Continued Nesting of California Least Terns in Sacramento County, California

Chris Conard, 2405 Rio Bravo Circle, Sacramento, CA 95826.
conardc@gmail.com

I previously reported on the 2008 and 2009 breeding activity and nesting behavior of the federally endangered California Least Tern (*Sternula antillarum browni*) at the Sacramento Regional Wastewater Treatment Plant (SRWTP; Conard 2009). That paper documented the first breeding record of the species in Sacramento County and the only documented nesting in the Sacramento Valley away from the adjacent Sacramento-San Joaquin Delta. This paper provides an update on the species' nesting status at the SRWTP through the 2017 season and discusses factors that have affected nesting success, as well as the relationship of this site to others in the region.

STUDY AREA

The SRWTP consists of sewage treatment facilities, including several solids storage basins (SSBs), and the surrounding Bufferlands. Each battery of SSBs consists of between four and eight sewer ponds and gravel levee access roads surrounded by four-meter-high metal walls that likely deter mammalian predators and provide some protection from the wind.

The Bufferlands is a 1,012-hectare (2,500-ac) open space buffer surrounding the SRWTP (Conard 2007). It supports a mix of grassland to the east and southeast of the SSBs, with seasonal wetlands and riparian forest in most of the western and northern portions of the property. Three constructed ponds are within 1,000 m (3,000 ft) of the nest site. Two of the ponds, one 7.5 hectares (19 ac) and one 11 hectares (28 ac) in size, are borrow pits from the original construction of Interstate 5. The third is a 5-hectare (12-ac) remnant agricultural pond (Conard 2007).

METHODS

Over the 2008-2017 study period, Bufferlands management staff monitored the SSBs as part of their various habitat management and monitoring duties at SRWTP. Because the Least Terns nested in the middle of a busy wastewater treatment plant, Bufferlands staff balanced recommendations for road closures near potential and known tern nest sites with the functioning of the plant. The main focus of nest site monitoring was to protect the terns from traffic on the gravel roads where nesting occurred. Beginning in late April, Bufferlands staff checked for the presence of Least Terns at SSB 2 several times per week by slowly driving roads and scanning with binoculars.

Likely nesting areas were indicated by the terns returning to the same site repeatedly and often aggressively interacting with other birds in the area by calling and diving at them. Tern breeding also was indicated by detections of birds flying near potential nest locations as well as roosting on roads or infrastructure, including metal railings on walkways and floating aeration equipment. Observed behavior preceding nesting included copulation, mate feeding, and synchronized side to side bill movements. When it appeared that terns selected a portion of road for nesting, we coordinated with SRWTP staff to close the road to vehicle traffic and personnel.

We monitored detected nests at least twice a week using a spotting scope from about 50 m away. We recorded timing and duration of nesting activities, foraging behavior, nesting success, and where possible, survival of fledglings.

RESULTS

Nesting Occurrence and Success

Least Terns were observed during the breeding season at the SRWTP during nine of 10 years between 2008 and 2017, and a single pair attempted to nest in eight of those years (Table 1). The terns fledged 10 young during the five years in which nesting was successful. The most successful period of nesting at SRWTP was during 2009 to 2011, when six of the 10 fledged young were produced. Multiple nesting attempts occurred only in 2012, both of which resulted in nest failure. Of the 10 fledged young, nine were observed flying with the adults for several days after first flight. Only in 2015 did one of the fledglings disappear shortly after first flight was observed, leading us to believe it had probably been captured by a predator.

Nesting Habitat and Protection

All Least Tern nesting activity at SRWTP occurred on gravel access roads between sewer ponds near the middle of the 28-hectare (70-ac) SSB 2 (Figures 1 and 2). All nest scrapes were within 200 meters of each other. The terns occasionally roosted in the adjacent 14-hectare (35-acre) SSB 3, though they haven't been found in the 18-hectare (45-ac) SSB 1 that is 500 meters to the north. Terns were observed foraging and capturing small fish in the three ponds on the Bufferlands near SSB 2.

Except for the 2016 season, we were able to identify a likely nest site and close the section of road where it appeared they were going to nest. Despite our efforts to detect and protect the nest sites early, in 2016 the first detection was of an adult already incubating on 22 May discovered by the SSB operations manager (Randy Price, pers. comm.).

Timing of Breeding Activity

During 2008 through 2017, the date of first Least Tern detection at SRWTP varied widely, from 8 May to 5 July, and the date of first documented incubation has ranged from 19 May to 12 July (Table 1). A single pair of Least Terns nested in eight of the 10 years in this period. In 2013, Least Terns were only detected for two days, and in 2014 they were never observed.

Nesting Observations

Our observations suggest that predation was a major cause of nest failure. In 2012, I found a likely territory and worked with SRWTP staff to close the road, and an adult tern began incubating on 16 June. At least one egg was seen on 20 June when the adults switched places on the nest, but they were off the nest on 21 June and there was no further sign of the egg. The adults, however, occupied a new nest site nearby on 27 June and hatched two chicks by 19 July. Only one chick was detected on 22 July, and by 25 July both chicks were gone. The adults stayed in the area through 7 August. Possible nest predators included coyotes (*Canis latrans*), which had been seen inside the facility during the nesting season, and various raptors. Swainson's Hawks (*Buteo swainsoni*) were often seen near the nest site and were chased by the terns, but no direct predation was observed. During the period when the two Least Tern nests failed, half-grown chicks of Black-necked Stilts (*Himantopus mexicanus*) and American Avocets (*Recurvirostra americana*) also disappeared, suggesting regular visits by predators.

Figure 1. Least Tern adult and chick (Sternula antillarum browni), 13 June 2017. Sacramento Regional Wastewater Treatment Plant, Sacramento Co., California. *Photo © Chris Conard*

Five consecutive years of nesting attempts ended in 2013. The season started with promise, when four adults were seen on 28 June near the previous nest locations in SSB 2. We observed only one tern on 29 June and none thereafter that year, or in all of 2014. The causes of early abandonment in 2013 and complete absence in 2014 are unknown.

In 2015, we first detected a pair on the late date of 5 July, and found a nest on 12 July, representing the latest first detection and latest documented nesting at SRWTP. On 17 August 2015, two chicks fledged and were making short, clumsy flights, with their bodies sagging well below the plane of their wings. Only one fledgling was seen after 19 August. A Peregrine Falcon (*Falco peregrinus*) was regularly in the area and could have easily captured one of the awkward fledglings. On 21 August, a Peregrine Falcon flew rapidly through the nesting area still frequented by the terns, causing them to circle and fly about calling for at least ten minutes before settling. On 24 August 2015, the two adults and the remaining fledged young were foraging over Black Crown Lake, the 11-hectare borrow pit, and by this time the young bird appeared nearly as agile in the air as its parents.

Two young terns fledged in 2016 and both developed into strong flyers. In 2017, three chicks hatched by 12 June, but all were gone by 15 June, presumably taken by predators.

Figure 2. Least Tern nestling (Sternula antillarum browni). 26 July 2016. Sacramento Regional Wastewater Treatment Plant, Sacramento Co., California.
Photo © Chris Conard

Table 1. Timing of Least Tern detections, nesting stages and nesting success at SRWTP, 2008-2017.

Year	First Adult Detection (and #)	First Eggs (#)	Date Chicks First Observed (#)	Fledged Date (#)	Last detection (# and age)
2008	27 Jun (2)	1 Jul (2)	Unhatched	n/a	5 Aug (2 ad)
2009	29 May (2)	3 Jun (3)	24 Jun (3)	13 Jul (2)	7 Aug (1 ad)
2010	27 May (1)	10 Jun (1)	5 Jul (1)	28 Jul (1)	24 Aug (1 ad)
2011	31 May (1)	14 Jun (3)	6 Jul (3)	26 Jul (3)	12 Aug
2012	21 May (1)	16 Jun (1+) 1st attempt	Failed by 21 Jun	n/a	See below
2012	Continuing	27 Jun (2) 2ndattempt	19 Jul (2)	Assumed predation (0)	7 Aug (2 ad)
2013	28 Jun (4)	No nest	none	n/a	29 Jun (1 ad)
2014	Undetected	n/a	none	n/a	n/a
2015	5 Jul (2)	12 Jul (2)	30 Jul (2)	17 Aug (2)	1 Sep (1 juv)
2016	22 May (2)*	22 May (2)	13 Jun (2)	30 Jun (2)	29 Jul (1 ad)
2017	8 May (2)	19 May (3)	12 Jun (3); Last seen 14 Jun	Assumed predation (0)	22 Jun (2 ad)

Although the terns were aggressive toward potential predators or other species approaching their nest site, at less than 50 grams (2 ounces) weight they were mostly ignored despite their loud calls and close dives. For example, on the morning of 3 August 2015, one of the adults was brooding the two very small but mobile chicks about a meter from the nest scrape. Three nearly full-grown Mallards (*Anas platyrhynchos*) walked up to the brooding site as if they might walk right over the terns. Both adult terns began diving at the ducks and calling, but the ducks continued on their way. As the diving intensified, one duck became aggressive and pecked at the diving terns and charged after one of the adults, nearly walking on one of the chicks. The duck appeared to notice the chick and looked to be about to peck at it, but was distracted by the dive of an adult, demonstrating that the dives were not completely ineffectual. The chicks clumsily fled about six meters (20 ft) away. Once the ducks moved off, relative peace resumed, with the chicks

returning to the side of one of the adults. The non-brooding adult periodically flew close to the ducks and made loud, piercing calls as the ducks stood at the edge of the water and groomed, behaving as if the tern wasn't there. I captured much of this interaction on video (https://www.flickr.com/photos/conardc/40411935345).

DISCUSSION

The 2008 arrival of Least Terns at SRWTP coincided with a dramatic rise in breeding pairs in the state. With the protection of nesting sites, numbers climbed from fewer than 500 pairs in the early 1970s to around 1,000 in the early 1990s and to around 4,000 pairs by 2000. They continued to rise to around 7,000 pairs from 2003 to 2010, and then fell to around 4,000 from 2012 to 2016 (Frost 2017).

The most recent published statewide California Least Tern breeding population is for the 2016 season, which documented 4,746 nests and between 3,989-4,661 pairs, including the one at SRWTP. Nearly all nesting has occurred along the coast or at estuaries, and all but 578 (12%) were in Southern California. There were 2016 reports from six Northern California sites, with 403 nests at Alameda Point, 88 at Hayward Regional Shoreline, 79 at Napa Sonoma Marsh, six at Montezuma Wetlands, one at the Pittsburg Power Plant, and one at SRWTP (Frost 2017).

Most of the nesting attempts at SRWTP are late compared to the coastal colonies, which usually begin their first nesting in May (Frost 2017). SRWTP nesters could be young birds or part of a second round of nesting (Conard 2009), but because the birds are not marked or readily distinguishable by age after their first year, it is impossible to know. Given the distance of over 50 km (30 mi) from the nearest breeding site at Montezuma Wetlands, Solano County, it seems likely that one or both members of the pair are returning to SRWTP rather than representing new colonizations; Least Terns can live for over 20 years (Thompson et al. 1997). Since 2010, when one pair nested at the Kettleman City Evaporation Ponds in Kings County, the Least Terns at SRWTP have been the only pair documented nesting in the Central Valley (Marschalek 2011).

Predation of eggs and young, while not directly observed, appears to be the main cause of nest failure at the SRWTP site. Swainson's Hawks and Northern Harriers (*Circus hudsonius*) regularly fly close to the nest site, triggering noisy chases by the adult terns that appear to be mostly ignored by the raptors. Common Ravens (*Corvus corax*) also have been regular summer residents on the SRWTP property since 2015; they were first documented nesting on the Bufferlands in 2016. I have observed ravens systematically flying low and checking the edges of the sewer ponds—surely a threat to any egg or unfledged shorebird or tern.

Previously I speculated that Least Terns might nest at other sites in the Sacramento Valley (Conard 2009). Although no nesting has been reported at other sites, new colonization still seems reasonable, given the terns' occasional appearances at apparently suitable locations. Since 2009, Least Terns have been detected at White Slough WTP, near Lodi in northern San Joaquin County, on 7 August 2011; along East Levee Rd in Natomas, Sacramento County, on 4 July 2012; at the Chico WTP in July of both 2014 and 2015, with two birds present on 8 July 2014; at the Yolo Bypass Wildlife Area on 4 June 2015; and from the Woodland WTP on 17 July 2015 (eBird data).

An impediment to potential nesting success at other sites is the vulnerability of nest sites and chicks to traffic on roads in busy sites such as SRWTP. Unlike Killdeer, stilts, and avocets, which usually nest on the edges of the roads in the SSBs, the Least Terns have each time nested well into the roadway and in immediate danger from the first vehicle to drive by. In its favor, SRWTP has a natural resource staff able to work with plant operations to create conditions where the terns can successfully nest. Replicating this at other sites requires considerable awareness of the terns and a willingness to postpone or divert operations. Successful nesting sites must allow the terns to select a site and nest, and then the hatched young must be closely watched, because after a few days they can wander tens of meters and later flutter into danger before fully fledged.

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Least Tern breeding pair (Sternula antillarum browni). 5 July 2015. Sacramento Regional Wastewater Treatment Plant, Sacramento Co., California.

Photo © Chris Conard