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# COMMON TERNS IN THE NORTHERN GREAT LAKES: CURRENT STATUS AND POPULATION TRENDS

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The number of Common Terns (*Sterna hirundo*) nesting on the North American east coast has fluctuated during the past century (Nisbet 1973). A recent overview from Maine to Virginia indicates that nesting numbers now appear to be stable in most regions with the exception of New England (Erwin 1979, also see Nisbet 1973, 1978; Drury 1974). Declines in New England, and Massachusetts particularly, may have resulted from insufficient natality to offset mortality (Nisbet 1978) and emigration (Drury 1974, Erwin 1979). Regional declines in nesting pairs have also been noted in the Canadian region of the southern Great Lakes (Blokpoel 1977, Blokpoel and McKeating 1978) and in the St. Mary's River region of the northern Great Lakes (Scharf 1981). In the Great Lakes, as in Massachusetts, fewer nesting pairs in a local area or colony may represent actual shrinking breeding populations (Morris and Hunter 1976, Morris et al. 1980) or emigration to other areas. These 2 factors are considered in this paper. We review past trends and update the current nesting status of this tern within the Michigan Great Lakes where it has been designated an endangered species (Michigan Department of Natural Resources 1978).

## METHODS

Throughout this paper a colony refers to the birds nesting on a colony site. A colony site is the physical area where nests were placed in the past or are currently placed.

Comparison of current and past colonial bird populations is often not possible, or is at least questionable, because methods used to obtain data in the past are ambiguous or the census areas or search efforts are not indicated (Drury 1974). If these conditions can be established for census data, then similar methods can be employed to collect comparative data. In the Great Lakes the first complete survey of an area large enough to assess population trends was Ludwig's (1962) survey of the area in Fig. 1a in 1962. Part of the Great Lakes was surveyed by Ludwig (1962) in 1960 and 1961, but only the 1962 data are complete enough for analysis of population trends. We used Ludwig's 1962 survey area (Fig. 1a, hereafter LSA) as a geographical base for comparisons of 1962, 1976, 1977, and 1980 nest counts.

Ludwig (1962, pers. comm.), while standing in a boat, used binoculars to search shorelines, islands, and shoals. When a colony was located, nests were counted. Searches were done during the first 3 weeks of June. In 1976 and 1977 we searched LSA (Fig. 1a) by floatplane while conducting larger-scale surveys of the U.S. Great Lakes (Scharf 1978, Scharf et al. 1979). Nest counts in 1976 and 1977 were completed during June (Scharf 1978).

In 1980, as part of a reassessment of the Common Tern's status in

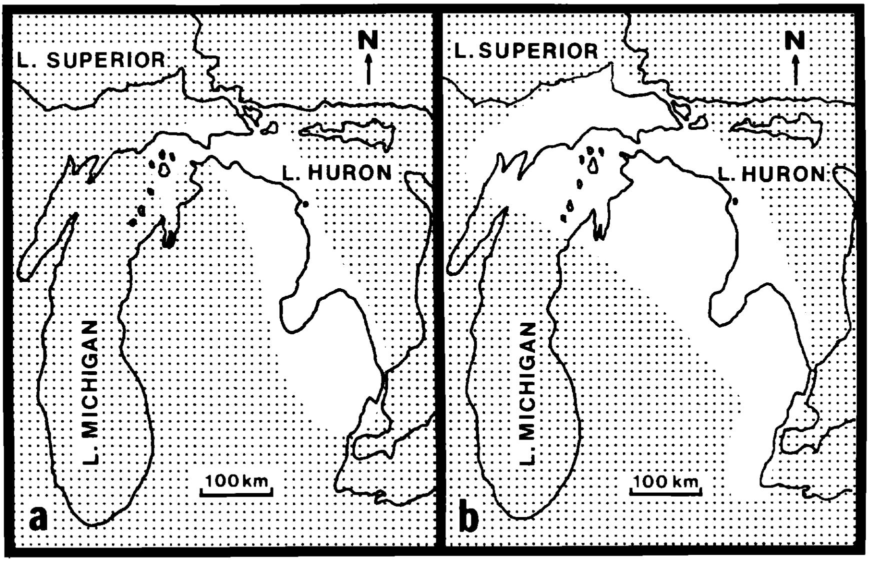


FIGURE 1. a. Ludwig survey area (LSA) in which shorelines, islands, and shoals were searched in 1962 (modified from Ludwig 1962). b. Area of the Michigan Great Lakes (MGL) where terns nested in 1976 and 1977 (Scharf 1978). The same area was searched in 1980 and a nest count was done using comparable methods.

Michigan, we surveyed that portion of the Michigan Great Lakes (Fig. 1b, hereafter MGL) where Scharf (1978) found nesting Common Terns. We monitored colony sites in MGL from mid-May to early June to determine when the first eggs were laid. The actual count of nests used for comparisons to previous years' censuses were completed from 8 to 27 June. This count was done approximately 3 weeks after eggs were laid in a subregion (i.e., NW Lake Michigan, NE Lake Michigan, St. Mary's River, NW Lake Huron, Saginaw Bay to southern border).

There are several sources of error in the census data summarized and presented in this paper. One source could be imprecision in counting which we assume was minimal and similar between investigators. Second, an undercount of breeding birds could occur because nests were washed away before the count. Third, use of the floatplane probably permitted a more thorough search of the region in 1976, 1977, and 1980, than the search by boat in 1962. For this reason we view Ludwig's 1962 estimate as a minimal count. We believe the sources of error were similar in all years and that the data are sufficiently comparable to assess changes in the number of nesting pairs for the years 1962, 1976, 1977, and 1980.

In 1980 we attempted to estimate reproductive success at colonies in MGL (Fig. 1b). The wide dispersion of colonies in the approximate 525 km × 360 km study area (Fig. 1b) and a limited number of visits to each did not permit precise studies of reproductive success as performed by Nisbet and Drury (1972). Therefore, we simply determined the percent of eggs present that hatched and survived from our first count to a second visit approximately 30 days later. Mechanical hand counters were used to record nest contents as we walked through colonies on dikes, breakwalls, or shoals, where the linear arrangement of nests permitted accurate counts by 1 person, or 2 people walking abreast. In colonies that could not be counted in 1 pass, areas were flagged or otherwise identified while counting to prevent duplication. On visit 2, we counted chicks 1+ week old, divided these by the number of eggs present on visit 1, and multiplied by 100, to obtain an index of colony success.

Our rationale for using the above method is as follows: The incubation period for Common Tern eggs is 21 to 30 days with a median of 23 to 25 days (Palmer 1941). Chicks average approximately 26 days from hatching to flying (Palmer 1941, Nisbet and Drury 1972, LeCroy and LeCroy 1974). Our preliminary flights in 1980 permitted us to schedule visit 1 at the approximate time the first eggs were to hatch. On the second visit 30 days later, the first few chicks that hatched should be able to fly, and most of the young would be between 2 and 3 weeks old assuming a normal progression of laying (see Nisbet and Drury 1972). We did not visit all colonies to determine when egg laying began, but assumed colonies in the same area would have a similar schedule. Not all colonies conformed regarding initiation of egg laying and data from only 8 colonies could be used to calculate reproductive success. At these we knew when the first eggs were laid, our first count occurred before eggs hatched, and we were able to return to the colony 26 to 30 days after visit 1, so that few chicks could have flown away from the colony site. The other colonies could not be used for estimating reproductive success because they did not meet one or more of the criteria.

## RESULTS

In LSA (Fig. 1a) the number of Common Tern nests declined from 1962 through 1976 and 1977, then returned to 1976 levels in 1980 (Table 1). The 50% decline from 1962 to 1976 probably was caused by several factors which resulted in a loss of nesting area and established colony sites. Within the Great Lakes the amount of insular nesting area available is influenced to some degree by fluctuating water levels which have an amplitude of 8 to 15 years (Fig. 2, Cohn and Robinson 1976). Relatively high water levels occurred in 1968 and 1969 and record highs occurred in 1973 and 1974 (Fig. 2). Effects of high water were evident by 1976, the first year of our regional studies (Scharf et al. 1979). By 1976, 6 (50%) of the colony sites, where at least 1600 pairs nested in 1962 (Ludwig 1962), were under water or periodically inundated by storm-driven waves. These sites presumably became unusable when the water levels rose in the late 1960's (Fig. 2). Terns attempted to nest on

TABLE 1. Common Tern census data[1] obtained using comparable survey methods from regions of the Great Lakes considered in this paper (see Fig. 1).

| | 1962 | 1976 | 1977 | 1980 |
|---|---|---|---|---|
| Ludwig Survey Area (LSA) | | | | |
| Pairs/number of colonies | 2885/12 | 1426/14 | 794/16 | 1496/15 |
| Mean colony size ± SE | 240 ± 70 | 101 ± 32 | 50 ± 10 | 100 ± 45 |
| Michigan Great Lakes (MGL) | | | | |
| Pairs/number of colonies | No data | 2082/22 | 1390/26 | 2058/26 |
| Mean colony size ± SE | No data | 95 ± 21 | 53 ± 9 | 79 ± 27 |

[1] From Ludwig (1962), Scharf (1978), and this paper.

2 of the sites in 1977 and 1980, but storm waves washed the eggs and nests away before clutches were completed.

Three (25%) of the 1962 sites, which had a total of 930 nests, were unaffected by water levels, but were not used by any larid species from 1976 through 1980 due to human interference at 1 site, and for unknown reasons at the other 2 sites. Of 12 sites in LSA used by Common Terns in 1962, only 3 were used in 1976 and 1977, and only 2 were still in use in 1980.

The sharp decline in Common Tern nesting pairs (Table 1) from 1976 to 1977 occurred when 700 pairs discontinued use of 2 island sites after predation in 1976 by rats (*Rattus norvegicus*) and canids (*Canis latrans* and *Vulpes vulpes*; Scharf 1978, Scharf et al. 1979).

By 1980, 66% of the total pairs in LSA were nesting at 3 colony sites that were first used in 1977 or later. Along with the almost total change in colony sites was an increase in the use of man-made sites. In 1962, only 30 pairs (1% in LSA) nested on man-made sites. In subsequent

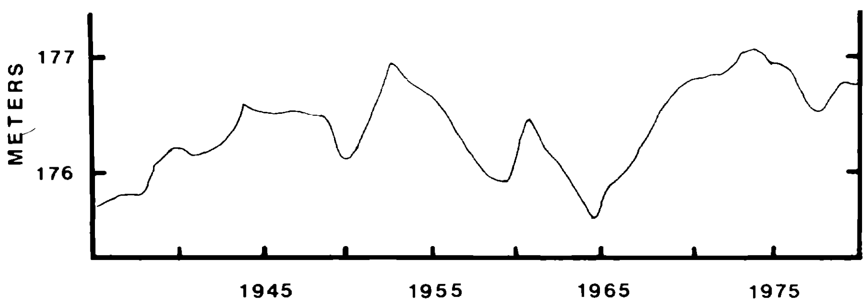


FIGURE 2. Fluctuating Lake Michigan and Lake Huron water levels. Meters above Chart Datum, a standard elevation. Data are from the spring of each year (modified from Cohn and Robinson 1976, U.S. Army Corps of Engineers, 1968–1980).

years the percent of nests on man-made sites in LSA was: 1976, 41% (581/1426); 1977, 43% (342/794); 1980, 81% (1210/1496).

The increase in pairs from 1977 to 1980 occurred as birds apparently moved onto a diked dredge disposal area and the breakwall and cribs at a privately owned lake-freighter harbor. These 2 sites alone accounted for the increase in nesting Common Terns from 1977 to 1980. By 1980, 62% (930/1496) of the nests in LSA were on these 2 sites.

The lake-freighter harbor was completed in the mid-1970's and was first occupied in 1977 by 12% (95/794) of the total pairs in LSA; this increased to 44% (662/1496) of the pairs in 1980. The disposal dike was constructed over 2 smaller dredge material islands, one of which had nesting Common Terns in 1977. The dike provided approximately 10 times more nesting area than the original island, and the number of pairs increased from 9% (69/794) of the 1977 total pairs in LSA to 18% (268/1496) in 1980.

*Suitability of sites and current reproductive success.*—We believe that terns have concentrated at 2 newly man-made sites because suitable nesting area was limited and few sites were available. We do not have the absolute data for testing this hypothesis, but the following circumstantial evidence lends support.

During our 1980 searches of MGL we found only 3 apparently suitable island sites that were unoccupied by larids. From our searches it appeared that few additional sites were available. At this time we are not able to determine availability of nesting area at sites now in use.

The suitability of sites in use can be assessed by reproductive success. If a large percentage of the eggs or young was destroyed by external factors (i.e., those not related to inherent reproductive capabilities), then it could be argued that the site was less than optimal for that nesting attempt. Unequivocal data in this respect would be total failure of nests at a site. During our searches of MGL, we found 36 sites which at one time or another had nests. (Only the 26 sites which had eggs between 8 and 27 June were used to derive comparative population estimates; see methods.) We returned to 33 of the 36 sites a second time. Seven sites (approximately 80 nests) had been washed over and eggs at 5 other sites (45 nests) had disappeared. Using total colony failure as a criterion, 21 (63%) of the 33 colony sites which we visited at least twice, were suitable for nesting.

At the 8 sites used for reproductive assessment, 2422 eggs were present on visit 1. Seven percent (163) survived to be counted as chicks on our second visit (unweighted colony mean = 10%). This did not meet our expectation of at least 30% survival derived from Palmer (1941) and Nisbet and Drury (1972).

Seven percent survival is equivalent to approximately 0.2 chick/pair. Assuming little emigration or immigration occurred, population parameters similar to those described by Nisbet (1978) and DiCostanzo (1980), and that the 1980 reproductive success was representative for the northern Great Lakes, then not enough young survived to maintain the population at the current level. Evidence of wash-outs, predation, and human disturbance were apparent at the sample colonies, but the actual impact of the various factors could not be measured accurately.

## DISCUSSION

The insular nature of nesting habitat used by ground-nesting colonial seabirds affords protection from terrestrial predators (Kruuk 1964, Lazell and Nisbet 1972), and insularity appears to be an important factor affecting habitat selection by the birds (Buckley and Buckley 1981). Within a region, such as the northern Great Lakes, availability of insular habitat and the amount of area required by each pair limit the number of birds which could nest. Within the boundaries imposed by water or other obstacles, factors such as interspecific competition for space, interspecific predation or food-stealing, or vegetational succession (Austin 1933, Nisbet 1973, Buckley and Buckley 1981, Erwin et al. 1981) could affect availability of suitable habitat for a species.

In the northern Great Lakes the land-water boundary and the amount of insular habitat change as water levels fluctuate. Water levels were high from 1969 to 1980 (Fig. 2). We found that high water was the most important factor responsible for the loss of colony sites which were used in 1962. Loss of these sites could account for a reduction in Common Terns from 1962 to 1976 if there were no other sites available to Common Terns in our study area. It appears sites were limited during the period of high water until the mid-1970's when man-made structures were built. This conclusion is based on our searches in 1980 when water was still high. We found few unused sites, except for man-made structures, and sites that were used appeared to be marginal judging from the poor reproductive success. With the provision of 2 man-made structures in the middle to late 1970's, sites were less limited. Nesting area at man-made sites was the major factor imparting some degree of stability to the number of Common Tern pairs nesting in the region since 1976. It appears that Common Terns were concentrated at these sites in 1980 because other sites were not available.

Common Terns share nesting habitat with gulls in the northern Great Lakes and the east coast of North America, and gulls often are implicated in declines of Common Terns (e.g., Drury 1974, Morris and Hunter 1976, Courtney and Blokpoel 1979). Rationale for this effect is that at colony sites which are suitable for nesting by several larid species, the earlier nesting species, which usually are gulls, have an advantage in acquisition of nesting area. Therefore when nesting area is limited, earlier nesters can reduce the amount of nesting area available to later nesters. Have gulls taken over or reduced the amount of nesting area available to Common Terns in the northern Great Lakes?

In the Great Lakes, Herring (*Larus argentatus*) and Ring-billed (*L. delawarensis*) gulls nest earlier and in sufficient numbers to influence the amount of nesting area. In 1962, 1976, and 1977, respectively, there were 20,000, 11,000, and 11,500 Herring Gull pairs in LSA (data from

Ludwig 1962, pers. comm.; Scharf 1978). Assuming 10 to 30% error in these estimates (Ludwig pers. comm., Scharf 1978), it is unlikely that Herring Gulls reduced the amount of nesting area available. Ring-billed Gull pairs have increased in LSA from 21,000 in 1962, to 65,000 in 1976 and 61,000 in 1977. However, this approximate 300% increase of Ring-billed Gulls from 1962 to 1976 did not result in the actual takeover of active Common Tern sites (e.g., Morris and Hunter 1976). On the other hand, increases in Ring-billed Gulls may have combined with the high water levels to reduce the amount of nesting area available to terns after the 1962 sites were lost.

In the southern Great Lakes, Morris and Hunter (1976) and Morris et al. (1980) suggested that exploitive competition for nesting area with earlier nesting Ring-billed Gulls resulted in instability in the use of colony sites by Common Terns, and that this influence was important in recent declines in the number of Common Terns in the Great Lakes. In 1980, we found Ring-billed Gulls using portions of 2 nesting areas used by Common Terns in 1979; other examples can be found in Ludwig (1962), Morris and Hunter (1976), and Scharf (1981). Morris and Hunter (1976) reviewed instances of increases of earlier nesting gulls and decreases in Common Terns on the east coast. However, for exploitive competition for nesting area to be important in causing declines in Common Terns at a colony site or in a larger geographical area, it would seem that available nesting area would have to be limited. This idea is implicit in the definition of competition (e.g., see Brown 1964). Morris and Hunter (1976) give the only Great Lakes example which provides a measure of nesting area. They state that 1.5 ha and .5 ha of apparently suitable tern nesting area remained at the colony sites after the Ring-billed Gulls took over tern nesting area in the year the terns did not return. When sites were provided (Morris et al. 1980) the terns still did not return which could indicate they moved elsewhere.

It is possible that other less obvious gull effects, such as gull predation on Common Tern eggs or young (Hatch 1970, Burger and Lesser 1978, Erwin et al. 1981), food stealing (Hatch 1970), or competition for food, may induce Common Terns to leave or not return to a colony site (Drury 1974). These gull effects might explain the movement from the sites despite the presence of suitable nesting area indicated by Morris and Hunter (1976), although in studies which have quantified Ring-billed Gull interference with Common Terns (Morris and Hunter 1976, Courtney and Blokpoel 1980), little interference was found.

Although there is evidence that Ring-billed Gulls can take over Common Tern nesting area, there is only indirect evidence that declines in Common Terns can be explained by loss of nesting area to Ring-billed Gulls. This includes loss due to the earlier physical occupation by the gulls or indirect loss because Common Terns avoid colony sites shared with gulls.

Perturbations such as inundation, vegetational succession, or earlier nesting by other species resulting in loss of nesting area have likely affected Common Terns throughout evolutionary history. The ability to move considerable distances between nesting attempts in the same or subsequent season (summary in DiCostanzo 1980) has been interpreted as an evolutionary response (Marples and Marples 1934; Austin 1940, 1951; Palmer 1941; McNicholl 1975). Common Terns appear to be adapted to use ephemeral or unstable colony sites and periodically move between sites when sites are lost or become otherwise unsuitable. As long as other nesting area was available, colony extinctions or decreases in the number of pairs within a small region could be expected and would have a minor effect on the population dynamics of a continuously distributed and long-lived species (Austin 1953).

With this reasoning, changes in subregional distributions or colony extinctions would have little biological significance and would not necessarily indicate declining regional populations. The original reason for placing the Common Tern on the Michigan endangered list apparently was a high rate of colony extinction (J. Lerg, DNR, pers. comm.) which we have shown has occurred. However, with count data from searches of the region in 1976, 1977, and 1980, the situation does not appear as critical as colony-oriented censuses indicated, because other nesting areas became available at man-made sites. If these sites had not been available, the number of pairs nesting within Michigan would likely have continued on a downward trend through 1980. Until further data are available, the low productivity we recorded in 1980 is sufficient reason to closely monitor this species in the future.

## SUMMARY

In 1980 we censused Common Terns in the same area of the northern Great Lakes that was covered by 1962, 1976, and 1977 censuses. In this area (designated LSA), the number of pairs declined from 2885 at 12 colonies in 1962, to 1426 (14 colonies) in 1976, and 794 (16 colonies) in 1977. The decline from 1962 to 1976 most likely resulted from a loss of 9 of the 1962 sites where 88% of the total pairs nested. Six sites were lost to rising Great Lakes water levels, 1 site to human influences, and 2 sites to unknown factors. The drop from 1976 to 1977 was due to predation at 2 large colonies combined with a failure to settle at alternate sites in 1977. Increased use of man-made sites from only 1% of the total pairs in 1962 to 82% of the total pairs in 1980 was important in the 1980 increase to 1496 pairs. In LSA, 62% of the total pairs nested at the 2 man-made sites. A 30% failure rate of colony attempts and poor reproductive success in 1980 appear to indicate that suitable nesting habitat was limited in the Michigan Great Lakes. Fluctuating Great Lakes water levels and possibly increases in Ring-billed Gulls have reduced the amount of suitable nesting habitat available to breeding Common Terns in the Michigan Great Lakes.

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