POPULATION SIZE AND REPRODUCTIVE SUCCESS

OF CALIFORNIA GULLS AT MONO LAKE, CALIFORNIA, IN 1993,

WITH EMPHASIS ON THE NEGIT ISLETS

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ABSTRACT

An estimated 60,844 adult California Gulls bred at Mono Lake, California, in 1993. The Negit Islets supported 72% of Mono Lake's breeding gulls, versus 28% on the Paoha Islets. Twain Islet remained the most important nesting island by holding 50.7% of Mono Lake's entire breeding gull population. The numbers of nests on most of the Negit Islets holding large populations (over 300 nests) decreased slightly (10% or less) from 1992 levels. In contrast, numbers of nests decreased 62% -- from 1040 nests in 1992 to 399 nests in 1993 -- on Java Islet, the only island visited by coyotes in 1992. The estimated 33,046-37,462 young fledged from all of Mono Lake's nesting islands in 1993 was the third highest total since our studies began in 1983. This relatively high number of young produced was in large part a function of the large nesting population of adults, because the fledging rate of 1.09 young per nest on the Negit Islet plots was about average for the 11 years of our study. Canids (presumably coyotes) that crossed a narrow water barrier to Java Islet in mid-nesting season were the apparent cause of a complete reproductive failure on that islet. The fact that coyotes crossed over to Java at a lake elevation of 6375 feet shows that prior predictions of the lake levels that will protect nesting gulls are incorrect.

INTRODUCTION

In 1993 Point Reyes Bird Observatory (PRBO) completed the eleventh 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). Since 1941, the lake has dropped almost 40 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 1991-92 were very dry, and lake level had fallen to 6374.3 feet by the end of the 1992 nesting season (P. Vorster pers. comm.). Precipitation in the Mono Basin watershed in the winter of 1992-93 was high, and, with runoff roughly 125% of normal, lake level began to slowly rise, attaining 6375.1 feet by 1 July 1993 (P. Vorster pers. comm.). At that time a water barrier of roughly 40m separated Java Islet from the Negit Island peninsula and an additional barrier of about 120m separated Twain Islet from Java. The spring and summer of 1993 were cooler and drier than normal.

STUDY AREA AND METHODS

The study area at Mono Lake has previously been described in Shuford (1985) and Shuford et al. (1984, 1985).

Nest Counts

Because of early indications of a late start to the 1993 nesting season on the Paoha Islets (J. Jehl pers. comm.), nests on the Negit Islets and Negit Island were counted from 27-31 May, a week later than in most years. Jan Dierks and co-workers walked through all the

colonies tallying each nest and its contents and marking nests with a dab of spray 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; none of these islets had more than 10 apparent nests. Nest totals for the Negit Islands and Negit Island were added to those for the Paoha Islets 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 four islands (Twain, Little Tahiti, Little Norway, and Spot islets) which were monitored to determine chick production and fledging rates.

Banding

During 1-5 July, Christine King and co-workers banded 844 chicks on the Negit Islets. Of these, 572 were from inside the eight fenced plots. On islets without plots the following numbers of chicks were banded, and most were dyed orange on the back with picric acid solution: Steamboat (249) and Krakatoa (23).

Chick Censuses

From 1-6 July, chicks were counted on the Negit Islets. On the smaller islets without fenced plots or dyed chicks, one to three observers attempted to count all chicks from a small motorboat. Chicks on these islets were sometimes counted several times on successive circumnavigations until observers were satisfied they had obtained the best possible count. The number of dyed and undyed chicks visible by boat on Steamboat and Krakatoa was counted on three consecutive days after chick dyeing. Dyed-to-undyed ratios from these counts were used to extrapolate the total number of chicks on each of these islets (see below). On the remaining islets, we counted all chicks at the time of banding within each of the eight fenced plots. Data from these plots were used to estimate total chick numbers on each islet with one or more plots, on all the Negit Islets combined, and on all of Mono Lake's nesting islands (see below).

Count of Dead Chicks

From 4-6 August, Dave Calleri and co-workers made a thorough search for dead banded chicks on all islets on which chicks had been banded, to assess survivorship from banding to fledging.

Calculating Fledging Rate in Fenced Plots

The number of chicks fledged per nest in a plot was calculated as: **(b-d)/n** where **b** is the number of chicks banded in the plot, **d** is the number of those that are found dead at the end of the season, and **n** is the total number of nests in the plot in May. The chicks that escaped from plots before being banded (18 of 590 chicks) were assumed to have survived in the same proportion as the banded chicks.

Reproductive Success

Three methods were used to estimate the number of chicks fledged in 1993 (see Shuford 1985):

I. **Islet-by-Islet Method.** Depending on the islet, the number of chicks fledged was determined in one of three ways:

a. On each of the smallest islets, chick counts from 2-5 July were multiplied by the proportion of birds surviving to fledging of those banded on all Negit Islets from 1-5 July.

b. For moderate-sized islets without plots, using the Lincoln Index method, the total number of chicks at the time of banding and dyeing **(n)** was estimated as **bt/m** where **b** is the total number of chicks that were dyed, **m** is the average number of dyed chicks counted on two consecutive days after dyeing, and **t** is the average number of all chicks (dyed and undyed) on the two counts. Total chicks fledging was **[(b-d)/b]n** where **d** is the number of dead banded chicks found on the island after the nesting season had ended.

c. For the largest islets, the number of chicks fledged per nest in the fenced plot(s) was multiplied by the total number of nests on the islet in May.

The Negit Islet and Negit Island totals were added to those for the Paoha Islets (data

from J. Jehl in litt.) to provide an estimate of the total number of chicks fledged at Mono Lake.

II. **Fenced Plot Method.** In this method the number of fledged chicks at Mono Lake **(F)** is calculated as: $(N/8)\sum_{i=1}^{8} f_i 1$ where **N** is the total number of nests at the lake and f_i is the number of young fledged per nest in the eight Negit Islet fenced plots.

III. **Combined Fenced Plot and Islet-by-Islet Method.** This method provides a lakewide estimate of the number of chicks fledged by combining an estimate of the number of chicks fledged on the Negit Islets based on the fenced plot method with an estimate from the Paoha Islets based on the islet-by-islet method.

RESULTS AND DISCUSSION

Phenology

Despite a later than usual start to nesting on the Paoha Islets (J. Jehl pers. comm.), the timing of nesting events on the Negit Islets in 1993 appeared similar to that in most other years of our study. If nesting in 1993 had been a week later than usual on the Negit Islets, our 6-day delay of the 1993 counts relative to 1992 should have produced a similar proportion of recently hatched young at the time of our counts in both years. Instead, counts on Twain Islet on 27-28 May 1993 found 254 of 15,431 nests with recently hatched young versus 13 of 15,896 nests with young on that islet on 21-22 May 1992 counts. That chick hatching increased over 1992 levels on our delayed 1993 nests counts indicates that nest initiation on the Negit Islets in 1993 was probably delayed at most a few days over that in 1992.

Number of Breeding Adults in 1993

An estimated 43,824 adult gulls nested on the Negit Islets and 24 on Negit Island (Table 1). An additional 16,996 nested on the Paoha Islets (J. Jehl in litt.). The lakewide estimate of 60,844 nesting adults in 1993 is similar in size to the nesting populations in 1990 and 1992. Nest counts for other years since 1983 have ranged from about 44,000 to 50,000 adults.

In 1993, the Negit Islets and Negit Island supported 72.1% of Mono Lake's breeding gulls versus 27.9% on the Paoha Islets. Twain remained the most important colony by holding 50.7% of the entire Mono Lake breeding population. The numbers of nests on most of the Negit Islets holding large populations (over 300 nests) decreased slightly (10% or less) from 1992 levels. In contrast,

Table 1. Nest counts on the Negit Islets from 1983 to 1993. Data for Paoha Islets from Jehl (in litt. and previous reports).

NEGIT ISLETS	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Twain	3808	7372	9309	11985	12422	11057	10573	15045	10883	15896	15431
L. Tahiti	5260	7051	6572	5763	4261	3692	2983	4218	3205	3810	3616
L. Norway	2218	1956	1407	810	360	254	269	432	355	473	428
Steamboat	997	1016	721	722	467	359	314	704	671	862	958
Java	143	396	195	400	439	458	543	789	586	1040	399
Spot	505	358	296	311	248	247	231	309	311	335	356
Tie 511	231	196	150	84	87	95	167	160	220	210	
Krakatoa	319	272	178	173	185	197	174	283	181	209	146
Hat	146	109	73	56	14	18	10	19	10	21	21
La Paz	105	58	43	30	22	21	23	46	49	70	77
Geographic	140	0	0	0	0	0	2	4	10	68	84
Muir	170	0	0	0	0	1	10	61	84	139	131
Saddle	175	46	41	29	14	13	10	18	8	14	10
Midget	5	3	3	4	4	2	3	3	2	2	3
Siren	51	0	1	0	0	0	1	7	7	19	20
Comma	2	1	1	1	0	0	0	0	1	1	1
Castle Rocks	2	3	4	3	4	6	5	4	5	5	3
Pancake	0	0	0	7	570	1216	1395	651	0	0	0
Java Rocks	0	0	0	0	4	3	0	4	2	13	15
No name	0	0	0	0	0	0	0	1	0	3	3
Negit Islet Totals:	14557	18872	19040	20444	19098	17631	16641	22765	16530	23200	21912
Paoha Islet Totals:	8001	3546	3151	3596	3208	2833	2682	5145	4442	9283	8498
Negit Island:	--	--	92	636	1502	2037	2765	2827	788	4	12
Paoha Island:	--	--	2	102	0	0	0	0	0	1	0
Mono Lake Totals:	22558	22418	22285	24778	23808	22501	22088	30737	21760	32488	30422
Nesting Adults:	45116	44836	44570	49556	47616	45002	44176	61474	43520	64976	60844

numbers of nests decreased 62% -- from 1040 nests in 1992 to 399 nests in 1993 -- on Java Islet, the only island visited by coyotes in 1992.

Fledging Rate in the Fenced Plots

The eight fenced plots held an average of 64.88 nests (SE=7.44) and fledged an average of 1.09 chicks (SE=0.05) per nest (Table 2). This fledging rate is only slightly above the mean rate of 1.03 (SE=0.10) chicks per nest over the 11 years (1983 to 1993) of our study and is the median value of the range of 0.28 to 1.43 chicks per nest measured during this period. The fledging rate within fenced plots was used to estimate the number of fledged chicks on islets with plots (Table 3) and to estimate the total number of chicks fledged at Mono Lake in 1993 (Table 4). Of all the chicks banded on the Negit Islets, 4.0% were found to have died before fledging.

Table 2. Reproductive success of gulls in eight fenced plots in 1993.

PLOTS	NESTS PER PLOT	CHICKS PER NEST AT BANDING	CHICKS FLEDGED PER NEST
Little Norway	31	1.10	1.03
Spot	55	1.34	1.31
Little Tahiti West	81	1.22	1.21
Little Tahiti East	43	0.98	0.93
Twain North	84	0.94	0.92
Twain South	64	0.98	0.94
Twain Northeast	92	1.18	1.10
Twain West	69	1.30	1.25
$\bar{x}2 =$	64.88	1.13	1.09
SD =	21.05	0.15	0.16
SE =	7.44	0.05	0.05

Reproductive Success

I. **Islet-by-Islet Method.** Using the production data from individual islets, an estimated 22,339 chicks fledged from the Negit Islets in 1993, and 13,647 from the Paoha Islets (J. Jehl in litt.), for a lakewide total of 35,986 fledged chicks (Tables 3 and 4). Although data were lacking, we suspect that no chicks were produced from the 12 nests on Negit Island in 1993, as was the case for the 4 nests there in 1992.

II. **Fenced Plot Method.** 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 at Mono Lake, an estimated 33,046 young fledged at Mono Lake in 1993 (Table 4).

III. **Combined Fenced Plot and Islet-by-Islet Method.** Based on the average number of young fledged per nest on the Negit Islets (Table 2) and the total number of nests on the Negit Islets and Negit Island (Table 1), an estimated 23,815 young fledged from these islands. Combining this total with the 13,647 young fledged from the Paoha Islets gives an estimate of 37,462 young fledged from Mono Lake in 1993 (Table 4).

That fledging success estimated by the fenced plot method was lower than that estimated by the other methods may reflect the lower fledging success on the Negit Islets versus that on the Pahoa Islets, a factor not incorporated in the former estimate. By contrast, the higher rate of fledging success on the Paoha Islets may in part be a result of delayed nesting there which could lead to an underestimate of nests and, consequently, an overestimate of the rate of fledging success. Regardless of the method used, or other considerations mentioned, the number of chicks produced in 1993 was the third highest since our studies began in 1983. The large number of chicks produced was a function of the large nesting population of adults relative to the modest fledging rate in fenced plots. As noted previously, the fledging rate of 1.09 chicks per nest was about average for the 11 years of our study.

Table 3. Chick production on individual Negit Islets and Negit Island in 1993. Paoha Islets total from J. Jehl (in litt.).

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ISLAND	CHICKS AT BANDING	SURVIVAL RATE	# OF CHICKS FLEDGED
*Twain	16974	0.95	16125
*Little Tahiti	3978	0.98	3898
*Little Norway	471	0.94	443
**Steamboat	918	0.97	890
**Java	0	-	0
*Spot	466	0.97	452
Tie	164	0.96	157
**Krakatoa	100	0.87	87
Hat	11	0.96	11
La Paz	53	0.96	51
Geographic	92	0.96	88
Muir	79	0.96	76
Saddle	9	0.96	9
Midget	1	0.96	1
Siren	38	0.96	36
Castle Rocks	3	0.96	3
Java Rocks	8	0.96	8
No Name	3	0.96	3
Comma	1	0.96	1
Pancake	0	-	0
Negit	?	-	?
	_____		_____
	23369		22339
Paoha Islets			13647
			_____
Mono Lake Total			35986

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 *Chick estimates extrapolated from mean number of chicks/nest inside fenced plots (4 plots on Twain, 2 on Little Tahiti, and 1 each on Little Norway and Spot).

**Chick estimates from Lincoln Index as described in Methods.

  Chick numbers for all other islets are direct counts adjusted for mortality between counting date and fledging.

Table 4. Estimates of the number of chicks fledged (± 1SE) at Mono Lake from 1983 to 1993 based on
three methods. Sample sizes in parentheses.

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	FENCED PLOTS	ISLET-BY-ISLET	PLOTS AND ISLETS
1983	14212 ± 2933 (2)	--	13521
1984	6402 ± 1210 (4)	6319	5859
1985	18942 ± 1337 (6)	17653	18411
1986	33202 ± 1487 (6)	32684	33019
1987	27141 ± 1428 (8)	26440	26721
1988	24203 ± 811 (8)	22920	23712
1989	26375 ± 2499 (8)	25117	26247
1990	43928 ± 3597 (8)	45778	46630
1991	20436 ± 1427 (8)	22304	22043
1992	42925 ± 1973 (8)	44038	44577
1993	33046 ± 1671 (8)	35986	37462

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Effect of Lake Level on Reproductive Success

As noted above, the number of nests initiated on Java Islet in 1993 was greatly

reduced over the number in 1992, presumably in response to the presence of coyotes there in

1992 (Shuford 1992). Prior to total abandonment of an island, this pattern of a reduction in

nesting numbers following coyote predation has been observed on Pancake Islet in 1990 and

on Negit Island in 1991 (Dierks 1991, Dierks and Shuford 1992). Reduced nesting success on

Java in 1992 was also attributed to the presence of coyotes (Shuford 1992). In 1993, nest

counts were conducted on Java on 28 May. On our next visit to Java on 1 July 1993,
Christine King and co-workers found that island totally abandoned by gulls and consequently
no chicks were produced there. They observed relatively fresh canid tracks and coyote scat
and found 5 dead adult gulls and 20 dead large gull chicks, all with signs of coyote predation.
 Thus in two years of coyote predation Java produced a total of 399 chicks, only 22% of the
total produced in the two previous years.

The lake level at the time of abandonment of Java in 1993 was about 6375 feet. This is
one foot above the lake level at which coyotes reached Java in 1992 and two feet above the
level of 6373 feet, above which nesting islands have been predicted to be protected from
coyotes (Jones and Stokes 1993). Fortunately, in 1993 coyotes did not reach Twain Islet,
which currently holds about 50% of the entire lake's population and is susceptible to coyote
access at the same lake levels as is Java.

Given our current state of knowledge, it is clear that prior predictions of the lake levels
suitable to protect nesting islands at Mono Lake are not accurate.   What levels will protect
nesting islands are still not certain. Observations over the years have shown us that once
coyotes reach a nesting island with a large food supply that they will return to exploit it in
following years. Observations in 1992 and 1993 further suggest that once coyotes are
rewarded for their efforts that they may cross water barriers that previously might have
inhibited them.

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