

MANAGEMENT OF BREEDING INTERIOR LEAST TERNS IN INDIANA

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ABSTRACT: The only population of interior least terns nesting east of the Mississippi River occurs at Gibson Lake in southwestern Indiana. This Federally endangered species was first noted nesting in Indiana in 1986. Recent management practices have been directed towards encouraging nesting by terns and at monitoring numbers and reproduction. To encourage tern use of the Gibson Lake site, decoys and broadcasts of tern vocalizations were employed as social attractants. Least tern reproductive effort has increased and evidence indicates that a small colony of least terns is now established. Production in 1991 was poor, and 1992 management focused on reducing predation. Other potential Indiana least tern habitat is restricted to the lower Wabash River. Surveys of these sites have demonstrated no use by breeding terns.

INTRODUCTION

The interior least tern (*Sterna antillarum athalassos*) breeds on exposed sand, shell, and gravel islands and bars of the Mississippi River and its major tributaries (Bent, 1921; Hardy, 1957; Ducey, 1981; Sidle, *et al.*, 1990). Breeding least terns occupy ephemeral colony sites dependant on regular scouring by high water to eliminate encroaching vegetation. Human recreational use and modification of these riverine systems, including impoundment and channelization, has resulted in extensive loss of breeding habitat (Downing, 1980; Ducey, 1981; Sidle, *et al.*, 1990). The breeding range of interior least terns is currently restricted to remnant localities within a wider historic distribution. Interior least terns no longer occur on most tributaries of the lower Mississippi. Sidle, *et al.* (1988) summarized the results of intensive least tern surveys conducted throughout the current range of the species in 1985-1987 and noted fewer than 5000 adults. Over half of all breeding terns occurred on the Mississippi River between Cape Girardeau, Missouri, and Vicksburg, Mississippi. Least terns have been eliminated from historic sites in the Ohio River basin. A single historical nest record exists for the Ohio River conterminous with Indiana. A single nest was discovered at the Falls of the Ohio near Louisville, Kentucky, in 1967 (Mumford and Keller, 1984).

Human activity can create functional breeding habitat. Nesting least terns have been observed on dredge spoil islands, parking lots, farm fields, roof tops, and various other artificial sites with sand or gravel substrates (Altman and Gano, 1984; Kotliar and Burger, 1986; Sidle, *et al.*, 1988). These artificial sites often are not widely used and contribute little to annual least tern recruitment. Kotliar and Burger (1986) noted that dredge spoil sites in New Jersey supported smaller colonies of costal least terns (*S.a. antillarum*) and had a higher frequency of colony abandonment than natural sites. Human disturbance, accessibility to ground predators, increased distance to water, and a higher proportion of coarse particles in the substrate at these sites may have contributed to low use and poor reproductive success.

Interior least tern nesting at Gibson Lake in Indiana is an example of the opportunistic use of an artificial colony site and represents the only known nesting of interior least terns east of the Mississippi River. Abundant natural least tern habitat occurs on the lower Wabash near Gibson Lake, but tern use of these sites had not been systematically evaluated prior to this effort. Least terns nests may fail at natural riverine sites because of flooding, predation, or human disturbance. Gibson Lake is, or may be, secured from all of these detrimental factors. Our purpose has been to develop a sustained breeding population of interior least terns in southwestern Indiana, and those management attempts are summarized in this paper.

STUDY AREA

Gibson Lake is an 1180-ha cooling impoundment for the Gibson Generating Station, a coal-powered electrical generating plant owned by PSI Energy. The lake is located less than 1 km from the Wabash River and 3.8 km southeast of Mt. Carmel, Illinois. Construction of the lake was completed in 1973. Gibson Lake is bisected by a 3.4 km-long central dike that extends out into the lake from the plant. The dike separates the generating plant warm water discharge and water intake structures to facilitate water cooling. The dike is composed of limestone rip-rap. Its 5 m-wide top is surfaced with finely crushed limestone and serves as a maintenance road. Annual herbicide applications have prevented vegetation encroachment on the dike. Access to the central dike is limited to IDNR personnel each year when terns are resident. Gibson Lake supports a large population of forage fish, principally threadfin shad (*Dorosoma petenense*) and brook silversides (*Labidesthes sicculus*).

MATERIALS AND METHODS

Field work was conducted from 1987 through 1992 and was initiated by late April in each year. In 1987 and 1988, field work was limited to regular inspections of the site to assess tern breeding activity and nest success. In 1989, 22 decoys were deployed at the distal end of the central dike. In 1990 and 1991, a second group of 22 decoys was added approximately 320 m from the first group. In 1992, all decoys were again located at the end of the dike in a single group. Decoys were constructed of laminated cedar and were anchored in place on rebar stakes. They were placed singly and in pairs at a mean interval of 2 m to maximize their social attraction value (Burger, 1988). Decoys have been used successfully in California, Virginia, New Jersey, and Maine to attract coastal least terns to abandoned colony sites or to sites secured from predation and human disturbance (Kress, 1983; Burger, 1988; Francher, 1984).

In 1990 and 1991, a 12-V tape player, amplifier, and public address speaker were employed to broadcast nonaggressive least tern colony vocalizations at one of the decoy groups. Recordings on three-minute endless-loop cassette tapes were broadcast from 0800 to 1600 hr daily at a maximum volume of 80 db. A timing device was employed to turn the system off from 1600 hr to 0800 hr the following day. Recordings of tern vocalizations were obtained from the Cornell University Library of Natural Sounds.

Decoys were observed in 1990 and 1991 from a blind or vehicle two or three times per week with a spotting scope at a distance of 50 to 300 m. To evaluate the social attraction value of decoys and vocalization broadcasts in least tern management, the distance of each tern landing from the nearest decoy group was recorded. Each alighting

with an intervening flight was regarded as a landing. The 320 m space between decoy groups was divided into four 80 m lengths. A landing was arbitrarily defined as in association with decoys when within 80 m of a decoy group. Data on landings were not recorded for nesting pairs after nests had been initiated as it was apparent that landing location was tied to nests and not to the presence or absence of decoys.

Least terns were color marked from 1989 to 1992 to facilitate assessment of colony site fidelity. Adult terns were trapped on the nest during late incubation. A net propped over the nest was dropped on an incubating adult by an observer in a blind 25-50 m away. To minimize disturbance, no more than one member of a pair was captured and banded. The marking system, which consisted of a combination of aluminum and colored Darvic bands, was coordinated with personnel of the Missouri Department of Conservation which conducts an extensive least tern banding program. The total time for capture and marking, during which the nest remained unattended, was less than 30 minutes. Chicks were captured in the vicinity of the nest after hatching.

Management efforts in 1992 focused on minimizing the impact of predators on tern reproductive success. A predator exclosure was constructed around the last 100 m of the central dike enclosing the decoys and all nests (Mayer and Ryan, 1991). A 90-cm-high barrier of 2.5 cm mesh poultry netting was constructed across the dike extending into the water on both sides. The barrier was supported by steel T-posts driven into the road and rip rap. An electric fence was constructed around the perimeter of the top of the road within the barrier. A single strand of electrically-charged, 17 gauge, smooth wire encircled the colony twice at heights of 6.25 and 14 cm.

Norway rat (*Rattus norvegicus*) predation within the exclosure was controlled with brodifacoum poison baits. Baits were wired in the center of 5 cm x 30 cm sections of plastic pipes to minimize the exposure of terns and other nontarget species.

Nocturnal avian predation by owls or black-crowned night herons (*Nycticorax nycticorax*) was discouraged through the use of a strobe-light-system (Kruse and Higgins, 1991). During late incubation, six strobe lights were placed at regular intervals throughout the exclosure. The lights were photocell activated and ran from sunset to sunrise. The system was powered by a 12-V battery.

Typical least tern breeding habitat on the Wabash River was surveyed during the breeding season by air and then by boat from Terre Haute, Indiana to the Ohio River in 1987 and from Mt. Carmel, Illinois, to the Ohio River in 1989-1991. Habitat quality was assessed using the USFWS Habitat Suitability Index model for least terns (Carreker, 1985).

RESULTS AND DISCUSSION

Gibson Lake. Least terns first nested on the central dike in 1986 (Mills, 1987) and again in 1987. In both years, a single nesting pair was present. No terns nested at Gibson Lake in 1988. By 1989 and 1990, the number of adults had increased to seven and eight, respectively. Twelve adults were observed in 1991. In 1992, the number of resident adults dropped to eight, possibly in response to disturbance by predators the previous year (Figure 1). In each year, nonbreeding adults were resident and participated in colony defense, most notably in the prebreeding and early incubation periods.

The number of nests and chick production at Gibson Lake has shown a similar pattern. Single nests were initiated and clutches hatched in 1986 and 1987. This number increased to three nests in 1989 and 1990. In 1991, seven nests were initiated, and twenty eggs successfully hatched. Of these nests, five were first nests and two were renesting

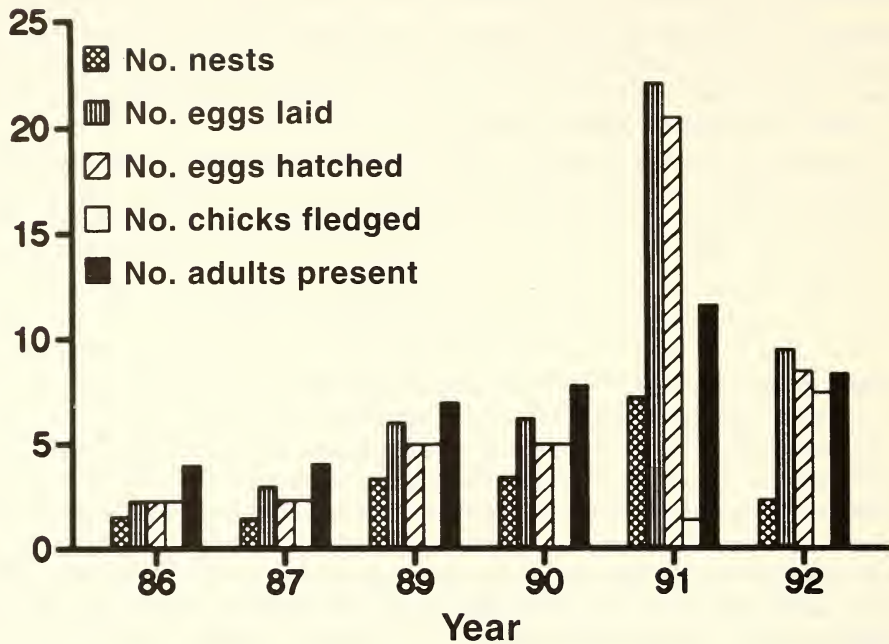


Figure 1. Least tern numbers and productivity at Gibson Lake, Indiana, 1986-1992.

attempts following chick predation. In 1992, three nests were initiated, and eight of nine eggs hatched.

No Gibson Lake nests have been predated prior to hatching. From 1986 to 1990, chick survival was high. Although it was not possible to obtain precise estimates of survival rates, fledging success may have approached 100 percent. Chicks were regularly observed late in the prefledging period, and fledged chicks were frequently seen. However, in 1991, chick predation was substantial, resulting in the loss of all chicks from the five first nests and four of five chicks from the two renesting attempts.

Predation on tern chicks at Gibson Lake probably represented the opportunistic use of a prey species by predators. An abundant fish population attracts and supports predators. Fish are readily available among the rip-rap at the water line and are very abundant on top of the dike as carrion. Increased tern numbers and activity at the site may have focused attention on the chicks. Predators using the site in 1991 evidently fed only on chicks and not on eggs.

Although difficulty in achieving an adequate ground limited the effectiveness of the electric fence as a predator deterrent, other 1992 efforts to minimize predation were successful. Although rat baits were readily consumed and up to 75 black-crowned night herons were seen on the dike away from the colony site, at least six of eight chicks were successfully fledged from within the enclosure.

Decoys appear to be an effective social attractant contributing to colony growth at Gibson Lake. The number of resident adults increased steadily after initiation of the use of decoys in 1989 (Figure 1). The distance from decoys and number of landings were strongly negatively correlated ($r = -0.931$, $p < 0.005$). Under the circumstances tested, broadcasts of colony vocalizations had no effect on the distribution of least tern land-

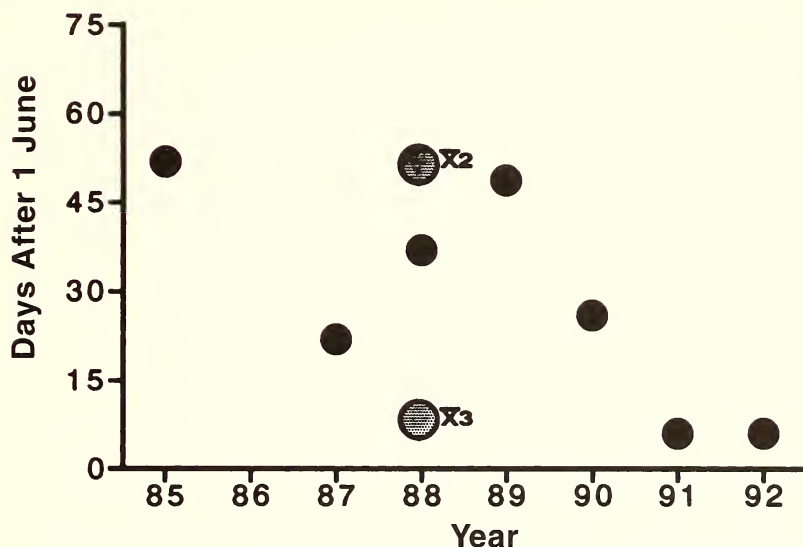


Figure 2. Mean nest initiation dates and the mean initiation dates for two and three-egg nests, 1986-1992. No terns nested in 1988.

ings. Terns landed with equal frequency at decoy groups with and without broadcasts ($\chi^2 = 2.31$, $p = 0.30$). Even though vocalizations had no demonstrable social attraction value, they presumably increase the realism of the simulated colony when played at a volume mimicking actual tern vocalization. The value of louder broadcasts as a long distance attractant has not been assessed.

Large interior least tern colonies on the Mississippi River south of Cairo, Illinois, appear to be the source of terns nesting at Gibson Lake. These perennial colonies are nearest the Ohio River basin. One member of a 1990 breeding pair had been color-marked as an adult on the Mississippi River in 1987 near Hickman, Kentucky, by personnel of the Missouri Department of Conservation. Another adult, also color-marked on the Mississippi in 1987, was captured in 1991, and a third, marked as a chick near Caruthersville, Missouri, in 1989, was captured on a nest at Gibson Lake in 1992 (R. Renken, pers. comm.).

Annual mean nest initiation dates in Indiana have traditionally occurred in late June to early July, 2.5 to 6 weeks after the peak of first nest initiation at Mississippi River sites in Missouri. These nests (with the exception of the single nest in 1987) have all contained two eggs. Clutch size for least terns is typically reported as two or three eggs (Bent, 1921; Whitman, 1988), but two-egg nests are commonly associated with first-time nesters or renesting attempts. Late nest initiation and small clutch size may have indicated a colony composed of young, first-time nesters prospecting new breeding sites or birds renesting after inundation or predation of first nests, perhaps at Mississippi River colonies. A nest was initiated on 10 July 1990 by a tern banded as an adult in Missouri and not seen previously that year at Gibson Lake. That all 1991 and 1992 nests contained three eggs suggests that Gibson Lake is now used as a primary colony site by experienced nesters for

the initiation of first nests. The mean first nest initiation date of 6 June in both 1991 and 1992 is significantly earlier than the mean date for the previous five years ($t = 9.81$, $p < 0.001$), suggesting that these were first nests of older terns and that Gibson Lake is developing into a traditional colony site (Figure 2).

Two pairs nesting on the center dike in 1992 contained members marked at the site in 1991 (Johnson, 1992). Site fidelity is important in colony establishment and maintenance. Because Gibson Lake is secure from inundation and because management prevents vegetation encroachment and minimizes human disturbance, an increase in colony size seems likely, if predation can be controlled.

To summarize, a general increase in least tern reproductive activity has occurred at Gibson Lake since 1986. Reproductive success has been good in each year with the exception of 1991, when predation virtually eliminated reproductive output. Efforts in 1992 to minimize predation proved effective. A nesting colony has been successfully established at Gibson Lake since 1986 through the use of decoys and through site fidelity demonstrated by terns.

Wabash River. Surveys of sandbar habitat along the Wabash River failed to locate nesting least terns. Forty-two potential colony sites were identified using aerial photos taken during a time of low river levels in the spring of 1987. All potential habitat was restricted to the river below Terre Haute, Indiana, and collectively comprised 25.4 km of shoreline habitat of which 20.6 km was located below Mt. Carmel, Illinois. Sites above Mt. Carmel were marginal in size and composition (i.e., silt and large river cobbles). Carreker (1985) notes a preference by least terns for nesting on substrates of fine gravel, shells, and coarse sands. Mean bar length was significantly greater for sites below Mt. Carmel than for sites above (977 m and 303 m, respectively). Mean maximum bar height above the water was 1.4 m below and 0.6 m above Mt. Carmel ($t = 3.44$, $p < 0.005$). Bar height and length were significantly correlated ($r = 0.78$, $p < 0.005$).

All Wabash River habitat was limited in quality by excessive human disturbance, accessibility to predators, or frequent inundation during the breeding season, and was determined to be unavailable to least terns due to fewer than 100 days of continuous exposure during the breeding season (Carreker, 1985; Smith and Renken, 1991).

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