State of California
The Resources Agency
Department of Fish and Wildlife
Wildlife Branch

Breeding Biology of the California Least Tern at Venice Beach, Marina Del Rey, California in the 2012 Breeding Season

by
Thomas Ryan and Stacey Vigallon

Nongame Wildlife Program, [2012-XX]

Report

To

State of California
Department of Fish and Wildlife

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Prepared February 5, 2013

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ABSTRACT

In 2012, California least terns (*Sternula antillarum browni*) arrived at the Venice Beach Colony on April 17 and departed after August 10. We estimate as many as 120 adult least terns were present at the site in 2012. Courtship activities began on April 17 and the first nest was found on May 8. All nests were predated between May 8 and June 4, when the last active nest was observed. We observed direct evidence of 14 one-egg nests. No chicks hatched or fledged due to a lack of foraging resources, and predation by crows (*Corvus brachyrhynchos*; crow). In 2012, crows were the primary predators on eggs, but unlike previous years, no predation occurred on adult least terns. In 2012, we estimate crows removed approximately 14 eggs (100%), same as 2011, 2010 and 2009, but an increase from 12% in 2007; 20.6% in 2006; and 61.6% in 2008. Average number of crows seen during May though June observation sessions was 5.8, with a high of 21 crows counted during a single observation session. It appears that there were also very low numbers of anchovies present. The least terns were laying relatively few eggs each day and there were few birds observed loafing at or adjacent to the colony during the day, supporting the possibility of food scarcity. Fewer least terns were present to defend the colony from crows. Therefore, while the proximate cause of colony failure was egg predation by crows, the ultimate cause may have been low food resources. Colony disturbance by helicopters was a regular occurrence in 2012 and the occasional flushing of the colony likely increased opportunities for local predators.

INTRODUCTION

Background

The California least tern (*Sternula antillarum browni*) (least tern) is one of three least tern subspecies breeding in North America. It nests from April through August and occurs along the coast from the San Francisco Bay in California to lower Baja California. This subspecies presumably winters in southern Mexico, Central America, or northern South America, although their wintering range remains unknown (Ryan and Kluza 1999, Keane 2001).

Least terns historically nested in several small, scattered aggregations on sandy beaches and salt flats along the California and Baja California coast, although the progressive loss throughout the last century of undisturbed sandy beaches resulted in a severe reduction in both nesting sites and numbers of nesting pairs (Chambers 1908). By the 1940's, least terns were gone from most beaches of Orange and Los Angeles Counties and were considered sparse elsewhere in the state (Grinnell and Miller 1944).

Historic Population Trends

Least terns have nested near Venice Beach since 1894 (Western Foundation of Vertebrate Zoology records). Nesting in the area from that time through 1976 was poorly documented. In 1977, three pairs of least terns nested on the sand at Venice Beach north of the Ballona Creek mouth (Atwood et al. 1977). Beach managers placed emergency fencing around the area to protect the nests and it has remained in the same general location since. This fence has allowed the colony to continue nesting with minimal disturbance (Comrack 2001). Since 1977, Venice Beach has supported up to 16.6 percent of the statewide pairs of breeding least terns and over 30 percent of statewide fledglings (Table 1). However, during the past ten years, the percentage of statewide pairs contributed by the Venice Beach colony has declined from a maximum of 12.4 percent in 1994 to 0.4 percent in 2004. Additionally, the proportion of fledglings produced at the Venice Beach colony declined from 12.4 percent in 1994 to 6.9 percent in 2003, with no productivity in 2003, 2004, and 2005 (Table 1). From 1999 to 2005, this site had failed to fledge young four of seven years. Crows likely caused these desertions in 1999, 2002, 2004, and 2005 (L. Comrack pers. comm.). Following recommendations made by biologists and the California Department of Fish and Game (CDFG), the size of the nesting area was enlarged in March 2006 from 4.2 acres to 7.7 acres (3.3 hectares) and a new fence was installed. In addition, a volunteer monitoring program, neighborhood outreach program, vegetation removal, and habitat study were initiated in 2005 and 2006. Between 2006 and 2008, the site returned to high productivity, producing the highest number of fledglings of any colony in its range in 2007, and was among the top five sites in 2006 and 2008. However, the colony has failed again from 2009-2012, and biologists attributed this to a combination of lack of foraging resources nearby and predation by crows (Ryan and Vigallon 2010, 2010a, 2011).

Habitat Selection Study

The study conducted from 2006 to 2009 found that predation by crow exerts an “edge effect,” with the heaviest predation on individuals away from the center of the colony and closest to the fence. Nests were less likely to succeed if they were placed within 20 m of the

enclosure fence, in grids with fewer than five other nests (<125 nests/ha), more than 5 m from their nearest neighbor and more than 70 m from the center of the colony. Additionally, least terns were more likely to be predated in areas with less than 5% vegetation cover, and prefer to nest, and are most successful, in areas with 20-40% vegetation cover. The best vegetation management technique was to reduce vegetation to less than 30% cover, but even this was not as successful as areas that are naturally between 5-30% vegetation cover. The least terns also prefer to nest, and are most successful in areas with dunes, although our findings indicate that predation increases with the number of dunes in an area (Ryan et al. 2010).

Site Management Plan

Drawing on current and past site monitor's experience and the findings of the nest site selection study completed in 2009 (Ryan and Vigallon 2009a), a site management plan was created to document how the site was to be managed each year. We summarized all aspects of the annual effort to manage the Venice Beach Least Tern colony, addressing volunteer organization, recruitment, training, coordination, public outreach, predation control, habitat management, general maintenance, monitoring during the courtship, incubation and fledgling periods, banding, funding and reports. If the reader is interested in a more detailed discussion of our study methods, this is an excellent source (Ryan and Vigallon 2010).

Overall, the goals of this report are to:

- Document the timing of the nesting cycle.
- Provide estimates of productivity at the colony.
- Document predation and other causes of mortality.
- Provide results of studies examining how the implementation of previous recommendations has affected the productivity of the colony.
- Provide further recommendations based on these results and on observations made during the 2011 nesting season to improve productivity at the colony.

Light-level Geolocator Migration Study

In 2012, we began a study of the migratory routes and wintering locations of the California least terns using light-level geolocators. Despite having been listed as endangered in 1970, researchers are still not certain of its migratory route and wintering destination. The goal of this study will be to determine the as-yet described migratory route and wintering grounds of the California Least Tern. This is one of the three primary action items recognized as an immediate research need by the USFWS's 5-year review of this species' status. We plan to study the migratory route and wintering grounds using a new technology called the "geolocator" that uses an internal clock and a light sensing diode to obtain daily latitude/longitude readings. It has been successfully used on seabirds including the arctic tern, as well as migratory passerine birds.

METHODS

Colony Preparation

The project team first re-marked the existing grid system using a Trimble GEO-XT GPS unit, then surveyed the site for special status plant species on March 9 (Figure 1). We marked areas with sensitive plant species and they were not disturbed during the vegetation clearing. It was determined that sand removal from the fence line was not needed. Assisted by crews from the local residents and the Dorsey High School Eco-Club, we conducted site maintenance on March 11. This included removing as much sea rocket (*Cakile maritime*) as possible from the entire site and modifying 20 x 20 m grids within the vegetated flat as part of the vegetation study (Ryan et al. 2010). In total, five grids were cleared of existing vegetation from the vegetation; we removed vegetation to less than 30% in the dune area. We followed recommendations made in Ryan and Vigallon (2010b) to avoid removing too much vegetation from the dunes to prevent destabilizing them. In addition, we placed bundles of native vegetation in the boundary areas in grids 9F – 9C and 10E-10C to help induce dune growth.

Colony Monitoring

The project team conducted site visits from April 16 to August 14, 2012 to observe and monitor nesting activities. Once the adult least terns arrived, we recorded observations of nest building, courtship, and anti-predator behavior. Nest monitoring consisted of walking through the colony, visually searching the sand surface for nests with eggs. When a nest was encountered, we recorded the contents and mapped the nest. We counted all predated eggs at the site. The project team visited and noted the condition of each nest during each visit. We considered eggs predated if they disappeared within three weeks of detection, were visibly predated, or were missing and other signs of predation (such as crow tracks) were observed. We considered eggs “did not hatch” if they remained in the nest more than 28 days. We considered eggs “presumed hatched” if they remained in the nest a minimum of three weeks, but no more than 28 days, or if they were located at nests that showed signs of hatching such as a pipped eggshell or tracks from chicks. We considered eggs “confirmed hatched” when chicks were observed at the nest or small chicks were observed within 1 m of the nest. For purposes of analysis, we combine presumed and confirmed hatched into “total hatched.” We included unknown-outcome nests in nest counts, eggs produced, and mean clutch size calculations, but not in measures of productivity.

In 2012, we observed heavy predation resulting in the removal of all eggs in all nests. We counted the number of predated eggs away from nests and used volunteer observations to estimate the number of eggs removed from the colony. Both the predated eggs and weekly estimates were used in producing the estimates of the total number of eggs, nests, and total pairs in 2012, as we did from 2008 to 2011. Our calculation for total nests was achieved by summing the total number of eggs estimated through the counts of predated eggs and volunteer observations and dividing them by the overall mean clutch size (1.98 eggs per nest) (Massey and Atwood 1981). No chick counts were conducted, as no eggs hatched.

Volunteer Monitoring and Outreach Events

Following the recommendations made in the Site Management Plan (Ryan and Vigallon 2010), the project team recruited volunteer observers from the local community and Audubon Chapters. LA Audubon biologist Stacey Vigallon coordinated volunteer recruitment, site maintenance, and monitoring efforts in 2012. The team held seven volunteer training sessions between April 10 and May 14 for new and returning volunteers. The project team discussed methods, purpose, and least tern identification.

A total of 21 people attended the training sessions, and 18 consistently helped to monitor the colony during the nesting season. Each volunteer observed the colony for a one-hour period at the same time once per week. They reported their observations via e-mail or phone to Ms. Vigallon, who conveyed urgent reports immediately to Mr. Ryan and summarized each week's observations in a brief report to Mr. Ryan. Volunteers monitored the colony from April 15 to August 22. There was an average of seven visits per week (range=1-14), totaling approximately 128 people-hours spent by volunteers observing the colony. Once abandonment of the colony had been confirmed, volunteers continued monitoring colony use by any remaining adult least terns, adult and fledgling least terns stopping over from other colonies, and the crow population at and adjacent to the colony. Two volunteers, who received training in July, focused their efforts on conducting crow surveys along the adjacent beach and nearby residential area on July 14, 21, 28, and August 4. These volunteers devoted a total of 5 hours specifically to conducting crow surveys (see Appendix B for full description). Additionally, volunteers spent approximately 356 people-hours conducting site maintenance on October 2, 2011 and March 11, 2012. Dorsey High School's EcoClub completed their tenth volunteer visit to the colony on March 11, 2012. The site maintenance event on October 2, 2011 marked the fourth annual visit by Toyota employees and their families, with students from five different Los Angeles Unified School District schools present, and 127 volunteers participating. In total, we documented that volunteers spent approximately 489 hours assisting with the Venice Beach colony between October 2011 and August 2012. We conducted the post-season site maintenance on Oct 6, 2012, with 119 volunteers in attendance from Dorsey High School's EcoClub, Toyota employees and their families, and students from Los Angeles Unified School District schools.

In addition to volunteer activities, the team also coordinated outreach activities to promote Least Tern conservation (see Appendix A for images). These included in-school presentations at two local public schools; engaging a local Girl Scout troop in site maintenance at the colony; tabling events at Cabrillo Aquarium, Toyota Corporate headquarters, and a local elementary school; and inclusion of Least Tern imagery on a permanent mural at a local public school.

Population Parameters

The project team estimated the total number of breeding pairs by subtracting an estimate of re-nesting pairs from the total number of nests.

Banding

No banding was conducted in 2012 as no chicks hatched.

Predation and Disturbance Monitoring

The project team monitored predation through personal observations during the colony monitoring and by reports from the team of volunteer observers. We estimated predation rates by adding the number of eggs, adults, chicks reported killed and removed from the colony by the volunteers to the number of eggs, chicks, and adults found dead at the colony. We also estimated egg predation as part of the monitoring of individual nests (described above). In addition, volunteers reported all helicopters flying below 500 feet directly over the colony enclosure, as well as any other human-related disturbance they observed.

Light-level Geolocator Migration Study

In 2012, we placed 42 geolocators on adult least terns at the Port of Los Angeles, Seal Beach, Coronado Naval Amphibious Base (NAB), and Chula Vista Wildlife Reserve ((CVWR) We captured the adult terns using drop traps and remote controlled traps (CVWR and Coronado NAB) placed over nests that had been active for a minimum of two weeks. Drop traps were operated with a biologist either laying still or under a camouflage net to pull a 50 ft string, trigger the trap to drop once an adult least tern was in the incubating position. We also used trucks as blinds at Coronado NAB and CVWR. All terns captured at CVWR were captured by Brian Foster using a remote controlled double-door trap. Each least tern was equipped with a USGS metal band with a geolocator tied to it using Kevlar string and marine epoxy to create a strong bond. We used LOTEK Mk20 model that weighs 0.6 g. With the Kevlar string and marine epoxy, the units weighed an average of 0.79 g. Given the average body weight of the least tern is 44-47 grams, it represents 1.8% of the terns total body mass, below the 5% recommended by most studies (Kenward 2001).

In 2013, we will identify previously marked birds and recapture them using the same trapping techniques. Once we recapture the adult and recover the band we will download the data and obtain a track of each bird's location over the prior year. We will then travel to areas that are identified as potential wintering areas to attempt to detect California Least Terns and identify key features of their wintering biology such as habitat type, key prey species, roosting areas, and potential threats.

RESULTS and DISCUSSION

Population Estimate

Least terns arrived at the Venice Beach Colony on April 17: four days before their arrival in 2009, 2010 and 2011; six days earlier than their arrival in 2008 and 2007. We estimate that only 28 breeding pairs were present in 2012, although as many as 120 individuals were counted attending the colony in early June (Table 1).

Table 1. Population Parameters at the Venice Beach Least Tern Colony 1977-2012.

Year	Number of Pairs[a]	Percent of Statewide Pairs[b]	Number of Nests	Number of Fledglings	Fledglings Per Pair	Percent of Statewide Fledglings[b]
1977	35	4.1%	N/A	30	0.86	5.7%
1978	68	8.2%	N/A	75	1.1	17.9%
1979	88	8.8%	N/A	140	1.68	20.1%
1980	158	13.5%	N/A	240	1.52	31.2%
1981	150	15.4%	N/A	195	1.3	23.4%
1982	170	16.6%	N/A	60	0.35	11.7%
1983	145	12.1%	N/A	140	0.97	15.7%
1984	83	8.6%	N/A	94	1.13	18.1%
1985	96	9.4%	N/A	113	1.18	17.3%
1986	104	10.8%	N/A	113	1.09	12.8%
1987	109	11.7%	N/A	82	0.75	13.0%
1988	165	13.2%	N/A	192	1.16	17.0%
1989	137	11.0%	N/A	134	0.98	17.5%
1990	206	12.1%	N/A	279	1.35	17.3%
1991	198	10.8%	N/A	200	1.01	11.2%
1992	229	10.9%	275	245	1.07	17.4%
1993	246	10.6%	219	288	0.85	14.2%
1994	345	12.4%	345	224	0.65	12.4%
1995	310	11.9%	354	44	0.14	4.1%
1996	271	8.0%	361	92	0.33	4.6%
1997	375	9.4%	400	263	0.7	8.2%
1998	383	9.2%	387	200	0.52	7.3%
1999	43	1.2%	50	0	0	0.0%
2000	274	5.9%	308	150	0.55	3.9%
2001	295	6.9%	348	388	0.91	8.5%
2002	2	0.1%	2	0	0	0.0%
2003	348	5.1%	371	181	0.52	6.9%
2004	24	0.4%	24	0	0	0.0%
2005	105	1.5%	90	0	0	0.0%
2006	276	3.9%	384	266	0.97	7.3 -10.3%
2007	453	6.5 - 6.7%	546	413	0.91	15.6 - 18.0%
2008	468	6.1 - 6.7%	928	296	0.63	11.5 - 13.1%
2009	295	4.0 - 4.1%	344	0	0	0%
2010	93	1.4%	164	0	0	0%
2011	14	<1%	28	0	0	0%
2012	14	<1%	28	0	0	0%

[a] Values are number of least tern nests minus estimated number of renesting pairs.

[b] Percent of statewide total of nesting pairs and fledglings, derived from means of ranges presented in annual reports prepared for the California Department of Fish and Game (see Marschalek 2008). The Venice Beach site is one of approximately 38 sites statewide.

N/A – not available

There were approximately 100 least terns present in early May, decreasing to about 50 during the last two weeks of May, and then rebounding to 120 the first week of June. Most were observed loafing in front of the colony and even during periods when egg-laying was observed it was rare if more than 30 individuals were observed within the enclosed colony. The colony began to fail and numbers declined sharply beginning approximately June 12-14 (Table 2). Team biologists estimated about 120-140 individuals attended the colony at its peak on June 5 (Table 2). Least terns were present until at least August 10. Interestingly, biologists and volunteers observed as many as eight recently fledged least terns between June 25 and July 29, 2012. These young were certainly not from Venice.

Table 2. Summary of least tern population estimates in 2010–2012.

	Volunteer Population Estimate Peak (Average)			Biologists' Population Estimate			Number of Nests Present		
Month	**2010**	**2011**	**2012**	**2010**	**2011**	**2012**	**2011**	**2011**	**2012**
April	35 (6.4)	75 (12.6)	60 (15.6)	46	80	50	0	0	0
May	150 (49.7)	160 (34.6)	100 (19.5)	240	220-260	100	14	14	8
June	135 (20.4)	85 (10.3)	60 (19.5)	120	25	120	14	14	6
July	28 (5.9)	20 (7.8)	38 (3.4)	28	6	12	0	0	0
August	4 (0.9)	0 (0)	12 (1.3)	ND	0	10)	0	0	0

Nesting Activity

Nest Timing

Courtship activities began immediately upon arrival on April 16. These included fish exchanges and courtship flights between adults. Egg laying began on May 8, but the least terns faced heavy predation by crows. This predation resulted in low numbers of active nests at any one time (see Nesting Activity below). Between May 8 and June 5, typically a time when the numbers of nests are continuously increasing, the total numbers of nests present remained between one to five nests and corresponding counts of adults by the volunteers remained at zero to 100 individuals. Meanwhile, the project biologists found 4 predated eggs and we estimate, based on volunteer observations, that the crows removed at least 2 eggs from the

colony (likely far more). As has been observed in previous years, when there are fewer than 150 nests, the least terns appear to be unable to defend the colony against crow predation. Between June 12 and 14, the colony began to fail and many least terns departed, but a group of between about 10-15 individuals remained at the site, mostly roosting in front and flying above the colony until late July.

Productivity

Based on the colony monitors estimating observation of 8 one-egg nests that were predated, 5 predated nests found on the colony and the volunteers observed of 2 eggs removed from the colony, we estimate that 14 eggs were produced by the least terns in 2012 (Table 3). No eggs remained for more than one week, no chicks hatched, and no young fledged in 2012.

Table 3. Summary of Nesting Statistics 2007-2012.

Statistic	2012	2011	2010	2009	2008	2007
Total Nests	**14**	**28**	**164**	**295**	**928**	**546**
Estimated Re-nesting least terns	14	14	71	0	460	97
Total Estimated Nesting Pairs[a]	14	28[b]	93[b]	295[b]	468	453
Total Eggs	**14**	**165**	**165**	**585**	**1236**	**775**
Mean Clutch Size (*mean eggs per nest*)	1.00[b]	1.00[b]	1.01[b]	1.77[b]	1.33	1.42
Number of Eggs Hatched	0	0	0	0	476	571
Hatching Success (*eggs hatched of total eggs*)	0%	0%	0%	0%	38.5%	73.7%
Eggs lost to Predators	14	28	165	585	720	110
Percent of Total Eggs Lost to Predators	100%	100%	100%	100%	58.3%	14.2%
Eggs abandoned and/or infertile	0	0	0	0	35	89
Percent of Total Eggs Abandoned/Infertile	0%	0%	0%	0%	2.8%	11.5%
Known Mortality (*dead chicks and fledglings*)	0	0	0	0	134	131
Percent Mortality (*of total chicks hatched*)	0%	0%	0%	0%	21.2	16.9%
First Fledgling count	0	0	0	0	124	121
Second Fledgling count	0	0	0	0	183	182
Third Fledgling count	0	0	0	0	17	111
Total Fledglings counted[c]	**0**	**0**	**0**	**0**	**296**	**414**
Fledglings per Nest	0	0	0	0	0.32	0.76
Fledglings per Hatched Egg (chick survival)	0	0	0	0	0.62	0.73
Fledglings per Pair	**0**	**0**	**0**	**0**	**0.63**	**0.91**

[a] The estimated number of pairs is the total number of nests, minus the estimated number of nests initiated by renesting pairs (from the same or other sites). This is impossible to determine accurately without uniquely banded birds and varies from site to site and year to year. However, based upon expected renesting after the loss of eggs and young to predation, abandonment, and natural mortality, the estimated number of renesting least tern pairs at Venice Beach in 2007 was 97.

The number of pairs is used to derive a statewide population estimate. Although less accurate than the number of nests, it is generally a better indicator of population status, as nest numbers will be high during years of high nest predation followed by renesting.

[b] Both the number of eggs and estimated numbers of nests were derived from observation of predation events. This provided us with a measure of the number of eggs removed from the colony by crows. This was then divided by the mean clutch size (1.98) provided by Massey and Atwood (1981) to estimate the number of nests. The mean clutch size presented here is the summary of observed nests.

[c] See Methods section of text.

Habitat Selection Study

In 2012, we were only able to obtain the GPS position of 8 nests; this low sample size is not sufficient to alter the findings of the 2006-2009 study. We will include these nests within the database and analyze them following the next season to obtain a larger sample size.

Predation and Human Disturbance

Predation

In 2012, as in the past, crows were the primary predator of least tern eggs at the Venice Beach colony. In 2012, volunteer observers noted only two least tern eggs removed from the colony by crows. The project team found an additional 4 predated eggs within the colony. Nest surveys by the project team found 5 nests predated based on nest outcomes. We estimate that crows predated 14 eggs (100%) from 14 nests.

Similar to what happened in 2009-2010, we did not reach more than 5 nests in any one day, and most adult terns had departed the colony by 9 am. Although the immediate cause of failure was the predation of eggs by crows, the ultimate cause was likely a lack of food, which caused the adults to lay eggs more slowly and spend more time away from the colony searching for food. Volunteer observers noted the crow activity at the colony was generally higher than in past years in most categories and in most months, other than April and May 2008 (Table 4).

Table 4. Crow activity near and within the least tern colony in 2009 to 2012.

	Average Obs.				Flying Over/hr.				Landing/hr.				Eggs Removed/hr.			
	2009	2010	2011	2012	2009	2010	2011	2012	2009	2010	2011	2012	2009	2010	2011	2012
Apr	4.9	5.6	7.3		2.7	3.2	4.5		1.8	2.2	2.7		0	0	0	
May	3.9	6.1	4.2		2.6	4.4	3.7		1.5	2.5	1.9		0.2	0.14	0.04	
Jun	5.7	5.9	4		3.6	3.9	2.5		1.7	1.9	0.9		0.3	0.10	0	
Jul	3.1	4.5	5.2		0.3	3.0	2.7		0.3	1.0	2.0		0	0.03	0	
Aug	ns	ns	ns		ns	ns	ns		ns	ns	ns		ns	ns	ns	

Additionally, small mammal tracks were observed within the colony, likely from rats. Volunteers reported Great Blue Heron, Great Egret, Snowy Egret, and Western Gulls flying over and landing adjacent to the enclosure.

Human Disturbance

In 2012, there was a large dredge working in the Ballona Channel south of the colony for the entire nesting season. Biologists did not observe the terns visibly react to its sound or movements and Keane Biological Consulting conducted a more thorough study of foraging in

relation to the dredge. However, one potential impact that cannot be determined is whether the presence of the large dredge may have affected settlement at the colony as fewer terns than normal were observed during its operation.

During the colony clean up in March, a homeless camp was removed from the dunes. In late June, this person returned and fresh tracks and material were located within the colony in late June and July. This was reported to CDFG and local police.

Historically, the most frequently reported human disturbance events have involved helicopter flyovers and Fourth of July fireworks. There was regular disturbance by helicopters, including the local LAPD and LA Sheriff's over-flights of the adjacent outdoor beachology class, where they circled the colony at low altitude and often sound their siren. By far the most common type of private helicopter observed was the Robinson Helicopter R44 Raven model. The colony was mostly abandoned by July 4 and the numbers of birds remaining at the colony did not change following the fireworks display.

Human Beach Use

In 2009, we expanded on the human-use data we asked volunteers to collect in order to gather more information on general beach use, such as recreation and the presence of vehicles. We continued this protocol in 2012, and volunteers collected this data simultaneously with their observations of least terns and predators while walking the perimeter of the colony enclosure. Thus, human-use data represented here pertains only to the section of beach adjacent to the enclosure, and not to Venice Beach as a whole. Volunteers collectively completed 137 observation sessions, but not all volunteers provided consistent data on human use. However, some general trends can be noted during the 19 consecutive weeks of volunteer monitoring. People were observed engaging in some form of recreation (walking, jogging, sports, and sitting) during 85% of observation sessions. On-leash dogs and off-leash dogs were recorded during 69% and 50% of observation sessions, respectively. Volunteers reported the presence of vehicles during 40% of observation sessions. Of those observation sessions where human activity was reported (116), the majority of people were observed walking or jogging, as opposed to sitting or engaging in sports. The largest number of people present on the beach during any one observation period was 30, recorded twice in May. Of those observation sessions where vehicle presence was recorded (55), vehicles were observed more frequently on the west and south sides of the colony. Of those observation sessions where presence of on- and off-leash dogs was recorded (94 and 68, respectively), both on- and off-leash dogs were observed more frequently on the east side of the colony. The largest number of on- and off-leash dogs recorded during any one observation session was 12 and 13, respectively.

Band Reports and Banding

Band Reports

No banded adults were found dead at the colony site in 2012.

Banding

No banding was conducted in 2012 because no chicks hatched.

Light-level Geolocator Migration Study

Geolocators were received in early June and taken out of sleep-state and attached to USGS bands. Permits allowed us to begin placing them on least tern in "mid-June." Permits for attaching them in Orange and San Diego Counties were received on June 26, 2012. Unfortunately, the nesting season was almost a month earlier than normal and the peak of egg laying and incubation had already passed at most colonies. The only colonies with substantial numbers of least terns meeting the requirement of incubating for at least two weeks, for which permission could be obtained, and within Los Angeles, Orange and San Diego counties was limited to those listed below. By July 18, 2012, there were no longer any substantial numbers of incubating adult California Least Terns at any of the colonies in Southern California. With these challenges, we deployed 42 of the 45 geolocators between June 10 and July 17, 2012. They were deployed at the Port of Los Angeles (18), Seal Beach NWR (5), Coronado Naval Amphibious Base (9), and South San Diego Bay (CVWR) (10).

Of the 42 adults captured, 19 were previously banded and will be included in the analysis of least tern age structure being conducted by Dr. Brian Foster. The average age of recoveries at Seal Beach NWR were 10.3 years (n = 3, range 9-12) and Port of Los Angeles 13.8 years (n = 5, range 11-16), and Coronado NAB 9.0 years (n = 3, range 6-12).

We settled on an attachment method using Kevlar thread and marine epoxy to attach the geolocator to Service Bands. We color banded the first seven, using a metal band with red tape, but stopped once we realized how visible the geolocators themselves are. They were easily visible sitting on the ground and in flight. The geolocators with attachments were 0.7 to 0.8 g. The average body weight of the adults captured was 42 g (range 39-47 g). The geolocators were an average of 1.8 % of adult body weight (range 1.4% to 2.0%).

In banding, we recommend the use of needle-nosed pliers instead of banding pliers. The USGS metal bands have marine epoxy on the back and banding pliers cannot be used to completely reach around. It was easier to control the closing of the band with needle-nosed pliers in this case.

We did not record any mortality among marked adults, or damage to eggs, and preliminary indications are they adults with geolocators continued to incubate and provision chicks. No eggs were damaged. Some minor cere damage was observed on two adults. Three bands were overlapped while placing them on the terns and were subsequently removed using two lengths of wire. One bird received a minor cut on the leg during this process, but the bleeding had stopped prior to release. At least one adult was observed flying with the leg with the geolocator attached lowered below the body. This same bird was also observed with fish in its beak. We have at least two examples of adults with geolocators whose nests failed re-nesting later in the season. We will be requesting information from the colony monitors regarding the outcomes of nests where geolocators were attached, outcomes from the previous and subsequent 10 nests, and overall hatching success at the colony. We will attempt a statistical analysis to compare outcomes and we will report the outcome when they become available. Our preliminary

analysis of these observations are that this study affects the birds in similar ways and shares the same risks as other studies involving the capture and marking of adult terns.

Recommendations

For this, and future reports, we refer to the *Site Management Plan for the Venice Beach Least Tern Colony Marina Del Rey, California* (Ryan and Vigallon 2010) for general recommendations that have frequently been carried through on previous reports. Here we make recommendations that in some way expand upon the Management Plan.

1) During the re-capture of marked adult least terns in 2013, we suggest that:
    a. Recapture should begin as soon as the nest has been incubated for two weeks, without any restriction for "mid-June" as the least tern nest timing has become unpredictable in recent years.
    b. That the restriction for 100 nests established should be dropped so that we can work at smaller colonies if needed.
    c. Two traps should be deployed at a time if more than two nests are targeted.
    d. Bands should be removed using two lengths of wire.

2) Create a community outreach program to make people aware that pet food kept outside and uncovered trash and garbage attract crows. Also, confirm that all trash cans have covers as part of the early March assessment.

Several items have been in our recommendations for many years. Two that we would like to see acted upon before 2013 are contacting pilots and the FAA regarding the colony and placing at least two interpretive signs near the colony as specified by the Coastal Commission permit. We currently have artwork created by elementary school students that would be very effective in conveying information about least terns to the public.

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Appendix A. Images from outreach and volunteer activities held during 2011-2012

Appendix A. Figure 1. View of the dredge from within the enclosure with American Crows flying over the enclosure.

Appendix A. Figure 2. Dogs off leash adjacent to where the terns roost in front of the colony.

Appendix B. Images from outreach and volunteer activities held during 2011-2012

Appendix B. Figure 1. Volunteers from Toyota Corporation and Los Angeles Unified School District public schools helped remove trash and invasive plants during the October 2nd, 2011 habitat restoration event at the Venice colony.

Appendix B. Figure 2. Volunteers from a local Girl Scout Troop helped remove trash and invasive plants during the March 11, 2012 habitat restoration event at the Venice colony.