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FALL DIET OF CHUKARS (ALECTORIS CHUKAR) IN EASTERN OREGON AND DISCOVERY OF INGESTED LEAD PELLETS

Hanspeter Walter\textsuperscript{1} and Kerry P. Reese\textsuperscript{2}

Key words: Alectoris chukar, Bromus tectorum, cheatgrass, Chukar, crops, diet, lead shot, Lithophragma parviflorum, Oregon, prairie starflower.

Chukars were widely introduced into the United States in the early 1900s and have thrived in the arid Intermountain West. Numerous investigations occurred during their introduction and establishment, but few field studies have examined this species in North America during the last 35 years. Chukar food habits were reported from Nevada (Alcorn and Richardson 1951, Christensen 1952, 1996, Weaver and Haskell 1967), Washington (Glabreath and Moreland 1953), California (Harper et al. 1958, Zembal 1977), Colorado (Sandfort 1954), and Hawaii (Cole et al. 1995), but never from Oregon despite an average annual harvest of 86,872 during 1990-1996, the highest among upland game birds in the state (Oregon Department of Fish and Wildlife 1998). Earlier diet reports were investigations of small, localized samples from throughout the West and consequently may not reflect current Chukar diets in eastern Oregon. Changes in composition of plant communities in western rangelands over the past decades, particularly the impact of exotic species (Franklin et al. 1999) and fire (Whisenant 1990), reinforce the need for regionally specific and timely diet information. Our objectives are to report the fall diet of Chukars in eastern Oregon and compare results to previous studies.

The study area was Succor Creek State Park and surrounding lands in the Vale District of the Bureau of Land Management (BLM) in Malheur County, southeastern Oregon. Privately owned irrigated pasture occupies a small portion of the area. Typical of Chukar habitat in Oregon, there are many canyons, steep slopes, and loose rock with elevations ranging from 600 m to 1700 m. Vegetation is a shrub-steppe community dominated by the Wyoming big sagebrush (Artemisia tridentata wyomingensis) / bluebunch wheatgrass (Agropyron spicatum) habitat type (Hironaka et al. 1983). Annual precipitation in the area averaged 23.8 cm during 1995–1998 (National Oceanic and Atmospheric Administration 1998).

Crops and gizzards of harvested Chukars were opportunistically collected from hunters in the field from October to January during the 1995–1998 hunting seasons and frozen. These were later thawed and their contents separated into component items. We carefully examined crops and gizzards for entry wounds to differentiate ingested lead pellets from those shot into the organs. Crop items were dried at 60°C for 24 hours and weighed to the nearest 0.01 g with an electronic scale. To assure that drying temperature and duration were sufficient to render all weights constant, we evaluated the procedures with a subsample of crops. Crop items were identified to the lowest practical taxonomic level using reference samples collected from the study area and a seed manual (Martin and Barkley 1961). We recorded the number of distinct food items and their dry weight for each crop, excluding empty crops from analysis. We calculated frequency of occurrence of crop items for the total sample and reported standard deviation and range when applicable. Contribution of each item is expressed using aggregate weight (Litvaitis et al. 1994). Items occurring in <3.0% of crops or contributing <3.0% of aggregate dry weight were excluded from analysis. Although there was annual variation, samples from all years were combined to form a single aggregate sample describing general fall diet. This facilitated...
comparisons with past studies. A discussion of possible causes of annual diet variation including climate and habitat use is presented in Walter (2000).

We found 72 different items in crops from fall 1995 (n = 10), 1996 (n = 66), 1997 (n = 36), and 1998 (n = 28). Number of different items per crop averaged 4.8 (s = 2.6, range = 1–12 items, n = 140). Mean weight of crop contents after drying was 2.51 g (s = 2.5, range = 0.01–10.93 g, n = 140).

Eighteen distinct items occurred in more than 3.0% of the crops (Table 1). Cheatgrass seeds were the most frequently encountered item, occurring in 87.5% of crops, while leaves and shoots of grasses, predominantly cheatgrass, were in 58.6% of the sample. The subterranean bulbils of prairie starflower occurred in 46.4% of the sample. Twenty other kinds of seeds occurred in 41.3% of crops and 18 other plant parts occurred in 15.7% of crops, collectively. Ten unidentified items occurred in 7.3% of crops.

Arthropods were found in 26.4% of crops. Grasshoppers (Orthoptera) were the most common, but others included ants (Hymenoptera), bugs (Hemiptera), and spiders (Arachnidae). Sagebrush (Artemisia spp.) leaves were found in 5.7% of crops, but galls, which are characteristic of sagebrush parasitization by gall midges (Jones 1971), were found in 26.4% of crops.

Our most startling discovery was ingested shot pellets in 7.1% of 140 non-empty crops. The mean number of ingested lead pellets was 1.7 (s = 0.5, range = 1–2 pellets, n = 8) and 2 crops had 1 and 3 steel pellets, respectively. Investigation of 123 gizzards also revealed ingested lead pellets in 7 (5.7%). Unfortunately, our collection of samples from sportsmen in the field precluded identification of crops and gizzards from the same bird.

Drying and weighing of the sample indicated that of the 18 most frequent diet items, an even smaller subset contributed the greatest amount to dry weight (Table 1). The subterranean bulbils of prairie starflower comprised 29.5% of dry weight of the sample and cheatgrass seeds 24.9%. Boraginaceae spp. seeds accounted for 12.6% of dry weight, with other items including grass leaves (7.2%), sagebrush galls (4.2%), arthropods (3.9%), and grit (1.6%). The contribution to dry weight of 25 other kinds of seed was 7.4%, 18 other plant parts 1.8%, and 10 unidentified items 0.1%.

Many of our findings were similar to those of past studies. Cheatgrass seeds and leaves were also the predominant food items found in other studies (Alcorn and Richardson 1951, Christensen 1952, 1970, 1996, Weaver and Haskell 1967, Zembal 1977). Other seeds of importance to Chukars in eastern Oregon such as filaree (Erodium spp.), and insects such as grasshoppers and ants, also have been documented (Alcorn and Richardson 1951, Christensen 1952, Weaver and Haskell 1967).

Seventy-two items were identified from crops in our study, but only 6 contributed 82.2% of the total dry weight. Previous studies also indicated that Chukars rely on relatively few foods for the bulk of their fall diet. Only 13 of 55 items were major components of the Chukar diet in California (Zembal 1977), and of 22 different plant genera found in crops from Nevada, only 5 comprised over 72% of the total volume (Weaver and Haskell 1967). Our data also suggest Chukars are opportunistic feeders that consume a wide variety of foods but heavily rely on only a small subset in a particular region. This exploratory foraging nature may have facilitated establishment and range expansion in North America by enabling Chukars to rapidly sample and identify suitable foods in new areas.

Subterranean bulbils of prairie starflower contributed most to the dry weight of our sample and ranked 4th in frequency, but they were less significant in previous studies. The bulbils, which function as asexual reproductive structures (Taylor 1965), occurred in 42.7% of fall crops collected in Washington but contributed only 4.6% to wet volume (Knight et al. 1979). They also occurred in 35.0% of crops from central Nevada, contributing 8.3% to wet volume (Weaver and Haskell 1967). The high contribution to aggregate weight of bulbils in our sample may be due to the fact that they were denser than other food items and lost less weight when dried, a factor not accounted for in the previous wet volume analyses. It may also be due to the large quantity of bulbils found in individual crops. Crops full of bulbils added significantly more to aggregate weight than those containing few bulbils, but frequency of occurrence remained the same. Bulbils appear to be an important fall food item where available in eastern Oregon.
Table 1. Items found in Chukar crops from eastern Oregon during fall, 1995–1998.

<table>
<thead>
<tr>
<th>Crop item</th>
<th>Scientific name</th>
<th>Frequency (%)</th>
<th>Dry weight (%)</th>
<th>Years foundb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheatgrass seeds</td>
<td>Bromus tectorum</td>
<td>87.5</td>
<td>24.9</td>
<td>95, 96, 97, 98</td>
</tr>
<tr>
<td>Grass leaves</td>
<td>Various</td>
<td>38.6</td>
<td>7.2</td>
<td>96, 97, 98</td>
</tr>
<tr>
<td>Grit</td>
<td>n/a</td>
<td>50.0</td>
<td>1.6</td>
<td>95, 96, 97, 98</td>
</tr>
<tr>
<td>Starflower bulbils</td>
<td>Lithophragma parviflorum</td>
<td>46.4</td>
<td>29.5</td>
<td>95, 96, 97, 98</td>
</tr>
<tr>
<td>Borage seeds</td>
<td>Boraginaceae spp.</td>
<td>31.4</td>
<td>12.6</td>
<td>95, 96, 97, 98</td>
</tr>
<tr>
<td>Sagebrush galls</td>
<td>Artemisia spp.</td>
<td>26.4</td>
<td>4.2</td>
<td>96, 97, 98</td>
</tr>
<tr>
<td>Filaree seeds</td>
<td>Erodium spp.</td>
<td>26.4</td>
<td>1.5</td>
<td>95, 96, 97, 98</td>
</tr>
<tr>
<td>Arthropods</td>
<td>Arthropoda spp.</td>
<td>26.4</td>
<td>3.9</td>
<td>96, 97, 98</td>
</tr>
<tr>
<td>Spiny lettuce</td>
<td>Lactuca scariola</td>
<td>22.9</td>
<td>1.0</td>
<td>96, 97, 98</td>
</tr>
<tr>
<td>Hawksbeard</td>
<td>Crepis acuminata</td>
<td>8.5</td>
<td>1.0</td>
<td>96, 97</td>
</tr>
<tr>
<td>Sunflower</td>
<td>Helianthus annus</td>
<td>6.4</td>
<td>1.0</td>
<td>96, 97</td>
</tr>
<tr>
<td>Sagebrush leaves</td>
<td>Artemisia spp.</td>
<td>5.7</td>
<td>&lt; 0.1</td>
<td>96, 97, 98</td>
</tr>
<tr>
<td>Bluebunch wheatgrass seeds</td>
<td>Agropyron spicatum</td>
<td>5.0</td>
<td>0.3</td>
<td>96, 97</td>
</tr>
<tr>
<td>Shot pellets</td>
<td>n/a</td>
<td>4.9</td>
<td>0.5</td>
<td>96, 97, 98</td>
</tr>
<tr>
<td>Spiny greenbush</td>
<td>Glossopetalon neovadense</td>
<td>4.3</td>
<td>0.4</td>
<td>95, 96, 97, 98</td>
</tr>
<tr>
<td>Feathers</td>
<td>n/a</td>
<td>4.3</td>
<td>&lt; 0.1</td>
<td>96, 97</td>
</tr>
<tr>
<td>Broomrape</td>
<td>Orobanche sp.</td>
<td>3.6</td>
<td>0.7</td>
<td>97, 98</td>
</tr>
<tr>
<td>Idaho fescue seeds</td>
<td>Festuca idahoensis</td>
<td>3.6</td>
<td>0.5</td>
<td>95, 96</td>
</tr>
<tr>
<td>Other seeds (20)</td>
<td>n/a</td>
<td>41.3</td>
<td>7.4</td>
<td>95, 96, 97, 98</td>
</tr>
<tr>
<td>Other plants (18)</td>
<td>n/a</td>
<td>15.7</td>
<td>1.8</td>
<td>95, 96, 97, 98</td>
</tr>
<tr>
<td>Unidentified (10)</td>
<td>n/a</td>
<td>7.3</td>
<td>0.1</td>
<td>96, 97, 98</td>
</tr>
</tbody>
</table>

aOnly items occurring in >3.0% of sample or contributing >3.0% to dry weight of the sample are listed.

b1995 (n = 10), 1996 (n = 66), 1997 (n = 36), 1998 (n = 28).

Because they must be uprooted from below-ground, we do not suspect bulbils are as readily available or ingested when the ground is frozen or covered in heavy snow.

It appears fall food requirements of Chukars in eastern Oregon will be met provided annual grasses, especially cheatgrass, are available. Heterogeneity of vegetation, however, is recommended due to the ingestion of many other food items and likely diet variation among seasons and age groups. Cheatgrass is not favored by other rangeland birds (Goebel and Berry 1976), and its high level of consumption by Chukars suggests that there is not strong competition between Chukars and native birds for food. Because the success of the Chukar in North America appears linked to cheatgrass, this is an interesting case of one exotic species facilitating the establishment of another (Simonoff and Von Holle 1999). Additional studies should investigate food preferences and causes of annual variation in Chukar diets.

Ingested shot pellets have never been reported in Chukars, although they have been found in other Galliformes such as Northern Bobwhite (Colinus virginianus; Westminster 1966), Scaled Quail (Callipepla squamata; Campbell 1950), Ring-necked Pheasant (Phasianus colchicus; Hunter and Rosen 1965), and Wild Turkey (Meleagris gallopavo; Stone and Butkas 1972). This discovery represents what may occur in Chukars during seasons of heavy hunting pressure in areas where conditions favorable to shot pellet ingestion are present. The arid climate and presence of rocky benches may leave pellets exposed for long periods, increasing their chance of random ingestion by Chukars who mistake them for seeds or grit. Rocky areas are heavily used by Chukars (Lindbloom 1998, Walter 2000) and are often where hunters focus activity. Concentrated hunting pressure in crop fields was reported to increase chances of lead shot ingestion by Mourning Doves (Zenaida macroura) favoring those fields (Lewis and Legler 1968), and a similar phenomenon may have occurred in our study.

While the hazards of lead shot are well documented for waterfowl and birds of prey, they are less known in other species; however, risk of lead shot to upland birds is becoming increasingly apparent and acknowledged as a potential management concern (Locke and Bagley 1967, Kendall et al. 1996). Our findings are site specific, but the possibility that lead ingestion may be occurring in other populations of Chukars...
or in other bird species in arid environments should be investigated. Continued documentation of this situation is necessary to evaluate the overall impact of lead shot on ground-foraging birds, especially in light of improved alternatives to lead shot.

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LITERATURE CITED


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