Point Blue Report

Population size and reproductive success of California Gulls at Mono Lake, California

Annual Report to the Mono Lake Committee

December 2014

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Conservation science for a healthy planet

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Acknowledgements

We are grateful to the Mono Lake Committee for providing financial and logistical support for this project again in 2014. Special gratitude to the June Lake Marina for servicing our boat engine, especially this July when Dave's quick response allowed our field work to continue. We greatly appreciated the help of the volunteers who assisted with field work – without dedicated people like you, the long-term effort would not have been possible. Volunteers for the 2014 season were: Courtney Gayer, Alexea Hendry, Ashli Lewis, Erv Nichols, Sandra Noll, Ryan Price, Zach Rhodes-Michelson, and Teague Scott. Special thanks to Jay Roberts and Ryan Burnett from Point Blue for their help with data analysis and report editing, and Greg Reis of the Mono Lake Committee.

Suggested Citation

Nelson, K.N. & A. Greiner. 2014. Population Size and Reproductive success of California Gulls at Mono Lake, California. Report to the Mono Lake Committee. Point Blue Conservation Science, Petaluma, CA.

This is Point Blue Contribution No. 2014.

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Cover photo: California Gulls on Twain Islet. Photo by Russ Taylor

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EXECUTIVE SUMMARY

We conducted our 32nd year of monitoring the California Gull breeding population on Mono Lake in 2014. An estimated 40,044 adult California Gulls (*Larus californicus*) nested at Mono Lake in 2014. This total is below the long-term average of 46,518 ± 1393 for the period 1983–2013 (*n* =31 years). Eighty-six percent of Mono Lake's gulls nested on the Negit Islets, 14% on the Paoha Islets, and <1% nested on Negit Island and the Old Marina islets. Due to California's extended drought, the surface elevation of Mono Lake dropped during the 2014 breeding season to lake levels not recorded since 1996. Piglet Islet and the Old Marina islets became connected or nearly connected to the mainland (Paoha Island in the case of Piglet Islet), resulting a dramatic drop nest numbers, islet abandonment, or islet-wide nest depredation. Lake-wide reproductive success of 1.02 ± 0.05 chicks fledged per nest was above the 1983-2013 average of 0.90 ± 0.06. An estimated 20,299 ± 979 chicks fledged from Mono Lake islets in 2014. For the 819 weighed in July, weight at banding was significantly greater for those that survived to fledging than for those that did not. Post-banding mortality was 13%, which is slightly below the 2004-2013 average of 15% ± 2%, but above the long-term (1986-1994 & 2000-2013) average of 10% ± 2%. Eight hundred and twenty-four chicks were banded in July. Of these, 254 received coded, auxiliary marked red color bands, 522 received a green cohort color band on the left leg over the federal USFWS band, and 48 very young chicks received no color band, as their tarsi were too small to accept two bands.

INTRODUCTION

Mono Lake in eastern California is a large hypersaline lake of great ecological importance. Its large seasonal populations of endemic brine shrimp (*Artemia monica*) and alkali flies (*Ephydra hians)* provide important food resources for a large numbers of birds. Mono Lake supports one of the largest breeding colonies of California Gulls in the world (Winkler 1996).

In 1983, Point Blue Conservation Science (founded as Point Reyes Bird Observatory) began standardized monitoring of the population size and reproductive success of California Gulls at Mono Lake. The goal of the project is to use gulls as an indicator to help guide long-term management of the lake ecosystem. Specifically we aim to track the long-term reproductive success and population size of the gulls through changing lake conditions and identify the ecological factors influencing fluctuations in these metrics. This study represents one of the longest term ongoing studies of birds in North America. It is a powerful tool for assessing the conditions at Mono Lake and can be an invaluable tool in understanding how wildlife populations respond to ecological change that manifests over longer periods (e.g. climate change).

In 2014, we conducted the 32nd consecutive year monitoring the population size and reproductive success of California Gulls (*Larus californicus*) at Mono Lake. We continued to collect information on nest numbers, banded young gulls, and surveyed for mortality. In recent years we have also added additional objectives to better understand gull movements, including fall and winter distribution and breeding colony fidelity through a color banding program. In this report we provide a detailed summary of the 2014 results with reference to historical conditions. We also discuss the impacts of the historic drought and low lake levels on the gull population at the lake.

Study Area

Mono Lake, California, USA, is located at 38.0° N 119.0° W in the Great Basin of eastern California at an altitude of 1945 m. The lake has a surface area of approximately 160 km2, a mean depth of about 20 m, and a maximum depth of about 46 m. As a terminal lake with no outlet, it is high in dissolved chlorides, carbonates, and sulfates, and has a pH of approximately 10.

Fig. 1. Locations of islands and islets within Mono Lake. Note when this photograph was taken the surface elevation of Mono Lake was approximately 1 m above that measured during the 2014 gull breeding season.

Gulls nest on a series of islands located within an approximately 14-km² area in the north-central portion of the lake. At various times the gulls have nested on Negit (103 ha) and Paoha (810 ha) islands, and on two groups of smaller islets referred to as the Negit and Paoha islets, which range in size from 0.3–5.3 ha (wrege et al. 2006). During the study period 1984–2012, the proportion of the gull population nesting on the Negit

islets, where we monitored nesting success, has varied from 70 – 91% of the lake-wide total and has contained 13,862 – 23,488 breeding individuals.

Fig. 2. View of the nesting islets within the Negit Islet complex. Note when this photograph was taken the surface elevation of Mono Lake was approximately 1 m above that measured during the 2014 gull breeding season.

METHODS

Nest Counts

In 2014, we continued using our standardized methods for counting gull nests. We counted nests in every plot from May 22 – 25 in 2014. We walked through colonies on 12 islets in sweep-lines to count nests. Each sweep line consisted of 3 to 6 personnel depending on islet size and nest density. Every nest (defined by containing at least 1 egg) was counted with a tally meter and marked with a small dab of water-soluble paint to avoid duplicate counts. For some small islets with low densities, incubating adults were counted from a small motor boat. Depredated nests (observed on Old

Marina South Islet) containing eggshell fragments and/or yolk stains within the nest bowl were counted, empty nests were not.

Clutch Size, Banding, and Reproductive Success

We sampled 9 fenced plots on 3 islets to estimate clutch size and sampled 8 plots on 3 islets to estimate reproductive success in 2014. 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 two smaller rounded fenced plots approximately 100 -120 m^2 are located on Coyote A Islet of the Paoha Islet complex (see Fig. 1 & 3). Average clutch size was estimated by counting the number of eggs per nest for all nests within the 9 plots during nest count in late May.

Data from some plots used in past years were excluded from our sample in 2014. Two plots on Piglet Islet have been excluded from our sample since 2012 due to localized nesting failure and/or abandonment caused by predation. Due to the relative isolation of this nesting failure, the Piglet Islet plots were not deemed representative for the overall population. One additional plot on Coyote Islet (Coyote Hilltop) was not used due to a large hole under the fencing caused by ground erosion which allowed chicks to freely move in or out of the plot. Though chicks in this plot were banded, multiple chicks (5+) escaped from the hole, and we decided to drop data from this plot for reproductive success measures due to the likelihood that the number of chicks banded did not accurately reflect the nest numbers in May. After banding, we removed an entire side of the plot fence to enable the escaped chicks to return to their territories. This plot was included in clutch size and chick mass evaluations.

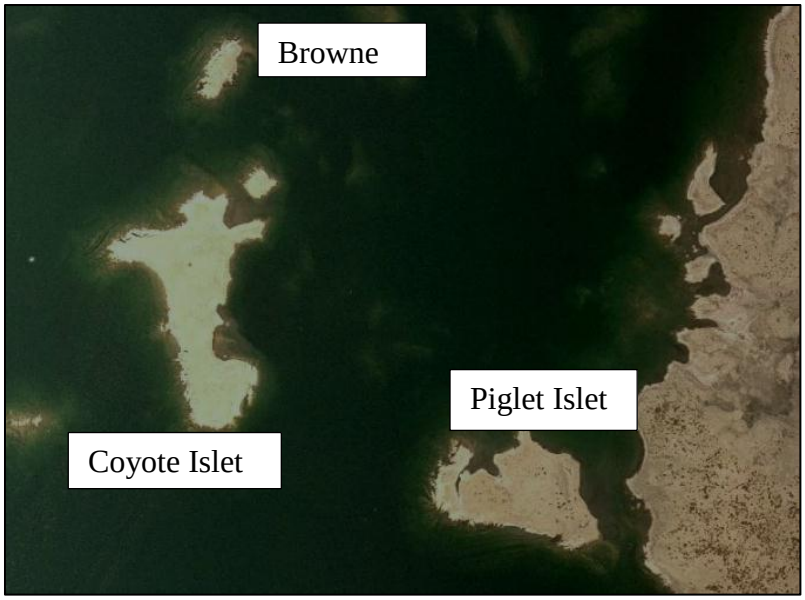

Fig. 3. The Paoha Islet complex. Note when this photograph was taken the surface elevation of Mono Lake was approximately 1 m above that measured during the 2014 gull breeding season.

From 7 - 10 July 2014, we banded all chicks within the plots with a silver U.S. Fish and Wildlife Service (USFWS) band as well a color band – either a single green cohort-style color band (applied over the federal band on the right leg of smaller or less vigorous chicks) or a red coded band engraved with a field-readable numeric code unique to each banded individual (applied to larger, more robust chicks). During banding, chicks were weighed using hand-held Pesola scales. Diet samples were taken from chicks that spontaneously regurgitated during banding. For each bolus of regurgitation, the percent volume of each prey item was estimated. From 29 August - 1 September 2014, we searched the islets in which chicks were banded 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 2014. We calculated the fledging rate for each plot **(fplot)** as:

$$fplot = (Cb - Cd) / Np$$

where **Cb** is the number of chicks banded in that plot in July, **Cd** is the number of chicks from that plot found dead in September, and **Np** 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 **fi** is the number of young fledged per nest in each of the fenced plots. Overall chick production is estimated by multiplying the average reproductive success by the total number of nests. In 2014, we modified this calculation by subtracting the number of nests known to have perished (i.e. nest tallies from Piglet Islet and the Old Marina islets) from the total. We analyzed variables associated with chick mortality 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 in 2014. We also checked for the presence of "mites" (which may be 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).

RESULTS

Number of Nests and Breeding Adults

In 2014, we counted a lake-wide total of 20,022 California Gull nests, yielding a population of 40,044 nesting adults. This is below the long-term mean population size of 46,518 ± 1393 for the period 1983-2013 (n = 31 years). Eighty-six percent of the gulls nested on the Negit Islets, 14% nested on the Paoha Islets and <1% nested on Old Marina and Old Marina South islets (Figures 1, 2 and 3, Appendix 1). Twenty-eight nests were counted on Negit Island, only the third time nests have been found there since 2007. Of the individual islets, Twain was the most populous, holding 9,144, or 46%, of the lake-wide total number of nests. Little Tahiti and Coyote islets were the next most populous islets, containing 3,899 and 2,618 nests; representing 20% and 13% of the entire nesting population respectively (Appendix 1).

Changes in nest numbers relative to recent years were noted on the Old Marina islets, Paoha islets, and Negit Island (Appendix 1). The Old Marina islets, which contained 2,045 nests in 2013, representing approximately 9% of the Mono Lake population (Nelson and Greiner 2013), was connected to the mainland in 2014. This resulted in abandonment of Old Marina Islet, and complete nesting failure due to Coyote (*Canis latrans*) predation on Old Marina South. Piglet Islet of the Paoha Islet complex also became connected to Paoha Island in 2014. Only 38 nests were counted on Piglet Islet in May and all had perished by July. This near abandonment likely reflects repeated predation and total nesting failure experienced on this islet since 2011, which became exacerbated as Coyotes from Paoha Island gained access to this islet due to lowered lake levels. Coyote Islet, however, experienced a jump in population size relative to recent years, which may reflect birds displaced from nearby Piglet Islet, or possibly even from Old Marina Islet.

Phenology

Four nests containing very freshly hatched chicks were detected during the May 22-25 2014 nest count. This is approximately average. In July, the plots contained 18 active nests with eggs, which represent 2.4% of the total counted in May. These numbers suggest the breeding season was not protracted. By comparison, in 2010, a year in which the breeding season was protracted, and nearly 27% of the nests within the plots still contained eggs in July (Nelson and Greiner 2010).

Clutch Size

In 2014, the lake-wide average clutch size was 1.9 ± 0.05 eggs/nest (range = 1-3 eggs, n = 723 nests). Overall, 29% of the nests contained one egg, 58% had two, and 14% had three. The average clutch size for Mono Lake since 2002 (n = 12 years) is 1.9 ± 0.05 eggs/nest.

Reproductive Success

The Negit Islet plots averaged 86 ± 11 nests and averaged 1.03 ± 0.05 fledged chicks per nest. Nesting density for the Negit Islet plots was approximately 0.38 nests/m^2. On the Paoha Islets, the two plots on Coyote Islet averaged 60 ± 3 nests and Coyote Cove (the only Paoha Islet plot used for reproductive success measurements in 2014) fledged 0.95 chicks per nest. Combined, the 8 plots used to estimate lake-wide reproductive success averaged 1.02 ± .05 fledged chicks per nest (Table 1), which is above the long-term average of 0.90 ± 0.07 chicks fledged per nest.

Table 1. Summary of Nest Counts, Chick Banding, and Mortality Counts from all plots in 2014.

Plot	# of nests in May	Avg. chicks/nest in July	Avg. mass of chicks in July(grams)	# chicks banded (# found dead)	Total chicks successfully fledged/nest
Cornell	135	1.13	548	152 (12)	1.04
Little Tahiti East	66	1.11	534	73 (6)	1.01
Little Tahiti West	106	1.15	507	122 (20)	0.96
Twain North	53	1.49	542	79 (8)	1.34
Twain South	80	1.2	473	96 (21)	0.94
Twain West	97	1.1	526	107 (9)	1.01
Twain New	66	1.06	545	70 (10)	0.91
Negit Islet totals/averages:	**603**	**1.18 ± .05**	**525 ± 5 gr**	**699 (86)**	**1.03 ± .05**
Coyote Cove	57	1.12	547	64 (10)	0.95
Coyote Hilltop	63	n/a	528	n/a	n/a
Paoha Islet Totals: * C. Cove only	**120**	**1.12***	**538 ± 10 gr.**	**64 (10)***	**0.95***
Lakewide totals/averages	**723**	**0.875 ± .07**	**527 ± 4.7 gr.**	**763 (96)**	**1.02 ± .05**

In May 2014, 20,022 California Gull nests with at least 1 egg were counted on Mono Lake. However, of these, at least 117 were known to have failed due to predation or abandonment. Thus, based on the remaining total of 19,905 California Gull nests not known to have been predated or abandoned, and an average of 1.02 ± 0.05 chicks fledged per nest, an estimated 20,299 ± 981 chicks fledged at Mono Lake in 2014. This is similar to the 1983-2013 average of 20,950 ± 1362 (n = 31 years). The long term average is calculated for the Negit Islets only from 1983-2002, and Negit and Paoha Islets combined since 2002.

Mass at Banding

The average mass of the 819 chicks banded and weighed in July 2014 was 527 ± 4g, which is well above the long-term average (calculated since 2002) of 500 ± 7g. Mass of chicks that survived to fledging (548 ± 4g; $n = 706$) was significantly greater than the average mass for chicks that did not survive to fledging (397 ± 13g; $n = 113$) ($X^2 = 111.8$, $df = 1$, $p = 0.0001$). This pattern has been consistent all years in which chicks were weighed.

Chick Diet

Diet samples were examined from 32 spontaneous regurgitations; 15 were obtained in the morning and 17 in the late afternoon. Brine shrimp accounted for 54% of the observed diet, alkali fly (*Ephydra hians*) larvae or pupae were 25%, and insects were 13%. Of the proportion of diet consisting of insects, grasshoppers (*Melanoplus sp.*) accounted for 51% of the volume, Mayflies (*Ephemeroptera*) 35%, and Cicadas (*Okanagan sp.*) 10%. Lesser diet items included garbage (4%), a California Gull embryo (3%), and adult alkali flies (0.3%).

Tick Infestation

Ticks were found on 63 chicks of the 824 examined, nearly 8% of the total, which is somewhat higher than in recent years. Of those with ticks, 57 had a tick score of 1, 5 had a score of 2, and 1 chick had a score of 3. All chicks with a tick score >1 were from Little Tahiti East plot, which has had large outbreaks of tick infestation in past years. The presence of "mites", small orange ectoparasites we now believe are likely tick nymphs, were more prevalent. Mites were detected on the tibia of 12% of chicks similar to 2013 (Nelson and Greiner 2013). Though not experienced in recent years, plots with very high levels of tick infestation have experienced reduced reproductive success (Hite et al. 2004).

Post-banding Mortality Rate

During our mortality count in early September, 96 dead, banded chicks (those from Coyote Hilltop plot excluded) were recovered from the islets on which they were banded. This post-banding, pre-fledging mortality rate represents 13% of the total number banded, which is above the long term (1984 – 2012) average of 10% ± 1%, although below the average mortality rate over the past 10 years, which is 15% ± 2%.

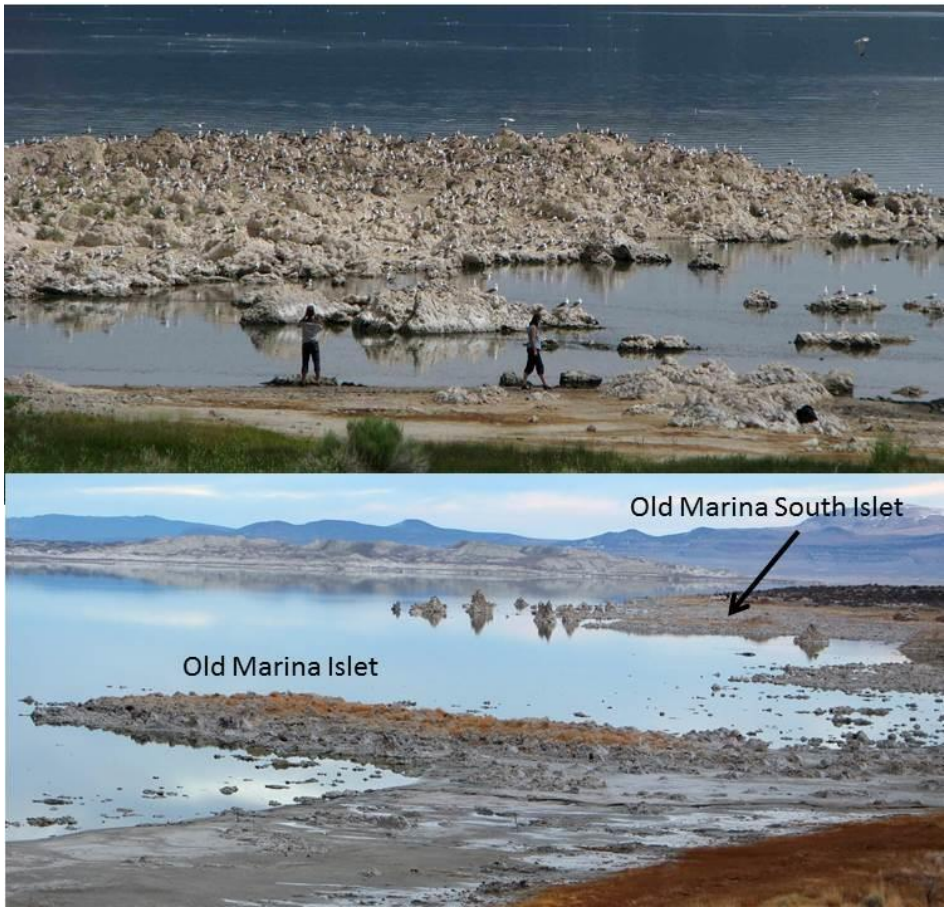

Fig.4. Old Marina Islet in 2008 (top) and in 2014 (below). The formation of the land bridge to this islet in 2014 displaced an estimated 7% of the breeding California Gulls on the lake.

Lake Level Related Nest Predation

The historic drought gripping California has had significant impacts on Mono Lake. This year marked the third consecutive year of extreme, nearly unprecedented, drought for California. The California Department of Water Resources reported the 2014 water year (which ended 9/30/2014) was California's 3rd driest in 119 years of record (www.water.ca.gov/waterconditions). Mono Lake dropped 0.43 m (1.4') from May 2013 to May 2014, and declined an additional 0.21 m (0.7') during the 2014 breeding season (May 1 – Aug. 1). On August 1 the lake level was 1944.6 m (6379.9') above sea level - the lowest recorded since 1996 (data courtesy of Los Angeles Dept. of Water and Power).

As a result of these lower lake levels, a number of gull nesting islands became accessible to predators. Old Marina Islet, which has contained approximately 7 – 8% of the Mono Lake nesting population since 2009, became fully connected to the mainland in 2014 (Fig. 4), and gulls abandoned this islet. Mono Lake Tufa State Reserve park rangers noted 9 nests containing abandoned eggs in mid-May (D. Marquart, pers. comm.). No further nesting activity occurred there. Old Marina South Islet, which contained 380 nests in 2013 (nearly 2% of the population), was raided by a Coyote in 2014 and all nests were destroyed. During our May nest count, we encountered dozens of empty and depredated nests. A small water (< 50 m wide) channel was all that separated this islet from the mainland and it was pocketed with boulders. Coyote scat and many small dug scrapes and holes were scattered around this small islet. A minimum of 70 gull nests containing relatively fresh eggshell fragments and/or yolk stains were counted. Many more recently constructed yet empty nests were found as well. We suspect these were also victims of predation (perhaps containing small chicks or eggs which were swallowed whole or carried away, leaving no remains). However, we did not include these empty nests in nest number estimation. Thus we suspect the 70 depredated nests on Old Marina South to be an underestimate.

The decline of Mono Lake in 2014 resulted in Gaines Island (Fig. 1 & 5) becoming connected to the mainland. Coyote scat was observed on Gaines Island in May 2014, and many tracks were seen in the alkali playa in the vicinity of the Gaines Island

Closer view of "A" from above, showing the distance between Pancake Islet and the Gaines Island landbridge

Closer view of "B" from above, showing the distance between Twain Islet, "Loafer's Landing" and the Gaines Island landbridge

Fig.5. Negit Islets and Gaines Island landbridge in late fall, 2014. "A" shows the proximity of Pancake Islet to Gaines Island; "B" shows the proximity of Twain Islet to Loafer's Landing and Gaines Island.

landbridge (KNN pers. obs.). In July, we estimated Twain Islet was approximately 200 m from "Loafer's Landing" a small islet nearly connected to Gaines Island near Twain Islet (Fig. 5). By late fall of 2014, this distance had declined to a greater extent, and an additional small islet near Loafer's Landing emerged (Fig. 5 bottom). The water in this area is also known to be shallow. Pancake Islet appears to be even closer than Twain to the Gaines Island landbridge (Fig. 5A), although this distance was not estimated during field work in 2014. Coyote(s) continually raided gulls nests on certain Mono Lake islets from 1989 – 1996, crossing up to 200 m of Mono Lake water in this area (Dierks 1990). Thus, Twain, Pancake, and perhaps other Negit Islets could be susceptible to Coyote predation in future years if the surface elevation of Mono Lake does not rise.

Eagle Predation

In May, we observed a Bald Eagle (*Haliaeetus leucocephalus*) consuming many gull eggs on two islets. Although we have observed eagles hunting adult gulls within the colony nearly annually, this is the first time we observed one taking eggs. On 22 May we observed the eagle on Twain islet moving slowly through the colony, consuming multiple gull eggs in fairly rapid succession. The next day we observed an eagle on Piglet Islet eating eggs. The number of gull eggs taken by the eagle is unknown, but if it continued to make regular foraging bouts to the colony, its impact could potentially be fairly high.

Detections and Recoveries of Banded Mono Lake California Gulls

There were approximately 50 detections or recoveries of banded Mono Lake gulls received in 2014; all were from California or near Reno, Nevada. The majority of these detections were of live gulls observed in the field wearing color bands (Fig. 6). Most reports were coastal, representing migrant or wintering individuals; and seven

individuals were detected within breeding colonies. We are particularly interested in recording marked birds in breeding colonies to investigate if gulls hatched from Mono Lake emigrate to breed elsewhere. We began using the easily detectable red coded bands in 2010. Since California Gulls reach first begin breeding at 4 years of age (Winkler 1996), we expect an increase in detections of Mono Lake gulls in the coming years. Six of the 7 gulls within breeding colonies were banded at Mono Lake in 2010, including two which were also detected in the same location within the colony in 2013. An additional bird, a 2-year old, was detected by biologists with the San Francisco Bay Bird Observatory within a breeding colony in the South San Francisco Bay in May (N. Washburn, pers. comm.). An additional 2-year old gull from Mono Lake was observed in June 2013 adjacent to one of the largest and fastest growing sub-colonies within the south San Francisco Bay complex (C. Nilsen, pers. comm).

Fig. 6. An adult color-banded Mono Lake gull detected at Dockweiler State Beach, Los Angeles Co. March 31 (ph. L. Sansone). This same individual had been reported as a juvenile at a nearby beach on November 21, 2010. Right: a third-year bird at the Sparks Marina, near Reno, Nevada on January 7 (ph. M. Meyers).

DISCUSSION

Population Size

The population size of California Gulls at Mono Lake was below average in 2014, despite the apparent presence of some conditions that Wrege et al. (2006) found to be conducive to a higher population size (e.g. warm spring, abundance of shrimp in May). The abandonment of Old Marina Islet could have contributed to the breeding population size if the gulls that typically nested there did not relocate. However, the addition of an expected population size for Old Marina would still leave the 2014 population size relatively low. Low recruitment may have also affected population size. Wrege et al. found the reproductive success 4 years previous to the current year affected the annual population size at Mono Lake by its influence in recruitment, i.e. the number of 4-year old gulls returning to Mono Lake to breed for the first time. In 2010, we documented the worst average reproductive success recorded in the history of the gull project. On average, only 0.26 chicks fledged per nest, and estimated chick production was approximately 4,700, compared to the long-term average 20,950 (Nelson and Greiner 2010).

The low population size recorded in 2014 could also be part of a longer-term population decline. Recent analysis has shown the population size of California Gulls at Mono Lake is in significant decline ($R^2 = 0.234$; Point Blue, unpubl. data; Fig. 7). Reasons for this long-term decline are unknown. Using data from 1987 – 2003, Wrege et al. (2006) found the population size of California Gulls at Mono Lake was positively correlated with the density of brine shrimp in spring around the time of egg laying. Since 2004, shrimp densities have been peaking significantly earlier in spring, closer to the time of gull egg-laying, relative to the long-term data collected since 1982 (Jellison and Rose 2012, Los Angeles Dept. of Water and Power 2013). We would thus expect the gull population to respond positively since this time, yet the opposite has occurred.

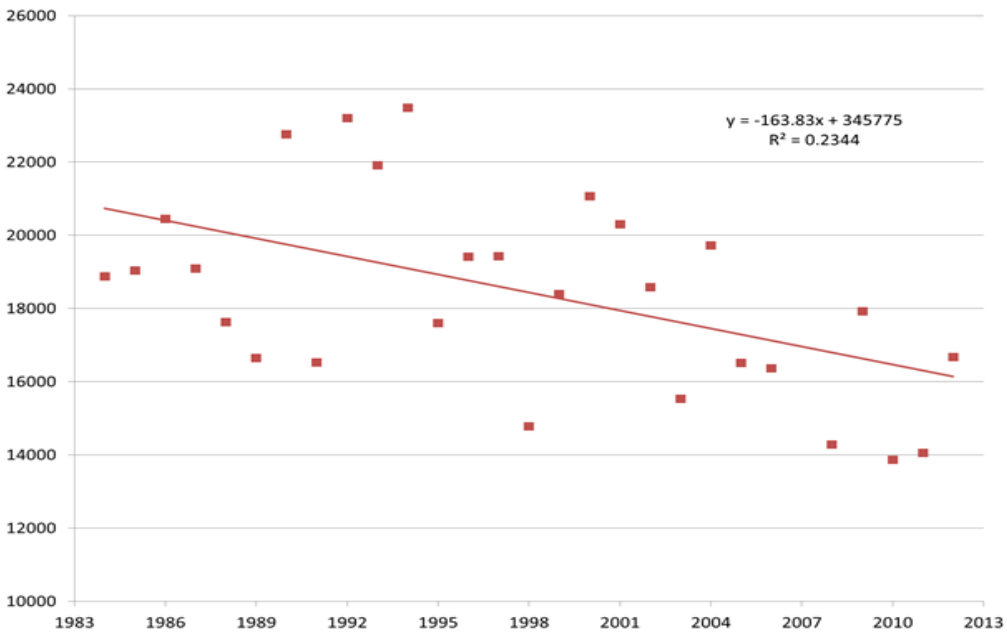

Figure 7. The number of California Gull nests on the Negit Islets in Mono Lake from 1983 – 2013 with linear trend.

One hypothesis is that gulls from Mono Lake could be emigrating to breed at colonies in the San Francisco Bay. Emigration from other colonies accounted for the pioneering breeders and continues to account for some of the high growth rate of colonies in the San Francisco Bay, as local chick production alone likely could not account for such rapid growth (Shuford and Ryan 2000, Fig. 8). Since 2008, in all years but one, the San Francisco Bay population of breeding California Gulls has exceeded that of Mono Lake. This year, the San Francisco Bay population outnumbered Mono Lake by the largest margin yet recorded - approximately 33%. Perhaps some Mono Lake gulls gain exposure to the large Bay Area colonies over-summering in that region as sub-adults, and begin breeding there when they reach sexual maturity.

Thus far, color band detections within breeding colonies do not indicate significant emigration is occurring. Rather, our limited results suggest fidelity to the natal colony. Yet our sample size is tiny. Additionally, field workers at Mono Lake spend

considerably more time in the colony over a greater proportion of the breeding season relative to efforts in the San Francisco Bay colonies, so would be expected to detect more banded gulls at Mono Lake. The great majority of in-colony band detections at Mono Lake have been during July chick-banding efforts, when it is far easier to scan territorial birds than during May nest counts. Such banding efforts are not conducted in San Francisco Bay colonies. More time is needed to increase our sample size. The breeding season sightings of sub-adult Mono Lake gulls detected in or near San Francisco Bay colonies suggest some young birds are summering in or near these colonies.

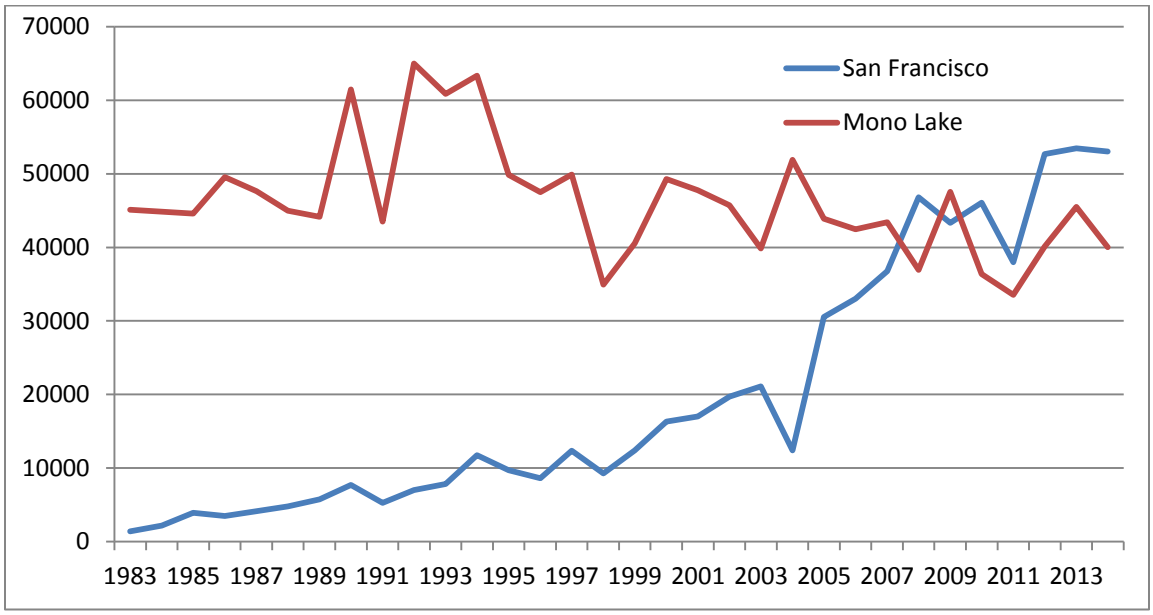

Figure 8. Breeding colony sizes of California Gulls nesting at Mono Lake and San Francisco Bay, 1983 -2014. San Francisco Bay data courtesey of San Francisco Bay Bird Observatory.

More study is needed to investigate why the gull population at Mono Lake is in decline. A re-evaluation of the factors Wrege et al. (2006) found to influence population size would be insightful, as it appears population trends and dynamics may have changed

since that time. Further investigations into mortality rates, breeding frequency, and other aspects of population biology would increase our understanding of this trend.

Reproductive Success

The above average reproductive success experienced by Mono Lake gulls in 2014 can likely be attributed in part to favorable environmental conditions including a warm spring and lack of meromictic stratification in the lake (Nelson et al. 2014). The relatively high reproductive success helped boost overall chick production to near the long-term average, despite the below average population size.

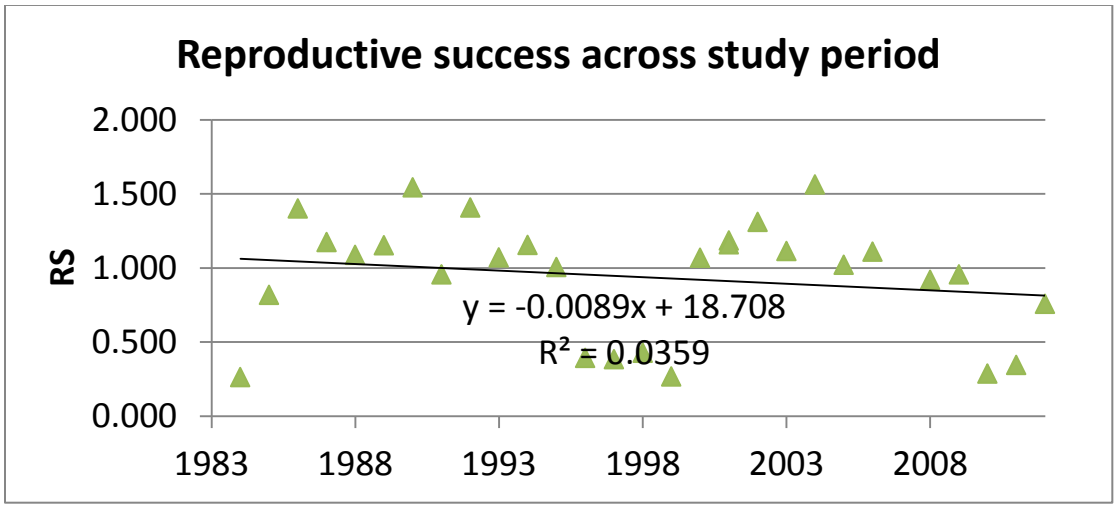

Figure 9. Annual trend in California gull reproductive success (RS) at Mono Lake, California from 1984 – 2012.

Recent analysis on long-term reproductive success data (see Nelson et al. 2014 for methodology) has shown a non-significant downward trend (Fig. 8). Continued monitoring will be important to see if the trend continues or worsens. Depressed annual reproductive success could lessen annual chick production, and thus amplify population decreases observed at Mono Lake.

Lake Level and Colony Stability

Mono Lake's decline in 2014 has revived the threat of predation pressure to the Mono Lake gull colony. Coyote(s) accessed some of the Negit islets in past years to depredate gull nests during lake levels similar to those of today. If drought in California continues, the Mono Lake gull colony could soon be in peril. If Coyote(s) learn of the profitable food resources the gull colony provides, they can become persistent predators if lake level conditions allow it. In addition, gulls often respond to Coyote predation by abandoning nesting islands/islets in subsequent years, which can further impact population size and overall productivity. Greg Reis (2014, *in litt.*) reported: "Once they learn they can gain food from the islands, coyotes swim longer distances at higher lake levels, as happened in 1996 when Twain was accessed at a lake level ~2 m (6.5') higher than the level at its initial invasion in 1982… Knowledge of island food resources may reside in the local population for a generation or more, which is why coyotes became bolder over the 1977-1996 period, even after higher lake levels created short intervals without access to the islands. Preventing renewed access is crucial, because once coyotes gain the knowledge, the memory lasts many years. If renewed coyote access to the Negit Islets occurs, it could jeopardize successful gull nesting for years or decades." Continued monitoring of lake levels and conditions, the gull population, and vigilance for Coyote sign on and near the nesting islets will be of great importance in coming years, particularly if Mono Lake does not rise significantly by next spring.

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Appendix 1. Nest number by islet, 2005 - 2014

Negit Islets	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Twain	9582	9900	10138	8891	11449	8219	8704	9396	9567	9144
L. Tahiti	2511	2700	3102	2477	2770	2429	2049	3366	3995	3899
L Norway	126	165	172	137	119	114	171	390	493	384
Steamboat	621	583	631	590	580	509	579	871	1175	1076
Java	779	710	648	482	433	367	432	325	234	216
Spot	127	75	9	49	87	122	151	39	95	162
Tie	50	33	0	9	37	55	58	30	56	65
Krakatoa	184	131	119	24	5	2	0	12	9	12
Hat	3	5	10	3	3	0	7	24	30	29
La Paz	2	0	0	0	0	0	0	0	0	4
Saddle	0	1	1	0	1	0	0	0	0	0
Midget	1	0	0	0	0	0	0	0	0	0
L.Tahiti Minor	[a]	[a]	[a]	[a]	152	151	162	253	282	255
Pancake	2530	2059	1602	1623	2293	1894	1741	1972	2450	1903
Negit Islets Total	**16516**	**16362**	**16432**	**14285**	**17929**	**13862**	**14054**	**16678**	**18386**	**17149**
Paoha Islets										
Coyote A	3174	3181	3094	1989	2591	1711	929	1393	2093	2618
Coyote B	63	40	0	0	0	0	0	0	0	n/a
Browne	253	225	118	99	135	116	50	60	75	110
Piglet	1649	1218	1269	1001	1314	997	599	344	148	38 [b]
Paoha Islets Total:	**5139**	**4664**	**4481**	**3089**	**4040**	**2824**	**1578**	**1797**	**2316**	**2766**
Negit Island:	285	120	63	0	0	0	0	7	8	28
Old Marina	1	94	723	1089	1775	1496	1133	1541	1665	9 [b]
O.M. So.	0	0	0	9	22	4	9	36	380	70 [b]
Lakewide Total	**21941**	**21240**	**21699**	**18472**	**23766**	**18186**	**16774**	**20059**	**22755**	**20022**
Nesting Adults	**43882**	**42480**	**43398**	**36944**	**47532**	**36372**	**33548**	**40118**	**45510**	**40044**

a. Nest numbers for Little Tahiti Minor were previously included within the Little Tahiti Total
b. Number of nests known to be depredated or abandoned on Old Marina South; likely an underestimate.