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BREEDING LARIDS OF THE SALTON SEA: TRENDS IN POPULATION SIZE AND COLONY SITE OCCUPATION

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Abstract. The Salton Sea, a large saline lake in southeastern California, and its surrounding agricultural lands and wetlands are rapidly becoming recognized as important habitats for migratory and resident birds in western North America. Apart from early ornithological explorations, little published information exists on the breeding of colonial waterbirds there. From 1991 through 2001, I surveyed suitable nesting habitat for breeding larids at the Salton Sea, and from 1992 through 2001 I estimated their population sizes. Composed of six species, this community regularly includes California Gulls (*Larus californicus*), Gull-billed (*Sterna nilotica*) and Caspian (*S. caspia*) terns, and Black Skimmers (*Rynchops niger*). Up to 20 pairs of Forster's Terns (*S. forsteri*) nest in some years and several pairs of Laughing Gulls (*L. atricilla*) have become regular breeders. Of the five species that nested regularly, the mean annual number of breeding pairs of Laughing and California gulls was 1 and 32, that of Gull-billed and Caspian terns was 119 and 480, respectively, and that of Black Skimmers was 360 pairs. Colony site availability and occupancy by breeding larids was variable between years, with a total of nine sites used over the study period. With growing populations of breeding gulls and abundant populations of breeding and roosting Double-crested Cormorants (*Phalacrocorax auritus*), the site occupancy of smaller species such as the Gull-billed Tern and Black Skimmer is now restricted to a fraction of the few existing sites. However, these two species have readily colonized newly available habitats, suggesting that their populations would benefit immediately from the creation of additional nest sites. Any plan to restore wildlife habitat at the Salton Sea should include the creation of nesting habitat suitable for breeding larids.

Key Words: breeding population trends; gulls; Laridae; skimmers; Salton Sea; terns.

LÁRIDOS ANIDANTES DEL MAR SALTON: TENDENCIAS EN TAMAÑO POBLACIONAL Y OCUPACIÓN DEL SITIO DE LA COLONIA

Resumen. El Mar Salton, un lago salino extenso en el sureste de California, y los campos agrícolas y ciénegas que lo rodean, están siendo reconocidos rápidamente como hábitats importantes para las aves residentes y migratorias del oeste de Norteamérica. Aparte de las primeras exploraciones ornitológicas, existe muy poca información publicada sobre la reproducción de las aves acuáticas coloniales en este lugar. De 1991 al 2001, se buscaron en el Mar Salton, todos los sitios potenciales adecuados para la anidación de láridos, y de 1992 al 2001 se estimaron sus tamaños poblacionales. La comunidad de aves acuáticas estuvo compuesta por seis especies que incluye regularmente a la Gaviota Californiana (*Larus californicus*), a los Charrán Pico Grueso (*Sterna nilotica*) y Caspio (*S. caspia*), y al Rayador Americano (*Rynchops niger*). Hasta 20 parejas del Charrán de Forster (*S. fosteri*) anidan en algunos años y varias parejas de la Gaviota Reidora (*Larus atricilla*) se han convertido en anidantes regulares. De las cinco especies que anidaron regularmente, el número anual promedio de parejas reproductoras de las Gaviotas Californiana y Reidora fue de 1 y 32, para los Charrán Pico Grueso y Caspio fue de 119 y 480, respectivamente y para el Rayador Americano fue de 360 parejas. La disponibilidad de sitios para las colonias y su ocupación por los laridos anidantes fue variable entre años, con un total de nueve sitios utilizados durante el período de estudio. Con poblaciones en aumento de gaviotas anidantes y poblaciones abundantes del Cormorán Orejudo (*Phalacrocorax auritus*) anidantes y de descanso, la ocupación de los sitios por especies mas pequeñas tales como el Charrán Pico Grueso y el Rayador Americano se restringe ahora a una fracción de los pocos sitios existentes. Sin embargo, estas dos especies han colonizado rápidamente nuevos hábitats disponibles, lo que sugiere que sus poblaciones se beneficiarían inmediatamente con la creación de nuevos sitios de anidación. Cualquier plan para restaurar el hábitat de la fauna silvestre en el Mar Salton deberá incluir la creación de hábitats de anidación adecuados para los láridos anidantes.

Palabras clave: Charránes; gaviotas; Laridae; Mar Salton; rayadores; tendencias de poblaciones reproductoras.

The Salton Sea, a large saline lake spanning the Coachella and Imperial valleys of southeastern California, and its surrounding agricultural lands and wetlands are rapidly becoming recognized as important habitats for waterbirds in western North America (Shuford et al. 2000). Whereas previous work has documented the area's importance to particular wintering species such as the Eared Grebe (*Podiceps nigricollis*; Jehl 1994), Snowy Plover (*Charadrius alexandrinus*; Shuford et al. 1995), White-faced Ibis (*Plegadis chihi*; Shuford et al. 1996), and Mountain Plover (*C. montanus*; Knopf and Rupert 1995, Shuford et al. *this volume*), surveys over the last two de-

cades indicate that it also supports a diverse community of colonial nesting waterbirds comprising several families, including the Phalacrocoracidae and Ardeidae (Molina and Sturm *this volume*) and Laridae (this paper). Of the last group, the recent breeding populations of the Gull-billed Tern, Caspian Tern, and Black Skimmer at the Sea are of regional significance in terms of their abundance (Shuford et al. 2000). The Salton Sea Laughing Gull population is significant as it is the only breeding population of this species in the western U.S. (Molina 2000a).

Breeding colonies of larids at the Salton Sea were first documented in 1927 for the Gull-billed and Caspian terns (Pemberton 1927) and 1928 for the Laughing Gull (Miller and van Rossem 1929). Subsequent reports of breeding larids have focused on additional colonizations (Forster's Tern, McCaskie 1970c; Black Skimmer, McCaskie et al. 1974; California Gull, Molina 2000a) or recolonizations (Laughing Gull, Molina 2000a), on aspects of nesting behavior (Black Skimmer, Grant and Hogg 1976; Forster's Tern, Grant 1982; Gull-billed Tern and Black Skimmer, Molina 1999), and on breeding biology (Black Skimmer, Molina 1996), yet no report has detailed recent population trends for the entire breeding larid assemblage. Here I report recent population trends for six species of larids breeding at the Salton Sea from 1992 through 2001, and patterns of colony site occupation from 1991 through 2001. I also review their historical status at the Salton Sea and discuss their regional significance and conservation.

METHODS

I surveyed suitable areas of the entire Salton Sea shoreline from mid-April through July 1991 through 2001 to detect and monitor active larid colonies. Such habitats were generally limited to near-shore islands along the northern, eastern, and southern shoreline, and to islets within managed impoundments concentrated along the southern and eastern shorelines (Fig. 1). Beginning in 1992, I recorded complete counts of breeding pairs for all species at each site, except for Forster's Terns, which only rarely nested in the vicinity of other larids. Efforts to survey Forster's Terns were extensive in 1995 and 1999 only. In the hot environment of the Salton Sea, incubating adults are readily detected and monitored at all islets from the nearest shore, except Mullet Island and Johnson Street, which required offshore observations from a boat. During these extra-colony visits, I counted the number of sitting adults during mid-day, when ambient temperatures were greatest, at one- to two-week intervals at each site. I continued to monitor colonies that were prematurely abandoned to detect any reestablishment at two- to three-week intervals. I assumed that the presence of an incubating adult during the hottest portion of the day represented an active nest, and thus a breeding pair. During the peak incubation period (usually 10–14 d post-colony establishment), I made intra-colony visits in the early morning to all sites to determine nest contents. Except for 2001, nests of Gull-billed Terns and Black Skimmers were uniquely marked to facilitate companion studies of nest success (Molina 2000b, unpubl. data) and of parental behavior (Molina 1999), enhancing my ability to monitor nest activity.

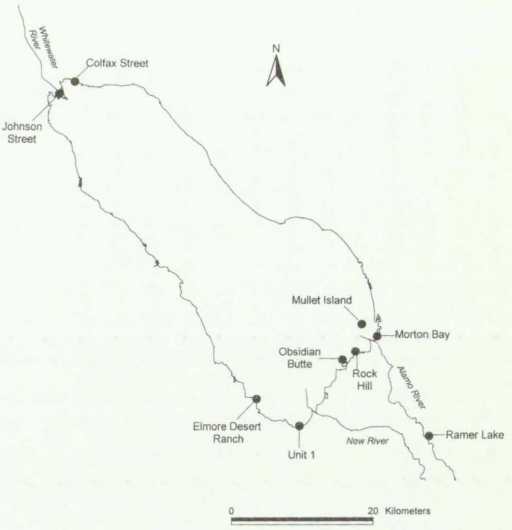

FIGURE 1. Location of colony sites of larids breeding at the Salton Sea, 1991–2001.

Failures of individual nests and of complete colonies were common throughout the study period, particularly for Gull-billed Terns. New nest initiations were regularly observed at continuously active colonies throughout the nesting period. Because I could not determine whether these new nest attempts represented new breeders or re-nesting pairs, the use of the total number of nest attempts in a season could lead to inflated estimates of the size of the breeding population. To minimize overestimation of population size, I report the maximum number of active nests recorded on a single visit to each colony for each season, rather than the total number of nest attempts tallied throughout a season. Although this technique may underestimate population size if new attempts represented new breeders, the number of new nest attempts generally corresponded to the number of abandoned nests. I then estimated the total number of breeding pairs for each species in each year by summing these colony maxima. Colony increases clearly due to an influx of nesters from other, prematurely abandoned sites, as occurred with Gull-billed Terns in most years, were excluded from the total.

I used linear regression analyses (Minitab 1998) performed on ranks to identify increasing or decreasing trends. The lack of regular focal surveys of Forster's Terns precluded population trend analysis for that species.

TABLE 1. ANNUAL NUMBER OF BREEDING PAIRS OF LARIDS AT THE SALTON SEA FROM 1992 THROUGH 2001

Year	Laughing Gull	California Gull	Gull-billed Tern	Caspian Tern	Forster's Tern[a]	Black Skimmer
1992			106	30[b]	≤20	100
1993			121	60	≤20	300
1994	1[b]		101	150	≤15	450
1995	0		72	313	?	487
1996	0	2[b]	155	1500	?	351
1997	0	22	152	1200	nd	300
1998	0	39	123	800	nd	270
1999	1	44	101	211	0	423
2000	3	44	115	207	nd	453
2001	5	42	143	327	nd	464
Mean ± sd	1 ± 2	32 ± 17	119 ± 26	480 ± 511		360 ± 121

[a] Summary statistics for Forster's Tern were not calculated as information for them is incomplete. They rarely nested in association with other larids and focal surveys for them were conducted only in 1995 and 1999. In 1995 and 1996 Forster's Terns were suspected of breeding along an inaccessible portion of the mouth of the New River, but nesting was not confirmed. nd = no data.

[b] These values indicate the year of colonization by the California Gull, or re-colonization by the Laughing Gull and Caspian Tern.

RESULTS

POPULATION SIZE AND TRENDS

From three to six species of larids bred at the Salton Sea each year from 1992 through 2001, with an annual average of nearly 1,000 total pairs (Table 1). In the present study Caspian Terns and Black Skimmers have been the most abundant species with mean annual populations of 480 and 360 pairs, respectively, followed by Gull-billed Tern (119 pairs). Although Forster's Terns were not consistently surveyed, small colonies (≤20 pairs) of this species were detected in some years of the study. Up to 44 pairs of California Gulls (annual mean 32 pairs) nested, beginning in 1996, and up to five pairs of Laughing Gulls (mean = 1) were noted beginning in 1994 (Table 1).

The breeding populations of the California Gull ($df = 5$, $P = 0.03$) and Laughing Gull ($df = 7$, $P = 0.05$) increased significantly in abundance over the study period (Fig. 2). The Caspian Tern ($df = 9$, $P = 0.14$) and the Black Skimmer ($df = 9$, $P = 0.23$) exhibited non-significant increases, whereas the Gull-billed Tern ($df = 9$, $P = 0.49$) showed no directional trend over the period examined (Fig. 2).

HISTORICAL REVIEW

Three species, the Gull-billed Tern, Caspian Tern, and Laughing Gull, were the first species to colonize the Salton Sea. Gull-billed Terns colonized the southwestern end by 1927, with an estimated 500 pairs breeding on a series of sandy islets, some of which were occupied by breeding American White Pelicans (*Pelecanus erythrorhynchos*; Pemberton 1927). At this time, Caspian Terns were also documented as breeders (Pemberton 1927). Although the size of their population was not quantitatively assessed by Pemberton, the number of breeding Caspian pairs appeared to be relatively few. Nesting by a few pairs of Laughing Gulls was first documented in 1928 (Miller and van Rossem 1929). Of these earliest colonizing species, the Gull-billed Tern appeared to be the most consistent nester, although its numbers were believed to have dwindled to only 17 pairs by the 1976 (McCaskie 1976). Unpublished notes of personnel of the Sonny Bono Salton Sea National Wildlife Refuge (SSNWR) indicated that 36 pairs of Caspian Terns nested in 1940, and up to 40 birds nested until 1957 (Small 1957). The last documentation of breeding Caspian Terns occurred in 1959 (Small 1959); after a hiatus of over 30 yrs this species recolonized in 1992 with 30 pairs on Mullet Island (Molina 1996). Throughout its breeding history at the Sea, this species was most abundant between 1996 and 1997, when they formed large colonies (≥400–1000 pairs) at up to three sites.

A few pairs of Laughing Gulls were also believed to nest annually until at least 1957 (Small 1957, Remsen 1978). Their recolonization of the Salton Sea by a single pair was documented in 1994 (Molina 2000a). Since 1999, a mean of three pairs have nested annually. The California Gull colonized the Salton Sea in 1996 (Molina 2000a), when two pairs nested. It has nested annually since with the population exhibiting a sharp increase between 1997 and 1999 (Fig. 2).

Forster's Terns were first documented as breeding near the New River in 1970 (McCaskie 1970c), although unpublished records indicated that "a few nested in 1939" (L. Goldman, SSNWR files). Little quantitative information about nesting Forster's Tern is available since the late 1970s and Patten et al. (2003) considered it an irregular breeder at the Sea. A maxi-

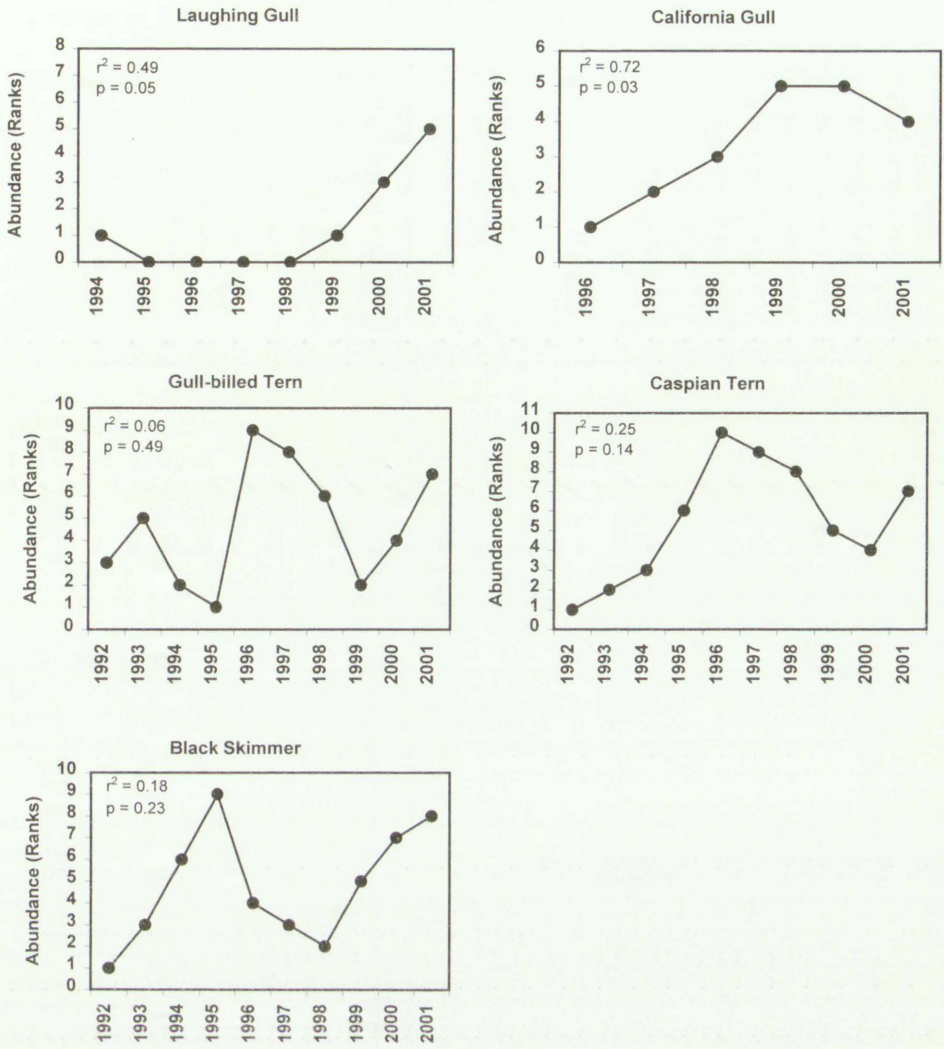

FIGURE 2. Trends in the number of pairs of five larid species that bred regularly at the Salton Sea, 1992–2000, using linear regressions on ranks.

mum of 200 pairs nested at the north end of the Sea in 1978 (McCaskie 1978). During the present study, about 20 pairs nested along the inner aspect of the perimeter levee of Morton Bay in 1992 (Table 1). In 1993 and 1994, 15–20 pairs attempted to nest on hummocks of vegetation on the shallowly flooded mudflats along the southeastern shoreline. In both years these attempts were inundated by water driven by high winds. Forster's Terns were suspected of nesting in an area inaccessible by foot or boat near the mouth of the New River in 1995 and 1996 (K. Molina, pers. obs.). In 1999 comprehensive foot, boat, and aerial surveys did not detect the species as breeder (Shuford et al. 2000).

Black Skimmers were first documented breeding at the Salton Sea in 1972 (McCaskie et al. 1974) and were thought to have bred nearly annually since, with an apparent hiatus in the early 1980s (Remsen 1978, Molina 1996). By 1988, Black Skimmers had increased to several hundred pairs (Collins and Garrett 1996).

Site Occupancy

From 1991 through 2001, breeding larids occupied nine colony sites at the Salton Sea (Table 2). Except for the sites near the northern shoreline at Johnson and Colfax streets, all sites were islets located at or near the south end of the Sea (Fig. 1). Only two, Unit 1 and Rock Hill, lie on federal lands and are managed by the SSNWR. All islets are less than 0.3 ha in area and subject

TABLE 2. PHYSICAL CHARACTERISTICS, PERIODS OF OCCUPATION, AND COLONY SUCCESS AT SITES USED BY AT LEAST ONE LAIRD SPECIES DURING THE PERIOD 1991–2001

Colony site	Habitat type	Nesting substrate	Period of occupation	Colony success[a]
Colfax St.	sea shoreline	barnacle	1999–2001	0
Elmore	eroded levee, near shore islet	bare earth	1991–1992	0.5
Johnson St.	eroded levee, near shore islet	bare earth	1991–2000	0.6
Morton Bay	eroded levee, near shore islet	bare earth	1991–1994	0.75
Mullet I.	offshore islet	bare earth, rock	1992[b]–1997	1
			2000–2001	0
Ramer Lake	islet in impoundment	earth with perimeter of vegetation	1995–1996	1
Rock Hill (NWR)	islet in impoundment	bare earth, rock	1995–2001	1
Obsidian Butte[c]	near shore islet	sand, barnacle, rock	1993–2001	1
Unit 1[d] (NWR)	islet in impoundment	bare earth, rock	2001	1

[a] The proportion of years of colony site use in which at least some young fledged.
[b] First year of colonization by larids although site was present as an island for >30 years. It was abandoned by larids after 1997 but re-colonized in 2000.
[c] The islet near Obsidian Butte was available since at least 1991; however, it is not certain that it was occupied by breeding larids in years prior to 1992.
[d] Site first available in 2001.

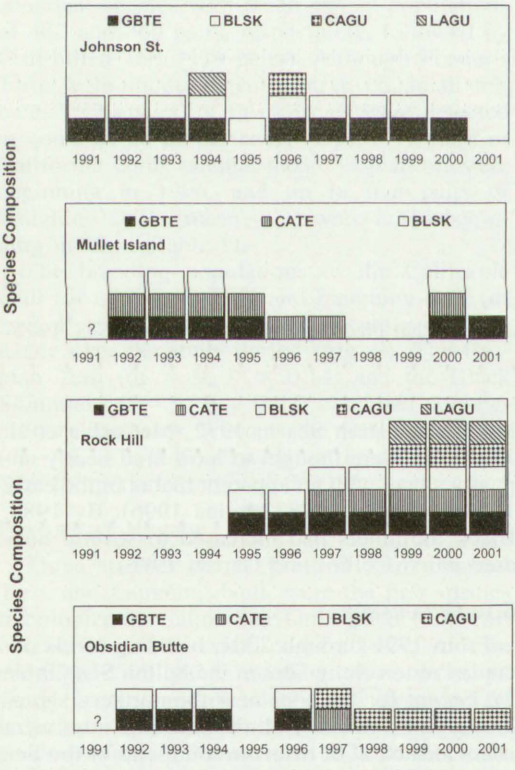

FIGURE 3. Patterns of occupancy by breeding larids for selected colony sites at the Salton Sea, 1991–2001. "?" indicates lack of data for that colony.

to continual erosion, except for Mullet Island, which lies well offshore and covers ~4.5 ha. Those islets in fresh or brackish water impoundments are subject to encroachment by vegetation such as tamarisk (*Tamarix ramosissima*) or iodine bush (*Allenrolfea* spp.)

All sites except the ones near Colfax and Johnson streets were isolated from the shoreline by water during the study period. Only four of these (Rock Hill, Mullet Island, Morton Bay, and Obsidian Butte) remained consistently available for nesting, although Obsidian Butte was unoccupied in 1995 as severe winds caused it to be inundated (Fig. 3). The islet near Elmore Desert Ranch was eroded away by wave action in 1993. The islet used by skimmers at Ramer Lake, a recreation area within the Imperial Wildlife Area approximately 5 km south of the Sea, was rendered unsuitable for nesting in 1997 by encroaching tamarisk. The remnants of levees near Johnson Street, isolated from the shore previously, became intermittently connected to the shoreline by 1999. As had occurred years earlier at Colfax Street, this connection to the mainland facilitated access to the colonies by mammalian predators. Gull-billed Terns and Black Skimmers ceased to breed at Morton Bay after 1994, although the nesting islets were intact. The extent to which widespread nest failures experienced by skimmers there in 1993 and 1994 (Molina 1996) may have influenced site occupancy in subsequent years is not known. An impact on colony establishment by the presence of large congregations of roosting Double-crested Cormorants (*Phalacrocorax auritus*) and American

White and Brown (*Pelecanus occidentalis*) pelicans on the islet in spring also seems likely.

Of the extant sites, colony success, as measured by the absence of colony-wide nest failures or desertions, has been greatest at Rock Hill, a site managed for nesting larids since 1995 by the SSNWR, and at an islet just offshore of Obsidian Butte (Fig. 1; Table 2). In contrast, the relatively small colonies (± 50 nests) of Black Skimmers and, occasionally, of Gull-billed Terns established on the shoreline near Colfax Street have never been successful. Colony size and success at Johnson Street, once highly productive for both Gull-billed Terns and Black Skimmers, have declined for these species since 1996 (Molina 2000b). Currently, no suitable colony sites exist at the north end of the Salton Sea. Another SSNWR site, established at Unit 1 at the south end in 2001 (Fig. 1; Table 2), was immediately colonized by Gull-billed Terns and Black Skimmers; both species appeared to have been successful in that year (Molina 2001).

Of the four colony sites active for ≥5 yrs during the study period (Johnson Street, Rock Hill, Mullet Island, and Obsidian Butte), Rock Hill had the greatest species richness, followed by Obsidian Butte and Mullet Island (Fig. 3). From 1999 through 2001, Rock Hill supported all five larid species that now breed regularly at the Sea. The largest colonies of Gull-billed Terns (up to 70 pairs) and Black Skimmers (up to 400 pairs) have consistently established here, and it was the sole nesting site for Laughing Gulls and Caspian Terns during that period. The islet near Obsidian Butte supported Gull-billed and Black Skimmers until 1996. Caspian Terns and California Gulls colonized the islet in 1997; since 1998 only California Gulls have occupied it (Fig. 3). The colonization of Mullet Island by Gull-billed and Caspian terns and Black Skimmers occurred in 1992 (Molina 1996). As this site had likely been isolated from the shore since the 1960s, the apparent delay of its colonization by breeding waterbirds may have been related to disturbances associated with high levels of boating and fishing activity in 1970s and 1980s (Molina 1996). Black Skimmers experienced a complete nesting failure in 1994 and did not occupy the island again until 2000. Several thousand pairs of Double-crested Cormorants colonized Mullet Island beginning in 1996 and may have displaced Gull-billed Terns from the site; Caspian Terns ceased nesting there in 1997 (Fig. 3). Although cormorants have continued to breed annually on Mullet Island, they have been much less numerous since 1999 and have departed the island earlier in spring. Gull-billed and Caspian terns and Black Skimmers reestablished there 2000 (Fig. 3).

DISCUSSION

Today, the breeding larid community of the Salton Sea, including two gulls, three terns, and the Black Skimmer, is diverse and well-established. The Salton Sea is the only interior nesting site for Gull-billed Terns, Black Skimmers, and Laughing Gulls in western North America north of Mexico. Additionally, the community forms an unique mix of species with the usually coastal breeding Gull-billed Terns, Black Skimmers, and Laughing Gulls reaching the northern extreme of their interior breeding range, while California Gulls reach their southern extreme there.

A combination of factors have influenced larid colonization and population trends at the Salton Sea, including prey availability, suitable colony sites, and possibly factors operating outside the immediate region such as climatic change and large-scale population dynamics. The colonization by the California Gull (Molina 2000a) and Brown Pelican (Sturm 1998) and the re-colonization of the Laughing Gull and Caspian Tern all occurred in a relatively short period during the mid-1990s. In addition, several of the piscivorous waterbird species breeding at the Sea reached peak population sizes during this time (Shuford et al. 1999, Molina and Sturm *this volume*). These events coincided with the development of a highly productive population of tilapia (*Oreochromis mossambicus*) during the 1990s (Costa-Pierce and Riedel 2000). My qualitative observations of foraging larids suggest that yearling tilapia are important prey for most Salton Sea larids, in particular Caspian Terns and Black Skimmers; California Gulls feed tilapia to chicks, and adults routinely forage on dead or dying tilapia along the shoreline.

The availability and suitability of colony sites at the Salton Sea is dynamic and related to the Sea's surface elevation. None of the historic sites first described by early ornithologists currently exist as islands. The sandy islets (Miller and van Rossem 1929) once shared by American White Pelicans, Caspian Terns, and Laughing Gulls off the southwestern shore eroded away in the 1950s, and the rocky ledges of Volcano I (= Black Butte or Obsidian Butte), present during the Sea's early formation (Grinnell 1908), are also no longer isolated from the mainland as sea surface elevation declined in later years.

Competition among species for suitable nesting and roosting habitat appears to have increased with the growing assemblage of breeding larids and abundant pelecaniform populations. Large-scale nest losses of Gull-billed Terns and Black Skimmers due to the crushing of eggs by loafing pelicans has occurred on the

islet near Elmore Desert Ranch in 1992 and, to a lesser degree, at Rock Hill in 1998. Crushed nest contents on Mullet Island and at Unit 1 in 2001 also coincided with the presence of large numbers of cormorants or pelicans using these areas for loafing (K. Molina, pers. obs.).

Gull-billed Terns and Black Skimmers once nested regularly at up to four sites (Fig. 3). A sustained reduction in species richness was observed at Obsidian Butte after the colonization by California Gulls. The contraction of colony site occupation exhibited by the smaller and less aggressive Gull-billed Terns and Black Skimmers is likely to continue as gull populations continue to grow and expand to other sites. At Rock Hill these two species now commonly experience the once novel losses of eggs and chicks to Laughing and California gulls. The decrease, and earlier departure, of breeding cormorants on Mullet Island may have allowed larids to immediately reestablish nesting there in 2000, though these reestablished colonies have been unsuccessful, at least in part due to interference by large aggregations of pelicans and cormorants that continue to loaf there. The reproductive losses suffered by Gull-billed Terns and Black Skimmers as a result of gull predation and interspecific competition for space at some colony sites may be offset by their ability to rapidly colonize new sites, provided that these are of suitable size, form, and location. With the decline of the Johnson Street colony, productive sites are now concentrated at the two SSNWR colonies at south end of the Sea. This consolidation of breeding sites increases the susceptibility of these populations to local disturbances and catastrophic events.

The population dynamics of Salton Sea larids may in part be related to larger-scale phenomena operating in the eastern Pacific Ocean. For example, Ainley and Divoky (2001) link colonizations and population growth of the Black Skimmer at the Salton Sea and in coastal California to increasing ocean temperatures following a series of El Nino/Southern Oscillation events since the early 1970s; such a relationship is imperfect at best, as skimmers were absent from the Sea and scarce along the coast of southern California (Collins and Garrett 1996) during the largest (1982–1983) ENSO event. The sporadic nesting presence of Laughing Gulls at the Salton Sea might reflect population dynamics within the breeding range in western Mexico.

The present study indicates that breeding larid populations have generally flourished in the last decade, remaining largely unaffected by diseases that have afflicted other large piscivores such as pelicans, Double-crested Cormorants, herons, and egrets (SSNWR, unpubl. data). Setmire et al. (1993) reported a 40% decrease in the numbers of breeding Black Skimmers during 1988–1990 from 1987 levels and suspected that contaminants played a major role in their perceived decline. This conclusion by Setmire et al. (1993) was likely flawed as reports of population size for that period were based on incomplete assessments (Molina 1996). Efforts to survey the entire population of Black Skimmers and other larids at the Salton Sea did not begin until this study, in 1992.

The construction of additional nesting habitats for larids should be considered in any restoration plan for the Salton Sea. Predation of nests by coyotes (*Canis latrans*), feral dogs (*C. familiaris*), and raccoons (*Procyon lotor*) is relatively rare at the Sea. Despite frequent observations of these mammals or their tracks, predation by these species has been confined to sites located on, or connected to, the shore. Any newly constructed habitats should be in the form of islets (or artificial materials such as rafts) completely isolated by water in order to minimize disturbances to nesting. Because all species feed in inshore waters, or in agricultural and estuarine habitats, nesting islets placed near the shore or within impoundments near the shore would be appropriately located.

The Salton Sea is an integral component of the lower Colorado River watershed. Its breeding larid assemblage shares affinities with those at two wetland sites in northern Baja California, Mexico: Isla Montague in the delta of the Colorado River (Palacios and Mellink 1992, 1993) and Cerro Prieto in the Mexicali Valley (Molina and Garrett 2001). Many of the breeding species are also shared with colonies in San Diego Bay on the California coast (Patton 1999). Recent opportunistic observations indicate that Gull-billed Terns and Black Skimmers hatched at the Salton Sea have moved, at least for one breeding season, to other nesting colonies in the southern California/Gulf of California region (K. Molina, unpubl. data). The degree of mixing among these populations remains to be quantified and more study is needed to fully understand their metapopulation dynamics and associated management implications.

The Salton Sea breeding colonies of some species of larids seem to be of particular importance in the region. For example, the population size and nesting success of Salton Sea Gull-billed Terns and Black Skimmers appear to be markedly greater than of those breeding on Isla Montague (Peresbarbosa-Rojas 1995, Peresbarbosa-Rojas and Mellink 2001) or at San Diego Bay (Patton 1999; Molina 2000b, 2001), the only other site of breeding for the Gull-billed

Tern in the western United States. This success, coupled with the growing evidence of the dispersal of Salton Sea hatched individuals to other breeding sites within the southern California-Río Colorado Delta region, suggests that the Salton Sea populations may play an important regional role as source populations for these species. To help maintain this potentially critical relationship, plans to restore wildlife habitat at the Salton Sea should include protection of productive foraging habitats, creation of additional nesting habitat suitable for breeding larids, and monitoring of the efficacy of its implementation.

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