

BIRDS OF EAGLE MOUNTAIN, JOSHUA TREE NATIONAL MONUMENT, CALIFORNIA

A. TOWNSEND PETERSON, Committee on Evolutionary Biology, The University of Chicago, Chicago, Illinois 60637

The Little San Bernardino Mountains of Riverside and San Bernardino Counties in southern California support a peninsula of oak-pine woodland running southeast from the higher San Bernardino Mountains (Figure 1). In spite of the continuity of the woodland connecting the two ranges, the birds of the Little San Bernardino Mountains are remarkably differentiated from populations to the west. Three subspecies requiring woodland are endemic to the range: a Mountain Quail, *Oreortyx pictus russelli*, a Plain Titmouse, *Parus inornatus mohavensis*, and a Bushtit, *Psaltriparus minimus sociabilis* (Miller 1946), and another, a Scrub Jay, *Aphelocoma coerulescens cana*, is endemic to the nearby Eagle Mountains (Miller 1946, Pitelka 1951).

Miller (1946), Pitelka (1951), and Miller and Stebbins (1964) discussed three alternative hypotheses for the origin of these differentiated populations. (1) The peninsula restricts gene flow from populations to the west. (2) The differentiated populations represent intergrades or hybrids between populations in the San Bernardino Mountains to the west and the Providence Mountains to the northeast. (3) A third hypothesis is one of faunal relaxation. Because as recently as 8000 years ago the Mojave Desert contained pinyon-juniper woodland (Wells and Berger 1967, Van Devender 1977), differentiated populations in the Little San Bernardino Mountains and other mountain ranges farther east may represent remnants of what was once a continuous distribution (Grinnell and Swarth 1913, Miller and Stebbins 1964). Hence, they may show traits that are either ancestral or intermediate owing to historical genetic interchange.

Information on populations of these species in the bits of woodland between the Little San Bernardino Mountains and the Providence Mountains is critical to assessing the latter two hypotheses. The Eagle Mountains, the Bullion Mountains, the Old Woman Mountains, and others provide elevated landscapes (Figure 1). Of these, only the Eagle Mountains are known to hold pinyon woodland, and this habitat is restricted to a small area (approx. 150 ha) around the peak of Eagle Mountain itself, in Joshua Tree National Monument. Eagle Mountain reaches a height of 1631 m, with a broad, flat valley at approximately 1460 m. Sparse woodlands of Single-leaf Pinyon (*Pinus monophylla*), California Juniper (*Juniperus californica*), and Scrub Oak (*Quercus turbinella*) occur above 1400 m. Eagle Mountain is isolated from the nearest woodland habitat in the Little San Bernardino Mountains by about 33 km of desert, the lowest point being Cottonwood Pass (914 m).

In the 1940s and 1950s, scientists from the Museum of Vertebrate Zoology (MVZ), University of California at Berkeley, led by Alden H. Miller, studied the vertebrates of the Monument. They visited Eagle Mountain twice (in May and October 1945) and assembled representative series of specimens from the area. Dennis Rainey and Richard Loomis of California State University at Long Beach apparently worked in the area briefly in the early 1960s. In 1986, George San Miguel of the Monument staff visited the area on several

occasions and recorded several important sightings. To my knowledge, these trips constitute the only ornithological work on the birds of Eagle Mountain prior to my visits. Information on other vertebrates known from Eagle Mountain was summarized by Miller and Stebbins (1964).

The purpose of this study is to summarize the existing information on the avifauna of Eagle Mountain. This paper represents an attempt to understand the historical processes leading to the differentiation of Mojave Desert edge forms of a number of bird species.

METHODS

As part of studies of the resident Scrub Jays (*Aphelocoma coerulescens cana*), I climbed Eagle Mountain four times: 13 May 1987, 14 May 1987, 14–15 March 1988, and 26–27 May 1988, each time with one other person, for a total of 102 observer-hours. Observations from visits to the area by other ornithologists are also summarized.

To check the validity of the five forms described as differentiated in the region [Mountain Quail, Scrub Jay, Plain Titmouse, Bushtit, and Bewick's Wren (*Thryomanes bewickii*)], I made comparisons of museum specimens in the collections of California State University at Long Beach (CSULB) and the Museum of Vertebrate Zoology (MVZ). At MVZ, the three specimens of the Scrub Jay from the Eagle Mountains were compared with other specimens from adjacent areas of the same age and sex, and collected in the same season and approximately the same years. At CSULB, I used the extensive series from the Little San Bernardino Mountains collected by Dennis Rainey and Richard Loomis to replicate the comparisons of Miller (1946), again controlling for variation due to age and sex, and year and season of collection.

RESULTS

Listed below are the species observed by the MVZ teams and by Rainey and Loomis (Miller and Stebbins 1964, A.H. Miller's field notes from the Field Note Collection at MVZ), by George San Miguel (pers. comm.), and by myself and my field companions. Habitat usage of species breeding in the Little San Bernardino Mountains is categorized into plant zones following Miller and Stebbins (1964): P, pinyon; Y, yucca; C, creosote. I do not describe the habitat usage of species that apparently do not breed in the region. Species presumed or known to breed on the mountain are indicated by an "x" or "***", respectively.

Red-tailed Hawk (*Buteo jamaicensis*). Single birds seen 13 May 1987 and 26 May 1988 soaring over peak. PYC_x.

Golden Eagle (*Aquila chrysaetos*). Pair seen flying by north base 20 Oct 1945. PYC_x.

Gambel's Quail (*Callipepla gambelii*). Seen 16 May and 19 Oct 1945. A covey of >20 flushed 26 May 1988 at Conejo Well. PYC_x.

Mountain Quail (*Oreortyx pictus*). Collected 16 and 20 May, and seen 19 Oct. 1945. PY_x.

Mourning Dove (*Zenaida macroura*). Several hundred seen flying to and from Conejo Well on 26 and 27 May 1988. PYC_x.

BIRDS OF EAGLE MOUNTAIN

Great Horned Owl (*Bubo virginianus*). One heard calling at dawn on 27 May 1988. PYCx.

Long-eared Owl (*Asio otus*). Seen 19 Feb (year?) at 1370 m (Rainey and Loomis, in Miller and Stebbins 1964). P.

Lesser Nighthawk (*Chordeiles acutipennis*). Seen at dusk on 26 May 1988. YCx.

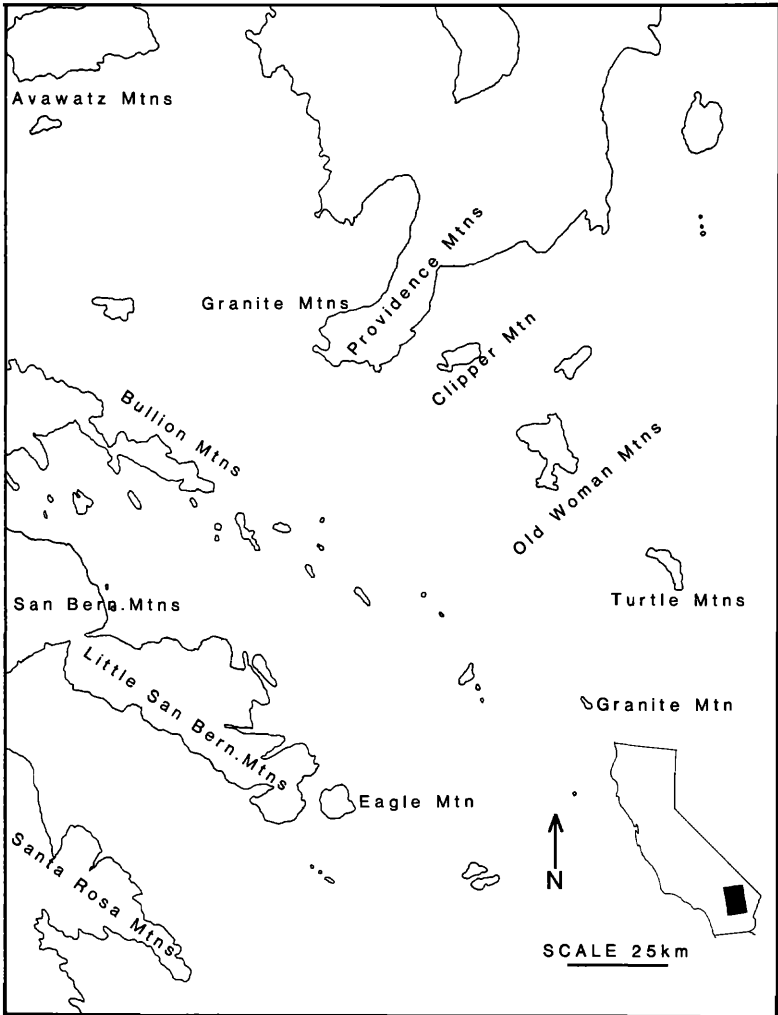


Figure 1. Topography of the southern Mojave Desert. The 1000 m contour line is shown. The black rectangle on the inset map of California shows the approximate area covered by the map.

BIRDS OF EAGLE MOUNTAIN

White-throated Swift (*Aeronautes saxatalis*). Seen 19-20 Oct 1945, 13-14 May 1987, 14-15 Mar, and 26-27 May 1988, with the recent records being of groups of 5-20 individuals. Several times, especially on 26 May 1988, seen entering cavities on cliffs which may have been nest sites. PYCx.

Anna's Hummingbird (*Calypte anna*). Collected 20 Oct and seen 21 Oct 1945, 17 Mar 1986, 13 May 1987, and 26-27 May 1988. Abundant 26-27 May 1988, with many aggressive encounters observed, but only one of >50 individuals had a gorget; two others had a few dark feathers on their throats.

Costa's Hummingbird (*C. costae*). Seen 17 Mar 1986 at west base of mountain. PYCx.

Acorn Woodpecker (*Melanerpes formicivorus*). An apparently immature vagrant of the Arizona form (*M. f. aculeatus*) collected 19 Oct 1945 (Miller 1947).

Ladder-backed Woodpecker (*Picoides scalaris*). Seen 19 Oct 1945, 17 Mar 1986, and single individuals seen 13 May 1987 and 26 May 1988. PYx.

Northern (Red-shafted) Flicker (*Colaptes auratus*). Seen 19-21 Oct 1945.

Western Wood-Pewee (*Contopus sordidulus*). Seen 14 May 1945.

Western Flycatcher (*Empidonax difficilis*). One individual seen on 13 May 1987; abundant 26-27 May 1988. None heard calling, so all probably represent migrants.

Say's Phoebe (*Sayornis saya*). Seen 17 Mar 1986 at west base of mountain. PYCx.

Ash-throated Flycatcher (*Myiarchus cinerascens*). Seen 17 Mar 1986 at base of mountain. PYCx.

Western Kingbird (*Tyrannus verticalis*). Three individuals seen 26-27 May 1988. PYCx.

Violet-green Swallow (*Tachycineta thalassina*). Seen 19-20 May 1945.

Scrub Jay (*Aphelocoma coerulescens*). Collected on 16 May, 19 and 20 Oct 1945. On 16 May 1945, a brood of fledglings was observed. One to five individuals seen 13 May 1987 and 14-15 Mar 1988. P*.

Common Raven (*Corvus corax*). Single individuals heard over peak on 13 May 1987, 14 Mar, and 26 May 1988. PYCx.

Mountain Chickadee (*Parus gambeli*). Seen Nov 1986.

Bushtit (*Psaltriparus minimus*). Collected 16, 19-21 May 1945, and observed several times daily 13-14 May 1987, 14-15 Mar and 26-27 May 1988. P*.

Cactus Wren (*Campylorhynchus brunneicapillus*). Seen 18-21 Oct 1945, and commonly at base of mountain 13-14 May 1987 (nest found), 14 Mar and 26-27 May 1988. PYC*.

Rock Wren (*Salpinctes obsoletus*). Seen 20-21 Oct 1945, 17 Mar 1986. PYCx.

Canyon Wren (*Catherpes mexicanus*). Seen 19 Oct and collected 20 and 21 Oct 1945; seen commonly 17 Mar 1986, 13-14 May 1987, 14 Mar and 26-27 May 1988. PYx.

Bewick's Wren (*Thryomanes bewickii*). Collected on 16 May and 18-21 Oct 1945; seen commonly 13-14 May 1987, 14-15 Mar, and 26-27 May 1988. Recently fledged young found 16 May 1945. PY*.

Ruby-crowned Kinglet (*Regulus calendula*). Seen 19 Oct 1945, 17 Mar 1986.

Blue-gray Gnatcatcher (*Poliotila caerulea*). Seen 16 May 1945, and commonly 13-14 May 1987, 14-15 Mar, and 26-27 May 1988, apparently on territories. PYx.

Townsend's Solitaire (*Myadestes townsendi*). Seen 19 Oct 1945.

Hermit Thrush (*Catharus guttatus*). Seen 19 Oct and collected 20 Oct 1945.

BIRDS OF EAGLE MOUNTAIN

- Northern Mockingbird (*Mimus polyglottos*). Seen singing 17 Mar 1986 at west base of mountain. PYCx.
- Cedar Waxwing (*Bombycilla cedrorum*). Seen 19-20 Oct 1945.
- Phainopepla (*Phainopepla nitens*). Seen near base of mountain 17 Mar 1986, 13 May 1987 (1). Several pairs on territories above 1370 m 26-27 May 1988. Nest with 3 eggs found 26 May 1988. YC*.
- Loggerhead Shrike (*Lanius ludovicianus*). Seen 16 May and 18-20 Oct and collected 21 Oct 1945, 17 Mar 1986. Bird with dependent young noted on 16 May 1945. PYC*.
- Gray Vireo (*Vireo vicinior*). Seen 13 May 1987. P.
- Solitary Vireo (*V. solitarius*). Seen 16 May 1945.
- Hutton's Vireo (*V. huttoni*). Collected 20 Oct 1945 at 1450 m.
- Warbling Vireo (*V. gilvus*). Collected 20 Oct 1945.
- Orange-crowned Warbler (*Vermivora celata*). Seen 16 May 1945, 17 Mar 1986.
- Yellow-rumped Warbler (*Dendroica coronata*). Seen 19 Oct 1945, 17 Mar 1986.
- Black-throated Gray Warbler (*D. nigrescens*). Seen 20 Oct 1945.
- Townsend's Warbler (*D. townsendi*). Seen 16 May 1945.
- Hermit Warbler (*D. occidentalis*). Male seen 13 May 1987.
- Wilson's Warbler (*Wilsonia pusilla*). Seen 16 May 1945 and 13 May 1988, the latter sighting of a single individual in the dense willows at Conejo Well.
- Western Tanager (*Piranga ludoviciana*). Seen 16 May 1945.
- Black-headed Grosbeak (*Pheucticus melanocephalus*). Seen 16 May 1945.
- Lazuli Bunting (*Passerina amoena*). Seen 16 May 1945.
- Green-tailed Towhee (*Pipilo chlorurus*). Seen 16 May 1945.
- Rufous-sided Towhee (*P. erythrophthalmus*). Collected 16 May and 19 Oct 1945. The May specimen had an enlarged oviduct and brood patch. P*.
- Black-chinned Sparrow (*Spizella atrogularis*). Collected 16 May 1945, testes 3 mm. Px.
- Black-throated Sparrow (*Amphispiza bilineata*). Seen 16 May, 18-21 Oct 1945, and commonly 13-14 May 1987. Nest with downy young found 16 May 1945. PYC*.
- Fox Sparrow (*Passerella iliaca*). Seen 19-21 Oct 1945.
- White-crowned Sparrow (*Zonotrichia leucophrys*). Seen 15, 18-19 Oct 1945.
- Dark-eyed Junco (*Junco hyemalis*). Seen 20 Oct and collected 19 and 21 Oct 1945.
- Northern (Bullock's) Oriole (*Icterus galbula*). Seen 17 Mar 1986 at west base of mountain.
- Scott's Oriole (*I. parisorum*). Several apparently territorial males seen 13 May 1987 and 26-27 May 1988. PYx.
- Cassin's Finch (*Carpodacus cassinii*). Seen 19-20 Oct 1945.
- House Finch (*C. mexicanus*). Seen 18-21 Oct 1945, 13-14 May 1987, 14-15 Mar and 26-27 May 1988. Several males singing 26-27 May 1988. PYCx.
- Lesser Goldfinch (*Carduelis psaltria*). Seen 19 Oct 1945; pairs seen at west base on 17 Mar 1986; several flocks of 5-10 individuals seen 26-27 May 1988. PYx.
- Lawrence's Goldfinch (*C. lawrencei*). Seen 19-20 Oct 1945. PY.

DISCUSSION

Sixty-two species have been recorded on Eagle Mountain. Of these, 30 are known or presumed to breed. Eagle Mountain constitutes the southeastern limit of the ranges of several species in southern California, including the Mountain Quail, Scrub Jay, Bushtit, and Rufous-sided Towhee. Except for the quail, all of these species are represented in the mountains of the Great Basin, the southwesternmost limit of which is about 117 km north in the Providence Mountains (Figure 1; Johnson et al. 1948).

Because Miller's and my visits to Eagle Mountain were brief, it is difficult to draw conclusions about temporal changes in the avifauna (e.g., Johnson 1974). Presences and absences of several species (e.g., Scott's Oriole in 1945, and Black-chinned Sparrow in 1987-88) are suggestive of colonizations and local extinctions, but given high year-to-year fluctuations in numbers of these two species (R. McKernan pers. comm.), their significance is difficult to assess. In the discussion that follows, I ignore temporal changes in the avifauna, thus potentially *overestimating* the number of species breeding on the mountain.

A comparison of the bird fauna of Eagle Mountain with that of the Little San Bernardino Mountains (Miller and Stebbins 1964) shows that several species breeding in the Little San Bernardino Mountains are either absent or probably not breeding on Eagle Mountain (Table 1). The habitat classifications of Miller and Stebbins (1964) provide insight into these distribution patterns. Seven of nine species (all except American Kestrel, *Falco sparverius*, and Lawrence's Goldfinch) inhabiting both pinyon and yucca habitats in the Little San Bernardino Mountains (Miller and Stebbins 1964) probably breed on Eagle Mountain. (American Kestrels have been observed within 20 km of Eagle Mountain, *vide* George San Miguel.)

In contrast, of the nine species restricted to pinyon habitats in the Little San Bernardino Mountains (Miller and Stebbins 1964), only four are known or presumed to breed on Eagle Mountain. Two others have been observed as migrants or winter visitors, and three have not been observed on Eagle Mountain (Table 1). That Gray Vireos and Long-eared Owls do not breed on Eagle Mountain seems probable, given the amount of habitat searched during my last two visits, which were early and late in the breeding season. I am confident that Pinyon Jays (*Gymnorhinus cyanocephalus*), Plain Titmice, and California Thrashers (*Toxostoma redivivum*) are absent, given that all three species are conspicuous and vocal when they are present.

Thus, only 44-67% of the pinyon-restricted bird species of the Little San Bernardino Mountains breed on Eagle Mountain. The proportion of species breeding in the Little San Bernardino Mountains but absent on Eagle Mountain differs significantly (binomial test, $P < 0.05$) between habitat-restricted (pinyon habitats only) and less restricted (pinyon and yucca habitats) species. This result indicates that species of higher-elevation habitats are less likely to be present in the peripheral habitat island on Eagle Mountain. Mammals and reptiles appear to show similar patterns of absence of pinyon-restricted species on Eagle Mountain (Miller and Stebbins 1964).

It is interesting, however, that species restricted to woodland habitats to the west and east (Long-eared Owl, Gray Vireo, Acorn Woodpecker, see Miller

Table 1 Occurrences of Bird Species Restricted to Pinyon or Yucca Habitats in the Little San Bernardino Mountains and on Eagle Mountain^a

Species	Little San Bernardino Mtns	Eagle Mountain
Pinyon Woodland Only (P)		
Long-eared Owl	*	+
Scrub Jay	*	*
Pinyon Jay	*	0
Plain Titmouse	*	0
Bushtit	*	x
California Thrasher	*	0
Gray Vireo	*	+
Rufous-sided Towhee	*	*
Black-chinned Sparrow	*	x
Pinyon Woodland or Yucca Habitats (PY)		
American Kestrel	*	0
Mountain Quail	*	x
Ladder-backed Woodpecker	*	x
Canyon Wren	*	x
Bewick's Wren	*	x
Blue-gray Gnatcatcher	*	x
Scott's Oriole	*	x
Lesser Goldfinch	*	x
Lawrence's Goldfinch	*	+

^a *, breeding; x, present and probably breeding; +, present but probably not breeding; 0, absent.

1947) have been recorded on Eagle Mountain as migrants, vagrants, or winter visitors. Opportunities for these species to colonize the limited habitat on Eagle Mountain therefore do occur, but either the habitat is too sparse or numbers of these species reaching Eagle Mountain are insufficient for successful colonization.

It appears that gene flow from the Great Basin does occur. Of the four pinyon-restricted species that breed on Eagle Mountain, Miller and associates collected series of two species: three Scrub Jays and 15 Bushtits. The three Scrub Jay specimens and one from northernmost Baja California Norte, Mexico, were described as a race *cana*, distinct from the coastal *obscura* in having the blue lighter and grayer throughout, the back lighter and grayer brown, and the belly somewhat grayer (Pitelka 1951). On the basis of the specimens then in existence from the Little San Bernardino Mountains, Pitelka suggested that the resemblance between *cana* and the race of the Great Basin, *nevadae*, was due to similar selective regimes imposed by life at the edge of the desert. However, on the basis of one specimen of *nevadae* and two apparent *obscura* × *nevadae* hybrids in a series of 66 collected from the Little San Bernardino Mountains in the 1960s (CSULB), I believe that

cana reflects genetic interaction of *obscura* with *nevadae*, in spite of the wide expanse of desert separating them (Peterson unpubl.).

In Bushtits, 12 of 15 individuals collected on Eagle Mountain belong to the race *sociabilis*, which is endemic to the Monument. The remaining three individuals, however, have the gray pileum characteristic of the Great Basin race *providentialis*, and probably represent intergrades or immigrants (Miller 1946).

In Bewick's Wrens (not pinyon-restricted), specimens from the Little San Bernardino Mountains and the Eagle Mountains show wide variation in back color, from the dark brown of the coastal race, *correctus*, to the pale gray of the race in the Providence Mountains, *eremophilus*. However, intrapopulation variability is sufficiently great that definite conclusions cannot be made (Miller and Stebbins 1964).

Three hypotheses were presented above to account for the differentiation of four subspecific forms in the Little San Bernardino and Eagle mountains. The isolation provided by the peninsular geographic situation may well be important in maintaining the integrity of the differentiated forms. However, in at least two of the species (Bushtit and Scrub Jay), evidence exists for genetic influence from the east. The Scrub Jay population in the Eagle Mountains appears to have originated by hybridization between coastal and interior populations. Thus, either historical or current gene flow (Hypotheses 3 and 2, respectively) may well be important in the differentiation of the desert-edge forms in Joshua Tree National Monument.

SUMMARY

Sixty-two species of birds have been recorded on Eagle Mountain, an island of pinyon woodland in Joshua Tree National Monument, Riverside County, California. Several species breeding in the nearby Little San Bernardino Mountains do not breed on Eagle Mountain, but vagrants of these species occasionally visit there. Although the avifauna of Eagle Mountain is most closely allied to the avifaunas of regions to the west, evidence exists for gene flow or historical influence from the east in three species. Similar avifaunal surveys and collections are badly needed from other small mountain ranges to the east, which may serve as stepping stones across the Mojave Desert.

ACKNOWLEDGMENTS

Many thanks to the staff of Joshua Tree National Monument, especially Bob Moon and Mark Heuston, for making my work on Eagle Mountain possible. Thanks to Amy Peterson, Lloyd Kiff, Manuel Marin, Dale Clayton, and Bill Schew, for companionship and assistance in the field under difficult conditions. Thanks to George San Miguel, Charles Collins, Bob McKernan, and Jon Atwood for information about the Eagle Mountains, and to Bruce Patterson and Lloyd Kiff for critical readings of the manuscript. Bob McKernan, Amadeo Rea, and Philip Unitt provided additional comments on a late draft of the manuscript. Special thanks to Frank Pitelka for advice and interest throughout this study.

BIRDS OF EAGLE MOUNTAIN

LITERATURE CITED

- Grinnell, J., and Swarth, H. S. 1913. An account of the birds and mammals of the San Jacinto area of southern California. Univ. Calif. Publ. Zool. 10:197-406.
- Johnson, D. H., Bryant, M. D., and Miller, A. H. 1948. Vertebrate animals of the Providence Mountains area of California. Univ. Calif. Publ. Zool. 48:221-376.
- Johnson, N. K. 1974. Montane avifaunas of southern Nevada: Historical changes in species composition. Condor 76:334-337.
- Miller, A. H. 1946. Endemic birds of the Little San Bernardino Mountains, California. Condor 48:75-79.
- Miller, A. H. 1947. Arizona race of Acorn Woodpecker vagrant in California. Condor 49:171.
- Miller, A. H., and Stebbins, R. C. 1964. The Lives of Desert Animals in Joshua Tree National Monument. Univ. Calif. Press, Berkeley.
- Pitelka, F. A. 1951. Speciation and ecological distribution in American jays of the genus *Aphelocoma*. Univ. Calif. Publ. Zool. 50:195-464.
- Van Devender, T. R. 1977. Holocene woodlands in the southwestern deserts. Science 198:189-192.
- Wells, P. V., and Berger, R. 1967. Late Pleistocene history of coniferous woodland in the Mohave Desert. Science 155:1640-1647.

Accepted 13 July 1990



Mountain Quail

Sketch by Narca Moore-Craig