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15 Status and Reproductive Performance of Marine Peregrines in Baja California and the Gulf of California, Mexico

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This report updates the paper by Banks (1969) on Peregrines in Baja California and the Gulf of California presented at the Madison Conference in 1965. It embraces research undertaken in the region since 1965, including the current population and reproductive status of the species in the area covered by Banks (1969) and Anderson (1976), and on islands off the states of Sonora, Sinaloa, and Nayarit (including the Revillagigedo Islands, where nesting is suspected). It also includes pre-1967 data not given by Banks.

FIELD SURVEYS

Banks' report contained data collected from other observers or incidental to other research in the region. It was the first detailed account of Peregrines in the Baja California region, and stimulated several of us to investigate Peregrines there.

M. Kirven first surveyed the area extensively for Peregrines from 1966-71, covering nearly all of the historical nesting localities on both sides of the Baja peninsula and on the offshore islands. He discovered 15 previously unknown occupied territories in the Gulf of California, and monitored eyries there from 1966-71. Kirven showed the locations of these eyries to D. Anderson and J. Keith in 1971. The middle area of the Gulf of California was surveyed by Anderson (1976) and Keith irregularly from 1971-82, in conjunction with their studies of the Brown Pelican; two new occupied territories were located. Porter, Jenkins, C. Stone, E. Boeker, and others surveyed the area from 1976-84. They checked most of the historical Baja peninsula sites, inland

eyrie locations and historical eyries in the middle region of the Gulf of California, but not all of the islands on the western side of the Baja peninsula. In 1976-80 they surveyed over 16,500 km of insular, mainland, and Baja peninsular shorelines along the Gulf of California, from the tip of the Baja peninsula to latitude 30°N, plus several islands in the Pacific. In 1981 Jenkins, accompanied by A. DeAnda, R. Graham, R. Ogilvie and J. Swift, checked the middle area of the Gulf of California, and in 1984 he and R. Ogilvie surveyed 40 previously known breeding territories in the Gulf of California from Puerto Peñasco in the north to La Paz in the south. All but three of the 23 breeding territories known before 1966 were checked from 1976-84.

POPULATION ESTIMATES

Pre-1966 Estimates. — Table 1 gives the number of Peregrine territories where eggs or young were recorded for regions of Baja California, 1800-1984. Through 1965, Banks (1969) reported 38 territories at 21 "localities" on the western side of the Baja peninsula and 17 territories at 14 "localities" on the Gulf of California side. He listed 4 suspected territories (where birds were seen but were not known to have nested) on the western side of the Baja peninsula, 4 in the interior and 5 in the Gulf of California. We discovered 12 additional records of territories unknown to Banks (1969), increasing the number known before 1966 to 42 on the western side of the Baja peninsula, 23 in the Gulf of California, and 2 insular sites off the Pacific coastline of mainland Mexico, for a total of 67 nesting territories (Table 1).

Population Decline. — Banks (1969) was unable to describe a decline in the Peregrine population in Baja California because the data were too meager. Kirven's studies revealed that by 1966-71 there were only 2-3 pairs still nesting on the western side of the Baja peninsula and that productivity appeared low in the Gulf of California. This decline in breeding pairs may have been caused by the effects of high levels of organochlorines, as reported for other areas. Anderson (1976) reported that Peregrines on the west coast of Baja California had either declined drastically or disappeared. We found none there in 1976. An aerial survey by Henny and Anderson (pers. comm.) in March 1977 revealed the presence of a Peregrine at only one of the historical nesting sites along the western coast of the Baja peninsula.

Post-1965 Estimates. — Between 1967-71 Kirven recorded 16 eyries in the Gulf of California. Anderson (1976) reported 19 occupied territories in the middle region of the Gulf of California between 1971-75, and believed that 35-50 was a reasonable estimate for the entire Gulf of California. As a result of our surveys, we now know of

TABLE 1. History and geographic distribution of Peregrine Falcon breeding territories in Baja California, the Gulf of California, and adjoining waters.

Region & Period	No. in the period				
	Occupied territories	With eggs or young	With fledged young	Probably occupied	Estimated occupied territories
Baja California					
Western side					
1800-1965	42	26	5	5	47
1966-1984	6	5	2	1	7
1800-1984	45	28	7	6	51
Sierra[a]	0	0	0	0	0
Gulf of California					
1800-1965	16	3	0	4	20
1966-1984	38	24	16	8	46
1800-1984	42	25	16	8	50
Sonora					
Gulf of California					
1800-1965	7	2	0	3	10
1966-1984	13	9	5	4	17
1800-1984	15	10	5	7	22
Sinoloa, Nayarit[b]					
1800-1965	2	2	0	2	4
1966-1984	0	0	0	1	1
1800-1984	2	1	0	2	4
All regions					
1800-1965	67	33	5	14	81
1966-1984	57	38	23	14	71
1800-1984	104	64	28	23	127

[a] Includes mountains of the Baja peninsula; there were sightings at 3 different localities, but all were post-breeding.
[b] Includes the Revillagigedo Islands.

104 sites where Peregrines have nested in our study area from the 1860s to the present; 57 of these were occupied after 1965 (Table 1). From 1965-84, 51 Peregrine breeding territories were occupied in the Gulf of California, but only 6 were occupied on the western side of the Baja peninsula. Nesting Peregrines were suspected at 23 other sites; 14 were prior to 1966 and 14 after 1965 (5 were common to both periods). Their geographic distribution is shown in Table 1.

REPRODUCTIVE PERFORMANCE

Breeding has been verified at 64 of the 104 nesting territories (62%) by the presence of eggs or young in or near the eyrie (Table 1). Eggs, nestlings, or fledged young were recorded at 33 of 67 territories (49%) prior to 1966 and at 38 of 57 territories (67%) in 1966-84. Before

1966, breeding was recorded at 26 of the 42 territories (62%) known on the western side of the Baja peninsula, 5 of 23 (22%) on the Gulf of California side, and 1 of 2 off the coast of Nayarit. Only four territories on the western side of the Baja peninsula and eight on the Gulf of California side were occupied or were suspected to have been occupied during the 1950-65 pesticide period. After 1965, 33 of 51 Gulf of California territories (65%) are known to have produced eggs or young compared with only 5 territories (100%) on the western side of the Baja peninsula. Known fledging occurred at 23 of 57 territories (40%) from 1965-84, but only 5 of 67 sites (7%) prior to 1966 (Table 1). In the Gulf of California, 21 of 51 territories (41%) are known to have fledged young after 1965 (Table 1). Because productivity data were not obtainable for all territories, the breeding data presented here reflect incompleteness rather than actual reproductive success. Although L. Walker (Banks 1969) reported seeing fledged young prior to 1966, he gave no specifics.

Percent Occupancy. — From 1967-71, Kirven made 50 checks to ascertain occupancy at 16 breeding territories in the Gulf of California and found 82% occupied. Anderson (1976) made 40 checks at 12 breeding territories in the middle region of the Gulf of California from 1971-75 and found 77% occupied. The average occupancy rate in the Gulf of California from 1966-84 was 81% (range: 59-100%, Table 2), based on 17 annual surveys of 51 territories. From 318 checks, 193 territorial pairs and 259 occupied territories (pairs plus lone birds) were seen (Table 2). New territories were included in the tally as they were found. In 1976-84, the average annual occupancy was 80% for 51 territories (range: 59-100%). Based on 80-84% occupancy between 1967-84, we expect that 41-43 territories were occupied annually in the Gulf of California.

Territory occupancy in the Gulf of California fell within ranges reported for other regions. In Great Britain, Ratcliffe (1980) reported about 80-85% of territories in most counties were occupied annually. For 39 territories in the Lakeland and northern Pennines districts of Great Britain in 1936-60, Ratcliffe (1980) reported that 28 (72%) were occupied on every visit. The occupancy rate was more variable in the Gulf of California than that reported by Ratcliffe. Although none of the territories in the Gulf of California were visited in all of the 17 years for which we have records, one territory was occupied 14 years out of 16 checked. Another territory was occupied in each of 13 years visited, and two others were occupied all 10 years they were checked. Three others were occupied consecutively for 13, 12 and 10 years.

Laying Dates. — Banks (1969) cited Howell (1917) and Bancroft (1927), who reported that eggs are laid from mid-March to mid-April on the Los Coronados Islands and the middle Baja peninsula,

TABLE 2. History of occupancy and reproduction at Peregrine Falcon breeding territories (BTs) in the Gulf of California, 1966-84.[a]

	Territories					Breeding success					
Year	No. visited	No. with pairs	No. with lone birds	No. newly found	% occupied	No. pairs with eggs	No. of eggs	No. pairs with nestlings	No. of nestlings	No. of BTs with fledglings	No. of fledglings
1966	1	1	0	0	100	nc	nc	nc	nc	0	0
1967	7	4	2	3	86	1	A	0	0	3	3
1968	14	10	1	4	79	1	3	2	2+, 1+	3	3
1969	14	8	4	5	86	2	2+1+	2	4	1	1
1970	13	10	2	3	92	es	es	1	2	0	0
1971	13	6	3	0	69	nc	nc	1	2	2[b]	3[b]
1972	12	5	5	1	83	en	en	nc	nc	1	2+
1973	12	8	2	0	83	nc	nc	nc	nc	0	0
1974	10	4	5	1	90	nc	nc	nc	nc	1	3
1975	8	3	4	0	88	nc	nc	nc	nc	1	2
1976	27	12	4	1	59	1+1ie	2+ie	1	2	5	7
1977	38	20	6	3	68	1	1	1[c]	4[d]	1	1
1978	44	28	13	11	93	1	2	2+1?	3+3?	6	14
1979	4	3	1	0	100	nc	nc	nc	nc	2	4
1980	33	26	3	1	88	4Ay	12Ay	6Ay	13Ay	6	10+yc
1981	28	19	3	0	79	1	2	9	24+	1	3+1?
1984	40	26	8	2	85	5+1Ay	14[e]+1A	9+1[f]	17[f]	6[f]	8

[a] nc = eyrie not checked for eggs or nestlings; A = addled eggs; es = BT containing eggshell fragments in eyrie; en = eggshell fragments on ground below an eyrie; ie = infertile egg; Ay = addled egg + 1 nestling in an eyrie — eggs were just hatching at 2 other eyries — one had 2 eggs + 1 hatchling, the other 2 eggs + 2 hatchlings; 8 nestlings were removed from 6 eyries for captive breeding project; yc = young calling in 1 eyrie, but not seen.

[b] Natal down found at another site.

[c] Adults carried food to 3 other sites.

[d] One young seen from below at another site.

[e] Includes clutch of 3 addled eggs which contained high mercury content — all failed. Another eyrie contained 3 eggs on 4 May and 2 young + 1 addled egg on 24 May; an adult at an additional eyrie was seen carrying food to eyrie.

[f] At one BT there were 2 well grown young in the eyrie + 1 flying young.

respectively. Banks (1969) reported that sets in which incubation had just begun, all apparently from the Pacific side of the Baja peninsula, were laid 24 March-19 April. Our data indicate laying on the western side of the Baja peninsula as early as the first week of March. McGregor (1899) wrote that six sets of eggs were taken at Natividad Island the first week of March, confirmed by Beck (1899). McGregor also reported eggs on San Gerónimo Island in the middle of March, and E. Sechrist collected four eggs there (now in the Western Foundation of Vertebrate Zoology) with little incubation on 12 March 1917. A. Anthony collected a 4- or 5-day-old chick on one of the San Benito Islands on 31 March 1897 (K. Parkes and C. M. White pers. comm.); the egg would have been laid about 18 February, the earliest known laying date for the western side of the Baja peninsula. We have only two recent observations on laying dates for the western side. Four eggs were found in an island eyrie off the southern coast of the Baja peninsula. The first hatched about 31 March (B. Reitherman pers. comm.). At a centrally located eyrie on the western coast, a single 17-day-old nestling found on 6 May 1980 is consistent with laying in the middle of March. First-clutches on the western side of the Baja peninsula appeared from about the third week of February through the third week of April and peaked in mid-March.

Only four egg sets are known from the Gulf of California, all collected by Bancroft and now in the collection at the Western Foundation of Vertebrate Zoology. They were collected on 14 April 1925, 18-19 March 1928, and 24 March 1930; the latter two had been incubated a week or less. We found that laying began in the Gulf of California in the first half of February and ended in the first half of April, with the peak in the first two weeks in March. The mean estimated laying date of 30 pre-1947 clutches from North American museums (see Anderson and Hickey 1972) is 17 March ±4 days. Thus, there are no apparent differences between current and historical egg-laying dates on either side of the Baja peninsula.

Clutch Size. — Table 3 compares the size of clutches from California (Thelander 1977) with those from Baja California including those reported by Bond (1946) and Banks (1969). Clutches reported by Bond (1946) averaged 3.30 eggs (n=23), all presumably collected in Baja California. Banks (1969) reported an average clutch size of 3.53 (n=19) in Baja California prior to 1966; two clutches were from an eyrie in the Gulf of California and the remainder from the Pacific coastal areas of northern Baja California.

We have records for 39 first-clutch sets collected from eyries in Baja California between 1897-1941, probably including those reported by Bond and Banks. All but one (collected on 30 April) were taken prior to 21 April. Four sets came from the Gulf of California and a fifth

TABLE 3. Clutch size comparisons between Baja California, Mexico and California, 1800-1965.

Geographic area	n	1 egg		2 eggs		3 eggs		4 eggs		5 eggs		Mean ± S.E.
		No. of clutches	% of clutches	No. of clutches	% of clutches	No. of clutches	% of clutches	No. of clutches	% of clutches	No. of clutches	% of clutches	
California[a]												
Central coast	93	0	0	3	3	20	22	68	73	2	2	3.74 ± 0.057
Southern	152	0	0	7	5	55	36	89	59	1	1	3.55 ± 0.048
Baja California												
Bond (1946)	23	1	4	3	13	8	35	10	43	1	4	3.30 ± 0.193
Banks (1969)	19	0	0	3	16	3	16	13	68	0	0	3.53 ± 0.177
Baja California[b]												
All clutches	39	0	0	9	23	11	28	18	46	1	3	3.28 ± 0.137
Incub. < 50%[c]	17	0	0	2	12	3	18	12	71	0	0	3.59 ± 0.173
Incub. > 50%[c]	14	0	0	5	36	4	29	5	36	0	0	3.00 ± 0.234

[a] Thelander (1977).
[b] Porter et al. (unpubl. ms.)
[c] These clutches came from the 39 given above; the extent of incubation for the remaining 8 was not given by the collector; those incubated <50% were significantly larger than those incubated >50% ($P<0.05$, $T=2.02$, $df=26$).

from Isabela Island, off the Nayarit coast. The remaining sets came from the western side of the Baja peninsula. The mean clutch size was 3.59 for the fresher 17 egg sets (Table 3). This is comparable to the mean sizes of fresh egg sets reported for Baja California by Banks (1969) and for southern California by Thelander (1977) (Table 3).

A mean of 2.64 eggs per clutch was determined for 14 clutches (exclusive of one-egg clutches) seen in eyries in the Gulf of California from 1967-84 (Table 4). This average is considerably smaller than that of the pre-1967 clutches, but was probably caused by loss of eggs preceding observations, and in some cases by egg loss resulting from contamination. The presence of four eggs at several eyries where laying was typically later supports this hypothesis.

Four probable second clutches, including three collected between 9-21 May 1920 and one taken on 29 April 1923 from localities on the northern Pacific coastline of Baja California, contained a mean of 3.75 eggs. Egg sets had been taken from each of these territories earlier in the season.

Bancroft (1927) believed three eggs were laid more often than four by Baja California Peregrines. Banks (1969), however, reported that most of the 19 records he examined were four-egg sets (Table 3). Our

TABLE 4. Clutch, brood and fledgling frequency distribution, percentages and averages for Peregrine Falcons in the Gulf of California, 1967-84.

	Clutch or Brood Size								
	1		2		3		4		
	No. of eyries	% of eyries	No. of eyries	% of eyries	No. of eyries	% of eyries	No. of eyries	% of eyries	Mean ± S.E.
Clutches									
1967-75	2	50.0	1	25.0	1	25.0	0	0	1.75 ± 0.479
1976-84	1	7.7	7	53.8	2	15.4	3	23.1	2.54 ± 0.268
1967-84	3	17.6	8	47.1	3	17.6	3	17.6	2.35 ± 0.242
Nestlings									
1967-75	2	33.3	3	50.0	1	16.7	0	0	1.83 ± 0.307
1976-84	9	31.0	10	34.5	6	20.7	4	13.8	2.17 ± 0.193
1967-84	11	31.4	13	37.1	7	20.0	4	11.4	2.11 ± 0.168
Fledglings									
1967-75	9	69.2	3	23.1	1	7.7	0	0	1.38 ± 0.180
1976-84	12	44.4	11	40.7	3	11.1	1	3.7	1.74 ± 0.156
1967-84	21	52.5	14	35.0	4	10.0	1	2.5	1.63 ± 0.122
All young									
1967-75	11	57.9	6	31.6	2	10.5	0	0	1.53 ± 0.160
1976-84	21	37.5	21	37.5	9	16.1	5	8.9	1.96 ± 0.127
1967-84	32	42.7	27	36.0	11	14.7	5	6.7	1.85 ± 0.105

data support Banks (1969). N. Carpenter told Bond (1946) that sets of two eggs were more frequent in Baja California (n=39) than they were in California (n=245), and our data also support this conclusion (P<0.001, χ^2=93.4, df=4) (Table 3). Among fresh clutches from southern California, 5% were two-egg sets (n=152) compared with 12% for two-egg sets among clutches less than 50% incubated (n=17) from Baja California (P<0.001, χ^2=23.9, df=4), and 36% among those more than 50% incubated. The percentage of four-egg clutches appears to be lower in Baja California than in California (Table 3), possibly a result of the latitudinal phenomenon but more likely caused by the difficulties encountered in collecting before incubation or during early incubation at the more inaccessible Baja California eyries.

Nestlings and Fledglings. — Peregrine productivity in the Gulf of California remained relatively stable from 1976-84 (Table 2). There is an indication that the average number of young reared by successful pairs at Gulf of California eyries was greater during 1976-84 (nestlings 2.17, fledglings 1.74) than it was from 1967-75 (nestlings 1.83, fledglings 1.38), but the differences were not statistically significant (Table 4). The mean difference for all young, however, was significant (P<0.05, t=2.14, df=69) between 1967-75 and 1976-84 (Table 4). Because we were unable to see all of the young at some of the sites, our counts underestimate the actual numbers of young, especially the fledglings. Based on the data available to us, reproductively successful Peregrines in the Gulf of California during the past two decades reared fewer young, on the average, than did Peregrines in the arctic, where Cade (1960) reported an average of 2.45 young (75 broods) and 2.18 fledglings (28 eyries), or Peregrines on Langara Island, Canada, where Beebe (1960) reported an average of 2.78 nestlings (9 eyries) and 2.36 fledglings (25 eyries). The smaller broods of successful nests currently recorded in the Gulf of California may be influenced, in part, by normally smaller clutches, but the inimical effects of chemical pollutants at a few local eyries may also play a role.

On the western side of the Baja peninsula, observations of young at nests have been few. R. DeLong and R. Crossin (unpubl. ms.) saw four Peregrines, two of which were probably fledglings, calling and circling at an historical site on 24 June 1968, and Kirven found two nestlings there in 1971. We saw one nestling at a second historical locality in 1980, R. Wauer (unpubl. ms.) noted two fledglings at a third in 1979, and B. Reitherman (pers. comm.) found a new site in 1981 that fledged two young both in 1981 and 1982.

CONCLUSIONS

A small remnant breeding population is extant on the western side of the Baja peninsula. Not only are most historically known nesting

localities in the Gulf of California still occupied, but additional localities and eyries have been discovered. However, because the Gulf of California was never thoroughly surveyed prior to the present study, a comparison between past and present populations is not meaningful. In the Gulf of California, rate of occupancy was normal for breeding territories, but productivity was somewhat less than normal. Although the Gulf of California environment is relatively uncontaminated, low productivity at a few eyries may have been caused by high levels of pollutants acquired from resident storm-petrels (Porter and Jenkins Chapter 40) and migrant prey species.

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