

Fall and Winter Diets of Mountain Quail in Southwestern Oregon

Abstract

Ninety mountain quail crops were collected in the fall of 1994-96 and the winter of 1998-99 to determine diets of mountain quail in the southwestern Cascade Mountains of Oregon. Mountain quail consumed items from 61 plant taxa, but the bulk of their diet was composed of 13 major plant genera or species. Legumes were the most prominent food consumed by Mountain Quail. In the fall, deer vetch species accounted for 47% of the total dry weight and were found in 58% of the crops. Hairy vetch constituted 38% of the dry weight of crops collected during the winter and occurred in 50% of the crops. Other legumes commonly eaten during the fall were black medic, clover, peavine, and Scot's-broom. California hedge-parsley, manzanita, and hawthorn were frequently used in the winter. Mountain quail ate greater quantities of grasses and green foliage in the winter, but berries were consumed more during the fall. In fall and winter, insects were frequently found in crops, but composed $\leq 3\%$ of the total volume of the diet. Mountain quail in southwestern Oregon are opportunistic foragers that seasonally shift diets to take advantage of prevailing food abundances.

Introduction

Mountain quail (*Oreortyx pictus*) occupy a diverse range of Pacific Coastal and Great Basin habitats from Baja, Mexico to Washington. They are highly herbivorous, and opportunistically exploit temporarily abundant food sources (Gutiérrez 1977). Mountain quail in central coastal California consumed 130 different food resources that consisted primarily of fruits, flowers, seeds, bulbs, or other plant parts (Gutiérrez 1977). However, mountain quail predominantly selected perennials, and >60% of the diet in central coastal California was composed of only six genera: woodlandstar (*Lithophragma*), oak (*Quercus*), starwort (*Stellaria*), filaree (*Erodium*), clover (*Trifolium*), and sumac (*Rhus*). In southeastern Washington, 85 of 95 food items collected from mountain quail crops and gizzards during the fall were plants, but >50% of the food biomass consisted of seven plant species (Yocum and Harris 1953). Mountain quail crops collected in western Idaho in the fall contained >37 different plant species, but four species accounted for >70% of the crop contents (Ormiston 1966).

Seasonally, mountain quail shift diets and foraging strategies to take advantage of prevailing food abundances. Chickweeds (*Holosteum* spp.) were important spring and early summer foods for mountain quail in western Idaho, but after

August these species were rarely found in crops (Ormiston 1966). In western Idaho, mountain quail diets changed from the seeds of small annuals in the summer to the seeds of larger perennials and annuals in September and October (Ormiston 1966). Mountain quail are sequential specialists with a diverse foraging repertoire that includes digging for bulbs in the fall, climbing trees to gather seeds, jumping to collect seeds from flower stalks, and shelling acorns found on the ground (Gutiérrez 1977).

Mountain quail are distributed throughout the western Cascades of Oregon, generally from 600 to 1,800 m elevation. In the Cascades of southwestern Oregon, mountain quail are abundant and occupy diverse habitats including many early, seral shrub and mixed-forest communities (Steve Denney, Oregon Department of Fish and Wildlife, personal communication). No studies have examined diets of mountain quail in the predominantly mesic, coniferous forests in the western Cascades. The objectives of our research were to understand mountain quail diets in the western Cascades, particularly during fall and winter when food resources are patchy in distribution and less abundant. We hypothesized that mountain quail in southwest Oregon would use a diverse range of plant species, but the bulk of their diet would consist of a few seasonally abundant species. We predicted that from fall to winter, consumption of particular food items would shift as food resources declined in quantity and variety.

¹ Author to whom correspondence should be addressed.
E-mail: popem@onid.orst.edu

Methods

Study Area and Data Collection

We selected a 1,400-km² study site in the Cascade Mountain Range of southwestern Oregon. The area, 50 km southeast of Roseburg in the Umpqua National Forest, is characterized by dense forests with floristically diverse forest overstories dominated by Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*) and other conifers, or by Oregon white oak (*Quercus garryana*) and Pacific madrone (*Arbutus menziesii*) (Franklin and Dyrness 1988). Common understory shrubs include manzanita (*Arctostaphylos* spp.), ceanothus (*Ceanothus* spp.), vine maple (*Acer circinatum*), salal (*Gaultheria shallon*), poison oak (*Rhus diversiloba*), and Oregon grape (*Berberis* spp.). Historically, fires, both naturally caused and set by native Americans, were the greatest single influence that created and perpetuated plant communities (Franklin and Dyrness 1988). Currently, logging is the major disturbance factor. Extensive timber removal on public and private lands has resulted in a mosaic of early to late-successional forest habitats. Elevations range from 600 to 1,800 m and climate conditions are generally temperate with hot, dry summers and cool, moist conditions in fall, winter, and spring. Mean monthly temperatures in 1999 ranged from 9°C in January to 29°C in August and annual precipitation was 76 cm (Oregon State University Climate Service 1999).

Sixty-one mountain quail were collected from the study area by hunters and Oregon Department of Fish and Wildlife biologists during the fall (1 September-1 December) of 1994 to 1996. Twenty-nine mountain quail were collected during the winter (2 December to 1 March) of 1998 and 1999. To insure independence of samples, we required that hunters collect one bird per covey. Crops were removed, and the contents extracted and dried in an oven at 50°C for 24 hr. Dried crop contents from each bird were sorted, weighed, and identified. Procedures for identification included photographic-key manuals, visual comparisons to seed collections, and assistance from Oregon State University's Seed Laboratory. Insect parts were sent to the Department of Entomology at Oregon State University for identification. Frequency of occurrence for each crop item was determined by recording the total number of

birds that consumed that item. Percent dry weight was determined by dividing summed weights for each item by the total weight of crop contents. We compared species composition, frequency of occurrence, and dry weight of fall and winter crop contents to assess seasonal shifts in diet selection.

Results

Mountain quail crops collected during the fall consisted of items from 24 plant taxa. Seeds were the most used food and composed the greatest biomass (dry weight) of crop contents (Table 1). Legumes were the most common family represented in mountain quail crops, and were 47% of the total dry weight (Table 2). Deervetches (*Lotus* spp.) were found in 35 of 61 (58%) of the crops, and accounted for 18% of the dry weight of all crops. Other common legumes in crops were black medic (*Medicago lupulina*), vetches (*Vicia* spp.), clover (*Trifolium* spp.), Scot's-broom (*Cytisus scoparius*), and peavine (*Lathyrus* spp.). Tarweed (*Madia* spp.) was found in 25% of crops but was only 2% of the total dry weight. Tall fescue (*Festuca arundinacea*), dogtail's grass (*Cynosurus echinatus*), blackberries (*Rubus* spp.), and snowberries (*Symphoricarpos* spp.) were frequently used (Table 2). Insects (termites, butterflies, earwigs, ants, grasshoppers, beetles, bugs, and spiders) from eight orders (*Isoptera*, *Lepidoptera*, *Dermaptera*, *Hymenoptera*, *Orthoptera*, *Coleoptera*, *Hemiptera*, and *Araneae*) were found in 45 of 61 (73%) of crops, but constituted 3% of the dry weight, and likely were only incidentally consumed. Unidentified green herbage was found in 15 of 61 (26%) of crops, but accounted for <2% of dry matter weight. Bulbs occurred in only 5 of 61 (8%) of the crops.

TABLE 1. Percent dry weights of major diet categories found in mountain quail crops (n = 90) collected in fall of 1994-96 and winter 1998-99 in the Cascade Mountains, southwestern Oregon.

Diet Category	Fall	Winter
Seeds	64	60
Grasses	12	22
Berries	9	0
Bulbs	5	0
Unknown	5	4
Insects	3	1
Greens	2	12

TABLE 2. Frequency of occurrence (%) and dry weights (%) of major food items found in mountain quail crops (n =90) during fall (1994-96) and winter (1998-99) in the southwestern Cascade Mountains, Oregon (a = non-native species).

Taxon	Fall		Taxon	Winter	
	Frequency	Weight		Frequency	Weight
Insects	73	3	Miscellaneous greens	82	12
<i>Lotus</i> spp.	58	18	<i>Vicia hirsuta</i> (a)	50	36
Miscellaneous greens	26	2	<i>Caucalis microcarpa</i>	50	5
<i>Festuca arundinacea</i> (a)	25	9	Insects	48	1
<i>Cynosurus echinatus</i> (a)	25	3	<i>Arctostaphylos</i> spp.	32	1
<i>Madia</i> spp.	25	1	<i>Cynosurus echinatus</i> (a)	25	16
<i>Rubus</i> spp.	24	5	<i>Bromus</i> spp.	25	5
<i>Vicia sativa</i>	22	3	<i>Lotus</i> spp.	25	4
<i>Ceanothus</i> spp.	22	2	<i>Crataegus</i> spp.	18	2
<i>Arctostaphylos</i> spp.	22	2	<i>Trifolium</i> spp.	18	2
<i>Medicago lupulina</i> (a)	21	5	<i>Festuca arundinacea</i> (a)	11	1
<i>Cytisus scoparius</i> (a)	20	7	<i>Oryzopsis</i> spp.	7	1
<i>Trifolium</i> spp.	20	3	<i>Phalaris</i> spp.	7	1
<i>Symphoricarpos</i> spp.	20	2	<i>Triticum</i> spp. (a)	4	6
Unknown seeds	16	4			
<i>Vicia hirsuta</i> (a)	16	1			
<i>Lathyrus</i> spp.	16	7			
<i>Vicia villosa</i> (a)	13	1			
<i>Garrya fremontii</i>	9	5			
Bulbs	8	5			
<i>Lupinus</i> spp.	8	2			
<i>Berberis</i> spp.	8	1			
<i>Plagiobothrys</i> spp.	4	4			

Crops collected in the winter contained parts from 37 plant taxa. Seeds were the most prominent items found in crops and constituted the greatest biomass of food contents (Table 1). The legume family was commonly used, primarily hairy vetch (*Vicia hirsuta*) (Table 2). Vetch was found in 15 of 29 (50%) of the crops and was 36% of the total dry weight. Deervetch appeared in 25% of the crops, but constituted <5% of the dry weight. California hedge-parsley (*Caucalis microcarpa*) was found in 14 of 29 (50%) crops and made up 5% of the dry weight. Manzanita occurred in 9 of 29 (32%) crops, but accounted for only 1% of the dry weight. Hawthorn (*Crataegus* spp.) was found in 5 of 29 (18%) of winter crops and was 2% of the dry weight. Tall fescue, dogtail's grass, and bromes (*Bromus* spp.) were the most common grasses eaten and constituted 22% of the total dry weight. Unidentified green foliage was found in 82% of the crops and accounted for 12% of the dry weight. Insects (ants, beetles, centipedes, grasshoppers, and millipedes) from five orders (*Hymenoptera*, *Coleoptera*, *Scolopendromorpha*, *Orthoptera*, and *Chordeumida*) were in 14 of 29

(48%) of the crops, but constituted only 1% of the dry weight.

Discussion

We confirmed that during fall and winter mountain quail in the southwest Oregon Cascades consumed a diverse range of food resources. For the combined seasons, mountain quail consumed items from 61 plant genera and species. The bulk of quail diets was composed of a few seasonally abundant plants. In the winter when food resources were likely less abundant, they selected from a greater range of food items and consumed more green leafage. Legumes were especially important in fall and winter diets, and represented a substantial proportion of the plants that were consumed. Particularly prevalent in fall crops were species of deervetch. This genus (*Lotus* spp.) in the Cascade Range is composed of both introduced birdsfoot-trefoil (*Lotus corniculatus*) and native species, and is widely distributed in moist, disturbed sites (Richard Helliwell, Umpqua National Forest Botanist, personal communication).

In Madera, Tuolumne, and Tulare counties in the Sierra Nevada region, and Fresno county in the Great Central Valley region of California, 22% (by volume) of mountain quail crop contents collected during the summer and nearly 19% collected during the fall was Spanish clover (*L. americanus*) seeds (Gutiérrez 1977). Other frequently selected species during the fall in the southwestern Cascades were black medick, peavine, and vetches. Legumes, particularly clover, lupine (*Lupinus* spp), and vetches, were important food items in the diets of mountain quail collected in southeastern Washington (Yocum and Harris 1953) and California (Gutiérrez 1977). The importance of legumes in other quail diets has been noted (Gullion 1966, Shields and Duncan 1966, Landers and Johnson 1976, and Blakely et al. 1993), evidence that this plant family provides a considerable source of nutrition. Duke (1981) listed a protein content of 35% for desert lotus (*Lotus rigidus*), 33% for black medic and peavine, and 25-48% for vetches. We also found that blackberries, huckleberries (*Vaccinium* spp.), snowberries, and two grasses (tall fescue and dogtail's grass) were relatively important in fall diets. In southeastern Washington, berries from smooth sumac (*Rhus glabra*) constituted nearly 25% of the total dry weight in mountain quail crops collected during the fall (Yocum and Harris 1953). However, in western Idaho and Nevada, berries were not an important food during the fall (Ormiston 1966, Gutiérrez 1977). Grasses were not a significant fall food for mountain quail in Idaho and Washington (Yocum and Harris 1953, Ormiston 1966), but in two counties of California, grass leafage constituted 19% of the total volume of fall crops (Gutiérrez 1977). Despite appearing in 73% of fall crops collected in the western Cascades, insects were only 3% of the total volume. Insects were eaten in greater quantities during the summer in the Great Basin, but represented <15% of the food used by mountain quail in fall and winter (Gutiérrez and Delehanty 1999).

Mountain quail used more food items in the winter, but many fall foods were not used in the winter, or were consumed in lesser amounts. We found less deervetch in winter crops, and no black medic, lupine, or peavine. Hairy vetch, the only species of vetch consumed in the winter, accounted for 36% of the total volume of winter crops. Dogtail's grass was more heavily represented in winter crops, but fescue was found in lesser quantities.

In comparison with the fall, green herbage occurred more frequently in winter crops and was found in greater quantities. Insects were selected less often during the winter and accounted for less of the total volume. Gutiérrez (1977) noted that in some areas of California, mountain quail shifted diets between fall and winter to take advantage of temporarily abundant foods. For example, he found that acorns were used heavily during the fall in Riverside and San Bernardino counties but figured much less prominently in winter diets. Compared to fall diets, leafage (*Erodium* spp. and Gramineae species) was found more extensively in winter crops, and mountain quail shifted from a fall diet composed largely of legumes (*Lotus* spp. and *Lupinus* spp.) to a winter diet composed prominently of ponderosa pine (*Pinus ponderosa*) and manzanita.

Mountain quail are closely associated with early successional vegetation, particularly shrub-dominated communities (Gutiérrez and Delehanty 1999). Many of the plants selected during the fall and winter are disturbance-related, introduced species, or native species typically found in disturbed sites (Richard Helliwell, Umpqua National Forest Botanist, personal communication). Black medic is a weedy exotic that thrives on highly disturbed sites and tall fescue is an introduced grass common along logging roads in the Cascade Range. Tall fescue is a common, weedy grass found along roadsides and disturbed openings. Hairy vetch is an introduced European legume that is widely distributed along trails and ditches, and Scot's broom is a noxious weed often found in disturbed ground along roadsides (Hitchcock and Cronquist 1973). Mountain quail in the southwest Cascades of Oregon are opportunistic foragers that seasonally and regionally adjust their diets.

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