The Reintroduction and Conservation of Breeding Forster's (*Sterna forsteri)* and Common Terns (*Sterna hirundo)* in Illinois

2005 Final Report

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INTRODUCTION

Both the Forster's (*Sterna forsterii)* and Common tern (*S. hirundo)* currently are listed as state-endangered in Illinois (Illinois Endangered Species Protection Board, 2004). In addition, the Illinois Department of Natural Resources (IDNR) has recognized both tern populations as critical; a species exhibiting the greatest conservation need in the state (IDNR, 2005). Lastly, the Common tern is listed as a species of special concern throughout its range by the U.S. Fish and Wildlife Service (2002).

Forster's terns, while once a common nesting species in Illinois, have experienced steady population decline over the past 20 years. In 1998 the only remaining nesting site for this species was abandoned as a result of excessive recreational boat traffic and the subsequent erosional loss of available nesting habitat (Table 1). By the following season, the Forster' s tern had been extirpated as a breeding species in Illinois. In 2003, using conspecific attraction and habitat creation, we were able to successfully re-establish a nesting colony at Grass Lake within the Chain O' Lakes State Park, Lake County, Illinois (Fig. 1; Semel and Ward 2003). In the initial year of the project a record number of young successfully fledged (Table 1). In 2004 we used the same techniques to enhance reproductive potential; Forster's terns returned and nested at the newly established colony site. Unfortunately, abnormally high water levels on Grass Lake resulted in flooding of the site and multiple nesting attempts were abandoned and no young were successfully fledged. An attempt to establish a secondary breeding colony at Lake Elizabeth, McHenry County (Fig. 2) was successful in attracting breeding pairs in 2004, but no young were fledged (Table 1).

Common terns have consistently nested in Illinois in small numbers and with limited success (Table 2). The primary factors limiting reproductive success of this species have been the susceptibility of nests to mammalian predators and the development and recreational use of suitable nesting habitat. The sole remaining active nesting colony in Illinois is located at the Great Lakes Naval Training Center (GLNTC) in Lake County (Fig. 3). To enhance reproduction and to protect nests from mammalian predators and human interference, a fence was installed around the GLNTC colony in 2002. Habitat within the fence was modified to provide optimum nesting substrate. The fence was further modified in 2003 to provide additional security from predators. Both 2003 and 2004 were successful years at GLNTC, with the two highest numbers of young fledged in 25 years (Table 2).

Both Forster's and Common terns are colonial nesters. There are two major advantages to nesting in colonies, including 1) social interactions related to foraging success and 2) protection from predators. An unfortunate attribute associated with colonial breeding, however, is that a single catastrophic event has the potential to eliminate an entire colony, or at the least, an entire season's

reproductive efforts. Establishing multiple nesting populations is a critical consideration in the management of endangered species, and specifically avifauna. Identifying techniques to protect and successfully establish multiple colonies of nesting terns was a primary objective of the project. Efforts to create a secondary nesting colony for Forster' s terns was initiated in 2004 at Lake Elizabeth Nature Preserve, McHenry County, Illinois (Fig. 2). Lake Elizabeth was selected because 1) suitable nesting habitat was available; 2) it is managed and protected by the McHenry County Conservation District as a dedicated Nature Preserve, and 3) because of documented breeding attempts within recent history (Table 1). In 2005 we expanded this effort to include Fourth Lake (Fig. 4) and Redwing Slough (Fig. 5). Both of these additional sites have suitable nesting habitat and are conservation properties under public ownership.

Tern breeding habitat often is in close proximity to human activity. Such encroachment increases the chances of disturbance by humans, as well as increasing predator populations closely associated with human habitation, such as gulls (*Larus* sp.), coyotes (*Canis latrans*), raccoons (*Procyon lotor*), and rats (*Rattus norveginicus*). The relationship between human activity and tern nesting success was explored in 2004 and again in 2005. Efforts to control gull populations were necessary in 2004 and 2005. Nesting platforms and conspecific attraction was used at each of the prospective Forster's tern nesting sites. The goal was to provide a better understanding of the population dynamics and nesting behaviors of Forster' s and Common terns and subsequently, to provide direction for establishing management plans for the conservation of these endangered species.

METHODS

Establishing Forster's Tern Colonies

A joint project of the Fox Waterway Agency (FWA), the Illinois Department of Natural Resources (IDNR), the U.S. Fish and Wildlife Service (USFWS), and the U.S. Army Corps of Engineers (USCOE), an artificial island with palustrine emergent wetland was designed and created in Grass Lake to replace lost nesting habitat historically used by the terns (Fig. 6). The island was created using geotextile fabric and spoil dredged from nearby navigational channels. Although the project was not scheduled for completion until 2006, construction and dredging activities from 1999 through 2002 provided potential nesting habitat for Forster's terns by summer 2003.

Models of Forster's terns used in 2003 to attract breeding pairs to the island (Semel and Ward 2003) were employed again in 2004 and 2005. Briefly, the models were made of plastic resin and painted to resemble adult breeding terns (Fig. 7). Vocalizations of nesting Forster's terns and other endemic terns and

shorebirds were broadcast from call boxes specifically designed for continuous use. The solar panel, solar-gel battery, charge controller, 12 volt digital timer, and a CD player, were configured to broadcast timed, conspecific attraction vocalizations throughout the daylight hours when migratory terns would most likely be present (Fig. 8). Broadcasts were timed for 0500-0700, 0900-1200, and 1700-1900 hours.

In Grass Lake we set up a call box on the north end of the island in the same area in which terns nested in 2003 and attempted to nest in 2004, along with appropriate nesting substrate and decoys. Nesting materials were in place and audio broadcasts began on 14 April 2005 at Grass Lake; detailed monitoring of the site began 29 April 2005. Artificial nesting platforms were added on 29 April 2005.

At Lake Elizabeth, we placed decoys on the western most of the islands (three) where nesting attempts were documented in 2004. This island was composed almost exclusively of *Decodon*, with limited *Typha latifolia* present. Floating platforms (4' X 8') covered with bundles of cattails (simulating nesting substrate) were placed immediately south of the island. A call box was placed on the south side of the central island (immediately adjacent). We chose the south side of the island for placement to obscure public visibility. We also placed two artificial nest platforms in an area that had a history of Black tern (*Chlidonas niger)* breeding activity. Nesting materials were in place and vocalization broadcasts were initiated on 22 April 2005. Detailed monitoring of the site began 17 May 2005.

At Fourth Lake we placed a call box on a small peninsula of land composed of *Typha* facing a small bay controlled by the Lake County Forest Preserve District. Along this same shoreline, we placed a number of decoys and artificial floating nesting platforms. The platforms were secured to concrete blocks. Materials were in place and vocalization broadcasts were initiated on 22 April 2005. Detailed monitoring of the site began 9 May 2005.

Redwing Slough State Natural Area is a large palustrine wetland with sections of emergent vegetation, primarily *T. latifolia*. It is designated as an Illinois Land and Water Reserve and is closed to public access during the nesting season, and thus protected from human interference. We placed a call box and several decoys on the top of an old duck blind in suitable habitat. Nearby we secured ten floating nest platforms. Materials were in place and vocalization broadcasts were initiated on19 April 2005.

Reproductive Success and Site Fidelity

Each site was monitored by a field assistant two to four times a week, and weekly by at least one of the principle investigators. Tern nests were located and numbered individually during these weekly visits. The number of eggs and young

in each nest was recorded. Young were banded with a U.S. Fish and Wildlife Service numerically numbered leg band and a colored leg band.

We searched for banded Common and Forster's terns at all sites throughout the nesting season. In particular, we searched for young that we had banded as yearly cohorts in 2003 and 2004 (Fig. 9).

Behavioral Observations

Preliminary observational data were collected on Forster's and Common terns at all sites: Lake Elizabeth, Fourth Lake, Grass Lake, and GLNTC. Observations were conducted during two to four-hour intervals, starting at 7 a.m. and concluding at 7 p.m. on different days of the week. Observations also were dispersed throughout all stages of nesting and fledging. Data collected included the number and diversity of avian species using the nesting islands, interactions with terns and other avian species, and foraging and breeding behaviors. A Bushnell rangefinder was used to measure foraging distances from the colony. Foraging distances were calculated using the range finder, a compass, and the law of cosines. Pair bond development, mating, nesting and parental behavior also was noted. Detailed observations began at the Grass Lake colony on 10 May 2005, at Fourth Lake on 26 May 2005, while studies were initiated at GLNTC on 16 May 2005.

RESULTS

Establishing Forster's Tern Colonies

At Lake Elizabeth, the first Forster's tern was observed on 22 April 2005. Two pairs were observed attempting to nest on the mats on 23 May 2005. Black terns had nests in two of the platforms by 2 June 2005. At this time we added four more platforms.

The first Forster's terns at Grass Lake were observed on 14 April 2005. On 29 April, approximately 75 Herring gulls (*Larus argentatus*) and 220 Ringed billed gulls (*Larus delawarensis*) were occupying the north cell of the geotube. The Forster's terns had dispersed to the south cell and to nearby duck blinds. Occupation of the north cell by gulls was discouraged, and by 13 May 2005 most had left the geotube. The terns remained active in the south cell. Their attempts to nest on two adjacent duck blinds failed. The Forster's that remained at Grass Lake throughout the breeding season was approximately 20-30 birds.

Two Forster's terns were observed foraging in Fourth Lake on 17 May 2005. Nests were discovered on a duck blind on 26 May 2005. By 17 June, three different duck blinds had active nests on them and the number of adult terns was 20.

Forster's terns occupied Redwing Slough from 19 April to 17 May 2005. However, no nesting attempts were documented. The site was abandoned by terns on 19 May 2005.

Reproductive Success

At Lake Elizabeth two nests were found destroyed and the colony site was considered abandoned by 25 May 2005. The nest platforms were covered in a significant accumulation of goose feces, which suggests that the nests were trampled by a large flock of geese roosting in the lake. Black terns successfully nested in two of the artificial nest platforms and had clutches of 2 and 3 eggs. Although the date on which eggs hatched was not recorded, evidence suggested these young had successfully fledged when the boxes were checked on 20 June 2005.

Fourth Lake had a total of 10 nests, 29 eggs, and 14 young fledged. All of the nests identified were on duck blinds located near the area in which we attempted to attract birds; artificial nest platforms were never utilized. We banded a total of 12 young: a yellow plastic band on the left leg and a USFW band on the right.

Grass Lake had limited success in 2005. All attempts to nest on duck blinds failed and the more suitable nesting habitat in the north cell was rejected, most likely due to early occupation by gulls. An area in the south cell, consisting of mounds of dredge spoil covered in Oak leaved goosefoot (*Chenopodium glaucum*), was chosen instead. This terrain made it difficult to complete accurate nest checks and to locate young prior to fledging. It also was near an area where Sandhill Cranes (*Grus Canadensis*) would consistently roost. The terns completed a total of 17 nests; 47 eggs, and 12 young were confirmed to have fledged. Of the 12 young, we were able to band 6, each with a yellow plastic band on the right leg and a USFW band on the left.

The colony of Common terns at GLNTC produced 23 nests; 67 eggs and the maximum number of adult terns recorded at one time was 96. We were able to band 20 young on 6 July 2005. On 13 July, upon inspection of the colony, 12 dead young were found and no living young remained in the colony. Adults appeared to have abandoned the site. At this time, two holes were discovered under the fence line. Subsequently, traps were set and on 18 July a male American mink (*Mustela vison*) was discovered in one of the traps. To the best of our knowledge, a total of 6 young had fledged before predation had eliminated remaining young.

Site Fidelity

No banded Forster's terns were observed at any site. At the GLNTC, five banded Common terns were observed on 29 June 2005. One bird had a green

band on the left and a silver band on the right (banded in 2003) and two birds had silver bands on the right leg only (the colored bands had apparently been lost, so banding date is unknown). Two had a silver band on the right and left leg, indicating that they presumably originated from our colony, but with a color that faded and left their cohort year unknown. On 7 July 2005, a Common tern was spotted with a silver band on the right and left leg at the same site, again indicating that it presumably originated from our colony, but with a color that faded and left its cohort year unknown.

Behavioral Observations

The number of fish brought into the colony at different stages of nesting was recorded. The number of forays and fish returned to the colony increased significantly when there were young present. Foraging distances also were calculated for each site. The mean foraging distance at Fourth Lake was 94.42 m, with a range of from 51.75m to 142.55m. At Grass Lake the mean foraging distance was 394.68 m, with a range of from 34.47m to 1430.0m. At GLNTC, the mean foraging distance for Common terns was 136.50m; the shortest was 27.80m and the longest was 202.08m. There was a significant difference in mean foraging distances among the colonies ($n=11$; $p=0.026$)

Interactions between terns and other avian species differed greatly between Common and Forster's terns. Common terns were extremely aggressive toward potential avian predators (e.g. ring-billed and herring gulls). In contrast, Forster's terns rarely pursued gulls, and ring-billed gulls exhibited a nearly constant presence at the geotube. Sandhill cranes also posed a threat to the chicks in 2005; their presence was a common sight in the south cell of the geotube where the Forster's chose to nest. The cranes often were seen walking along the perimeter of the nesting area: the adult tern's attempts at chasing them from the colony were ineffective.

DISCUSSION

In 2005 we successfully established a second Illinois breeding colony of Forster's terns. Fourth Lake had the largest number of young fledged in the recorded history of the lake (Table 1). Although four young had previously hatched from this site in 1996, we had concerns whether the water quality and aquatic resources present were sufficient to support a viable colony. Recent studies indicated low and unhealthy levels of dissolved oxygen (Lake County, 2001). These low levels were indicative of possible low fish productivity. Foraging observations indicated that the fish fed to the young all were caught within the confines of the lake, verifying its viability as providing sufficient food resources.

Lake Elizabeth has great potential as an alternative breeding site. A population of roosting Canadian geese (*Branta canadensis*) appears to be the major deterrent for successful nesting. Observations from 2004 and 2005 suggest habitat modifications are necessary to make the site unattractive to geese. The use of artificial nest platforms remains an option. The platforms were very successful with Forster's terns in Wisconsin (Mossman, 1988). The nest platforms placed in Lake Elizabeth for Forster's terns were readily used by Black terns. This could be a future strategy for managing Black tern populations; they also are listed as a species of special concern by the U. S. Fish and Wildlife Service (2002) and their habitat requirements are similar to that of Forster's terns.

The Forster's tern population at Grass Lake was substantially lower than in the previous two years (Table 1). The reason for this could be two fold. First, the terns may have chosen an alternative site based on the lack of nesting success in 2004 at Grass Lake due to flooding. Birds may select breeding sites by assessing the reproductive success of conspecifics in one season and choose (or not choose) these spots the following year (Danchin et al, 2000). Secondly, the presence of the large number of gulls may have discouraged them from settling in the north cell. Given their lack of aggressiveness towards gulls (Jablonski et. al., 2004), they may have abandoned the more suitable habitat in the north cell, which was used in previous years, for the less suitable habitat in the south cell. At small populations, the range of habitat selection is close to the preferred value, but as populations expand, the range of habitat increases, possibly to include less suitable habitat (Brown,1969; Krebs,1971, as cited by Kristan, 2003).

Selection of sub-optimal habitat due to interspecific competition by gulls may help explain the low number of young Forster's terns fledged at Grass Lake. Visual detection of potential predators is essential to colonial nesters such as terns, whose defense depends on warning calls and predator mobbing (Gochfeld, 1978; Burger, 1981, as cited by Mallach and Leberg, 1999). Vegetation obstructs vision and provides cover for predators less likely to venture into the open (Buckley, 1980, as cited by Mallach and Leberg, 1999). The nesting area used by the terns in the south cell in 2005 was thickly covered in oak leaved goosefoot, which could have easily obstructed the tern's view and provided cover for predators. To make more suitable habitat available to the terns in the future, the gulls need to be dissuaded from using the site earlier in the season, before the terns arrive. The removal of gulls from an area could substantially improve fledgling success and this removal needs to be repeated during consecutive years (Guillemette et. al., 2002).

The Common tern population at GLNTC in 2005 was more numerous than in previous years (Table 2). The number of nests and eggs laid was similar to that of 2004. Without the depredation of young by the mink, the number of fledged would most likely also have been similar. Immediately upon discovery of the

presence of mink, the predator fence was reinforced with small mesh fencing material that extended beneath the ground level. Following reinforcement of the fence and removal of a second mink, no further entry by a predator was noted. However, because the predation occurred late in the season, the terns were unable to re-nest. American mink is a generalist carnivore that subsists mainly on fish and small rodents in the winter, but birds are the main prey in the spring and summer (Nordstrom et. al., 2002). Predation by American mink has been documented to cause extensive colony breeding failures in common gull colonies, which often lead to colony abandonment (Craik 1999, 2000; as cited by Nordstrom and Korpimaki, 2004).

FUTURE RESEARCH

The few remaining tern colonies in Illinois, along with the great potential for disturbance, dictate that we establish additional colonies for each species. We need to continue the efforts to expand the breeding habitat of the Forster's terns to include Lake Elizabeth, Fourth Lake and Redwing Slough. Exploration of nesting alternatives, such as artificial nest platforms, needs to be continued along with modifications to existing nest sites to discourage the presence of other avian species, such as Canadian geese and gulls. Steps need to be taken to reduce the number of gulls at Grass Lake before the terns arrive in the spring.

Additional sites for Common terns also need to be aggressively explored. Suitable habitat along the Lake Michigan shoreline needs to be evaluated as potential future nesting areas. Conspecific calls and models could be used to create a secondary nesting population if an area can be accessed and secured. Enhancement of the existing fencing at GLNTC will be continued to ensure protection against all mammalian predators.

Least terns (*S. anitillarum)* will be included in future tern research and management. They currently are listed as a state-endangered species in Illinois (Illinois Endangered Species Protection Board, 1999), and federally endangered by the U.S. Fish and Wildlife Service (USFWS, 2002). In addition, the Illinois Department of Natural Resources has recognized all three populations of terns as critical; species exhibiting the greatest need of conservation in the state (IDNR, 2005). Limited information is available on nesting success and site fidelity, and recorded productivity is likely over-estimated due to the limited number of observations of colonies during the breeding season.

Toxicology screening and necropsy should be employed to determine the extent of environmental contamination and parasite loads. Reduced hatching success, deformities in hatchlings (e.g., cross bills, foot lesions), and lethargic behavior in broods in previous years, dictate the need to conduct toxicological screenings. Common terns have been used in New Jersey to examine spatial and temporal trends of contaminants. Common terns are useful bioindicators because they

are high on the food chain, are geographically widespread, and eat the same fish prey base that are consumed by the predatory fish consumed by humans (Burger and Gochfeld, 2004).

Continued behavioral observations and research needs to be done to better understand the impact of human disturbance on reproductive success and nest site selection. Our initial research endeavors will help toward the development of successful guidelines for the management of colonial nesting species in Illinois. Much additional work is necessary to better understand the reproductive ecology and nesting requirements for all species discussed.

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Table 1. Nesting records and survey of Forster's terns (*Sterna forsteri*) during the breeding season in Illinois.

	Grass Lake			Fourth Lake			Lake Elizabeth			Statewide		
Year	Adults	Nests	Yng	Adults	Nests	Yng	Adults	Nests	Yng	Adults	Nests	Yng
1876	14	7										
1983	28	16	19							28	16	19
1986	0			0			0			0	0	
1987	0			0			0			0	0	
1988	0			0			0			0	0	
1989	7	3	-	0			0			7	3	-
1990	-			0			0					
1991	35	39	-	0			0			35	39	-
1992	76	49	-	0			0			76	49	-
1993	90	46	-	0			0			90	46	-
1994	60	10	-	0			0			60	10	-
1995	162	92	67	0			0			162	92	67
1996	3	0	0	5	4	4	16	7	5	24	11	9
1997	57	27[a]	0	2	0	0	14	5	2	73	32	2
1998	2	0	0	0			11	4	2	13	4	2
1999	0			0			0			0		
2000	5			0			0			5		
2001	2			0			0			2		
2002	2			0			0			2		
2003	65	57	149	0			0			65	57	149
2004	67	131	0	0			5	4	0	72	135	0
2005	35	17	12	20	10	14	2	0	0	57	27	26

Table 2. Common tern (*Sterna hirundo*) nesting summaries for Illinois.

Year	Site	Maximum Tern Number	Maximum Nesting Attempts	Maximum Eggs Laid	Total Young Fledged
1936	Waukegan		5		
1937	Midwest Generation				0
1938	Midwest Generation				0
1939	Midwest Generation				0
1948	Midwest Generation		4		0
	Johns-Mansville	30		36	33
1976	Johns-Mansville		2		0
	Midwest Generation		8		0
1977	Waukegan Harbor	16	9		0
	Waukegan Island		12		9
1978	Waukegan Harbor		16		0
1979	Midwest Generation	43	15		35
1980	Midwest Generation	60	29	52	0
1981	Midwest Generation	70	33	98	0
1982	Midwest Generation	50	25	70	16
1983	Midwest Generation	64	32	87	21[3]
1984	Midwest Generation	22	17	41	0
1997	Midwest Generation	26	10		0
	Johns-Mansville	6	3	9	0
1998	Midwest Generation	17	9		7
1999	Midwest Generation	35	8		0
2000	Midwest Generation	17	1	1	0
	Naval Training Center	42	12	27	0
2001	Naval Training Center	49	54	109	0
2002	Naval Training Center	49	18	44	26
2003	Naval Training Center	49	46	129	43
2004	Naval Training Center	66	26	67	32
2005	Naval Training Center	96	23	57	6

Figure 6. Aerial photograph from 1939 depicting historic composition of the emergent palustrine habitat of Grass Lake.

Figure 7. Plastic resin models used to attract terns to proposed nesting colonies in northeastern Illinois.

Figure 8. Broadcast call boxes used to attract terns to suitable nesting habitat: solar panel, CD player, transformer, and timer.

Figure 9. Color-banded young Forster's tern.