Population Size and Reproductive Success of California Gulls at Mono Lake, California in 2000, With Emphasis on the Negit Islets

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Abstract

In 2000, nest counts estimated that about 49,300 adult California Gulls *(Larus californicus)* were nesting at Mono Lake in late May. About 85% of Mono Lake's breeding gulls were on the Negit Islets, 14% on the Paoha Islets complex, and less than 1% on Negit Island. Twain Islet remained the most populous nesting island, holding 48% of Mono Lake's breeding gulls, followed by Little Tahiti Islet with 21%. The colony site on the southwest shore of Negit Island was again occupied this breeding season, and a second site with relatively few nests was established on a small peninsula at the southeast corner of Negit. The fledging rate on the Negit Islets of 1.06 chicks per nest was significantly higher than the long-term average of 0.87. An estimated 26,129 young fledged from Mono Lake in 2000 (combining estimates from the Negit Islets and the Paoha Islets complex). An early and warm spring accelerated the population growth of brine shrimp (*Artemia monica*). However, it remains unclear whether this directly affected chick production. During a prior six-year period of meromixis in the 1980s, gull nesting success was low the first two years but increased thereafter. During the current period of meromixis, which began in 1996, gull reproduction was extremely low for four years, but 2000 may mark the beginning of recovery. Any reconsideration of management alternatives should take a holistic, ecosystem-wide approach and balance any short-term impacts of meromixis against the long-term prospects for improved productivity and the positive benefits of current stream flows and lake level rise to stream restoration, wetland restoration, alkali fly *(Ephydra hians)* productivity, and curtailment of air pollution from dust storms.

Introduction

The long-term study of California Gull (*Larus californicus*) population density and reproductive success at Mono Lake, California, under the direction of David Shuford of the Point Reyes Bird Observatory, was continued between May and August 2000. During this period, spanning most of egg laying through the fledging of young, three standardized measures of reproduction were obtained on gulls nesting on the Negit Islets. In addition, intensive observations conducted on the foraging ecology of the species focused on the use of prey endemic to the Mono Lake ecosystem. Here we summarize the results obtained from the nest counts and chick banding surveys and make some general observations based on the foraging ecology study.

The objectives of this ongoing study are to measure year-to-year variation in population size and reproductive success and to determine their relationship to changing lake levels. This report focuses on the Negit Islets, which currently support most of the lake's nesting gulls, and on Negit Island, which supported the majority until the gulls abandoned it in 1979.

The effects of recent changes in the Mono Lake ecosystem are of special interest to biologists (Patten et al. 1987, Botkin et al. 1988) and to public agencies charged with protecting the lake's valuable natural and scenic resources (Jones and Stokes 1993). Because a recent decision that protects the Mono Lake ecosystem will allow the lake's surface elevation to rise to 6392 feet (SCWRCB 1994), there is a continuing need to monitor the lake's resources, including nesting gulls, to document their responses to the changing conditions.

Study Area And Methods

The study area at Mono Lake has previously been described in Shuford (1985) and Shuford et al. (1984, 1985), though conditions that potentially could affect nesting gulls have changed considerably over time. Since 1941, the lake has dropped almost 45 vertical feet and nearly doubled in salinity because of diversions of its inflowing streams. Wet winters in the early and mid-1980s caused a temporary reversal of the downward trend. The winters of 1986-87 through 1993-94 averaged very dry, and the lake level fell to a surface elevation of 6374.5 feet by May 1992. Very wet winters returned in 1994-95, 1996-97, and 1997-98 and lake level rose to 6384 feet in 1999 (P. Kavounas in litt.) and remained at that level through the 2000 breeding season.

Additionally, for the six-year period 1983 to 1988, Mono Lake experienced chemical stratification (meromixis), which lowered the lake's productivity (Jellison and Melack 1993). Since 1996 the lake has entered another episode of meromixis, which initially was predicted to last for up to several decades (Jellison et al. 1998). Deeper than expected mixing in the fall of 1999, along with a mild and early spring in 2000, contributed to an early abundance of brine shrimp (*Artemia monica*) in 2000 (R. Jellison, pers. com.).

Over the years, small numbers of gulls have intermittently initiated nesting on a peninsula of Paoha Island (immediately adjacent to the Paoha Islets), which is either partially or completely

(e.g., 1999-2000) isolated as a small islet by the rising lake (J. R. Jehl Jr. in litt.). The Paoha Islets and this peninsula/islet are referred to below as the Paoha Islets complex.

Nest Counts: Nests on the Negit Islets and Negit Island were counted from 24 to 28 May. Field workers walked through all the colonies tallying all nests and marking each with a dab of paint to avoid duplicate counts. For some small, steep-sided islets incubating/brooding adults were counted from a small motorboat to estimate the number of nests present. Nest totals for the Negit Islets and Negit Island were added to those for the Paoha Islets complex provided by Joseph R. Jehl, Jr., and the number of adult gulls breeding at Mono Lake was estimated as twice the total number of nests at the lake.

Separate subtotals were compiled for nests within eight 10 X 20 m fenced plots on three islets (five on Twain, two on Little Tahiti, and one on Little Norway) that were monitored to determine chick production. Within plots, counts included the number of eggs in each nest.

Egg predation by conspecifics is a common event within the dense aggregations typical of California Gull colonies, and the disruption caused by observers walking through the colony to count nests unavoidably causes additional predation. In an effort to quantify just how much additional nest loss is induced by the census method, standardized focal sampling was conducted in three areas both before and during the nest counting process. One sampled area was on Little Tahiti, observed from the Krakatoa camp, and two were on Twain, each observed from a high point toward the center of the islet. The Little Tahiti area represented medium nesting density while the Twain areas both had high nest densities. In each area we obtained three to five one-hour focal samples between 9 and 22 May, prior to the nest count, and an additional 30-minute sample immediately before the nest count began. Each focal involved recording the number of observed predation attempts in each 5-minute interval. Only predation events involving the accumulation of numerous birds at the depredated nest were counted, because these were extremely visible events. Thus, the sampling method underestimates actual predation rates because more cryptic predation also occurs.

During the actual nest count in each sampling area, and using the same observation position as for control samples, we recorded the frequency of large-group predation events occurring behind the line of nest counters. Because of frenetic activity by nesting birds during the count, only

situations in which a bird was seen with an egg, or where a group of birds could be seen repeatedly pecking at a nest, with yolk visible on their bills, were counted as predation events. These slightly more restrictive criteria would tend to underestimate the rate of predation compared to the control samples. Estimates of the hourly rate of predation per 1000 nests were calculated from the number of observed predation events during the sample(s) and the number of nests counted in those areas.

Chick Counts and Reproductive Success: From 1-5 July, we banded chicks within the eight fenced plots on the Negit Islets. Combined with a follow-up count of all banded nestlings that died before fledging (conducted 12-15 August), we estimate the total number of gulls successfully fledged from the Negit Islets in 2000. The number fledged **(F)** is calculated as:

$$(N/8)\sum_{i=1}^{8} f_i$$

where $\boldsymbol{N}$ is the total number of nests on the Negit Islets and $\boldsymbol{f_i}$ is the number of young fledged per nest in the eight Negit Islet fenced plots. Given the 35-day interval between the nest count and banding, and an incubation period of 28-30 days, chicks younger than 5 days of age would have hatched from clutches laid after the count and so are not included in calculations. An estimate of the number of young fledged on the Paoha Islets complex, based also on fenced plots (J. R. Jehl Jr., pers. com.), was added to the corresponding number for the Negit Islets to provide an estimate of the total number of young produced at Mono Lake in 2000.

Results and Discussion

Phenology: In 2000 chicks occupied 0.3% of 21,131 nests counted 24-28 May. These data indicate that nest initiation began about the same time as in most other years of study. However, during chick banding there were many nests with eggs and newly hatched chicks throughout the colony, indicating that nest initiation was quite protracted. The early abundance of shrimp in the lake and perhaps considerable nesting by first-time breeders might explain the protracted nesting. The possibility that significant numbers of young breeders swelled the nesting population in 2000 is supported by our observation that 5% of breeders within one observation plot had one or more black-tipped tail feathers (3 year old birds).

Number of Breeding Adults: In 2000, late May nest counts estimated that 42,328 gulls were nesting on the Negit Islets, 6,956 on the Paoha Islets complex (J.R. Jehl Jr., pers. com.), and 200 on Negit Island for a lake wide total of 49,484 nesting adults (Table 1). About 85% of the nesting gulls occupied the Negit Islets, 14% the Paoha Islets complex, and less than 1% on Negit Island. Twain Islet alone held 48% of the lake-wide breeding population followed by Little Tahiti with 21%. The sharpest rise in nest numbers was on Pancake Islet, where gull nests increased from 13 in 1998 to 1136 in 1999, to 2098 in 2000.

Table 1. Nest counts on the Negit Islets and totals for Mono Lake – 1990 to 2000.

Negit Islets	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Twain	15045	10883	15896	15431	15792	11035	12690	13140	9488	10728	11856
L. Tahiti	4218	3205	3810	3616	4505	4021	4570	4092	3846	5108	5076
L. Norway	432	355	473	428	533	493	766	794	606	732	887
Steamboat	704	671	862	958	1217	981	459	505	405	381	477
Java	789	586	1040	399	199	4	70	41	65	149	480
Spot	309	311	335	356	449	422	399	341	191	27	29
Tie	167	160	220	210	320	264	267	194	81	5	16
Krakatoa	283	181	209	146	175	116	57	33	16	76	120
Hat	19	10	21	21	14	19	41	58	47	43	29
La Paz	46	49	70	77	57	55	44	30	17	0	0
Geographic	4	10	68	84	69	51	0	0	0	0	-
Muir	61	84	139	131	116	87	4	0	0	0	-
Saddle	18	8	14	10	11	21	31	13	1	2	1
Midget	3	2	2	3	2	2	2	3	0	3	2
Siren	7	7	19	20	14	16	10	0	0	0	-
Comma	0	1	1	1	0	0	1	0	0	0	-
Castle Rocks	4	5	5	3	3	3	4	4	3	3	1
Pancake	651	0	0	0	0	0	0	1	13	1136	2098
Java Rocks	4	2	13	15	9	5	1	0	0	0	0
No name	1	0	3	3	3	1	0	0	0	0	-
Totals Negit Islets:	22765	16530	23200	21912	23488	17596	19416	19249	14779	18393	**21072**
Totals Paoha Islets:	5145	4442	9284	8498	8182	7331	4334	5708	2687	1858	**3478**
Negit Island:	2827	788	4	12	0	0	0	0	0[a]	14	**100**
Totals Mono Lake:	30737	21760	32488	30422	31670	24927	23750	24957	17466	20265	**24650**
Nesting Adults:	61474	43520	64976	60844	63340	49854	47500	49914	34932	40530	**49300**

On Negit Island, gulls again occupied an area on the southwest shoreline that was just barely detached from the main island by the rising lake level. In addition, a small number of nests were established on a narrow peninsula at the northeast corner of Negit. The total number of nests on Negit increased by nearly an order of magnitude since 1999 (Table 1). No evidence of coyotes or any other canid was seen on Negit Island in numerous surveys of the shore and interior.

Egg predation: Estimates of naturally occurring egg predation decreased over the sample period of 9 to 22 May, ranging from a high of 6 nests/1000/hr to near zero toward the end of incubation (Figure 1). Nests appear to be most vulnerable to predation during the egg-laying period, particularly between the first and second eggs when the nest is guarded but the egg not consistently incubated (unpubl. observations). At this time, breeders frequently stand near the nest, but may be distracted by agonistic interactions with near neighbors, thus leaving the nest open to attack by other individuals. As the season progresses and clutches are completed, there are fewer susceptible nests on the colony.

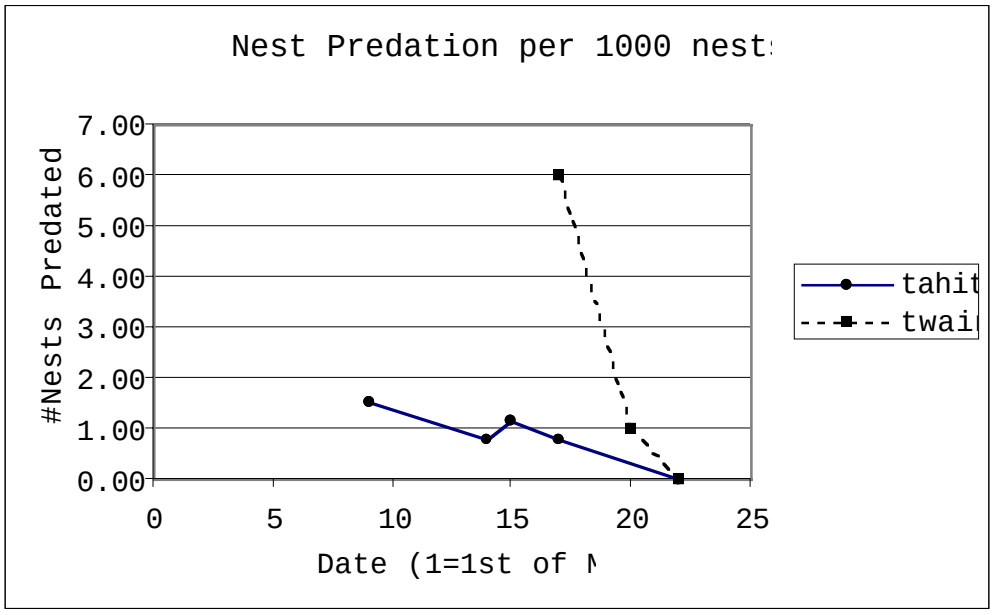

Figure 1. Natural rates of egg predation on two islets during the incubation period, standardized to hourly rates per 1000 nests. Twain samples are the sum of two sub-plots with a total of about 2000 nests. The Tahiti plot included about 1300 nests.

The very high predation rate observed 17 May on Twain was probably atypical and might have been related to (1) cold temperatures over a period of several days before the sample, and (2) rain and high winds on the day of observation. We suspect that these weather conditions caused large numbers of gulls to be food stressed, thus increasing the attractiveness of remaining on the colony and attempting to prey on the nests of conspecifics. Without replication in the sample, we cannot dismiss the possibility of changes in predation rate through the day. However the similarity of three samples obtained on Little Tahiti 14-17 May (Figure 1), that included both morning and afternoon samples, does not suggest any strong diurnal effect. We estimate overall nest loss to egg predation over the entire incubation period to be about 31% of nests (calculation assumes a constant predation rate through the day, no egg predation during the night, and a linear decrease in predation over time as defined by the regression through data for Little Tahiti). Losses were likely somewhat higher on colonies with the most densely packed nests (e.g. Twain).

During the actual nest count, predation rates behind the line of counters was quite high for the short period of time before nesting pairs could settle and re-defend their clutches of eggs. Our focal observations indicate that an additional 0.85% of nests were predated at typical densities, and as many as 2.8% of nests may be lost at the higher Twain densities during the nest count. While this additional nest loss is undesirable, there can be no question that it is sustainable by the population, given the very high natural predation rates.

Fledging Rate in the Fenced Plots: The fledging rate from fenced plots in 2000 averaged 1.06 fledglings per nest (Table 2), three times the average rate since meromixis was established in 1996, and above the 17-year average of 0.87 (SD= 0.40) chicks per nest (PRBO unpubl. data). Fledging success in enclosure plots on the Paoha Islets in 2000 was comparable at 1.12 fledglings per nest (J.R. Jehl Jr., pers. com.)

Using the estimate of fledging success from the fenced plots, and the total count of nests listed in Table 1, at least 22,442 chicks fledged from the Negit Islets and Negit Island, with an additional 3,895 fledged from the Paoha Islets (J.R. Jehl, Jr., pers. com.). This gives an estimate of 26,337 young California Gulls fledging from Mono Lake in 2000. This is certainly an underestimate for

this season, because there were many nests initiated after the nest counts in late May, and many of these nests certainly fledged young (pers. observation).

Table 2. Summary of nest counts and fledging success in eight plots on the Negit Islets, 2000.

Site	Total Nests	Chicks per Nest[1]	Chicks Banded (died)		Fledged per Nest
Little Norway[2]	81	**1.26**	101	(8)	**1.15**
Little Tahiti West	116	**1.43**	166	(12)	**1.33**
Little Tahiti East	85	**1.13**	96	(6)	**1.06**
Twain North	82	**0.85**	70	(6)	**0.78**
Twain South	127	**1.44**	183	(16)	**1.31**
Twain Northeast	130	**1.00**	130	(14)	**0.89**
Twain West	122	**1.16**	141	(9)	**1.08**
Twain New	77	**0.97**	75	(9)	**0.86**
Totals / Means:	820	Mean=1.16	901	(71)	Mean=1.06

[1] calculated at the time of banding

[2] A badly damaged fence on the west side of the Norway plot may have permitted older chicks to move in and out of the plot. It is not known whether any of the chicks banded originated in nests outside of the plot (not counted in the nest total for the plot), nor whether some chicks originating in nests within the plot had moved out before banding activities.

Overview: The reasons for year-to-year variation in the number of adult gulls breeding at Mono Lake, and the nesting success of breeders, remain imperfectly known. During the tenure of this long-term monitoring program, low reproduction has been associated with each period of meromixis (1983-1988, 1996-present). During these meromictic episodes, the productivity of Mono Lake has been reduced and brine shrimp phenology has been delayed (Jellison and Melack 1999). In 2000, some of the typical effects of meromixis were at least partially absent: adult shrimp were available in the water column three-four weeks earlier than in the preceding four years, and shrimp population density increased rapidly during the early chick hatching period (R. Jellison, pers. com.; Wrege et al. unpubl. data). Detailed studies of California Gull nestling diets showed an overwhelming dependence on brine shrimp, particularly when nestlings were very young (Wrege et al. 2001). Although the exact mechanism responsible for suppression of nesting

success in some years remains to be explained, the phenology of maturation of brine shrimp relative to the primary period of gull chick growth in June and early July may be critical.

Although it warrants concern, the long-term effect of meromixis on gull productivity at Mono Lake is uncertain. During the previous period of meromixis from 1983 through 1988 (Jellison and Melack 1993), gull productivity on the Negit Islets was low in 1983 and 1984, increased in 1985, and increased further to above average levels from 1986 through 1988 (PRBO unpubl. data) as meromixis weakened with falling lake levels (R. Jellison pers. com.). These events suggest that over the course of the prior period of meromixis, invertebrate food supplies increased or the gulls otherwise adapted to the meromictic conditions. Although Jellison et al. (1998) initially predicted the current episode of meromixis would last for up to several decades, preliminary analysis of additional data suggests that it will not last as long as previously thought (R. Jellison pers. com.).

Literature Cited

Botkin, D., W. S. Broecker, L. G. Everett, J. S. Shapiro, and J. A. Wiens. 1988. The future of Mono Lake. University of California Water Resources Center Report 68.

Jellison, R., and J. M. Melack. 1993. Meromixis in hypersaline Mono Lake, California. Part 1: Stratification and vertical mixing during the onset, persistence, and breakdown of meromixis. Limnol. Oceanogr. 38:1008-1019.

Jellison, R., and J. M. Melack. 1999. Mixing and plankton dynamics in Mono Lake, California. 1999 annual report to the Los Angeles Department of Water and Power and the National Science Foundation.

Jellison, R., J. Romero, and J. M. Melack. 1998. The onset of meromixis during restoration of Mono Lake, California: Unintended consequences of reducing water diversions. Limnol. Oceanogr. 41:706-711.

Jones and Stokes Associates. 1993. Environmental impact report for the review of Mono Basin water rights of the City of Los Angeles. Draft. May. (JSA 90-171). Sacramento, Calif. Prepared for California State Water Resources Control Board, Div. of Water Rights, Sacramento.

Patten, D. T. et al. 1987. The Mono Basin ecosystem: Effects of changing lake level. National Academy Press, Washington, DC.

Shuford, W. D. 1985. Reproductive success and ecology of California Gulls at Mono Lake, California in 1985, with special reference to the Negit Islets: An overview of three years of research. Point Reyes Bird Observatory Report, Contribution No. 318.

Shuford, W. D., E. Strauss, and R. Hogan. 1984. Population size and breeding success of California Gulls at Mono Lake, California in 1983. Final report for contract #14-16-0009-83-922 to the U.S. Fish and Wildlife Service.

Shuford, W. D., P. Super, and S. Johnston. 1985. Population size and breeding success of California Gulls at Mono Lake, California in 1984. Point Reyes Bird Observatory Report, Contribution No. 294.

State of California Water Resources Control Board. 1994. Mono Lake Basin water right decision 1631. State Water Resources Control Board, Division of Water Rights, 901 P St., 3rd Floor, Sacramento, CA 95814.

Wrege, P.H., J.M. Hite, and D. W. Winkler. 2001. The diet of California Gull nestlings at Mono Lake: seasonal and diurnal variation. Point Reyes Bird Observatory Report, Contribution No. 939.

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