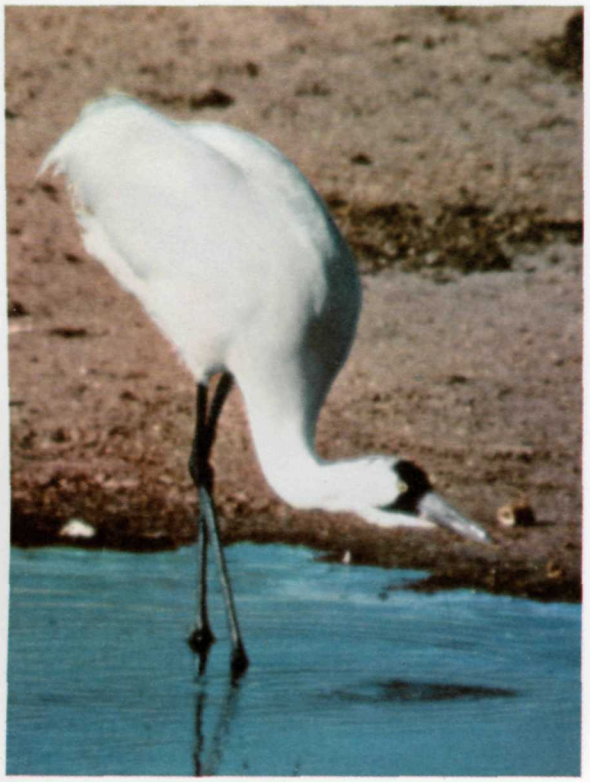

N. S. NOVAKOWSKI

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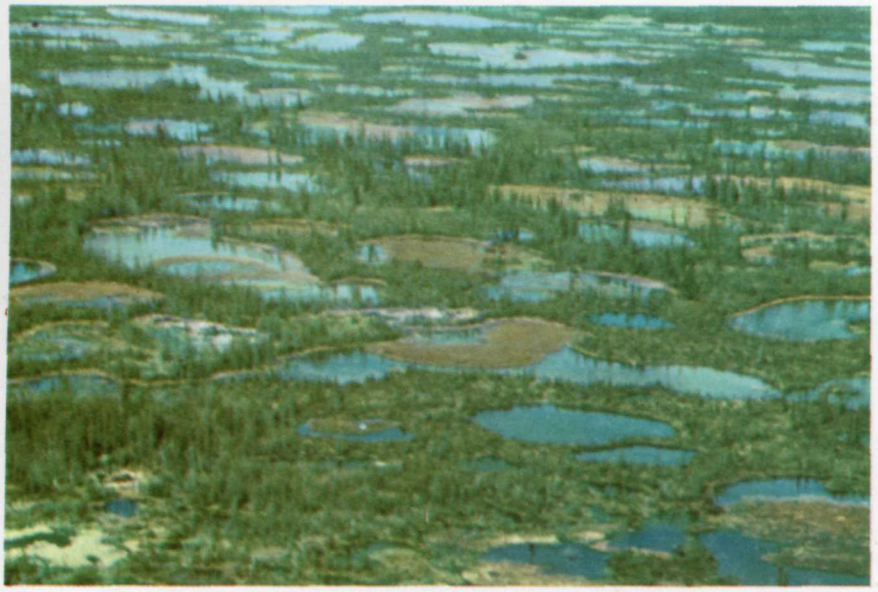
CANADIAN WILDLIFE SERVICE REPORT SERIES—NUMBER 1



Whooping Crane Population Dynamics on the Nesting Grounds, Wood Buffalo National Park, Northwest Territories, Canada

by N. S. Novakowski

Canadian Wildlife Service Report Series—Number 1
Department of Indian Affairs and Northern Development

A new series of CWS publications

This publication on the whooping crane is the first in a new series which replaces Wildlife Management Bulletins and Occasional Papers. The titles that have been published in those series are listed on page 20.

Ottawa, 1966

Issued under the authority of the
Honourable Arthur Laing, P.C., M.P., B.S.A.,
Minister of
Indian Affairs and Northern Development

Cover

Top left—Adult whooping crane in the Aransas National Wildlife Refuge, Texas. Photograph by Luther Goldman, United States Department of the Interior, Fish and Wildlife Service.
Top right—Juvenile whooping crane in the Aransas National Wildlife Refuge, Texas. Photograph by Luther Goldman, United States Department of the Interior, Fish and Wildlife Service.
Bottom left—Whooping crane nesting area, Wood Buffalo National Park, N.W.T. Photograph by L. H. Walkinshaw.
Bottom right—Whooping cranes calling, Aransas National Wildlife Refuge, Texas. Photograph by Luther Goldman, United States Department of the Interior, Fish and Wildlife Service.

Abstract

The whooping crane *Grus americana* has long been in danger of extinction. It is a large white bird with black wing tips. The height is four feet and the wing spread nearly eight feet. The wild population, which now numbers 38 birds (September 1966), winters in the Aransas Refuge in Texas and migrates each spring to breeding grounds in northern Canada. The largest known breeding population is found in the Sass River area of the Northwest Territories section of Wood Buffalo National Park. The cranes have been observed in this area each spring, summer, and autumn since 1954 by personnel of the Department of Northern Affairs and National Resources. The area they inhabit has many shallow ponds in which they nest and feed. The Sass River birds have produced 32 young between 1954 and 1965 and the production from other breeding areas in this period was 29 young, yet the adult population has increased by only 11 birds. It is postulated that the juvenile birds are more subject to mortality than the adults, and as a result the total population remains fairly static. This high mortality seems to occur the year following a successful breeding season, and so long as this mortality cannot be reduced the whooping crane has little hope of reaching population levels at which it would be out of danger.

Roger Duhamel, F.R.S.C.
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Introduction

The early history of the whooping crane, *Grus americana*, a bird endemic to North America, has been well documented by Allen (1952). He showed that the bird was never abundant even during the earliest days of colonization by Europeans. Although rarely seen in large flocks by early explorers, unauthenticated reports persisted that there were thousands of the birds. By 1920, however, there were no more than 50, indicating earlier observations on abundance were exaggerated. As hunting pressure cannot fully explain the "dramatic decline" of the birds from the eighteenth and nineteenth centuries to the present, it appears that the crane may have never been abundant and that it has been for some time in danger of extinction.

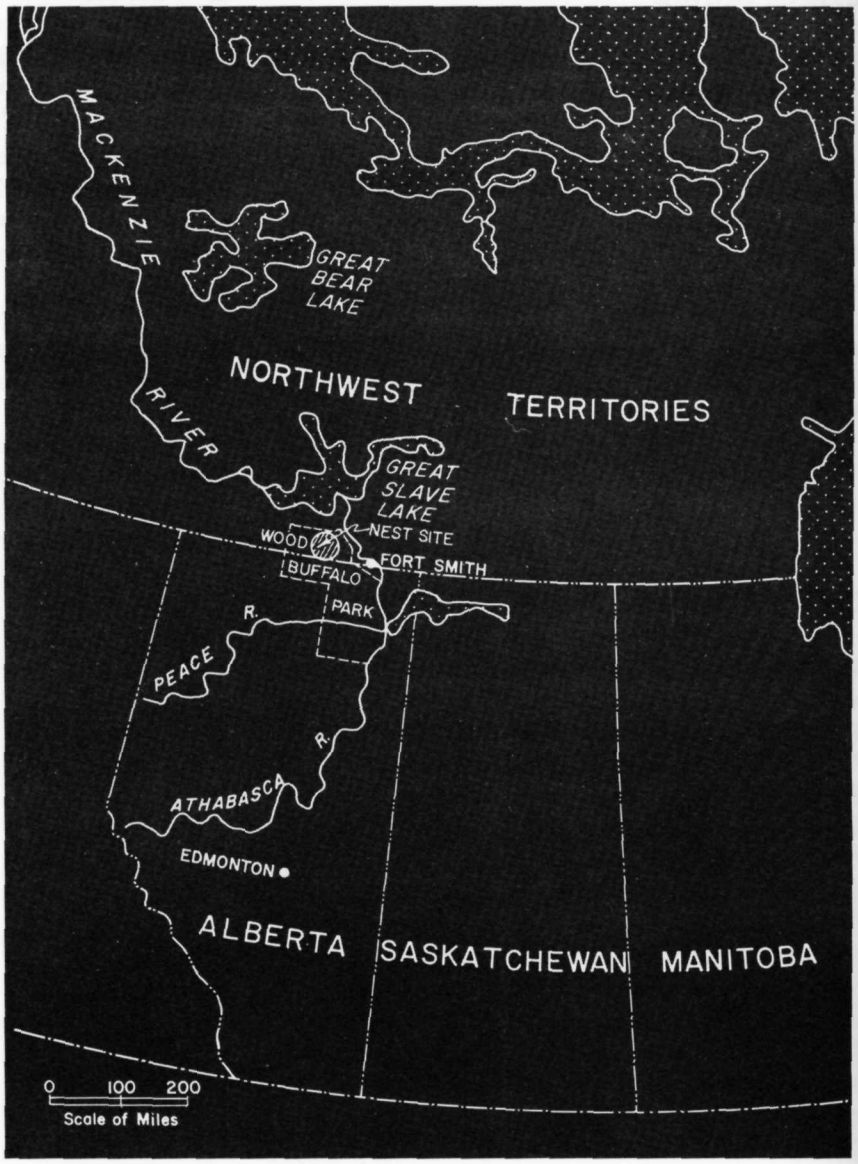
The whooping crane is a large white bird with black wing-tips. Adult birds are about 4 feet in height and have a wing-spread of about 8 feet. The birds are migratory and at present spend the winter in the Aransas Refuge on the Gulf Coast of Texas (see Howard, 1954) and the summer in northern Canada, presumably in the Northwest Territories. Allen (*op. cit.*) states that in the past the birds wintered in Louisiana and Mexico and both he and Walkinshaw (1949) reported evidence of summer nesting sites on the northern fringe of the Great Central Plains. Both nesting and wintering grounds have become restricted, apparently because of human interference and low populations having definite area affinities.

The total continental population of the birds reached a recorded minimum of 15 in 1941, and by 1945 steps were taken to protect the birds during migration. Plans were made shortly after World War II to learn as much as possible about their habits and to search out their nesting grounds (see Allen, 1952). The result was an extensive conservation program by government and private agencies in Canada and the United States. Efforts were intensified in 1954 after the nesting grounds were found in Wood Buffalo National Park by Canadian government personnel. The events leading to this find and the results of a ground survey in 1955 have been reported by Allen (1956).

The location of the nesting area is shown in Figure 1. Since 1954 aerial surveys of the area have been conducted by the Canadian Wildlife Service of the Canadian Department of Northern Affairs and National Resources. Dr. W. A. Fuller was responsible for the initial find and subsequent surveys until 1956; the writer has continued the surveys to the present time. The surveys have been largely concerned with counting the whooping cranes at the site and determining breeding success and mortality. The annual population was determined by the number of birds returning each autumn to the Aransas Refuge in Texas. The bulk of the population winters and is kept under constant observation at this refuge (described by Howard, 1954).

The observations given in this paper are an annual chronology of whooping crane population changes and of events on the breeding grounds from 1954 to 1965.

Figure 1 Location of major whooping crane nesting area in Canada.



Description of the nesting area

The habitat in the nesting grounds has been described by Allen (1956) and by Novakowski (1965) as a marshy area interspersed with numerous potholes which are generally shallow and have soft marly bottoms. The potholes are separated by land areas on which grow black spruce (*Picea mariana*), tamarack (*Larix laricina*), and willows, notably *Salix candida*. The understory is formed by dwarf birch (*Betula glandulosa*), Labrador tea (*Ledum groenlandicum*), bearberry (*Arctostaphylos uva-ursi*), and several species of lichen under which there is sphagnum moss several feet thick. A general view of this area is shown in Figure 2.

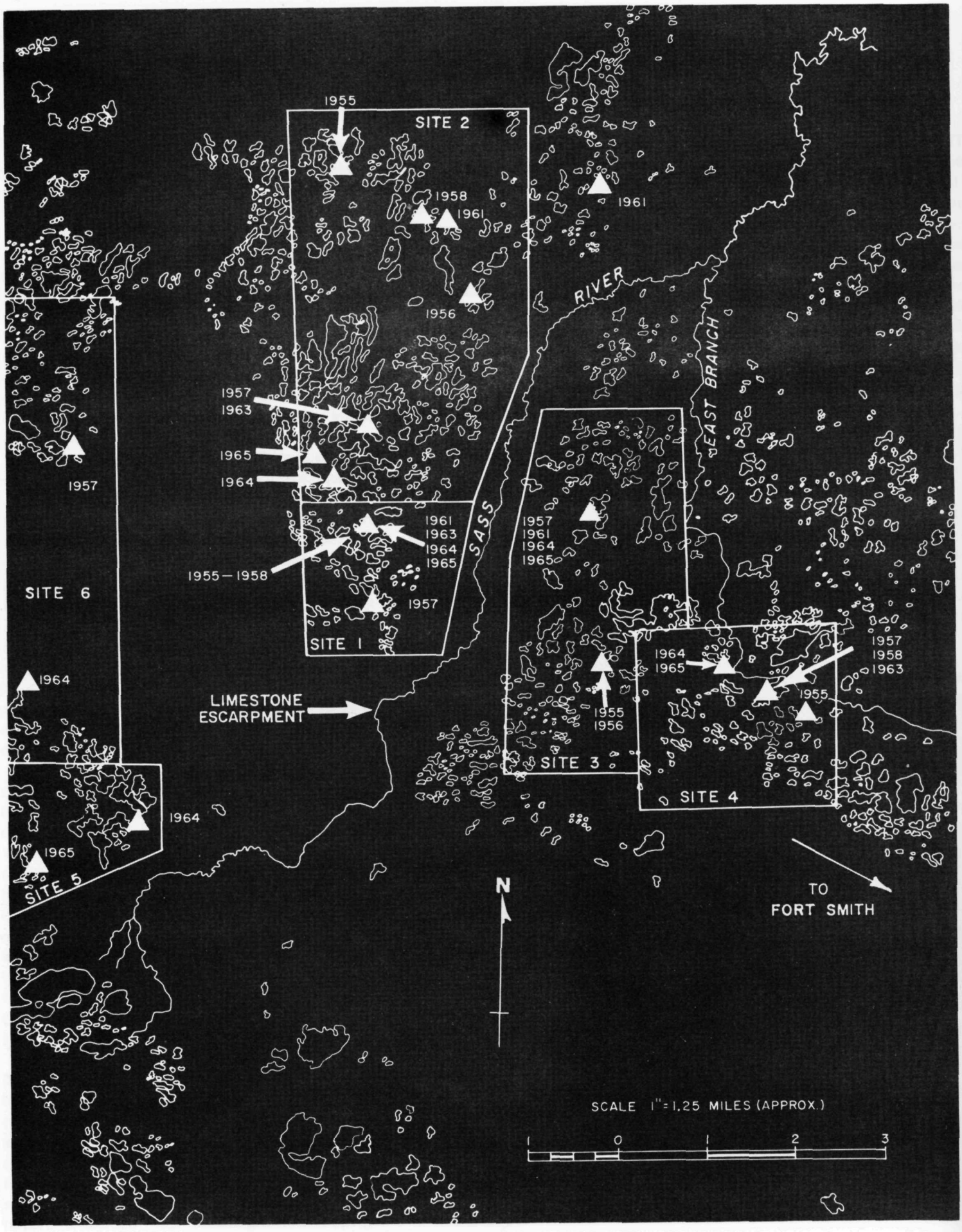
The dominant emergent vegetation in potholes occupied by whooping cranes is the bulrush *Scirpus validus* and this plant forms the major component of their nests. Cat-tail (*Typha latifolia*) and sedge (*Carex aquatilis*) are common in the area, but are associated with deeper sloughs which are not used by the whooping crane for nesting or feeding. The pH of the water in potholes occupied by the cranes for feeding and nesting ranges from 7.6 to 8.3 whereas the pH in adjacent potholes not utilized is approximately 7.2–7.3. Furthermore, only those potholes which are shallow enough to allow feeding by wading are utilized even though deeper adjacent potholes may have abundant food.

The weather in the Sass River area is generally that of the upper subarctic climatic zone described by Kendrew and Currie (1955), and the June–July–August mean monthly temperature is over 50° Fahrenheit. Annual precipitation in the nesting area is light (13 inches), although local weather fluctuations may produce either a higher than average rainfall or an extremely dry summer. When the former occurs early in the season, nesting is delayed, the nests are flooded, and nesting success is poor, whereas when weather is dry nesting proceeds normally, but the adults and offspring must travel much farther from the nest site to feed. The abundance of potholes of various depths in the area is, however, more than sufficient to supply food and nesting grounds indefinitely regardless of weather conditions.

The inaccessibility of the area, and the danger that human interference might jeopardize nesting success, preclude detailed studies of the fauna and flora.

Figure 2 Sass River nesting area, Wood Buffalo National Park, N.W.T. (L. H. Walkinshaw)

Figure 3 Locations of whooping crane nest sites, Sass River, Wood Buffalo National Park, 1955–1958, 1961, 1963–1965.



The whooping cranes arrive on the Sass River nesting grounds as breeding pairs. Records kept by the United States Fish and Wildlife Service indicate that adult pairs leave the Aransas Refuge with their young from the previous year. At some time during their migration north the young apparently "break off" from the family group, as they are never found with their parents on the nesting grounds. Their contact with their natal area is thus minimal and records indicate that few if any return.

The resident population has averaged 8.6 birds annually (6.2 as nesters and 2.4 as non-nesters), the maximum number being 12 birds (1958) and the minimum 3 birds (1962). When no nesting occurs spatial relationships break down, as in 1962; however, during active nesting the nesting pairs are at least 1 mile from each other. This is shown in Figure 3 where the locations of nests are plotted for those years between 1955 and 1965 for which records are available. Nests are rarely used longer than 4 years and another is generally made in the same locality. The nests are made of rushes *Scirpus validus* (shown in Figure 4), and these tend to settle in time. Also, the area immediately surrounding the nest dries up during the summer and may remain dry the following spring. This may explain why nests are abandoned. The original pair of whooping cranes found in 1954 has changed nests four times in a radius of perhaps 300 yards. As shown in Figure 5, the nests are crowned so that the eggs lie precariously on the crown when unattended. The responsibility of brooding the eggs may be shared, although one of the pair has a less pronounced affinity for the nest site than the other. When a pair is disturbed, invariably the parent sitting on the nest will walk or fly only a short distance from the nest, while the other will leave the area entirely. This is not the case after the young have hatched when both parents become extremely protective.

The parents and young leave the nest site approximately 1 week after the eggs hatch and thereafter throughout the summer move from water body to water body. At first the young hide under one of the parents when disturbed. By midsummer they adopt an avoiding reaction and generally hide in undergrowth bordering the water body they happen to be found in. By the end of their first summer but before taking their first flight the young will again stand beside their parents when disturbed, instead of running or hiding. Their size by September is almost that of the adult (see Lahrman, 1957; Bard, 1956, 1958; Pratt, 1961).

During September and October whooping cranes move into the Sass River area from other unknown areas. It appears that this is a "staging area" from which the birds leave for the south in small groups—probably in families. In 1960, 27 whooping cranes were found in the area by T. W. Barry, Canadian Wildlife Service, and in 1961, 26 were found by the writer. In 1962, 23 were seen; in 1963, 16; in 1964, 18, and in 1965, 11. These counts indicate that some of the group are migrants from further north and that few, if any, whooping cranes nest south of the 60th parallel of latitude.

Figure 4 General view of whooping crane nest area, Sass River. (N. S. Novakowski)

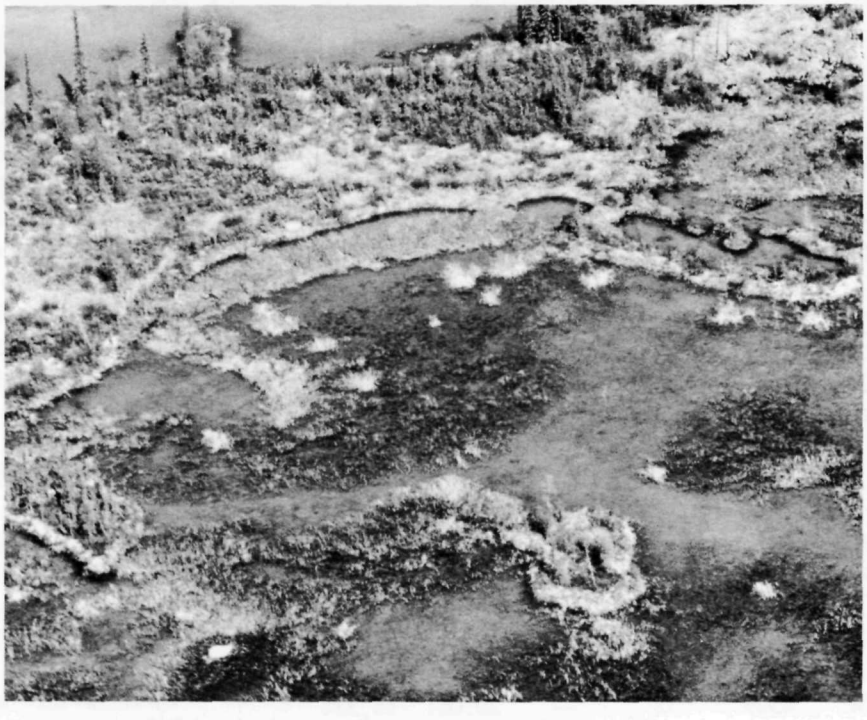


Figure 5 Whooping crane nest at Sass River with two eggs. Nest-building material Scirpus validus surrounds nest. (L. H. Walkinshaw)

The food habits of the whooping crane are imperfectly known, largely because specimens from which stomach contents could be analysed have not been available. The stomach contents of a whooping crane that died were reported by Allen (1954). Allen (1952) listed a wide variety of predominantly aquatic foods thought to be eaten by the crane on the wintering grounds. Such an analysis was attempted on the nesting grounds in 1965 by the writer. Dredgings of bottom material were taken from a hovering helicopter in the exact positions where whooping cranes had been feeding a few minutes before and in adjacent potholes where no feeding was done. These potholes were selected from the six nest sites shown in Figure 3.

The results of the analysis are shown in Table 1.

TABLE 1 Density and weight of dominant organisms per 6-inch Ekman dredge from potholes utilized and adjacent potholes not utilized by whooping cranes

	No. molluscs	No. insect larvae	No. crustacea	Dry weight (gms.)	Ash (gms.)
Site 1					
1A	1755	216	—	9.639	8.748
1B	1755	108	—	5.065	3.375
2A	1143	55	—	1.674	1.323
2B	1288	28	—	5.173	3.996
Site 2					
1A	3213	36	—	9.180	8.239
1B	1890	122	42	5.184	3.159
2A	1296	189	—	8.370	7.749
2B	2349	486	—	8.424	7.911
Site 4					
1A	3294	30	—	7.031	6.197
1B	2973	54	—	6.792	5.924
2A	2241	243	—	17.469	15.984
2B	4509	32	—	20.061	18.334
Site 6					
1A	3726	176	—	55.134	50.193
1B	1377	—	1	6.345	5.724
2A	1215	142	127	7.074	6.156
2B	4239	30	459	34.047	30.240

Note: 1A and 1B were utilized; 2A and 2B were not utilized.

As each sample had the same volume, the productivity of each water body is based on the area covered by the 6-inch Ekman dredge; however, not all the organisms taken by the dredge would be available to the crane because it feeds below the surface of the ooze. The molluscan fauna which forms the majority of organisms is extremely low in organic material and high in undigestible residue (ash), which appears to exclude it as a food source. The balance of the fauna (insect larvae and amphipods) are randomly distributed, but undoubtedly the crane feeds specifically on the few larger insect nymphal or larval forms and crustacea found in the sample.

The characteristics of the bottom material not evident in Table 1 are as follows:

1. Calcium carbonate concretions found in suspension in the marl make up approximately 28 per cent by weight and 6 per cent by volume of each sample excepting those from sites 4 and 5 which had negligible amounts. These concretions are largely of pebble size and are formed by the solution of the limestone which forms the basin of each pothole. The content of organic material within these concretions is limited (19.9 per cent of dry weight) so that it is unlikely they are used as food by the whooping crane.
2. Small pebbles (pea size and smaller) were also found in suspension in the marl. These originate from metamorphic rocks found in the glacial till which provides a shallow overburden on the limestone bedrock in the area. Although no sand is evident anywhere in the nesting area other than on the escarpment overlooking the area, it appears possible that the till material provides the necessary silica for the production of diatoms which, except for one colonial form of blue-green algae, are the dominant algae found in the samples.
3. The species composition of the marl is mostly diatoms. As the amount of inorganic material is high (65.86 per cent) it appears the algal forms are bound by inorganic salts to form the marl and provide the major organic material in the ooze. The bottom ooze from potholes in sites 4 and 5 does not share this characteristic.

This writer assumes it is unlikely that the whooping crane feeds indiscriminately as the extraneous material, such as pebbles and concretions, and the high inorganic content of the ooze provide little energy to sustain such a large bird.

The proximal analysis of composite samples of the two types of bottom ooze is presented in Table 2. The sample from composite B is from potholes at the periphery of the area at sites 4, 5, and 6, whereas the sample from composite A is more

Figure 6 Typical area at periphery of Sass River nesting grounds showing advanced encroachment of sphagnum. Bottom ooze in ponds is not marl. (N. S. Novakowski)

typical of the centre of the nesting area at sites 1, 2, and 3 (see Figure 3). An example of the former is shown in Figure 6 and of the latter in Figure 4. The table shows that the organic content of bottom ooze of ponds is higher at the periphery of the nesting area; however, it is doubtful whether this provides the major impetus for nesting in these areas. Spatial relationships appear to be more important than food in the choice of nesting sites. Certainly the high fat content of bottom forms reported by Allen (1956) could not be demonstrated and as a result could not provide the high food value he postulated.

TABLE 2 Proximal analysis of composite samples of bottom fauna. Samples expressed as percentage dry matter

	Composite A*	Composite B†
Protein	5.44	13.35
Carbohydrate	11.50	42.84
Fat	0.03	0.06
Ash	60.46	24.08

*From sites 1, 2, and 3.
†From sites 4, 5, and 6.

The larger insect forms and crustaceans whose contribution to the productivity of the potholes is shown in Table 1 are chiefly naiads of the dragon-fly *Aeschna* sp., caddis-fly larvae *Platycentropus* sp., chironomid larvae of the genus *Tendipes* sp., mayfly larvae *Siphlonurus* sp., and the amphipod *Hyalella aztica*. The occurrence of these forms is sporadic, indicating why the whooping crane family feeds in so many potholes during a summer.

It is doubtful whether molluscs comprised of three major groups, the snails *Stagnicola* sp., *Physa* sp., and *Lymnaea* sp., the wheel snail *Gyraulus* sp., and the pill clam *Pisidium* sp., are utilized as, although numerous, they provide little organic matter for food. It was reported by Novakowski (1965) that the whooping cranes may eat berries during the autumn—the young crane captured in 1964 on the nesting grounds excreted berries in the faeces shortly after capture. The whooping crane is generally found feeding in potholes and rarely on land, indicating that berries are likely used as a supplementary food.

Population changes

The population dynamics of the wild population from 1954 to 1965 are shown in Table 3, which is based in part on the results of surveys of the breeding population on the nesting grounds at Sass River and in part on the spring and autumn departures and arrivals at the Aransas Refuge in Texas as recorded by the United States Fish and Wildlife Service.

Thirty-two of the 61 young which have returned to the Aransas Refuge over the period 1954–1965 have been produced in the Sass River area from a maximum of six breeding pairs. The total production of young, particularly in the years 1958 and 1963, indicates that at least three to six breeding pairs nest elsewhere. At least two of these pairs nest sporadically in the Klewi River area of Wood Buffalo National Park (as found in 1958 and 1963) in habitat similar to that found in the Sass River area. It appears that other nesting areas may exist but these are likely scattered throughout a large area.

The over-all annual production has not changed, indicating that there has been no recruitment into the established Sass River breeding population. Erickson (1961) observed that all the production has been derived from a stable group of long-lived birds. Table 3 shows that the Sass River group has produced 32 young from 1954 to 1965 without an increase in the number of nesting pairs, with perhaps one exception (site 5). The migrating juveniles apparently do not return to the Sass River area in subsequent years, but locate elsewhere. It is obvious they contribute nothing to breeding success as production from other areas has been relatively static from 1954 to 1965. This also leads to the conclusion that the mortality of adult birds shown in Table 3 has not been suffered by breeding adults but by the non-breeding birds, which are likely to be sub-adults in their first year back on the breeding grounds or in their second migration south. Adult mortality from 1954 to 1965, including all whooping cranes which are not young of the year, has nearly equalled the production of young for the same period. The balance has produced an adult population gain of 11 birds, an average increase of one per year for the period 1954–1965, and an increase produced largely in 1 year (1959–1960). The inference drawn from Table 3 is that when a high production of young is followed by a low number of adult deaths as in 1959–1960 numbers will stabilize at a higher figure. If the opposite occurs, as in 1955–1956 and 1961–1962, recovery is slow. It appears that in most cases high adult mortality follows high production the year previous and that the juvenile population may be the most susceptible to mortality. The cause of this phenomenon is not

TABLE 3 Population changes of wild flock whooping cranes 1954–1965

	No. migrating north		No. resident Sass River		No. young Sass River			No. arriving Aransas		Annual mortality	
Year	Adults	Young	Nesting	Non-nesting	Eggs laid*	No. hatched†	No. surviving	Adults	Young	Adults	Young
1954	21	3	6	0	6	1	0	21	0	3	1
1955	21	0	8	2	8	6	4	20	8	1	2
1956	20	8	2	4	2	1	1	22	2	6	0
1957	22	2	10	0	10	3	3	22	4	2	0
1958	22	4	4	2	4	3	3	23	9	3	0
1959	23	9	4	2	4	2	2	31	2	1	0
1960	31	2	8	4	8	4	3	30	6	3	1
1961	30	6	6	5	6	4	3	33	5	3	1
1962	33	5	0	3	0	0	0	32	0	6	0
1963	28	0	4	4	4	3	3	26	7	2	1
1964	26	6	10	4	10	7	6‡	32	10	0	1
1965	32	10	10	0	10	6	4	36	8	6	2
Totals	309	55	72	30	72	40	32	328	61	36	9

*Based on observed occurrence of two eggs to each clutch.
†Observable hatching.
‡Includes one young captured.

definitely known. However, the early separation of young from their parents (first spring migration) seems to be critical, particularly when the total population is of such a low density that the learning process on migration is not complete and the juvenile birds do not have the advantage of a flock in which to continue the learning process. The writer believes that indications of danger, finite migration paths, food changes and availability along the route, and obstacles are imperfectly known to the juvenile on its first trip south alone, thus increasing its susceptibility to mortality. Familial relationships break down after the first summer and winter; this is the critical factor and difficult to understand in such a long-lived bird.

Figure 7 Nest of captive whooping crane in Aransas National Wildlife Refuge, Texas. (C. A. Keefer)

Figure 8 Whooping cranes flying across a pond in the Aransas Refuge. (L. Goldman)

The production of whooping crane chicks in the Sass River area has been confined to six well-defined nesting areas, presumably occupied by the same adult nesting pairs. Four of these pairs have held tenure over their nesting areas for at least 11 years; one pair has held very sporadic tenure on site 6; and another has established a new site which has been held only in the last 2 years, site 5. The locations of each nesting site and presumed territorial boundaries are shown in Figure 3, and a summary of the nesting success for each pair for the years 1954–1965 is shown in Table 4. The most consistent nesting group in eggs laid and young produced has been the original pair found in 1954 at site 1. They have not moved far from the nest site found in 1954, and judging from the pattern of nest abandonment had not been there earlier than 1950. The presence of nesting cranes at most of the six sites during the 12-year period also indicates that the nesting pairs are well established and that none are the progeny of any of the pairs except that those in site 5 might be the progeny of the earlier pair at site 6. It is obvious that the young from the previous year do not follow the parents to the nesting ground. Furthermore it also appears that the high adult mortality during the period 1954–1965, as shown in Table 3, did not affect the breeding population from the Sass River area in total or in part.

During the period 1956–1959 another presumed adult pair shared the area in site 2 with the resident nesting pair, but never nested and eventually left the site. Perhaps they now remain in the area as the non-nesters which comprise one-third of the Sass River summer population (Table 3). These non-nesters may be juvenile pairs of non-breeding age with an affinity to the nest site; however, production of young has far exceeded the somewhat stable population of non-nesters.

TABLE 4 Nesting success by site at Sass River

	Site 1		Site 2		Site 3		Site 4		Site 5		Site 6	
Year	Eggs laid	Hatched	Eggs laid	Hatched	Eggs laid	Hatched	Eggs laid	Hatched	Eggs laid	Hatched	Eggs laid	Hatched
1954	2	1	0	0	0	0	0	0	0	0	0	0
1955	2	2	2	2	2	1	2	1	0	0	0	0
1956	2	0	2	0	1	0	0	0	0	0	0	0
1957	2	0	0	0	2	1	2	1	0	0	2	1
1958	2	2	0	0	0	0	2	1	0	0	0	0
1959	2	0	2	1	0	0	2	1	0	0	0	0
1960	2	2	2	0	2	1	2	1	0	0	0	0
1961	2	1	2	1	2	1	0	0	0	0	0	0
1962	0	0	0	0	0	0	0	0	0	0	0	0
1963	2	2	2	0	2	1	0	0	0	0	0	0
1964	2	1	0	0	2	2*	2	2	2	1	2	1
1965	2	2	2	1	2	1	2	1	2	1	0	0
Totals	22	13	14	5	16	9	14	8	4	2	4	2

*One young captured, the other died.

Figure 9 Captive whooping crane and chick in the Aransas Refuge.

The years 1954, 1956, 1959, and 1962 were poor years for the production of young whereas 1955, 1957, 1958, 1960, 1961, 1963, 1964, and 1965 were relatively good years (Tables 3 and 4). A summary of weather conditions for Fort Smith, the nearest weather station to the nesting grounds, is shown in Table 5 for the period 1954 to 1965. The weather during May and June is the most critical for nesting and hatching, although it has been observed that the weather, particularly precipitation, is also important during July, when mortality of the young due to drowning and exposure may occur.

There appears to be some relation between the amount of snow falling in May and nesting success, particularly in 1959 and 1962 when above-average snowfalls may have produced the relatively poor results. The observation records for 1954 are incomplete, as the nesting grounds were not found until late in the season. However, based on observations in subsequent years, the poor results in 1954 can be attributed to high mortality of young during the extremely wet period in July. No reason relating to weather can be found for the poor results of 1956. In general, the weather records indicate that average conditions (low precipitation particularly) on the whooping crane nesting grounds are most likely to produce a good hatch.

TABLE 5 Summary of weather data from Fort Smith, N.W.T.*

Year	Months	Mean monthly max. temp.	Mean monthly min. temp.	Recorded Max.	Recorded Min.	Precipitation (in.) Rain	Precipitation (in.) Snow
1954	May	55.6	31.9	76	–3	0.39	T
	June	73.0	43.9	84	33	0.024	
	July	72.1	50.6	83	40	5.41	
1955	May	57.6	34.9	77	17	0.89	2.3
	June	75.4	49.1	92	32	0.37	
	July	73.2	50.6	89	37	2.43	
1956	May	58.0	32.8	79	16	0.47	0.2
	June	65.7	48.8	84	36	3.35	
	July	72.6	51.0	84	37	2.06	
1957	May	52.7	32.5	75	14	0.31	0.8
	June	63.4	40.2	80	22	0.25	T
	July	69.1	48.3	80	36	4.05	
1958	May	59.0	43.2	76	1	1.17	1.1
	June	65.5	40.8	81	24	0.28	T
	July	72.5	49.7	88	36	0.92	
1959	May	49.3	27.6	72	3	0.18	5.6
	June	62.9	38.9	76	21	1.38	
	July	74.5	48.0	91	35	0.93	
1960	May	55.1	34.5	72	18	0.92	1.8
	June	66.1	45.2	79	33	2.91	
	July	72.5	50.1	89	39	2.06	
1961	May	56.9	33.4	89	15	0.18	.03
	June	75.1	49.6	91	31	0.62	
	July	74.9	52.0	92	40	2.12	
1962	May	53.2	30.0	68	15	0.86	3.0
	June	68.1	47.4	83	35	2.99	
	July	70.9	49.8	83	36	3.75	
1963	May	56.9	29.9	82	10	0.41	0.5
	June	70.6	46.8	83	34	3.07	
	July	74.2	52.6	89	36	2.45	
1964	May	56.2	35.1	68	23	1.77	0.8
	June	70.6	43.8	82	32	1.10	
	July	76.8	50.1	90	39	0.99	
1965	May	60.0	32.6	79	21	0.36	T
	June	66.9	43.1	84	26	1.87	1.6
	July	72.4	51.5	85	39	2.93	

*Data from Canada Department of Transport, Records.

Figure 10 Whooping cranes in flight over the Aransas Refuge. (L. Goldman)

Figure 11 Four adult whooping cranes and three juveniles with Canada geese on the cranes' wintering grounds in the Aransas Refuge. (L. Goldman)

Mortality and predation on the nesting grounds

In all instances in which eggs were observed on nests during hatching, there were always two eggs. However, shortly after the hatching of one young, all trace of the other egg (other than fragments) disappeared. This suggests either that two young are hatched and one quickly dies or that if there is a time lag between hatching of the two eggs the second egg is destroyed. In two instances (in 1964 and in 1965) nests were examined after the adult pair which had hatched one young had wandered away with the young chick. The debris on the nest (feathers) suggested that another young might have hatched or nearly hatched but had been destroyed. It is believed that the potential of each breeding pair is equivalent to the number of eggs laid and other factors (time lag in hatching, nest abandonment, exposure, or predation) mitigate against full production. The efficiency of production is approximately 56 per cent (Table 3) under the conditions mentioned, and the assumed hatching mortality is 44 per cent. Observed mortality of young-of-the-year as shown in Table 3 is based on observation of the number of young known to be hatched and the number surviving to migration. This mortality has averaged 20 per cent of observed production during the period 1954 to 1965.

The loss of eight chicks known to have hatched during the period 1954–1965 cannot be attributed to any one factor, although in 1964 and in 1965 those young lost were on the periphery of the breeding grounds (sites 4 and 5) where accidents from drowning or predation could occur. One type of accident mentioned by Novakowski (1965), injury during attempts to fly, is actually quite rare, as the losses of young occur early after hatching.

In the area the writer has observed bears, foxes, mink, and wolves, and predatory birds, such as bald eagles, hawks, and ravens. The land predators have not been seen deep within the nesting area, and birds of prey have little room to manoeuvre in the small potholes frequented by the whooping crane family. Also, they would be hard put to handle any of the adults, which would defend the young. It appears, therefore, that some predation may occur at the periphery of the nesting area where land predators are more numerous, but that losses are minimal after hatching by those breeding pairs closer to the centre of the area.

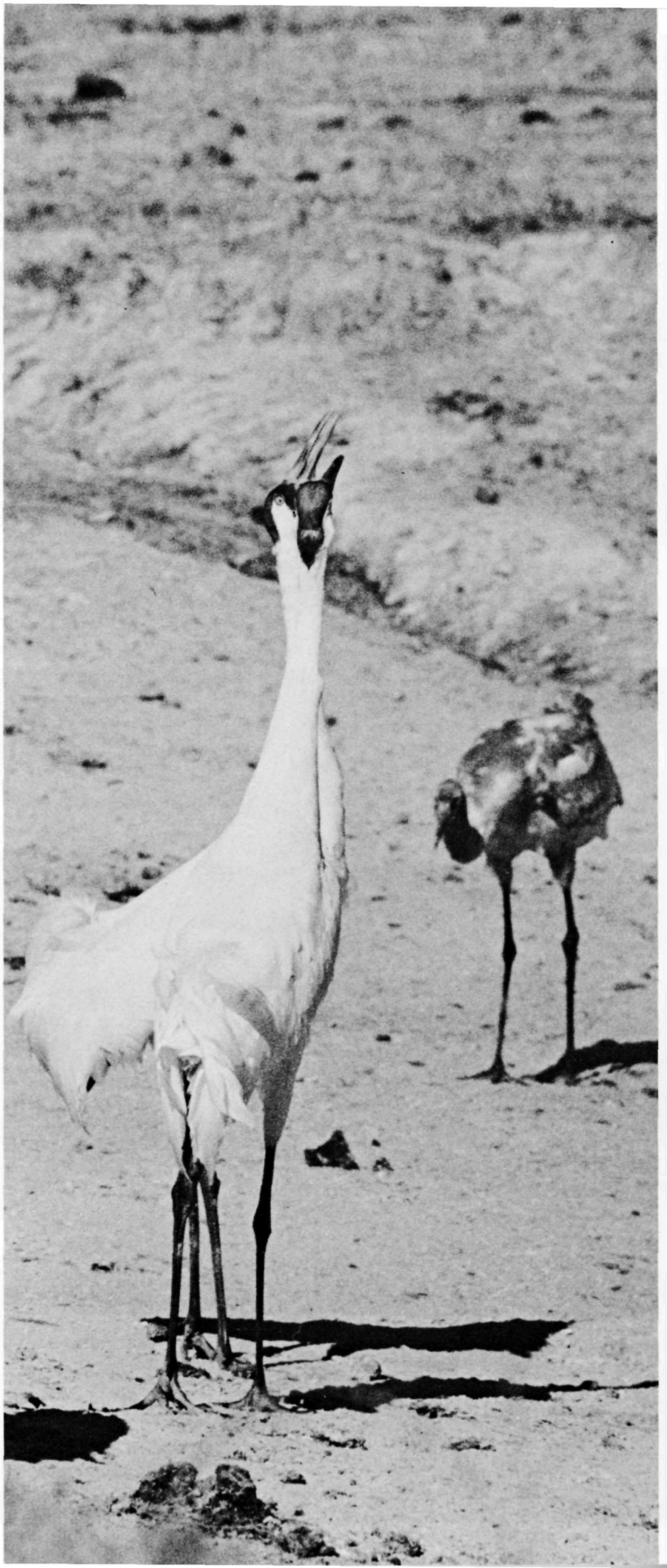


Figure 12 With heads raised, whooping cranes at the Aransas Refuge call Ker-loo, Ker-lee-oo! (L. Goldman)

Discussion

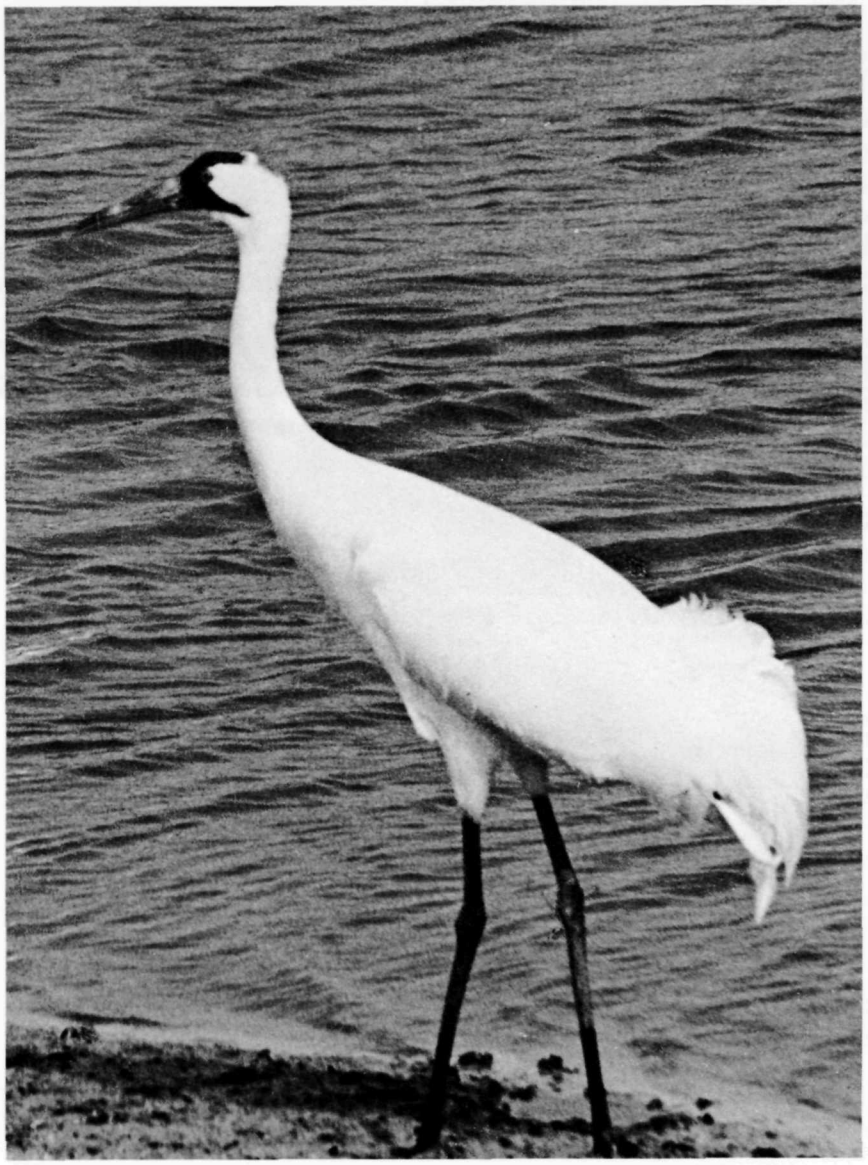
Except for the good reproductive success of 1964 and 1965 the prognosis for the survival of the whooping crane is not good. Years in which production has been good have been followed by years of poor production and high cumulative adult mortality. The stability of the nesting and non-nesting groups in the Sass River nesting grounds appears to indicate that none of these have been subjected to mortality and that none of the breeding pairs elsewhere have been adversely affected. It appears that the young pre-breeding birds are the ones subject to the most mortality and obviously any effort made to help this group over this critical period would be advantageous.

There is every indication that the whooping crane lays two eggs each spring and that while both are fertile usually only one is hatched. It appears that a time lag in laying produces a time lag in hatching. The single hatched young cannot move for some time (1 week) as the nest is surrounded by deep water. There is insufficient room on the high-crowned nest for a precocious chick and an unhatched egg and the later egg becomes expendable. The years in which twinning was observed in more than one pair were 1955 and 1964, years which had the highest mean monthly minimum temperature in May and a comparatively warm month in June. As the time of hatching is approximately the first week in June the weather in the earlier period (about mid-May) is probably critical in determining the time spacing in laying.

The food of the whooping crane appears to consist chiefly of larval insect forms, particularly when the chicks are small. When travel by the family group becomes possible undoubtedly frogs and berries on the margins of potholes are utilized. It appears that nesting sites are chosen for considerations other than food, as usable bottom fauna is not abundant, and the birds must travel over a considerable area in search of food.

In considering the best possible means of artificially increasing the population, and it appears inevitable that this must be attempted, authorities have now formulated plans whereby eggs will be taken from nesting whooping cranes in the Sass River area and incubated artificially. This plan is to operate in wet years only, when high precipitation in the area may either endanger the eggs on the nest or the newly hatched young by flooding. Some thought must be given to trapping the young-of-the-year, preferably at the Aransas Refuge when they have completed their first flight south. If they could be held until sexually mature, it is possible that mating and nesting would provide greater motivation to migrate over a route at least partially known. It seems apparent that birds in their second year are most vulnerable to mortality and as a result removing them from the population for experimental purposes would seemingly have little effect upon the structure and growth of the whooping crane population. At the same time, a captive group would counterbalance the many disastrous seasons to which the wild flock is apparently subject.

Figure 13 Adult whooping crane at the Aransas Refuge. (L. Goldman)



Abrégé

La grue blanche d'Amérique, *Grus americana*, est menacée d'extinction depuis longtemps. Oiseau blanc de taille imposante, qui possède de grandes ailes aux extrémités noires, la grue a quatre pieds de hauteur et jusqu'à huit pieds d'envergure. La population sauvage, qui compte maintenant 38 oiseaux (septembre 1966), hiverne au refuge Aransas dans le Texas et rallie chaque printemps ses terrains de nidification dans le Nord canadien. La plus grande population reproductrice connue se retrouve dans la région de la rivière Sass (Territoires du Nord-Ouest), dans la partie septentrionale du parc national de Wood-Buffalo. Le personnel du ministère du Nord canadien et des Ressources nationales a surveillé les grues dans cette région tous les printemps, étés et automnes depuis 1954. Leur habitat renferme de nombreux étangs où elles nichent et se nourrissent. Les oiseaux de la rivière Sass ont donné naissance à 32 petits entre 1954 et 1965, alors que ceux des autres régions ont donné naissance à 29 petits durant la même période, mais en fait, la population adulte n'a augmenté que de 11 oiseaux. On attribue cet état de choses à ce que la mortalité est plus grande chez les jeunes que chez les adultes; c'est pourquoi la population globale reste pratiquement la même. Cette forte mortalité semble se produire l'année qui suit une bonne saison de reproduction et tant que l'on ne pourra réduire cette mortalité, la grue blanche d'Amérique a peu de chance d'atteindre un taux de population assez fort pour se soustraire à ce danger d'extinction.

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Figure 14 A bit of a dispute between two adult whooping cranes at the Aransas Refuge. (L. Goldman)

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