

**POPULATION SIZE AND REPRODUCTIVE SUCCESS
OF CALIFORNIA GULLS AT MONO LAKE, CALIFORNIA, IN 1998,
WITH EMPHASIS ON THE NEGIT ISLETS**

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ABSTRACT

In 1998, nest counts estimated about 34,932 adult California Gulls were nesting at Mono Lake in late May. Evidence of a protracted period of egg laying, though, suggests these counts probably underestimated the total number of nesting gulls. The Negit Islets supported 85% of Mono Lake's breeding gulls, versus 15% on the Paoha Islets complex. Twain Islet remained the most populous nesting island by holding 54% of Mono Lake's breeding gulls. Only a few gulls recolonized Negit Island, which became further isolated from the mainland but again showed signs of coyote presence. The fledging rate on the Negit Islets of 0.46 chicks per nest was the fourth lowest since our studies began in 1983. An estimated 7035 young fledged from all the lake's nesting islands in 1998. The delayed maturation of brine shrimp (*Artemia monica*) and their near absence in the chick diet suggests food limitation may have contributed to reduced chick production. The low gull nesting success the last three years corresponds with the onset of a period of meromixis and lowered lake productivity. During a prior six-year period of meromixis in the 1980s, gull nesting success was low the first two years but increased thereafter. Any reconsideration of management alternatives should take a holistic, ecosystem-wide approach, thereby recognizing 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

In 1998 Point Reyes Bird Observatory (PRBO) completed the sixteenth year of a study of the California Gull (*Larus californicus*) at Mono Lake, California. The objectives of our 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. Negit Island was recolonized in 1985 and was abandoned again in 1991.

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 vested 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 effect nesting gulls have changed considerably over time. Since 1941, the lake has dropped almost 45 vertical feet and nearly doubled in salinity because of water 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 lake level fell to 6374.5 feet by May 1992. Very wet winters returned in 1994-95, 1996-97, and 1997-98 and lake level rose to 6382.8 feet in May 1998 and 6384.1 feet in August 1998 (P. Kavounas in litt.). Consequently, the channel that reformed between Negit Island and the landbridge in 1995 continued to widen in 1998. 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.,

1998) 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.

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 is predicted to last for up to several decades (Jellison et al. 1998).

Weather during the gull nesting season of 1998 was cooler and wetter than normal for the 16-year period since our studies began in 1983. Mean monthly temperature at Cain Ranch, located 4 mi (6.4 km) south of Mono Lake at 6850 ft (2088 m) elevation, was 35.2° F (0 = 41.5, SE = 1.0, min.-max. = 34.2-48.4) in April, 41.0° F (0 = 48.6, SE = 0.8, min.-max. = 41.0-54.7) in May, 51.6°F (0 = 56.2, SE = 0.7, min.-max. = 51.2-60.2) in June, and 61.9° F (0 = 63.0, SE = 0.7, min.-max. = 59.3-66.3) in July (LADWP data, P. Kavounas in litt.). Monthly total precipitation was 0.69 in (med. = 0.38, min.-max. = trace-0.76) in April, 0.44 in (med. = 0.28, min.-max. = 0.00-2.37) in May, 1.12 in (med. = 0.38, min.-max. = 0.00-1.12) in June, and 0.13 in (med. = 0.12, min.-max = 0.00-0.82) in July.

Nest Counts

Al DeMartini and co-workers counted nests on the Negit Islets from 22 to 26 May. Field workers walked through all the colonies tallying each nest and marking them with a dab of paint to avoid duplicate counts. For some small, steep-sided islets brooding adults were counted from a small motorboat to estimate the number of nests present. Nest totals for the Negit Islets 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 seven 10 X 20 m fenced plots on three islets (Twain, Little Tahiti, and Little Norway) which were monitored to determine chick production. A plot formerly on Spot islet was inundated and rendered unusable by the rising lake level.

Chick Counts

From 2-5 July, Richard Kaufmann and co-workers banded chicks within the seven fenced plots on the Negit Islets. The numbers of chicks produced in these plots were used to estimate total chick numbers on all the Negit Islets combined and on all of Mono Lake's nesting islands (see below).

Counts of Dead Chicks

To assess survivorship from banding to fledging, from 2-4 August field workers made a thorough search for dead banded chicks on islets on which chicks had been banded.

Reproductive Success

In 1998 we used the fenced plot method to estimate reproductive success:

Combined Fenced Plot Method. In this method the number of fledged chicks on the Negit Islets (**F**) is calculated as: $(N/7) \sum_{i=1}^7 f_i$ where N is the total number of nests on the Negit Islets and f_i is the number of young fledged per nest in the seven Negit Islet fenced plots. As in prior years, all newly hatched (unbanded) chicks in July were assumed not to have fledged. An estimate of the number of young fledged on the Paoha Islets complex, based also on fenced plots (J. R. Jehl, Jr. in litt.), 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 1998.

RESULTS AND DISCUSSION

Phenology

In 1998 we found the first hatched chicks on 25 May, indicating that nest initiation began about the same time or slightly later than in most other years of our study. Large numbers of newly hatched chicks in July (19% of all chicks in plots), however, indicated that egg laying was very protracted compared with most years. Brine shrimp productivity in 1998 was delayed and individuals were small early in the season, but by July the second generation of shrimp was larger than that in 1997 (B. Jellison pers. comm.).

Number of Breeding Adults

In 1998, late May nest counts estimated 29,558 gulls were nesting on the Negit Islets and 5374 on the Paoha Islets complex for a lakewide total of 34,932 nesting adults (Table 1). This total was the lowest in the last 16 years, but probably underestimated the number of gulls that actually bred because of the apparent protracted egg laying period. Even if the population was augmented by post-May breeders, the total number of nesting gulls still was likely among the lowest since our studies began.

In 1998, the Negit Islets supported 85% of Mono Lake's breeding gulls versus 15% for the Paoha Islets complex. Twain Islet alone held 54% of the lakewide breeding population. The decrease in the relative proportion of the gull population nesting on the Paoha Islets appears to reflect a reduction in the size of those islands caused by inundation and erosion from the rising lake level. Although no gulls appeared to be nesting on Negit Island in late May, a nearshore boat survey there on 8 July found 5 adults apparently incubating eggs and a pre-fledgling chick (J. R. Jehl, Jr. in litt.). The reasons for the lack of recolonization of extensive areas of suitable gull nesting habitat on Negit Island are unknown, though fresh canid (presumably coyote, *Canis latrans*) tracks and scat were found on that island on 4 July 1998 (R. Kaufmann et al. pers. obs.).

Fledging Rate in the Fenced Plots

The seven fenced plots held an average of 68.43 (SE = 7.63) nests and fledged an average of 0.46 (SE = 0.06) chicks per nest (Table 2). The fledging rate from fenced plots in 1998 was the fourth lowest recorded since our studies began and, hence, was well below the average of 0.94 (SE = 0.10) chicks per nest for the Negit Islets for the last 15 years, 1983 to 1997. The fledging rate in fenced plots may have been an overestimate if additional adults initiated nests in the plots after the late-May nest counts as suggested by the evidence of protracted laying. Assuming that protracted laying after our nest counts led to an increase in 1998 nest numbers in the seven plots to the levels found in 1997 (the year of highest densities since all plots have been used), and no other chicks had fledged from the additional nests, the

Table 1 Nest counts on the Negit Islets from 1983 to 1998. Data from the Paoha Islets from J. R. Jehl, Jr. (in litt.).

NEGIT ISLETS	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Twain	3808	7372	9309	11985	12422	11057	10573	15045	10883	15896	15431	15792	11035	12690	13140	9488
L. Tahiti	5260	7051	6572	5763	4261	3692	2983	4218	3205	3810	3616	4505	4021	4570	4092	3846
L. Norway	2218	1956	1407	810	360	254	269	432	355	473	428	533	493	766	794	606
Steamboat	997	1016	721	722	467	359	314	704	671	862	958	1217	981	459	505	405
Java	143	396	195	400	439	458	543	789	586	1040	399	199	4	70	41	65
Spot	505	358	296	311	248	247	231	309	311	335	356	449	422	399	341	191
Tie	511	231	196	150	84	87	95	167	160	220	210	320	264	267	194	81
Krakatoa	319	272	178	173	185	197	174	283	181	209	146	175	116	57	33	16
Hat	146	109	73	56	14	18	10	19	10	21	21	14	19	41	58	47
La Paz	105	58	43	30	22	21	23	46	49	70	77	57	55	44	30	17
Geographic	140	0	0	0	0	0	2	4	10	68	84	69	51	0	0	0
Muir	170	0	0	0	0	1	10	61	84	139	131	116	87	4	0	0
Saddle	175	46	41	29	14	13	10	18	8	14	10	11	21	31	13	1
Midget	5	3	3	4	4	2	3	3	2	2	3	2	2	2	3	0
Siren	51	0	1	0	0	0	1	7	7	19	20	14	16	10	0	0
Comma	2	1	1	1	0	0	0	0	1	1	1	0	0	1	0	0
Castle Rocks	2	3	4	3	4	6	5	4	5	5	3	3	3	4	4	3
Pancake	0	0	0	7	570	1216	1395	651	0	0	0	0	0	0	1	13
Java Rocks	0	0	0	0	4	3	0	4	2	13	15	9	5	1	0	0
No name	0	0	0	0	0	0	0	1	0	3	3	3	1	0	0	0
Negit Islet Totals:	14557	18872	19040	20444	19098	17631	16641	22765	16530	23200	21912	23488	17596	19416	19249	14779
Paoha Islet Totals:	8001	3546	3151	3596	3208	2833	2682	5145	4442	9283	8498	8182	7331	4334	5707	2383
Negit Island:	--	--	92	636	1502	2037	2765	2827	788	4	12	0	0	0	0	0 ^a
Paoha Island ^b :	--	--	2	102	0	0	0	0	0	1	0	0	0	0	1	304
Mono Lake																
Totals:	22558	22418	22285	24778	23808	22501	22088	30737	21760	32488	30422	31670	24927	23750	24957	17466
Nesting Adults:	45116	44836	44570	49556	47616	45002	44176	61474	43520	64976	60844	63340	49854	47500	49914	34932

^a No nesting gulls were seen on Negit Island in late May, but a nearshore boat survey on 8 July 1998 found 5 adults apparently incubating and 1 pre-fledging chick (J. R. Jehl, Jr. pers. comm.)

^b Numbers of nests intermittently attributed to Paoha Island are from a peninsula of that island (immediately adjacent to the Paoha Islets), which in various years is either partially or completely (e.g., 1998) isolated as a small islet by the rising lake. The Paoha Islets and this peninsula/islet here are collectively termed the Paoha Islets complex.

plots still would have fledged 0.40 (SE = 0.06) chicks per nest (Table 2). Evidence from July and August surveys, however, suggest that some late season nests fledged chicks. At the time we banded 293 chicks in the plots in July we also counted, but did not band, 70 recently hatched chicks. On 2 August a total of 40 medium- to large-sized chicks or juveniles were counted in the plots, 23 of which appeared to be attended by adults. If these latter chicks were assumed to have fledged then the number of chicks fledged per nest, based on the late May nest counts, would have been 0.50 (SE = 0.07) chicks per nest. Thus under the worst and best case scenarios presented the fledging rate of chicks on the Negit Islets in 1998 was likely between 0.40 to 0.50 chicks per nest.

Reproductive Success

Based on the average number of young fledged per nest in seven fenced plots on the Negit Islets (Table 2) and the total number of nests there (Table 1), an estimated 6798 young fledged from the Negit Islets in 1998. Combining this total with the approximately 237 young estimated to have fledged from the Paoha Islets complex (J. R. Jehl, Jr. in litt.) gives an estimate of about 7035 young fledged from Mono Lake in 1998.

Chick Diet

Although in most years brine shrimp is the most prevalent food fed to gull chicks, in 1998 alkali flies dominated the diet of chicks in early July. Alkali flies occurred in 65.4% of all food samples ($n = 26$) and, by percent volume, dominated or co-dominated in 61.5% of all samples. Garbage was next in importance, occurring in 26.9% of all samples and dominating or co-dominating in 15.4%. The other main food item was fish, which occurred in 19.2% of all samples and dominated or co-dominated in 11.5%. By contrast, brine shrimp occurred in only 3.7% of all samples and did not dominate or co-dominate in any.

Table 2 Reproductive success of gulls in seven fenced plots in 1998

PLOTS	NEST PER PLOT ^a	CHICKS PER NEST 2-5 JULY	CHICKS FLEDGED PER NEST ^b
Little Norway	38 (50)	0.68	0.60 (0.46)
Little Tahiti West	82 (85)	0.80	0.45 (0.44)
Little Tahiti East	44 (49)	0.80	0.57 (0.51)
Twain North	74 (88)	0.22	0.16 (0.14)
Twain South	73 (81)	0.73	0.53 (0.48)
Twain Northeast	94 (121)	0.42	0.32 (0.25)
Twain West	<u>74 (85)</u>	<u>0.77</u>	<u>0.61 (0.53)</u>
	0 = 68.43 (79.86)	0.63	0.46 (0.40)
	SD = 20.18 (24.69)	0.22	0.17 (0.15)
	SE = 7.63 (9.33)	0.08	0.06 (0.06)

^a Numbers in parentheses are the number of nests in these plots in 1997, the year with the highest overall nest densities since all these plots have been used.

^b Numbers in parentheses are estimated chick fledging rates if protracted egg laying after nest counts in 1998 had caused the number of nests per plot to increase to the level of those in 1997 and no additional chicks had fledged.

Conclusions

The reasons for year-to-year variation in the number of adult gulls breeding at Mono Lake is imperfectly known. Although the estimate of the number of nesting adults in May 1998 was the lowest on record, it is likely that the number that actually nested was higher as indicated by evidence of a period of protracted egg laying. Pugesek and Wood (1992), however, reported that large numbers of California Gulls skipped breeding in Wyoming in a year of "unusually poor environmental quality" (extremely cold conditions; B. Pugesek pers. comm.), and this also may have been the case at Mono Lake in 1998. It is likely that California Gulls arrived back from their Pacific coast wintering grounds

in poor condition given the reduction in oceanic food supplies during the intense El Niño event over the winter of 1997-98 (B. Sydeman pers. comm.). The degree, if any, to which this may have influenced the number of nesting gulls or their reproductive success at Mono Lake, though, is unknown.

Chick productivity in 1998 was low for the third consecutive year, and, as in most years, the reasons for this are unknown. It is possible that the gulls have been impacted by the recent period of meromixis in Mono Lake, which began in 1995-96 and has since lowered the lake's primary productivity (Jellison et al. 1998). The delayed maturation of brine shrimp in 1998 and their very limited occurrence in the chick diet in early July suggest that food limitation may have been a factor in this year's poor reproductive success. No data were collected in 1998 on the abundance of alkali flies at Mono Lake. Although the rising lake level should improve conditions for alkali flies, it is possible that flies may have been impacted by low temperatures early in the season and the lag time needed to colonize attachment substrates inundated by the rising lake (D. Herbst pers. comm.).

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). These events suggest that over the course of the prior period of meromixis that invertebrate food supplies increased or the gulls otherwise adapted to the meromictic conditions. The current episode of meromixis is predicted to last for up to several decades (Jellison et al. 1998), and any discussion of alternative water management strategies should recognize the long-term prospects for increased productivity and the positive benefits that current stream flows and lake level rise may have on stream and wetland restoration, alkali fly productivity, and curtailment of air pollution via a reduction in dust storms.

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