POPULATION SIZE AND REPRODUCTIVE SUCCESS OF CALIFORNIA GULLS AT MONO LAKE, CALIFORNIA, IN 1999, WITH EMPHASIS ON THE NEGIT ISLETS

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ABSTRACT

In 1999, nest counts estimated about 40,530 adult California Gulls *(Larus californicus)* were nesting at Mono Lake in late May. About 91% of Mono Lake's breeding gulls were on the Negit Islets, 9% on the Paoha Islets complex, and <0.07% on Negit Island. Twain Islet remained the most populous nesting island, holding 53% of Mono Lake's breeding gulls, followed by Little Tahiti Islet with 25%. The few gulls that have recolonized Negit Island, which became further isolated from the mainland, may reflect the continued presence of coyotes there in 1999. The fledging rate on the Negit Islets of 0.26 chicks per nest was the lowest since our studies began in 1983. An estimated 4786 young fledged from all the lake's nesting islands in 1999. The fourth consecutive year of low gull productivity likely reflects reduced primary productivity during a corresponding period of meromixis at Mono Lake. Although the lake's brine shrimp *(Artemia monica)* population matured slowly in spring 1999, it is unclear if this directly affected chick diet or 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. 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

In 1999 Point Reyes Bird Observatory (PRBO) completed the seventeenth year of a study of the California Gull 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 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 6384.4 feet in May 1999 and 6384.7 feet in July 1999 (P. Kavounas in litt.). Consequently, the channel that reformed between Negit Island and the landbridge in 1995 continued to widen in 1999. 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) 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 initially was predicted to last for up to several decades (Jellison et al. 1998).

Weather during the gull nesting season of 1999 was cooler and drier (except in April) than normal for the 17-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 35.0° F ($\bar{0}$ = 41.1, SE = 1.1, min.-max. = 34.2-48.4) in April, 46.7° F ($\bar{0}$ = 48.4, SE = 0.8, min.-max. = 41.0-54.7) in May, 55.2°F ($\bar{0}$ = 56.1, SE = 0.6, min.-max. = 51.2-60.2) in June, and 61.5° F ($\bar{0}$ = 62.9, SE = 0.6, min.-max. = 59.3-66.3) in July (LADWP data, P. Kavounas in litt.). Monthly total precipitation was 0.81 inch (med. = 0.41, min.-max. = trace-0.81) in April , 0.11 inch (med. = 0.22, min.-max. = 0.00-2.37) in May, 0.15 inch (med. = 0.23 min.-max. = 0.00-1.12) in June, and 0.18 inch (med. = 0.13, min.-max = 0.00-0.82) in July.

Nest Counts

Project staff and volunteers counted nests on the Negit Islets and Negit Island from 22 to 27 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 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 (Twain, Little Tahiti, and Little Norway) that were monitored to determine chick production. These included seven plots used in 1998 and a new one established on Twain to replace the plot on Spot Islet that was inundated by rising waters in 1998. To better assess phenology, field workers recounted nests in two

plots on Little Tahiti on 4 June and three plots on Twain on 5 June.

Chick Counts

From 2-6 July, project staff and volunteers banded chicks within the eight 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 12-14 August field workers made a thorough search for dead banded chicks on islets on which chicks had been banded.

Reproductive Success

In 1999 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 $\boldsymbol{N}$ is the total number of nests on the Negit Islets and $\boldsymbol{f_i}$ is the number of young fledged per nest in the seven Negit Islet fenced plots. As in previous 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 1999.

RESULTS AND DISCUSSION

Phenology

In 1999 we found the first hatched chicks on 25 May, and chicks occupied 13% of 363 nests checked in plots on 4-5 June. These data indicate that nest initiation began about the same time or slightly later than in most other years of our study. A 23% reduction in total numbers of nests in five plots between checks on 24-26 May and 4-5 June (Table 2) indicate that if there was any protracted egg laying it was

more than offset by nest loss during this period.

Number of Breeding Adults

In 1999, late May nest counts estimated 36,786 gulls were nesting on the Negit Islets, 3716 on the Paoha Islets complex, and 28 on Negit Island for a lakewide total of 40,530 nesting adults (Table 1). This total was the second lowest in the last 17 years, though a substantial rise over the 34,932 nesting adults estimated in 1998. In 1999, about 91% of the nesting gulls occupied the Negit Islets, 9% the Paoha Islets complex, and <0.07 Negit Island. Twain Islet alone held 53% of the lakewide breeding population followed by Little Tahiti with 25%. The sharpest rise in nest numbers was on Pancake Islet, where gull nests increased from 13 in 1998 to 1136 in 1999. 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. The small numbers of nesting gulls on Negit Island occupied an area on the southwest shoreline that was just barely detached from the main island by the rising lake level. The lack of recolonization of extensive areas of suitable gull nesting habitat on Negit Island may reflect the continued presence of canids (presumably coyote, *Canis latrans*) indicated by recent tracks and scat found on that island on 23 May 1999 (D. Calleri et al. pers. obs.).

Fledging Rate in the Fenced Plots

The eight fenced plots held an average of 93.6 (SE = 7.2) nests and fledged an average of 0.26 (SE = 0.04) chicks per nest (Table 2). The fledging rate from fenced plots in 1999 was the lowest recorded since our studies began, slightly eclipsing the previous low of 0.30 chicks per nest in 1984. For comparison, the long-term average (1983 to 1999) for the Negit Islets is 0.87 (SE = 0.10) chicks per nest.

Table 1 Nest counts on the Negit Islets from 1983 to 1999. 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	1999
Twain	3808	7372	9309	11985	12422	11057	10573	15045	10883	15896	15431	15792	11035	12690	13140	9488	10728
L. Tahiti	5260	7051	6572	5763	4261	3692	2983	4218	3205	3810	3616	4505	4021	4570	4092	3846	5108
L. Norway	2218	1956	1407	810	360	254	269	432	355	473	428	533	493	766	794	606	732
Steamboat	997	1016	721	722	467	359	314	704	671	862	958	1217	981	459	505	405	381
Java	143	396	195	400	439	458	543	789	586	1040	399	199	4	70	41	65	149
Spot	505	358	296	311	248	247	231	309	311	335	356	449	422	399	341	191	27
Tie	511	231	196	150	84	87	95	167	160	220	210	320	264	267	194	81	5
Krakatoa	319	272	178	173	185	197	174	283	181	209	146	175	116	57	33	16	76
Hat	146	109	73	56	14	18	10	19	10	21	21	14	19	41	58	47	43
La Paz	105	58	43	30	22	21	23	46	49	70	77	57	55	44	30	17	0
Geographic	140	0	0	0	0	0	2	4	10	68	84	69	51	0	0	0	0
Muir	170	0	0	0	0	1	10	61	84	139	131	116	87	4	0	0	0
Saddle	175	46	41	29	14	13	10	18	8	14	10	11	21	31	13	1	2
Midget	5	3	3	4	4	2	3	3	2	2	3	2	2	2	3	0	3
Siren	51	0	1	0	0	0	1	7	7	19	20	14	16	10	0	0	0
Comma	2	1	1	1	0	0	0	0	1	1	1	0	0	1	0	0	0
Castle Rocks	2	3	4	3	4	6	5	4	5	5	3	3	3	4	4	3	3
Pancake	0	0	0	7	570	1216	1395	651	0	0	0	0	0	0	1	13	1136
Java Rocks	0	0	0	0	4	3	0	4	2	13	15	9	5	1	0	0	0
No name	0	0	0	0	0	0	0	1	0	3	3	3	1	0	0	0	0
Negit Islet Totals:	14557	18872	19040	20444	19098	17631	16641	22765	16530	23200	21912	23488	17596	19416	19249	14779	18393
Paoha Islet Totals:	8001	3546	3151	3596	3208	2833	2682	5145	4442	9283	8498	8182	7331	4334	5707	2383	1435
Negit Island:	--	--	92	636	1502	2037	2765	2827	788	4	12	0	0	0	0	0[a]	14
Paoha Island[b]:	--	--	2	102	0	0	0	0	0	1	0	0	0	0	1	304	423
Mono Lake Totals:	22558	22418	22285	24778	23808	22501	22088	30737	21760	32488	30422	31670	24927	23750	24957	17466	20265
Nesting Adults:	45116	44836	44570	49556	47616	45002	44176	61474	43520	64976	60844	63340	49854	47500	49914	34932	40530

[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.

Reproductive Success

Based on the average number of young fledged per nest in eight fenced plots on the Negit Islets (Table 2) and the total number of nests there (Table 1), an estimated 4782 young fledged from the Negit Islets in 1999. Combining this total with the approximately 94 young estimated to have fledged from the Paoha Islets complex (J. R. Jehl, Jr. in litt.) gives an estimate of about 4876 young fledged from Mono Lake in 1999.

Table 2 Reproductive success of gulls in eight fenced plots in 1999.

Plots	Nests Per Plot 24-26 May	Nests Per Plot 4-5 June	Chicks Per Nest 2-6 July	Chicks Fledged Per Nest
Little Norway	78	–[a]	0.29	0.20
Little Tahiti West	118	75	0.24	0.19
Little Tahiti East	72	46	0.36	0.30
Twain North	87	–[a]	0.13	0.11
Twain South	116	106	0.46	0.43
Twain Northeast	115	–[a]	0.26	0.22
Twain West	93	75	0.41	0.34
Twain New	70	61	0.28	0.26
	$\bar{0}$ = 93.6	$\bar{0}$ = 72.6	$\bar{0}$ = 0.30	$\bar{0}$ = 0.26
	SD = 20.2	SD = 22.2	SD = 0.10	SD = 0.10
	SE = 7.2	SE = 9.9	SE = 0.04	SE = 0.04

[a] No data available, as these plots were not resurveyed on 4-5 June.

Overview

The reasons for year-to-year variation in the number of adult gulls breeding at Mono Lake remain imperfectly known, though large numbers of California Gulls will skip breeding in Wyoming in years of "unusually poor environmental quality," i.e., extremely cold conditions (Pugesek and Wood 1992, B. Pugesek pers. comm.). Although weather conditions were not extreme during the 1999 gull nesting season, this was the fourth year of a period of meromixis during which the productivity of Mono Lake has been reduced and brine shrimp phenology has been delayed (Jellison and Melack 1999). As in 1998, the effects of meromixis on lake productivity appeared to continue to lessen slightly in 1999. Although primary production, brine shrimp biomass, and shrimp cyst production increased over the levels of the previous three years, the former two measures remained well below long-term averages. The poor productivity of gulls since 1996 is likely related to the meromictic conditions in the lake. Although the exact mechanism responsible for suppression of nesting success remains to be explained, the delayed maturation of brine shrimp reduces their abundance and mass during the primary period of gull chick growth in June and early July. Brine shrimp comprised the bulk of the diet of at least half of gulls chicks in 1999, and brine flies and long-legged flies (Dolichipodidae) also were important sources of chick nourishment (Hite et al. 2000). Still, it is unclear if the slow maturation of the spring *Artemia* population in 1999 (Jellison and Melack 1999) influenced the diet of gull chicks.

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. comm.). 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. comm.). Also, the impacts of meromixis on lake productivity will likely decrease substantially before the complete breakdown of meromixis and the lake's return to monomictic conditions. Regardless, any discussion of alternative water management strategies at Mono Lake should weigh the short-term impacts of meromixis against 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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