Point Blue Report

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

Annual Report

December 2018

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I am grateful to the **Mono Lake Committee** for providing financial, logistical and personnel support for this project. I am extremely thankful to **Lighthawk**, and pilot Geoff Pope, for providing flight time, which allowed this project to transition to aerial photography to count gull nests on Mono Lake. This benefits the gulls (who are no longer are disturbed during nest counts) and the people who study them. Additional thanks goes to the collaboration and support of Inyo National Forest staff, California State Park staff, and Steve Parmenter of California Dept. of Fish and Wildlife for contributing to the plan of action for burning off the *Bassia* weed off the Negit Islets.

I greatly appreciated the help of volunteers and others who assisted with field work – without dedicated people like these, this long-term effort would not have been possible. Participants for the 2018 season were: Nigel Bates, Michelle Desrosiers, Sarah Hecocks, Nora Livingston, and Joslyn Rogers

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**Cover photo:** The west shore of Twain Islet July 6, 2018. The yellow vegetation is dead *Bassia hyssopifolia*. This invasive weed has engulfed the Negit Islets since 2016 and has severely reduced nest site availability. A controlled burn conducted by Inyo National Forest to eradicate *Bassia* is planned for 2019

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## EXECUTIVE SUMMARY

Point Blue conducted the 36th year of monitoring the California Gull (*Larus californicus*) breeding population on Mono Lake in 2018. The population size was estimated by counting nesting gulls from aerial photographs – a technique which was newly implemented last year following a piolet study. Reproductive success was measured by counting the number of chicks in the plots in July, and applying the long-term mean post-banding mortality rate to estimate the total number of chicks that successfully fledged per nest.

The surface elevation of Mono Lake remained fairly steady through the 2018 nesting season, which was about a meter higher than it was in spring 2017. For a second consecutive year coyotes (*Canis latrans*) were not detected on Negit Island or the Negit Islets. This was due to the rising lake levels of 2017 and the effective electric fence erected on the land bridge in 2017.

The population size of California Gulls in 2018 was the lowest recorded in the 36 year history of the project. The estimate of 24,582 breeding California Gulls is well below the long-term average of 45,448 ± 1415 for the period 1983–2017 ($n$ =35 years). Likely explanations for the low population size include nest site reduction caused by *Bassia hyssopifolia* invasion of the Negit Islets, average brine shrimp (*Artemia monica*) densities in Mono Lake, and continued abandonment of islets that were raided by Coyote(s) in 2016.

Average reproductive success in the sample plots was 0.431 ± 0.10 chicks fledged per nest. The 1983 - 2017 average is 0.88 ± 0.06 chicks fledged per nest. Based on plot data, I estimated 5,297 ± 540 chicks fledged from Mono Lake in 2018. This is approximately the 5th lowest chick production measured since efforts began in 1983.

# 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 2018, I conducted Point Blue's 36th consecutive year monitoring the population size and reproductive success of California Gulls (*Larus californicus*) at Mono Lake. I continued to collect information on nest numbers and reproductive success with new methodologies adopted in 2017 which reduce disturbance to the gulls. In this report I provide a detailed summary of the 2018 results with reference to historical conditions. I also discuss the ongoing status of the invasive weed *Bassia hyssopifolia* which overtook most of the nesting areas on the Negit Islets in 2017.

**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 223 $km^2$, 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.


Gulls nest on a series of islands located within an approximately 14-$km^2$ 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 (fig. 1-3, Wrege et al. 2006).

**Fig. 2**. View of the nesting islets within the Negit Islet complex.


**Fig. 3**. The Paoha Islet complex.

# METHODS

## Nest Counts

**Aerial Surveys:** In 2017, I adopted a new standardized method using aerial photography to count gull nests. This new methodology allows for the population size to be accurately measured without the disturbance involved in ground counts. This switch came following two years of pilot study testing and calibrating aerial photography results with the traditional ground counts. Aerial photo-based nest counts were found to be a good alternative to the ground counts, with results reflecting 90% - 100% of ground count tallies when photographs with sufficient detail were used.

On 24 May 2018, I photographed all islets from the open window of a Cessna 180 flying above the lake using an 18 – 200mm zoom lens. The typical focal length used was 100mm – 140mm. The goal was to obtain images with sufficient resolution so that incubating and standing gulls are easily differentiated, and the area captured in each photograph is maximized in order to reduce time spent "stitching" images together (using GIS to "stitch" images wasn't satisfactory in my trial study). For larger islets (Twain, Tahiti) first I photographed the perimeter of the islet, then the interior systematically. The plane made several passes of each islet so that a large number of photos were available to choose from.

**Plot Counts:** I continued to count the number of nests within the nest plots with ground based counts in 2018. On 28 May Nora Livingston, Michelle Desrosiers and I counted the number of nests in each plot and recorded clutch size. We walked systematically through the plot and marked each nest with a small dab of water soluble paint to avoid double-counting.

**Figure 4.** Example of images used for counting with drawn boundary lines. The top line on the left image matches the lower boundary line on the right image. Other boundary lines match on adjacent images.

**Counting Nests from Aerial Images:** I selected images for counting based on clarity and by area captured. The images I chose contained overlapping zones with adjacent images, covering the entire islet. I then used Adobe Photoshop to draw boundary lines on each image with the Brush Tool. In overlapping zones, I drew corresponding boundary lines following matching landmarks between the two images (i.e. rocks, vegetation, etc.). In some cases individual nests were woven around to ensure the boundary lines matched exactly (figure 4). This year for Twain Islet I selected images of lesser resolution that those used in 2016 and 2017, but that covered larger land areas. I did so to lessen the amount of image "stitching", which is a very time-consuming task. The Twain images I chose covered a larger area, but still contained enough detail that bird posture (i.e. sitting or standing) was generally easy to differentiate (e.g. fig. 5).

After boundary lines on each image were drawn, the Count Tool on Adobe Photoshop was used to count gulls. Each gull or pair was given a color-coded dot representing one of three count groups: 1. **Incubating**: a gull sitting/incubating within a nesting area. Many but not all of these were obviously nestled in a nest; 2. **Standing**: gulls that are obviously standing (upright posture and shadow angle were useful for assessment). Additionally, I considered gulls that were sitting in an area known not to contain as standing. The third count group were **Pairs**: An obvious gull pair, in which one bird is sitting/incubating. Combining the totals for Incubating and Pairs were used to count the number of nests for each islet. If it was uncertain if a gull was sitting or standing, it was considered Incubating. Results from the pilot study showed that combining "Uncertain", "Incubating" and "Pairs" consistently provided the closest match to nest numbers obtained by ground counts.

**Figure 5.** Sample of a cropped image used on Twain Islet for counting gulls showing lesser resolution detail than in many of the 2017 images. Image would be zoomed in further to count.

For counting, most images were enlarged to 200% of the original resolution (this varied between 150 – 300%), and each image was systematically scanned side to side or up and down in passes, and gulls were marked with the Count Tool to their corresponding count group. Following this process, the entire image was scanned again for any missed gulls. Gulls are remarkably camouflaged against the Negit Islet topography. Images need to be carefully scrutinized to obtain an accurate count. The bright white heads, clear-cut white neck and gray mantle, and overall shape of nesting gulls were useful search images.

Determining whether a gull is standing or incubating can be a challenge with some images, and develops with experience. Over the past several years I have counted thousands of gulls from images, and have been able to ground truth my aerial photo-based plot-counts with ground-count tallies of nests within the plots. Useful characters I associate with standing birds is that their bodies are angled upwards and the white circles of their breast show prominently. Incubating birds are often nestled down in nests with their gray backs showing prominently (fig. 6).

**Figure 6.** Sample of standing and incubating postures on a photo with poor resolution. The birds marked with green stars are considered incubating. The remaining birds are standing: their bodies are angled upwards and their white breasts show more prominently than the gray backs.

## Clutch Size and Reproductive Success

I continued to sample 9 fenced plots on 3 islets to estimate clutch size and sampled 8 of those to measure reproductive success in 2018. 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 Islet of the Paoha Islet complex. Average clutch size was estimated by counting the number of eggs per nest for all nests within the 9 plots in late May.

On 5 and 6 July 2018 all chicks within eight sample plots were counted. Due to close proximity to an active Peregrine Falcon nest, chicks in the Cornell plot were not counted. In some plots older, mobile chicks were temporarily corralled into holding pens within the plot in order to obtain an accurate count. Un-corralled chicks were tallied, and then corralled chicks were counted as they were released. This temporary corralling was used during banding efforts in past years. Chick count trials conducted in 2016 in which volunteers visually counted chicks within the plots using tally meters (i.e. no corralling) consistently underestimated the actual totals when chick concentrations were relatively high. Thus temporary corralling would be necessary to obtain an accurate count in plots with moderate to large numbers of chicks. Plots with very low chick numbers (under about 20), corralling to aid in counting was unnecessary. Three observers would independently count chicks (whether in low density plots or the number of un-corralled chicks) two to three times. If our counts matched, they were considered accurate.

The post-banding mortality count (counting the number of dead, banded gull chicks to measure the post-banding mortality rate) was dropped in 2017 and instead I used the mean long-term post-banding mortality rate obtained from 2000 – 2016 data. An analysis showed that the post-banding mortality rate is fairly constant and contributes relatively little to the overall annual reproductive success estimate. Thus counting chicks in July and applying the long-term average post-banding mortality rate is an excellent way of estimating overall reproductive success while reducing the disturbance and efforts of banding and mortality counts.

I estimated the fledging rate for each plot, and, applied the average fledging rate to the entire population to estimate the total number of gulls successfully fledged from Mono Lake in 2018. I calculated the fledging rate for each plot **(fplot)** as:

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

where **Cb** is the number of chicks counted in that plot in July, **Cd** is the number of chicks from that plot that were estimated to have died after being counted in July (obtained using the long-term average post-banding mortality rate of 13.2% applied to the number of chicks counted in July), and **Np** is the number of nests counted in that plot in May. I 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.

# RESULTS

## Number of Nests and Breeding Adults

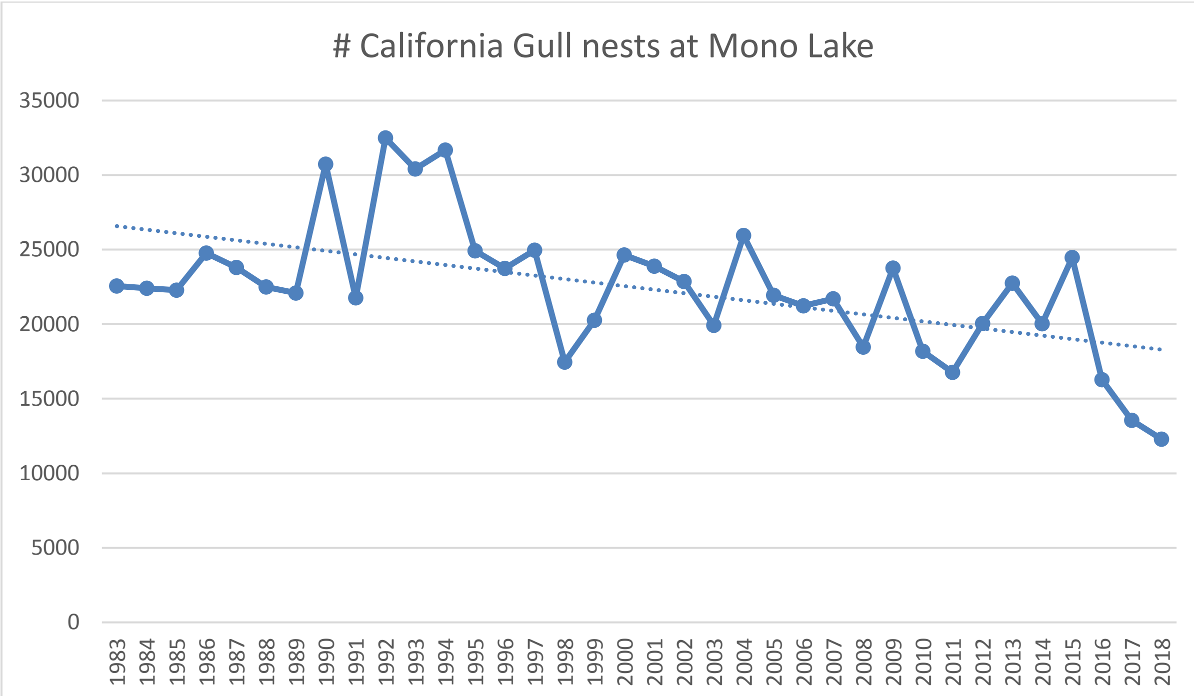
In 2018, a lake-wide total of 12,291 California Gull nests were counted, yielding an estimated population of 24,582 nesting adults. This is the lowest ever recorded over the course of this study (Fig. 7, Appendix 1). If the total estimate was increased by 4% (the amount that 2016 aerial photography underestimated the population compared to ground counts), the result would be similar with an estimated 12,783 nests. The past three consecutive years have each contained the lowest population size recorded. The long-term mean population size is 45,448 ± 1415 for the period 1983-2017 ($n$ = 35 years), and the mean population over the past 10 years is 38,865 ± 905. The number of nests counted in 2018 represented a relative decline of 9% compared to 2017 nest numbers, which was the previous low by a substantial margin. Java Islet continued to be abandoned in 2018, likely due to Coyote presence that occurred there in 2016. Steamboat continued to decline sharply in nest occupancy. In 2013 it hosted 1,175 nests, and in 2018 only 143 were counted (Appendix 1).

Ninety-one percent of the gulls nested on the Negit Islets and 9% nested on the Paoha Islets (Figures 1 -3, Appendix 1). The proportion of the population nesting on the Paoha Islets decreased this year relative to last, and the number of nests on Pancake Islet dropped sharply. Of the individual islets, Twain was the most populous, supporting 7,639, or 62%, of the lake-wide total number of nests. This is the highest proportion of the population recorded nesting on Twain although the number of nests it held is similar to the number tallied there in 2017. Little Tahiti and Coyote islets were the next most populous islets, containing 1,860 and 1,038 nests respectively. Each held approximately 8% of the nesting population this year. Twain and Tahiti had similar numbers of nests in both 2017 and 2018, while the number on Coyote dropped about 30% relative to last year.

**Clutch Size**

In 2018, the lake-wide average clutch size was below average at 1.86 ± 0.04 eggs/nest (range = 1-3 eggs, $n$ = 476 nests), which is up from last year. Overall, 26% of the nests contained one egg, 61% had two, 13% had three, and one nest had 4 eggs. The average clutch size for Mono Lake since 2002 ($n$ = 16 years) is 1.90 ± 0.04 eggs/nest.

**Figure 7.** Number of California Gull nests at Mono Lake, 1983 – 2018 with trend line.




## Reproductive Success

The Negit Islet plots averaged 59 ± 4 nests per plot, with an average nesting density of 0.27 ± 0.02 nests/m². The Negit islet plots fledged an average of 0.33 ± 0.10 chicks per nest. The Paoha Islet plots averaged 32.5 ± 7.5 nests per plot and averaged 0.74 ± 0.11 chicks fledged per nest. This is the largest margin by which the reproductive success was greater on the Paoha Islets than on the Negit complex. Typically, the average reproductive success on the Paoha islets is less than Negit. Nest density on the Paoha Islets is uncertain due to the irregular sizes of the plots. Combined, the 8 plots averaged 0.431 ± .10 fledged chicks per nest (Table 1). This is below the long-term average of 0.88 ± 0.06 chicks fledged per nest.

**Table 1.** Summary of nest and chick count results from all plots in 2018

| Plot | # nests in May | Avg. chicks/nest in July | # chicks in July | # estimated to die before fledging (# in July x 0.132) | Total successfully fledged/nest |
|---|---|---|---|---|---|
| Cornell | 74 | n/a | n/a | n/a | n/a |
| L. Tahiti East | 46 | 0.07 | 3 | 0.4 | 0.06 |
| L. Tahiti West | 56 | 0.13 | 7 | 0.9 | 0.11 |
| Twain North | 47 | 0.23 | 11 | 1.5 | 0.20 |
| Twain South | 51 | 0.45 | 23 | 3.0 | 0.39 |
| Twain West | 73 | 0.78 | 57 | 7.5 | 0.68 |
| Twain New | 64 | 0.63 | 40 | 5.3 | 0.54 |
| **Negit Islet totals/averages:** | **411** | **0.38 ± .12** | **141** | **3.1 ± 1.1** | **0.330 ± .10** |
| Coyote Cove | 25 | 0.72 | 18 | 2.4 | 0.62 |
| Coyote Hilltop | 40 | 0.98 | 39 | 5.1 | 0.85 |
| **Paoha Islet Totals:** | **65** | **0.85 ± 1.4** | **57** | **3.8 ± 1.4** | **0.74 ± .11** |
| **Lakewide totals/averages** | **476** | **0.50 ± .12** | **159** | **3.3 ± 0.9** | **0.431 ± .10** |

Based on the total of 12,291 California Gull nests counted in late May, and an average of 0.431 ± 0.10 chicks fledged per nest in the sample plots, an estimated 5,302 ± 540 chicks fledged at Mono Lake in 2018. This estimate is far well below the 1983 - 2017 average of 20,913 ± 1838 ($n$ = 35 years) chicks produced annually. This long term average is calculated for the Negit Islets only from 1983 - 2002, and Negit and Paoha Islets combined since 2002.

# DISCUSSION

## Population Size

The nesting population size of California Gulls at Mono Lake has been in decline since about 2004, and this year the number of nests plunged at a rate greater than the trend line for the third consecutive year (Fig. 7). A previous study using data from 1987 – 2003 found that 4 variables explained over 80% of the variability in the Mono Lake gull population, particularly brine shrimp densities around the time of egg-laying, springtime temperatures, and recruitment (Wrege et al. 2006). Today, the relationship between the population size and some of these variables appears to be shifting in the opposite direction. Brine shrimp have been trending significantly towards an earlier peak in abundance - closer to the gull egg-laying period since 2004 (Jellison and Rose 2012, LADWP 2018), yet the gull population has been in decline relative to the long-term mean since that time. Springtime temperatures in California and the Mono Lake region have been trending warmer (e.g. LADWP 2018) while the gull population has been declining, and recruitment (measured by average reproductive success at Mono Lake 4 years previously) which was significantly and positively correlated with population size from 1987 – 2003, has since correlated slightly *negatively* with population size. What is driving these shifts remains unknown and in need of further investigation.

### *Bassia* Encroachment on the Negit Islets

A major factor for the low California Gull population at Mono Lake in recent years is *Bassia hyssopifolia* encroachment. Beginning in 2016 this Eurasian invasive weed exploded on the gull colony and now covers an estimated 70% or more of the Negit Islets (figures 8, 9, 10, KN pers. obs.). The unprecedented decline in Mono Lake's gull population recorded in the past three years parallels significant annual reductions in nest site availability due to *Bassia* encroachment. Aerial photo documentation shows the majority of *Bassia* growth occurred in late summer and fall of 2017, which resulted in vast and rapid ecological change on the landscape. Although *Bassia* is an annual, the dead carcasses of the plants persist for many years, such that nest site availability continues to decline with each seasons' additional growth (fig. 8, 9, 10, aerial photo archives). Figures in the 2017 annual report (Nelson 2017) illustrate "before and after" images of *Bassia* cover engulfing areas of the islets which were previously open and contained high nest densities.

**Figure 8.** Twain South plot in July 2017 (left) and May 2018 (right). Little or no new, green *Bassia* growth is seen, although the dead plant carcasses from 2017 greatly reduced nest site availability.


In 2018 *Bassia* growth slowed and germination rates were much lower than they were in 2016 and 2017. Aerial photos taken in May 2016, May 2017, and July 2017 showed abundant *Bassia* germination as bright green growth. But the May 2018 aerial photos showed little to no green growth indicating little or no spring germination. In general the pattern of *Bassia* growth on photos of the Negit Islets taken in May 2018 was similar to aerial photos taken in July 2017 except that the *Bassia* had expanded somewhat and "filled out", but was yellow and dead (figs. 8, 9). Although relatively little new *Bassia* grew in 2018, the dead plants from previous years continued to provide a barrier for nesting. While counting nests from the aerial photos, I did not observe any gulls nesting in/on dense *Bassia* patches.

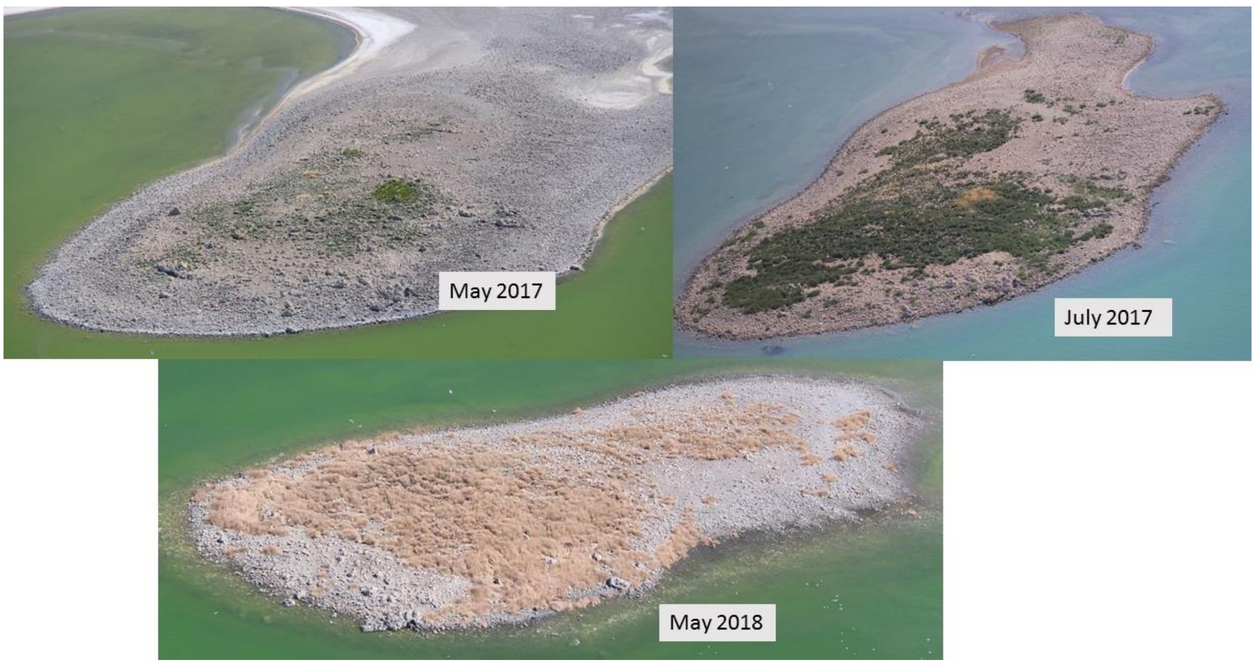
Although most of the *Bassia* currently covering the Negit Islets grew in 2017, its effects on the nesting population size were not fully measured until this year. Because much *Bassia* growth on the Negit Islets occurred in late summer and early fall, less was present in May 2017 when nests were counted. Many of the nests tallied in 2017 were overwhelmed by *Bassia* growth during the course of the nesting season. This seemed especially true on Pancake Islet (fig. 10) which contained the lowest number of nests ever recorded (excluding years following connection to the mainland).

**Figure 9.** West shore of Twain Islet in July 2017 and May 2018. Blue stars indicate matching landmarks. Note how the green *Bassia* "filled in" by spring of 2018. The lack of green germination and generally matching growth pattern on the landscape indicates little germination occurred in early spring 2018.


Nesting distribution among the islets in 2018 was generally similar to 2017 with the exception that the number of nests on Pancake Islet dropped sharply, the number of nests on Coyote Islet dropped somewhat, and the proportion nesting on Twain was relatively high. The decline on Pancake is expected given the significant reduction in nest site availability due to *Bassia* growth and the lake level rise that occurred between May 2017 and May 2018 (fig. 10). The drop on Coyote is more difficult to interpret. In 2017 I recorded a relative jump in nest numbers on Coyote which I attributed to its lack of *Bassia.* However this year the proportion of the gull population nesting on the Paoha Islets dropped to tie the lowest proportion measured. Part of that is because Piglet Islet, which formally contained large numbers of nests, has been abandoned since 2014 following Coyote depredation and connection to Paoha Island (fig. 3). Due to the rising lake level last summer, Piglet again became an islet, although no gulls nested there in

2018. Why nest numbers on Coyote Islet dropped this year despite it being *Bassia* free while nest numbers on Twain increased proportionally is difficult to explain. Average reproductive success on the Paoha Islets is typically much lower than on the Negit Islets suggesting it is of lower habitat quality. It faces strong prevailing winds and its muddy substrate often coats eggs with mud following rains, which likely reduces hatchability.

**Figure 10.** Pancake Islet in May and July 2017, and May 2018. Relatively little *Bassia* covered the islet when nests were counted in May 2017. *Bassia* likely overwhelmed hundreds of nests during the 2017 nesting season, and lake level rise may have inundated nests as well. In 2018 Pancake contained the lowest number of nests ever recorded (excluding years following mainland connection).




During chick counts in July and a plot repair visit in September some green *Bassia* growth was noted, although relatively little compared to what was observed in the fall of 2017. However, I noticed a fair amount of new tumbleweed (*Salsola* sp.) growth (fig. 11). I do not recall seeing much if any *Salsola* on the Negit Islets previously. The plants were large and healthy.

**Figure 11.** Twain New plot on September 19, 2018. The greenish bushes in foreground are *Salsola* tumbleweeds. *Salsola* appears to be a new invasive weed on the Negit Islets. The mostly yellow weeds in the background are *Bassia*. There are also numerous Rabbitbrush *Ericameria* bushes in bloom.

## Other Factors Affecting Population Size in 2018

The breeding population size of California Gulls at Mono Lake is likely responding to changes in their primary food source, brine shrimp. Long-term monitoring has shown that the peak mean abundance of adult brine shrimp at Mono Lake has been in decline since about 1989 and since 2015 has been exceptionally low (LADWP 2017, LADWP 2018). This may help explain the long-term declining trend observed in Mono Lake's gull population (fig. 7). The 4 year running average of peak adult shrimp densities from 2014 – 2017 was the lowest on record, and peak densities in 2015 and 2016 were by far the lowest recorded since monitoring began in 1979 (LADWP 2017). Promisingly, shrimp numbers in 2017 were higher and showed an increasing trend since the unprecedented low recorded in 2015 (LADWP 2018). The gull population has experienced a sharp decline since 2015 despite growing shrimp densities, though *Bassia* encroachment is likely to blame for those recent lows. Shrimp data for 2018 are not yet available.

Coyote activity in 2016 likely contributed to a continued reduced number of nesting gulls in 2018. Over the course of this study we have found that islets raided by Coyotes are typically abandoned by nesting gulls the following year or longer. Thus, islets that were raided by Coyotes in 2016 we would expect partial or complete abandonment the following year(s). In 2016, Coyote signs (scat and tracks) were widespread on Negit Island and scat was found on Java Islet in July, confirming that Coyote(s) had swum to Java, probably from Negit Island. The islets surrounding Java including Steamboat had greatly reduced numbers of chicks relative to other islets in July 2016, suggesting that these also may have been raided by Coyote(s) (Nelson 2016). This year Java continued to be abandoned, and nest numbers on Steamboat have plummeted since 2016 (Appendix 1). Another factor may be poisonous spiders. Large numbers of Black Widow Spiders (*Latrodectus hesperus)* have been observed on Java and Steamboat. In September 2016 when we searched Java and Steamboat for coyote sign, we found areas of these islets, Steamboat in particular, were glistening with webs and dozens of black widow spiders were observed. Although spider numbers appear to peak in fall after gulls have departed, perhaps the abnormally high populations of black widows has contributed to nest occupancy declines on Steamboat and possibly Java Islets.

In 2018, no evidence of Coyotes was noted on Negit Island or Islets for the second consecutive year. The lack of Coyotes since 2017 was due to the significant lake level rise that occurred last summer and the success of an electric Coyote exclusion fence that was funded and managed by the Mono Lake Committee in 2017.

## Reproductive Success

The average of 0.431 chicks fledged per nest in 2018 was below the 1983-2017 mean average of 0.88 ± 0.06 chicks fledged per nest, yet above last year's low value of 0.235 chicks fledged per nest. Average reproductive success on the Paoha Islets was notably greater than that on the Negit Islets (table 1), which is a first in at least 10 years.

Previous analysis has found that annual average reproductive success of California Gulls at Mono Lake is negatively correlated with meromictic (i.e. highly stratified) conditions (Nelson et al. 2014). Meromixis occurs following high levels of runoff, which create a stratification of fresh and salty waters. This disrupts nutrient cycling in Mono Lake and depresses lake productivity. Mono Lake rose 1.34 m from January to October 2017 which initiated another phase of meromixis (LADWP 2018). Therefore we would expect average reproductive success to be below average this year.

Other factors besides those associated with meromixis likely affected average reproductive success in 2018. This year I observed multiple cases of wing droop in gull chicks. Chicks with wing droop are unable to retract their wings, so that one or both wings hang low, and in severe cases drag on the ground. The chicks often twitch their wings as if trying to tuck them in normally. Otherwise, the chicks appear alert, normally coordinated, and can walk. In July four of the 7 chicks in Little Tahiti West plot had severe wing droop and several freshly dead chicks were also found in the plot, which had extremely low reproductive success. I did not observe wing droop in the Twain plots this year. In 2015 and 2016 I also observed wing droop in Tahiti plots. Average reproductive success was notably low in the Tahiti plots relative to the Twain plots (table 1) this year which could be due to the condition associated with wing droop.

What causes wing droop in gull chicks at Mono Lake has not been conclusively determined, but is thought to be related to *Argas monolakensis*, the endemic tick found on Mono Lake California Gulls. *Argas* infestation is known to cause paralysis. In birds, tick paralysis has been described as a progressive, ascending motor paralysis (Luttrell et al. 1996). Another factor involved could be the Mono Lake Virus which is transmitted by *A. monolakensis.* Though the effects of this virus on gull chicks are unknown, it was found in 2.2-8.8% of ticks tested and neutralizing antibodies to the virus were found in 37% of chicks tested (Schwan et al. 1992). Whatever the cause, wing droop in Mono Lake gull chicks was considered epidemic in 1981, and observed in 15 out of 1,051 chicks in 1987 (Strauss 1987). In 2016, at least 9 such chicks were noted, including 4 or 5 on Steamboat Islet and 4 in the Cornell Plot (Nelson 2016). Until 2015 I had not observed severe cases of wing droop in 12 years of working on the gull colony (that I recall), however a slight droop in one or occasionally both wings was not uncommon. Pathological analysis of affected gull chicks is needed to better understand this condition that likely affected average reproductive success on the Negit Islets this year.

In summary, the breeding population size of California Gull's at Mono Lake has been in decline since 2004, and in steep decline since 2016. Since 2016, each year has been the lowest population size recorded. The long-term decline may be in reaction to lessening average shrimp densities at Mono Lake. The steep drop in nest numbers recorded since 2016 is associated with *Bassia hyssopifolia* encroachment. The Negit islets will be unable to host a robust gull population unless *Bassia* is reduced or removed. Plans are in place with the Inyo National Forest to burn off the weeds and open up nesting area for the gulls. The future of the gull colony at Mono Lake likely depends on this control burn being accomplished. The Mono Lake Committee and others are committed to continued *Bassia* management within the gull colony. We have found manual pulling of young *Bassia* plants resulted in visibly reduced *Bassia* density lasting 5 years.

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**Appendix 1.** Nest number by islet, 2009 - 2018

| **Negit Islets** | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 [c] | 2018 [c] |
|---|---|---|---|---|---|---|---|---|---|---|
| Twain | 11449 | 8219 | 8704 | 9396 | 9567 | 9144 | 12263 | 7760 | 7672 | 7639 |
| L. Tahiti | 2770 | 2429 | 2049 | 3366 | 3995 | 3899 | 4258 | 2923 | 1795 | 1860 |
| L Norway | 119 | 114 | 171 | 390 | 493 | 384 | 505 | 284 [c] | 163 | 220 |
| Steamboat | 580 | 509 | 579 | 871 | 1175 | 1076 | 1010 | 675 | 217 | 143 |
| Java | 433 | 367 | 432 | 325 | 234 | 216 | 439 | 60 | 0 | 0 |
| Spot | 87 | 122 | 151 | 39 | 95 | 162 | 184 | 144 | 55 | 36 |
| Tie | 37 | 55 | 58 | 30 | 56 | 65 | 181 | 170 | 49 | 55 |
| Krakatoa | 5 | 2 | 0 | 12 | 9 | 12 | 84 | 38 | 40 | 73 |
| Hat | 3 | 0 | 7 | 24 | 30 | 29 | 25 | 21 | 2 | 8 |
| La Paz | 0 | 0 | 0 | 0 | 0 | 4 | 7 | 16 | 19 | 0 |
| Saddle | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Midget | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| L. Tahiti Minor | 152 | 151 | 162 | 253 | 282 | 255 | 202 | 116 | 64 | 64 |
| Pancake | 2293 | 1894 | 1741 | 1972 | 2450 | 1903 | 3159 | 2497 | 1814 | 1099 |
| ***Negit Islets Total*** | **17929** | **13862** | **14054** | **16678** | **18386** | **17149** | **22317** | **14704** | **11890** | **11215** |
| **Paoha Islets** | | | | | | | | | | |
| Coyote | 2591 | 1711 | 929 | 1393 | 2093 | 2618 | 2042 | 1432 | 1505 | 1038 |
| Browne | 135 | 116 | 50 | 60 | 75 | 110 | 87 | 146 [c] | 152 | 38 |
| Piglet | 1314 | 997 | 599 | 344 | 148 | 38 [b] | 0 | 0 | 0 | 0 |
| ***Paoha Islets Total:*** | **4040** | **2824** | **1578** | **1797** | **2316** | **2766** | **2129** | **1578** | **1657** | **1076** |
| **Negit Island:** | 0 | 0 | 0 | 7 | 8 | 28 | 16 | 0 | 0 | 0 |
| **Old Marina** | 1775 | 1496 | 1133 | 1541 | 1665 | 9 [b] | 0 | 0 | 0 | 0 [d] |
| **O.M. So.** | 22 | 4 | 9 | 36 | 380 | 70 [b] | 0 | 0 | 0 | 0 |
| ***Lakewide Total*** | **23766** | **18186** | **16774** | **20059** | **22755** | **20022** | **24462** | **16282** | **13547** | **12291** |
| ***Nesting Adults*** | **47532** | **36372** | **33548** | **40118** | **45510** | **40044** | **48924** | **32564** | **27094** | **24582** |

**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.
**c.** Nest numbers obtained through aerial surveys and photographs
**d.** Nesting activity was looked for with binoculars from the mainland. None observed.