

NESTING PHENOLOGY OF LANDBIRDS IN BAJA CALIFORNIA¹T. LUKE GEORGE²*Department of Biology, University of New Mexico, Albuquerque, NM 87131*

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Breeding seasons of birds in high and mid-latitudes generally are short and are sharply constrained by suitable environmental conditions. In subtropical regions, there generally is a distinct breeding season but the season is longer and there is more "out of season breeding" (Immelmann 1971). In deserts, climatic effects (especially precipitation) have a pronounced effect on the initiation and termination of breeding (Serventy 1971). Southern Baja California is an extremely arid subtropical region; thus climatic factors may have a large impact on annual variation in the breeding season of birds.

The literature on the breeding seasons of landbirds in Baja California is scarce and, for some species such as the Black-throated Sparrow (*Amphispiza bilineata*), contradictory. Based on observations and collections, van Rossem (1945) suggested that Black-throated Sparrows on Margarita, Magdalena, and Espiritu Santo Islands breed in February whereas those on the adjacent peninsula breed in October. Banks (1963a) found evidence of breeding on Cerralvo Island in the fall of 1960 and 1961, and collected several birds in breeding condition in April and May 1962. Collections on Magdalena Island in April 1963 indicated that breeding had occurred in the spring (April or May) and the previous fall (Banks 1964). Banks found no evidence for February breeding on either island and concluded that the breeding season for Black-throated Sparrows extends from mid-May through September or October (Banks 1963a, 1964). Collections from Partida, Monserrate, Danzante, and Carmen Islands led Banks (1964) to conclude that breeding started in early May on these islands and that the March breeding date suggested by van Rossem (1945) for the gulf islands was too early. Data presented here on the breeding phenology of Black-throated Sparrows and other landbirds on Coronados Island and an adjacent location on the Baja California peninsula (hereafter referred to as the mainland) in 1984 and 1985 indicate that breeding phenology changes between years, perhaps explaining the differing conclusions reached by van Rossem and Banks.

I conducted field work from 1 January to 3 June

1984 and from 4 January to 25 June 1985 on Coronados Island and the adjacent Baja peninsula (hereafter referred to as the mainland) as part of a study of the landbird communities in the two locations. At each location I established two 10-ha study plots where I color-banded birds, mapped territories, and searched for nests. When a nest was found, it was periodically checked (usually at 1- to 4-day intervals) until the young fledged or the nest failed. If a nest was found before laying was completed, the date at which incubation started (initiation date) was recorded as the midpoint between the nest check when incubation had started and the previous check (unless the hatching date or fledging date provided a more accurate estimate). If laying was completed, I estimated initiation date by extrapolation based on hatching date, fledging date, or the size of the young when the nest was found and the number of days for incubation and nestling period for each species. Only nests for which the initiation date could be estimated to ± 4 days were included in the analysis.

I obtained sufficient data for the 2 years to compare the nesting phenology of five species: Black-throated Sparrows, Verdins (*Auriparus flaviceps*), Costa's Hummingbirds (*Calypte costae*), and Blue-gray (*Polioptila caerulea*) and Black-tailed (*P. melanura*) gnatcatchers. Nesting began in early January in 1984. In 1985, however, no nests were initiated until early February and it was not until late February or early March that nesting began in earnest (Fig. 1). The median nest initiation date for 1984 was 40 days earlier than in 1985 (Table 1, $P < 0.0001$). I did not see any juveniles nor did I find any nests that were well advanced in early January 1984 or 1985. Thus, I feel confident that breeding had not occurred for several months before my arrival in either year.

The earliest nest initiation date for each species was 23 to 52 days earlier in 1984 than 1985 (Table 2). Median initiation dates for Black-throated Sparrows, Verdins, and Costa's Hummingbirds were significantly earlier in 1984; there was no significant difference for either of the gnatcatcher species (Table 1). The lack of significant difference for the gnatcatchers probably was due to the small sample size for these species because the earliest initiation date was considerably earlier in 1984 than 1985 for both species (Table 2). The earlier median dates in 1984 were not due to the extended field season in 1985. When I consider only those nests that were discovered on or before day 151 (the last day in 1984 that a nest whose initiation date could be determined was found) the differences were still significant for Black-throated Sparrows ($P = 0.0013$), Verdins ($P = 0.0027$), Costa's Hummingbirds ($P < 0.0001$),

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TABLE 1. Median nest initiation dates for 1984 and 1985.

Species	1984		1985		D ²	P ³
	n	Date ¹	n	Date ¹		
Black-throated Sparrow	17	76	14	109	33	0.0007
Costa's Hummingbird	32	36	23	51	15	<0.0001
Verdin	30	59	57	82	23	0.0008
Blue-gray Gnatcatcher	7	99	12	108	9	0.55
Black-tailed Gnatcatcher	12	97	6	110	13	0.22
All species	98	50	112	90	40	<0.0001

¹ Median Julian date.² Difference between medians in 1984 and 1985.³ Statistical comparisons were made using a Mann-Whitney *U*-test. The appropriate significance value for the comparisons using a Bonferroni adjustment is $P = 0.008$.

and for all species combined ($P < 0.0001$). Nesting undoubtedly continued after I left in both years but the peak of spring breeding had passed (Fig. 1) and it is unlikely that later nests would have affected the analysis.

Van Rossem (1945) suggested that Black-throated Sparrows on the islands off southern Baja California have a different breeding season than those on the adjacent peninsula. To determine if the breeding seasons may differ between island and mainland locations for other species, I tested for differences in the initiation dates of Verdins and Costa's Hummingbirds between Coronados Island and the mainland in 1984 and 1985 (too few Black-throated Sparrow nests were located on the mainland for statistical treatment within years). None of the differences was significant (Table 3).

On 24 March 1984 I observed two fledgling Black-throated Sparrows on Carmen Island indicating that Black-throated Sparrows also bred early there in 1984. The birds were in juvenal plumage and flew well, indicating that they had been out of the nest for at least 7 days. Given that the incubation and nestling period averages 21 days, the clutch must have been completed by 24 February. This supports the March breeding date for Black-throated Sparrows reported by van Rossem (1945) for the gulf islands.

I have no direct evidence of fall breeding of Black-throated Sparrows. A Black-throated Sparrow that I collected on Santa Catalina Island and one collected on Coronados Island in January 1984 had completed their postjuvinal molt and had incompletely ossified skulls, indicating that they had fledged the previous fall (Banks 1964). Banks (1963b) collected specimens from eight islands in the southern and central gulf (including Santa Catalina and Coronados) in the spring of 1962

and found no evidence of fall breeding. However, he did find evidence of fall breeding for three islands in the southern gulf in 1960, 1961, and 1962 (Banks 1963a, 1964). Thus, it appears that fall breeding occurs intermittently, but more data are needed. Nests and recently fledged juveniles of all five species were seen during May and June in 1982 and 1983 on or near the study sites. This suggests that breeding always occurs during these months but that the initiation of breeding is variable from year to year.

Breeding season variability may be related to climatic variation through its effect on food availability (Immelmann 1971). Baptista (1984) attributed the ear-

TABLE 2. Earliest initiation date (Julian) for five species in 1984 and 1985 and difference between years (D).

Species	1984	1985	D
Black-throated Sparrow	38	75	37
Verdin	18	54	36
Costa's Hummingbird	11	34	23
Blue-gray Gnatcatcher	43	75	32
Black-tailed Gnatcatcher	47	99	52

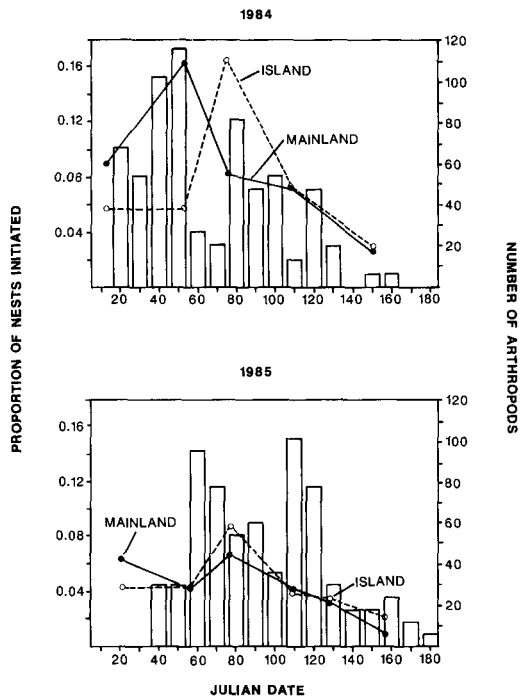


FIGURE 1. Proportion of nests initiated for all species during 10-day intervals in 1984 and 1985 and number of arthropods caught on stickboard traps on island and mainland sites in 1984 and 1985.

TABLE 3. Median nest initiation date (n) on Coronados Island and the adjacent mainland for Costa's Hummingbirds and Verdins in 1984 and 1985.

Species	1984			1985		
	Island	Mainland	P^1	Island	Mainland	P^1
Costa's Hummingbird	39 (20)	24 (12)	0.02	52 (7)	49 (15)	0.08
Verdin	69 (22)	90 (8)	0.64	79 (38)	71 (14)	0.36

¹ Statistical comparisons were made using a Mann-Whitney U -test. The appropriate significance value for the comparisons using a Bonferroni adjustment is $P = 0.01$.

ly breeding of Savannah Sparrows (*Passerculus sandwichensis sanctorum*) on San Benito Island in 1983 to the effects of an El Niño year and the associated heavy rainfall on the island. I considered the influence of precipitation, temperature, and food availability on initiation of breeding.

Because the effects of precipitation on the initiation of breeding are probably mediated through an increase in plant productivity and food availability for most species, the amount of precipitation just before the breeding season may have a large impact on the timing of breeding. Rainfall in southern Baja California has a bimodal pattern, with a large peak in August to September and a much smaller peak in December to January (Hastings and Humphrey 1969).

To examine the effect of precipitation on nesting phenology, I compared November to December precipitation between 1983 and 1984. I obtained precipitation data from a station in Loreto, Baja California Sur (B.C.S.), 15 km S of the mainland study site. The mean precipitation during these months for a 45-year period (1940 to 1984, no data were available for 1967) was 16.5 mm (SD = 23.3). Precipitation during November and December 1983 was 56 mm; only 2 years (5%) of the 44 years had more precipitation during these months. Precipitation during the same 2 months in 1984 was 35 mm; there were 7 years (16%) with greater precipitation in the 44 years. Thus, precipitation in both years was above normal, although 1983 was exceptional.

Banks' (1963a, 1963b, 1964) observations on Carmen and Cerralvo Islands are consistent with the correlation between rainfall and timing of breeding. Based on observations of nests and recently fledged juveniles, Banks (1963a, 1964) suggested that breeding began in April or May on Carmen Island in 1962 and 1963. Precipitation in Loreto, B.C.S. (approximately 20 km W of Carmen Island) during November and December 1961 and 1962 was 0.0 and 20.5 mm, respectively. These values are lower than both 1983 and 1984; hence, the late breeding during these years is consistent with the correlation. Banks (1963b) also found no evidence for early breeding on Cerralvo Island in 1962. Rainfall in La Paz, B.C.S. (approximately 40 km NE of the island) was 10 mm during November and December 1961. Average precipitation during these months is 29.9 mm (SD = 39.8); rainfall was thus below normal and breeding began late. Van Rossem (1945) did not specify the year in which he made his observations of February breeding on Magdalena and Espiritu Islands but he collected birds on these islands in 1930 (Jim Northern, pers. comm.) so I assume that he made the observations at that time. Rainfall in La Paz during

November and December 1929 was 12 mm. This is well below the average (29.9 mm) and the early breeding in 1930 is therefore inconsistent with the pattern found in the other years. Because of the spotty distribution of rainfall in Baja California, however, it is likely that the rainfall on the islands differed from nearby mainland areas. Thus, the correlations (or the lack thereof) between rainfall and breeding are tentative.

Temperature may also affect breeding initiation by advancing plant or insect phenology, or through direct effects on testicular growth (Jones 1986). I monitored temperature with a recording thermograph on the mainland study plots in 1984 and 1985. During the first 60 days of 1985, the daily low temperatures were significantly lower than 1984 ($F = 54.25$, $P < 0.0001$, $n = 27$, paired t -test), although the daily highs did not differ significantly ($F = 0.293$, $P = 0.59$, $n = 29$). Thus, both the higher daily low temperature and the increased rainfall were associated with early breeding in 1984.

I estimated arthropod abundance on the island and the mainland study sites in 1984 and 1985 using sticky-board traps. I placed 12 stickyboard traps on the ground and 24 in shrubs on the island and the mainland at 1-month intervals from January to May in 1984 and January to June in 1985. The number of arthropods caught on the stickyboards differed significantly by location (island vs. mainland) and site (shrub vs. ground) so I analyzed the data separately for each location and site and then tested for differences between years for each month using a Fischer's combined probability test (Sokal and Rohlf 1969, p. 623). The number of arthropods was significantly higher in 1984 than 1985 in February and March, but there was no difference for the other months (January to April $\chi^2 = 10.6$, $df = 8$, $P = 0.22$; $\chi^2 = 21.6$, $df = 8$, $P = 0.0007$; $\chi^2 = 21.6$, $df = 8$, $P = 0.006$; $\chi^2 = 13.6$, $df = 8$, $P = 0.09$; there was no consistent difference in May so a combined test was not appropriate). The number of arthropods caught on all of the stickyboards are plotted separately for the island and the mainland sites for each month in Figure 1. In both years the number of arthropods reached a peak in February or March then decreased each month as the season progressed. Thus, arthropod abundance was higher early in the season in 1984 which is consistent with the early breeding observed during that year.

These data indicate that the initiation of breeding of landbirds in southern Baja California and the nearby islands varies greatly from year to year, perhaps in association with variations in climatic factors and food abundance. The different breeding seasons for Black-throated Sparrows reported by van Rossem (1945) and

Banks (1963a, 1963b, 1964) may have been due to different climatic factors and/or food availability in the years that they made their observations.

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WESTERN GULLS AS A POSSIBLE PREDATOR OF CALIFORNIA SEA LION PUPS¹

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Key words: Western sea gulls; California sea lions; predation; pinnipeds; seabirds; ecology.

The breeding period of Western Gulls (*Larus occidentalis*) extends from April to mid-August (Sowls et al. 1980), overlapping with that of California sea lions (*Zalophus californianus*) that breed from late May to the end of July (Peterson and Bartholomew 1967). Both species may occupy the same beaches, thus favoring the occurrence of a commensalist relationship in which gulls consume sea lion placentas (Hunt and Butler 1980). Sea lions on the other hand, may be alerted by gull squawks when the seabirds detect some possible danger (pers. observ.). Interactions among gulls and sea lions, however, may take another context as referred to below. During the beginning of the California sea lion breeding season of 1982, we visited the rookery located on Santa Margarita Island (24°18' to 24°32'N; 111°42'

to 112°01'W) and counted the first 20 pups born that year. Of these, three animals were dead and exhibited rounded holes on the belly and no eyes. At that time, about 200 Western Gulls were present on the beach, many of them walking around the sea lions. During our observations we made some noise that caused many mothers of the pups to go to the sea. Immediately after the mothers were gone, many gulls surrounded the pups and began to peck them. Based on these observations we supposed that the gulls could have caused the wounds on the dead pups.

To test this hypothesis, we planned an experiment for the first week of June 1983. For that purpose we selected a place for observing a small section of the sea lion colony from which the disturbances were minimized. The numbers of females, pups, and gulls were recorded, as well as the interspecific attacks. Pecking on a pup body was considered to be a gull attack and a sea lion attack was any attempt to bite or pursue the gulls. The observations were registered under two conditions, undisturbed and disturbed colony. In the first case, the gulls walked around the sea lions sometimes attempting to peck the pups and doing so on a few

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