

## WHITE PELICAN PRODUCTION AND SURVIVAL OF YOUNG AT CHASE LAKE NATIONAL WILDLIFE REFUGE, NORTH DAKOTA

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The current status of the White Pelican (*Pelecanus erythrorhynchos*) in North America is unclear. Two recent surveys have been conducted (Lies and Behle 1966, Sloan 1973) and each have placed the continental population at between 30,000 and 35,000 individuals. This pelican has been placed on the blue list of bird species that should be closely watched because unexplained population declines have occurred throughout its range (Arbib 1975).

Many authors, including Hall (1925), Low et al. (1950), Schaller (1964), and Kolstoe (1966) have reported on the nest success and pre-fledging survival of the White Pelican. In 1973, we undertook a study at Chase Lake National Wildlife Refuge in North Dakota on some aspects of the biology of White Pelicans. Here we report our results relating to nest success and pre-fledging survival and relate these results to the distances adults seem to have to travel to feed.

### STUDY AREA AND METHODS

Chase Lake National Wildlife Refuge is located approximately 13 km north of Crystal Springs in Stutsman County, North Dakota. The surface of the 1775 ha area is covered by approximately 50% water, 45% native and tame grasses, and the remainder marsh and brush. The refuge is typical of the Coteau region of the Missouri plateau (U.S.D.I. 1971).

Chase Lake is highly alkaline and supports no fish population. Two islands, totaling 6.48 ha in size, lie within the lake. The large island is located .4 km from shore while the smaller island is .2 km from the mainland. Both islands grade gradually from the shore to central areas which are located 3 m above lake level on the small island and 5 m above lake level on the large island.

The dominant plant species found on the islands include annual marsh elder (*Iva xanthifolia*), which forms dense stands over much of the islands, wild barley (*Hordeum jubatum*), and various sedges (*Carex* spp.) which grow along the shoreline. Lamb's quarters (*Chenopodium album*) and the narrow-leaved goosefoot (*Chenopodium leptophyllum*) grow in association with the marsh elder.

The Chase Lake colony is the largest breeding concentration of White Pelicans in North America, varying from 4000 to 5000 breeding pairs annually (Sloan 1973). During the periods 25 June through 28 July 1973 and 24 April through 10 June 1974, Johnson observed synchronized breeding colonies daily from a blind.

Number and fate of nests, number and fate of young and their behavior, including sibling rivalry, adult aggression, and feeding activity of the young, were recorded. Behavioral patterns were observed with the aid of a 20 to 60 $\times$  spotting scope.

In 1974, 100 young, less than 3 days old, were marked with self-piercing, size 1 web tags (Style 4-1005, National Band and Tag Company, 721 York St. Newport, Kentucky

41072). Tags were placed on young in 40 nests containing 2 young each and on young in 21 nests containing a single bird. In 1975, 176 young in nests with 2 birds each and less than 3 days old were marked with web tags.

Nest checks were conducted on a weekly basis until the young reached 3 weeks of age and were no longer easily approachable. Surveys were maintained at 1 week intervals in order to keep disturbance to a minimum.

Frequent searches were made for spaghetti-type fish tags on the breeding islands. The nesting colonies were searched by slowly walking through them and carefully observing the ground. The colored fish tags contrasted with the ground litter in the colonies which aided in their recovery. Such tags are used to mark fish in order to study their movements, longevity, etc. They pass through the digestive tract of pelicans and can provide an indication of pelican foraging areas.

#### RESULTS AND DISCUSSION

*Foraging.*—The diet of the White Pelican consists primarily of rough fish and amphibians (Mansell 1965). Food requirements for the Chase Lake colony, based on 8000 breeding adults, are substantial (Table 1). As Chase Lake supports no fish life, the pelicans must find food elsewhere. Reported round-trip foraging distances for White Pelicans range from 96 km (Behle 1958) to 241.5 km (Low et al. 1950). At Chase Lake round-trip distances have ranged up to 611 km (Fig. 1). Foraging distances have been based on the recovery of 31 fish tags which were found on the breeding islands in 1974. These tags had been placed on walleyes (*Stizostedion vitreum*) and northern pike (*Esox lucius*) by personnel of the North Dakota Game and Fish Department. One tag was placed on a bigmouth buffalo (*Ictiobus cyprinellus*) by personnel of the U.S. Fish and Wildlife Service when the fish was released in Lake Oahe in South Dakota. Twenty-eight of the recoveries were within a 128 km radius of Chase Lake, however, the 3 tags that were recovered from greater distances indicate that foraging movements may be significantly greater than 241.5 km round-trip. The bulk of the pelican diet consists of rough fish and amphibians and presently we have no means to determine where this food is obtained.

*Nest abandonment.*—Both members of the pelican pair participate in incubation, one relieving the other after a period of foraging. Nest abandonment may result when one adult is not relieved after a prolonged absence of the mate. Knopf (1976) reported that each adult was present on the nest for 72 h (N = 14) during the incubation period. Nest relief occurred every 24 (N = 18) or 48 (N = 2) h after the eggs had hatched. The adults in the colonies that we observed were not marked and we were unable to distinguish between individuals on the basis of facial patterns. Consequently, we have insufficient data to determine a nest relief time sequence for Chase Lake.

During the observation of the synchronized breeding colony in 1974, 6

TABLE 1

ESTIMATED FOOD REQUIREMENTS OF THE CHASE LAKE PELICAN FLOCK BASED ON A 108 DAY BREEDING SEASON

	Consumption <sup>1</sup>	Number	Total
Adults	1.8 kg per day per adult	8000	1,567,607 kg
Young	68 kg to flight stage	4320 <sup>2</sup>	293,926 kg
Total			1,861,533 kg

<sup>1</sup> Consumption rate reported by Hall (1925).<sup>2</sup> Number based on a fledging rate of 1.08 young per nest to maintain colony at 8000 breeding adults (Strait and Sloan 1974).

of 18 abandoned nests were deserted without any apparent reason. The incubating birds flew off the nest and left the area. No other birds showed any signs of disturbance. These nests were abandoned at least 2 weeks after our observation blind had been erected. The observer was not visible to the colony while entering the blind, thus making it highly unlikely that human disturbance was the cause of abandonment. In addition, an adult was observed throwing both of its less than 5-day-old young from the nest. Two

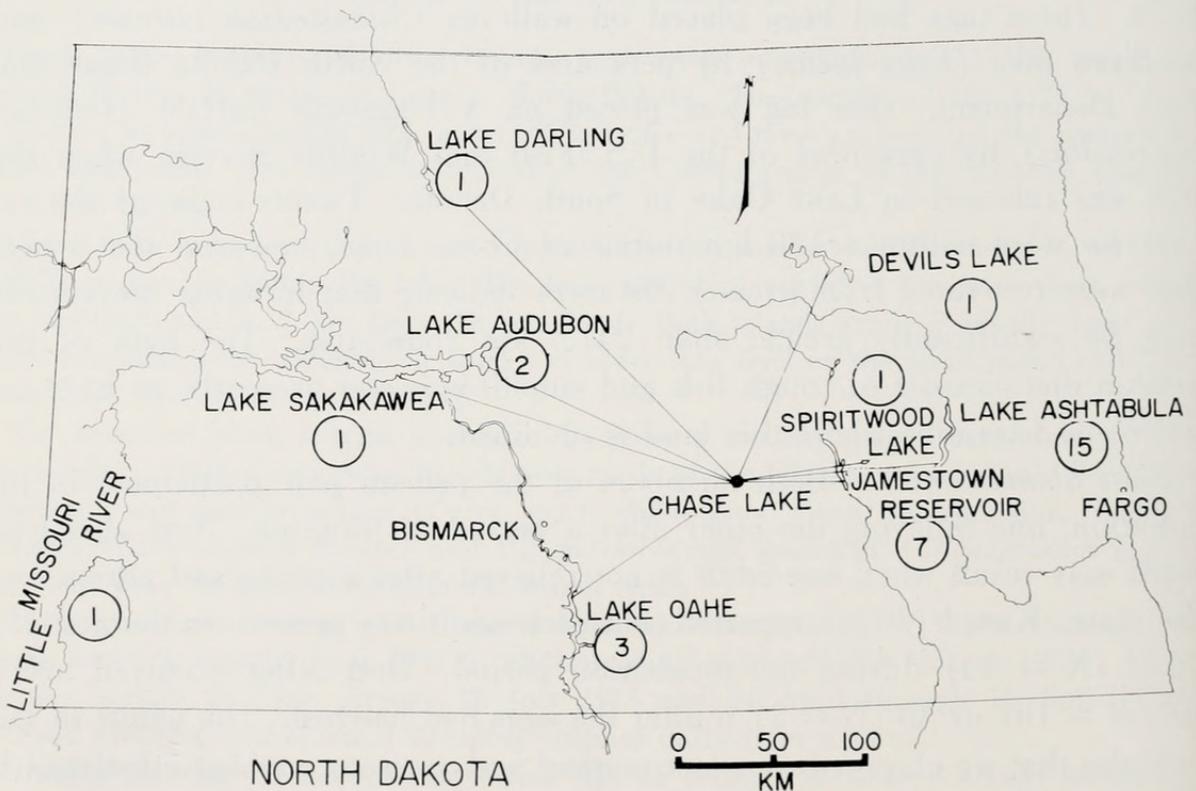


FIG. 1. Localities where tagged fish were released whose tags later showed up in the Chase Lake White Pelican colony. Circled numbers indicate the number of tags recovered from that locality.

other small young were seen in the air, although the adult was not actually seen throwing these young from the nest. Both instances occurred in the colony under observation. The synchronized colony that was observed in 1973 contained 26 nests with 8 nests abandoned (31% nest loss) and the 1974 colony was comprised of 24 nests with 18 abandoned (75% nest loss). Ninety-nine % of 219 nests in 4 additional colonies were abandoned in 1974. These colonies were visited only once during the nesting sequence. Nest abandonment was a serious problem in other colonies, although, in order to minimize disturbance, we did not closely observe additional colonies.

Brown and Urban (1969) observed both eggs and young abandoned by the Great White Pelican (*Pelecanus onocrotalus*) at Lakes Natron and Rukwa in Tanzania when food was no longer available. Feeley (1962) noted a complete lack of breeding in years of inadequate food supplies at Lake St. Lucia in Zululand.

High rates of nest abandonment in 1974 may be attributed to difficulty in obtaining food. The birds may have been forced to travel further in response to low water levels and spend more time foraging. Incubation periods increased and nest relief did not occur, causing the incubating birds to abandon their nests. Knopf (1976) observed 22.4% of 1930 nests abandoned at Gunnison Island in Great Salt Lake, Utah, in 1973 and 28.7% of 2348 nests in 1974. The extremely high rates of nest abandonment and aberrant adult behavior observed in 1974 might be attributable to some external factor, such as a difficulty in obtaining food.

*Survival.*—Survival at time of nest departure in the observed colonies was .62 young per nest in 1973 and .21 young per nest in 1974. Young left the nest at between 2 and 3 weeks of age. In 1973, 16 young left the observed colony, while in 1974, 5 young departed from the nests. Overall colony production (fledged young) was estimated at 2100 young from 3911 nests in 1973 (.54 young per nest). In 1974 an estimated 1200 young were produced from 3082 nests (.39 young per nest).

In both 1974 and 1975, the survival of the larger nestlings in nests with 2 young until 1 and 2 weeks after hatching was significantly greater than that of the smaller birds ( $\chi^2 = 25.96$ ,  $p < .01$  in 1974;  $\chi^2 = 66.32$ ,  $p < .01$  in 1975). At least 1 week after hatching in 1974, 79.5% of the large young and 10.3% of the small young in 2-bird nests ( $N = 40$ ) were known to be alive. In 1975, 74% of the large young and 28% of the small young in 2-bird nests ( $N = 88$ ) were known to be alive at least 1 week after hatching (Table 2). All of the young in nests with single birds ( $N = 21$ ) were alive 2 weeks after hatching in 1974.

In over 90% of the observed nests, the smaller nestling died as a direct result of physical abuse by the older young. The larger nestling was ob-

TABLE 2

SURVIVAL OF WEB-TAGGED YOUNG FROM 2-CHICK NESTS AT CHASE LAKE IN 1974 AND 1975

Size of Young	Year	Number tagged	Number alive to 1 week	Number alive to 2 weeks
Large	1974	39	31	23
Small	1974	39	4	1
Large	1975	25	21	16
Small	1975	25	13	2
Large	1975	25	16	—
Small	1975	25	1	—
Large	1975	38	—	23
Small	1975	38	—	1

served continually pecking and biting the small young. The adult male made no active effort to terminate the harassment. Adults did end the abuse passively by separating young during brooding.

Some smaller nestlings probably died of starvation. In these cases the larger young prevented the smaller from feeding as frequently or successfully as itself. In 1974, 187 feeding attempts were observed in the colony under observation. Large young initiated 122 (65.2%) of these attempts. Fifty-one successful feeding attempts were observed with large young getting the food in 38 (74.5%) of them.

The intense sibling rivalry as well as the high rates of nest abandonment observed at Chase Lake may be the result of difficulty in obtaining food. Some nest abandonment was likely caused by investigative activities; however, it is highly unlikely that entire colonies could be abandoned after only 1 visit by a single researcher.

There is significant discrepancy in the production figures among North American White Pelican colonies (Table 3). Most reported high survival rates are associated with quick visual observations, while low survival rates were found when actual counts of nests and young were made. Very few data dealing with the survival rates of juvenile White Pelicans from hatching exist. Consequently, any attempts to explain low production in terms of environmental factors results in a lack of supporting data from other colonies. A more comprehensive system of monitoring all White Pelican colonies is necessary if we are to determine if factors such as nest abandonment and sibling rivalry are, in fact, related to food availability or are a normal segment of the reproductive process in the White Pelican.

Previous studies have shown that sibling rivalry may be related to factors other than food. Ingram (1959) found that in many species of birds of prey

TABLE 3  
PRODUCTION OF SELECTED WHITE PELICAN COLONIES IN NORTH AMERICA

Location	Number of Nests	Number of Young	Young per Nest
Yellowstone Lake Wy. (Schaller 1964)	298	117	.39
Sand Lake S.D. (McCrow 1974)	29	13	.45
Lake of the Woods Ont. (Mansell 1965)	160	61	.38
East Shoal Lake Man. (Hosford 1965)	282	92	.33
Chase Lake N.D. (1974)	24	5	.21
LaCreek NWR S.D. <sup>1</sup>	900	1100	1.22
Medicine Lake NWR Mt. <sup>1</sup>	1700	1850	1.23
Anaho Island NWR Nev. <sup>1</sup>	3000	2980	.99
Bowdoin NWR Mt. <sup>1</sup>	1250	1480	1.18

<sup>1</sup> Figures are for 1971 (Sloan 1973).

the smallest young was eliminated regardless of the amount of food available. Gannets (*Morus bassana*) are capable of raising and feeding 2 young even though the second hatched young is virtually always killed by the first (Nelson 1964). Only the first hatched young of Sandhill Cranes (*Grus canadensis*) and Whooping Cranes (*Grus americana*) fledge, since the second is eliminated by the extreme aggressiveness of the older young (Miller 1973). However, the possibility of other factors influencing the survival of the younger sibling should not be completely discounted at present.

#### SUMMARY

Foraging distances for the Chase Lake flock range up to 611.8 km round-trip or twice as far as previously reported. Nest abandonment accounted for 31% of the nest loss in 1973 and 75% in 1974 in intensely observed colonies. It also appeared to be a significant problem throughout the entire colony in both years. The larger nestling in 2-chick broods survived more frequently than the smaller one in both 1974 and 1975. One week after tagging in 1974, 79.5% of the large young and 10.3% of the small young in 2-bird nests (N = 40) were known to be alive. In 1975, 74% of the large young and 28% of the small young in 2-bird nests (N = 88) were alive 1 week after tagging. Survival of small young in 2-bird nests was less than 5% after 2 weeks.

Large young fed more frequently and successfully than small young in 2-bird nests. In 1974, 187 feeding attempts were observed. The larger young initiated 122 (65.2%) of these attempts. Fifty-one successful feeding attempts were observed and large young completed 38 (74.5%) of these attempts.

Production was estimated at 2100 young from 3911 nests in 1973 (.54 young per nest) and 1200 young from 3082 nests in 1974 (.39 young per nest).

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