



**Population Size and Reproductive Success of California Gulls
at Mono Lake, California in 2009**



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December 2009

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PRBO Contribution # 1709

Summary

An estimated 47,532 adult California Gulls (*Larus californicus*) nested at Mono Lake in 2009. This total is very close to the annual average of $47,653 \pm 1497$ SE for the period 1983–2008 ($n = 26$ years). Seventy-five percent of the gulls nested on the Negit Islets, 17% on the Paoha Islets, and 7% on Old Marina Islet. No nests were found on Negit Island in 2009. Twain Islet remained the most populous, holding 48% of the lake-wide total, followed by Little Tahiti Islet with 12% and Coyote A Islet with 11%. Lake-wide reproductive success of 0.95 ± 0.04 SE chicks fledged per nest was close to the 1983–2008 average of 0.97 ± 0.07 SE. An estimated $22,655 \pm 1039$ SE chicks fledged from the Mono Lake islets in 2009. For the 754 chicks banded and weighed in early July, weight at banding was significantly greater for those that survived to fledging than for those that did not. Cohort color banding was initiated in 2009 in order to investigate gull movements. Up to 16 color-banded juvenile gulls were observed during a two-week period in the fall at Southeast Farallon Island, California, and two others were found in coastal locations during the fall.

INTRODUCTION

We continued long-term monitoring of population size and reproductive success of California Gulls (*Larus californicus*) at Mono Lake, California, in 2009. Our objectives are to measure year-to-year variation in population size and reproductive success as they relate to changing lake levels and other environmental conditions. In addition, through color banding, we aim to better understand gull movements, their fall and winter distribution, and the influence, if any, that Mono Lake California Gulls may have on the rapidly increasing breeding population in the San Francisco Bay area.

The present gull study also provides an important long-term data set that is useful as a measurement of Mono Lakes' ecological condition.

STUDY AREA

The study area has previously been described in detail (see Wrege et al. 2006, Shuford 1985). Locations of the Mono Lake nesting islets are shown in Figures 1 and 2. The lake level was approximately 1945.3 m (6382.3 ft) in May 2009, a decline of 0.27 m (0.89 ft)

from the level in May 2008. Lake-level data from Los Angeles Department of Water and Power are available on the Mono Lake Committee website www.monolake.org.

Fig. 1. Location of gull nesting islets within Mono Lake.



METHODS

Nest Counts

In 2009, we counted all nests within the Mono Lake colony from 24-27 May. Field workers walked through all the islet colonies counting each nest with a tally meter and marking them with a small dab of water-soluble paint to avoid duplicate counts. For some small, steep-sided islets, incubating adults were counted from a small motor boat.

Clutch Size, Chick Banding, and Reproductive Success

We sampled 11 fenced plots on 4 islets to estimate clutch size and reproductive success. Six fenced plots measuring 10 x 20 m are located on the Negit Islets (four on Twain, two on Little Tahiti) and four fenced plots of various but smaller sizes (Jehl 2001) on the Paoha Islets (two on Coyote A, two on Piglet Islet). The Cornell Plot located on Little Tahiti was added to research efforts in 2009; it measures approximately 20 x 20 m.

Fig. 2. View of individual islets within the Negit Islet complex.



We estimated average clutch size from counts of the number of eggs per nest for all nests within the 11 plots censused in late May . From 8-10 July 2009, we banded all chicks within the plots, placing a pale blue color band over a silver U.S. Fish and Wildlife Service band on the tarsus of the left leg. Two small downy chicks received the silver band on the right leg since their tarsi were too small for two bands, and seven chicks were accidentally banded blue over silver on the right leg.

From 4-5 September 2009, we searched the islets with plots to determine the number of banded chicks that died before fledging. We estimated the fledging rate for each plot in which data was collected, and, using the average fledging rate for the entire population, the total number of gulls successfully fledged from Mono Lake in 2009. We calculated the fledging rate for each plot (f_{plot}) as:

$$f_{plot} = (C_b - C_d) / N_p$$

where C_b is the number of chicks banded in that plot in July, C_d is the number of chicks

from that plot found dead in September, and N_p is the number of nests counted in that plot in May. We calculated the total number of gulls successfully fledged (F) from Mono Lake as:

$$F = (N/P) \sum_{i=1}^P f_i$$

where N is the total number of nests on Mono Lake, P is the number of plots, and f_i is the number of young fledged per nest in each of the fenced plots.

We analyzed results using a nonparametric test (Wilcoxon/Kruskal-Wallis) with Stata 8.0 (Stata Corp. 2003).

Tick Infestations

Because of the potential effect on gull reproductive success, we recorded the presence and abundance of the bird tick *Argas monolakensis* for all 754 chicks that we banded. Each bird received a score of 0-3 based on the approximate proportion of the fleshy part of the leg (tibia) covered by tick larvae: 0, no ticks; 1, up to one-third covered; 2, up to two-thirds covered; and 3, more than two-thirds covered. For more information on the life cycle of this endemic tick, see Schwan et al. (1992) and Nelson et al. (2006).

Chick Mass at Banding

We used hand-held Pesola scales to weigh the chicks that were banded.

Color-band Resight Efforts on Southeast Farallon Island

Between 27 September and 9 October 2009 flocks of California Gulls at Southeast Farallon Island were scanned in order to search for color-banded birds from Mono Lake. Southeast Farallon is an approximately 48-ha island located 43 km west of San Francisco and 32 km south of Point Reyes, California. Color-band resight efforts were only conducted within this 2-week period at Southeast Farallon when KNN was present. Future extended efforts will likely result in more sightings. California Gulls generally roosted on the island in the evening and departed during the day to forage (KNN). Flocks of gulls were scanned with binoculars and a spotting scope in late afternoon-evening

periods when numbers were greatest. Island biologists made daily estimates on the number of California Gulls present.

RESULTS AND DISCUSSION

Number of Nests and Breeding Adults

In 2009, we recorded a lake-wide total of 23,766 California Gull nests and estimated a population of 47,532 nesting adults. This was very close to the mean population size of $47,653 \pm 1497$ SE for the period 1983-2008 ($n = 26$ years). The population estimate for 2009 was 22% greater than in 2008 and the highest since 2004. In 2009, 75% of the gulls nested on the Negit Islets, 17% on the Paoha Islets, and 7.5% on Old Marina and Old Marina South islets (Figures 1, 2). Of the individual islets, Twain held 48% of the total, Little Tahiti 12%, Coyote A 11%, Pancake 10%, and, collectively, the remaining islets 19% (Appendix 1). No nests were found on Negit Island.

Nesting Dispersion on Mono Lake

The proportion of nests distributed among the islets in 2009 was very similar to that in 2008 (Appendix 1). The number of nests on Old Marina Islet continued a trend of rapid increase since 2005, with 61% more in 2009 than in 2008. Nests on Old Marina South increased similarly by 59%; it had 22 nests in 2009 versus 9 nests in 2008, the year active nests were first found there.

Phenology in 2009

Of the total nests counted from 24-27 May, only nine contained newly hatched chicks which is a typical proportion for this time in the breeding season. During chick banding, only two nests with eggs (perhaps infertile) were detected within the plots, both in the Twain North plot. No unfledged chicks were detected during mortality counts on 4-5 September, which is expected given most chicks typically have fledged by early August.

Clutch Size

In 2009, average clutch size at Mono Lake was 1.94 ± 0.03 eggs/nest (range = 1-3 eggs [except one 5-egg nest], $n = 693$ nests). Twenty-one percent of the nests contained one

egg, 65% had two, and 14% had three. The average clutch size for Mono Lake since 2002 ($n = 8$ years) is 1.98 eggs/nest.

Overall Reproductive Success

The seven plots on the Negit Islets held an average of 75.1 ± 14.9 nests and fledged an average of 0.94 ± 0.05 SE chicks per nest in 2009. The four plots on the Paoha Islets held an average of 40.7 ± 6.2 SE nests and had fledged an average of 0.98 ± 0.10 chicks per nest (Table 1). Combined, the 11 plots held an average of 63.0 ± 10.8 nests and fledged an average of 0.95 ± 0.05 chicks per nest, which is similar to the average of 0.97 ± 0.07 SE chicks fledged per nest. The long term average is calculated for the Negit Islets only from 1983-2002, and Negit and Paoha Islets combined since 2002.

Table 1. Summary of Nest Counts, Chick Banding, and Mortality Counts in 2009.

Site	Nests per Plot	Clutch Size	Number banded (# dead)	fledged/nest
Cornell	137	1.98	136 (23)	0.82
Little Tahiti East	12	2.08	14 (1)	1.08
Little Tahiti West	97	1.85	112 (8)	1.07
Twain North	61	2.07	46 (2)	0.72
Twain South	92	1.89	101 (11)	0.98
Twain West	80	1.87	96 (15)	1.01
Twain New	51	1.8	52 (8)	0.86
Negit Isl. Totals:	530		557 (68)	-
Average =	75.71	1.93	79.6 (9.7)	0.934
SE =	14.9	0.04	16.3 (2.9)	0.051
Coyote Cove	51	1.94	64 (15)	0.96
Coyote Hilltop	51	2.02	57 (4)	1.04
Piglet East	26	1.88	27 (8)	0.73
Piglet West	35	2	49 (7)	1.2
Paoha Isl. Totals	163		197 (34)	-
Average =	40.75	1.96	49.2 (8.5)	0.983
SE =	6.2	0.03	8.0 (2.3)	0.1
Lakewide Totals				
Total Nests	693		-	-
Average =	63.00	1.94	68.5 (9.3)	0.952
SE =	10.85	0.03	11.4 (1.9)	0.046

Based on the total of 23,766 California Gull nests on Mono Lake and an average of 0.95 ± 0.05 chicks fledged per nest, an estimated $22,655 \pm 1039$ chicks fledged at Mono Lake in 2009.

Mass at Banding

The average mass of the 754 chicks banded in 2009 was 501 ± 4 g. The average mass for chicks that survived to fledging (518 ± 4 g) was significantly higher than the average mass for chicks that did not survive to fledging (392 ± 10 g; $X^2 = 109.0$, $df = 1$, $p = 0.0001$). This pattern has been consistent through all years in which chicks were weighed.

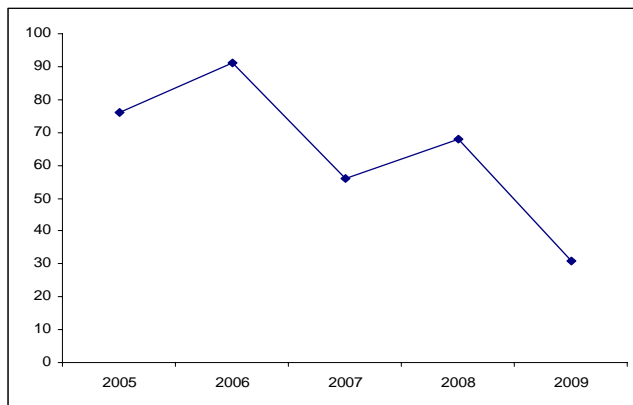
Tick Infestation

Ninety-three percent of the chicks had a tick score of 0 and 7% had a tick score of 1. Only 3 chicks (<1%), all from the Cornell Plot, had a tick score of 2. Plots with high levels of tick infestation have had low levels of fledging success (Hite et al. 2004).

Other Species Nesting on Mono Lake Islets

In addition to the California Gull, other species nesting on the Mono Lake islets in 2009 were the Black-crowned Night-Heron (*Nycticorax nycticorax*) and Osprey (*Pandion haliaetus*). Thirty-one Black-crowned Night Heron nests were tallied in late May – 17 on Twain and 14 on Little Tahiti. The number of Black-crowned Night-Herons nests on the Mono Lake islands has declined in recent years (Fig. 3). One Osprey nest was on Saddle, one of the Negit Islets northwest of Kratatoa Islet (Fig. 2).

Fig. 3. Numbers of Black-crowned Night-Heron nests on the Negit Islets, 2005-2009.



Coastal Observations of Gulls Color-banded at Mono Lake

In fall 2009, there were detections at several sites on the coast of juvenile gulls color-banded as large chicks at Mono Lake in July 2009. Most sightings were from Southeast Farallon Island, where the senior author searched intensively for color-banded gulls during a two-week period from late September to early October. Six color-banded gulls were seen on the island on 27 September, followed by five, three, and two on 1, 2, and 9 October, respectively. It is unclear how many total color-banded gulls this represents given the high rate of turnover of gulls on the island during this migratory period and the same color combination was used on all banded gulls. Roughly estimated, 0.5%- 0.75% of the juvenile California Gulls present on Southeast Farallon Island were color-banded (KNN). Additionally, a single color-banded juvenile was seen at Cayucos on Morro Bay on the southern coast on 28 August (M. Harms, pers. comm.), and an incapacitated color-banded juvenile was picked up east of Antioch, adjacent to Suisun Bay, on 20 October (D. Humple, pers. comm.).

Figure 4 Color-banded gull from Mono Lake at Morro Bay, California. Photo: M. Harms

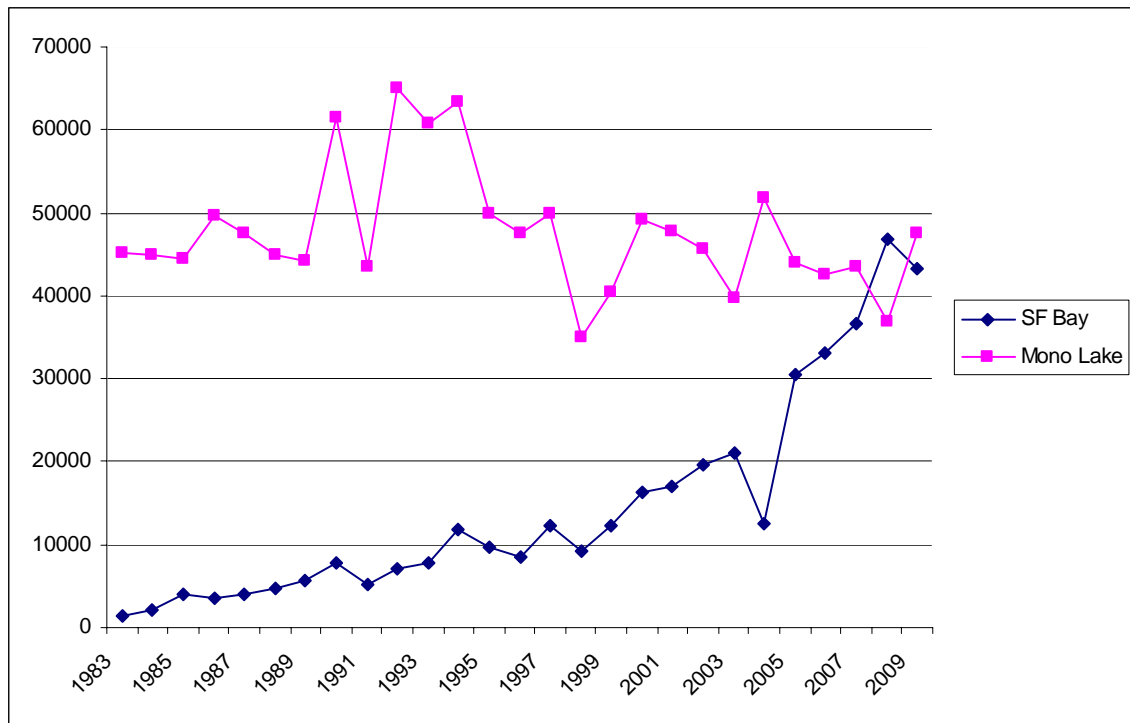


Population Trends

No clear trends have been detected in the Mono Lake gull population over the tenure of this study, which began in 1983 ($r^2 = 0.07$, $p = 0.18$; Fig. 5). There has been speculation in recent years that the massive population growth experienced by the California Gull colonies in south San Francisco Bay has been aided by an influx of Mono Lake gulls

(Nelson et al. 2008). Reasons for this speculation are varied, including that the two populations show a weak negative correlation over the last 10 years ($\rho = -0.63$, $p = 0.07$). Also, the impressive growth rate in the Bay Area indicates favorable breeding and foraging conditions which may be attractive to gulls from other populations. Immigration from other population(s) accounted for the pioneering breeders and least some the large growth rate in the Bay Area, as local chick production alone likely could not account for such rapid growth (Shuford and Ryan 2000). However, with no significant downward trend in Mono Lake numbers, it appears there is little evidence for significant emigration. Yet the possibility exists, and we will continue to monitor the two populations for any change in trends.

Figure 5. Nesting population size of California Gulls at Mono Lake and San Francisco Bay, 1980-2009. Data for Mono Lake unavailable before 1983. SF Bay data from J. Demmers, San Francisco Bay Bird Obs.



Acknowledgments

We are grateful to the Mono Lake Committee and an anonymous donor for providing the financial support for this monitoring effort. We greatly appreciated the help of the individuals who volunteered their time to assist with field work – without dedicated volunteers like these, this long-term effort would not have been possible. Volunteers for the 2009 season were Aaron Dore, Douglas Greiner, Justin Hite, Nora Livingston, Mary Malec, William Owens, Roxann R. Preston, and Lundy Schneider. Thanks to Jen Roth at PRBO Conservation Science for the statistical analysis on population trends. Dave Shuford of PRBO provided insightful and valuable edits on the manuscript. Special thanks to John Frederickson of the June Lake Marina for servicing our motor, as well as his abundant enthusiasm and well wishes. Jill Demers from the San Francisco Bay Bird Observatory provided information on the California Gull populations in the Bay Area. This is PRBO Contribution Number 1709.

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Appendix 1 Nest counts on Negit Island and the Negit and Paoha islets from 1983 to 2009. Data from the Paoha Islets before 2002 from J. R. Jehl, Jr.

Negit Islets	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Twain	3808	7372	9309	11985	12422	11057	10573	15045	10883	15896
L. Tahiti	5260	7051	6572	5763	4261	3692	2983	4218	3205	3810
L. Norway	2218	1956	1407	810	360	254	269	432	355	473
Steamboat	997	1016	721	722	467	359	314	704	671	862
Java	143	396	195	400	439	458	543	789	586	1040
Spot	505	358	296	311	248	247	231	309	311	335
Tie	511	231	196	150	84	87	95	167	160	220
Krakatoa	319	272	178	173	185	197	174	283	181	209
Hat	146	109	73	56	14	18	10	19	10	21
La Paz	105	58	43	30	22	21	23	46	49	70
Geographic	140	0	0	0	0	0	2	4	10	68
Muir	170	0	0	0	0	1	10	61	84	139
Saddle	175	46	41	29	14	13	10	18	8	14
Midget	5	3	3	4	4	2	3	3	2	2
Siren	51	0	1	0	0	0	1	7	7	19
Comma	2	1	1	1	0	0	0	0	1	1
Castle Rocks	2	3	4	3	4	6	5	4	5	5
Pancake	0	0	0	7	570	1216	1395	651	0	0
Java Rocks	0	0	0	0	4	3	0	4	2	13
No name	0	0	0	0	0	0	0	1	0	3
<i>Negit Islet Total</i>	14557	18872	19040	20444	19098	17631	16641	22765	16530	23200
<i>Paoha Islets</i>										
Coyote A	a	a	a	a	a	a	a	a	a	a
Coyote B	a	a	a	a	a	a	a	a	a	a
Browne	a	a	a	a	a	a	a	a	a	a
Piglet Islet	a	a	a	a	a	a	a	a	a	a
<i>Paoha Islets Total</i>	8001	3546	3153	3694	3208	2833	2682	5145	4442	9284
<i>Negit Island</i>	--	--	92	636	1502	2037	2765	2827	788	4
<i>Lakewide Total</i>	22558	22418	22285	24778	23808	22501	22088	30737	21760	32488
<i>Nesting Adults:</i>	45116	44836	44570	49556	47616	45002	44176	61474	43520	64976

^a Data published elsewhere by J. R. Jehl, Jr.

Appendix 1 Continued.

Negit Islets	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Twain	15431	15792	11035	12690	13140	9488	10728	11856	11773	10772
L. Tahiti	3616	4505	4021	4570	4092	3846	5108	5076	4309	3831
L. Norway	428	533	493	766	794	606	732	887	665	357
Steamboat	958	1217	981	459	505	405	381	477	570	621
Java	399	199	4	70	41	65	149	480	611	706
Spot	356	449	422	399	341	191	27	29	36	42
Tie	210	320	264	267	194	81	5	16	23	24
Krakatoa	146	175	116	57	33	16	76	120	141	129
Hat	21	14	19	41	58	47	43	29	23	9
La Paz	77	57	55	44	30	17	0	0	0	0
Geographic	84	69	51	0	0	0	0	0	0	0
Muir	131	116	87	4	0	0	0	0	0	0
Saddle	10	11	21	31	13	1	2	1	1	0
Midget	3	2	2	2	3	0	3	2	0	0
Siren	20	14	16	10	0	0	0	0	0	0
Comma	1	0	0	1	0	0	0	0	0	0
Castle Rk.	3	3	3	4	4	3	3	1	1	1
Pancake	0	0	0	0	1	13	1136	2098	2145	2085
Java Rocks	15	9	5	1	0	0	0	0	0	0
No name	3	3	1	0	0	0	0	0	0	0
<i>Negit Islet Total</i>	21912	23488	17596	19416	19429	14779	18393	21072	20298	18577
Paoha Islets										
Coyote A	a	a	a	a	a	a	a	a	2237	2612
Coyote B	a	a	a	a	a	a	a	a	22	26
Browne	a	a	a	a	a	a	a	a	279	261
Piglet Islet	a	a	a	a	a	a	a	a	776	991
<i>Paoha Islets Total:</i>	8498	8182	7331	4334	5708	2687	1858	3478	3314	3890
Negit Island:	12	0	0	0	0	0 ^b	14	100	271	391
Old Marina	0	0	0	0	0	0	0	0	0	c
<i>Lakewide Total:</i>	30422	31670	24927	23750	24957	17466	20265	24650	23833	22858
<i>Nesting Adults</i>	60844	63340	49854	47500	49914	34932	40530	49300	47766	45716

^b No nesting gulls were seen on Negit Island in late May 1998, but a nearshore boat survey on 8 July found five adults apparently incubating, and one pre-fledged chick (J. R. Jehl, Jr. pers. comm.).

^c The number of nests on Old Marina Islet in 2002 (and prior years) is uncertain. Nesting activity was not discovered until 5 July 2002, making a standard nest count impossible; pre-fledged chicks were observed with a spotting scope from shore, but nests were concentrated on an area obscured from view from shoreline. A minimum of five pairs of gulls initiated nests, but this is likely an underestimate.

Appendix 1. Continued

Negit Islets	2003	2004	2005	2006	2007	2008	2009
Twain	9288	11480	9582	9900	10138	8891	11449
L. Tahiti	2632	3303	2511	2700	3102	2477	2770
L. Norway	249	213	126	165	172	137	119
Steamboat	575	635	621	583	631	590	580
Java	718	915	779	710	648	482	433
Spot	70	98	127	75	9	49	87
Tie	38	49	50	33	0	9	37
Krakatoa	113	181	184	131	119	24	5
Hat	7	9	3	5	10	3	3
La Paz	0	1	2	0	0	0	0
Saddle	0	0	0	1	1	0	1
Midget	0	1	1	0	0	0	0
Little Tahiti Minor	^e	^e	^e	^e	^e	^e	152
Pancake	1847	2837	2530	2059	1602	1623	2293
<i>Negit Islets Total</i>	15537	19722	16516	16362	16432	14285	17929
Paoha Islets							
Coyote A	2480	3244	3174	3181	3094	1989	2591
Coyote B	34	55	63	40	0	0	0
Browne	224	283	253	225	118	99	135
Piglet	1010	1552	1649	1218	1269	1001	1314
<i>Paoha Islet Total:</i>	3748	5134	5139	4664	4481	3089	4040
Negit Island:	452	587	285	120	63	0	0
Old Marina	178 ^d	511	1	94	723	1089	1775
Old Marina So.	0	0	0	0	0	9	22
<i>Lakewide Total</i>	19915	25954	21941	21240	21699	18472	23766
<i>Nesting Adults</i>	39830	51908	43882	42480	43398	36944	47532

^d Nests were not counted with water soluble paint, which typically serves as a counting aid, and counters judged that the 178 nests they recorded is an underestimate.

^e Numbers for Little Tahiti Minor previously included within the total for Little Tahiti.