Literature Review and Bibliography of the Mountain Quail

(Oreortyx Pictus)

USDA Forest Service  California Region
A LITERATURE REVIEW AND BIBLIOGRAPHY OF THE
MOUNTAIN QUAIL, Oreortyx pictus (Douglas).

by

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The mountain quail is an important resource in California's National Forests. As the demand for forest use increases, wildlife and forest managers need information on wildlife so that they may be able to wisely manage and conserve the species.

Since very little biological information is readily available on the mountain quail, the U.S.D.A. Forest Service, California Region and I felt that there was a need to summarize the present state of knowledge of this bird. The primary purpose of this report, therefore, is to provide a concise review of this knowledge. An attempt was made to include as much of the published and unpublished literature as possible, particularly of California. The second function of this paper is to provide an outlet for some of the unpublished summary Pitman - Robertson (P-R) research completed in California in the late 1940's. Finally, the extensive bibliography provides an initial route to those interested in further reading or studying the mountain quail.

I gratefully acknowledge the permission of the California Fish and Game Department to use some of the unpublished information of P-R project 19-R, July 4, 1950. The use of this material is acknowledged whenever it is used in the text. David J. Dunaway and Edward R. Schregens of the U. S. Forest service saw the project through from beginning to end. The following persons read the manuscript and made helpful suggestions: John Davis, Hastings Natural History Reservation of the Museum of Vertebrate Zoology (MVZ), University of California, Berkeley; M. X. Gutierrez; A. Starker Leopold and Walter Koenig, MVZ. Jeanne A. Baxton typed the paper.
Gene Christian, M.D., drew Fig. 1. Finally, I would like to thank the Ford Foundation for fellowship support during the time this project was undertaken and completed.
Fig. 1. Distribution of the subgenus of mountain quail, Oreortyx, in California. Slightly modified from Getzwiller and Miller 1964. Open circle indicates literature records and dots indicate specimen.
INTRODUCTION

The mountain quail, *Oryzivora picta*, is probably the least known of all the game birds in the United States. This lack of information centers around the bird's secretive behavior, low population densities, and rugged habitat. Early naturalists commented often on these and other factors that made the bird difficult to locate, hunt, or study (Heerman 1853 and 1859, Naberry 1857, Cooper in Causs 1874, Henshaw 1874 in Bent 1932, Nelson 1875). strangely, however, Douglas (1829), who originally named the bird, claimed to have seen the bird in "Vast flocks" in the Willamette Valley of Oregon.

Only four natural history studies of substance have been published (Grinnell et al. 1918, McLean 1930, Kahn 1938, Miller and Stebbins 1964), Edminster (1954) and Johnsgard (1973) have presented good reviews of mountain quail life history. Several others have conducted studies on the mountain quail (California Fish and Game Ytitan - Robertson Project report 19-8, July 4, 1950 - henceforth referred to as P-R Rept., July 1950, Lahnin 1944, Ornston 1946), but many of the original data are not available.

It is not the intent of this review to duplicate the efforts of Edminster and Johnsgard but to go beyond their work in areas of interest to wildlife and forest managers in particular and to ornithologists and naturalists in general.

DESCRIPTION

Plumage: Both sexes of mountain quail are similar in appearance. The head, breast, and neck are slate to blue gray; the extent of the blue-gray on the neck and back is in my opinion a combination of sexual
and geographic variation. Males generally have more blue-gray on the upper back. Two long black feathers form a plume on the head, slightly longer in males than in females (Johnsgard 1973; Ormiston 1966). A bright chestnut throat patch is bordered by black and white. The sides are red with white flank bars. The remainder of the body is olive drab-brownish in appearance. Peterson (1961) presents a good painting of the bird. Johnsgard (1973:345) gives the following description of juveniles: "[they] have dull fuscoous chest feathers (under 60 mm) of which the terminal third is banded with tawny drab (Kidgee and Friedman 1948) and have whitish chins surrounded by dark gray throats. Downy young... exhibit... whitish tones, especially on the sides of the head and body, and particularly just below the chestnut crown. The black-bordered chestnut color is also present on the back as a middorsal stripe.... A second blackish stripe, separated from middorsal stripe by a white line, occurs above the legs, and black is also evident on the upper neck region. There is a blackish mark extending from the rear of the eye to the ear region, where it expands considerably in size."

Physical characteristics: Grinnell et al. (1918:504) presented the following data on the various measurements of the bird: "Males: Total length 10.60-11.75 inches (269-299mm.) (ten specimens); folded wing 5.10-5.46 (129.3-138.5); bill along culmen 0.53-0.57 (13,4-14,3); tarsus 1.38-1.48 (33,1-37,6) (ten specimens); weight 7.0-10.3 oz. (200.0-292.0 gns.) (ten specimens). Females: Total length 10.40-12.12 (264-308) (nine specimens); folded wing 5.00-5.38 (127-142); bill along culmen 0.52-0.56 (13.2-14.2); tarsus 1.32-1.46 (33.5-37.0) (ten specimens)." Amsden (1963) listed the average weight of 30 male mountain quail as 234.57 gns, and of
30 females 230.62 gms. These weights probably represent a cross section of geographic areas since the weights were recorded from specimens in the collection of the Museum of Vertebrate Zoology in Berkeley. Orriston (1966:21) recorded the average plume of males to be 35.3 mm and that of females to be 62.1 mm, however, he found that this was not a statistically significant difference (P > .7).

As with all United States quail first year birds can be distinguished from adults by the buff tipped upper primary wing covert (Leopold 1939).

**TAXONOMY**

**Species:** The mountain quail was first described by David Douglas (1829). The type specimen was lost in a river fording during his expedition and the species was described from his field notes shortly before his death (Gould 1837). Douglas originally named this bird *Oryx picta*.

The genus was later redescribed as *Oreortyx* by Bailey (1858). *Oreortyx pictus* (Douglas) takes its meaning from the Greek words orex, oreas (mountain) and oryx (quail) and the Latin *pictus* ("painted, as its plumage appears to be the work of an artist in color"; Choate 1973:160).

**Subspecies:** The A.O.U. Check-list (1957) currently lists 5 subspecies of the mountain quail: *O. p. pictus* (Douglas) of the Sierra Nevada from the western Cascades to the interior ranges of California; *O. p. palmeri* Oberholser of the coast ranges from Washington to San Luis Obispo Co., California; *O. p. concentricus* (Anthony) of Baja California; *O. p. cremnophila* Van Rossem of the arid portions of the southern Sierra Nevada to the Baja California boundary; *O. p. russelli* (Miller) of the Little San Bernardino Mountains, California. The reader is referred to the following works concerning the original descriptions of the above subspecies, respectively (Douglas 1829, Oberholser 1923, Anthony 1889, Van Rossem 1937, Miller 1946).
Common names: The following vernacular names have all been used to describe the mountain quail: *codornis de montaña* (Leopold 1972); San Pedro partridge (Anthony 1889); painted quail, plumed quail, plumed partridge (Grinnell and Wythe 1927), mountain partridge, San Pedro quail (Johnsgard 1973); Sierra Mountain quail, coast mountain quail, San Pedro mountain quail, desert mountain quail, pallid mountain quail (A.O.U. 1957).

Phylogenetic and evolutionary relationships: Holman (1961) proposed a new sequence of generic relationships among living and fossil New World quails based on osteological characteristics. He felt that *Oreortyx* showed closest relationship to *Callipepla squamata* (scaled quail) and more distant relationship to *Colinus virginianus* (bobwhite quail) and *Lophortyx* (California, *L. californicus*, and Gambel quail, *L. gambelii*). However, a close relationship must exist with *Lophortyx* since two *Oreortyx pictus* x *Lophortyx californicus* hybrids have been recovered from wild populations (Peck 1911, Zeiley 1925). Johnsgard (1973:355) hypothesized that since *Oreortyx* was widespread in pre-Columbian times (see below) the species probably evolved from a pre-*Callipepla* stock in a semi-arid woodland or xeric chaparral of the southwest.

**DISTRIBUTION**

The general distribution of the mountain quail in California is presented in Fig. 1. The bird also occurs in Baja California, Nevada, Oregon, Washington, Idaho, Hawaii, and British Columbia. Apparently the species is less widespread today than in the past. Fossil remains have been found in caves at levels associated with the Basketmaker group in south central, south eastern, and south western New Mexico (Howard and Miller 1933, Wetmore 1932, Howard 1962). Pleistocene fossils have also...
been recovered from California (Miller 1911, 1917).

Unsuccessful introductions have been attempted into New Mexico (Campbell et al. 1973), Alabama and Nebraska (Edminster 1954), and New Zealand as early as 1881 (Hunter 1913). Successful introductions have been made on Vancouver Island, British Columbia (Golguet 1955 in Johnsgard 1973:347), Hawaii (Lewis 1973), Idaho (Merrill 1898 [may have been native]), eastern Oregon (Anthony 1912), parts of Nevada (Lindale 1951), and possibly Colorado (Ragers 1966).

HABITAT REQUIREMENTS

An understanding of the habitat requirements of any species is the chief basis for wise management. Unfortunately, little information on the habitat requirements of this bird has been published. In this section I will primarily rely on the unpublished P-N reports of the California Fish and Game Department.

Miller (1951) classified the mountain quail as part of the Boreal avifauna of California (i.e., Transition and Boreal zones). The bird is found in the pifer-Juniper, oak woodland, chaparral, coastal forest, and montane forest associations; thus it is well distributed throughout most of California's National Forest system. However, mountain quail are not evenly distributed throughout these associations. Certain elements of cover and water within these vegetation types form mountain quail habitat.

Cover: As suggested by the California workers, mountain quail cover can consist of plants, rocks, and/or slope. I feel that plants are the primary physical cover elements in mountain quail habitats. Slope is used in conjunction with cover to facilitate escape. Anyone who has chased mountain quail quickly realizes the value of slope to these birds. There is no one species of plant that is characteristic or necessary in the life
of the mountain quail. It is apparent that the quail do require cover in some form during most of their activities. The following data (Table 1) are taken from P-R Rept., July 1950 in which certain features of mountain quail cover are summarized.

Table 1. Vegetation characteristically associated with activities of mountain quail.

<table>
<thead>
<tr>
<th>Use</th>
<th>Minimum Height</th>
<th>Minimum Density</th>
<th>Area Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loafing</td>
<td>5 ft.</td>
<td>High</td>
<td>Medium to high</td>
</tr>
<tr>
<td>Traveling</td>
<td>2 ft.</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Roosting</td>
<td>6 ft.</td>
<td>High</td>
<td>Medium to high</td>
</tr>
<tr>
<td>Escape</td>
<td>6 ft.</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Foraging</td>
<td>2 ft.</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Protection from weather</td>
<td>6 ft.</td>
<td>High</td>
<td>Medium to high</td>
</tr>
<tr>
<td>Nesting</td>
<td>2 ft.</td>
<td>High</td>
<td>Medium to high</td>
</tr>
</tbody>
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(Reproduced by permission of the California Fish and Game Department.)

Shrubs and/or trees appear to be critical to maintenance of the mountain quail. It is a relatively rare occurrence to find these birds far from cover. The minimum amount of cover necessary to maintain a quail population is unknown. However, it can be said that the type of shrub cover should be of an interspersion type rather than of an edge type to provide optimum quail habitat. It may also be true that too much cover reduces their food supply and may hinder their movements (P-R Rept., July 1950).

Table 2 is taken from California P-R Rept., July 1919 on the vegetative measurements that presumably reflect the composition of the cover requirements for this species. These measurements (no4) represent an area of about a quarter of a square mile in extent near Yreka, Siskiyou
County. It must be remembered that measurements are only locally applicable, and that cover and vegetation requirements may be quite different in another area.

Table 2. Cover values from measurements taken in Humbug Creek study area, Yreka, Siskiyou County, California.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Cc</th>
<th>Qg</th>
<th>Ag</th>
<th>Pp</th>
<th>Pt</th>
<th>Ch</th>
<th>Dead Wood</th>
<th>Total percent</th>
</tr>
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<tr>
<td>1</td>
<td>61</td>
<td>13</td>
<td>25</td>
<td>1</td>
<td>1</td>
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<td>2</td>
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<td>15</td>
<td>10</td>
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<tr>
<td>3</td>
<td>7</td>
<td>9</td>
<td>30</td>
<td>3</td>
<td>8</td>
<td>1</td>
<td>2</td>
<td>66</td>
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<tr>
<td>4</td>
<td>7</td>
<td>9</td>
<td>73</td>
<td>6</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>71</td>
</tr>
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</table>

Cc = *Coastal Chuemus cumstus*; Qg = *Quercus knarryae*; Ag = *Arctostaphylos* sp.; Pp = *Pinus ponderosa*; Pt = *Pseudotsuga taxripila*; Ch = *Corokia betuloides*; Dead = dead plant growth. (Reproduced by permission of the California Fish and Game Department.)

The above table indicates that mountain quail use a diverse plant association. The areas in Table 2 show a high proportion of shrub understory with oak (*Quercus*) and pine (*Pinus*) canopy. These areas also support a high proportion of total shrub and tree cover. This diversity no doubt supplies much of the needs of the birds as suggested by Table 1. My own work with mountain quail tends to support these observations.

Water: One fact that is generally agreed upon is the need for daily water during the summer and this may be a main limiting factor in quail populations (Rahn 1938, P-R Rept., July 1950, Miller and Stebbins 1964, Craigston 1966). It is equally well known that the birds are usually found near water, especially during hot weather (Grinnell and Craig 1913).
Grinnell et al., 1918, McLean 1930, Bahm 1938, P-R Rept., July 1950, Miller and Stebbins 1944, Ormiston 1966). Bahm (1928) also felt that the morning watering time depended on the lateness of the previous evening watering; thus the birds apparently drank twice daily in his study area.

Research done in California indicates that chicks need water shortly after hatching and the ability to get free water may determine their survival. It was also found that adults could not survive more than three days without water in the summer (P-R Rept., July 1950:20).

The need for water has the effect of concentrating the quail in certain locations. Thus population densities may reach more than one bird per acre in summer around watering points. However, with the beginning of fall rains, the birds are no longer dependent on free water as they satisfy their water needs by eating succulent green vegetation. Therefore, considerable population dispersion is characteristic of the species during the wet season in California.

As has been recorded with other species of quail, there is a relationship between rainfall and fall age ratios. Young : adult ratios are higher in years of high rainfall, at least in arid portions of the range (P-R Rept., July 1950:21).

**Food**: Food habit studies indicate that adult mountain quail eat primarily vegetable matter (more than 96 percent) and only small amounts of animal matter (less than 4 percent) (Belding 1892, Judi 1905, Grinnell et al. 1918, Martin et al. 1951, Yocom and Norris 1953, Ormiston 1966). Young birds may eat up to 20 percent animal food according to Lahnum (1944 in Ormiston 1966) or less (7.5 percent recorded by Ormiston 1966).

Judd's (1905) analysis of 23 California mountain quail showed that animals comprised only three percent of the foods eaten. He also listed grain (18 percent), seeds of weeds, grasses, and legumes (47 percent),
fruit (8 percent), and miscellaneous vegetation (24 percent) as comprising the remaining 97 percent of the food eaten. Yocom and Harris (1953) found smooth sumac (Rhus glabra) the most important food item by volume of 95 food items eaten in the fall by 33 quail in Washington. Animals were unimportant as a food source in their study.

Olmsted's (1966) food habits studies in Idaho provide the best data available. He found that tagged chickweed (Holosteum umbellatum) and microstelis (Microstelis practica) were the two most important spring foods. Other important spring foods were common chickweed (Stellaria media) and blue-eyed Mary (Collinsia parviflora). Bulblets of fringecap (Lithophragma bulbiferum) were used both in spring and early fall. In the fall he found that seeds of large annuals, perennials, and woody species were important. In all he found that 59 species of plants and 25 species of animals were taken.

Finally, acorn weats (Quercus sp.), pine nuts (Pinus sp.), winter green vegetation, and many other types of seeds have been found to be important to the species (Marin et al. 1971, P-E Quarterly, April 1948: 165 in Johnsgard 1973).

POPULATION DENSITY

Population estimates are difficult to obtain because of the nature of the habitat in which the birds live. Consequently few estimates have been attempted. Maximum densities have been summarized as one bird per two acres (Edminster 1954) but these have been summer concentration areas about watering points.

Covey sizes are generally small. Miller and Stebbins (1964) found an average covey to be 11 birds (3-20) in the 20 groups that they observed. Occasionally coveys of as many as 40 are reported (Emerson 1897) but these are by far the exceptions.
MORTALITY

Environmental: As mentioned above water (summer drought) may be a main limiting factor in arid land mountain quail. Presumably, lack of water causes direct mortality of young and adults (P-R Rept., July 1950). Helsey (1878) and Mallard (1928) also commented on water scarcity affecting quail populations and movements.

In mountainous regions, populations of quail can apparently be severely depleted by heavy snowfall. Two unusually severe weather periods in the past 75 years (1915-1917 and 1948-1949) in eastern California have resulted in reports of extremely high quail mortality as a result of the deep snow (Anon. 1916, Howell 1917, Bryant 1918, Jetter 1918, P-R Rept., July 1950).

Mountain quail have been observed to fly into the flames of a forest fire and perish as a result (Clark 1935). Stivers (1920) also reported on presumed quail as well as habitat loss in a southern California fire.

Predation: There is no evidence to suggest that mountain quail suffer greater or less predation than that known for any other species of quail. Grinnell and Storer (1924) stated that predation was the principal cause of mortality in this species but provided no quantitative evidence.

Predation by the Cooper's hawk (Accipiter cooperi), scrub jay (Aphelocoma coerulescens), weasel (Mustela frenata), and rattlesnake (Crotalus sp) has been observed (Rahn 1930, P-R Rept., July 1950, Kellogg 1916, Pierce 1933, respectively). Predators accused without documentation include the bobcat (Lynx rufus), coyote (Canis latrans), gray fox (Urocyon cinereoargenteus), goshawk (Accipiter gentilis), and the great horned owl (Bubo virginianus) (Jetter 1918, Grinnell and Storer 1924, McLaren 1930).

Skunks (species ?) and snakes (species ?) have, presumably, been found to be nest predators (Ingersoll 1913, P-R Rept., July 1950). Other animals
Animals such as scrub jays and ground squirrels (Scopus phyllos au.) have been implicated in nest predation (Anon. 1920, McLean 1930).

Hostility due to hunting will be covered under hunting and recreation.

Land use: Heavy grazing by cattle and sheep has been noted to be detrimental to these quail by California investigators (P-R Rept., July 1950) and Hardin (1978). Overgrazing prevented the maturation of herbaceous annual vegetation, the seeds of which are important quail food. On the other hand some grazing and movement of cattle through dense brush might open up some areas previously unusable. Nest disturbance by cattle has also been shown to exist (P-R Rept., July 1950, personal observation).

Logging was found to be the most serious cause of nest loss in the Sierra Nevada (P-R Rept., July 1950). This loss would, however, be local and the short term loss might be compensated for by the cover produced as a result of chaining the trees.

Linford (1932) reported mountain quail as victims of poisoned grain set out for ground squirrels. However, earlier reports claimed that the mountain quail was never observed to be poisoned or was immune to strychnine poisoning (Anon. 1916 and 1920).

Mountain quail have also been affected by the damming of rivers. When birds descending from higher elevations encounter a reservoir in their path they attempt to fly across the water. When the quail's maximum flight distance has been covered they fall into the water and drown (P-R Rept., July 1950).

Finally, Forbush (1927) stated the bird was disappearing before the advance of civilization but gave no data. Clearly a loss in habitat would mean a loss of quail.
PARASITES AND DISEASES

petrusa: Holding (1900) stated that 1 in 10 young quail has tapeworms and probably dies as a result. Wehr (1971) has recorded the roundworm Capillaria contorta from mountain quail. Melconson (1960) listed two species of Mallophaga (external parasites) parasitizing mountain quail: Colloides pictus and Logococcus californicus. Finally, two species of mites have been recorded from mountain quail on the Hastings Natural History Reservation, Monterey County: Euschöngastia radfordi and Neeschöngastia aspericana (Brennan and Jones 1954).

Protozoa: Three species of coccidia have been isolated from the mountain quail: Eimeria tenella, E. acervulina, and E. mitis (Henry 1931). E. tenella and E. acervulina are morphologically indistinguishable from two coccidian species found in the domestic chicken (Gallus gallus).

The validity of these identifications has been questioned, however (Todd and Hammond 1971). The blood parasites Haemoproteus lophortyx (1 specimen) and Plasmodium sp. (6 of 25 specimens) were reported by Wood and Harman (1943) and Stabler et al. (1974), respectively. Stabler (personal communication) feels that this was probably P. radieosetii. Hamerton (1939) also reported Plasmodium sp. from a mountain quail held in the London Zoo.

All of the above identifications of protozoan parasites, with the exception of the one specimen of Haemoproteus lophortyx, have been made from captive birds. Therefore, they may not reflect the state of parasitism in the wild.

In addition, this bird is susceptible to "quail disease" (ulcerative enteritis) caused by bacteria (Peckham 1971).
Migration: One of the most striking features of mountain quail natural history is its annual vertical migration in the high mountain portions of its range. The term "migration" here is used loosely in terms of the type of movement deer normally undertake between summer and winter range. Audubon (1839) was the first to state that the birds were migratory but to my knowledge he had no first hand knowledge of these quail. Douglas' (1829) initial observations on the species did not mention their migratory behavior.

Most accounts of high mountain populations of the mountain quail mention these migrations but, as yet, they are little known from the point of their proximate stimulus (ultimately it is snow cover and subsequent loss of food), distance moved, or the method and route of movement of individuals.

Edminster (1954) believed that migration is stimulated by frost; Dewson (1923) believed that it was ripened berries; and Belding (1902) believed that the birds could predict the severity of the winter and its duration and migrated accordingly. I agree with McLean (1930) that the birds migrate because of snow. Whether this is the result of an approaching storm, changing weather patterns, cold, actual snow, or a combination of these remains unknown.

Local movements: Local movements are generally restricted to areas around water in the summer drought in California and Idaho (P-R. Rept., July 1950, Ormsby 1966). Winter movements in California appear to be much more extensive because the birds are not dependent on tree water when green vegetation, rain water, and dew are available. The extent of these movements is unknown at present.
Reproductive season: The length of the nesting season has been summarized by Day (1982) in that nests have been found from early April to mid August depending on the locality. Nesting is earlier in more southern areas and at lower elevations.

Average clutch size for 29 sets of eggs was recorded as 5.9 with a range of 3-14 (P-Z Barn., July 1950). These eggs were laid approximately every two days. Peterson (1961) lists the maximum number of eggs recorded in a single clutch as 22.

Nest: The nest of the mountain quail is usually a slight depression scratched out by the bird and lined with grasses, leaves, or pine needles (Day 1982). The nest is often found at the base of a tree, alongside a log, or under a bush (Day 1982, Barlow 1889, Kaye 1905).

The birds do not usually desert the eggs if flushed from the nest (Barlow 1889). If disturbed, they also tend to "sit tight" before flushing (Carriger in Bent 1932).

Eggs: Bent (1932:46) presented a good description of mountain quail eggs: "In shape they vary from ovate to subpyriform; some eggs are quite pointed; the shell is smooth and somewhat glossy. The color varies from pale brown to a reddish buff, or from 'pinkish buff' to 'pale ochraceous - salmon.' They are entirely unspotted. The measurements of 61 eggs average 34.7 by 27 millimeters; the eggs showing the four extremes measure 38 by 28, 35 by 29, and 33 by 25 millimeters."

The California valley quail has been reported to deposit its eggs in the nest of the mountain quail (Grinnell et al. 1918). The eggs of the valley quail are "usually heavily marked and show considerable"
VOCALIZATIONS

Aspects of social behavior are little known but some of the vocalizations that wildlife managers should recognize are the “male advertisement” call and the “excitement call.” The first call resembles a two note whistle that sounds like “querk” or “ploork” (Johnagard 1971, personal observation). The second call I think is best written as “cree auk, cree auk, cree auk auk” delivered with varying frequency and intensity. This is basically an alarm call used when the bird is excited as with the approach of a human (Williams 1902, personal observation).

HUNTING AND RECREATIONAL QUALITIES

Hunting can be evaluated as a source of mortality to the birds and as a form of recreation. The following discussion may be of interest to forest managers in planning both for conservation of native species and providing opportunities for recreation.

Hunting as a source of mortality has evoked more controversy in the literature than any other topic herein discussed. Early writers proclaimed that the bird was decreasing as a direct result of hunting pressure (Bach 1917 a and b, Koch 1917). Possibly this could have been the case prior to 1900 as evidenced by a reported hunting season of from 1 September - 15 February and no bag limit during the years 1897 - 1898 (Chambers 1936). Wellward (1923) felt that the bird was “hunted mercilessly” in northern California but managed to avoid extinction because it was extremely wary. Rank (1938) recommended that brush control not be applied to areas supporting mountain quail populations because the species would be incapable of withstanding the hunting pressure.

Moore (1917), however, felt that hunting would not have the species...
because of the brushy nature of its habitat. To this we might add that the steepness and ruggedness of most of its range discourages most "quail" hunters. The conclusion of the California study of 1950 was that less than five percent of the population was harvested in a given hunting season.

Hunting as recreation is closely linked to the question of mortality as a serious problem. Recently Johnsgard (1973) estimated that 370,000 mountain quail were harvested in the western states supporting populations of these birds. Considering that these same states also support the majority of the California quail populations and the harvest of these was 2,200,000, I think he has overestimated the number taken. In my work, I have yet to find another hunter who "specializes" in mountain quail or harvests more than 30 birds a year. This is certainly not the case with the California quail. On one military reservation in the coast range of California some 1-5 thousand California quail are harvested annually, whereas, only 15-50 mountain quail are killed. This occurs in spite of the fact that mountain quail occur over much of the same area. I feel that hunting in its present form and intensity will not lower or endanger mountain quail populations in the future. Clearly much research is needed on this species to insure its conservation in the event that the demand for hunter opportunity or other land uses increase.

The art of hunting mountain quail requires, in short, a knowledge of where the birds are located, physical stamina, and a good dog (depending on the area hunted). It is interesting to note the accounts of early naturalists attempting to collect the bird for scientific specimens. Most of them remarked that the bird is shy, difficult to put up, not easily shot, or impossible to shoot without a dog (Heerman 1853, and 1859, Newberry 1857, Cooper in Copes 1874, Nelson 1875). Indeed, the report by
Orriston (1966:27) clearly indicates that the situation has not changed in the last 100 years.

Mountain quail are among the finest table birds. The quality of the most commanded a price of $2.50-4.00 per dozen in San Francisco during the market hunting era (Grinnell et al. 1918, McLean 1930).

Because the mountain quail does not support a great deal of hunting, it nonetheless supplies a good deal of recreation for other forest users. This species is probably more valued aesthetically than any other United States quail per sighting (with the possible exception of the Hermit quail, Crypsora montezumae, of Arizona and New Mexico) to birders, campers, and other "naturalists."

**MANAGEMENT**

Recommendations for management are difficult to make at this time. Water development is certainly an obvious method of providing more available summer range. Summary statements by the California investigators (P-R Rept., July 1950:26-27) include recommendations for brush control in the coastal ranges; closed seasons following severe drought or snow; and restocking of the above depleted areas. They did not recommend predator control, refuge, changes in harvest regulations, except that no early hunting season in the high Sierra should occur because the birds were too young at this time. I would proceed with extreme caution with any plans to restock a depleted range because of the danger of introducing genetic material of birds from different areas not locally adapted to the low population area.

Brush control was recommended primarily to facilitate hunter access; no guidelines are available on optimum brush densities or the effect of brush control on the quail. I do not agree with Orriston (1966:31) that
management practices now used in California quail management will suffice for the mountain quail. Until more is known about this unique bird and its ecological relationships with its environment and closely related species (California and Gambel quail *Lophortyx gambelii*), we must proceed with caution with any plan to "improve" the habitat or status of this species.
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