

BREEDING BIOLOGY OF THE CALIFORNIA LEAST TERN
AT VENICE BEACH, MARINA DEL REY, CALIFORNIA
IN THE 2007 BREEDING SEASON



Prepared for:

California Department of Fish and Game

October 31, 2007

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Prepared for:

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1. SUMMARY

1.1 POPULATION

Least Terns arrived at the site on April 22, 2007 and departed after August 23, 2007. We estimate 453 breeding pairs were present at the site in 2007; numbers peaked between June 8 and July 9. This is the highest population recorded for this site. This large population likely contributed to the colony's ability to fend off egg predation by American Crows in 2007.

1.2 NESTING

Courtship activities began on April 23. We found the first nest on May 14. Two peaks of egg laying occurred, the first from May 21 to June 8, and the second from June 11 to 18. We observed the first chick on June 18, numbers of chicks peaked between July 2 and July 25. We observed the first fledgling within the enclosure on July 9 and the last on August 7, Least Terns were present in the vicinity until at least August 23. We counted a total of 546 nests and 775 eggs, resulting in a mean clutch size of 1.42 eggs per nest. We estimate 571 chicks hatched (73.7%) and 413 fledged. This was the highest number of fledglings produced by the colony since re-colonization of the site in 1977.

1.3 PREDATION AND DISTURBANCE

In 2007, American Crows were the primary predators on eggs; an American Kestrel was the primary predator on chicks; and Peregrine Falcons were the primary predators on adult Least Terns. Volunteers observed the frequency of Crows flying over and landing in the colony declined in June and July, at the peak of nesting. Predation rates on eggs continued to decline in 2007.

We estimate American Crows removed approximately 98 eggs (12.6 percent) in 2007, an improvement from 123 eggs (20.6 percent) removed in 2006, and 177 eggs (100 percent) removed in 2005. American Crows predated five chicks between July 10 and August 6. We suggest this improvement is the result of larger numbers of Least Terns defending the colony, expansion of the enclosure, and measures taken by predator control personnel early in the nesting season.

However, there was increased predation on chicks and adults due to predation events by an American Kestrel and Peregrine Falcons. Observers noted the Peregrine Falcons taking two adults and one chick between June 1-5 and July 12-17. A single female American Kestrel killed as many as six chicks in one day and an estimated 65 chicks between July 12 and 24.

Studies of nest placement and productivity showed that predation was relatively even throughout the colony and that the tendency for higher predation near the fence observed in 2006 (Ryan 2006) was not a factor this year. Human disturbance of fledglings roosting outside the colony may be a potential source of mortality for newly fledged Least Terns and we recommend implementation of additional protective measures between July 10 and August 15.

2. INTRODUCTION

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 at nesting sites along the coast from the San Francisco Bay 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).

California 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 this 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).

Least Terns have nested near Venice Beach since 1894 (WFVZ 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 Colony declined from 12.4 percent in 1994 to 6.9 percent in 2003, and with no productivity in 2003, 2004, and 2005 (Table 1). From 1999 to 2005, this site has failed to fledge young four of seven years. American Crows caused these desertions in 1999, 2002, 2004, and 2005 (L. Comrack pers. comm.). Since 2005, efforts by project biologists and CDFG staff to recover this colony have included increasing the colony size, replacing the enclosure fence, earlier and aggressive predator control, vegetation management, and volunteer monitoring.

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. The fence has thin mesh wire (chick fencing) around the bottom to prevent chicks from wandering out of the site and an angled top to keep people and other mammals from climbing into the site. However, in both 2006 and 2007 the chick fence on the north and west sides was covered in sand and a temporary 2-ft high fabric fence was installed approximately 10 ft from the new chain link fence to prevent chicks from escaping from the colony.

The project team modified predator control efforts to better target egg-specializing Crows, beginning efforts earlier, and techniques that specifically target egg-eating predators. A volunteer colony monitor program began in 2005 (Ryan 2005). Volunteers provide timely reports of disturbance and predation events and assist biologists in monitoring tern populations. In 2007, Los Angeles Audubon coordinated volunteer efforts.

In 2006 and 2007, the project team has studied the placement and success of nests in relation to habitat conditions and location within the colony. They have used measures of nest placement, hatching success and predation rates to make recommendations for long-term habitat management and restoration at the site. We summarized these efforts in a separate report titled, *Venice Beach Least Tern Colony Habitat Improvement and Restoration Study: 2006-07 Preliminary Results* (Ryan et al. 2007).

Overall, the goals of this report are:

- 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 looking at how the implementation of previous recommendations has affected the productivity of the colony.
- Provide further recommendations based on these results and observations made during the 2007 nesting season to improve productivity at the colony.

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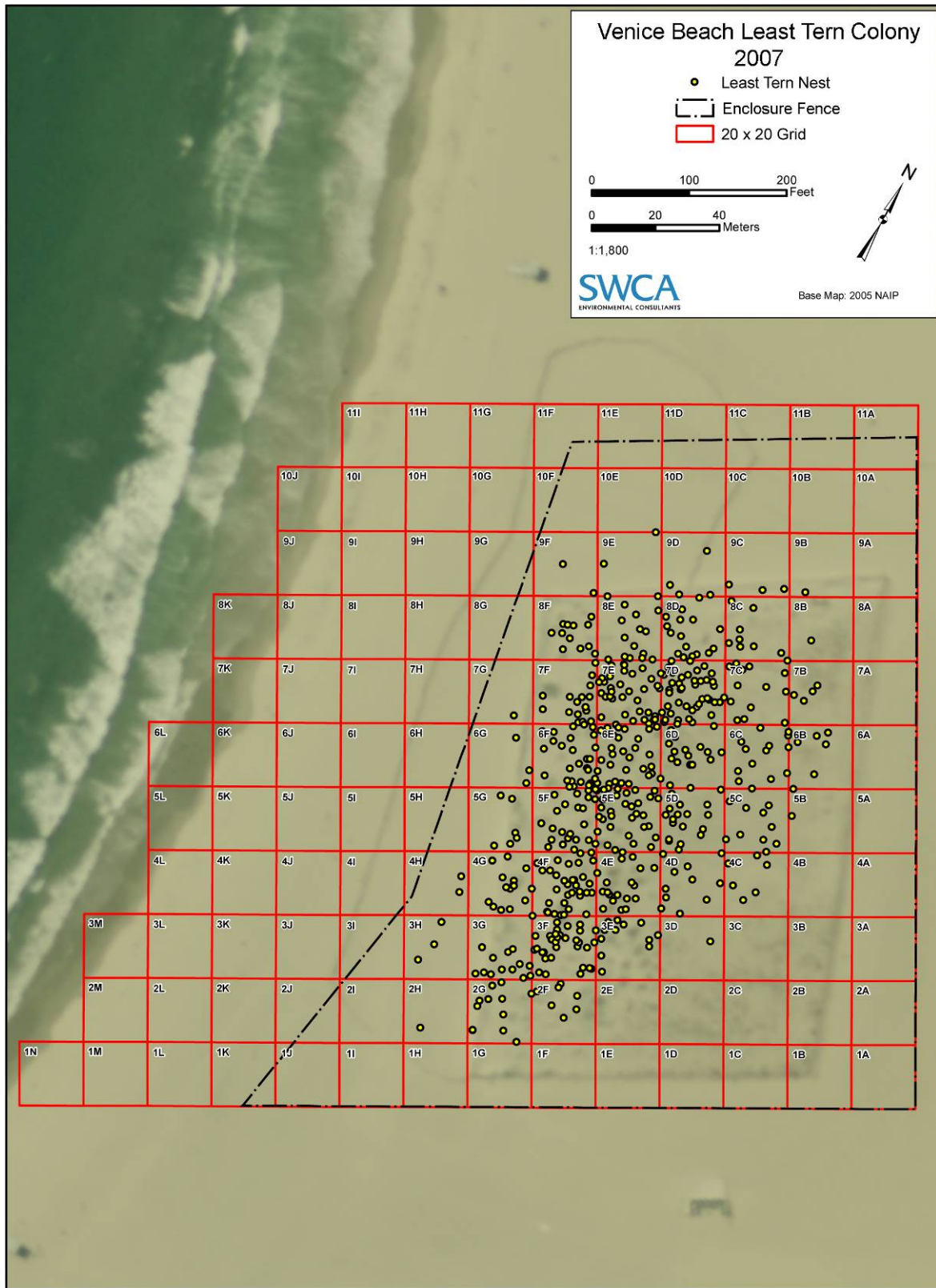


Figure 1. Aerial Photograph of the site showing the 20 x 20 m grid and 2007 nests. The darker colored area within the grid shows the pre-2006 vegetated area.

3. METHODS

3.1 COLONY PREPARATION

The project team first re-marked the grid system used in 2006 using a Trimble GEO-XT GPS unit and searched the site for special status plant species on March 16 (Figure 1). The project team marked areas with sensitive plant species and they were not disturbed during the vegetation clearing. Then, assisted by crews from the Los Angeles County Department of Beaches and Harbors (LACBH), local volunteers, California Department of Fish and Game (CDFG) and U.S. Fish and Wildlife Service, they conducted site maintenance between March 18 and April 16. This included removing as much sea rocket as possible and modifying 20 x 20 m grids as part of the vegetation study (Ryan et al. 2007). In total eleven grids were cleared of existing vegetation (the other seven were already <5 percent vegetated); and three grids were reduced to less than 30 percent vegetation cover (the other fourteen were already less than 30 percent vegetated). In addition, LACBH crews used heavy equipment and hand crews to remove the sand from the chick fence on March 29. On June 8, prior to the first expected chick hatching, a two-foot tall chick fence was installed on the north, west, and part of the south fence, where sand blown by unusually strong winds had built up over the existing chick fence, rendering it useless.

3.2 COLONY MONITORING

The project team conducted weekly site visits from April 16 to August 23 to monitor nesting activities. Once the adult Least Terns arrived, they recorded observations of their activity, including nest building, courtship, anti-predator behavior, and nest monitoring. This consisted of walking through the colony, visually searching the sand surface for nests with eggs. When they encountered a nest, they marked it using a wooden tongue depressor with a letter indicating date and a number indicating order of detection. They recorded the contents and mapped the nest using a Trimble GEO-XT GPS unit. They did not mark nests until 100 nests were present in an effort avoid predators associating markers with nests. They counted all chicks not in nests and fledglings within and adjacent to the colony. They buried most dead chicks and predated eggs; few were collected for the LACMNH.

After completing each survey, biologists downloaded mapped nest locations using Trimble Pathfinder. GIS Specialists then used the shape-files generated to map each nest and its alphanumeric identifier on an aerial photograph, with the grid system super-imposed. GIS Specialists generated field maps each week for use by the biologists in locating active nests on their next visit.

The project team visited and noted the condition of each nest weekly. They considered the eggs predated that disappeared within three weeks of detection, or they found predated eggs or other signs of predation (such as Crow tracks). They considered eggs “did not hatch,” if they remained in the nest more than 28 days. They considered eggs, “presumed hatched,” if they remained in the nest a minimum of three weeks, but no more than 28 days; or at nests that showed signs of hatching such as a pipped eggshell, tracks from chicks, etc. They 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, presumed and confirmed hatched are combined into, “total hatched.” They included unknown-outcome nests in nest counts, eggs produced and mean clutch size calculations, but not in measures of productivity.

They estimated total chicks present by summing a) the number of chicks hiding within the colony; b) the number of running chicks in congregation areas in the southwest and north end of the colony; c)

the number of chicks hiding along the fence line; and d) the number of fledglings observed. They estimated total adults present by taking multiple counts of the flock flying above the colony when flushed.

3.3 VOLUNTEER MONITORING

Following the recommendations made in previous annual reports (Ryan and Taylor 2004, Ryan 2005, Ryan 2006), the project team recruited volunteer observers from the local community and Audubon Chapters. LA Audubon biologists Stacey Vigallon and Jennifer Jones coordinated volunteer recruitment, colony clean up, and monitoring efforts in 2007. They held a volunteer training session in conjunction with the site clean ups on March 18 and 25. The project team discussed methods, purpose, and Least Tern identification.

Volunteers 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 Audubon biologist Stacey Vigallon. Ms. Vigallon 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 17. There were an average of five visits per week by the thirteen volunteers; totaling 98 hours spent observing the colony. Volunteer John Trefts does not regularly submit data sheets, but lives adjacent to the colony and spent approximately 50 hours observing the colony, submitting 50 reports over the 2007 season. Dr. Charles Collins and Patricia Collins donated approximately 24 hours for the banding studies. Additionally, volunteers spent approximately 120 hours conducting the pre-season site clean-up and volunteers from Dorsey High School spent approximately 220 hours conducting the post-season sea rocket removal. We document and estimate that volunteers spent over 512 hours assisting with the Venice Beach Colony in 2007.

3.4 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. Estimates of fledging success are notoriously difficult to obtain. We used two methods suggested by CDFG, and attempted to corroborate them using banded chicks to generate an estimate of daily mortality.

Method 1: The project team subtracted the number of dead chicks found on the colony and estimated predated chicks from the total estimated eggs hatched.

Method 2: The project team counted the number of fledglings present during three predetermined windows and summed those counts.

The overall fledgling estimate used in comparisons with previous years was made by averaging Methods 1 and 2 (Ryan 2006).

Additionally, with the assistance of Dr. Charles Collins, we banded chicks and estimated the average age of banding. We then recorded all dead banded chicks. We divided the total dead by the total banded to generate an estimate of mortality. We then subtracted the average age of banding from the oldest estimated chick age, generating an estimate of average number of days on the colony. We then divided the estimate of mortality by the average number of days to generate a daily estimate of mortality. This estimate was then multiplied by 20, which is the average number of days until fledging (Thompson et al. 1997) to obtain an overall estimate of mortality/survivorship. We then

multiplied the estimated total eggs hatched by the survivorship estimate to obtain a third estimate of total fledged.

3.5 BANDING

The project team conducted two banding sessions in 2007 under the direction of permitted biologist and master bander, Dr. Charles Collins assisted by Patricia Collins. These occurred on July 12 and 19. They captured chicks by herding them against the chick fence, capturing them by hand, and placing them in holding boxes. Biologist banded chicks using standard banding pliers with USGS 1A bands. They measured wing chord using a metal wing rule and weight using a Pesola spring balance scale.

3.6 PREDATION AND DISTURBANCE MONITORING.

The project team monitored predation through their observations during the colony monitoring and by reports from the team of volunteer observers. They estimated predation rates using the number of eggs, adults, and chicks reported killed and removed from the colony by the volunteers, adding to it the number of eggs, chicks, and adults found dead at the colony. The project team combined counts of dead chicks to estimate of mortality, which they used to estimate fledging success. They also estimated egg predation as part of the monitoring of individual nests (described above). These are the measures used in the analysis presented in *Venice Beach Least Tern Colony Habitat Improvement and Restoration Study: 2006-07 Preliminary Results* (Ryan et al. 2007). Volunteers reported all helicopters flying below 500 ft directly over the colony enclosure, as well as any other human-related disturbance they may observe.

4. RESULTS AND DISCUSSION

4.1 POPULATION ESTIMATE

Least Terns arrived at the Venice Beach Colony on April 22, 16 days later than their arrival date in 2006, and six days later than in 2005. We estimate 453 breeding pairs were present (Table 1). Their numbers continued to increase through April and May. Peak numbers of individuals were present between June 8 and July 9. Numbers declined through August (Table 2). Biologists and volunteers estimated between 800 and 900 individuals attended the colony in June and July (Table 2). Least Terns were present until at least August 23. This was the highest number of birds in attendance in this colony's history, and the highest number of active nests (Table 1).

This large population likely contributed to the colony's ability to fend off egg predation by American Crow (see Predation, below). In recent years, high populations have resulted in high productivity. A regression analysis shows a strong positive relationship between the Number of Pairs and Fledglings per pair from 1996 to 2007 ($R^2 = 0.69$, $SE = 0.95$) (Table 1). An ANOVA shows this to be statistically significant ($F = 21.92$, $DF = 10$, $P < 0.05$).

4.2 NESTING ACTIVITY

Nest Timing. Courtship activities began immediately upon arrival on April 23, two days earlier than observations in both 2005 and 2006. These included fish exchanges and courtship flights between adults. Egg laying began on May 14, although, only two additional nests had eggs the following week on May 21. However, it appears heavy American Crow predation may have influenced detections as

volunteers reported 32 eggs removed from the colony by Crows between May 15 and 31. On May 30, the project team found 159 active nests. The colony continued to increase, reaching a peak of 410 nests on June 18. Two peaks of egg laying occurred, the first from May 21 to June 8, and the second from June 11 to 18. They detected the first chick on June 18. Chick numbers peaked between July 2 and July 25, the two highest chick counts were of 203 pre-fledged and 2 fledged chicks on July 9; and 75 pre-fledged and 182 fledged chicks on July 24. They observed the first fledgling on July 9. From 111-180 fledglings were observed at or adjacent to the colony between July 19 and August 7.

Productivity. The project team counted 546 nests at the Venice Beach Colony in 2007. These nests produced 775 eggs, resulting in a mean clutch size of 1.42 eggs per nest (Table 3). We observed 319 1-egg nests, 225 2-egg nests, and 2 3-egg nests. Of the 775 eggs laid, we confirmed that 322 (41.5 percent) hatched; 249 (32.1 percent) likely hatched; 110 (14.2 percent) were predated, 89 (11.5 percent) did not hatch and five (0.6 percent) were unknown result. We estimate that 571 chicks hatched (73.7 percent) (Table 3). Of the chicks hatched, we found 60 dead in the colony of non-predation-related causes (7.7 percent) and estimate 65 were killed by an American Kestrel; observed 5 killed by American Crow; and 1 killed by a Peregrine Falcon (9.2 percent) (Table 3).

Estimates of fledging are notoriously difficult. We present three measures:

Total estimated hatched (571) – mortality (131) = 440 fledglings.

Counts of fledglings present from CDFG window survey dates July 12, 26, August 9 = 414 fledglings.

Counts of feathered, pre-fledged chicks from surveys 2 weeks apart = 385 fledglings.

Each of these estimates has many problems. In the interest of consistency, we conform to previous reports in our total estimate of fledging by taking the average of the highest and lowest estimates. Our official estimate for 2007 is **413** fledglings (Table 3). However, given the low mortality, good coverage of the colony, and the lack of the volunteer observers detecting predators removing carcasses from the colony, it is our opinion that this may underestimate the actual total and that estimate #1 (440 fledglings) is likely closer to the actual total fledged. Even this lower estimate is the highest number of fledglings produced by the colony since re-colonization of the site in 1977. It is the among the highest pair-to-fledgling ratio (0.91 fledglings/pair) (Table 3) and compares favorably to the high productivity enjoyed by the colony during its healthier years from 1977 to 1993, and 2006.

4.3 PREDATION AND HUMAN DISTURBANCE

Predation. In 2007, as in the past, the American Crow was the primary predator upon Least Tern eggs at the Venice Beach colony. In 2007, volunteer observers noted 50 Least Tern eggs removed from the colony by American Crows. The project team found an additional 48 predated eggs within the colony. Nest surveys by the project team found a similar number of 110 nests predated based on nest outcomes.

Between March and May and prior to nesting, CDFG personnel trapped and removed four American Crows from the local population. This effort, combined with a similar one in 2006 that also removed four Crows appears to have resulted in a decline in Crow activity observed by volunteers (Table 5) and in a reduction in the number of eggs taken. Crow activity and predation is relatively high in mid-late May as nesting began, declined during the peak of nesting, then increases again in late July and August as the Least Terns depart the colony and fewer adults remain to defend their nests. Egg removal peaked early in the nesting season, between May 21 and June 8, prior to the peak of nesting.

Mostly when there were fewer than 150 nests prior to May 30. We suggest that the factors that originally changed in 2006 that continue to allow the Least Terns to overcome this high level of activity by American Crows are (1) a larger population that allowed for better defense of the colony; (2) a larger enclosure that (a) allowed the Least Terns more time to react to Crows entering the nesting area (see below), and (b) may have allowed for the larger population to be present; and 3) early season trapping that removed four known egg-predating Crows from the vicinity prior to nesting.

Between July 12 and July 23, a female American Kestrel foraged on chicks at the Least Tern colony. Based mostly on volunteer counts and effort, the project team estimates that this resulted in the predation of approximately 65 pre-fledged Least Tern chicks. CDFG personnel removed the female American Kestrel from the area on July 24, and no additional attacks were reported.

The project team and volunteers observed a juvenile Peregrine Falcon foraging on both adult and pre-fledged chicks between June 1-5 and July 12-17. Volunteers documented the Peregrine Falcon killing two adults and one chick. The colony was visibly disturbed during surveys between May 31 and June 5. They would fly out over the water continuously when other birds or helicopters were above the colony.

Other potential predators detected include gulls, raccoons, domestic dogs, domestic cats, and rats. Least Terns chased gulls on several occasions, although no predation was observed. The project team detected rodent tracks within the colony. Large numbers of rats occur in the adjacent breakwater. They detected raccoon tracks within the colony and CDFG personnel placed a trap, no raccoons were captured. They observed cat tracks in the colony. These were tracked back to gaps in the fence, which were repaired.

Human Disturbance. Historically, the most frequently reported human disturbance events have involved helicopter flyovers and Fourth of July fireworks. As in previous year, helicopters continued to fly low over the colony (Table 5). The most frequently reported helicopters were from local police and fire agencies. There were several incidents where the Least Terns flushed in response to helicopters. In the interest of both public safety and reducing disturbance to the Least Terns, the project team recommends that CDFG and USFWS coordinate with local airports and the FAA to have pilots maintain a minimum of 1000 ft over the colony and have it placed on aeronautical maps. We also recommend that pilots that violate the existing restriction of 500 feet be disciplined.

This year, the Fourth of July fireworks occurred as scheduled. A volunteer reported that a small group of people remained late into the night firing off illegal fireworks above and into the colony. This group was likely there between 11 p.m. and 2 a.m. The project team found fireworks within the enclosure on subsequent visits. There was a noticeable reduction in the number of adults attending the colony in the following days. We recommend that a CDFG warden visit the site during and after the public fireworks display.

In 2006 and 2007, the fledgling Least Terns tended to leave the colony and roost in a relatively unprotected area west of the colony. This occurred between July 9 and August 23. This is troubling because the newly fledged tern chicks are still most likely to freeze in response to a potential threat, and may not fly away. Volunteers reported beach goers, off-leash dogs, and vehicles in the area. Vehicles, including beach groomers, maintenance staff, sanitation workers, lifeguards, and police patrols, regularly transit this area. Additionally, volunteers reported five police ATVs practicing in this area on August 10. In late July, The project team requested that LACBH minimize beach grooming to the extent possible in this area and LACBH staff was helpful in implementing this recommendation. In the future, the project team recommends that between July 15 and August 15,

this area become a restricted access area. This would involve putting up signage or symbolic fencing and reducing non-essential vehicle activity and beach grooming, and enforcing dog-related ordinances between the colony and the beach between the lifeguard towers north and south of the colony site.

4.4 BAND REPORTS AND BANDING

Band Reports. The project team found two banded adult Least Terns dead at the colony. The first (band no.1841-96419), was found on July 9 and was banded prior to fledging on June 30, 2004 at the Naval Amphibious Base on Coronado Island, San Diego. The second (band no.1781-45470), was found on August 23 and was banded prior to fledging on June 6, 2001 at the North Island on Coronado Island, San Diego.

Banding. Dr. Charles Collins banded 85 chicks during two banding sessions on July 12 and July 19. The project team found eight of these dead at the colony prior to fledging. We used growth curves generated at other tern banding sites with known age chicks to estimate the average age at 16 days old. They then estimated survivorship from day 16 to fledging at 90.6 percent, with a daily survival estimate of 98.1 percent. Therefore, based on banded individuals we estimated an overall survivorship for hatchlings at 60.5 percent, slightly lower, but close to fledging estimates provided by other methods (77.1 percent).

Measurements of wing length and body weight indicate the chicks were in good condition. Studies at other colonies indicate that survival is higher in chicks that are above 35 grams once wing length is above 100 mm, or a wing length: body weight ratio of 2.85. All eight chicks found dead were below this ratio. The overall ratio for all chicks banded with wing lengths over 100 mm was 2.89.

5. RECOMMENDATIONS

We suggest the following recommendations based on observations made at the colony between 2004 and 2007. We suggest that implementation of these recommendations along with recommendations generated from the *Venice Beach Least Tern Colony Habitat Improvement and Restoration Study: 2006-07 Preliminary Results* (Ryan et al. 2007) will help maintain and increase the number of nesting adults and their productivity at the Venice Beach Least Tern Colony.

- 1) Continue aggressive predator control activities in March-May before the nesting season. Methods initiated in 2006 and modified in 2007 have proved effective. We recommend setting a schedule for these activities and coordinating with the CDFG warden on dates before the nesting season. We recommend that techniques that are more aggressive be used every 1-2 weeks to reduce the number of egg-eating Crows in the vicinity before the tern's arrival in April. These efforts should include:
 - a. Continue experimentation with deterrent and aversion techniques for corvids beginning in early March.
 - b. Continue placing Crow carcasses within the colony in late March. The latter measures will discourage any Crows new to the area from going within the colony before the Least Terns return to the vicinity.
 - c. Implementation of methods targeted at removing egg-eating Crows should be implemented in early March and continued until volunteers note a decrease in Crow activity. Past methods have proved successful and we recommend that they be

- implemented again, although experimentation with new methods is advantageous as well because of the Crow's intelligence.
- d. We should then employ adaptive management techniques to adjust our techniques and level of aggressiveness based on the monitoring reports.
- 2) Continue vegetation clearing on plots within the colony according to the *Venice Beach Least Tern Colony Habitat Improvement and Restoration Study* Methods before April 1. Follow further recommendations made in this report (Ryan et al. 2007)
 - 3) Continue volunteer monitoring program with a goal of having at least one monitor checking the colony daily. Provide an updated volunteer training session prior to April 1. Expand their monitoring of the area in front of the colony between July 10 and August 15 and to provide more detailed descriptions and photographs of human-related disturbance events.
 - 4) Request that police and sheriff personnel enforce existing dog regulations west of the colony between July 10 and August 15.
 - 5) Request that vehicle use by all agencies that use the beach be minimized west of the colony between July 10 and August 15.
 - 6) Have a CDFG or USFWS warden present during and after Fourth of July festivities near the colony.
 - 7) Have the USFWS contact pilots observed flying low over the colony in 2006 and have them issue a general letter to pilots and local airports on or around April 1, requesting they fly over the water when flying near the Marina del Rey harbor entrance. We should consider working with the FAA on additional airspace restrictions to limit aircraft to flying above 1,000 ft. within ½ mile of the colony between April 1 and August 15, and placing the colony on air-charts with a notation.
 - 8) Placing at least two interpretive signs near the colony as specified by the coastal commission permit.
 - 9) Use volunteers to continue the public education campaign by creating display materials and having them set up a table near the boardwalk in front of the colony during heavy use weekends.
 - 10) Ensure local garbage have functional lids within ¼ mile of the enclosure.
 - 11) Begin a public awareness campaign to discourage people from feeding local Crows, including covering garbage and covering pet food or keeping it inside.
 - 12) Members of the local community have requested that a viewing platform or other structure be erected in a manner that will not interfere with the Least Terns so that the local community can view the nesting cycle within the fence.

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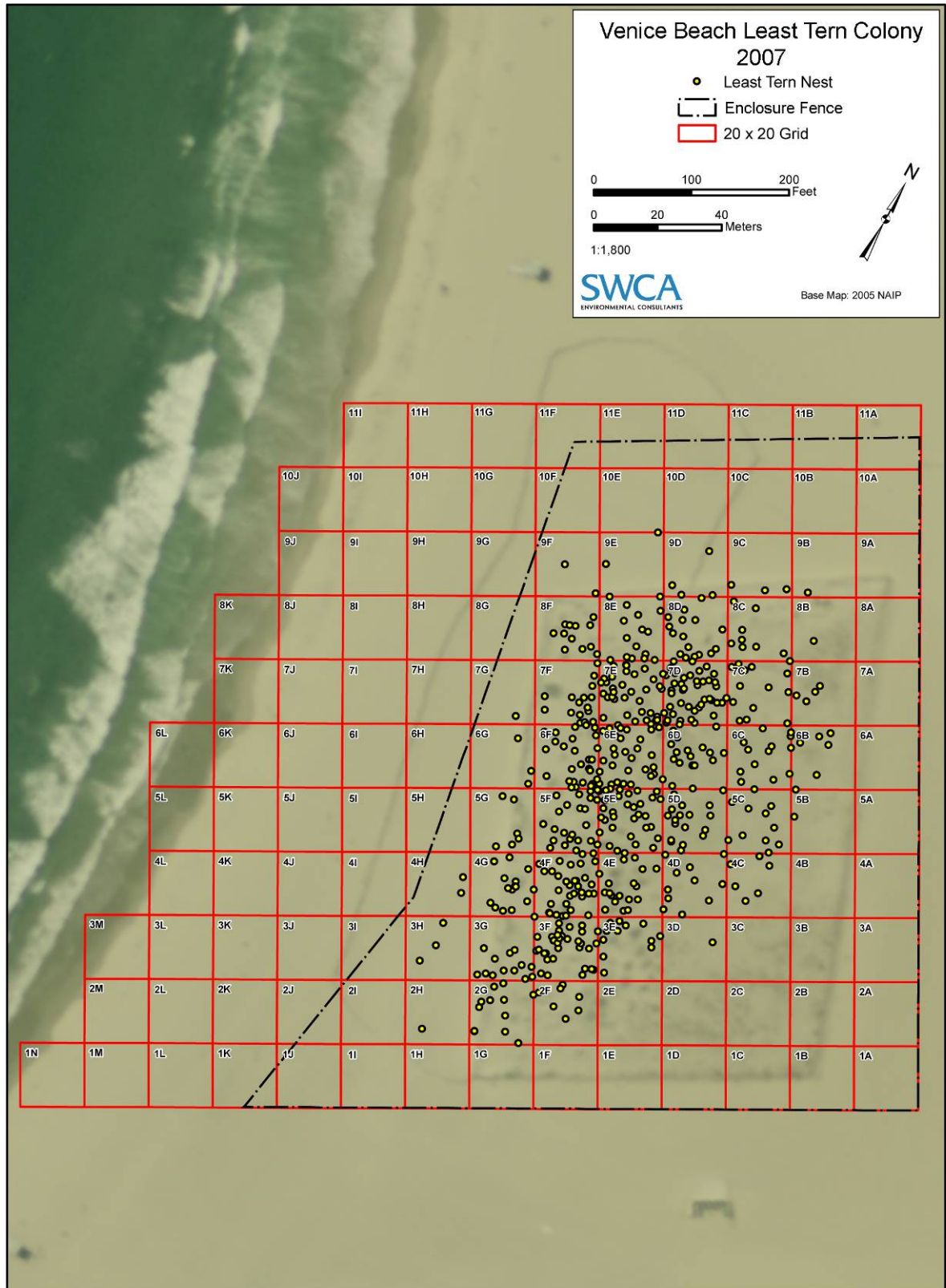


Figure 2. Map of the enclosure, study grid and locations of nests in 2007.

**Table 1. Summary of Least Tern Nesting and Productivity at the Venice Beach Nesting Site,
1977 to 2007.**

Year	Number of Pairs ^a	Percent of Statewide Pairs ^b	Number of Nests	Number of Fledglings	Fledglings Per Pair	Percent of Statewide Fledglings ^b
1976	Nesting site not active					
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	331	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	N/A	546	413	0.91	N/A

^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. The Venice Beach site is one of approximately 38 sites statewide.

N/A – not available

(Ryan and Taylor 2004, Ryan 2005)

Table 2. Summary of Least Tern Population Estimates in 2005–2007.

Month	Volunteer Population Estimate Peak (Average)			Biologists' Population Estimate			Number of Nests Present		
	2005	2006	2007	2005	2006	2007	2005	2006	2007
April	32 (17.1)	100 (17.0)	65 (45.4)	18	100	200	0	0	0
May	200 (84.7)	150 (63.4)	273 (86.6)	250	250	400	3	97	159
June	205 (35.5)	300 (151)	350 (221.4)	180	544	900	48	272	410
July	0	600 (241)	325 (205.7)	0	500	600	0	98	261
August	0	251 (146)	140 (79.0)	0	300	250	0	3	25

Table 3. Least Tern Breeding Statistics for Venice Beach, 2002-2007

Statistic	2007	2006	2005	2004	2003	2002
Total Nests	546	384	90	24	371	2
Estimated Re-nesting Least Terns	97	108	0	Unk.	23	0
Total Estimated Nesting Pairs ^a	453	276	105	24	348	0
Total Eggs	775	597	177^b	26	629	2
Mean Clutch Size (<i>mean eggs per nest</i>)	1.42	1.55	1.07 ^b	1.08	1.70	1
Number of Eggs Hatched	571	382	0	0	532	0
Hatching Success (<i>eggs hatched of total eggs</i>)	73.7%	64.0%	0	0	84.6%	0.0%
Eggs lost to Predators	110	123	177 ^b	26	24	2
Percent of Total Eggs Lost to Predators	14.2%	20.6%	100%	100%	3.8%	100%
Eggs abandoned and/or infertile	89	60	0	0	72	0
Percent of Total Eggs Abandoned/Infertile	11.5%	13.3%	0	0	11.4	0
Known Mortality (<i>dead chicks and fledglings</i>)	131	57	0	n/a	135	0
Percent Mortality (<i>of total chicks hatched</i>)	16.9%	14.9%	0	n/a	25.4%	0
First Fledgling count	121	23	0	0	41	0
Second Fledgling count	182	120	0	n/a	56	0
Third Fledgling count	111	85	0	n/a	84	0
Total Fledglings counted^c	414	266	0	0	181	0
Fledglings per Nest	0.76	0.69	0	0	0.49	0
Fledglings per Hatched Egg (<i>chick survival</i>)	0.73	0.70	0	n/a	0.34	0
Fledglings per Pair	0.91	0.96	0	0	0.52	0

^a The estimated number of pairs is the total number of nests, minus the estimated number of nests initiated by re-nesting 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 re-nesting after the loss of eggs and young to predation, abandonment and natural mortality, the estimated number of re-nesting Least Tern pairs at Venice Beach in 2007 is 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 re-nesting.

^b In 2005, 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 (177). 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 (n = 14).

^c See Methods section of text.

Table 4. American Crow Activity Near and Within the Least Tern Colony in 2005

	Avg. Observed			Flying Over Per Hr.			Landed Per Hr			Eggs/Chicks Predated Per Hr. (all)		
	2005	2006	2007	2005	2006	2007	2005	2006	2007	2005	2006	2007
April	5.0	3.8	1.3	3.5	4.0	1.1	2.2	1.6	0.5	0	0	0
May	5.1	3.6	2.6	2.5	3.4	1.5	1.6	1.6	1.6	0.1	0.1*	0.4
June	3.6	3.0	1.5	2.5	1.4	0.6	1.7	0.5	0.5	0.4	0	0.1
July	n/a	1.0	1.1	n/a	0.9	1.3	n/a	0	2.1	n/a	0	0.3
August	n/a	3.0	3.0	n/a	0.6	2.3	n/a	0.4	2.3	n/a	0	0.3

*John Trefts reported 18 eggs removed by american Crows over a 4-hour period on May 30, 2006 apart from the regular volunteer effort.

Table 5. Log of Helicopters Observed Flying Below 500 feet Over the Colony

Date & Time	Tail Number	Photo	Notes
4/27/07: 1830	N50120	N	grey
4/27/07: 1850	N230LA	N	LAPD
4/27/07: 1853			white with red strip, no number
4/30/07: 1803	N41SAT		dark charcoal
4/30/07: 1815	N338BP		black helicopter
5/1/07: 1800			KLOS radio helicopter
5/1/07: 1815	N338BP		black
5/7/07: 1300-1400	N21FFN		Skyfox 11
5/8/07: 0900	1N845S		
5/18/07: 1855	N83800		yellow with red stripe
5/25/07: 1717	N120LA		LA County Fire white and yellow
5/25/07: 1745	AR7KD		blue and yellow
5/28/07: 1707			L.A. fire dept
5/28/07: 1705			LA Sheriff
6/11/07: 1522			flying low over colony from s to n: flushed birds (dark grey with white and red stripes at belly)
6/12/07	N6655 N3055N 68855		wht/bl all blk wht/bl,
6/19/07			Least Terns frightened by LAPD chopper flying closely over colony
6/26/07			LAPD flew directly over enclosure
7/17/07	N25D..		all yellow, flushed LETEs
7/25/07			police helicopter
7/27/07	N97150		Sheriff flew directly over colony
7/27/07	N266LA		LAPD flew directly over colony
7/31/07			Yellow-green sheriff circled over colony n-s, s-n;

Bold denotes that it was also observed in 2005 and/or 2006.