

State of California
The Resources Agency
Department of Fish and Wildlife



**2012 Breeding Season Monitoring Results for
California Least Tern, *Sternula antillarum browni*,
at the Bolsa Chica Ecological Reserve**

by

Kelly M. O'Reilly
Environmental Scientist/Reserve Manager

and

Peter L. Knapp
Scientific Aide

California Department of Fish and Wildlife
South Coast Region, Lands Program
Bolsa Chica Ecological Reserve
Huntington Beach, CA
Kelly.O'Reilly@wildlife.ca.gov

Revised February 2013

INTRODUCTION

The goal of this report is to describe breeding season results for California least tern (*Sternula antillarum browni*) at the Bolsa Chica Ecological Reserve (BCER) as well as management actions taken by Department of Fish and Wildlife staff during 2012; and, to provide management recommendations for 2013.

BCER is located in Huntington Beach in Orange County, California. BCER is a coastal estuary with a number of different habitats including open water, mudflats, salt marsh, coastal dunes, seabird nesting islands, and freshwater marsh. The 585-hectare (1,445.5-acre) reserve is bordered on the north by Warner Avenue, on the west by Pacific Coast Highway (PCH) and the Bolsa Chica State Beach, on the south by Seapoint Avenue, and on the east by residential neighborhoods. The Department of Fish and Wildlife (Department) operates a small field office on the reserve located at 17783 Graham Street.

There are five seabird nesting sites at BCER: Two islands within Bolsa Bay known as North and South Tern Island, respectively; and three nesting areas within the Bolsa Chica lowlands: Nest Sites 1-3 (Figure 1). During 2012, California least terns (LETE) nested on Nest Sites 1-3 and South Tern Island (STI).



Figure 1. Seabird nesting sites at Bolsa Chica Ecological Reserve in Orange County. North Tern Island (NTI) and South Tern Island (STI) are in Inner Bolsa Bay, a muted tidal estuary. Nest Sites 1-3 (NS1, NS2, NS3) surround the Full Tidal Basin and are part of a restoration project completed August, 2006.

On NS1-NS3 and STI, LETE share nesting habitat with western snowy plover (*Charadrius alexandrinus nivosus*). Because North Tern Island (NTI) is used by large terns, LETE and plover nests, when initiated on NTI, are later

abandoned. Three large tern species migrate to BCER annually to breed. These species include elegant tern (*Thalasseus elegans*) which breeds on NTI in large numbers (<20,000 pair) and is listed internationally as Near Threatened (IUCN); and Caspian tern (*Hydroprogne caspia*) and Royal tern (*Thalasseus maximus*) which each breed on NTI and NS1 in relatively small numbers (<100 pairs). Over the years, the black skimmer (*Rynchops niger*), a California Species of Special Concern, has nested on NTI, STI, and NS1.

Forster's terns (*Sterna forsteri*) nest on the pickleweed (*Salicornia spp.*) that grows on the western perimeter of NTI and within Bolsa Bay. Four other tern species have been observed at BCER, but do not breed here: the gull-billed tern (*Gelochelidon nilotica*) – another California species of Special Concern and a candidate for Federal Listing; the sooty tern (*Onychoprion fuscatus*); the common tern (*Sterna hirundo*); and, the black tern (*Chlidonias niger*).

Department staff record observations of large terns and skimmers throughout the breeding season. When these larger birds establish colonies on NS1, impacts to least tern and plover may occur due to interspecies competition for nesting space.

On 3 March 2012, the first elegant terns (ELTE) began to arrive at Bolsa Chica. By 2 April, ELTE on NTI numbered ~1,000 and there were 50 Caspian terns (CATE). A peregrine falcon disturbed the terns on NTI during April and this caused most of the ELTE to move from Bolsa Chica to the Port of Los Angeles. Approximately 300 ELTE nested on NTI during 2012.

The first black skimmer (BLSK) arrived on 7 May and by 18 May they numbered ~300 on NTI. By 25 May, BLSK numbered at least 400 and had begun to nest on NTI. CATE had 79 nests on NTI and ~40 royal tern (ROTE) nests were mixed in with the main ELTE colony on central NTI. ROTE had at least 4 chicks and the nest count for ELTE was 168 with at least 30 chicks. On 8 June, BLSK nests numbered 180 and most were still incomplete clutches (typical BLSK clutch size is 4-5 eggs).

By August 1st, the breeding season for large terns was essentially finished; most of their chicks had fledged and few remained on NTI. In contrast, BLSK still numbered more than 200 adults with a few large chicks. For unknown reasons, BLSK produced no fledglings at Bolsa Chica during 2012.

METHODS

Site Preparation

Each of the seabird nest sites on the reserve (Figure 1) were prepared for the season by CDFW staff and volunteers. This work was conducted September 2011 through January 2012. Methods included treating non-native vegetation with herbicides and manually removing non-native plants from each nest site. Overall, the goal was to have not more than 15-20% vegetative cover so as to leave enough open space for nesting.

In an effort to standardize monitoring methods within and between reserves, CDFW is moving to a standard grid size on all its nesting sites: 20m X

20m (400m²). During 2012, new number-letter grid systems marked by painted wooden stakes were installed on Nest Sites 2 and 3 with 20m X 20m grids. The grid system created in 2006 on NS1 has grids that are 27m X 27m (729m²). At the completion of the 2013 nesting season, the grid design on NS1 will be revised to be comparable with the other sites' grid systems.

Because each nest site has different surface areas and shapes, the number of grids on each site varies. The surface area of NS1 is 6.0ha. NS2 has a surface area of approximately 0.48ha and the area of NS3 is approximately 1.28ha. The surface areas reported here are for usable nesting habitat and do not include edges or slopes that normally would not support nesting.

Based on measurements we made of the usable nesting habitat area on STI, the calculated surface area of that site is 0.46ha. During 2012, the grids on STI were not 20m X 20m; however, that grid system will be revised for the 2013 nesting season. On STI, labeled roof tiles form a grid system for data collection.

Since NTI is used by large tern species and not LETE, there is no grid system installed on that island. Nonetheless, the usable nesting habitat on that site was measured and the calculated surface area is 0.77ha.

Clay roof tiles were used as potential chick refugia on NS1 (n=40), NS2 (n=2), NS3 (n=4) and STI (n=55). On the north end of NS1, the tiles were painted black and white and arranged so as to assist Eyes On Nest Site (EONS) volunteers in the identification of nest locations.

During the 2012 breeding season, only NS1 was protected by fencing. Unfortunately, coyote (*Canis latrans*) did get around the ends of the fence during low tide and coyote predation was also high on NS2 and NS3. To deter black skimmers from nesting on STI, two scarecrows were used at each end of the island.

Thanks to NGOs (Amigos de Bolsa Chica and the Bolsa Chica Conservancy) that funded the construction, fence extensions were installed during January 2013 at three locations on NS1 where coyote and possibly dogs had accessed it. In addition, a gated fence was installed surrounding the entire base of NS3.

Monitoring

The monitoring method used on Nest Sites 1-3 and STI is categorized as Type 1: Monitors entered the colony weekly to mark nests and record the number of eggs and chicks observed during each visit. Monitors also recorded any evidence of disturbance such as predation. Each nest was marked with a pair of numbered tongue depressors (Figure 2).

When a nest appeared to be unattended by adult LETE, the egg or eggs were turned up in the nest and an up arrow (↑) was recorded next the nest number. If the egg(s) remained up for three consecutive monitoring visits, the nest was record as "A" for abandoned. Once eggs were known to be abandoned, they were buried so they would not attract predator species. (Beginning 2013, abandoned eggs will be collected for isotope/heavy metal studies.)

As mentioned above, each nesting site has a number-letter grid system used to identify the location of individual nests.

In addition to weekly monitoring visits, NS1, NS3, and STI were monitored daily from a vehicle using binoculars and NS2 was monitored daily from the nearest levee using a spotting scope.

At least weekly, NTI was checked from a distance using a spotting scope (Type 2 method). No LETE nests were initiated on NTI.



Figure 2a & 2b. California least tern nests marked with numbered tongue depressors. Photos by Connie Boardman (left) and Ross Griswold (right).

For each breeding season, the number of breeding pair was estimated by using actual counts of birds as nests were initiated. The fledgling count reported for 2012 was based on field observations made by the primary monitor. Because LETE fledglings may leave Bolsa Chica within hours or days of fledging and are not banded, accurate fledgling counts are difficult, if not impossible, to estimate.

Predator Management

Due to the high number of predator species at BCER and the level of mortality they can inflict upon least tern as well as western snowy plover, predator control is an essential management tool for the recovery of these species' populations. The goal of predator management is to identify species known to prey upon least tern and plover eggs, chicks, and adults and prevent mortality by those predators during the breeding season. At Bolsa Chica, at least 20 species are known or suspected predators of LETE.

CDFW employs a predator management specialist, Wally Ross, who patrolled BCER a total of 148 hours over 53 days between March and July, 2012. During his visits, W. Ross noted the activities of least tern and plover, predator species and or their tracks and scat. In an effort to condition predators to avoid the eggs of birds on NS1 and NS3, he set out decoy nests. Each decoy nest consisted of 3-4 quail eggs that had been filled with a foul-tasting, non-lethal substance.

Because Bolsa Chica staff were not permitted to band raptors at Bolsa Chica, no birds were trapped or relocated during 2012. A total of five (5) common

ravens (*Corvus corax*) and one (1) black-crowned night heron (*Nycticorax nycticorax*) were removed by predator management.

Other staff used additional means of predator control and these included patching holes dug underneath the perimeter fence to prevent encroachment from domestic pets from neighboring housing tracts and shooing predators away from nesting areas (the later was not effective).

RESULTS AND DISCUSSION

Monitors

During the 2012 breeding season, LETE activity was monitored primarily by Peter Knapp. Knapp was assisted by Ross Griswold, Kelly O'Reilly, Gary Keller and Wally Ross.

Chronology

The first LETE of the season were observed flying over NS1 on 15 April. The first nest of the season was found on NS1 on 8 May. The last nest of the season was found 26 June on STI. Hatching was recorded 31 May through 7 June. Bolsa Chica had no second wave of nesting. The first fledgling was recorded 1 July on STI. The last least terns of the 2012 season were observed foraging over Cell 46 in the Central Muted Tidal Basin on 25 July.

Data Summary

A total of 305 nests were initiated by 305 pair of LETE. Of the 527 eggs laid, up to 26% hatched. Only 16 chicks survived to fledgling age (Table 1, Figure 3). More nests were depredated (158) than hatched (min=81, max=137) (Table 1). Each nesting site had from 2 to 3 abandoned eggs for a reserve-wide total of 10 (Table 1). There were six 3-egg clutches, 462 2-egg clutches and 59 1-egg clutches.

Table 1. Summary of California Least Tern Breeding Activity at the Bolsa Chica Ecological Reserve during 2012. Data include the number of nests hatched (H); nests that probably hatched (PH); eggs; chicks; nests predated (P); nests abandoned (A); total nests; and, observed fledglings for each nesting site: South Tern Island and Nests Sites 1-3.

Nest Site	Nest H	Nest PH	Eggs	Chicks	Nests P	Nests A	Total Nests	Fledglings
STI	41	5	94	80	7	3	56	15
NS1	20	25	306	86	129	2	176	1
NS2	17	12	82	53	14	3	46	0
NS3	3	14	45	29	8	2	27	0
BCER ALL	81	56	527	248	158	10	305	16

Summary by Nest Site
South Tern Island (STI)

Table 2. Counts of new and active nests during each survey made on South Tern Island.

Survey Date	New Nests	Active Nests
8-May-12	14	14
15-May-12	12	26
22-May-12	15	40
29-May-12	4	36
5-Jun-12	5	24
12-Jun-12	3	15
19-Jun-12	2	13
26-Jun-12	1	10
3-Jul-12	0	0

The first nests on STI were found during the first week of May. By 8 May there were 14 nests and nest initiations peaked during the later half of May (Table 2). The first chicks were seen at the end of May with no sign of any predation of eggs or chicks. However, during mid June, red-tailed hawks were seen taking an unknown number of chicks from STI and the last six nests initiated on this site during June were depredated. Ravens were also suspected to have impacted STI.

On 5 June, a dead adult LETE was found in nest #6 with no sign of external trauma on its body. The deceased bird wore USFWS band #1841/74593. According to Dr. Charles Collins, this tern was banded at the Port of Los Angeles on 2 July 2003 by Kathy Keane. By the time we found this tern, its nest had produced two chicks (from a two-egg clutch).

A total of 56 nests were initiated on STI, producing an estimated 80 chicks (Table 1 and Figure 3); however 4 dead chicks were found between 12 June and 3 July. The first fledglings were seen on 15 June and 15 fledglings came from STI. With the exception of one fledgling from NS1, these were all the LETE fledglings produced at Bolsa Chica during 2012.

Nest Site 1 (NS1)

Table 3. Counts of new and active nests during each survey made on Nest Site 1.

Survey Date	New Nests	Active Nests
8-May-12	85	85
15-May-12	32	64
22-May-12	20	53
29-May-12	21	51
5-Jun-12	8	41
12-Jun-12	4	19
19-Jun-12	1	1

By 8 May there were 85 nests established on NS1 and that was the peak number for the season. Between 8th and 15th May, extensive coyote predation

took place on this site. Aversion nests were created by predator management in an effort to thwart additional predation, but continued coyote presence was evident on successive surveys. By the end of May, gull tracks were also evident at a number of nests. By 12 June, there were only 19 active nests (Table 3) and a red-tailed hawk had been seen hunting on NS1, taking an unknown number of chicks.

A total of 176 nests were initiated on NS1 producing an estimated 86 chicks but only one verified fledgling (Table 1 and Figure 3). The dramatic impact on LETE production on NS1 by predators is illustrated in Table 3 which shows the highest number of active nests during the first survey and declines in active nests on each successive survey. In the absence of predation, NS1 would most likely have had far and away the highest productivity on the reserve.

Nest Site 2 (NS2)

Table 4. Counts of new and active nests during each survey made on Nest Site 2.

Survey Date	New Nests	Active Nests
17-May-12	13	13
24-May-12	19	32
31-May-12	5	37
7-Jun-12	3	27
14-Jun-12	4	4
21-Jun-12	3	4
26-Jun-12	0	1
3-Jul-12	0	0

By the end of May, 37 nests had been initiated on NS2 with no signs of either egg or chick predation. However, between 7th and 14th June, Coyote attacks were evident and by 14th June only 4 nests were active (Table 4). A total of 46 nests were initiated on the site, producing 53 chicks (Table 1 and Figure 3); yet no fledglings were produced. All predation was attributed to coyote.

Nest Site 3 (NS3)

Table 5. Counts of new and active nests during each survey made on Nest Site 3.

Survey Date	New Nests	Active Nests
17-May-12	6	6
24-May-12	16	22
31-May-12	3	24
7-Jun-12	1	19
14-Jun-12	1	2
21-Jun-12	0	2*

(*nests likely abandoned)

This site produced 27 nests (Table 1 and Figure 3) and all were predated or likely abandoned by 21 June (Table 5). Coyote and raven tracks were wide spread throughout the site. This site produced no fledglings.

Documented Predation

Given the low number of observed fledglings and abundant coyote signs left on Nest Sites 1-3, we are confident that actual predation was considerably higher than documented predation (Table 6). Egg losses were documented on Nest Sites 1-3 and attributed to coyote (18+ eggs) and corvids—likely ravens (5+ eggs). Documentation was based on coyote or corvid tracks next to nests, field observations of corvids by monitors and peck marks on some damaged eggs.

Suspected predators included: opossum (*Didelphis virginiana*), American kestrel (*Falco sparverius*), red-tailed hawk (*Buteo jamaicensis*) and gulls (*Larus ssp.*) (Table 6). A red-tailed hawk (RETH) was seen near and on STI and this caused a great deal of disturbance to LETE nesting there. Thus, this species was likely responsible for LETE nest failures later in the season on STI. A RETH was also seen disturbing nesting terns and plovers on the north end of NS1.

Table 6. Possible (P), suspected (S) and documented (D) predators of California least tern at each Bolsa Chica Ecological Reserve nest site during 2012.

Predator Species	STI	NS1	NS2	NS3
American Kestrel	P	S	P	P
Ants	P	P		
Black-crowned Night Heron	P	P	P	
CA Ground Squirrel		P		
Cooper's Hawk	P	P	P	P
Corvids	S	D	D-3eggs	D-2eggs
Coyote	P	D	D-14eggs	D-4eggs
Crow	P	P	P	P
Gull	P	S	P	
Horned Lark		P		
Northern Harrier	P	P	P	
Opossum	P	S		
Raccoon		P	P	P
Raven	S	S	S	S
Red-tailed Hawk	S	S	P	P
Snakes		P		
Starling		P		

Discussion

In 2012, we saw an encouraging increase in breeding pair (n=305) of LETE compared to the low of 80 breeding pair experienced the previous year (Figure 6). However, although the number of nests (n=305) increased by 45% in 2012 compared to 2011 (n=167) (Figure 3 and 4), the number of fledglings (n=16) decreased by 76% - 83% compared to last year (n=66-95) (Figure 5). Whereas the 2011 fledgling/pair estimate was 0.8 – 1.2, in 2012, it was an abysmal 0.05.

Predation, especially by coyote had a tremendous impact during 2012. Corvids and raptors also had an impact on LETE productivity. Although

additional fencing is planned to protect nests on Nest Sites 1 and 3, we do not have a good solution for depredation on NS2 and additional fencing will not protect LETE and western snowy plover from avian predators at any of the sites. No attempts were made during 2012, or are planned during 2013, to remove coyote from Bolsa Chica because such attempts are not expected to be successful. Not only are coyotes numerous in the area, their presence on the reserve controls other predators such as raccoon and domestic cats.

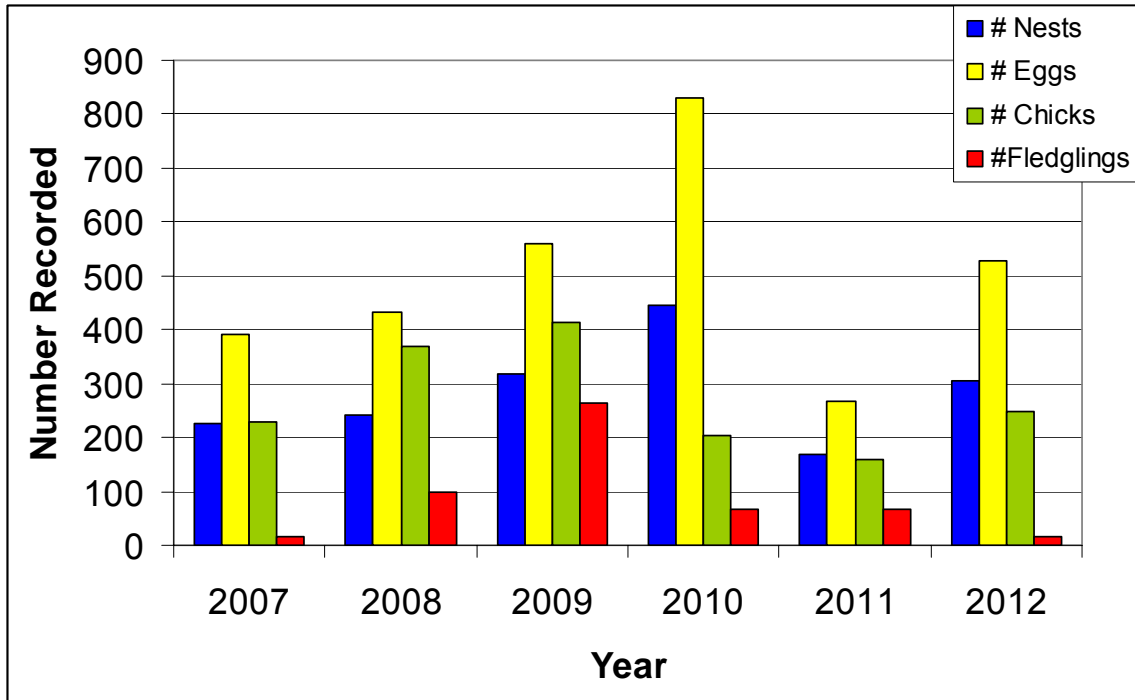


Figure 3. California least tern breeding success from 2007 to 2012 at the Bolsa Chica Ecological Reserve.

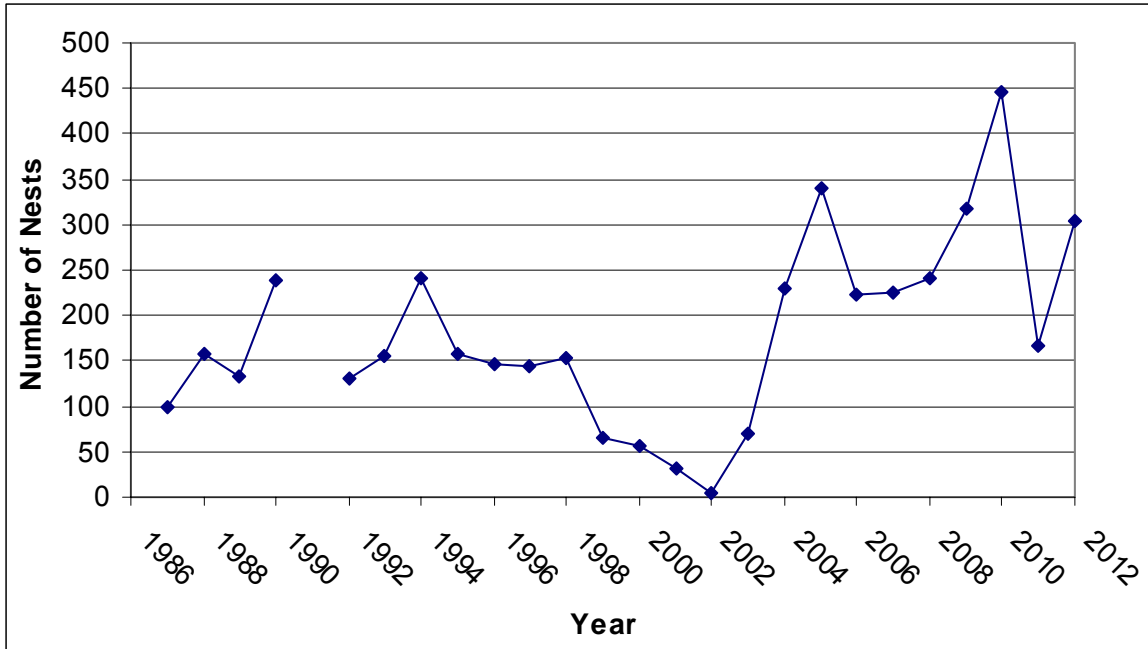


Figure 4. Annual California least tern nest totals at Bolsa Chica, 1986 to 2012 (no data for 1991).

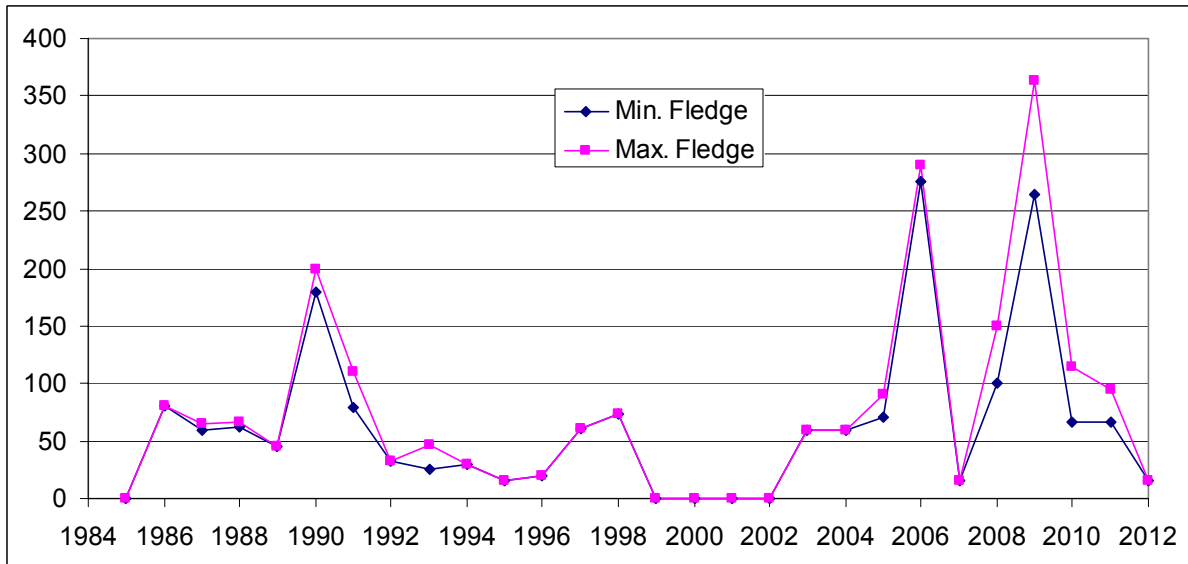


Figure 5. Annual minimum (blue diamonds) and maximum (pink squares) fledging estimates for California least tern at Bolsa Chica, 1984 – 2012.

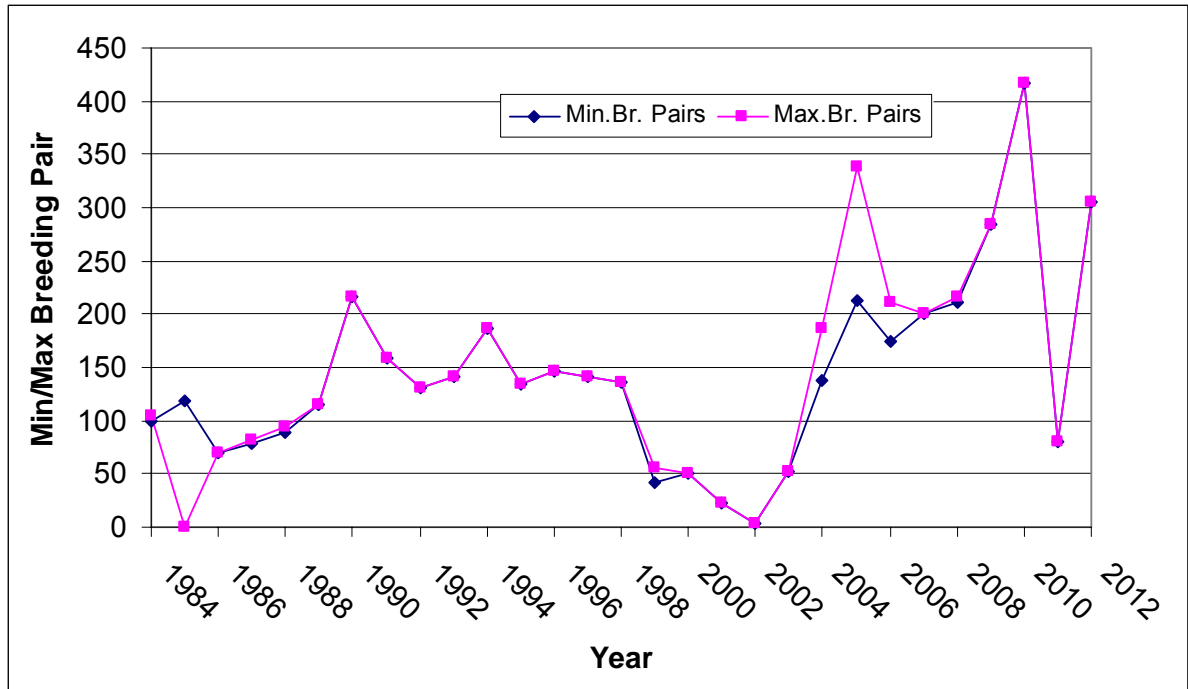


Figure 6. Annual minimum (blue diamonds) and maximum (pink squares) breeding pair estimates for California least tern at Bolsa Chica, 1984 – 2012.

Recommendations for the 2013 Season

To increase breeding success of LETE at Bolsa Chica, we recommend the following actions for 2013:

1. Surround Nest Site 3 with fencing to prevent predation by coyote and other potential predators (e.g. domestic dogs and cats, raccoons, opossums and skunks). Note: This action was suggested for seasons 2011 and 2012; however, funds were not available until the end of 2012.
2. Install extensions to fences protecting the north and south ends of NS1. Note: Along with Action 1 above, funding became available and the installation of three fence extensions during January 2012 is planned.
3. Continue to control vegetation on all nest sites.
4. Increase the number of hours per month of predator monitoring and management during and leading up to the nesting season.
5. Continue using scare crows to deter skimmer and other large tern species from nesting on South Tern Island and other sites as needed.
6. Continue using decoy terns on NTI to encourage large terns to nest there rather than on NS1.
7. Continue the use of aversion nests on the nest sites to discourage egg eating by predators.
8. Continue to monitor the perimeter fence line and seal all holes to exclude domestic animals.



Least tern chick, Ross Griswold.

AKNOLWEDGEMENTS

The authors wish to express their gratitude to R. Griswold and G. Keller for their help with monitoring and W. Ross for performing predator management. We also thank the Eye On Nest Sites (EONS) volunteers who made observations of nesting activity on the northern end of NS1 during 2012.

REFERENCES

O'Reilly, K. and P. Knapp. 2011. Internal report: 2011 annual breeding season monitoring results for the California least tern, *Sternula antillarum browni*, at Bolsa Chica Ecological Reserve. 10 pp.