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Breeding Biology of an Interior Least Tern (Sterna Antillarum Athalassos) Colony in Childress County of North Texas

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BREEDING BIOLOGY OF AN INTERIOR LEAST TERN (*STERNA ANTILLARUM ATHALASSOS*) COLONY IN CHILDRESS COUNTY OF NORTH TEXAS

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Abstract.—This study documented nest success, nest initiation chronology and nest site selection for interior least terns (*Sterna antillarum athalassos*) along the Prairie Dog Town Fork of the Red River in Childress County, Texas during 1998. Terns experienced a 65% nest success rate (Mayfield estimate 71%) and clutch sizes ranged from 1 - 3 eggs ($\bar{x}$ = 2.25) for 20 nests. Seventy percent of all nests were initiated during the first 20 days of June, which coincided with the highest number of adult terns observed on the study site. All nests were found on gravel/sand bars in the river basin; 25% were placed on gravel and 75% were placed on sand. Sixty-five percent of tern nests were located within 15 cm of driftwood and/or rocks, but nests were not more frequently associated with objects than random sites ($P > 0.05$). Nests were generally > 10 m from vegetative cover and 200 m from surface water. However, habitat variables (i.e., distances to upland, mudflat, water and vegetative cover) did not vary ($P > 0.05$) between nests and random sites nor between successful and nonsuccessful nests. This colony of interior least terns was last documented in the mid 1980s and evidently has some degree of stability. Conservation efforts should focus on protecting, restoring and enhancing riparian wetland habitats in the High and Rolling Plains of Texas for this endangered species.

Breeding colonies of interior least terns (*Sterna antillarum athalassos*) commonly occur in prairie stream bottoms, alkaline flats and other similar habitats throughout the midcontinental United States (Thompson et al. 1997. In contrast to its coastal counterparts, which place nests on sparsely vegetated beaches, dried mudflats and rocky shores (Brunton 1997; Thompson et al. 1997), the interior least tern (*Stern antillarum athalassos*) forms breeding colonies on river sandbars and saline/alkaline flats in the interior U.S with 52-65% of all known nesting populations occurring in the lower Mississippi River (Thompson et al. 1997). These latter wetland types are relatively scarce and are susceptible to intense short-duration flooding, extended periods of drought and human induced alterations (Grover & Knopf 1982; Hill 1985; Sidle et al. 1992; Thompson et al. 1997). The interior least tern was designated as endangered by the U. S. Fish and Wildlife Service in 1985 (USFWS 1985)

and 52-65% of all nesting populations occur in the lower Mississippi River (Thompson et al. 1997).

Interior least terns generally nest in colonies, but colony fidelity and stability is variable (Renken & Smith 1995). Colonies are usually small (20-50 nests; Thompson et al. 1997) and are more ephemeral than coastal ones due to rapid changes in suitable habitats from flooding (Sidle et al. 1992; Smith & Renken 1993), changes in vegetation from controlled water flow below dams (Thompson et al. 1997), river channelization (Smith & Stucky 1988), and periodic, but locally intense, recreational use by humans (Smith & Renken 1993). Tern nests are often constructed near rocks, driftwood and other debris (Hill 1985; Gochfield & Burger 1987).

Historically, interior least tern colonies existed in the Mississippi, Missouri, Ohio, Arkansas and Platte rivers (Sidle et al. 1992; Kirsch 1996; Thompson et al. 1997). In Texas, the interior least tern has been found nesting on the Canadian and Red rivers in the Panhandle as well as along portions of the Rio Grande, Brazos and Trinity rivers (Locknane 1988; Thompson et al. 1992; 1997, Seyffert 2001). However, few data are available for colonies in the High/Rolling Plains of Texas (see Kirsch 1996; Seyffert 2001); although nesting has been confirmed on the Canadian River in Hemphill County, as recently as 1998 (J. P. Hughes, pers. comm.).

Breeding biology of interior least terns was evaluated in the Prairie Dog Town Fork of the Red River, near Childress, Texas, in 1998. The last report of interior least terns in this portion of the Prairie Dog Town Fork of the Red River was in 1984, where 15-19 adults and five nests were observed from helicopter surveys in late June (Locknane 1988). The objectives of this study were to monitor nesting chronology and synchrony, estimate nesting success and quantify nest-site selection for this breeding colony of interior least terns.

Materials and Methods

Nest chronology and success.—Approximately 4.5 km of the Prairie Dog Town Fork of the Red River in Childress County, Texas, were surveyed for nesting terns on June 2, 3, 4, 9, 10, 11, 17, 22, 29, 30 and July 2 and 8, 1998. All adults were counted on each visit. Nest searches were executed by locating adult terns performing distraction displays and by intensively searching suitable non-vegetated habitats for nests.

Upon discovery, nests were marked with wire flags 3 m away from nests to avoid attracting potential predators. Nests were checked every

2 – 7 days until (1) the eggs hatched, (2) the nest was abandoned, or (3) the status was otherwise undetermined. Nests were considered successful if ≥ 1 egg hatched. Five nests were classified as those with unknown outcomes (Manolis et al. 2000).

Nest Site Selection.—After nest fate was determined, habitat variables were measured at each nest site and at an associated random location. Nest/random site habitat data were collected after nest fate was determined to prevent disturbing nesting terns or attracting potential predators to active nests. Nest site selection was evaluated at both macro- and micro-scales.

To quantify nest site selection on a macro-scale, the following variables were measured at each nest site and at an associated random location 10 m away: (1) distance (m) to adjacent non-wetland habitat (i.e., upland), (2) distance to vegetative cover, (3) distance to surface water, (4) distance to mudflat (i.e., non-vegetated area characterized by a saturated substrate), (5) relative elevation (potentially important during rainfall/flooding events) and (6) vertical cover in cm (measured from each of the four cardinal directions 4 m from a Robel pole; Robel et al. 1970).

To examine micro-scale nest site selection, the following variables were measured at each nest and its associated random location: substrate (i.e., gravel or sand), distance in cm and orientation (0-360°) to rocks, driftwood, bones, root debris and other objects ≤ 15 cm from nest edges and random locations. In many instances, there were several objects surrounding tern nests. However, in order to be included, objects ≤ 15 cm of the nest or random site were at least 5 cm long and 5 cm wide. Random locations for the micro-scale analyses were the same as used previously.

Data analysis.—June and July were divided into four 10-day periods to quantify adult occurrence and nest initiation chronology (i.e., 6/1-6/10; 6/11-6/20, etc.). A Chi-square test for independence was used to examine differences in arrival and nesting chronology by each 10-day period (Zar 1996). Nest success was estimated for terns (1) using a raw proportion and (2) calculating nest exposure days and mean nest survival probabilities using a Mayfield estimate (Mayfield 1975). Days of exposure were estimated as follows: the last date of exposure was considered as the midpoint between the last observed active date and the first observed inactive date for all nests (Manolis et al. 2000).

To evaluate nest site selection patterns at the macro (i.e., wetland) scale, a one-way analysis of variance (*ANOVA*) was used to examine

Table 1. Nesting parameters of interior least terns nesting in the Prairie Dog Town Fork of the Red River in Childress County, Texas, 1998.

Nesting parameters	Least tern nests
Total number of nests (*n*)	20
Successful nests (*n*)	13
Abandoned nests (*n*)	2
Nests with unknown status (*n*)	5
Raw nest success (%)	65
Mayfield estimate (%)	70.7
Clutch ($\bar{x}$)	2.25
Range	1—3
Nests located on gravel substrate (*n*)	5
Nests located on sand substrate (*n*)	15
Nest dimensions (north to south) (cm) ($\bar{x}$)	9.7
Nest dimensions (east to west) (cm) ($\bar{x}$)	10.2
Nest depth (from nest rim to nest bowl bottom) (cm) ($\bar{x}$)	1.9

differences among measured habitat variables between nests and random points (Zar 1996). A one-way *ANOVA* was also used to examine nest site selection patterns between successful nests and those which were not (i.e., abandoned or nests with unknown outcomes). All nest and random site habitat variables were square root transformed to meet assumptions of parametric tests (Zar 1996).

To evaluate nest site selection patterns at the micro-scale, a Chi-square goodness of fit test was performed on circular data to examine distribution uniformity of objects (i.e., rocks, driftwood, etc.) around tern nests (i.e., successful and non-successful) and random sites (Zar 1996). Four equal orientation zones were developed to summarize these data: north (316°-45°), east (46°-135°), south (136°-225°) and west (226°-315°). The frequency and distance to objects (i.e., $\leq$ 15 cm) within each zone were calculated for each nest and random site. Two by four Chi-square contingency tests for independence were used to compare (1) the frequency of objects and (2) the mean distance of objects within orientation zones between successful and nonsuccessful least tern nests and between nests and random sites (Zar 1996). Only those nests and random sites that were $\leq$ 15 cm of objects were used during these analyses.

RESULTS

Nest success and chronology.—Twenty least tern nests were monitored during this study. Least terns experienced a raw nest success of 65% and an adjusted (Mayfield) success rate of 70.7%. No nests were obviously depredated during this study, although two nests were abandoned (Table 1).

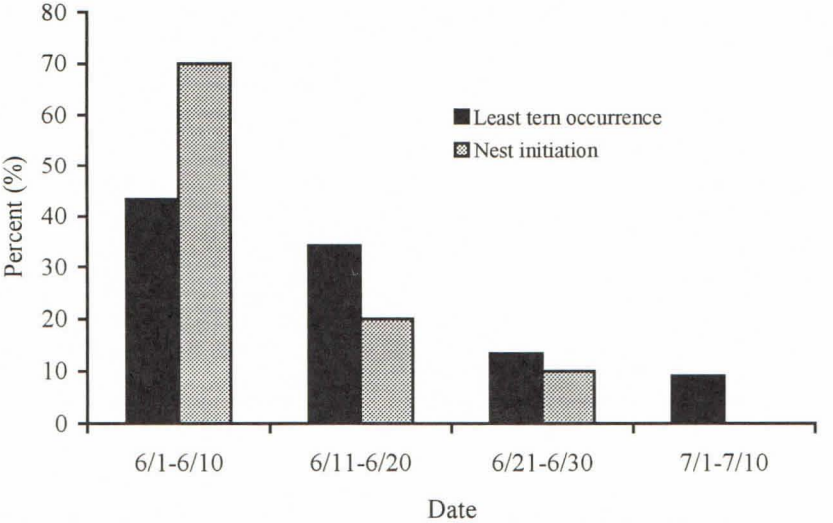

Figure 1. Chronology of occurrence and nest initiation (% of total number for each category) for interior least terns nesting in the Prairie Dog Town Fork of the Red River in Childress County, Texas, 1998.

Highest numbers of interior least terns were observed during the first 10 days of June and 42 adults were seen on 3 June. Numbers of adults declined throughout the duration of the study. Similarly, 70% of nests were discovered during the first 10 days of June. No nest was discovered in July although adult terns were observed until 8 July. Least tern occurrence and nest initiation chronology coincided ($\chi^2 = 6.11$; $P = 0.106$) (Figure 1).

Nest site selection.—Five tern nests were located on gravel bars and 15 were placed on sand bars in the river basin. Habitat variables did not vary between nests and random sites (Table 2). Similarly, habitat variables did not vary between successful and non-successful nests (Table 3).

Thirteen of the 20 tern nests were located within 15 cm of $\geq$ 1 object (i.e., driftwood, rock, root or bone debris), and seven nests were in the open. Nine random sites were within 15 cm of $\geq$ one object and 11 random sites were in the open. Least tern nests were not within 15 cm of objects more frequently than random sites ($\chi^2 = 1.6$; $P > 0.05$), nor did the number of objects within 15 cm vary between nests or random sites ($\chi^2 = 1.07$; $P > 0.05$). Objects within 15 cm of tern nests ($\chi^2 = 10.77$; $P > 0.05$) and associated random sites ($\chi^2 = 6.24$; $P > 0.05$) formed a uniform distribution and were not oriented in specific direction(s) (Table 4).

Table 2. Habitat variables between interior least tern nests and random sites in the Prairie Dog Town Fork of the Red River, Childress County, Texas, 1998.

Habitat variable [1]	Nests (n = 20) ($\bar{x}$)	*SE*	Random (n = 20) ($\bar{x}$)	*SE*	*F*	*P*
Distance to upland (m)	285.7	28.9	257.1	24.5	0.64	0.43
Distance to vegetation (m)	10.9	2.1	10.5	2.7	0.09	0.77
Distance to mudflat (m)	106.1	25.6	97.2	26.8	0.01	0.97
Distance to water (m)	198.3	35.2	195.5	34.7	0.01	0.95
Vertical cover [2]	1.0	0	1.0	0	0.00	1.0
Relative elevation [3]	14.2	2.9	14.9	2.8	0.01	0.94

1. Means followed by the same letter in the same row did not vary ($P > 0.05$).
2. Vertical cover measure using Robel pole (Robel et al. 1970) from each of the cardinal directions, 4 m from the nest and/or random point.
3. Relative elevation measured as the difference between the nest/random sites and the mean elevation of the river bottom generated from random transects.

Table 3. Habitat variables between successful and non-successful interior least tern nests in the Prairie Dog Town Fork of the Red River, Childress County, Texas, 1998.

Habitat variable [1]	Success (n = 13) ($\bar{x}$)	*SE*	Non-success (n = 7) ($\bar{x}$)	*SE*	*F*	*P*
Distance to upland (m)	263.2	34.3	341.7	50.7	1.03	0.322
Distance to vegetation (m)	11.9	2.76	8.23	2.46	0.52	0.48
Distance to mudflat (m)	113.1	27.4	88.8	61.8	0.03	0.87
Distance to water (m)	196.4	45.1	203.0	55.2	0.05	0.83
Vertical cover [2]	1.0	0	1.0	0	0.00	1.0
Relative elevation [3]	13.7	3.97	15.5	2.12	0.34	0.57

1. Means followed by the same letter in the same row did not vary ($P > 0.05$).
2. Vertical cover measure using Robel pole (Robel et al. 1970) from each of the cardinal directions, 4 m from the nest and/or random point.
3. Relative elevation measured as the difference between the nest/random sites and the mean elevation of the river bottom generated from random transects.

Discussion

Twenty least tern nests were monitored on the Prairie Dog Town Fork of the Red River in Childress County, Texas, during June and July 1998. Nest initiation was synchronous with the highest numbers of adults and nesting activities ceased by the second week of July, and 70% of all nests were initiated prior to 10 June. Although surveys were not performed before 2 June, adults may arrive up to 3 weeks prior to nest initiation (Thompson et al. 1997), so some nests may have been initiated prior to commencement of field work. During some years, delays in nest initiation may occur in prairie rivers until suitable nest sites (i.e., sand/gravel bars) are exposed following water recession (Sidle et al 1992).

Table 4. Parameters for objects near successful and non-successful interior least tern nests and interior least tern nests and random sites in the Prairie Dog Town Fork of the Red River, Texas, 1998.

	North (316-45°)	East (46-135°)	South (136-225°)	West (226-315°)
Nests (n = 13)				
Number of objects (n)	9	6	3	4
Mean distance cm ($\bar{x}$)	6.73	10.04	9.23	6.68
Range (cm)	1.4—13.2	2.1—14.5	4.8—12.8	4.4—11.3
Random sites (n = 9) [1]				
Number of objects (n)	6	2	2	4
Mean distance cm ($\bar{x}$)	8.47	4.7	6.15	7.9
Range (cm)	0.9—15	1.8—7.6	4.5—7.8	2.1—10.5
Successful (n = 6)				
Number of objects (n)	3	4	2	5
Mean distance cm ($\bar{x}$)	6.97	9.68	8.8	6.68
Range cm ($\bar{x}$)	1.9—13.2	2.1—14.5	4.8—12.8	4.4—11.3
Nonsuccessful (n = 5) [1]				
Number of objects (n)	6	2	1	0
Mean distance (cm)	6.61	10.4	10.1	—
Range (cm)	1.4—12.8	8.2—12.6	10.1	—

1. The nests and random sites reported are only those that were associated with objects within the 15 cm radius of the random point. Those nests and random sites that were not associated with objects are not reported.

Interior lest tern nests were initiated later than least tern nests in coastal Texas, which generally begin in late April (Thompson 1982), but these dates were similar to those in Oklahoma (12 June - 18 July) given by Hill (1985) and previously reported initiation dates reported by Locknane (1988) in the Texas Panhandle (last week of May). The seasonal nature of water flow in prairie streams in the High and Rolling Plains of Texas likely does not prevent terns from establishing nest sites in most years, but in years with heavy spring precipitation, colony formation may be prevented, delayed, or even destroyed.

Nest success estimates from this study (65%; Mayfield estimate = 71%) are similar to the highest estimates reported from other regions in the interior U.S. Interior least terns nesting in Oklahoma experienced a nest success rate of 16.7-64.3% (Grover & Knopf 1982) and 25.3-59.6 % (Hill 1985). Terns nesting in the lower Mississippi River had a success rate of 51-68% (Smith & Renken 1993), whereas in the lower Platte River, Nebraska, terns experienced 52-72% nest success rates (Lingle 1993). Although nest predation has been cited as a major source of nest failure (Thompson et al. 1997), no predation was observed during this research. Other studies have shown that human-related

activities around tern colonies may cause colony failure (Burger 1984). Although this stretch of the Red River in Texas is accessible to the public, activities are generally restricted to areas within a few hundred feet of highway overpass. As such, overall colony failure due to human interference is not likely, although individual nests may be disturbed, resulting in nest abandonment.

All tern nests were discovered on sand/gravel bars in the river bottom and most nests were located in scrapes constructed in sand substrate. Nests were generally >10 m from vegetation. Similarly, 30-50% of least tern nests in New York and New Jersey nested >10 m from vegetation (Burger & Gochfield 1990). Least tern nests in the present study were generally located 200 m from water, farther than in Oklahoma ($\bar{x}$ = 110.5-146.1 m) (Grover & Knopf 1982). Unlike coastal areas, where least terns may be associated with black skimmers (*Rhynchops niger*), or Oklahoma, where American avocets (*Recurvirostra americana*) and snowy plovers (*Charadrius alexandrinus*) share similar nesting habitats (Grover & Knopf 1982; Hill 1985), the only other nesting species present in Childress County was the snowy plover (Conway 2001). Although 65% of nests in the present study were within 15 cm of driftwood or rocks, there was no relationship between nest placement and location or orientation of debris.

Mean clutch size was 2.25 (range 1-3), similar to other values reported for this species (2.09-2.48) in the Mississippi River Valley by Smith & Renken (1993), but smaller than those found by Hill (1985) in Oklahoma (2.53-2.68). Low quantity or quality of food items may depress clutch size, which might partially explain these findings. Future studies should address this potential problem.

Conclusions

The study site is accessible to the public and cattle were observed walking on the river bottom. Despite public access to this stretch of the Prairie Dog Town Fork of the Red River, evidence of human activities was generally limited, and no least tern nests were found where human activities were obvious. Few human-induced disturbances probably occurred in areas where terns were nesting. No nest depredation was observed, although tracks of several potential nest predators were observed, such as coyotes (*Canis latrans*), feral hogs (*Sus scrofa*) and raccoons (*Procyon lotor*). Nest predation by feral hogs was an important source of shorebird nest failure in Southern High Plains saline wetlands during the same period (Conway 2001). Although predation was not an important cause of nest failure on this study site, such

impacts may become problematic, particularly if colony size increases, making nests more susceptible.

As part of a larger study, similar riparian/river and saline lake wetland habitats in the Southern High and Rolling Plains of Texas were also surveyed during 1998-2000 and found no least tern nesting activity (Conway 2001). This colony was previously documented once using aerial surveys in the mid 1980s, may be relatively stable, and is larger than estimated in 1984 (maximum of seven nests and 10 adults; Locknane 1988). Nevertheless, no significant expansion to nearby river habitats has occurred, despite the presence of similar suitable habitat in other riparian wetlands in the region (Conway 2001). Future conservation efforts for this colony of interior least terns should include continued protection from human disturbance, which may trigger nest abandonment or force incubating adults off nests for long periods of time. Second, and more importantly, management efforts should focus upon restoration of river flows and eradication of invasive woody vegetation, both native and exotic, in riparian habitats. Increased woody growth in these habitats has significantly impacted riparian habitats in the region (Magill 1998). There is a paucity of information on interior least terns in the High and Rolling Plains of Texas, but management efforts should work to enhance nesting habitats throughout the region.

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