FINAL REPORT

SECTION 6

ENDANGERED SPECIES ACT

FEDERAL AID PROJECT E-31

Monitoring of Least Terns on the Canadian River in Oklahoma

SEPTEMBER 27, 1996 - SEPTEMBER 26, 2001

FINAL REPORT

STATE: Oklahoma GRANT NUMBER: E-31

GRANT TYPE: Research

GRANT TITLE: Least Tern Colony Monitoring

SEGMENT DATES: September 27, 1996 - September 26, 2001

PROJECT TITLE: Monitoring of Least Terns on the Canadian River in Oklahoma

I. OBJECTIVES:

1) Monitor Least Tern nesting colonies on Packsaddle WMA to estimate reproductive success and determine the primary causes of nest failure.

2) Develop nesting sites for Least Terns on upland sites on Packsaddle WMA immediately north of the Canadian River by removing vegetation in 2-3 acre patches.

3) Assist in the voluntary management efforts for Least Terns on the Canadian River Least Tern Preserve in McClain and Cleveland counties.

II. ABSTRACT:

Least Tern nesting colonies were located and monitored along a nine mile reach of the Canadian River on and adjacent to the Packsaddle Wildlife Management Area (WMA) in 1997 through 2001. Least Terns were documented within the study area during all five nesting seasons encompassed by this project. Tern numbers were small and ranged from only two to eight nesting pairs each year (average 5.2 pairs/year). Small numbers of fledglings were produced in three of five years and the total number of fledglings per nesting pair was estimated to be between 0.54 and 0.77 fledglings/pair. Though the sample size is small, Least Terns appear to have a fledging success that is sufficient to maintain the population.

III. INTRODUCTION:

Nesting colonies of Least Terns (*Sterna antillarum*) have been monitored annually on the Packsaddle Wildlife Management Area since the 1994 breeding season (Howery and Hickman 1995, Howery 2000). During the summer months (late May through late August), Least Terns occur in small nesting colonies where suitable nesting habitat exists along the major tributaries of the Mississippi River in the Great Plains (Sidle et. al. 1988). Suitable nesting habitat for terns consists of sandbars, sand islands and wide beaches (usually at a scoured bend in the river) which are largely devoid of vegetation but contain some driftwood or similar debris that may be used as cover by tern chicks. Least Terns usually nest in small colonies of three to 15 pairs. Tern nests are simple depressions in the sand which are scraped out by the breeding pairs. These nests are typically constructed near driftwood, rocks or other structures that provide shelter (Boyd 1990, Hill 1993, Leslie et. al. 1997). The sandbars and islands used by terns for nesting are relatively ephemeral because their distribution and structure are reshaped almost annually by spring and early summer floods. Because of this, Least Tern colony locations change frequently and tern populations are difficult to monitor (Kirsch 1996).

The interior population of the Least Tern has declined substantially since the early 1900's due primarily to the loss of nesting habitat resulting from river flow modifications caused by reservoir construction. Other human-related causes for the Least Tern's decline include disturbance of nesting colonies, and additional habitat alterations resulting from the construction of navigation systems and the removal of water from rivers for municipal and agricultural uses. As a result of this decline in habitat quantity and quality, the interior population of the Least Tern was placed on the federal endangered species list in 1985 (U.S. Fish and Wildlife Service 1990).

The primary study area, Packsaddle Wildlife Management Area, is located near the western edge of the Least Ten's nesting range on the Canadian River. The river segment on Packsaddle WMA appears to be typical of the western 1/4 of Oklahoma and the eastern portion of the Texas panhandle based upon personal observations and the descriptions provided by McCament-Locknane and Thompson (1988). The conditions that affect Least Tern nesting success on the WMA are therefore likely to be applicable over a wider area. The construction of Meredith Reservoir in the 1960s has contributed to a recent reduction in base and peak flows in the Canadian River in the eastern Texas panhandle and western Oklahoma. Hill (1993) examined U. S. Geological Survey water gauge data for the Canadian River at Canadian, Texas and documented that the annual average maximum discharge had decreased from 122,000 cfs prior to the construction of Meredith Reservoir, to 14,600 cfs following construction. This change has affected tern habitat by reducing the frequency and magnitude of scouring flows and the availability of bare sandbars and islands for nesting. Earlier investigations have documented successful nesting of terns on Packsaddle WMA (Howery and Hickman 1995), but the small number of nests which are initiated on the WMA in any given year make it difficult to quantify reproductive success and the causes for nest failure.

IV PROCEDURES:

Approximately 9.5 miles of the Canadian River on and adjacent to Packsaddle WMA were surveyed for Least Tern nesting colonies and these colonies were monitored to determine their reproductive success during the nesting seasons from 1997 through 2001. This reach of the river spanned the area from the SW/4 of Section 5, T16N, R24W, through the NE/4 of Section 23, T16N, R23W, all on the Ellis/Roger Mills county line. The study segment of the Canadian River was surveyed annually in June and July either on foot (1997 and 1998) or using a small, broad-bottomed boat that was capable of navigation in water as shallow as six inches (1999 through 2001).

All locations where terns were observed on the ground exhibiting nesting or courtship behaviors were recorded on a map. Nesting behaviors include adults producing alarm calls as we approached, adults sitting on nest scrapes, adults constructing potential nest scrapes or adults tending to eggs or chicks. Courtship behaviors included adults presenting fish to one another, copulations or allopreening. All sites were marked as active (nests with eggs or chicks present) or potential (only empty scrapes present) colonies.

Monitoring visits to all active and potential colonies were conducted approximately every two weeks from the initial survey through mid August to determine the number of chicks that fledged. Bi-weekly monitoring visits were generally adequate to determine fledging success, but were too infrequent to determine the actual cause of all nest failures. During these biweekly colony checks, the colony was observed initially from a distance of 75 - 125 meters from the edge of the colony using either a 22X spotting scope or 10X binoculars. Consistent with earlier work on colonial waterbird flushing distances (Rodgers and Smith 1995), these observation distances did not appear to cause substantial restlessness among the birds. After initially observing adults and chicks within each colony, the colony sites were entered for a period of time less than 5 minutes to check and confirm nest contents and to locate precocial chicks hiding in vegetation or drift wood debris.

Records were kept of other wildlife species observed incidentally during the colony surveys and monitoring visits. These observations of rare and unusual species were summarized in each Annual Performance Report. Financial and personnel assistance was provided to the preserve monitor for the Canadian River Least Tern Preserve near Norman, Oklahoma. The assistance provided each year was summarized in each Annual Performance Report. Project personnel varied from year to year and included Mark Howery, Natural Resources Biologist, Alva Gregory - Packsaddle WMA Wildlife Technician, Melynda Hickman, Natural Resources Biologist, Julianne Hoagland, Natural Resources Biologist, Karen Gibbs, Biologist Aide, and Kathy Humphries, Biologist Aide.

V. RESULTS and DISCUSSION:

Summary of the 2001 Nesting Season:

Project personnel for the 2001 nesting season were Mark Howery, Natural Resources Biologist, and Alva Gregory, Packsaddle WMA Wildlife Technician. Based upon gauge data from Canadian, Texas, the volume of flow within the river held near the 50-year average from late May through mid -July 2001, then dropped below normal from late July through August. The water level in the Canadian River remained sufficiently high that substantial areas of bare sand were not exposed until the third week in June. The river maintained continuous surface flow on Packsaddle WMA into the third week of July, but this flow declined rapidly during the last 10 days of July and was non existent by the end of July. From the last week in July through August, the surface water in the river was reduced to a series of widely dispersed pools.

An initial survey of the study area was conducted on 21 June 2001. U.S. Geological Survey stream gauge data indicated that the river's flow had been diminishing for approximately one week prior to the survey, however, we found that small sandbars and beaches were just becoming exposed for the first time in the season and were only sparingly distributed along the river in Sections 4, 10, 13, 14, T16N, R24W, and Sections 18, 20 and 23, T16N, R23W. A minimum of eight adult Least Terns were observed fishing in the river, but no nesting colonies were located.

A second survey of the study area was conducted on 19 and 20 July. Because of low water depth, the second survey was conducted on foot with the river segment west of the SH 283 bridge being surveyed on 19 July and the segment east of the bridge being surveyed on 20 July. One colony of Least Terns was located on a small sandbar in the southwest 1/4 of Section 18, T16N, R23W (Figure 1). This sandbar was approximately 300 feet long and 40-50 feet wide. No part of the sandbar was more than 12 inches above the water level on that date and the sandbar was nearly barren of vegetation except for some scattered rushes. The main channel of the river flowed along the south side of the sandbar and was approximately 25 feet wide; a minor, shallow channel approximately 15 feet wide flowed along the sandbar's north side. This sandbar was at the same location where tern colonies nested in 1999 and 2000, but more sand appeared to have been deposited on the downstream side of the island making it slightly larger. The colony was occupied by 11 adult terns and two nests and two broods of chicks were observed during distant visual observations. The nests and broods consisted of one brood of two chicks which appeared to be approximately five and six days old; another brood of two chicks which appeared to be three and four days old; one nest with a newly hatched chick and two unhatched eggs; and one nest with three unhatched eggs.

Return visits to the tern colony were made on 31 July and 6 August. The island containing the colony was land-bridged prior to the 31 July visit and no chicks were found at the original colony site. Four adults were located west (upstream) of the former island and, after observing the behavior of the adults, two chicks approximately 14 days old were located in the

river bed approximately 600 feet west of the original colony. During the monitoring visit of 6 August, two adult terns and two young terns were located approximately 1/4 mile west (upstream) of the original colony. The two adult terns were fishing in a large pool on the north side of the river bed. One of the young terns flew with difficulty when we approached, while the other chick tried to hide next to drift wood. The first chick appeared to be newly fledged while the second chick appeared to be only one or two days from fledging. Because both chicks appeared to be healthy and no obvious signs of predators were found in the vicinity, we classified both chicks as having fledged. On 4 August, Alva Gregory, the wildlife technician that oversees Packsaddle WMA, had observed two adult terns and one fledgling at a pool by the SH 283 bridge. We walked toward the bridge which was approximately two miles west (upstream) of the tern colony. Adjacent to the bridge, we found two adult terns and two recently fledged terns that would have matched the ages of the two tern chicks that were classified as three and four days old on 21 July. We suspect that these chicks and their parents had moved upstream along the river bed after their nesting island was land-bridged. Because we know that no other tern colonies existed in the river reach three miles upstream and six miles downstream from the highway bridge, we feel confident that these terns were part of our monitored colony.

Least Tern Productivity:

The number of adult terns nesting on the Canadian River on and adjacent to Packsaddle WMA in 2001 was small, but similar to the annual numbers we have documented since 1994. Based upon the 20 July survey, at least 11 adult terns occupied the study area in mid-summer and at least four nesting attempts were made. Because the river's flow was nearly bank full in early June, it is very unlikely that terns nested successfully prior to 21 June, however it is possible that additional adults may have settled in the study area in late May and early June but moved off site to search for suitable nesting sites rather than wait until mid-June for bare sand to become exposed.

Based upon the estimated ages of the chicks found during the 20 July survey, it appears that all nests were initiated on or after 23 June. Of the four known nesting attempts in 2001, it appears that at least three nests successfully hatched at least two chicks each, while the fate of the fourth nest is unknown. A minimum of six chicks hatched from the three successful nests and at least four of these chicks fledged. The two chicks from the first nest that hatched disappeared between 20 July and 31 July and may have traveled along the drying river bed with their parents away from the colony site. The sandbar on which the colony nested, was land-bridged and ceased to function as an island a few days after 20 July. This would have facilitated the movement of older chicks away from the colony, and dispersal of chicks and parents from the colony is the most logical explanation for the two fledglings that were located on 6 August nearly two miles from their nesting colony.

Nesting evidence confirmed the presence of four pairs of Least Terns. Because an additional three adult-plumaged terns were located at the colony on 20 July, we assume that a

fifth pair of terns had unsuccessfully attempted to nest in the colony shortly before or after our survey. Given the time constraints of the nesting season, it is very unlikely that a pair of terns could successfully fledge chicks from a nest laid after 20 July, therefore we assumed that these three additional adult terns represented at least one unsuccessful breeding pair. Assuming that five pairs of Least Terns attempted to breed within the study area, the minimum fledgling to pair ratio was 0.80 (four fledglings to five pairs). This figure places the reproductive success of Least Terns in the study area in 2001 above the estimate of 0.51 needed to maintain the population (Kirsch and Sidle 1999). Given the ability of Least Tern chicks and adults to disperse away from their nesting colony on the dry river bed, it is possible that the terns associated with the first nest to hatch at the colony may have moved east (downstream) and fledged one or two additional chicks that went undetected in our subsequent monitoring visits.

Incidental Records of Other Wildlife Species:

On 20 July, two adult Snowy Plovers (*Charadrius alexandrinus*) were observed in the Least Tern colony (SW/4 Section 18, T16N, R23W), but there was no evidence that these birds attempted to nest in the study area or that they were a bonded pair. Also on 20 July, a small flock of 16 Western Sandpipers (*Calidris mauri*) was observed foraging along the river west of the tern colony. As in past years, the Killdeer (*Charadrius vociferus*) was the most commonly observed shorebird in the study area. Between 19 and 20 July, 16 Killdeer (12 adults and one brood of four downy chicks) were observed on sandbars and beaches along the Canadian River. Spotted Sandpipers (*Actitis macularia*) also were common in the study area and 14 Spotted Sandpipers were observed during the survey of 19 and 20 July. These birds included 8 adults, two juvenile-plumaged bird which were capable of flight, and one brood of four chicks that had not yet fledged. Four singing male Bell's Vireos (*Vireo bellii*) were located on 22 June and 20 July (one male in the SW 1/4 of Section 13, T16N, R24W; one male in the NE/4 of Section 14, T16N, R24W; and two males in the SW/4 of Section 18, T16N, R23W). Two Texas Horned Lizards (*Phrynosoma cornutum*) also were located incidental to the tern monitoring - one adult was observed in the SE/4 of Section 4, T16N, R24W, and one adult was observed along the county road in the NE/4 of Section 3, T16N, R24W.

During the 2001 nesting season, financial assistance was provided to the Canadian River Least Tern Committee, to help pay the salary of this season's Preserve monitor. Two Least Tern colonies were located and monitored within the Preserve boundaries by the paid monitor and local volunteers. One colony of approximately 12 pairs nested in the vicinity of Indian Hills Road, and a colony of 10-12 pairs nested in the vicinity of the confluence of Brookhaven Creek and the Canadian River. The Indian Hills colony fledged a minimum of 14 Least Terns. Terns fledged from the second colony, however it was not monitored on a sufficiently frequent interval to accurately estimate fledging success.

Five-Year Summary of Least Tern Nesting Success at Packsaddle Wildlife Management Area:

Table 1 summarizes the reproductive success of Least Terns on the Packsaddle Wildlife Management Area from the 1997 through 2001 nesting seasons. Least Terns were present on the Canadian River in the Packsaddle WMA study area in all five years of this project. Due to unusually high rainfall in the spring and summer of 1997, this reach of the Canadian River lacked suitable areas of bare sand for terns to establish nesting colonies. Sandbars become exposed too late in the season, were too small, or were inundated by flood waters too frequently for terns to successfully incubate eggs and rear chicks. The opposite rainfall conditions occurred in 1998 which was one of the warmest and driest summers on record in Oklahoma. Continuous surface flow in the Canadian River ceased during the third week of June and all potential nesting islands were land-bridged. In addition, afternoon high temperatures exceeded 95 degrees almost daily from late June through mid August, which could have affected the viability of any tern eggs laid.

Least Terns successfully fledged chicks during the 1999, 2000 and 2001 breeding seasons. In each of these years, the flow of the Canadian River was nearly bank full in early to mid June, and continuous surface flow persisted into late July or early August. All successful nesting attempts during these three years were initiated between 15 June (1999) and 12 July (2000). Though Least Terns should return to the study area in mid May (based upon arrival data from the Canadian River Least Tern Preserve, Byre 2000), potential nesting areas are frequently inundated until the second or third week in June. The typical nesting scenario in this reach of the Canadian River appears to be for most nesting attempts to be initiated in mid June to early July as potential nesting areas first become exposed. As the summer progresses from late June through August, the afternoon high temperatures gradually increase while the river's volume of flow diminishes. In most years, this reach of the Canadian River ceases to flow during the month of July. The combination of increasing afternoon temperatures, diminishing availability of water (for fishing and for buffering colonies from potential predators), and the time constraints placed on terns to migrate by early September, probably act to limit the window of opportunity for Least Terns to nest successfully.

Those terns that loose their nests to predators or flooding early in the summer, have the ability to re-nest either in the study area or elsewhere. In some years, monitors on the Canadian River Least Tern Preserve near Norman, Oklahoma, have recorded an influx of new breeding terns into existing colonies in early July. We speculate that these birds may be terns that have lost earlier nesting attempts upstream in western Oklahoma and have moved downstream in search of existing nesting colonies where water flow is more substantial. For purposes of calculating the ratio of fledglings to nesting pairs, we do not include those pairs of terns that are present in June but leave the study area prior to about 5 July. The reasoning is that these terns still have sufficient time available to them to move out of the study area and re-nest elsewhere (e.g. downstream). However, it is possible that the adults which abandoned the study area in late June and early July do not attempt to re-nest, possibly as a result of lost reproductive time and energy spent in attempting to nest in the study area in June. As a result, our estimates of

fledgling to pair ratio may be too high because some pairs were inappropriately removed from the analysis. Conversely, there were adult terns that remained in the study area into early July, that we were not able to document whether or not they attempted to nest. In our calculation of fledging to pair ratios, these adult birds were considered to be unsuccessful breeders, primarily because time constraints greatly limit their ability to relocated and re-nest. As examples, in 1997 and 1998, two and four pairs of Least Terns respectively remained in the study area into July. To be conservative in our calculations of fledgling to pair ratios, we considered these birds to be unsuccessful breeders even though we did not find evidence that these terns were reproductively mature. Because Least Terns typically do not breed until the age of two, it is possible that these were sexually immature, adult-plumaged birds and therefore our estimates of the fledgling to pair ratio may be too low because we classified non-breeding immature birds as adult pairs.

Least Tern reproductive success appears to vary dramatically from year to year, a situation which may be common among relatively long-lived colonially nesting birds (Diem and Pugesek 1994). The fledgling to pair ratio was zero in two of the five years of this study, however, in three of five breeding seasons this ratio was above the theoretical replacement value of 0.51. Summing all values for all five nesting seasons, 26 pairs successfully fledged between 14 and 20 chicks for a total fledgling to pair ratio between 0.54 and 0.77. While the sample size is small, these data suggest that reproductive success along the Canadian River in western Oklahoma is sufficient to maintain a population of Least Terns at or slightly above replacement level. It is unlikely, however, that the Least Tern population in this reach of the river functions as a substantial source population.

Several physical characteristics of this reach of the Canadian River and behavioral traits of the terns that nest there, may explain why reproductive success meets or exceeds replacement in the study area. The Canadian River in western Oklahoma does not support riparian forests; much of the riparian vegetation is comprised of tall grasses, small shrubs such as sand plum and sandbar willow, and only widely scattered cottonwood and elm trees. The lack of forest cover may limit the suitability of this habitat for potential nest predators such as Great Horned Owl, Red-tailed Hawk, bobcat and mink. Also, large herons and egrets which may prey upon tern chicks are rare in this region. Least Terns in the study area form smaller nesting colonies than those that have been studied elsewhere in Oklahoma; these colonies are typically smaller than seven pairs. The smaller nesting colonies may be more difficult for potential predators to locate and may reduce the likelihood that chicks will be preyed upon. Additionally, there appears to be a tendency for broods of terns to disperse away from their natal colony before fledging. Because many tern colonies are established on beaches and scoured bends in the river, the river's flow may provide only minimal protection from predators. Where colonies do nest on sandbars, these sandbars are surrounded by water that is usually less than two feet deep and rarely more than 50 feet wide, thus the water provides limited protection from mammalian predators and no protection from avian predators. Nesting sandbars rarely function as islands for the entire incubation (21 days) and pre-fledging (18-19 days) periods, therefore dispersal of mobile chicks away from the colony and onto the drying river bed, may improve chick survival by providing a larger area of bare sand in which the chicks can hide. Sparsely dispersed, mobile chicks may be

more difficult for predators to locate, than concentrations of chicks on a small sandbars and beaches. Because of this, predators may not be conditioned to seek out tern colonies as potential sources of prey.

VI: SIGNIFICANT DEPARTURES:

Creation of Off-River Nesting Areas:

Though originally conceived as an objective of this study, no upland nesting areas (areas of bare sand) were created during this project segment. Following the 1998 field season, project personnel discussed the possibility of clearing the vegetation from two 2-acre areas in the Sections 13 and 14, T16N, R24W, however wet weather conditions in late winter and early spring prevented these from being constructed in 1999 or 2000. When the proposal for this project was developed in 1996, we believed that removing patches of vegetation to create areas of bare sand adjacent to the river might provide safe, off-river nesting sites that could be used by nesting terns. We theorized that these might be especially useful during years when high water levels in June prevented nest initiation from occurring early in the summer. Additionally, in comparison of Least Tern nesting success on sandbars and sandpits (off-river) on the Platte River, off-river nesting sites experience fewer nest losses due to flooding, though they experience higher rates of nest depredation and nest abandonment (Kirsch 1996). Finally, off-river nesting areas might be better protected from vehicles and cattle traveling along the river.

During the 2000 and 2001 nesting seasons, we became less optimistic that creating upland nesting areas would be beneficial. Though high river flows in early summer frequently delay successful nesting in the study area until late June, tern colonies that initiated nesting in late June and early July in 1999, 2000 and 2001 were able to successfully fledge more than the 0.51 chicks per pair believed to be needed to maintain a population. Water level fluctuations in the study area during the period from early June through August are rarely of sufficient magnitude to flood nesting colonies, and relatively few nests are lost to flooding as compared to the situation in central and eastern Oklahoma.

The current summer flow pattern in the Canadian River in the study area is such that the sandbars that terns use for nesting are very likely to be land bridged by receding water levels sometime during the nesting cycle. While the land bridging of sandbars may provide predators with greater access to tern nests and chicks, it has the potential benefit of allowing mobile chicks to disperse away from the colony to find shelter. Once the river bed dries, tern chicks have access to dozens of linear acres of sand, sparse vegetation and drift wood in which to hide from predators. Terns nesting on islands or artificially created patches of off-river sand, are largely confined to these areas until they fledge because of the danger of entering moving water, in the case of islands, or dense grasses and shrubs in the case of artificial nesting areas. On these areas, tern nests and chicks might actually be more vulnerable to predators and experience higher levels of predation. Off-river nesting areas should reduce the incidence of human disturbance to

nesting colonies; however, human disturbance (e.g. vehicles or horses on the river bed) is uncommon in remote areas of western Oklahoma and we have not documented it as a source of nest loss. The benefits from reduced human disturbance on off-river nesting areas would therefore be minimal. A final consideration that discouraged us from constructing artificial off-river nesting areas, was the realization that due to the small number of terns that annually occupy the study area, it would require many years of data collection to statistically evaluate the differences in reproductive success between off-river nesting areas and natural nesting areas. The funding that would have been directed toward the creation of artificial upland nesting areas, was used to provide additional financial support to the Canadian River Least Tern Preserve. The Preserve's monitor was hired and paid by the Oklahoma Chapter of The Nature Conservancy, however, through this federal aid grant, we purchased most of the supplies used by the monitor and paid mileage costs.

VII. Prepared by: Mark D Howery

Mark D. Howery
Oklahoma Department of Wildlife Conservation

VIII. Date: December 20, 2001

IX. Approved by: Harold Namminga

Harold Namminga, Federal Aid Coordinator
Oklahoma Department of Wildlife Conservation

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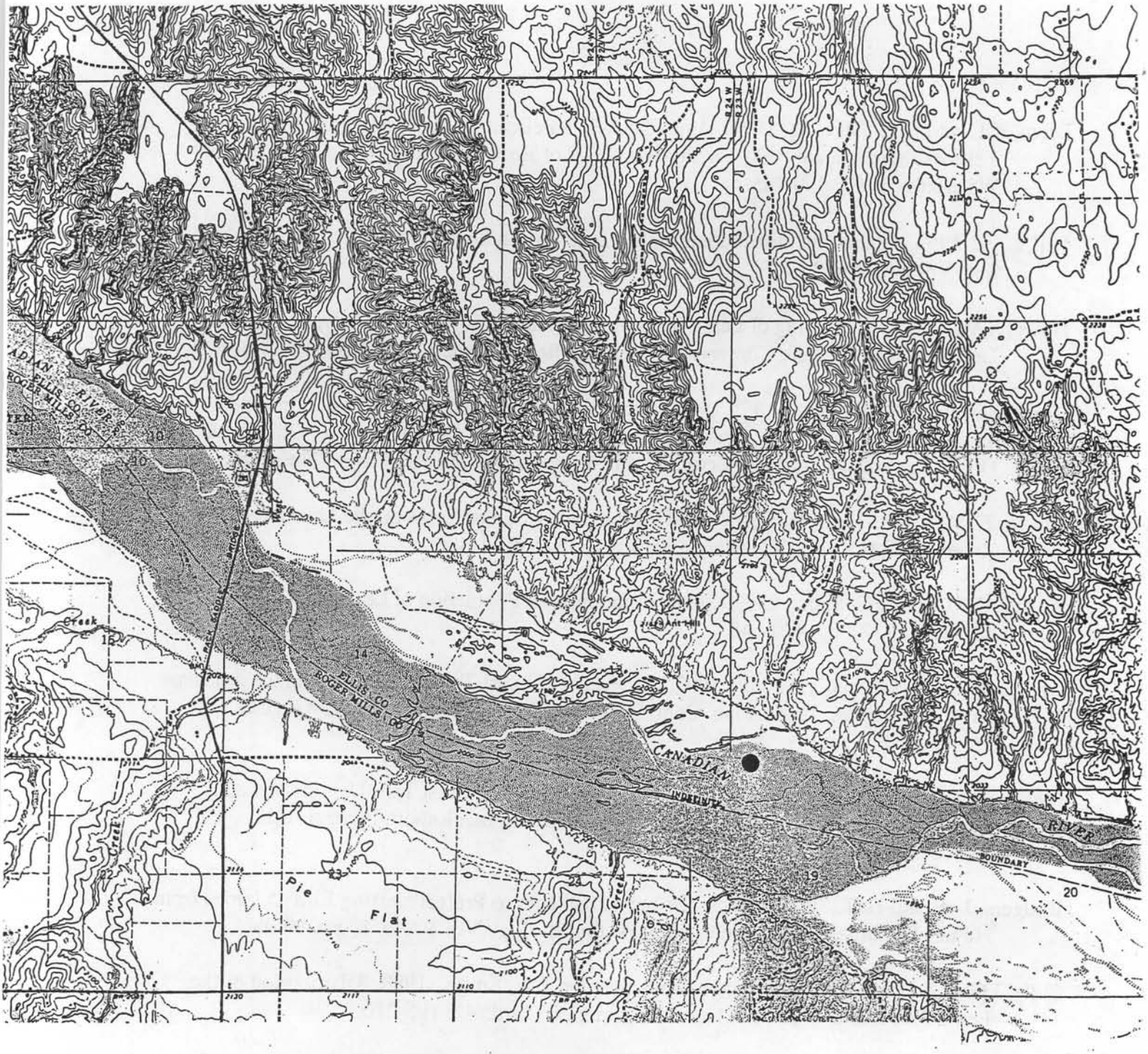

FIGURE 1. Portion of Packsaddle WMA Survey Area Depicting 2001 Nesting Colony Location

TABLE 1. Summary of Least Tern Productivity for 1997 through 2001.

Breeding Season	No. of Pairs	No. of Fledglings	Fledgling to Pair Ratio
1997	4	0	0
1998	2	0	0
1999	7	5 - 9	0.71 - 1.29
2000	8	5 - 7	0.65 - 0.88
2001	5	4	0.80
Cumulative Totals	26	14 - 20	0.54 - 0.77