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California Quail in Western Oregon: A Review

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CALIFORNIA QUAIL IN WESTERN OREGON: A REVIEW

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Abstract: Habitat use by California quail (*Callipepla californica*) was studied at the E. E. Wilson Wildlife Area in northwestern Oregon, a mesic extension of the range of this species, from 1974 to 1992. Abundance of quail on the area was related to plant succession. Dietary studies revealed that legumes–particularly deervetch (*Lotus* spp.), peavine (*Lathyrus* spp.), Scot's broom (*Cytisus scoparius*), and vetch (*Vicia* spp.)–composed 67% of the relative dry mass of the annual diet. California quail typically nested in shrub/grassland and roadside habitats with less grass and shrub cover and more bare ground than at random locations within those cover types. Blackberry (*Rubus* spp.) stands were used consistently for roosts and were the most frequently used escape cover. Abundance and productivity measures of California quail on treated sites–including disked areas, food plots, and wheat plantings–revealed most birds (on a year-round basis) were found on disked areas and most chicks were produced on these sites. Fewest young hatched on food plots and wheat plantings and the latter had the lowest abundance of breeding adults. Most important food and cover plants responded positively to prescribed burning and disking but returned to pretreatment levels of abundance within 2-3 years. I concluded that the successful introduction of California quail into the Willamette Valley and abundance and productivity of these populations were related to the presence of certain early seral species of plants, particularly some exotic species, and plant succession.

Key words: California quail, *Callipepla californica*, habitat management, Oregon.

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In Oregon, California quail originally inhabited the relatively dry valleys of the southwestern part of the state (Fig. 1), but relocation efforts dating to 1870, resulted in a statewide distribution (Gabrielson and Jewett 1940:222). Although California quail were found within approximately 100 km of the Willamette Valley, there are no authenticated records of quail for this area (see Bent 1932:60-61, Gabrielson and Jewett 1940:222). These birds were first introduced to the Willamette Valley in 1914 (Finley 1914). Despite, and likely because of, human-induced habitat changes, California quail are common to abundant in many parts of Oregon. The range expansion of this species, adapted to semiarid lands, into mesic regions such as western Oregon, western Washington, and southwestern British Columbia revealed California quail possessed the adaptations necessary to inhabit these altered landscapes. California quail are important game birds in these regions. In Oregon, California quail are the most heavily harvested game bird; approximately 185,000 were taken annually during the past 20 years, based on Oregon Department of Fish and Wildlife estimates (unpubl. data). California quail were the subject of numerous scientific inquiries during the past 75 years within their range in California, many of which were summarized by Leopold (1977). Much less

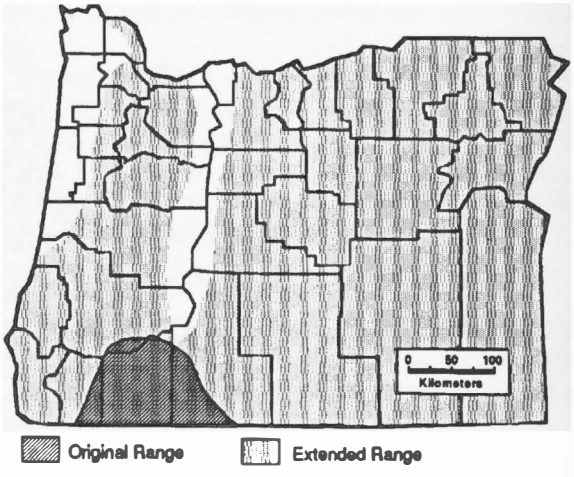

Fig. 1. Original and current distributions of California quail in Oregon.

attention, however, was paid to this species in mesic extensions of its range. Habitat studies of California quail in mesic environments may reveal information about habitat tolerances and adaptability of this species, which may be of direct value to managers in these areas. The studies also may reveal some of the habitat characteristics that allowed California quail to inhabit areas successfully, which under natural conditions they were unable to colonize. Since 1974, my students

and I have undertaken a number of studies to better understand the biology and ecology of California quail in western Oregon. The objective of this paper is to provide a synthesis of these studies and to elucidate management implications of the investigations.

During the past 18 years, California quail research was conducted on lands administered by the Oregon Department of Fish and Wildlife to whom I am genuinely grateful for their cooperation. K. L. Blakely, K. M. Kilbride, and R. M. Oates were responsible for much of the data collection and analysis. The U.S. Environmental Protection Agency, the Mzuri Wildlife Foundation, and the National Rifle Association supported portions of the work reported herein.

STUDY AREA

Investigations used as the basis for this paper were conducted on the 650-ha E. E. Wilson Wildlife Area (Wilson WA), located 16 km north of Corvallis, Benton County, Oregon. During the 1940's, this site served as an extensive military base but was abandoned and buildings removed by 1950; the system of approximately 25 km of paved roads was left intact. When secondary succession began in approximately 1950, the area resembled a rather typical housing development but only the foundations of barracks, offices, and other buildings remained. Rainfall averaged 108 cm from 1951 through 1989.

Management activities on the study site included: burning of 40-55 ha areas annually on a rotational basis from 1953 through 1967 and 2-49 ha from 1980 through 1989; establishment of 24 food plots, averaging 0.7 ha, which were gradually eliminated by 1989; disking of plots (<5 ha) and strips throughout the area from 1988 through 1992; farming operations, primarily wheat and grass seed production on as much as 120 ha, which were terminated in 1988; and installation of 4 gallinaceous guzzlers.

When my work began, the Wilson WA was composed of shrub/grassland (67%); cultivated areas (18%); woodlands (8%); and roads, graveled roadsides, and concrete foundations (7%). Shrub/grassland areas were dominated by blackberries, Scot's broom, rose (*Rosa* spp.), fescue (*Festuca* spp.), oxeye daisy (*Chrysanthemum leucanthemum*), thistle (*Cirsium* spp.), wild carrot (*Daucus carota*), Klamath weed (*Hypericum perforatum*), tarweed (*Madia sativa*), vetch, and teasel (*Dipsacus sylvestris*). Approximately 85% of shrub cover in shrub/grassland habitat was composed of blackberries (Crawford 1978). The most commonly cultivated crops included ryegrass, wheat, orchardgrass, and fescue. Two stands of Oregon white oak (*Quercus garryana*) were present on the Wilson WA. Other common trees included Oregon ash (*Fraxinus latifolia*), black cottonwood (*Populus trichocarpa*), black hawthorne (*Crataegus douglasii*), willow (*Salix* spp.), and apple (*Pyrus malus*). The remaining portion of the area was composed of a complex system of asphalt roads, graveled ditches and parking lots, and the concrete remains of numerous buildings. A critical assumption of our studies was that habitat use by quail on the Wilson WA was characteristic of use by these birds throughout the Willamette Valley and representative of use in other mesic regions.

QUAIL POPULATIONS

Long-term (approximately 30 years) trends of California quail in the Willamette Valley indicated rather stable populations (Kilbride et al. 1992). On the Wilson WA, however, population indexes collected by the Oregon Department of Fish and Wildlife from 1953 through 1976 revealed that the population declined. This decrease in quail numbers was attributed to the advance of plant succession in the area because of the inverse relationship of quail abundance (r = -0.58) to time (Crawford 1978). Subsequently, fall populations increased from approximately 250 birds in 1976 (Crawford and Oates 1986) to an estimated 400 birds in 1990 (unpubl. data). Breeding density for 1988 and 1989 was approximately 1 bird/5 ha (Kilbride et al. 1992). Since 1975, immatures composed 62-80% of fall populations on the Wilson WA (Crawford 1986 and unpubl. data). Throughout the semiarid portion of their range, California quail typically exhibit great variations in annual productivity; Leopold (1977:115-118) noted young in fall populations in California ranged from 4 to 81%.

Weather factors may influence productivity and survival of California quail in western Oregon. Hatching chronology at the Wilson WA (Crawford 1986) was related to total precipitation during May and June (e.g., the greater the amount of precipitation, the later the hatching date). Furthermore, a 3-week period of unusually high rainfall in July 1976 was associated with a lapse in hatching. In comparison, Raitt and Genelly (1964) found that high amounts of rainfall during January through March in northern California were related to delayed hatching.

Heavy rainfall and cold temperatures apparently affected quail survival at the Wilson WA during winter 1977-78. Indexes to abundance during that period decreased substantially compared with the previous year (Oates and Crawford 1983), and sex and age ratios shifted strongly to favor males and adults (Crawford and Oates 1986). Browning (in Leopold 1977) noted that rainfall was a major factor influencing availability and nutrient content of key foods and commented that inadequate amounts of rainfall were not conducive to high populations. Consequently, annual variations in productivity may relate to diet and ultimately to precipitation.

FOODS AND DIETARY PREFERENCES

Diets of California quail and availability of foods on the Wilson WA were examined seasonally from winter 1975 through summer 1978 (Oates 1979, Oates and Crawford 1983) and from winter 1985 through fall 1987 (Blakely et al. 1988, Blakely 1990). Crops from 222 quail were examined. Three measures were used to assess importance of individual foods in the diet: (1) percent frequency of occurrence in crops; (2) relative percent dry mass; and (3) relative preference indexes (RPI), frequency of occurrence in crops (%) ÷ frequency of occurrence in available habitat (%) (see Van Dyne and Heady 1965).

The composite annual diet was comprised of 70% forbs, 21% shrubs/trees, 8% grasses, and 1% invertebrates on the basis of relative mass. Among the most frequently occurring foods in the diet (Table 1) were vetch--67%, wild carrot--58%, teasel--37%, and dandelion (*Taraxacum officinale*, *Hypochoeris radicata*, and similar milky-juiced composites of the Cichorieae)--36%. Of 53 plant taxa in the diet of California quail, 4 legumes contributed >60% of the relative dry mass of the diet: deervetch--20%, peavine--16%, Scot's broom--16%, and vetch--11% (Table 1). Collectively, legumes contributed 67% of the relative mass of the diet (Blakely 1990). Among foods with the highest preference indexes (Table 1) were peavine, deervetch, and clover (*Trifolium* spp.). Five of these 8 most important foods were legumes and all were introduced forbs or escaped crops. Blackberry, apple, and sorrel (*Rumex* spp.) were seasonally common plants in the diet of California quail (Oates and Crawford 1983, Blakely 1990). All grasses combined occurred in 60% of crops but amounted to only 8% of the relative mass of the diet. Sudan grass and wheat, the only cultivated crops in the diet, had frequencies of 5% each during 1976-78 but, except for a small amount of wheat placed at feeding stations, were not available on the area during 1985-87. Remaining plant foods were found infrequently in the diet and collectively contributed 12% of the mass. Relative availability of primary plant foods was similar between 1976-78 and 1985-87 (Blakely 1990).

Invertebrates occurred with an annual frequency of 51% and ranged from 37% in fall to 80% during summer, but contributed only 1% of the diet by mass (Blakely et al. 1988). Fifteen invertebrate groups were represented in the diet but 4 composed 87% of the relative mass of invertebrate matter: ants (Hymenoptera)--27%, grasshoppers (Orthoptera)--22%, moths and butterflies (Lepidoptera)--20%, and beetles (Coleoptera)--18%. Ants and beetles occurred with the highest annual frequencies, 34 and 20%, respectively.

Leopold (1977:172-174) summarized dietary studies of California quail from much of their California range and concluded that diets were diverse and differed with location. Legumes, filarees, and grasses constituted 70% of diets in California, and invertebrates made up 1-6% of the diet. Legumes commonly constitute 25-35% of the diet (Edminister 1954:314), but Shields and Duncan (1966) found that legumes composed 60% of

Table 1. Frequency of occurrence, relative mass, and mean relative preference indexes (RPI) of foods of California quail, E. E. Wilson Wildlife Area, OR, 1975-78 and 1985-87 (from Oates 1979 and Blakely 1990).

Food	Frequency (%)	Mass (%)	RPI[a]
Vetch	67	11	2
Wild carrot	58	4	2
Teasel	37	2	3
Dandelion	36	1	6
Sorrel	28	1	8
Deervetch	26	20	17
Peavine	26	16	19
Scot's broom	24	16	5
Blackberry	24	2	1
Apple	22	3	5
Clover	20	2	11
Other forbs	—	12	—
Other shrubs/trees	—	1	—
Grasses	60	8	—
Invertebrates	51	1	—

[a] RPI = $\frac{\text{\% frequency of occurrence in diet}}{\text{2\% frequency of occurrence in foraging habitat}}$

volume of the fall and winter diet in an arid zone of California. Many of the important dietary components were annual forbs and grasses.

California quail in western Oregon seemingly relied more heavily on legumes and less on other forbs for food compared with birds in California. Grasses were used to approximately the same extent. Although frequencies of invertebrate matter in the diet were higher for birds in western Oregon, animal matter composed less of the mass of the diet (1%) compared with birds in California (up to 6%). In both the semiarid rangelands of California and the mesic Willamette Valley of Oregon, California quail relied greatly on introduced annual plants for food.

WATER

Free water was widely available on the Wilson WA from 4 guzzlers and 3 intermittent streams. Although California quail regularly use drinking water in arid portions of their range, the need for drinking water by these birds during the relatively dry summers in western Oregon is unclear.

USE OF COVER

The most important types of cover for California quail in western Oregon were identified as those used for nesting, brood-rearing, escape, loafing, roosting, travel, and foraging. Habitat use by 58 radio-tagged females during 1988 and 1989 provided information about use of nesting and brood-rearing cover by California quail in western Oregon (Kilbride et al. 1992). Fifteen of 25 nests were located in shrub/grassland habitat, but roadside cover (7 nests) was the only type used more than expected. Remaining nests were found in woodlands or agricultural fields. Within cover types used for nesting, nest-sites (area within 5-m radius of the nest) had significantly less grass and shrub cover and more bare ground than did random locations within the same cover types (Table 2). On the average, only 1/3 of the cover immediately adjacent to nests was made up of live vegetation. From the 15-day period preceding laying through incubation, use of cover types by female California quail reflected habitats available on the study area (Kilbride 1991). Females used shrub/grassland habitats (68%), agricultural fields (18%), woodlands (8%), roadsides (1%), and other (6%) cover types in proportion to their availability. Although home range sizes of California quail females differed during early parts of the breeding season (ranging from 22 ha during laying to 4 during incubation), relative use of cover types remained similar during prelaying, laying, and incubation periods (Kilbride et al. 1992). Habitats used for early brood-rearing (15-day period after hatching) likewise were similar to those used from prelaying through incubation and to the relative availability of habitats on the study area. Nearly 2/3 of the locations of radio-tagged females with broods were in shrub/grassland habitat. Glading (1938) found that females used open areas characterized by annual forbs and grasses such as fescue (*Festuca megalura*), soft-chess brome (*Bromus mollis*), and broadleaf filaree (*Erodium botrys*) during the breeding season.

Table 2. Cover composition at California quail nest sites and random locations, E. E. Wilson Wildlife Area, OR, 1988–89 (from Kilbride et al.1992).

	Cover (%)		
Cover category	Nest site ($n = 25$)	Random locations ($n = 25$)	P
Grass	9.1	14.5	0.06
Forb	7.5	9.0	0.52
Shrub	10.0	21.6	0.04
Tree	7.3	6.6	0.88
Litter	30.4	29.7	0.93
Bare ground	24.4	12.3	0.02

Blackberries, Scot's broom, rose, and stands of Oregon white oak provided the most commonly used escape and loafing cover (Crawford 1978). Observations during the past 18 years revealed that all of the 16 repeatedly used roosts at the Wilson WA were associated with stands of blackberries. Some of these sites also contained apple trees or Scot's broom overgrown by Himalayan blackberry (*Rubus discolor*).

In mesic zones, such as western Oregon, where the rate of plant succession is rapid and grass and shrub cover quickly dominate disturbed sites, travel lanes for California quail may be important to provide access to needed habitat components. On the Wilson WA, quail made frequent use of the extensive road system that characterized this former military installation for movements from 1 cover type to another. In addition, roadsides, disked or bulldozed areas, and sites with compacted rock were used for movement by these birds. Large amounts of bare ground typified areas that received the greatest use by quail (Crawford 1978, Oates and Crawford 1983, Kilbride et al. 1992).

Foraging cover at the study area was characterized by availability of early successional

plants, particularly in disked areas, roadsides, or sites of compacted rock with escape cover (typically blackberries) within 10 m. California quail also foraged on plants used for roosting and loafing; among these plants, blackberries, apple, and Scot's broom were the most common.

In a study of seasonal relationships between population abundance of California quail and habitat characteristics, Oates and Crawford (1983) found quail numbers were positively related to amounts of forb cover, especially legumes (excluding vetch, which was widely available), dandelions, and wild carrot. Quail abundance was negatively related to amount of grass cover. In California, McMillan (1964), Francis (1970), and Leopold (1977:175) noted direct relationships between quail productivity and forb abundance.

HABITAT MANAGEMENT TECHNIQUES

Numerous techniques were used to manage California quail on the Wilson WA; 3 of these methods (disking, food plots, and wheat plantings) were evaluated (Oates and Crawford 1983). Twelve 16.2-ha plots were established on the Wilson WA: 3 had disked areas of 2.4 ha, 3 were planted with 0.4-ha plots of sudan grass and corn (food plots), 3 had 3-6 ha wheat plantings, and 3 were controls. Abundance (seasonal transects) and productivity (summer production routes) of quail were used to evaluate the merits of each management technique. Disked areas supported the most birds on a year-round basis (Table 3). Productivity was highest on disked areas; the fewest young hatched on food plots and wheat plantings. The fewest breeding adults were present on wheat plantings. The initially favorable response of quail populations to disking, however, lasted only approximately 1 year (Oates and Crawford 1983).

Responses of key habitat components, primarily food, were evaluated for disking (Oates and Crawford 1983, Blakely et al. 1990) and prescribed burning (Blakely et al. 1990) as management techniques. Key foods that responded positively (measured as percent cover) to disking treatment included deervetch, vetch, clover, wild carrot, dandelions, and sorrel. Grass cover declined in response to disking; no key trees or shrubs were evaluated. No changes in the amount of cover of peavine and teasel were noted after disking. Blackberries, clover, and vetch responded positively to burning; however, teasel, wild carrot, and dandelions seemingly were unaffected. Grass cover also declined after burning. Bare ground increased to 20 (burned)-40% (disked) of total ground cover immediately after treatments. Bare ground, however, returned to pretreatment levels of ≤4% within 2.5 years of treatment. Cover of key vegetative features that initially responded positively to treatment returned to control levels within 3 years (Blakely et al. 1990).

IMPLICATIONS

Results of these studies implied that abundance and productivity of California quail in western Oregon were related closely to vegetative communities, particularly to certain exotic plants, and the stage of plant succession. Stands with abundant food supplies of largely exotic species of legumes (deervetch, peavine, vetch, Scot's broom, and clover) and several other groups (wild carrot, teasel, sorrel, and dandelions) and adequate amounts of cover (also of primarily introduced plants such as blackberries, Scot's broom, and apple), were favored habitats for California quail. Contrastingly, areas with dense stands of grass, in the form of either agricultural fields (e.g., ryegrass or fescue) or naturally occur-

Table 3. Abundance and productivity of California quail on treatment and control sites, E. E. Wilson Wildlife Area, OR, 1976-78 (from Oates and Crawford 1983).

	Number of observations			
Category	Disked	Food plots	Wheat plantings	Control
Seasonal transects[a]				
Birds	451	293	56	151
Summer censuses				
Adults	47	46	5	45
Chicks	71	11	11	18

[a]Sum of seasonal counts from winter 1976 through spring 1978.

ring stands, were used little by these birds. Bare ground is apparently another characteristic feature of California quail habitat in western Oregon. Areas of bare ground afford travel lanes for birds, serve as sites for production of early seral plants used as food by quail, and may facilitate detection of predators and allow maintenance of visual contact with conspecifics. Bare ground reflects the very earliest stages of secondary plant succession. Because abundance and productivity of quail were related to availability of key foods, land management practices that encourage these foods presumably would benefit quail. Conversely, practices that reduce availability of these important forbs, such as use of herbicides and other clean-farming techniques, may negatively impact populations.

Timing and amount of spring and summer rainfall seemingly influence quail populations in western Oregon by affecting the chronology of hatching and, to a limited extent, recruitment of young into the fall population. Quail populations in this region, however, are relatively stable in numbers and consistent in productivity compared with populations in much of California. The greater amount and consistency of rainfall in western Oregon may affect quail productivity through more consistent production of key foods.

Like other species of wildlife, California quail are a product of land-use practices within their habitat. Results of our studies indicated that plantings of wheat or corn and sudan grass were not particularly beneficial for California quail and neither management method was as effective as disking in encouraging early seral forbs eaten by these birds. This work also revealed that both disking and burning encouraged production of important food forbs and, by implication, it is not necessary to seed these legumes or other food species, which are widespread throughout the Willamette Valley. Disking allows for production of more desirable foods at less cost than does planting of legumes or grains. California quail relied on blackberries to a great extent for escape, roosting, and loafing cover and secondarily for food. In the Willamette Valley, blackberries seemingly are an essential habitat component. In some areas, however, blackberries may form very large stands; in these cases, thinning of blackberries by bulldozing or burning may be desirable to achieve a favorable balance of food and cover. Blackberries are common landscape features in the Willamette Valley and form hedges along ditches, fencerows, and railroad tracks. Commonly, agricultural crops abut blackberry hedges. Such areas typically support quail populations but often are lacking in abundant year-round food supplies. Disked strips (no more than 2 m wide) between blackberry stands and agricultural crops will provide proportions of food and cover capable of supporting larger populations of California quail.

Our studies revealed that California quail at the Wilson WA were associated with early stages of plant succession and relied heavily on introduced plants for food and cover. Reliance on early seral and nonnative vegetation for primary food and cover needs may explain why these birds that evolved in semiarid lands were not native inhabitants of the Willamette Valley.

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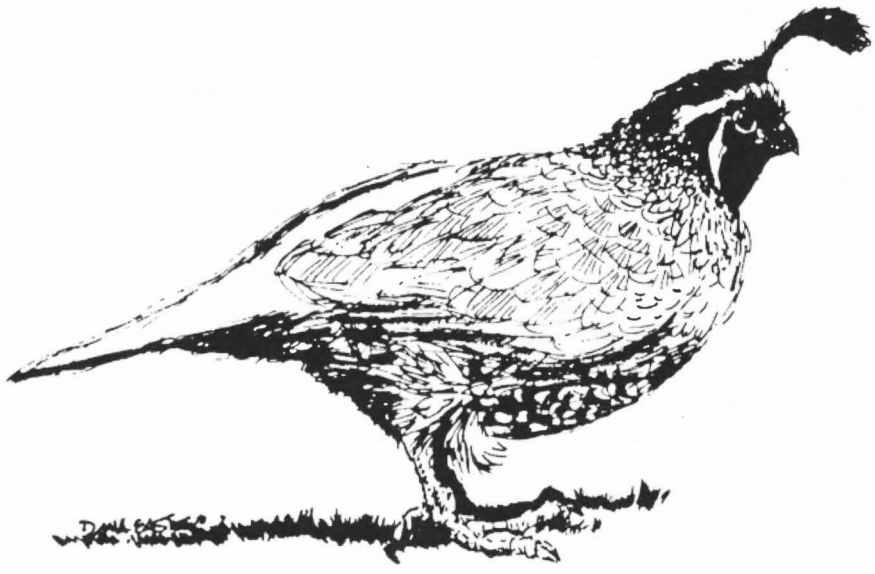


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