

SHORT COMMUNICATIONS

The Forster's Tern in Minnesota: status, distribution, and reproductive success.—Forster's Tern (*Sterna forsteri*) often breeds in prairie marshes characterized by emergent vegetation or muskrat houses (Bergman et al. 1970). Breeding is restricted to North America, and the northern Great Plains comprise the primary range (AOU 1983). Since presettlement times, well over 50% of prairie wetlands in this region have been converted to agriculture (Leitch 1989), but population size and breeding success of Forster's Tern in Minnesota were unknown prior to the present study. In 1984, the Forster's Tern was designated a species of "special concern" by the Minnesota legislature (Coffin and Pfannmuller 1988). Our study examines breeding distribution and population size, reproductive success, and factors affecting reproductive success of the species in Minnesota.

Study area and methods.—Census sites were selected from records obtained from the Minnesota Dept. of Natural Resources Colonial Waterbird Data Base (MDNR CWDB). Breeding pair estimates were made at 16 sites during the two years of our study. Census sites are described in greater detail in Louis (1989). For each site we obtained information on wetland size and classification from MDNR Division of Waters (Shaw and Fredine 1956, Cowardin et al. 1979). We completed most census activities during the first week of June; efforts were timed to coincide with late incubation. Colonies were reached either by boat or wading from shore. Nests containing one or more eggs or young were counted. We selected three colony sites in 1985 (Clearwater, Mother, and Swan lakes) and two colony sites in 1986 (Mother and Swan lakes) to monitor on a regular schedule. Nests were visited weekly from late incubation through fledging or disappearance of the offspring. A sample of nests was selected for study: Clearwater Lake (24 in 1985), Mother Lake (11 in 1985; 7 in 1986), and Swan Lake (45 in 1985; 45 in 1986). During each visit, the number of eggs and chicks was recorded in each monitored nest. The fate of each egg (e.g., non-viable, hatched, disappeared) and each chick (e.g., died, disappeared, fledged) was also recorded, as was any evidence of factors that may have affected reproductive success (e.g., weather, predators, human disturbance). Chicks were banded with a USFWS aluminum leg band. Three variables were used to measure breeding success: hatching success (chicks hatched/total eggs laid), fledging success (fledglings/total eggs laid), and reproductive success (fledglings/breeding pair).

Results.—We recorded 817 and 993 Forster's Tern nests in Minnesota in 1985 and 1986, respectively. The colony sites were located in the southern and western portions of the state, from as far north as Thief Lake to southernmost North Heron Lake and west as far as Coon Creek, with Wood Lake at the eastern edge of the range. Breeding was concentrated at five sites during the two years. From 64% (1985) to 93% (1986) of the pairs nested in Jackson, Marshall, Nicolet, Pope, and Wright counties. Because Forster's Terns may nest in small colonies and often change sites between years, we recognize that our coverage of all potential breeding sites was incomplete. We are quite confident that the major colonies were visited and believe the total breeding population in Minnesota was less than 1100 pairs.

While no major difference was found in the size of the total population between the two years, significant interseasonal variation in colony size occurred. The nests at Lake Osakis and Clearwater Lake comprised 40% of the total 1985 population. In 1986, there were no Forster's Tern nests at these sites. The largest colony in 1985 (326 pairs), located at Swan Lake, was approximately the same size in 1986 (316 pairs). At the same time, Agassiz National Wildlife Refuge colony increased by about 250 pairs and North Heron Lake colony by almost 180. The other sites varied by fewer than 30 nests between years.

TABLE 1
FORSTER'S TERN BREEDING SUCCESS IN 1985 AND 1986

Colony Site	Year	Hatching success (%)	Fledging success (%)	Reproductive success
Clearwater Lake	1985	33	17	0.46
Mother Lake	1985	0	0	0.00
	1986	20	0	0.00
Swan Lake	1985	20	6	0.16
	1986	33	5	0.13
Means	1985	18	8	0.20
	1986	27	3	0.07

Colony sites in Minnesota were limited to wetland types 3 (one site), 4 (nine sites), and 5 (six sites). Of the non-urban sites used in 1985 or 1986, only one, Coon Creek, was small (207 ha). The rest were 700 ha or larger. The urban sites, Mother Lake and Wood Lake, were both small (55 and 49 ha, respectively). During the study, hatching success ranged from 0–33% among colonies and 18–27% for all study sites between years. Fledging success varied from 0–17% among colony sites but was 3–8% for all study sites between years, and reproductive success ranged from 0 chicks/pair at Mother Lake in both years to 0.46 chicks produced/pair at Clearwater Lake in 1985 (Table 1). Of 282 eggs, 171 (61%) disappeared prior to hatching; only 25% of the eggs hatched. Approximately 13% of all eggs were deserted, and only four eggs (<2%) were non-viable. Of the 70 chicks that hatched, disappearance also was the most common fate; 67% disappeared before reaching 15-days-of-age. Only one chick (<2% of all chicks from monitored nests) was known to be killed by a predator, but other chicks from adjacent unmonitored nests were found decapitated. Another 1% of chicks were found dead of unknown causes.

Discussion.—Our estimate of the current Minnesota breeding population of Forster's Terns as less than 1100 pairs indicates the state population has declined by approximately 60% since 1942 (MDNR CWDB). Although fewer pairs now nest in the state, their breeding distribution appears similar to that reported early in this century (Roberts 1932, MDNR CWDB). We found Forster's Terns breeding throughout the western prairie wetlands and eastward through the prairie-woods transition, including an extension into the central part of the state to the Twin Cities.

Forster's Terns utilized a range of wetland type colonies but were found most often in Type 4 wetlands, which are characterized by large stable stands of dense emergent vegetation and extensive water for foraging. Nests were almost always constructed on rooted cattail bases, but at several lakes they were placed in dense stands of bulrush (*Scirpus* sp.). Our study and historical data indicate that Forster's Terns often select Type 5 wetlands when large floating vegetation mats or other suitable nesting substrates are available. The deeper water and more open expanses of Type 5 wetlands may provide a predictable food resource and greater protection from mammalian predators. Type 4 wetlands were consistently used, but terns utilizing these sites may, on average, have much lower reproductive success than pairs nesting in Type 5 wetlands. Type 4 sites appear very vulnerable to several species of predators and nest destruction by major summer storms. Although Forster's Terns periodically utilize small wetlands characterized by shallow water and emergent vegetation (Type 3), these sites

appear less than ideal because of easy access by mammalian predators and greater sensitivity to drought.

Forster's Tern has been one of the least censused colonial waterbird species in Minnesota (Guertin and Pfannmuller 1985) and probably elsewhere throughout its range. Although there is no estimate of the total number of Forster's Terns that breed in North America, a few regional figures are available (e.g., Kress et al. [1983] recently reported 3100 pairs in the northeastern United States). In the area surrounding Minnesota, several states and provinces have assessed Forster's Tern population size but the status of this species in this region is poorly understood (Louis 1989).

In this study, hatching rate was as high as 33% (Swan Lake, 1986) and as low as 0% (Mother Lake, 1985). McNicholl (1982) found hatching rates of 5–15% in Manitoba. In South Dakota, Houston (1973) reported 66% hatching success, and in California, Coulter found that 65% of the eggs hatched (McNicholl 1982). Fledging success in Minnesota also varied among sites and between years. The success (approximately 17%) recorded at Clearwater Lake in 1985 is the highest reported for this species in the literature. Other studies report 1–14% (Bergman et al. 1970, McNicholl 1982). The highest estimate of reproductive success recorded in this study, 0.46 fledglings/pair, is below the 1.1 fledglings/pair needed to maintain a population of Common Terns at its current size (Nisbet 1978, DiCostanzo 1980). Because data on Forster's Tern life expectancy and mortality rates are not available, it is not possible to obtain good estimates of the level of reproductive success required to sustain the Minnesota Forster's Tern population. McCaskie and Pugh (1964) reported reproductive success rates of 0.14 fledglings/pair, and McNicholl (1982) found that 7% of all eggs fledged in 1968; none survived to this stage in 1969. Data on other species of marsh nesting terns also indicate apparently low fledging success for terns nesting in wetland habitats (McCaskie and Pugh 1964, Burger and Lesser 1979, Ohlendorf et al. 1985).

Wave action, wind, and rain destroyed a number of nests during both years of our study. Runoff also affected nesting areas after initial storms were over and high water level was an important factor influencing breeding success at several Minnesota colonies. Although flash flooding may occur soon after a storm we found that water levels often continued to rise for days following significant precipitation. Although only one chick was known to be predated, other evidence (e.g., decapitation, flesh wounds, punctured eggs, missing eggs, and missing chicks) indicated that predation was a common cause of mortality during both years of the study. Although we could not document the extent of predation either year, we believe that most missing eggs were eaten by predators and that some portion of the chicks that disappeared prior to fledging also experienced this same cause of mortality. We estimate egg loss to predators may have ranged from 100% at Mother Lake (1985), 45–75% at Swan Lake, 34% at Clearwater Lake and believe most mortality was caused by Great Horned Owls (*Bubo virginianus*), Black-crowned Night Herons (*Nycticorax nycticorax*), and mink (*Mustela vison*).

We recommend protecting traditional colony sites against wetland development so that Forster's Terns will have alternative nesting habitat available during years of water level extremes. We also encourage a coordinated census effort by states and provinces in the Northern Great Plains region to evaluate the current status of this species throughout its primary breeding range.

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