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Population Size and Reproductive Success of California Gulls at Mono Lake, California in 2011

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Summary

An estimated 33,548 adult California Gulls (*Larus californicus*) nested at Mono Lake in 2011. This total is the lowest population size recorded for Mono Lake since efforts began in 1983 and well below the annual average of 47,246 ± 1394 for the period 1983–2010 (*n* =28 years). The gull population on the Paoha Islets experienced a large decline in population size compared to past years, and complete nest failure in 2011. Eighty-four percent of the gulls nested on the Negit Islets, 9% on the Paoha Islets, and 6% on Old Marina Islet. Lake-wide reproductive success of 0.315 ± 0.06 chicks fledged per nest was well below the 1983-2010 average of 0.94 ± 0.06. An estimated 5,284 ± 301 fledged chicks from Mono Lake islets in 2011. Cold weather conditions in the Mono Lake region during late spring likely contributed to the depressed population size and reproductive success of Mono Lake's gulls. Cold, windy conditions also negatively impacted our nest count efforts in late May, necessitating us to estimate the population size of a portion of the colony. For the 183 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. Seventy-seven chicks were banded with coded red color bands, the rest received a green color band above the USFWS band on the left leg.

INTRODUCTION

We continued long-term monitoring of population size and reproductive success of California Gulls (*Larus californicus*) at Mono Lake, California, in 2011. 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. Through color banding, we aim to better understand gull movements, fall and winter distribution, and investigate whether individual gulls breed in different colonies in different years. This study provides an important long-term data set that is a useful measurement of Mono Lakes' ecological condition.

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

STUDY AREA AND SPRING CONDITIONS

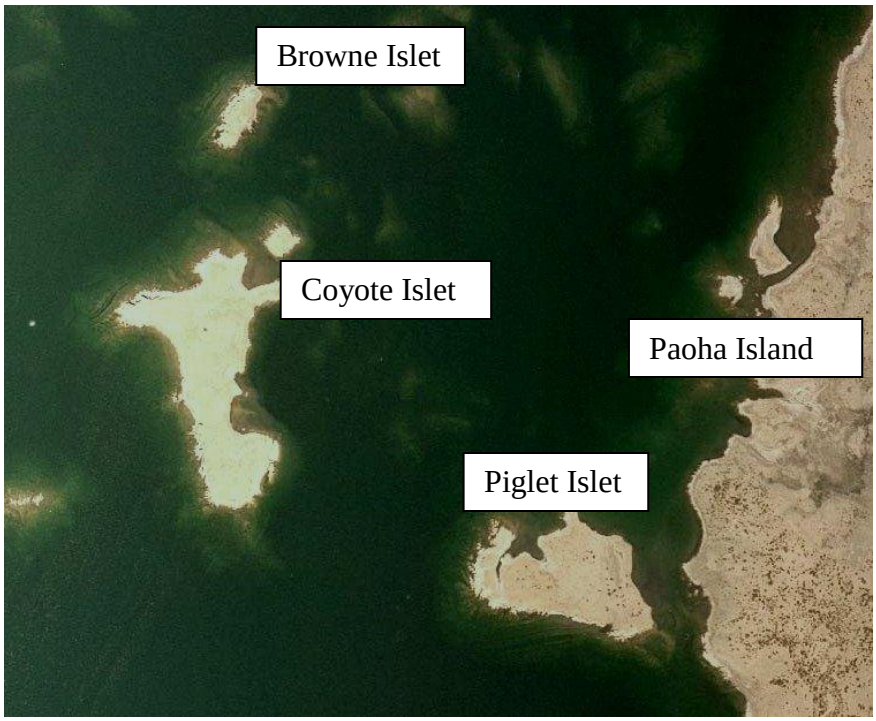
The study area has previously been described in detail (see Wrege et al. 2006). Locations of the Mono Lake nesting islets are shown in Figures 1, 2 and 3.

According to data collected from a weather station in Lee Vining, the winter of 2010-2011 was the 4th snowiest for Mono Lake since 1950, following 1969, 2005, and 1983 (G. Reis, Mono Lake Committee information specialist, see http://www.monolake.org/today/2011/05/03/cool-april-maintains-high-elevation-snowpack/). Snow surveys from the Eastern Sierra watersheds of Owen's River and Walker River measured between 147-173% and 165-170% average snowpack by early May, respectively (California Dept. of Water Data Exchange center: http://cdec.water.ca.gov/snow/current/snow/). The above average runoff in Mono Lake's tributary streams caused Mono Lake to rise well over .5m during the spring and summer of 2011. The lake level was approximately 1945.7 m (6382.6 ft) in May 2011, and peaked at 1945.8 m (6383.9 ft.) during August and September (lake-level data from Los Angeles Department of Water and Power are available on the Mono Lake Committee website www.monolake.org.).

April 2011 weather in the Mono Basin was near average, but cool and dry compared to recent years. It was the windiest April since 2004, with an average wind speed of 7.9 kmph (4.9 mph). May, especially late May during the nest count period, was cold and windy. The average temperature in Lee Vining for the entire month of May 2011 was 7.9 C (46.2 F); 4 C below the 2004-2010 average of 11.9 C (53.5 F) (prior to 2004, this weather station was located against a building which influenced temperature readings). Although the average wind speed of 4.8 kmph (3 mph) for the entire month of May 2011 was below average, late May was very windy. The last 8 days of May in which we attempted nest counts on Mono Lake, the average wind speed was 10.4 kmph (6.5 mph). Weather data for Lee Vining available at: http://www.monobasinresearch.org/data/

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

Fig.3. View of Paoha Islet complex



METHODS

Nest Counts

Between May 26-27 and June 3, 2011 field workers counted most colony islets following protocol of walking in sweep-lines, counting each nest with a tally meter and marking it with a small dab of water-soluble paint to avoid duplicate counts. On small, steep-sided islets, incubating adults were counted from a small motor boat. This year, the number of nests on some islets was estimated by methodology described below.

Nest Count in 2011: Nest count was initiated May 26, but efforts were soon abandoned by May 27 to due excessively stormy, miserable weather. Winds caused unsafe boating conditions and increased disturbance to the gulls. At dawn on May 28 researchers retreated to the northshore of Mono Lake in the lee of Negit Island, as it was too rough to return to the boat dock on the Southwest shore. Java Islet, the Paoha Islets, and over half of Little Tahiti Islet were left uncounted. We monitored conditions daily for the opportunity to finish nest counts and return the boat to the safety and care of the dock. It

was not until June 3 a break in the wind allowed us to do so. Due to limited time available and still moderate weather conditions on June 3, nest count completion was abbreviated. On Little Tahiti, researchers finished counting the east half of the island, and counted just the plots on the west half (Cornell and Little Tahiti West plots). The entire nesting population for Little Tahiti in 2011 was estimated by using the number of nests in the plots as a sample. We averaged the proportion of nests counted in the Little Tahiti East and West plots between 2004 and 2010. The Cornell plot has only been sampled since 2009 so could not be used to calculate a long-term average. The total number of nests counted in the Little Tahiti East and West plots in 2011 (84) was then divided by the 7 year average (0.41) to yield the estimated population size for Little Tahiti in 2011 (Table 1). Years prior to 2004 were not included in this estimation, since the population size on Little Tahiti East was formally much larger (see past Mono Lake California Gull reports). Its population declined apparently in response to increased tick infestations (Nelson et al. 2008, PRBO unpubl. data).

Table 1. Nest Numbers of Little Tahiti Plots used to estimate the population size in 2011

Year	Plot Totals	Islet Total	Percent in plots
2004	137	3303	0.041
2005	112	2511	0.045
2006	102	2700	0.038
2007	128	3102	0.041
2008	101	2477	0.041
2009	109	2770	0.039
2010	108	2429	0.044
7 Yr. Avg.			***0.041***
2011	84	**2049**	0.041

On the Paoha Islets, Coyote and Piglet islets were counted by usual protocol June 3, and Browne islet (fig. 3), which is relatively small, was photographed from all angles, and nests were counted later by photographic analysis. The population size for Java and Little Tahiti Minor, which contain about 3% of the total population, were estimated by averaging the 2009 and 2010 totals, and adding 8%. This reflects the 8% relative increase noted on the Negit islets in 2011 compared to 2009 and 2010, and the relatively stable population sizes experienced on those islets in 2009 and 2010 (Appendix 1).

Clutch Size, Chick Banding, and Reproductive Success

We sampled 9 fenced plots on 4 islets to estimate clutch size, and sampled all 11 fenced plots to estimate reproductive success (Table 2). Six fenced plots measuring 10 x 20 m are located on the Negit Islets (four on Twain, two on Little Tahiti), another plot approximately 20 x 20 m is located 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).

We estimated average clutch size by counting the number of eggs per nest for all nests within the 9 plots censused in late May (we did not measure clutch size for the Little Tahiti West or Cornell plots counted June 3). From 3-5 July 2011, we banded all chicks within all 11 plots with a silver U.S. Fish and Wildlife Service band as well a color band – either a single green color band (applied to small, less vigorous chicks) applied over the silver band on the left leg, or a red coded band stamped with field-readable numeric code unique to each banded individual.

From 2-4 September 2011, 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, and, using the average fledging rate for the entire population, the total number of gulls successfully fledged from Mono Lake in 2011. 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 or June. 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 **fi** is the number of young fledged per nest in each of the fenced plots.

In 2011, we modified the lakewide reproductive success measurement to correct for over-sampling of the Paoha Islet plots, which experienced total nesting failure. The Paoha islets represented just 9% of the total Mono Lake population, but 20% of our plot sample. Therefore, we multiplied the Negit islet reproductive success value by 91% (0.91), so that only 9% of the zero reproductive success value of the Paoha sample was factored into the lakewide total. Other years when reproductive success on the two islet complexes is similar, this correction is unnecessary.

We analyzed results using a nonparametric test (Wilcoxon/Kruskal-Wallis) with Stata 10.0 (Stata Corp. 2003). Results are presented with plus or minus one standard error.

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 banded chicks. We also checked for the presence of "mites" (perhaps tick nymphs). Each bird received a tick 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. "Mites" were recorded as either present or absent based on examination of the tibia. 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.

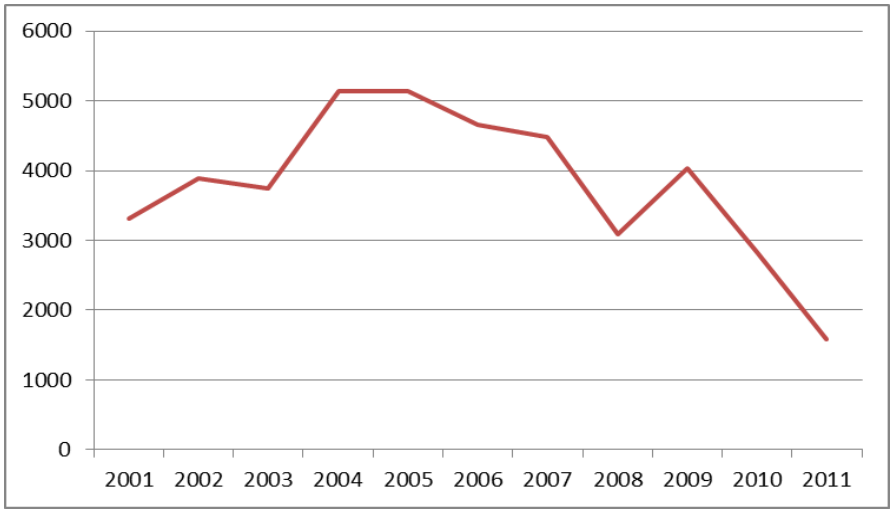
RESULTS AND DISCUSSION

Number of Nests and Breeding Adults

In 2011, we estimated a lake-wide total of 16,774 California Gull nests, yielding a population of 33,548 nesting adults. This is well below the mean population size of 47,245 ± 1395 for the period 1983-2010 (n = 28 years), and represents the lowest population size recorded at Mono Lake since efforts began in 1983 (Nelson and Greiner 2010).

Eighty-four percent of the gulls nested on the Negit Islets, 9% on the Paoha Islets, and 6% on Old Marina Islet (Figures 1, 2 and 3). The 1578 nests counted on the Paoha Islets in 2011 is the smallest population size recorded for this islet complex, although it ties 1999 for containing 9% of the overall population (fig. 4, Appendix 1 in Nelson and Greiner 2009). The Negit Islets contained proportionally more nests than they have in 10 years, and an 8% proportional increase over the averaged 2009 and 2010 Negit Islet totals.

Fig. 4. Number of California Gull nests on the Paoha Islets: 2001-2011



Of the individual islets, Twain was the most populous, holding 52% of the lake-wide total, followed by Little Tahiti Islet with 12% and Pancake A with 10% (Appendix 1). No nests were found on Negit Island.

Islets and plots counted on June 3 appeared to have fewer nests than expected relative to counts conducted earlier in May, suggesting that during the period of inclement weather between May 27 and June 3, some nests were abandoned or lost.

Phenology in 2010

Many adults (approximately 14%) were observed still incubating nests with eggs in early July, especially on the Paoha Islets (Table 2). These gulls either initiated nesting later

than usual or re-nested as a result of loss of their first clutch. Late nest attempts are associated with increased failure rates (Nelson and Greiner 2010). A much larger proportion of gulls incubating eggs was observed in July 2010, which experienced an even lower reproductive success rate than 2011. In an average year, we see very few or no incubating adults in July (KNN, pers. obs.).

Two nests containing small chicks were detected during the May 26-27 2011 nest count, which is roughly average. On June 3, about 24 nests with chicks or pipping eggs were detected on the Little Tahiti Islet plots, approximately 15-20% of the total. On the Paoha Islets, however, only 2 nests with chicks were observed on islet-wide counts on June 3 (essentially 0%). Additionally, no chicks were observed on the Paoha Islets in early July (see below), indicating a complete or nearly complete localized nesting failure.

Clutch Size

In 2011, average clutch size for the Negit and Paoha Islets combined was 1.80 ± 0.03 eggs/nest (range = 1-3 eggs [except one 4-egg nest], n = 366 nests). Average clutch size for the Negit Islets was 1.89 eggs/nest, while the Paoha Islets averaged 1.69 eggs/nest. (Table 2). Overall, 32% of the nests contained one egg, 53% had two, and 15% had three. The average clutch size for Mono Lake since 2002 (n = 9 years) is 2.00 ± 0.05 eggs/nest.

Overall Reproductive Success

The seven plots on the Negit Islets held an average of 60.0 ± 8.5 nests and fledged an average of 0.354 ± 0.03 chicks per nest in 2011. The four plots on the Paoha Islets held an average of 25.5 ± 3.0 nests and fledged no chicks (Table 2). Combined, the 11 plots held an average of 47.5 ± 7.5 nests and fledged an average of 0.22 ± 0.06 chicks per nest. In 2011 we modified the lakewide reproductive success to correct for over-sampling of the Paoha Islet plots which experienced localized nesting failure (see Methods, above). This yielded a lakewide reproductive success value of 0.31 ± 0.05 chicks fledged per nest, which is below the long-term average of 0.94 ± 0.05 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 2. Summary of Nest Counts, Chick Banding, and Mortality Counts from all plots in 2011.

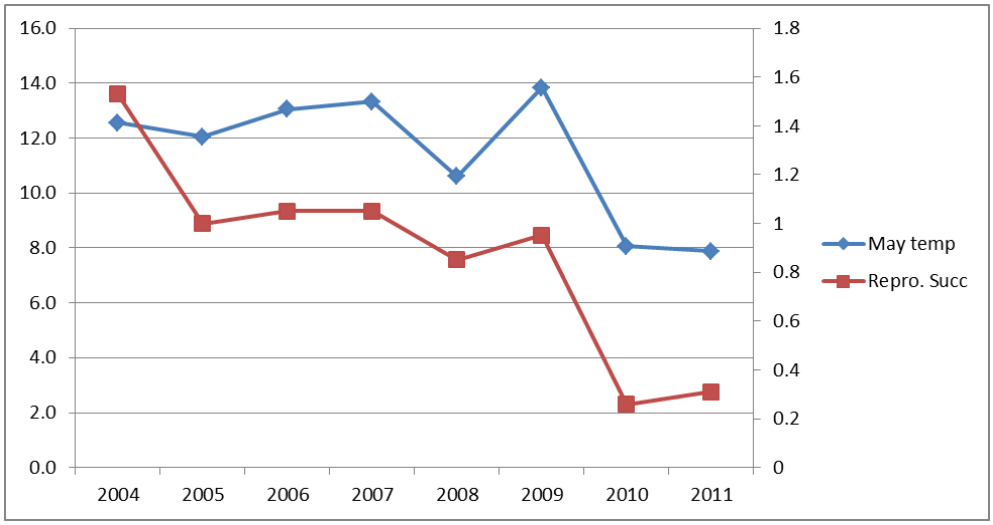
Plot	Total nests in May/June	Avg. Clutch Sz.	# Chicks Banded in July (#died by Sept)	Nests with eggs in July	Total chicks fledged/nest
Cornell	95	unk	35 (5)	0	0.31
Little Tahiti East	23	1.9	13 (3)	8	0.43
Little Tahiti West	61	unk	34 (6)	10	0.46
Twain North	49	2.0	18 (0)	7	0.37
Twain South	70	1.7	22 (5)	14	0.24
Twain West	72	1.9	36 (16)	6	0.28
Twain New	50	1.9	25 (6)	4	0.38
Negit Islet Totals:	**420**		**183 (41)**	**49**	
Average =	**60.0**	**1.9**		**12%**	**0.35**
Coyote Cove	20	1.4	0	9	0
Coyote Hilltop	27	1.8	0	6	0
Piglet East	33	1.7	0	0	0
Piglet West	22	1.8	0	7	0
Paoha Islet Totals:	**102**		**0**	**22**	**0**
Average =	**25.5**	**1.7**	**0**	**21%**	**0.00**
Lakewide Totals	**522**		**183 (41)**	**71**	
Average =	**47.5**	**1.8**	**22% mort.**	**13.6%**	**0.22**
SE =	**7.5**	**0.06**			**0.06**
Lakewide Reproductive Success, corrected (see methods)					**0.315**

Based on the total of 16,774 California Gull nests on Mono Lake and an average of 0.31 ± 0.06 chicks fledged per nest, an estimated 5,284 ± 301 chicks fledged at Mono Lake in 2011. This is well below the 1983-2010 average of 23,344 ± 697 (*n* = 28 years), and marks the second consecutive year all measures of population health (population size, reproductive success, estimated chick production) have been well below average for Mono Lake's gulls (Nelson and Greiner 2010).

The California Gull population size at Mono Lake has found to be closely associated with average spring temperatures and spring-time brine shrimp density on Mono Lake (Wrege et al. 2006). Wrege et al. found April temperatures at Mono Lake are highly correlated with population size: cold springs result in reduced shrimp and fewer gulls. Although factors influencing California Gull reproductive success at Mono Lake have not been

thoroughly analyzed, temperatures experienced in May, the period spanning incubation and early chick rearing, appear highly correlated with reproductive success in recent years (Fig. 5). May 2011 was 4 C below the 2004-2010 average in the Mono Basin (http://www.monobasinresearch.org/data/); this along with other factors has negatively affected the gulls.

Fig. 5. Average May Temperatures in the Mono Basin vs. Gull Reproductive Success



Mass at Banding

The average mass of the 183 chicks banded in early July was 509 ± 7g, which is similar to the 2002-2010 average mass of 500 ± 10g. Mass of chicks that survived to fledging (530 ± 7g; n = 142) was significantly greater than the average mass for chicks that did not survive to fledging (434 ± 19g; n = 40) (X^2 = 22.9, df = 1, p = 0.0001). This pattern has been consistent through all years in which chicks were weighed.

Tick Infestation

Ticks were found on only 5 chicks of the 182 examined in 2011, less than 3%. Those with ticks had very few, and the presence of ticks was not significantly associated with chick mortality. The presence of "mites", small orange ectoparasites we now believe to be larval ticks, was more widespread. Eighty-one chicks (44%) had "mites" present on the tibia, although their presence was not associated with increased mortality. Though not

experienced in 2011, 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 found nesting on the Mono Lake islets in 2011 were the Black-crowned Night-Heron (*Nycticorax nycticorax*), Osprey *(Pandion haliaetus*), and Violet-green Swallow (*Tachycineta thalassina*). Black-crowned Night-heron nests were not thoroughly counted on the Mono Lake islets this year but were present on Twain and Little Tahiti Islets only. The/a Osprey pair returned to nest on the Negit Islet Midget, although they did not successfully fledge young this year. Violet-green swallows are abundant breeders in rock crevices on Negit island and some of the Negit Islets.

Detections and Recoveries of Banded Mono Lake California Gulls in 2011

There were 8 detections of banded Mono Lake gulls in late 2010 and 2011; all were from California. No banded gulls from Mono Lake were detected on Southeast Farallon Island in 2011, where most color-band detections have occurred in previous years. Southeast Farallon Island experienced a dramatic decline in fall visitation of migrant California Gulls in 2011 compared to recent years (PRBO unpubl. data, J. Tietz, pers. comm.) which resulted in the lack of color band detections. Daily totals of California Gulls tallies at Southeast Farallon during fall 2011 were generally in the single or double digits (PRBO unpubl. data, data from ebird.org, and KNN pers. obs.). Similar dates in 2009 and 2010 hosted several hundred to well over a thousand individuals, and multiple observations of color-marked individuals (PRBO unpubl. data, Nelson and Greiner 2009, Nelson and Greiner 2010).

Band recoveries and sightings of Mono Lake gulls over the past year are as follows:

● A juvenile found dead at Mono Lake County Park December 16, 2010 was banded in July 2010

● An adult found dead at Old Marina on the west shore of Mono Lake on June 17, 2011 had been banded as a chick on Mono Lake in July, 1997. It was 14 years old.

● An adult was found in Modesto, Stanislaus County, CA on May 2, 2011. It had been banded at Mono Lake as a chick in July 2001. It was 10 years old.

● One found in Long Valley, Mono County near Crowley Lake on July 23, 2011 had been banded as a chick on Mono Lake in July 1992. It was 19 years old.

● On August 21, 2011, a juvenile with a red coded band from Mono Lake in 2011 was observed in the Coast Casey forebay near Mountain View, in the San Francisco Bay, Santa Clara County.

● A third-cycle California Gull with the 2009 Mono Lake color-band combination (pale blue over silver on the left leg) was observed on the beach at Half Moon Bay, San Mateo County on October 19, 2011 by Alvaro Jaramillo (Fig. 5).

● A dessicated leg with an attached band was found on the east side of Paoha Island on October 23, 2011. It had belonged to a chick banded in July 2010. Based on the condition of the leg, it probably died the previous summer or fall shortly after fledging.

● A juvenile with a red coded band was observed a Cabrillo Beach, Los Angeles County, California on December 21, 2011. It was banded as a chick in 2011.

Fig. 5. Third-cycle California Gull banded at Mono Lake as a chick in 2009, photographed at Half Moon Bay, CA. Oct. 2011. Ph. Alvaro Jaramillo

Acknowledgments

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Appendix 1. Nest number by islet, 2003-2011

Negit Islets	2003	2004	2005	2006	2007	2008	2009	2010	2011
Twain	9288	11480	9582	9900	10138	8891	11449	8219	8704
L. Tahiti	2632	3303	2511	2700	3102	2477	2770	2429	2049
L. Norway	249	213	126	165	172	137	119	114	171
Steamboat	575	635	621	583	631	590	580	509	579
Java	718	915	779	710	648	482	433	367	432
Spot	70	98	127	75	9	49	87	122	151
Tie	38	49	50	33	0	9	37	55	58
Krakatoa	113	181	184	131	119	24	5	2	0
Hat	7	9	3	5	10	3	3	0	7
La Paz	0	1	2	0	0	0	0	0	0
Saddle	0	0	0	1	1	0	1	0	0
Midget	0	1	1	0	0	0	0	0	0
Little Tahiti Minor	[a]	[a]	[a]	[a]	[a]	[a]	152	151	162
Pancake	1847	2837	2530	2059	1602	1623	2293	1894	1741
Negit Islets Total	**15537**	**19722**	**16516**	**16362**	**16432**	**14285**	**17929**	**13862**	**14054**
Paoha Islets									
Coyote A	2480	3244	3174	3181	3094	1989	2591	1711	929
Coyote B	34	55	63	40	0	0	0	0	0
Browne	224	283	253	225	118	99	135	116	50
Piglet	1010	1552	1649	1218	1269	1001	1314	997	599
Paoha Islet Total:	**3748**	**5134**	**5139**	**4664**	**4481**	**3089**	**4040**	**2824**	**1578**
Negit Island:	452	587	285	120	63	0	0	0	0
Old Marina	178[e]	511	1	94	723	1089	1775	1496	1133
Old Marina So.	0	0	0	0	0	9	22	4	9
Lakewide Total	**19915**	**25954**	**21941**	**21240**	**21699**	**18472**	**23766**	**18186**	**16774**
Nesting Adults	**39830**	**51908**	**43882**	**42480**	**43398**	**36944**	**47532**	**36372**	**33548**

a. Nest numbers for Little Tahiti Minor were previously included within the Little Tahiti Total

b Nests were not counted with water soluble paint on Old Marina Island this year. The paint serves as a counting aid, and counters judged that the 178 nests they recorded was an underestimate.

c. 2011 totals in RED represent estimates. See text