Nesting Success of Western Gulls on Bird Rock, Santa Catalina Island, California

Judith L. Hand

Biology Department, University of California, Los Angeles, California 90024

INTRODUCTION

In 1965 and 1966, Charles Harper studied aspects of reproductive biology in a colony of less than thirty pairs of Western Gulls *(Larus occidentalis wymani)* on Bird Rock, a small islet approximately 530 m off the east side of the isthmus at Santa Catalina Island, California (Harper 1971). In 1974, I made observations on breeding success at Bird Rock which were comparable to some of the data reported by Harper. This paper presents results of comparison of the two studies.

STUDY SITE AND METHODS

Bird Rock is roughly oval and dome shaped, about 135 m long by 90 m wide. For the most part, the hard surface is smooth and bare with few fissures or prominent contours. A low-growing patch of vegetation ringed by prickly pear cactus *(Opuntia occidentalis)* covers part of the southwest end.

With the exception of a pair of Killdeer *(Charadrius vociferus)* found on 22 June 1975, I saw no other vertebrates on the island. Harper noted a breeding pair of Black Oystercatchers *(Haematopus bachmani)* in 1966 and occasional sea lions *(Zalophus californianus)* resting on the island, but otherwise he also saw no other vertebrates. The Killdeer seen in 1975 performed impressive distraction displays on the south end of the island, suggesting that they were nesting or intended to nest there, but my superficial hunt did not detect the nest. It may have been within the border of the vegetation patch.

The highest part of the islet forms a ridge that runs lengthwise across the top and middle and separates the northeast and southwest slopes. The gulls do not nest on the northeast side, probably because the surface is too steep. Nests are found primarily along the ridge and over the face of the southwest slope (Fig. 1).

The area around Bird Rock is used extensively for human recreation. Access to the islet itself is hindered to some extent because the intertidal zone has numerous jagged rocks and there is always considerable swell, even in calm weather. Difficulties in getting onto the islet, plus its barren and uninteresting appearance, have probably contributed significantly to continued occupation of the gull colony in spite of heavy human traffic in the area. Nevertheless, Harper reported significant mortality in both 1965 and 1966 which he attributed to human disturbances.

Harper visited the colony six times each season, at roughly two-week intervals, beginning in late May and continuing through July. At each visit he counted numbers of nests, eggs, and chicks present. Nests were labeled by painting numbers next to them on the rock. Chicks were banded with temporary bands when about twenty days old.

I made a census of the colony three times in 1974, on 12 May, 19 May, and 13 July. This was sufficient to collect data on nest locations, clutch sizes, and probable hatching success which are comparable to the data collected by Harper. Nests were identified by numbers painted on the rock. Individual eggs and chicks were not marked.

I made no visits during the weeks following completion of clutches or following hatching, so

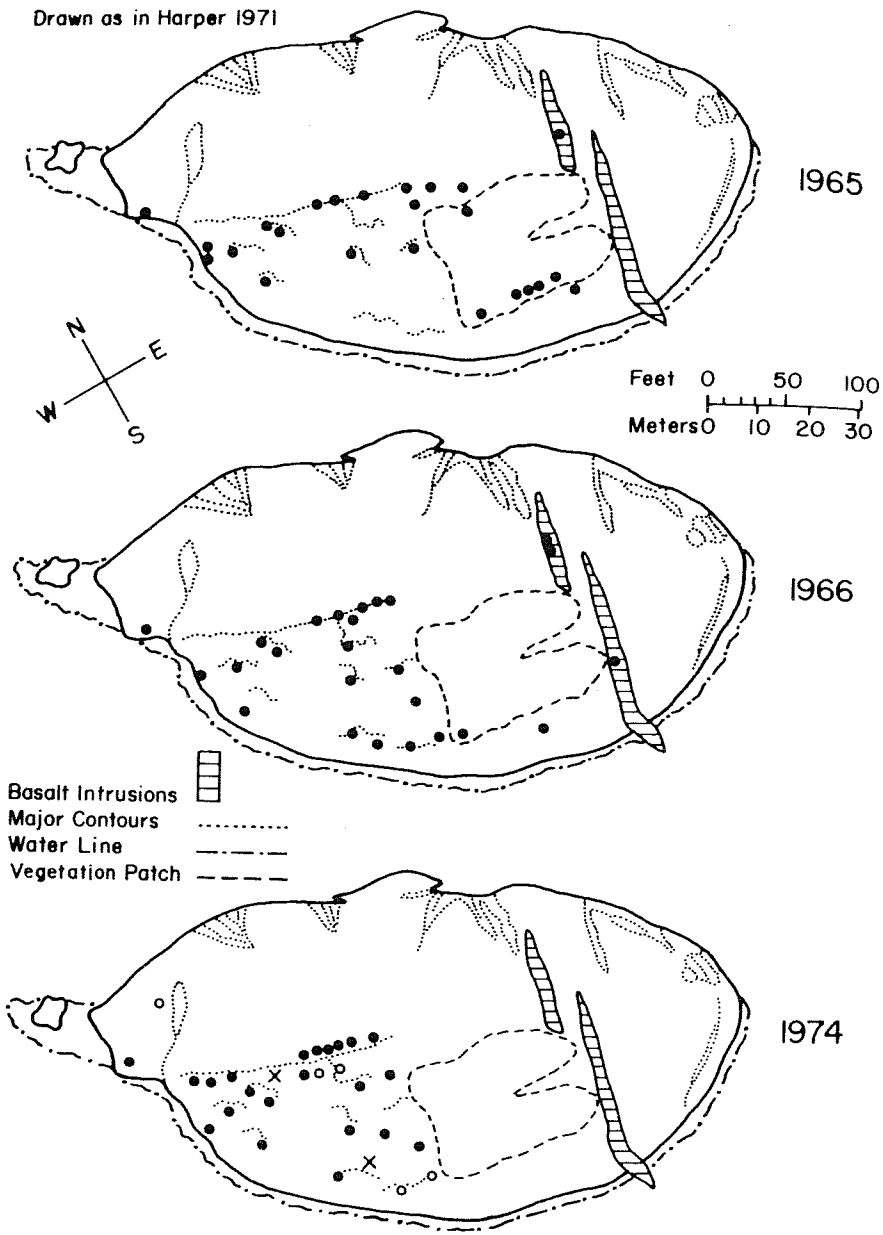

FIGURE 1. *Nest locations on Bird Rock. For 1974 only, solid circles represent three-egg clutches, open circles represent clutches of less than three eggs, and Xs represent clutches exceeding three eggs.*

I have few data on causes of egg loss and no data on causes of chick mortality which might be compared with Harper's observations.

Harper counted the number of young on or around the islet in middle and late July (22 July 1965 and 15 July 1966) and presumed that those young would eventually fledge. I made a similar count on 13 July 1974; the numbers obtained on that date are those used to determine fledging ratios.

RESULTS

Peak of laying. —Harper reports that breeding seasons on Bird Rock in 1965 and 1966 were "nearly identical to those Schreiber reported for 1968" on San Nicolas Island. Schreiber (1970) estimated that the peak of laying by Western Gulls in 1968 occurred between 6 and 16 May. In 1974, 83 per cent of clutches were complete by 12 May, and by 19 May 93 per cent (27 of 29 clutches) were complete. Two new clutches (with three and two eggs) were found on 13 July, possibly representing renesting attempts (one clutch placed very near the high tide line was lost between 12 and 19 May). A member of the University of Southern California Marine Station staff, John Pilger, visited the island in mid-August, checked these two nests, and reported that all eggs from the three-egg nest were absent and that neither of the eggs from the two-egg nest had hatched.

Nest site preference. — Figure 1 shows locations of nests in all three years. A shift occurred between 1965 and 1966. In 1965, hatching was markedly lower in the vegetation patch compared with the rest of the colony (56 *vs.* 76 per cent, respectively), and Harper suggested that birds which had experienced failures there in 1965 avoided the patch in 1966. Birds in 1974 also avoided it; no nests were found in or adjacent to the vegetation. The closest was approximately 2 m from the plants.

In all three years the "preferred" sites were on the central ridge that overlooks the slope where other nests are located (Fig. 1). The territory sizes are generally smaller here than on the slope, having internest distances ranging from 1 to 4 m (Harper 1971, and pers. obs.). The ridge is perhaps more desirable because it provides the most level spots, has some short vegetation (not exceeding 10 cm in height) for nest construction, and some loose soil in which to make a scrape.

In 1965 there were four nests along this prime area, and in 1966 seven pairs were occupying the area (these nests are joined by a dotted line in Figure 1). By 1974, ten pairs were located in this region. Although proportions in Figure 1 make it look more crowded, the placement of nests in 1974 was such that internest distances were similar to those in the other two years, ranging from 1 to 4 m, with a mean of about 2 m.

Clutch size and hatching success. —Table 1 presents data on clutch size and hatching success. Discounting a few known cases of egg loss before hatching, the figures for 1974 are based on the assumption that when I made the census of the colony on 13 July, absence of eggs from the nest was the result of hatching. Although some instances of egg disappearance not attributable to hatching were detected by both Harper and me, visits by neither of us were frequent enough to explain all cases of egg loss. Since some loss invariably occurs in Western Gulls due to predation, particularly by conspecifics, as well as to other minor factors (Schreiber 1970, Coulter 1973, Hunt and Hunt 1975), and because of human disturbance on Bird Rock (Harper 1971), the figures for all three years represent maximum probable hatching values.

Despite these uncertainties, some trends in hatching success are evident. In all three years, three-egg clutches were the most common (67 per cent of all clutches) and generally the most successful, with hatching success ranging from 82 to 96 per cent. The sample sizes for single-egg and two-egg clutches are too small to be meaningful, but they were generally less successful in hatching than were three-egg clutches.

TABLE 1. Clutch sizes and per cent of eggs hatching in 1965, 1966, and 1974.

Year	Size of clutch	Number of clutches	Per cent of clutches	Per cent of eggs hatched
1965	1	6	25.0	33
	2	3	12.5	33
	3	14	58.3	88
	4	1	4.2	75
1966	1	4	16.0	50
	2	3	12.0	100
	3	17	68.0	96*
	6	1	4.0	—*
1974	1	1	3.4	100
	2	4	13.7	50
	3	22	75.8	82
	5	1	3.4	—†
	6	1	3.4	—†

* Per cent hatching of the six-egg clutch was not calculated separately but was treated as two clutches of three eggs.
† See text for explanation.

Supernormal clutches. — Clutches exceeding three eggs, sometimes referred to as supernormal clutches, occurred on Bird Rock in all three years. Because of differences in egg coloration within supernormal clutches of Western Gulls on San Nicolas Island, Schreiber suggested that the eggs might have been laid by more than one female (Schreiber 1970). On Santa Barbara Island, Hunt and Hunt (1977) have found that not only do two females lay eggs in the same nest, they apparently form pairs that exhibit the same kind of territorial behavior used by heterosexual pairs. The phenomena associated with clutches exceeding three eggs in Western Gulls are being studied in detail by G. Hunt and his colleagues on Santa Barbara Island (Hunt and Hunt 1977, Wingfield *et al.* 1980).

Harper reported one of these nests in 1965 (four eggs) and one in 1966 (six eggs). In 1974 I found two, and in 1975 I visited the colony on 22 June and found three such clutches with the eggs still unhatched. Although the increase from one to three nests is small, it is interesting in view of the small size of the colony itself since it suggests that the percentage of supernormal clutches may be increasing. Further observations to verify this possibility seem warranted.

In Table 1, I have not presented a value for per cent hatching in the five- and six-egg supernormal clutches. On 13 July, two eggs were missing from the five-egg clutch and three were missing from the six-egg clutch. Calculation of hatching success in these clutches, based on the assumption that the missing eggs had hatched, would give a 60 per cent hatching rate for the five-egg clutch and 50 per cent for the six-egg clutch. However, Schreiber reported that only one egg hatched out of 74 eggs in supernormal clutches on San Nicolas Island, and Hunt and Hunt (1977) estimated that the number of eggs which were even fertile in such clutches on Santa Barbara Island was slightly less than 15 per cent for 144 eggs from five- and six-egg clutches. It seems most probable that eggs missing from these nests disappeared for reasons other than hatching, such as rolling from the nest, being broken, or being taken by a neighbor. It is for this reason that no estimated value for hatching success appears in Table 1.

Fledging success. —Table 2 summarizes data on breeding at Bird Rock in all three years.

TABLE 2. Summary of nesting success of Western Gulls on Bird Rock in 1965, 1966, and 1974.

Year	1965	1966	1974
Number of nests	24	25	29
Number of eggs	58	67	86
Mean clutch size	2.41	2.68	2.97
Per cent of eggs hatching	76	80	76
Young present (mid-July)	32	24	15
Fledging ratio (young/nest)	1.33	0.96	0.52
Per cent of clutches exceeding 3 eggs	4.16	4.00	6.90

The fledging ratio in 1965 was a healthy 1.33 young/nest, and 0.96 young/nest in 1966. In 1974, this dropped to 0.52 young/nest. The seemingly consistent decline suggests a trend toward reduced fledging success on Bird Rock.

DISCUSSION

I would like to discuss two points of interest. The first concerns supernormal clutches. The presence of these clutches, and presumably the female pairs with which they are associated (as demonstrated on Santa Barbara Island), is of some comparative interest because territory sizes on Bird Rock are quite small, unlike those on Santa Barbara Island (Hunt and Hunt 1975). Data presented by Wingfield *et al.* (1980) show that the adult sex ratio is skewed on Santa Barbara Island, with females outnumbering males. Hunt and Hunt (1977) have suggested that if there were an excess of females in the population, homosexual pairing, combined with polygamous heterosexual mating, would make it possible for excess females to raise offspring. Whatever the causal factors of this phenomenon may be, one might argue that low population density, as seen on Santa Barbara Island, is also a requisite if female pairs are to establish and maintain a territory. Males of the Herring Gull *(Larus argentatus)* group generally carry the bulk of responsibility for defending territories and are certainly more aggressive than females. Western Gulls are no exception (Pierotti 1976, and pers. obs). But territories on Bird Rock are not large, averaging 22.3 m^2 (Harper 1971), compared with an average of 150 to 214 m^2 on Santa Barbara Island (Hunt and Hunt 1975). In addition, the barren surface provides no barriers to visibility, which have been shown to reduce tension between neighbors in other gull species (Burger 1974). If the supernormal clutches found on Bird Rock do belong to female pairs, as they do on Santa Barbara Island, it would indicate that low breeding density within the colony is not a necessary condition for the phenomenon of territory establishment by female pairs. This is not meant to suggest that paired females are likely to be able to hold a territory in direct competition with a male. Rather, it may be that as long as all males wishing to breed have some place to do so, even if it is a small territory, female pairs can maintain a territory, as well. Further investigation of the pairs associated with supernormal clutches on Bird Rock might help provide answers to this kind of question.

The second point, one which is also speculative, relates to the reduced fledging success on Bird Rock in 1974. The decline is particularly interesting since mean clutch size increased during this same period (Table 2). Even if the nests containing supernormal clutches are eliminated from calculations, the average clutch size in 1974 was 2.78 eggs/nest, an increase over the two years sampled earlier. The rate of hatching also appears to be similar to what Harper reported, although the number of fledglings was one-third the lowest number reported by Harper (1966) and less than one-half the number in 1965. Total mortality from egg to fledging was 83 per cent in 1974.

The three factors which could contribute to reduced fledging success are decrease in food supply, increase in human disturbance, and problems associated with pesticides. No obvious effects of pesticide poisoning, such as eggshell thinning, were detected by Harper or me. It is difficult to assess the possible effects of human disturbance on the colony. However, Douglas Bombard (pers. comm.), who has operated the Twin Harbor facilities at the isthmus for over fifteen years, stated that the overall recreational activities had not altered significantly in the past ten years, nor did he believe that greater numbers of people were likely to be visiting the island. Furthermore, Harper's values for chick mortality in 1965 and 1966 were already elevated, in his opinion, by human disturbances in those years. Yet values for fledging were much higher than in 1974.

Declines in fledging might stem from the same factor that caused a decline in sport fish abundance, namely, elimination of food items. If these declines represent a genuine trend and are not due to human disturbance, then they may indicate that the area around the isthmus has become so depauperate that there are not enough food alternatives available for gulls at this colony.

Several considerations argue against this explanation, however. First, in view of the flexible nature of gull diets, I find it difficult to imagine that the waters around the isthmus would not provide enough forage for less than 30 pairs of gulls and their young. Furthermore, Hunt and Hunt (1975) found little evidence of starvation (only 6.06 per cent of their sample) in the considerably larger colony of Western Gulls on Santa Barbara Island in 1972. In that colony, 84.8 per cent of chicks reached a weight of 500 g (the Hunts' criterion for chick survival). In addition, since clutch sizes actually increased, food presumably would have to be abundant early in the season but decrease significantly at some point after laying to lead to starvation of young.

Another explanation for the decline in fledging on Bird Rock might be that egg and chick mortality stemming directly from crowding and aggression has increased to a point where fledging is severely reduced. Such conditions would be seriously aggravated by any human visits to such a small colony. This possibility seems plausible in view of the small amount of suitable nesting habitat on Bird Rock and the small and visually exposed spaces between nests. Examination of Figure 1 shows that, in addition to increased numbers of nests in 1974 (29 compared with 24 in 1965), the nests were also less spread out in 1974, resulting in higher density on the preferred slope. At such close internest distances, and without any visual barriers between pairs or cover for chicks, aggressive interactions with several neighbors might keep the birds in sufficient turmoil to facilitate numerous egg thefts. High chick mortality might be even more likely.

On Santa Barbara Island, with roughly 1,200 to 1,500 pairs of gulls, abundant space seems to be available and some other factor or factors are probably limiting colony growth. On Bird Rock, space may be more critical. If this is the case, we have some interesting contrasts in factors affecting Western Gull colonies within the limits of the Channel Island area. Long-term comparative studies of both colonies of this species, located within a few miles of each other, could provide valuable information on gull population dynamics.

SUMMARY

In 1974, data were collected on nest placement, clutch sizes, and rates of hatching and fledging of Western Gulls on Bird Rock, Santa Catalina Island. This paper compares these data with a similar study made at the same site in 1965 and 1966. Judged by the number of nests and eggs laid, the colony appears to be stable or growing, but the number of fledglings in 1974 was significantly reduced below 1965-66 values. This may have been caused by increased nesting density in 1974. "Supernormal" clutches were found in four years: one in 1965, one in 1966, two in 1974, and three in 1975.

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