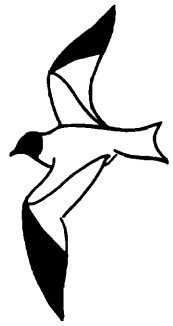


WESTERN BIRDS



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THE BREEDING AVIFAUNA OF SAN BENITO MOUNTAIN, CALIFORNIA: EVIDENCE FOR CHANGE OVER ONE-HALF CENTURY

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The San Benito Mountain region of the southern Diablo Range, San Benito and Fresno counties, California, is of unusual biological interest for several reasons. The highest peaks, San Benito Mountain (5241 ft [1599 m]) and Santa Rita Peak (5165 ft [1575 m]), support on their upper slopes significant forest well isolated from such growth in other areas. The nearest major stands of mixed conifers appear approximately 50 miles (80 km) to the west, in the northern Santa Lucia Range, Monterey County. Eastward, a distance of approximately 93 miles (150 km) separates the San Benito conifers from the rich forests of the Sierra Nevada (Figure 1).

The dominant species of conifer in most of the forest is Coulter Pine (*Pinus coulteri*). It hybridizes extensively with the much scarcer Jeffrey Pine (*Pinus jeffreyi*), the latter species growing in strongly disjunct stands far from its main Sierran distribution (Griffin and Critchfield 1976:82). Digger Pine (*Pinus sabiniana*) and Incline-cedar (*Calocedrus decurrens*) are also prevalent. According to Griffin (1974:13), "the combination of these three related pines all growing together can not be duplicated anywhere else and is of great interest to forest geneticists." Strangely, much of the forest grows in open and highly insolated stands which are largely confined to otherwise bald serpentine soils (Figure 2). A diverse group of shrubby species also forms a conspicuous chaparral element on the serpentine. However, most of these shrubs are not those usually associated with montane forest. In addition, the serpentine soils support an interesting assemblage of herbaceous species, some of which are endemic. The foregoing floristic notes are mainly from Griffin (1974 and 1975). He also fully describes other aspects of the local ecology.

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Although the San Benito Mountain area has been easily accessible for years and received concentrated attention from at least two groups of vertebrate zoologists prior to our visits in 1983 and 1984, only scattered bird records from there have been published (Grinnell and Miller 1944). Our survey of *American Birds* for the last decade turned up no recent records for the region. Insofar as we have been able to ascertain, the notes and specimens taken by all previous workers are preserved in the Museum of Vertebrate Zoology, University of California, Berkeley. The first major sample of birds from the region was taken by Fletcher G. Palmer between 9 and 21 June 1936. He was accompanied by David H. Johnson, who mainly collected mammals. Camping at 4400 ft (1342 m), 1 mile (1.61 km) southeast of the San Benito Mountain summit, they collected primarily on the mountain but also visited nearby Santa Rita Peak. Importantly, their work was done during the heart of the breeding season. Eight years later, from 6 to 11 August 1944, Alden H. Miller and Robert W. Storer collected a large number of birds and other vertebrates from much of the highland area surrounding San Benito Mountain as well as from the peak itself. Although their August records are too late to document breeding status for the summer resident species, they are suitable as evidence for the occurrence of permanently resident forms. Our work in 1983 (12-14 May and 8-9 June) and 1984 (12-18 May and 31 May-1 June) focused on the densest stands of conifers on San Benito Mountain, those occurring on north and northeast-facing slopes and draws between 4000 ft and the summit. On 17 May 1984, we censused species found along a 3-mile transect following San Carlos Creek, from 3700 ft (1129 m) to 4400 ft. We also hiked the lower canyon of the East Fork of San Carlos Creek, which differs from much of the area in that it is relatively moist and dominated by Canyon Live Oaks (*Quercus chrysolepis*). Despite the fact that our work emphasized the mid-May period, we stress that nesting behavior and reproductive condition of collected specimens clearly established breeding status for the vast majority of birds present at that time. Surprisingly few birds seem to use San Benito Mountain as a stop-over site during migration. Our studies, as well as those conducted by earlier field parties, are supported by complete and annotated lists of every species encountered in the region. Although we do not consider such compilations to be exhaustive lists, they are complete enough to support the discussion and conclusions on avifaunal change offered beyond.

Coniferous forest in the North Temperate Zone is occupied largely by a boreal avifauna. According to Miller (1951:582-591), such an avifauna in California is comprised of species of fundamentally northern derivation that range into boreal environments of the state, either along the coast or in the highlands. In general, such species are adapted to cool and/or moist habitats. As Miller has mapped (loc. cit.:588), boreal environments along the coast of west-central California are fragmented into two components, Santa Cruz and Monterey; these are positioned north and south of Monterey Bay, respectively. The coniferous forest of San Benito Mountain represents a boreal island lying approximately 50 miles to the east of Miller's Monterey component (hereafter called "the Monterey District"). For one or more reasons, Miller did not include the San Benito Mountain region on his map of the boreal areas of California. First, perhaps he regarded it as one of an

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unspecified number of "very small detached boreal areas" which were neither plotted nor analyzed (Miller 1951:583). Second, he may have considered the region to have been incompletely explored avifaunally. Third, he had not personally visited the mountain during the breeding season. In any event, despite the small size, isolation and impoverishment of the boreal environments of the San Benito Mountain region, a substantial mountaintop avifauna occurs there. The first purpose of our paper is to describe this avifauna and to compare it with disjunct boreal avifaunas to the west, namely those of the Monterey District and Hastings Natural History Reservation, and with a more remote boreal avifauna to the east, that of Yosemite National Park in the main Sierra Nevada (Figure 1).

The avifauna of San Benito Mountain deserves special attention for another reason. Because of the thoroughness of the surveys, it is possible to search for evidence of temporal change over the approximate $\frac{1}{2}$ century that elapsed between the early and recent visits. This is the second purpose of our

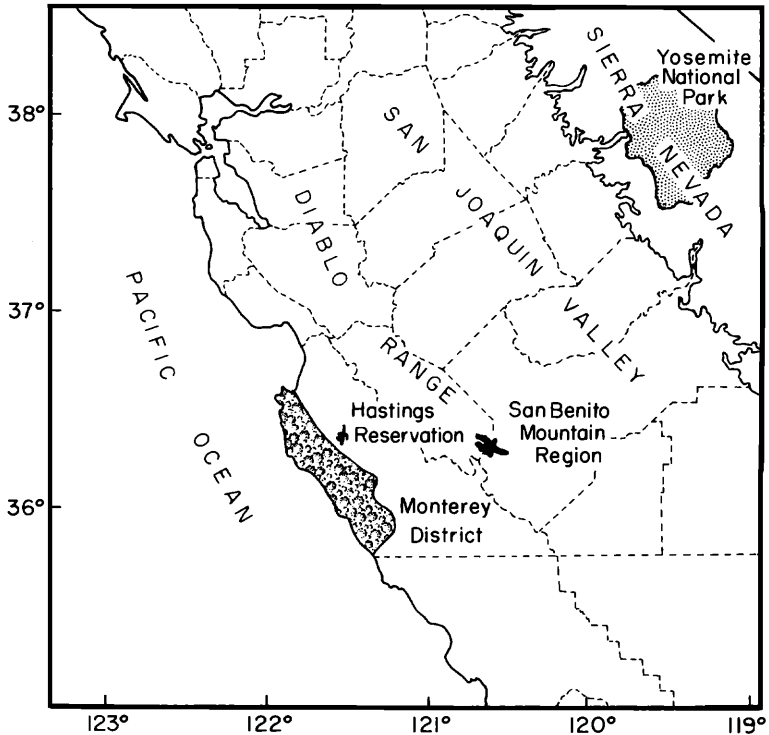


Figure 1. Map of central California showing the location of the San Benito Mountain region in relation to the Monterey District as defined by Miller (1951), the Hastings Natural History Reservation, and Yosemite National Park.

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paper. As the following species accounts will show, some surprising changes have indeed occurred, both in the composition of the avifauna and in the abundance of certain breeding species. Although the emphasis of this paper is on boreal species, accounts are also included for austral forms that have either colonized or changed in status within recent decades. Furthermore, we also comment on interesting habitat relationships for particular species.

SPECIES ACCOUNTS

MOUNTAIN QUAIL (*Oreortyx pictus*). Although well-known from the Santa Lucia Range of Monterey Co., this species was not reported from the San Benito Mountain region by Grinnell and Miller (1944:117-119). Thus, Palmer did not record it during his work there in 1936. In contrast, we heard Mountain Quail commonly in 1983, when several widely-spaced individuals were calling on each of several mornings. In May 1984, the species was again recorded but less frequently. Evidently, these individuals were descendants of 43 birds introduced above New Idria in 1957, from stock native to the China Lake region [probably from the nearby Argus Mountains] (*vide* Don Pine of California Department of Fish and Game, J.R. Griffin *in litt.* 10 Jan 1984). There is no evidence that Mountain Quail ever occurred naturally on San Benito Mountain, although the extensive habitat of diverse brushland there seems ideal for this species.



Figure 2. View of the high country, looking north, from the north slope of San Benito Peak, 8 June 1983. Note the open nature of the forest, small stature of the trees, and the prevalence of bare serpentine soil. The track of a dirt bike is visible in the left-center of the foreground.

Photo by Carla Cicero

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NORTHERN SAW-WHET OWL (*Aegolius acadicus*). At 0250 on 18 May 1984, we awoke to the rhythmic whistles of this species coming from the forest approximately 400 yards above camp along the East Fork of San Carlos Creek, 4500 ft (1373 m) at ½ mile north and ½ mile east of San Benito Mountain). The night was clear and cool (Temp. 50°F) with a gibbous moon. In response to our imitations of the call, the owl moved upslope for ½ mile before finally taking a stand in a clump of young Incense-cedars just below the peak. Surrounding this steep site were scattered yellow pines (*P. coulteri* and/or *P. jeffreyi*) and a broken understory of Leather Oak (*Quercus durata*). We approached within 8 ft, and with a dim flashlight watched it call continuously for 8 minutes from the same perch. These calls fluctuated in amplitude, giving the false impression that the owl was changing perches. After departing for approximately 10 minutes, it returned briefly to the same nearby perch and then moved laterally along the slope for several hundred yards. It was not followed further.

In view of the behavior and habitat of this individual, we do not hesitate to include the Northern Saw-whet Owl among the probable breeding species of the region.

HAIRY WOODPECKER (*Dendrocopos villosus hyloscopus*). All ornithologists who have visited the San Benito Mountain region have encountered this woodpecker in the coniferous forest near San Benito Peak. Palmer recorded four to five individuals at 1 mile southeast of San Benito Mountain, 4400 ft. between 9-22 June 1936; during that period, he collected two adult males (testis 4 x 2 mm) and one juvenile male. Miller and Storer also noted several Hairy Woodpeckers at the same locality on 6-12 August 1944. In 1983 and 1984, this species was found regularly in the conifers surrounding the summit. One or two birds were recorded daily, including several pairs, and, on 16 May 1984, a pair was observed in courtship behavior. Therefore, a small breeding population still thrives in the San Benito Mountain region. No change in historical status is indicated.

OLIVE-SIDED FLYCATCHER (*Contopus borealis*). Palmer (MS) stated in June 1936 that he saw Olive-sided Flycatchers "fairly regularly" in the conifers. He took a male in breeding condition (testis 8 x 3 mm) on 10 June. Miller and Storer also reported the species in August 1944, but the individuals at that season could have been early migrants. In 1983 and 1984, this species was surprisingly numerous on San Benito Mountain, with 5-15 males singing on a single day; 14 regularly-spaced singing birds were encountered along our 3-mile transect. One male was taken (testis 11 x 4 mm, no fat) on 13 May 1984 along San Carlos Creek, 4400 ft. These records indicate that the Olive-sided Flycatcher has probably increased in population size between 1936 and 1983-1984.

WESTERN WOOD-PEWEE (*Contopus sordidulus*). This species has definitely increased in numbers on San Benito Mountain in recent decades. Palmer (MS) reported the Western Wood-Pewee as "not common in the conifers" in June 1936. Storer (MS) noted that the species was "seen in the trees around camp and down the stream from camp" between 6-12 August 1944. He took an adult male (testis 3.5 mm; "little" fat) on 10 August at 4400 ft; this individual may have been a locally breeding bird. In contrast, the species was abundant on the mountain in 1983 and 1984. We recorded 6 to 8 individuals on 13 May 1983, approximately 20 territorial males in the conifers during the morning of 9 June 1983, and 34 singing and chasing males along the 17 May 1984 transect. One breeding male (testis 6 x 3.5 mm, no fat) was collected on 16 May 1984 at San Carlos Creek, 4400 ft, and on 1 June an active nest was found in a Coulter Pine near the same creek.

DUSKY FLYCATCHER (*Empidonax oberholseri*). The Dusky Flycatcher had not been recorded as a definite summer resident in the San Benito Mountain region before our visits in 1983 and 1984. Now, a substantial population occupies the mountain, and up to 10 individuals have been found singing on territories in a single day. On 8

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June 1983, a singing male in breeding condition (testis 7 x 3 mm, no fat) was taken. Miller and Storer's specimen (testis 2 mm) from the area was not taken until early August (1944), and thus provides equivocal evidence for local nesting. Palmer (MS) did not mention the species.

During our visits, these flycatchers inhabited mixed yellow pines and Incense-cedars with clumps of *Arctostaphylos* and oak brush always nearby. A chaparral or low thicket element seems crucial for nesting wherever the species occurs (Johnson 1963). The nearest probable breeding locality for the Dusky Flycatcher occurs to the west at Chews Ridge, Monterey Co., where singing individuals have been found during late spring and summer in recent years (Chandik and Baldrige 1969; DeSante and LeValley 1971). Prior to these reports, the closest breeding sites included the Mt. Pinos area of Ventura Co. to the south and the higher elevation habitat in the Inner Coast Range of Lake Co. to the north.

GRAY FLYCATCHER (*Empidonax wrightii*). This species is well-known as a summer resident in eastern California. It occurs on the Modoc Plateau, in Mono and Inyo counties (Johnson 1963 and 1966), and throughout the higher mountains of the Mohave Desert (Johnson and Garrett 1974:47, Cardiff and Remsen 1981). Locally, it also breeds on the east slopes of the mountains of southern California (Garrett and Dunn 1981, Weathers 1983). Furthermore, a substantial population occurs in the Chimney Peak area of eastern Tulare Co. (Johnson and Garrett 1974:47). In 1983 and 1984, we found a population of summer resident Gray Flycatchers in the open conifers of San Benito Mountain. One singing male was taken (testis 5 x 3 mm, no fat) on 8 June 1983, ½ mile east of the summit, 4800 ft (1464 m); two others were collected (13 May, 6 x 3 mm; 1 June, 7 x 3 mm) in 1984, 1 mile southeast of the peak, 4400 ft. These birds were patrolling territories in well-spaced Incense-cedars and yellow pines, 2-2.5 ft (0.6-0.8 m) in diameter and 20-25 ft (6-8 m) in height, with a scattered understory of scrub oak and manzanita (Figure 3). Much of the ground was bare, an apparent habitat requirement of this flycatcher (Johnson 1963). Several other individuals were encountered in similar habitat on 9 June 1983, and daily during our work in May 1984. We counted seven birds along our 3-mile transect on 17 May 1984, five of which were males singing repeatedly from small pines and Incense-cedars near the road; the remaining two birds, as well as one seen near Sawmill Creek on 13 May 1984, were probable females that occurred with males nearby and which behaved excitedly at our presence. Importantly, the males were singing in the same areas during our visits in both mid-May and early June 1984. Although no nests were found, the evidence strongly indicates that the flycatchers were established for breeding. This surprising occurrence extends the probable nesting range of the species approximately 150 miles (240 km) westward from the principal breeding distribution on the east side of the Sierra Nevada.

WESTERN FLYCATCHER (*Empidonax difficilis*). Breeding sites for this species are widely scattered in the generally dry Inner Coast Range of central California (Johnson 1980). Palmer took a breeding male (testis 5 x 2.5 mm) of *E. d. difficilis* at 1 mile southeast of the summit of San Benito Mountain, 4400 ft, on 13 June 1936. Miller (MS) reported a family group with short-tailed young in the conifers on 6 August 1944. In 1984, we collected a mated pair of Western Flycatchers (male, testis 5 x 3 mm, no fat; female, ova enlarged, ovary with 2 collapsed follicles, active incubation patch) along the East Fork of San Carlos Creek, 4200 ft. The male was delivering position notes from Canyon Live Oaks and the female was repeatedly uttering alarm notes at our presence, suggesting a nearby nest. The moist, steep-sided canyon of the East Fork, with large oaks shading a small, boulder-studded stream, provided excellent nesting habitat. Such habitats are very local in the region, however, and thus the San Benito population of Western Flycatchers is probably sparse at best. The records indicate no change in historical status.

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PURPLE MARTIN (*Progne subis*). Palmer, and Miller and Storer, all recorded this swallow in the San Benito Mountain region. On 21 June 1936, Palmer collected two breeding males (testes 13 x 9 mm and 12 x 8 mm, respectively) 1 mile south of the summit of Santa Rita Peak. Eight years later, on 9 August 1944, at 1 mile southeast of San Benito Peak, Miller and Storer noted that individuals of this species were "overhead frequently." In contrast, we did not record Purple Martins. Therefore, we conclude that the species no longer occurs as a summer resident. Davis et al. (1980) state that the Purple Martin was last recorded at the Hastings Reservation in Monterey Co. on 30 June 1958. Moreover, Arbib (1979) reports the general decline of this species throughout its range in recent years.

VIOLET-GREEN SWALLOW (*Tachycineta thalassina*). This species was fairly numerous on San Benito Mountain in 1983 and 1984. Ten individuals were seen foraging over the forest and near the roads on 8-9 June 1983, and, similarly, several swallows were recorded daily during our work in May 1984; on 17 May, we counted eight individuals along our 3-mile transect. These birds commonly foraged in flocks, often over deep, bare serpentine canyons surrounded by forest near San Benito Peak. Although some of these birds may have been migrants, a few definite pairs were noted. In addition, we found three suspected nests along the road. One was in a crack in a serpentine rock outcropping near the headwaters of the East Fork of San Carlos Creek, 4500 ft (1373 m), and two were in earth banks at 3800 ft (1159 m) and 4500 ft; requisite perches consisting of dead-topped trees or exposed tree roots were always present nearby. A breeding female (ova enlarged to 1 mm) was taken on 14 May 1984 near the first nest, and pairs were seen entering and leaving the other two nest openings. Surprisingly, Palmer did not record the Violet-green Swallow on San



Figure 3. Habitat of a singing male Gray Flycatcher, San Benito Mountain, 8 June 1983 (see species account).

Photo by Carla Cicero

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Benito Mountain in 1936; however, he reported small numbers in late June near a creek at 2 miles north-northwest of New Idria, a mining camp located downslope. Miller noted three individuals over Sawmill Creek on 8 August 1944, but these could easily have been migrants. The records indicate a substantial increase in the breeding population of this species in the region within recent decades.

STELLER'S JAY (*Cyanocitta stelleri*). Palmer failed to observe this species in 1936 and it is uncertain whether the Steller's Jay bred on San Benito Mountain at that time. Miller, on the other hand, mentioned (MS) two Steller's Jays calling from a deep, oak-filled canyon on 11 August 1944. He stated that this gulch provided the most favorable habitat for the species in the region, largely because of the lack of "requisite shade" in the open coniferous forest on nearby slopes. Grinnell and Miller (1944:286) also described the need for "cool, wooded canyons or shaded slopes" by interior populations of the Steller's Jay. We found the species to be common during our recent field work. In 1983, two individuals were recorded on 8 June in dense yellow pines and Incense-cedars near the summit of San Benito Peak. Steller's Jays were especially numerous in 1984, when individuals were seen daily in the conifers. A male in breeding condition (testis 9 x 6 mm) was taken along the East Fork of San Carlos Creek, 4200 ft, in a canyon similar to the one which Miller described. We conclude that this jay has increased in abundance on the mountain since 1936.

PLAIN TITMOUSE (*Parus inornatus*). As expected, all surveys have listed the Plain Titmouse for the San Benito Mountain region. In 1936, Palmer (MS) found the species to be "common in the blue oaks," and Grinnell and Miller (1944:308) also reported records for San Benito Mountain, 4400 ft. Grinnell and Miller described the characteristic habitat of the subspecies *P. i. inornatus* as "open-type woodland of which oaks . . . are exclusive or dominant constituents." While such a description seems accurate for much of the range in central California, it conflicts with our observations in 1983 and 1984 for San Benito Mountain. There, all species of arboreal oaks are rare or lacking altogether, especially above 3900 ft (1200 m) (Griffin 1975:20). We saw the species commonly in pines, especially *P. coulteri* and *P. sabiniana*, with lesser use of *P. jeffreyi*. Palmer (MS) also reported titmice in conifers. Of interest here is the possible extent to which the Plain Titmouse is occupying coniferous habitat potentially acceptable to the Mountain Chickadee (*Parus gambeli*), a species not yet known from San Benito Mountain. The closest breeding locality for the Mountain Chickadee is in the Santa Lucia Range, Monterey Co., at 3000 ft (915 m) (Grinnell and Miller 1944:300-302).

PYGMY NUTHATCH (*Sitta pygmaea*). Neither Palmer nor Miller and Storer encountered this species in 1936 and 1944, respectively. In contrast, we found a substantial population of Pygmy Nuthatches in the area. Several birds were present in the pines near our camp on 13 May 1983, and on 8-9 June 1983 we found a number of individuals in the conifers on the east-northeast slope; one pair was seen at a possible nest cavity in a pine snag. Johnson collected a breeding male (testis 5 x 3 mm) of the subspecies *S. p. pygmaea* in an Incense-cedar at approximately 1/2 mile east of the summit. In May 1984, the species was again encountered fairly commonly; five birds were counted during one morning in the conifers along San Carlos Creek. The discovery of this form on San Benito Mountain represents a definite extension of known range. The nearest previously-known localities for the species, as listed by Norris (1958:121), are 50 miles to the west of San Benito Mountain at Big Pines, 3700 ft (1130 m) (9 miles [15 km] west of Jamesburg), and at 1/4 miles (2 km) south of Chalk Peak, 3000 ft (915 m), both in Monterey Co.

AMERICAN DIPPER (*Cinclus mexicanus*). Although San Benito Mountain has a drier climate than any of the Santa Lucia Range peaks to the west, it has more permanently flowing streams than the latter region (Griffin 1975:7) and, therefore, more potential

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habitat for American Dippers. Nonetheless, the species has never been found in the region. Both San Carlos Creek and Sawmill Creek appeared suitable for this species during our visit in 1983, a year of extra-heavy precipitation and runoff. In 1984, on the other hand, the water flow seemed inadequate. Perhaps annual variation in stream volume is too great to permit colonization.

Another factor might also exclude American Dippers from San Benito Mountain. Degradation of water quality by naturally-occurring toxic chemicals could adversely affect aquatic insects upon which dippers forage. Signs in the area currently warn humans that the water is not potable because of chemical contamination. Two biologically-poisonous chemicals, mercury and chromium, have been mined in the region, and an open-pit mine for asbestos is presently active below nearby Santa Rita Peak. Furthermore, the soils derived from serpentine have a serious magnesium-calcium imbalance and are extremely low in total nitrogen and total phosphorus (Griffin 1974:12). Such deficiencies would presumably affect the plants upon which some aquatic insects feed. Although Sawmill and San Carlos creeks contain at least small populations of some aquatic insects, as well as a few frogs, the aquatic resources in general may be insufficient to support breeding dippers.

BLUE-GRAY GNATCATCHER (*Polioptila caerulea*). Palmer in 1936 and Miller and Storer in 1944 all recorded this species as being *the most common bird* in the San Benito Mountain region. Furthermore, Palmer collected two males in breeding condition (11 June, testis 6 x 4 mm; 18 June, testis 6 x 3 mm) during his trip. In contrast, not a single individual was found in 1983 and only two widely-separated pairs were seen in May 1984, although we spent many hours in the same places and habitats where the previous workers had encountered the species abundantly. Thus, we conclude that the Blue-gray Gnatcatcher has dramatically declined on San Benito Mountain, at least at higher elevations where it previously occurred in large numbers.

AMERICAN ROBIN (*Turdus migratorius*). In early June 1983, several American Robins were singing in the yellow pines near moist places along San Carlos and Sawmill creeks. These records are the first for the species from San Benito Mountain. We again recorded several robins in comparable habitats in May-June 1984. Two of these were lone males, one of which was singing vigorously near Sawmill Creek on 12-14 May. The other birds were an interacting pair that responded to imitated Northern Pygmy-Owl (*Glaucidium gnoma*) calls near San Carlos Creek; the male sang continuously for approximately 30 minutes while the female uttered alarm notes, and then the pair departed together. Although there is still no conclusive evidence that the species nests in the area, the records suggest that a few individuals were at least attempting to colonize the mountain. Other nesting localities in central California are scattered through the Coast Range, the nearest being that for Hastings Reservation, Monterey Co. Even there it has only recently become established (Davis et al. 1980). San Benito Mountain's arid coniferous forest provides very limited potential nesting habitat for the species.

SOLITARY VIREO (*Vireo solitarius cassinii*). This species breeds very locally in the San Benito Mountain region, mainly in the deep ravine of the East Fork of San Carlos Creek between 4000 and 4200 ft elevation. There, two pairs and a single male were stationed in May 1984. All three males sang steadily from fixed positions in the canyon; they were not moving through as is typical of singing migrants of this species. The birds were excited by our presence and decoyed readily to imitated Northern Pygmy-Owl calls; presumably, they had active nests in the dense woodland of Canyon Live Oaks along the stream. We collected two of these males, both in breeding condition (testis 5 x 3 mm, slight fat; 7 x 5 mm, slight fat), on 15 May 1984. On 1 June 1984, another male was singing in mixed Canyon Live Oaks and Coulter Pines at 4300 ft, on the canyon slope high above the East Fork of San Carlos Creek. The generally open and arid coniferous forest surrounding San Benito Mountain is apparently un-

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suitable for nesting Solitary Vireos, although we recorded a singing migrant in such habitat along Sawmill Creek, 4300 ft, on 12 May 1983. Miller collected an immature Solitary Vireo of unknown sex (no fat) in a Digger Pine on 8 August 1944. Palmer does not mention the species.

HUTTON'S VIREO (*Vireo huttoni*). On 9 June 1983, we saw a singing Hutton's Vireo in an Incense-cedar near the summit of San Benito Mountain. A second bird may have been present nearby. Several individuals were again recorded in 1984 along the East Fork of San Carlos Creek. Males were singing steadily from Canyon Live Oaks, and an actively-breeding mated pair (male, testis 3 x 2 mm; female laying, ovary with 4 collapsed follicles, egg in oviduct ready for shell, active incubation patch) was collected on 14 May from a 20 ft oak at the headwaters of the creek, 4500 ft (1373 m). These are the first records of the species from the region. Palmer, and Miller and Storer, failed to encounter the species several decades ago. This vireo is a common resident in the luxuriant oak woodland at the Hastings Reservation, Monterey Co. Although scarce and local, the Hutton's Vireo has seemingly colonized the San Benito Mountain area within the past 40-50 years. The limited occurrence of arboreal oaks provides habitat for only a small population.

NASHVILLE WARBLER (*Vermivora ruficapilla*). According to Grinnell and Miller (1944), this warbler requires open oak or yellow pine forest for foraging and singing, and an understory of scattered shrubs to conceal and shade the nest. These authors state (1944:396) that "the combination is essential and as a consequence this warbler is usually only found in moderately open forests which permit suitable bush growth." The San Benito Mountain region locally provides these requisite habitat elements and supports a small breeding population of Nashville Warblers, as the following records document. We found four vigorously singing males in mid-May 1984. Two of these males, one of which was identified by a peculiar inflection at the end of its song, were still present on their respective territories on 1 June. These birds were patrolling territories in pine-brush or oak/pine-brush habitats, and one was seen chasing another warbler. A singing male in reproductive condition (testis 5 x 3 mm, medium cloacal protuberance, no fat) was taken from a yellow pine on 15 May at the East Fork of San Carlos Creek, 4200 ft; another individual, also in reproductive condition (testes strongly dissimilar in size: left testis 9 x 6.5 mm, right testis 1 x 0.5 mm; large cloacal protuberance, no fat), was taken on 1 June at the same locality. Our records represent the first for the San Benito Mountain region. The nearest known probable breeding localities for this species occur to the north in the Inner Coast Range of Lake Co. (vicinity of Crockett Peak, N.K. Johnson MS), and to the south in the vicinity of Pine Mountain, Ventura Co. (Garrett and Dunn 1981). To the east, this warbler breeds commonly on the west slope of the Sierra Nevada.

YELLOW-RUMPED WARBLER (*Dendroica coronata*). Palmer failed to record this warbler in 1936. However, Miller (MS) collected a male (testis 1 mm, no fat) in a yellow pine 1 mile southeast of the summit, at approximately 4400 ft, on 10 August 1944. In examining the specimen, he noted that "judging from its condition of molt it may be a local summer resident." Records obtained in 1984 strengthen Miller's suspicion. On 17 May, a singing male in breeding condition (testis 8 x 6 mm, very large cloacal protuberance) was taken near San Carlos Creek at 4200 ft (1281 m); a female was seen near this site later that morning. While these individuals could have been late migrants, the evidence suggests that Yellow-rumped Warblers possibly breed in the region. The habitat of open yellow pine appears to be at least marginally suitable for a small summer resident population. Nesting records of the species exist for Monterey Co. in the "yellow pine belt at the summit of coastal slopes" (Grinnell and Miller 1944:403), and Davis et al. (1980) also note that the "Audubon's Warbler nests within 3 km of the [Hastings] Reservation."

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BLACK-THROATED GRAY WARBLER (*Dendroica nigrescens*). This warbler breeds in a variety of habitats from oak woodland and open coniferous forest to pinyon-juniper woodland. Mixed chaparral is often a common component of the habitat. Warm and at least moderately arid conditions seem essential wherever the species occurs (Grinnell and Miller 1944:404-405). Thus, on San Benito Mountain, the open yellow pine forest and/or mixed yellow pine-Canyon Live Oak association, with an understorey of manzanita, scrub oak and other species of brush, appears ideal. In June 1936, Palmer recorded (MS) Black-throated Gray Warblers as "common in the conifers." He collected a male (testis 6 x 4 mm) on 12 June at 1 mile southeast of the summit, 4400 ft. D.H. Johnson took a male at the same place on 20 June. This species was again encountered fairly regularly in August 1944, when Storer reported (MS) scattered families and a few single birds. Miller collected an immature female on 7 August near the summit of San Benito Mountain, 5000 ft. Fifty years later, the Black-throated Gray Warbler is still present on the mountain but in reduced numbers. A singing male was found on 9 June 1983 in a yellow pine at 4800 ft, and several other individuals were recorded in May-June 1984. On 13 May, a silent bird was seen in the brush below San Benito Peak, and another was present on 15 May in mixed yellow pine-Canyon Live Oak-chaparral on the canyon slope above the East Fork of San Carlos Creek, 4500 ft. A third individual was seen on 1 June in a yellow pine near the upper East Fork, 4200 ft. Some or all of these birds, except for the singing individual, were doubtless spring migrants. Although the species still breeds in the San Benito Mountain region, the records indicate a substantial decline in the nesting population between 1936 and 1983-84.

WESTERN Tanager (*Piranga ludoviciana*). Miller and Storer first recorded the Western Tanager on San Benito Mountain, although the species nests on Santa Lucia Peak, Monterey Co. (Grinnell and Miller 1944:440). On 11 August 1944, they noted (MS) one calling at 1 mile southeast of the summit, 4400 ft. Apparently the species was scarce then and, in light of the late summer date and the lack of specimens, it may not have been breeding. In contrast, in May and June 1983-1984, a large population of Western Tanagers was established for breeding on San Benito Mountain. Five to ten individuals were recorded on a single day, including nine birds during our 3-mile transect. Most of these tanagers were vigorously singing males, but several pairs were observed and a female was seen carrying nest material on 16 May 1984 near San Carlos Creek. A breeding male (testis 12 x 8.5 mm, enlarged cloacal protuberance, no fat) was taken from a yellow pine near the East Fork of San Carlos Creek, 4300 ft, on 15 May 1984. This species has increased dramatically on San Benito Mountain in recent decades and we strongly suspect that colonization of the region took place since Palmer's work in 1936.

BLACK-CHINNED SPARROW (*Spizella atrogularis caurina*). This subspecies of the Black-chinned Sparrow breeds at only a few localities in west-central California and was considered "rare" by Grinnell and Miller (1944:518). Evidently, the metropolis of the form *S. a. caurina* occurs on San Benito Mountain. *S. a. caurina* was first encountered in the region by Palmer in mid-June 1936, when he recorded seeing 10 or more individuals in the mixed chaparral between 4400 ft and the summit (5241 ft). He also noted the species from 1 mile south of Santa Rita Peak, 4500 ft (1373 m). During the same 2-week period, Palmer collected three adult males (left testis lengths 6 x 3 to 7 x 4 mm), one juvenile male, and one female (ova enlarged), all from San Benito Mountain. Palmer's records were reported in Grinnell and Miller (1944:518). Miller failed to record the species in August 1944. However, because Black-chinned Sparrows are most easily detected by the singing of males, it is probable that he overlooked this species due to the timing of his visit in late summer. In 1983 and 1984, we found males singing fairly commonly in the chaparral at the same localities as Palmer's observations. Thus, it appears that the Black-chinned Sparrow has maintained a substantial

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breeding population in the region for at least the past 50 years. In view of the very local distribution of *S. a. caurina*, we are pleased to report the good health of the San Benito Mountain population. Unfortunately, the increasing degradation of brushlands in the region by extensive mining, especially near Santa Rita Peak, and by trailbikes and other off-road vehicles, poses a distinct threat to this isolated population.

SAGE SPARROW (*Amphispiza belli*). Palmer in 1936, and Miller and Storer in 1944, collected a series of specimens of this species high on San Benito Mountain. Miller identified these as intergrades between *A. b. canescens* and *A. b. belli* (Grinnell and Miller 1944:501). Because the skins were determined to be intermediates, we were originally prompted to visit this region to inspect the habitat where the sparrows were found. Typical populations of *canescens* and *belli* differ strikingly in this regard; *canescens* prefers shadscale scrub and *belli* occupies chaparral primarily comprised of Chamise (*Adenostoma fasciculatum*). Surprisingly, although we searched for several days in the exact places where the earlier workers found the species very commonly, none could be found. Although San Benito Mountain is cited as a breeding locality for the species, we doubt that they have ever nested there. The four specimens taken by Palmer, and the series of skins taken by Miller and Storer, were all in non-breeding condition, based on examination of gonads. This is understandable for the August series taken by the latter workers, but it is surprising that none of Palmer's June birds showed breeding activity. Perhaps San Benito Mountain is not a breeding area but rather is a site where post-breeding groups congregate after nesting at lower elevations, either in shadscale scrub in the San Joaquin Valley to the east or in *Adenostoma* chaparral in the southern Diablo Range. Miller also mentioned (MS) that the Sage Sparrows he found on San Benito Mountain occurred in large flocks, a point which further suggests possible post-breeding movement into the area. Therefore, we may have failed to record the species because our visits were prior to this postulated uphill movement by post-breeders.

DARK-EYED JUNCO (*Junco hyemalis pinosus*). As Grinnell and Miller (1944:510-511) described, juncos of the subspecies *J. h. pinosus* are distributed interruptedly in west-central California, with the population on San Benito Mountain being especially isolated. All ornithologists who have visited the region, starting with Palmer in 1936, have reported the species. Palmer (MS) found them "In flocks for the most part, 10-15 in number [and] usually in heaviest stands of conifers or very brushy gulches with streams." He collected an adult male in breeding condition (testis 8 x 5 mm) on 9 June and juveniles on 12 and 18 June. Miller (MS) took two adult females on 6 and 8 August 1944, and also reported flocks as well as adults with nearly independent young. Storer (MS) collected an adult male (testis 1 mm) on 8 August and stated that the species was fairly common and most numerous near streams. In 1983 and 1984, Dark-eyed Juncos were common; 11 were found along the transect of 17 May 1984. A male taken on 13 May 1984 was breeding (testis 7 x 5 mm, large cloacal protuberance). No change in historical status is indicated.

PURPLE FINCH (*Carpodacus purpureus*). The Purple Finch was one of the most abundant species on San Benito Mountain in 1983 and 1984. In a single day we recorded five to ten vigorously singing males and up to 21 individuals along the 3-mile transect. Most of these finches were in mated pairs, and a female was seen carrying nest material on 16 May 1984 near San Carlos Creek at 4200 ft (1281 m). A small series of specimens, all of which were at the peak of reproductive condition, was taken between 13 May and 17 May 1984. The finches preferred clumps of conifers scattered through mixed chaparral, the latter including several berry-producing shrubs that probably were an attractive food source. Unexpectedly, Palmer did not list the species in 1936. Miller stated in 1944 (MS) that Purple Finches were "heard all day at camp," and he took an immature female at 4400 ft on 10 August. Because Miller's records were from late summer, they provide no certain evidence for breeding status. These

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data strongly point to a substantial increase in the breeding population of this species since 1936. Indeed, this finch may have colonized San Benito Mountain sometime between 1936 and 1944. This locality defines the eastern edge of the nesting distribution of Purple Finches in the Inner Coast Range of south-central California.

CASSIN'S FINCH (*Carpodacus cassinii*). On 13 May 1984 we collected a steadily singing male (testis 9 x 7 mm) in a yellow pine along Sawmill Creek, 1 mile southeast of San Benito Mountain, 4400 ft. Several other probable Cassin's Finches were subsequently seen along San Carlos Creek on 16 May in mixed forest of yellow pine and Incense-cedar with an understory of manzanita-scrub oak. Although this finch probably nests in the area, additional evidence is needed. Summer residence has also recently been suggested for Chews Ridge in Monterey Co. (DeSante and LeValley 1971). Neither Palmer in 1936 nor Miller and Storer in 1944 reported this finch for the San Benito Mountain region.

HOUSE FINCH (*Carpodacus mexicanus*). Although less numerous in 1983 and 1984 than its sibling species, the Purple Finch, the House Finch used pine and brushland habitat on San Benito Mountain apparently identical to that occupied by *C. purpureus*. Both species occurred side by side; males of either sang persistently from conifer tops and intraspecific chases were noted through the foliage in space occupied by the other congener. Mated pairs were also commonly observed in these areas. In view of such local sympatry of the two species in the same habitat during the nesting season, San Benito Mountain would be an ideal place to study their interactions. A small series of specimens was taken during our visit between 14 May and 17 May 1984, all of which were in reproductive condition. Palmer in 1936 and Miller and Storer in 1944 also recorded the House Finch.

LESSER GOLDFINCH (*Carduelis psaltria*). This species, a common resident of the Inner Coast Ranges of California (Grinnell and Miller 1944:461-462), has definitely increased in abundance on San Benito Mountain within the past half-century. Palmer recorded only four or five individuals and collected a breeding female (ovum 5 x 4 mm) during his 2-week stay on the mountain in 1936. Similarly, Miller and Storer found the species in 1944 but not in unusual numbers. In contrast, the Lesser Goldfinch seemed to be among the most abundant species in the region in 1983 and 1984. During our June 1983 visit we found at least 40 individuals in the pines and shrubs; these were actively chasing in small groups or in pairs. On 9 June, we collected a female in breeding condition (ovum 8 mm). Pairs and singing males were again commonly encountered in May 1984, and on 16 May a male was taken (testis 6 x 6 mm, large cloacal protuberance) near San Carlos Creek, 4400 ft. The reason for this impressive increase in numbers is unknown, although the open forest and brushland seem ideal for the species according to the habitat description of Grinnell and Miller (1944:412).

LAWRENCE'S GOLDFINCH (*Carduelis lawrencei*). This species was also very common on San Benito Mountain in 1983, although it was not as abundant as its congener. On 8-9 June, we observed at least 25 birds in the pine and chaparral habitat, many of which were in interacting pairs or in social groups mixed with Lesser Goldfinches. We also saw several pairs during our trips in May of 1983 and 1984. On 16 May 1984, a breeding male was taken (testis 6 x 4 mm, cloacal protuberance) along San Carlos Creek, 4400 ft. Such numbers represent a substantial increase in the population within the past 40-50 years. Palmer failed to observe any Lawrence's Goldfinches in the region in 1936. Miller and Storer (MS) did report the species in 1944, but without commenting on numbers present.

DISCUSSION AND CONCLUSIONS

Species richness and avifaunal resemblance. In Table 1 we compare the total number of boreal breeding bird species recorded from San Benito Mountain (14) with those from two other areas of west-central California, Monterey (33 species; Miller 1951 plus Dusky Flycatcher [Chandik and Baldridge 1969, DeSante and LeValley 1971]) and the Hastings Natural History Reservation (19 species; Davis et al. 1980). We included Hastings because it is roughly comparable in size to the San Benito Mountain region (Figure 1). Furthermore, the boreal avifauna of Hastings essentially represents a subset of that found in the adjacent Monterey District as defined by Miller (1951). Fourteen species known from Miller's Monterey component have not been recorded as summer resident at Hastings. However, a number of these species breed in the Santa Lucia Mountains only a few miles from the Reservation. Evidently, these forms require high elevations and cool-adapted forest not found at the Reserve. Such species include the Flam-mulated Owl, Dusky Flycatcher, Mountain Chickadee, Hermit Thrush, Yellow-rumped Warbler, Western Tanager and Pine Siskin. Other species that are missing from Hastings but found in the broader Monterey region need either (a) large permanent streams or rivers (Common Merganser), (b) heavy woodland or forest in steep-sided canyons (Spotted Owl), (c) the generally moist summer environments and associated thickets found at or near the coast (Winter Wren, Swainson's Thrush, Wilson's Warbler and White-crowned Sparrow), or (d) extensive yellow pine forest (Pygmy Nuthatch).

The avifauna of San Benito Mountain is substantially depleted relative to those occurring in the more moist and heavily-wooded Hastings and Monterey areas. This is largely in keeping with its isolation near the western border of the arid San Joaquin Valley. Among the species lacking from the mountain are the Sharp-shinned Hawk, Chestnut-backed Chickadee, Brown Creeper and MacGillivray's Warbler. All of these nest in both coastal locations but apparently do not breed at San Benito Mountain because of the comparatively stunted and highly insulated conifers there. Another species, the American Dipper, may be excluded from the region because of excessive annual fluctuations in streamflow volume and possible chemical contamination of the aquatic habitat. San Benito Mountain also seems to be missing two species of small forest-woodland owls, the Northern Pygmy-Owl and Flam-mulated Owl. We recorded only the Western Screech-Owl (*Otus kennicottii*) and Northern Saw-whet Owl during several nights of persistent hunting by means of imitated calls. More intensive searching of the conifers would likely reveal the Northern Pygmy-Owl; Johnson has recorded this species in similarly inferior conifer stands at several localities in the western United States. *Otus flammeolus*, on the other hand, may not occur, especially in view of the current scarcity of mature conifers in the logged and burned forest. In comparing the boreal avifaunas of the three regions, it was further noted that some species inhabit San Benito Mountain but are absent from either the Monterey District and/or the Hastings Reservation. Of these, the Nashville Warbler is the only species that breeds on San Benito Mountain but not in the other two areas; the Dusky Flycatcher, Pygmy Nuthatch and Western Tanager are shared with Monterey but do not nest at Hastings.

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Table 1. Probable breeding species of boreal birds.^a

	MONTEREY ^b	HASTINGS RESERVATION ^c	SAN BENITO MTN. ^d
1.	Common Merganser (<i>Mergus merganser</i>)		
2.	Sharp-shinned Hawk (<i>Accipiter striatus</i>)	X	
3.	Mountain Quail (<i>Oreortyx pictus</i>)	X	[X] ^e
4.	Flammulated Owl (<i>Otus flammeolus</i>)		
5.	Northern Pygmy-Owl (<i>Glaucidium gnoma</i>)	X	
6.	Spotted Owl (<i>Strix occidentalis</i>)		
7.	Northern Saw-whet Owl (<i>Aegolius acadicus</i>)		X
8.	Hairy Woodpecker (<i>Picoides villosus</i>)	X	X
9.	Olive-sided Flycatcher (<i>Contopus borealis</i>)	X	X
10.	Western Wood-Pewee (<i>Contopus sordidulus</i>)	X	X
11.	Dusky Flycatcher (<i>Empidonax oberholseri</i>)		X
12.	Western Flycatcher (<i>Empidonax difficilis</i>)	X	X
13.	Violet-green Swallow (<i>Tachycineta thalassina</i>)	X	X
14.	Steller's Jay (<i>Cyanocitta stelleri</i>)	X	X
15.	Mountain Chickadee (<i>Parus gambeli</i>)		
16.	Chestnut-backed Chickadee (<i>Parus rufescens</i>)	X	
17.	Pygmy Nuthatch (<i>Sitta pygmaea</i>)		X
18.	Brown Creeper (<i>Certhia americana</i>)	X	
19.	Winter Wren (<i>Troglodytes troglodytes</i>)		
20.	American Dipper (<i>Cinclus mexicanus</i>)	X	
21.	Swainson's Thrush (<i>Catharus ustulatus</i>)		
22.	Hermit Thrush (<i>Catharus guttatus</i>)		
23.	American Robin (<i>Turdus migratorius</i>)	X	
24.	Wrentit (<i>Chamaea fasciata fasciata</i>)	X	[X] ^f
25.	Solitary Vireo (<i>Vireo solitarius</i>) [Nashville Warbler] ^g	X	X
26.	Yellow-rumped Warbler (<i>Dendroica coronata</i>)		
27.	MacGillivray's Warbler (<i>Oporornis tolmiei</i>)	X	
28.	Wilson's Warbler (<i>Wilsonia pusilla</i>)		
29.	Western Tanager (<i>Piranga ludoviciana</i>)		X
30.	White-crowned Sparrow (<i>Zonotrichia leucophrys</i>)		
31.	Dark-eyed Junco (<i>Junco hyemalis</i>)	X	X
32.	Purple Finch (<i>Carpodacus purpureus</i>)	X	X
33.	Pine Siskin (<i>Carduelis pinus</i>)		
	TOTAL NO. SPECIES	19	14

^a Nomenclature follows 6th edition of the AOU Check-list (AOU 1983).

^b From Miller (1951:584-587), except for species 4, 6, 7 and 25, the first 3 of which were recorded subsequently. The Solitary Vireo has long been known to breed in the Monterey region and was apparently overlooked by Miller.

^c From Davis et al. (1980).

^d Based on present study.

^e Introduced, and thus not included in total for number of species; see species account.

^f Non-boreal subspecies occurs.

^g Species not known to breed in Monterey region.

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Finally, we note that several species (American Robin, Yellow-rumped Warbler and Cassin's Finch) are either attempting to colonize or are possibly established as breeders in small numbers on San Benito Mountain; thus, the nesting avifauna of this region may actually be somewhat richer than we now conclude.

A quantitative method for judging avifaunal resemblance among various regions is provided by the calculation of similarity coefficients (Table 2). We attempted several approaches, each of which incorporates different information: (1) Jaccard's (1902 and 1908) Coefficient of Community; (2) Simple Matching Coefficient (Sneath and Sokal 1973); (3) Simpson's (1943) Index; and (4) Schilder's (1955) Index. However, only the results obtained with Jaccard's Coefficient and the Simple Matching Coefficient are presented here. These techniques are compared by Sneath and Sokal (1973:129-133) and by Udvardy (1969:273).

Table 2. Similarity coefficients for avifaunas of four areas of California. Upper right triangular matrix, Jaccard's (1902) Coefficients.^a Lower left triangular matrix, Simple Matching Coefficients^b (Sneath and Sokal 1973). For either of these coefficients, a value of zero indicates complete avifaunal dissimilarity and a value of one indicates total avifaunal resemblance.

	1.	2.	3.	4.
1. Monterey	----	0.58	0.38	0.47
2. Hastings Reservation	0.79	----	0.43	0.26
3. San Benito Mountain	0.69	0.81	----	0.21
4. Yosemite National Park ^c	0.47	0.26	0.22	----

$$^a S_j = \frac{c}{a + b - c}$$

where *a* is number of species in larger fauna, *b* is number of species in smaller fauna, and *c* is number of species in common. Numbers of species shared by each pair of the four areas are as follows: Monterey-Hastings, 19; Monterey-San Benito Mountain, 13; Monterey-Yosemite, 32; Hastings-San Benito Mountain, 10; Hastings-Yosemite, 18; San Benito Mountain-Yosemite, 14.

$$^b S_{jm} = \frac{m}{m + u}$$

where *m* = *a* + *s* and *u* = *b* + *c*. *a* is number of shared species, *b* is number of species in first avifauna that are not in second avifauna, *c* is number of species in second avifauna that are not in first avifauna, and *d* is number of species missing from both avifaunas, using as a base the complete list of species found in all avifaunas (68 species, that is, the list for Yosemite [67 species] plus the boreal form of Wrentit found at Monterey and Hastings).

^c Data from Johnson (1975:564-567), whose species list was developed from Grinnell and Storer (1924). Four additional species can be added to Grinnell and Storer's list: *Mergus merganser* and *Contopus sordidulus*, two species inadvertently omitted by Johnson; and *Parus rufescens* and *Anthus spinoletta*, two species that have recently colonized the Yosemite region.

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Each method for estimating avifaunal resemblance has its merits and weaknesses. According to Udvardy, Jaccard's Coefficient tends to give a biased index where substantial discrepancies exist in the size of the different faunas. In such cases, the proportional role of the shared taxa (*c*) is much greater in the smaller fauna (*b*) than in the larger one (*a*), and the coefficient does not take this factor into account. To avoid this problem, Udvardy recommends the use of either Simpson's Index or Schilder's Index. In our opinion, results obtained from the latter two indices are misleading because they exclude important data. Although Simpson's Index evaluates the contribution of both the number of shared taxa and the absolute size of the smaller fauna, it is of limited utility because it omits consideration of the size of the larger fauna. Similarly, Schilder's Index excludes data on the number of shared taxa and thus disregards qualitative faunal differences. Furthermore, it does not incorporate information on the absolute size of the smaller fauna into its computation.

We regard Jaccard's Coefficient and the Simple Matching Coefficient as the most realistic measures of avifaunal similarity because they consider all of the information pertinent to such comparisons. Calculation of Jaccard's Coefficient includes data on the absolute size of each fauna and on its composition in terms of number of shared species. The Simple Matching Coefficient is even more comprehensive. It incorporates information on shared species (positive matches), unshared species (mis-matches), and, importantly, species missing in the two faunas being directly compared (negative matches) but occurring in at least one of the faunas in the entire comparison group.

To our analysis of avifaunal resemblance among the three areas of western California, we added Yosemite National Park in the Sierra Nevada. Yosemite supports the greatest number of boreal breeding species in California (67; Johnson 1975 and Table 2, footnote c) and therefore provides a broader perspective by which to judge similarity of the other regions. Many of these species are absent from the boreal environments in the western portion of the state. Consequently, Yosemite is the main source of negative matches between pairs of the three other avifaunas. Therefore, because the Simple Matching Coefficient considers negative matches in its computation, it is a more appropriate measure of similarity among avifaunas when Yosemite is included in the comparison. In contrast, Jaccard's Coefficient is most useful when comparing only the three western regions because it excludes negative matches from its computation.

The spatial relationship of resemblance coefficients is schematically illustrated in Figure 4. Jaccard's Coefficients (Figure 4a) clearly show a gradual avifaunal depletion eastward from Monterey, through Hastings, to San Benito Mountain. This trend matches a similar depletion in bird species richness as one progresses from north to south along the California coast (Miller 1951:589). Miller attributes the latter trend to moisture and temperature gradients. Presumably, similar climatic changes inland from the coast account for the relative impoverishment of the small and local boreal avifaunas considered here. Jaccard's Coefficients also reveal a stronger avifaunal relation between Monterey and Yosemite than between Monterey and San Benito Mountain. Finally, the low coefficient connecting San Benito

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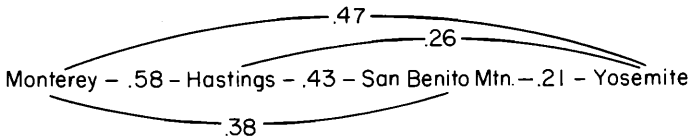
Mountain and Yosemite underscores the profound break in boreal environments and associated avifaunas across the San Joaquin Valley.

Coefficients derived by the Simple Matching (S_{sm}) approach are very similar in magnitude to Jaccard's Coefficients (S_j) for any pairwise comparison in which Yosemite is involved (Figure 4b). For example, S_{sm} and S_j for both Monterey and Hastings versus Yosemite are identical. However, values of S_{sm} are higher and more uniform than those of S_j when comparing any two of the three smaller avifaunas. This difference arises from the disproportionate influence of negative matches (d) between pairs of coastal avifaunas, caused by the missing Yosemite species. The S_{sm} data point to a strong avifaunal resemblance among Monterey, Hastings and San Benito Mountain. In addition, these coefficients again reveal the substantial dissimilarity in avifaunas divided by the San Joaquin Valley.

Temporal change. The data strongly suggest that the breeding avifauna of San Benito Mountain has changed markedly since the surveys of the region in 1936 and 1944. This change has involved both the composition of the avifauna and the relative abundance of particular species. We recorded eight species that were not previously known as summer residents on the mountain: Northern Saw-whet Owl, Dusky Flycatcher, Gray Flycatcher, Pygmy Nuthatch, Solitary Vireo, Hutton's Vireo, Nashville Warbler and Western Tanager. In addition, seven other species appear to have increased in numbers within the past 50 years: Olive-sided Flycatcher, Western Wood-Pewee, Violet-green Swallow, Steller's Jay, Purple Finch, Lesser Goldfinch and Lawrence's Goldfinch. Finally, three species, two of them formerly common or even abundant, have apparently either vanished or become very scarce on San Benito Mountain in recent decades: Purple Martin, Blue-gray Gnatcatcher and Black-throated Gray Warbler.

As one examines these changes more closely, a pattern becomes evident. Most of the species that are either new to the mountain (6, or 75%), or are

a. Jaccard's Coefficients



b. Simple Matching Coefficients

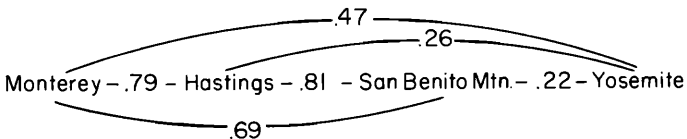


Figure 4. Schematic illustration of the spatial relationships of the four boreal avifaunas and of their resemblance as measured by similarity coefficients.

currently more abundant (5, or 71%), represent boreal forms characteristic of cool, moist environments. Therefore, fully 79% of the present boreal avifauna consists of species that have either arrived or increased in numbers in the past half-century. Importantly, no boreal species present in 1936 has diminished in numbers in the ensuing decades. Furthermore, the three species currently attempting to colonize (American Robin, Yellow-rumped Warbler and Cassin's Finch) are also boreal forms. Only the Northern Saw-whet Owl is suspect; it could have been present but overlooked in 1936. The remaining two new additions, the Hutton's Vireo and Gray Flycatcher, although not considered to be of boreal derivation, are adapted to cool habitats in either the oak woodlands or in the elevated valleys and highlands of the interior of the western United States, respectively. Another related trend is shown by the three species unexpectedly missing or scarce on San Benito Mountain in 1983. All of these are associated with either warm and/or arid environments. Thus, these avifaunal losses are directly opposite in kind to the gains we observed in the latest censuses. Furthermore, we stress that the species previously recorded as being *most abundant on the mountain*, the arid-adapted Blue-gray Gnatcatcher, is now *very scarce*. In sharp contrast, several cool-adapted species that were formerly absent or uncommon, such as the Western Wood-Pewee, Dusky Flycatcher and Purple Finch, were among the most abundant forms in 1983 and 1984!

The conclusion is inescapable that we have witnessed a broad adaptive response by the high-elevation avifauna of San Benito Mountain to a pervasive environmental change occurring within the last 50 years. One plausible explanation is that the habitat has undergone substantial modification over one-half century, either naturally or through human perturbation. Evidence of extensive logging in the region around the turn of the century and before is provided by existing stumps and by early records (Griffin 1974). Jepson wrote in 1907 (*in* Griffin 1975:7) that "the trees have been logged clean for the mines, even the 6-inch stuff taken for logging." Griffin (1975:43) discusses conifer reforestation in October 1910 in the Clear Creek area of San Benito Mountain. He also notes that *Pinus jeffreyi* was "probably more dominant prior to the heavy logging for mine timbers." One habitat change that is difficult to assess is the removal of most of the old-growth timber. Griffin (1974) provides evidence that large old Incense-cedars and Jeffrey Pines were once much more common than at present. Virtually all of the San Benito forest is now second-growth.

Another factor could have been fire. In 1936, Palmer noted (MS) a large burn at Santa Rita Peak. Similarly, Miller stated (MS) in 1944, in reference to a spur running northeast from San Benito Mountain, that "a fire has swept the southeast slope to the crest." It is probable that some of these habitat modifications would have altered the environment in ways selectively favorable to particular species of birds. For example, subsequent chaparral regeneration in the burned areas would have encouraged populations of the Blue-gray Gnatcatcher, a species that both Palmer and Miller reported in numbers. Moreover, as the density of brush increased and as young conifers began to invade, the acreage of habitat appropriate for gnatcatchers would have declined while its suitability for species such as Dusky Flycatchers and Purple Finches would have increased. Natural succession and the eventual

colonization of conifer seedlings on at least some logged or burned sites also would then allow forest-adapted species to invade.

Despite the effects of logging and fire evident early in this century, the field notes of Palmer and of Miller and Storer clearly describe the presence of extensive forest and rich brushland habitats suitable for boreal birds in the San Benito Mountain region in the 1930s and 1940s. Consequently, we prefer another explanation for the avifaunal dislocation. Because of the particular combination of species involved in this secular change, the underlying cause may have been a shift in recent decades toward cooler and more moist summer climates. Two other studies are relevant to this explanation. Ten years ago, Johnson and Garrett (1974) published data to document the westward spread of eight interior bird species into southern California, including seven boreal forms and the Gray Flycatcher. These authors attributed the expansion to "some complex pattern of change in recent decades of spring and summer average moisture and temperature regimes . . ." (Johnson and Garrett 1974:54). In addition, Johnson (1974) demonstrated that a striking increase in boreal species had occurred between 1939-1940 and 1971 in the Grapevine Mountains and on Potosi Mountain, southern Nevada. He speculated (Johnson 1974:336) that, "we are witnessing the recovery in recent years of Boreal faunas which were reduced in diversity sometime prior to the census of 1940, perhaps by the deleterious environmental effects of the relatively warm-dry period of the 1930s." The new and parallel findings from San Benito Mountain provide clear evidence to support these earlier suppositions. Former speculation can now be transformed into a working hypothesis.

Since the aforementioned papers, a publication has appeared (Diaz and Quayle 1980) that confronts the issue squarely by presenting substantial information on climatic change in the United States from 1895 through 1977. This elaborate analysis reveals three distinctly different periods in terms of temperature: (1) 1895-1920, cooler than average temperatures; (2) 1921-1954, warmer than average temperatures; and (3) 1955-1977, reversal to cooler than average temperatures. Importantly, all of the early surveys of the Grapevine Mountains, Potosi Mountain and San Benito Mountain fall within the warm middle period, and all of the later censuses from the same three regions occurred during or after the cool, more recent period. Despite geographical and seasonal variation in the climatic data, the information offered by Diaz and Quayle for the far West is fully compatible with the suggestion of decreased average spring and summer temperatures since the mid-1950s.

The patterns of moisture are generally more complex and difficult to interpret. Nonetheless, Diaz and Quayle (1980:259) conclude that "average summer precipitation in the far western United States was greater in the recent period compared to the previous one," and that winter precipitation increased in the Northwest.

Diaz and Quayle present two other conclusions of relevance to the present study. First, they show that the recent period has been relatively more stable (reduced variance) in average temperature and total precipitation. This suggests that the cooling trend that has occurred since 1955 represents an unambiguous environmental shift, one striking enough to have led to a more

defined avifaunal displacement than might otherwise have been the case. Second, Diaz and Quayle (1980:264) report that "in the recent cooling period, the greatest drop in mean temperature occurred essentially over those areas that reflected the greatest increases during the warm interval." We regard this finding as especially significant and exciting. In particular, it implies that if the greatest extremes between warm-arid and cool-moist climates were reached in the same region, then the magnitude of secular environmental change necessary to drive the kind of avifaunal response described here would have been perfectly plausible.

SUMMARY

We review the breeding avifauna of the isolated San Benito Mountain region, southern Diablo Range, San Benito and Fresno counties, California. Field notes and specimens resulting from concentrated field work in 1936 and 1944, and preserved in the Museum of Vertebrate Zoology, allowed assessment of the avifauna as it existed approximately 1/2 century ago. These data are compared in detail with new information gathered in May and June of 1983-1984. The boreal avifauna of San Benito Mountain is contrasted with those of Monterey and the Hastings Reservation to the west, and with that of Yosemite National Park to the east. Species richness of the four regions is compared, and avifaunal similarity is measured by Jaccard's Coefficient and the Simple Matching Coefficient. The avifauna of San Benito Mountain is substantially depleted relative to those of Monterey and Hastings, and it contains only 21% of the boreal species known from Yosemite. Most of the species missing from the region require dense forest, moist thickets and/or aquatic habitats, either at low or high elevations. Such habitats on San Benito Mountain are either limited or impoverished, or are lacking altogether. The similarity coefficients illustrate avifaunal depletion from Monterey inland, through Hastings, to San Benito Mountain. In addition, they underscore the strong break in boreal environments and associated avifaunas across the arid San Joaquin Valley.

A comparison of the censuses of 1936 and 1944 with those for 1983-1984 reveals that striking avifaunal changes have occurred in the San Benito Mountain region over the interval of approximately 1/2 century. Eight species of probable colonists, and several other forms that have increased profoundly in numbers, are nearly all species of boreal derivation. Three other species, two of which were recorded as being common or abundant in 1936 and 1944, have either declined in numbers or vanished from the mountain; these forms are typically associated with warm and arid environments. Although habitat disruption from fire and logging may have influenced the occurrence of some species, we conclude that the major avifaunal shift is attributed to secular climatic change. The reduced average temperatures and increased winter and summer precipitation recorded in the western United States since 1955 appear to have dramatically improved environments for boreal species. Apparently we are witnessing a widespread and ongoing adaptive response by mountaintop avifaunas to these more favorable conditions.

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Black-chinned Sparrow

Sketch by Narca Moore-Craig



Northern Hawk-Owl (*Surnia ulula*) at Cantwell, just outside Denali National Park, Alaska, 17 June 1982. This immature was one of three Roger Harris found in a nest on top of a 3-m broken top snag 3 days earlier. On 17 June the three young were on the ground, with an adult in close attendance—see cover photo, *Western Birds* 15(2), 1984.

Photo by Roger D. Harris