wintering localities in Korea and Kyushu, Japan (below).

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hindneck and nape, surrounding an extensively reddish face patch, serve to identify this species, which is the only crane with pinkish legs and a dark gray and white striped neck. Its calls are loud, and during the unison call the male strongly raises his wings while letting the primaries droop.

In the hand, the combination of pinkish legs and a neck that is vertically striped with dark gray and white serves to identify this species. The trachea is coiled within the keel of the sternum.

DISTRIBUTION AND HABITATS

Historical and Current Breeding Ranges

The exact limits of the past and current breeding ranges of this rare species are still extremely uncertain. Probably it was more extensive in the past, although summer records west of Lake Baikal are likely to have resulted from nonbreeding birds summering outside the known breeding range.

The western limits of the current breeding range may be in the Zabakalskiy area south of Lake Baikal, in the valley of the Selenga River, and the eastern limits are around Lake Khanka, Maritime Territory, where breeding occurred as recently as the early 1960s. Apart from this latter area, known recent breeding areas are very few. They include the middle courses of the River Amur and its northern tributaries (the Zeya, the Bureya, and the Archara), and the vicinity of Jaranton in northwestern Manchuria (Yamashina, 1978). However, the major part of the nesting range probably occurs in northeastern Mongolia, in the basin of the Kerulen River, and especially in the Uldz and Onon River valleys (Flint, 1978b, Kucheruk, unpublished ms).

In Mongolia, the white-naped crane is a common but not numerous nesting species throughout the forest-steppe zone of eastern Mongolia, from the Halhin River to the headwaters of the Kerulen (Bold, 1981). Kucheruk (unpublished ms) found that in Mongolia its breeding range is confined to a narrow strip of forest-steppe of the southeastern Hetiy foothills, but does not include the steppe plains and the eastern Gobi Desert. Isolated encounters with the bird in the basin of the Halhin River and to the north of Tsitsikhar (Ch'ich'ihaerh) in the region of Haerhpin (Harbin) in Manchuria suggest that its range stretches in a narrow band of forest-steppe along the western and eastern foothills of the Greater Khingan Range and the northern edge of the Central Manchurian Plain, northward into the lowlands of the Zeya and Bureya river basins, and eastward to Lake Khanka. The range configuration seems to coincide with that of the Daurian and Manchurian mole-rats (*Myospalix* spp.), according to Kucheruk.

In the upper and middle reaches of the Uldz River and west to the vicinity of Hentiyn Nuruu, the species is fairly common in the breeding season. Kucheruk observed 35 cranes in five areas along a 530 kilometer route through this region. Two pairs with three juveniles were seen in the valley of the Dzharkai-Bulka River, 15 kilometers south of the Uldz. This river is a tributary to the Uldz, and flows into it 30 kilometers west of Dash-Balbar. A group of 15 was observed feeding in the Uldz Valley, near Norovlin, and a pair was seen where the Shasyn River flows into the Onon. Six more were seen along the lower reaches of the Dund-Bayan, which enters the Uldz about 50 kilometers from the mouth of that river. Finally, two pairs were seen in the wide, swampy valley of the Barunburt River about 20 to 25 kilometers northeast of Omnodelger.

The other major apparent breeding area of the white-naped crane is in the middle Amur River drainage, especially between the Bureya and Uril Rivers, and possibly extending to the middle reaches of the Zeya River and into the valley of the Urkanka. About ten pairs nest in the Amur region at present (USSR Crane Working Group Information Bulletin No. 2, 1981). In 1970 four pairs were known to be nesting in an area of 300 square kilometers of the Amur Basin (Dymin and Pankin, 1975). In the same year, an estimated two to four pairs nested on an area 50-300 square kilometers between the mouth of the Bureya River and the Bureinskii Range, according to Kucheruk, and perhaps referring to the same observations. Yamashina (1978) has plotted breeding records and other areas of occurrence during the breeding season for this region; the map inset is based on his compilation. The birds have been seen summering in the Jewish Autonomous Region (Yevreysk A.O.), and in the Bikin River basin of northern Primorskiy Kraj, and possibly have nested there too (Flint, 1978b). No nests have been found in the Upper Amur basin, but pairs have been encountered along the Zeya and its tributary streams (Dymin and Pankin, 1975). It is possible that at present no more than about twenty pairs exist within the USSR, with the remainder of the population presumably breeding in Mongolia and Manchuria (King, 1979).

In the Ussuri River valley, white-naped cranes were fairly common when studied by Prezhwalsky (1877), nesting on the Prihanka plain. Vorobiev (1954) observed the birds to be present in the Lake Khanka region in late spring of 1945, but was unable to confirm that they still nested there. Shibaev (1975) found no information on nesting there after Prezhwalsky's studies (1877) except for a report of nesting in the middle reaches of the Bolshaya (Greater) Ussurka River, in 1938-39. However, he stated that as recently as the 1960s an amateur observer reported white-naped cranes nesting in the Bikin River area. As recently as 1961-1964 four or five pairs still nested at Lake Khanka, and in 1980 four or

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five pairs were counted there at the mouth of the Ilistay River (USSR Crane Working Group, Information Bulletin No. 2, 1981).

Habitat Requirements, Densities

Flint (1978a) characterized the breeding habitat as level, marshy, and unforested areas within forest-steppe habitats. He also describes it (1978b) as consisting of grassy moors or herbaceous swamps, and flooded meadows, in wide river valleys and lake hollows in steppe or forest-steppe. These are essentially the same conditions required by Japanese cranes, and such habitats are frequently the ones affected by drainage and subsequent cultivation or used as hayfields and pastures. Kucheruk stated that the species nests only in wide, dish-shaped boggy and unwooded valleys in the upper reaches of small rivers, and believed that in such areas of the Onon and Uldz river valleys the breeding density is in the vicinity of about a pair per 30-50 square miles. As noted earlier, a nesting density of about four pairs in 300 square kilometers (a pair per 75 square kilometers, or 29 square miles) was estimated for the Amur Valley.

Nonbreeding Range and Habitats

The historic wintering range of this species included Korea, southern Japan (Kyushu), and eastern China (the lower Yangtze), according to Vaurie (1965) and Walkinshaw (1973). Records indicate that in China the major wintering area is the Yangtze River, although a few may also winter in the southern park of the Maritime Province on the Suyfun River south of Lake Khanka. Cheng (1981) lists the white-naped crane among the species of cranes currently wintering in China, and stated that some birds also occasionally winter in Fukien and Taiwan provinces. However, King (1979) indicates that there are no recent records of white-naped cranes wintering on the Lower Yangtze River. The species used to winter in large numbers in Korea, prior to the Korean war, and still occurs in fair numbers there. However, its major current wintering area is now probably in Kyushu, Japan. It was also collected once on Bonin Island well to the south of Japan, (Walkinshaw, 1973).

In Korea, the species once wintered throughout the entire country, but now is found primarily in North and South Chungchong provinces, with the Han River Estuary of the Demilitarized Zone an important staging area. The species was designated a Natural Monument in 1968 in South Korea, and the Han River staging area has been named a provisional Natural Monument, as well (King, 1979). The wintering status of the birds there has been recently summarized by Kyu and Oesting (1981), Won (1981), and Archibald (1981a). The white-naped cranes arrive in Korea in early October, and

concentrate in October and November on the Han River Estuary. Several hundred also gather along the Sachon River, which passes through the center of the DMZ, and a group of 15 to 20 winters in the Cholewon Basin of the central highlands, some 75 kilometers east of the Han River estuary. The Sachon River and Cholewon Basin populations are stable through the winter, but about half of the Han River population migrates south in late November, and is presumably the flock that winters in Kyushu, near Izumi.

The wintering population of the white-naped cranes in Japan is concentrated in the vicinity of Izumi, Arasaki, and Sendai City, Kagoshima Prefecture. Nishida (1981) has summarized the recent numerical data on this flock, which is summarized in table 32. Walkinshaw (1973) has described the wintering activities around Arasaki, as has Archibald (1973). Inasmuch as this group seems to be simply a subcomponent of the Korean flock, total numbers wintering in Kyushu in any given year may not reflect actual population changes so much as changes in local weather or feeding conditions in Korea. Thus, the increases in numbers of birds in the late 1970s were much larger than could have occurred by reproduction alone.

Wintering habitats in Korea are mostly brackish marshlands and rice paddies, with roosting occurring on salt marshes and mudflats. Those cranes wintering along the Sachon River sometimes are forced by bad weather to roost on open water and sandbars of a sheltered lake near Panmunjom (Archibald, 1981a).

FOODS AND FORAGING BEHAVIOR

Foods of Adults

In the Korean wintering areas, the white-naped cranes are primarily vegetarians, and in the salt marshes of the Han River estuary the birds feed on sedge tubers of *Scirpus maritimus* and seeds of various grasses. In rice paddies they feed mainly on gleanings of grain. They prefer to forage in the recently wetted area of the Han marsh, usually along tidal channels where there is moist mud where they can easily dig for tubers. Where the soil isn't covered by water at high tide, the birds often walk slowly about, apparently searching for seeds or small animals on the surface. When feeding on tubers, the birds are primarily diggers, rarely moving much, and often exhibit feeding territoriality, but when feeding on seeds they are wandering searchers, and usually are nonterritorial (Archibald, 1981a).

In Kyushu, white-naped cranes feed in company with hooded cranes, and their fecal droppings have been analyzed by Nishida (1981). He reported that rice hulls comprised the most common food residue, occurring in 73.2 percent of the droppings. Wheat or barley husks were in 35.7 percent of the droppings, grass fragments

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were in 26.8 percent, and other edible materials (seeds, shell fragments, and insects) occurred in less than 4 percent. Grit was also found in nearly 20 percent of the droppings. Probably the majority of these droppings were those of hooded cranes, rather than white-naped cranes, since the former are much more common in the area. Walkinshaw (1973) stated that in early years the birds of the Arasaki area fed largely on bulbous roots, grain, and foods given them by local residents, but more recently feed almost entirely on wheat and carp fed them by a local crane warden and his helpers.

On the breeding grounds, the foods of this species are essentially unknown.

Foods of Young

No specific information is available on the foods of young cranes in the wild.

Foraging Behavior

Walkinshaw (1973) stated that while on their wintering areas of Japan, the cranes are no longer distinctly territorial, but instead feed side by side for some time, day after day, and are usually strung out in a long line. However, small territories are maintained around each family and even around each individual, with the male being more obvious in his territorial behavior than the female. Nishida (1981) also reported winter foraging territories in white-naped and hooded cranes in Kyushu. He stated that territories in rye, wheat, or rape fields during winter range from 20 to 300 square meters, and average about 100 square meters. The size of a particular territory seems to be influenced by population size or the area of standing crops available. Nishida did not specify differences in territorial behavior of the two species studied. As noted earlier, Archibald (1981a) found that white-naped cranes feeding in salt marshes on sedge tubers are often territorial, while those foraging on surface seeds are usually nonterritorial.

MIGRATIONS AND MOVEMENTS

Seasonal Movements

According to Dementiev and Gladkov (1969), initial arrival of these cranes on their breeding grounds in Maritime Territory occurs during the second half of March, with a major movement in mid-April. They begin to depart in September and October, remaining in southern Maritime Territory until the end of November. The fall migration mainly occurs during the second half of October and early November. By the middle of October the birds are in the vicinity of Lake Khanka and the mouth of the Tumannaya River. By the last third of October they are appearing in central Korea; presumably these not only include Maritime

Territory birds, but also those from farther west, in Mongolia and Manchuria. However, in the spring the cranes are not seen in the Ussuri area until about two weeks later than the time they leave the Korean peninsula, suggesting that the first birds to leave Japanese and Korean wintering grounds are those that are headed for the more western areas, while those nesting in the Ussuri Basin leave the wintering grounds later.

Archibald (1981a) reported that the first fall arrivals of white-naped cranes reach Korea in early October, and increase to about 2,000 by mid-November. Kyu and Oesting (1981) stated that the white-naped is the first of the cranes to arrive in Korea in autumn, appearing in late October and November in Kangwon Do Province of North Korea.

Arrival in Japan seems to be associated with yearly weather variations. Some of the white-napes wintering there arrive in mid-October, while others do not appear until January. Many begin departing shortly after the middle of February, and all are usually gone by the first of March (Walkinshaw, 1973). Walkinshaw reported on the departure of one large group of birds on the morning of February 21, 1969, after eight days of rainy weather. In late morning, after a period of feeding, preening, drinking, and loafing, the birds left during conditions of a light northeasterly wind and a clear sky. In the DMZ area of Korea, the white-naped cranes remain in the area until mid-March (Won, 1981). Shibaev (1975) reported arrival in the Lake Khanka area at about the end of March.

Daily Movements

At least on the wintering grounds, daily movements of white-naped cranes seem to consist of flights from nocturnal roosting sites to daytime feeding sites, and back again. In the Izumi area of Kyushu, all of the wintering cranes, white-naped and hooded, numbering about 1,000 or more, roost in a common location, although the two species remain separate. Archibald (1981a) stated that in Korea the families leading young are usually the first to leave the roosting flock at dawn. Some of the families and pairs establish feeding territories that roughly include an area of 10 to 20 meters in diameter from their prime foraging spot, while the rest of the cranes usually feed at or near their roosting site and do not evidence territorial behavior. This flock is surrounded by the family groups holding territories. Sometimes small groups leave the main flock and fly elsewhere in the estuary to forage, but they usually return at dusk to roost with the large flock. During very cold weather, the birds abandon their feeding territories, flock together, and sometimes circle high in the sky, as if to migrate further south. During such cold weather they may also remain on their roosts until early afternoon, fly out to wetlands for a few hours to feed, and then return again to their roosts. As the weather

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becomes mild again in spring, the birds leave their roosts early in the morning, but instead of visiting rice paddies, they move to freshwater wetlands and probably begin foraging on aquatic animal life prior to departing in mid-March.

GENERAL BIOLOGY

Sociality

At least on the wintering grounds, the social structure of white-naped cranes seems to consist of two subunits: a large group of nonbreeders, plus a smaller component of breeding pairs leading young (Archibald, 1981a). Nishida (1981) stated that in a sample (size unstated) of white-naped cranes in Kyushu, the ratio of cranes leading two young to those leading a single young was 27:73, suggesting that about one in three families are able to raise both young successfully, and that brood size averaged 1.27 young in this case.

In Korea, wintering white-naped cranes often associate with Japanese cranes, often feeding together in rice paddies, where the slightly larger Japanese cranes dominate the white-napes. The two species roosted in adjacent areas. In one area where they were being fed corn, a pair of white-napes supplanted several pairs of Japanese cranes that attempted to land there, but on the other hand territorial pairs and families of Japanese cranes, even though they were dominant, did not attack intruding white-napes (Archibald, 1981a). In general, the white-naped crane is more of a vegetarian than is the Japanese crane, and thus competition is not likely to be severe between these two species.

Daily Activities

According to Walkinshaw (1973), white-naped cranes on their wintering grounds of Kyushu would feed for hours, more or less, during the early morning hours, at times during midday, and again about 4:00 p.m. When it was nearly dark, they would return by family groups to their roosting field, which in the case described by Walkinshaw was an old rice field covered by shallow water. In the mornings the birds did not leave their roosts until all or nearly all of the hooded cranes had departed, and then the white-naped cranes departed as a single flock at about sunrise. While on their foraging grounds, family groups tended to become separated from larger groups, but the members of each family remained in fairly close proximity to each other.

Interspecific Interactions

As noted above, associations with Japanese cranes are common in Korea. Likewise, in Kyushu, Japan, association with the smaller hooded cranes is frequent, although the two species roost separately. In Korea,

they also feed in company with bean geese (*Anser fabalis*), white-fronted geese (*Anser albifrons*), and mallards (*Anas platyrhynchos*). Although both white-tailed sea eagles (*Haliaeetus albicilla*) and golden eagles (*Aquila chrysaetos*) prey on these waterfowl, Archibald (1981a) noted that the cranes paid little attention to these particular predators.

The species has been studied too little on the breeding grounds for any significant predators to be identified there.

BREEDING BIOLOGY

Age of Maturity and Time of Breeding

There are only a limited number of egg records for this species (see table 14), but these suggest that the egg-laying period begins in April, with most records for May and a small number extending into June. Dementiev and Gladkov (1968) indicate that egg-laying occurs from the end of April until the end of May. In the Ussuri Valley and Lake Khanka area the earliest reported broods are for May 30 and June 1, according to these authors, although Prezhwalsky (1877) reported that young were collected at Lake Khanka on May 19, while Grote (1943) stated that hatching occurs toward the end of May.

In the Amur River valley, a full clutch of eggs was reported on April 19 (Dymin and Pankin, 1975), or about a month after spring arrival.

The age of maturity and initial breeding is not known for wild birds, but is presumably similar to that of other large *Grus* species. At Flamingo Gardens in England a pair of white-naped cranes initially nested when the male was 12 years old and the female the same age (unpublished survey of Joe Blossom pers. comm.).

Pair Formation and Courtship

According to Archibald (1975, 1976), the white-naped crane is part of a species group that also includes the sarus and brolga. In all of these, the female begins the unison call, and the vocal patterns during the introductory phase of the unison display are similar in both sexes, with a short continuous call that is followed by a pause and then by a series of sexually distinct calls. During the introductory portion of her call, the female white-naped crane extends her head and neck farther back behind the vertical than do female sarus or brolga cranes. She then utters a rapid series of short calls that grade into her more pulsed and broken calls, which are uttered with the neck vertically outstretched, the bill pointed upward, and the wings held against the body. Following his introductory call, the male likewise begins a series of pulsed calls, which are longer and lower in pitch than the female calls, and with each call the male raises his humeri and drops his wrists, while

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between calls the humeri are lowered and the wrists folded. The neck is thrown back well behind the vertical, and this movement is accentuated by the contrasting neck and nape patterning. The light gray tertials and wing coverts likewise contrast with the darker gray flight feathers, emphasizing the wing movements. The male remains in this conspicuous posture for the rest of the display. The pair remains stationary and side by side throughout the entire display.

Walkinshaw (1973) reported that dancing occurs both in adult and in young birds. He observed that adults jumped, catapulted, spread their wings, and sometimes called while dancing. They also picked up objects with their bills, and sometimes had synchronized dancing. He noted that the unison call was uttered throughout the winter in Japan, and under zoo conditions he observed it once when the pair was exchanging places at the nest and on another occasion when they were attacking a pair of sarus cranes.

Threat displays of the white-naped crane appear to be identical to those of other *Grus* species. Walkinshaw observed that on two occasions, attack was preceded by "false-preening" displays, and on two other occasions, by laying down in front of other birds, the "squat-threat" display. The usual aggressive sequence observed by Walkinshaw was the false-preening display, followed by arching the neck, and pointing the bill groundward, and finally by overt attack. At times, a "fluffed feather" display occurred after the false preening; presumably this corresponds to the "ruffle" display described in Chapter 2.

Territoriality and Early Nesting Behavior

As noted earlier, territorial behavior is evident during winter as well as during the breeding season, particularly among birds that are tending young. Walkinshaw (1973) states that the birds are to some extent territorial during the fall period too, and probably are especially so during spring.

Wintering territories are relatively small, as noted earlier, but there is no good information on the size of breeding territories in the wild. There are also rather few descriptions of nesting sites of wild birds. Blaauw (1897) reported that the nest is placed in the marshy parts of steppes. The birds use an islet that is elevated a few inches above the surrounding marsh, and build a nest of dead, dry grasses. The nest is flat, with a depression in the middle. Dymin and Pankin (1975) likewise reported that the nest is placed in the middle of a grassy marsh, and is a mound of dry leaves of sedges and grasses, with some additional mosses and aquatic plant stems. The diameter on one nest was 90 centimeters, the height was 20 centimeters, the diameter of the depressed area was 50 centimeters, and its depth was 2 centimeters.

In zoos, white-naped cranes typically build their nests on dry ground. Walkinshaw (1951) reported on four nests built by a pair of cranes at the Detroit Zoological Park during successive years. The first two nests were in nearly the same location, and about 46 meters from the small lake in the enclosure. The nest was even farther from the water the third year, but in 1948 it was on an "island" almost surrounded by water and well up on a ridge. In that year, the birds were released into the area in mid-April, and both eggs hatched on June 1, suggesting that nest-building must have begun almost immediately and the first egg must have been laid about April 30.

Egg-laying and Incubation

The normal clutch size is two eggs, although there are relatively few data available on clutch sizes in the wild. Koga (1975) reported that in captivity white-naped cranes lay up to eight clutches (16 to 17 eggs) in a single season when the eggs are taken from their nests, suggesting that two eggs are the normal clutch, and that rarely three may be laid. His data suggest that the eggs are usually laid two or three days apart, with gaps of about ten days between successive laying cycles.

Walkinshaw (1951) provides considerable information on incubation behavior in a pair of white-naped cranes obtained during two days of observation. During these two days, the female was on the nest a total minimum of 536 minutes (probably over 1,200 minutes, including the preceding night), and was off feeding 13 times for a total of 197 minutes. Her incubation periods ranged in length from 55 minutes to more than 12 hours (one night). The male incubated for a total of 1,373 minutes, and was off feeding 8 times for a total of 117 minutes. His incubation periods ranged from 65 minutes to more than 16 hours (including one night). During a total of 32 hours of observation, the eggs were being incubated by one or the other bird for all but about ten minutes. When not incubating, the birds were either feeding on provided grain, probing in the earth (apparently for earthworms), drinking, bathing, or preening.

While incubating, the female rose from the eggs to turn them or adjust the nest on an average of once every 28 minutes, ranging from 1 to 114 minutes. The male did so on an average of once every 80.5 minutes, ranging from 41 to 139 minutes.

The incubation period is 30 to 33 days, averaging 31 days, under conditions of zoo incubation (Walkinshaw 1973).

Nest defense displays and distraction behavior are evidently performed by either sex. Walkinshaw (1951) stated that whichever crane was not incubating always watched the other zoo animals. It would chase away Dorcas gazelles and attack other cranes, such as white-naped, Eurasian, blue, sarus, crowned, and demoiselle. The larger sarus cranes were usually given more

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“respect” than the other cranes, and once a male sarus attacked the female white-naped. On occasion the incubating male rushed from his nest and both birds attacked the sarus, chasing it to the far corner of the island. Other large birds, such as vultures, peafowl, pelicans, storks, flamingos, and geese were also attacked when they approached the vicinity of the nest, but the cranes paid little attention to the smaller birds.

Hatching and Postbreeding Biology

Walkinshaw (1951, 1973) observed that the parent birds fed a chick the day following its hatching. In only a few more days it was picking up objects by itself, although the parents continued to feed it periodically, even into the following winter. When it was 10.5 months old, it was evicted from its parents' vicinity, by the male repeatedly driving it away when it approached the female. However, Walkinshaw noted that during the winter months in Japan, when the young birds were probably approaching 10 months old, they were still with their parents in late February, and departed with them.

The fledging period has not yet been accurately determined for this species, but it is apparently in excess of 70 days (Archibald and Viess, 1979). The distinctive nape marking is present in young white-naped cranes but the cheeks are still feathered. Judging from migration records, it is likely that fledging has occurred by about this time. By the spring after hatching, the cheeks become bare but are not as red as in the adults, and the iris has changed from dark brown to yellowish as in adults (Walkinshaw, 1973).

There is no detailed information on molting cycles in the adults.

RECRUITMENT RATES, POPULATION STATUS, AND CONSERVATION

The best information on recruitment rates in this species is that of Nishida (1981), who reported an overall 16.0 percent juvenile component in a sample of 1,826 wintering cranes between 1968 and 1972. However, individual samples ranged from as little as 4.7 percent to 27.8 percent, suggesting that the sampling error might be substantial. Quite possibly the proportions of

young in the wintering flocks in Korea are different from those in Japan, although Archibald (1981a) stated that in Korea the proportion of juveniles is about 15 percent, or close to that of the Japanese estimate. These figures would suggest that the white-naped is somewhat more successful in breeding than most other Northern Hemisphere cranes. Additional information on family size and on the percentage of wintering birds leading young would be very valuable. Nishida (1981) stated that the ratio of families leading single young to those with two young was 73:27 in a 1980 count, but did not provide an indication of actual sample size.

The information on wintering populations in Japan (table 32) is certainly suggestive of a favorable trend, although it must be remembered that Korea is the primary wintering area and that the numbers in Japan are largely a reflection of how many birds continue on to there from Korea. Both wintering areas are crucial to the continuing survival of the white-naped crane, especially as there is no definite indication that the Chinese wintering areas are still being used. Given the very limited known breeding range of the species, it seems unlikely that China would support a significant number of wintering birds at present. Thus, continued monitoring of the Korean and Japanese populations is especially important. The problems caused by large numbers of cranes in the Izumi area of Kyushu, with attendant problems of crop damage, sightseers, and the like must also be solved if the birds are to continue to thrive there (Nishida, 1981).

White-naped cranes breed very well in captivity, and such efforts as those of Koga (1975) prove that substantial success is possible in developing captive populations of this species through avicultural techniques.

EVOLUTIONARY RELATIONSHIPS

There is some evidence that the sarus and brolga are the closest relatives of the white-naped crane, as Archibald (1975, 1976) has concluded on the basis of behavioral studies. However, Wood (1979) determined that, except for one analysis, the Eurasian, hooded, and white-naped clustered in the same cladistic group, so the problems of relationships of the white-naped crane are perhaps not fully settled.