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Technical Note: Diets and food selection of sage grouse chicks in Oregon

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Abstract

Diets and food selection by sage grouse *(Centrocercus urophasianus)* chicks were determined during 1989 and 1990 on 2 areas that differed in long-term grouse productivity. Chicks consumed the same foods in similar frequencies and exhibited similar dietary selection on the areas, but relative dry mass differed. Forbs and invertebrates composed 80% of the dietary mass on the area with higher grouse productivity, whereas chicks on the other area consumed primarily (65%) sagebrush (*Artemisia* spp. L.).

Key Words: *Centrocercus urophasianus*, diets, food, Oregon, sage grouse, selection

Insects are the primary food of sage grouse chicks during the first 1 to 2 weeks after hatching (Patterson 1952, Klebenow and Gray 1968). Thereafter, succulent forbs predominate in the diet (Nelson 1955, Klebenow and Gray 1968) until immatures are >3 months of age, at which time sagebrush becomes a common dietary component (Dargan et al. 1942, Peterson 1970). Common dandelion (*Taraxacum officinale* Weber), clover (*Trifolium* spp. L.), June beetles (Scarabeidae), and sagebrush were reported in the diets of chicks (Dargan et al. 1942, Klebenow and Gray 1968, Peterson 1970). Food habits relative to population status were not evaluated in these studies (Gullion 1966), and availability of foods or dietary selection are poorly documented. Klebenow and Gray (1968) and Peterson (1970) suggested that the amounts and types of foods consumed by chicks were related to survival, but this hypothesis is untested. The relationship between chick diets and survival of young, which is reflected in recruitment rates, is poorly established for most galliforms, especially grouse (Potts 1986:80). Consequently, we compared 4 measures of the diet of sage grouse chicks (types of foods eaten, frequency of occurrence, relative mass of foods consumed, and dietary selection) on 2 areas with long-term differences in sage grouse productivity and abundance.

Study Areas

The study was conducted at Hart Mountain National Antelope Refuge (Lake County) and Jackass Creek (Harney County) in southeastern Oregon. At Hart Mountain, sage grouse were more abundant and exhibited higher productivity than at Jackass Creek. Long-term productivity trends were determined from summer transect counts conducted by the U.S. Fish and Wildlife Service (USFWS) at Hart Mountain and by the Oregon Department of Fish and Wildlife (ODFW) at Jackass Creek. From 1985 to 1992, the only period for which comparable data were available, counts averaged 1.6 and 0.9 chicks/hen ($t = 3.74$, $P<0.01$) at Hart Mountain and Jackass Creek, respectively. Furthermore, results from Gregg (1992) supported long-term productivity trends at these areas during 1989 and 1990; 18% of radio-marked hens had chicks at Hart Mountain whereas only 11% of marked hens had chicks at Jackass Creek. Estimates of sage grouse densities since 1980 were 2.5 birds/km^2 at Hart Mountain and 1.5 birds/km^2 at Jackass Creek (J.C. Lemos, ODFW, unpubl. data; M.C. Smith, USFWS, unpubl. data).

Hart Mountain ranged in elevation from 1,500 to 2,450 m (Warner Peak). Dominant cover consisted of low sagebrush (*A. arbuscula* Nutt.), big sagebrush (*A. tridentata* Nutt.), and bitterbrush (*Purshia tridentata* Pursh). High elevation stands included western juniper (*Juniperus occidentalis* Hook.), curl-leaf mountain-mahogany (*Cercocarpus ledifolius* Nutt.), and aspen (*Populus tremuloides* Michx.). Characteristic annual and perennial forbs included mountain dandelion (*Agoseris* spp. Raf.), hawksbeard (*Crepis* spp. L.), desert-parsley (*Lomatium* spp. Raf.), lupine (*Lupinus* spp. L.), and phlox (*Phlox* spp. L.). Grasses consisted largely of bluegrass (*Poa* spp. L.), wheatgrass (*Agropyron* spp. Gaertn.), needle-and-thread grass (*Stipa* spp. L.), and fescue (*Festuca* spp. L.). At refuge headquarters (elevation 1,700 m), annual temperature averaged 6° C and mean precipitation was 29 cm (1939–86). Precipitation was 30 cm in 1989 and 21 in 1990. Cattle were grazed on the area with a rest-rotation, deferred grazing system with about 0.13 AUM/ha allotted from 15 April to 15 December (M.C. Smith, USFWS, pers. commun.).

Jackass Creek was 100 km northwest of Hart Mountain and ranged in elevation from 1,200 to 1,700 m. Prominent vegetation consisted of low sagebrush and big sagebrush; western junipers were present on the eastern portion of the study area. Forbs and grass genera were similar to those at Hart Mountain. Annual temperature averaged 10° C and mean precipitation was 25 cm (1939–86). Precipitation was 24 and 13 cm during 1989 and 1990, respectively. Cattle grazing averaged 0.18 AUMs/ha from 1 April to 1 September and use by wild horses averaged 0.05 AUMs/ha from 1995 to 1990 (W.F. Taylor, Bur. of Land Manage., pers. commun.).

Methods

Crops from sage grouse chicks were analyzed to determine types of food consumed, frequency of occurrence, relative dry mass, and selection of foods. We collected 64 chicks, 36 from Hart Mountain and 28 from Jackass Creek, during 1989 and 1990. Roads and trails at both areas were traversed during the 3 hours before sunset in June and July of each year to locate broods foraging in low and big sagebrush stands. Once a group of sage grouse chicks was located, contact was maintained until foraging was observed for a minimum of 15 minutes, whereupon 1 chick was collected by shotgun. The location was then marked with a witness stake for subsequent

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vegetation sampling and no chicks were taken from that site during the same year.

After a chick was collected, age in weeks was determined by the sequential replacement molt of primary feathers (Eng 1955) and the crop was removed. Ages of chicks ranged from 3 to 10 weeks on both study areas except for 1, 1-week old bird from Hart Mountain and 1, 11-week old chick taken at Jackass Creek. Preliminary analysis revealed that ages of chicks collected for study ($\bar{x}$ = 6 weeks ± 0.3 at Hart Mountain and $\bar{x}$ = 7 weeks ± 0.3 at Jackass Creek) were similar (t = 1.75, P>0.10), which eliminated age differences between areas as a bias in dietary information. Crop contents were separated and identified to species for plants and genus for insects. For analytical purposes, however, plants were categorized to genus and invertebrates to family. Percent relative dry mass of each food item was determined after items were oven dried at 50° C for 72 hours. Percent relative dry mass was defined as mass of each food item/total mass of all foods in crops × 100 and percent frequency of occurrence as the number of crops in which a food item was found/total number of crops × 100.

At each collection site, vegetation and arthropods were sampled ≤1 week after a chick was collected. Four transect lines, each 11.3 m, were established within a 400-m² area with the witness stake as the center of the plot. The direction of the initial transect was selected randomly and each subsequent transect was arranged in a perpendicular manner. Percent cover of forbs and grasses was determined from 30 rectangular, nested microplots (0.025, 0.05, and 0.10-m²) spaced equidistantly along transects (Winward and Martinez 1983). Senescent forbs were not considered as available foods. Occurrence of ground-dwelling arthropods was estimated from 12 pitfall traps (Morrill 1975) equidistantly placed along transects and kept open for 3 days. Shrub availability was measured with the line-intercept method (Canfield 1941). Dietary selection was determined with an assessment procedure formulated by Johnson (1980). This method includes the Waller-Duncan (W statistic) test for differences among ranks in relation to selection, which indicates preference for foods. This procedure provides a measure of the relationship between availability of foods and the frequencies at which they are consumed, which are expressed as Tbar values. Negative Tbar values indicate greater frequency of occurrence in the diet than at random sampled areas within foraging habitat. The W statistic provides separation among dietary components to indicate preference rank. Selected foods were those used greater than available in the habitat and preferred foods were those that differed among ranks. Within each of the major food categories (grasses, shrubs, forbs, and invertebrates), primary foods were identified as ≥1% relative dry mass and ≥10% frequency of occurrence in the diet. Remaining foods, within each food category, were combined and classified as 'other'. Tests for differences between years and differences in use and availability between study areas were performed with Chi-square analysis (Snedecor and Cochran 1980:208). Proportionalized weights of relative dry mass between years and study areas were used for this analysis. The Spearman Rank Correlation test was used to test relative ranking of primary forbs used by sage grouse chicks between study areas (Snedecor and Cochran 1980:191). Fiducial limits for all tests were established a priori at P≤0.01 and all stated differences refer to that level of confidence.

Results

Sage grouse chicks consumed 122 different foods, which included 34 genera of forbs, 2 genera of shrubs, 1 genus of grasses, and 41 families of invertebrates. Of these foods, 10 genera of forbs, 3 families of insects, and sagebrush were classified as primary foods. Food items were selected from 97 genera of forbs, 7 genera of shrubs, 12 genera of grasses, and 10 families of arthropods that were measured as available to sage grouse chicks at foraging locations. A number of infrequently consumed arboreal insects were not captured in pitfall traps.

Table 1. Relative dry mass (%) and frequency of occurrence (%) of food items in crops of sage grouse chicks and available at collection sites at Hart Mountain (n = 36), Lake County, and Jackass Creek (n = 28), Harney County, Oregon, 1989–1990.

	Use				Availability	
	Hart Mountain		Jackass Creek		Hart Mountain	Jackass Creek
Food items	Relative dry mass	Frequency	Relative dry mass	Frequency	Frequency	Frequency
	%					
Forbs						
Milkvetch	26	81	3	54	13	5
Mountain dandelion	8	78	1	21	8	1
Hawksbeard	5	69	4	29	1	2
Microsteris	4	31	4	46	4	1
Common dandelion	2	19	1	7	1	0
Clover	2	6	4	43	1	1
Desert-parsley	2	33	1	14	4	3
Broomrape	1	3	1	14	0	0
Daisy	1	16	1	3	1	3
Blepharipappus	0	0	7	11	0	2
Other	1	100	1	100	68	39
Total	52	100	28	100	68	41
Shrubs						
Sagebrush	19	86	65	89	14	18
Other	1	8	0	0	5	6
Total	20	78	65	89	19	23
Grasses						
Total	1	4	0	0	60	45
Arthropods						
Scarabeidae	16	58	1	18	9	1
Tenebrionidae	3	28	4	43	15	12
Formicidae	1	89	2	82	78	47
Other	5	64	1	64	78	46
Total	25	89	8	82	99	67

Initial analyses revealed only 1 significant difference in frequency of occurrence of the major food categories available on either study area between 1989 and 1990. In the singular exception, forbs occurred at a slighter greater frequency ($X^2 = 8.74$) at Hart Mountain in 1990 (72%, $n = 23$) compared with 1989 (60%, n = 13). No other significant differences in frequency of occurrence of major food groups were found for either study area between years and, consequently, data were combined for the 2 years of study for subsequent comparisons of diets and availability of foods between study areas.

No significant differences were found between study areas in frequency of occurrence of any of the 4 major food categories in the crops of sage grouse chicks (Table 1). However, relative dry mass of forbs ($X^2 = 48.8$) and invertebrates ($X^2 = 14.3$) was greater at Hart Mountain than at Jackass Creek and shrubs were less ($X^2 = 31.4$); grasses constituted only 1% of relative dry mass at Hart Mountain and were not found in any crops from Jackass Creek.

Among forbs, 9 of 10 primary foods were the same between areas; 1, belpharipappus (*Blepharipappus scaber* Hook.), was not taken by chicks at Hart Mountain but composed 7% of the mass of the diet at Jackass Creek (Table 1). Overall frequency of occurrence of forbs in diets of chicks was similar between areas, but mountain dandelion ($X^2 = 20.7$) and hawksbeard ($X^2 = 9.2$) were consumed in higher frequencies at Hart Mountain and clover ($X^2 = 10.9$) was taken in greater frequency at Jackass Creek. Although frequency of occurrence of milkvetch (*Astragalus* spp. L.) was similar between areas, chicks at Hart Mountain consumed substantially more milkvetch than chicks at Jackass Creek (26% and 3% of relative dry mass, respectively). Among arthropod foods, June beetles were consumed in higher frequency at Hart Mountain than at Jackass Creek. Frequencies of darkling beetles (Tenebrionidae) and ants (Formicidae), which constituted the other major arthropod foods, were similar on both areas.

Four foods (milkvetch, mountain dandelion, June beetles, and sagebrush), which collectively composed about 70% of the mass of the diets on each area, accounted for differences in primary foods consumed between areas. At Hart Mountain, chicks relied heavily on milkvetch, mountain dandelion, and June beetles, whereas Jackass Creek chicks ate predominantly sagebrush. Other foods were consumed in similar amounts.

Availabilities of the 4 major food categories differed between study areas: forbs ($X^2 = 252.7$), grasses ($X^2 = 39.3$), and invertebrates ($X^2 = 335.6$) were available in greater frequencies at Hart Mountain and shrubs ($X^2 = 10.2$) were present at a greater frequency at Jackass Creek (Table 1). Among primary forbs, higher frequencies of milkvetch ($X^2 = 47.3$), mountain dandelion ($X^2 = 37.1$), and microsteris (*Microsteris gracilis* Hook.) ($X^2 = 49.3$) were available at Hart Mountain than at Jackass Creek (Table 1). Contrastingly, Jackass Creek had a higher frequency of daisy (*Erigeron* spp. L.) ($X^2 = 31.9$) than did Hart Mountain. Availability of all groups of arthropod foods differed between study areas: Scarabeidae ($X^2 = 32.1$), Tenebrionidae ($X^2 = 11.6$), Formicidae ($X^2 = 82.6$), and other arthropods ($X^2 = 83.0$). In all instances, Hart Mountain supported higher frequencies of invertebrate groups. The availability of sagebrush was significantly greater ($X^2 = 7.6$) at Jackass Creek (18%) than at Hart Mountain (14%).

Availability (frequency of occurrence) of all 'other' forbs ($X^2 = 22.1$) and 'other' arthropods ($X^2 = 18.2$) was significantly greater at Hart Mountain than at Jackass Creek. These taxa also represented the highest frequency of food items available to sage grouse chicks on both study areas. Forbs such as lupine, phlox, and sandwort (*Arenaria* spp. L.) were the most commonly available forbs at foraging sites but were rarely consumed.

Dietary selection by chicks was similar on the 2 study areas; all primary forbs eaten more than available [broomrape (*Orobanche* spp. L.), clover, common dandelion, hawksbeard, microsteris, milkvetch, and mountain dandelion] were similar (Table 2). Within arthropods, all families identified as primary foods and eaten selectively were similar between areas. All forbs eaten selectively at Jackass Creek were equally preferred (W = 2.07), whereas 4 (hawksbeard, milkvetch, common dandelion, and mountain dandelion) of 7 forb taxa eaten selectively at Hart Mountain were preferred (W = 1.96) over other forbs used. June beetles were the most preferred arthropod on each study area (W = 1.83 and 1.93 at Hart Mountain and Jackass Creek, respectively). Forbs and invertebrates in the 'other' category were little used relative to availability and were not preferred. Selection of forbs was similar between areas but relative rank of food forbs was not significant ($r = 0.63$, $P = 0.06$) because of the substantially greater use of clover at Jackass Creek. Relative selection ranking of invertebrates was identical between study areas.

Table 2. Dietary selection of forbs and arthropods by sage grouse chicks, Hart Mountain ($n = 36$) Lake County, and Jackass Creek ($n = 28$), Harney County, Oregon, 1989–1990.

Hart Mountain		Jackass Creek	
Food items	Tbar[1,2]	Food items	Tbar[1,2]
Forbs		Forbs	
Hawskbeard	–1.37a	Clover	–1.68a
Milkvetch	–0.96ab	Milkvetch	–1.18a
Common dandelion	–0.85ab	Hawksbeard	–0.91a
Mountain dandelion	–0.65abc	Microsteris	–0.71a
Broomrape	–0.50 bc	Broomrape	–0.48a
Microsteris	–0.36 bc	Common dandelion	–0.07ab
Clover	–0.26 bc	Mountain dandelion	–0.03ab
Desert-parsley	0.35 c	Desert-parsley	0.25ab
Daisy	0.85 c	Blepharipappus	0.38 b
Other	4.26 d	Daisy	0.86 b
		Other	3.43 c
Arthropods		Arthropods	
June beetles	–1.58a	June beetles	–0.89a
Darkling beetles	–0.28 b	Darkling beetles	–0.09 b
Ants	0.64 c	Ants	0.25 bc
Other	1.22 c	Other	0.73 c

[1]Negative Tbar indicates use > availability
[2]Taxa not sharing common letters differed in preference ($P<0.01$)

Discussion

Sage grouse chicks consumed a wide variety of foods on both study areas; however, only a small number received high use and few were eaten more than available. Milky-juiced composites (Cichorieae), milkvetches, microsteris, beetles, ants, and sagebrush were characteristic components of the diet but relatively few primary foods were abundant at foraging sites. Use of similar foods by juvenile sage grouse was reported from other areas (Dargan et al. 1942, Nelson 1955, Klebenow and Gray 1968, Peterson 1970).

Chicks at the 2 areas ate the same foods and displayed similarities in dietary selection and preferences. Frequencies in the diet of several foods differed between Hart Mountain and Jackass Creek, but the overriding difference in diets was in the relative dry mass of foods consumed, which corresponded directly to availability of primary foods. At Hart Mountain, forbs and invertebrates constituted >75% of the diet, whereas at Jackass Creek sagebrush composed 65% of the mass consumed by chicks. Forbs and arthropods were more available at Hart Mountain and were consumed in

greater mass than at Jackass Creek.

We found concordance between the amounts of forbs and insects in the diet and long-term productivity estimates from the 2 study areas. Substantially lower consumption of forbs and invertebrates and increased reliance on sagebrush may affect chick growth and survival, which would be reflected in long-term differences in productivity between areas. Insects are a critical nutritional source to developing chicks. In laboratory feeding trials, sage grouse chicks deprived of insect material died within 10 days after hatching or had restricted growth (Johnson and Boyce 1990). Availability of preferred insects was the most important factor that affected growth and survival of gray partridge *(Perdix perdix)* chicks (Potts 1986:86–88). Protein obtained from insects in diets of ruffled grouse *(Bonasa umbellus)* (Korschgen 1966) and red grouse *(Lagopus scoticus)* (Hudson 1986) influenced growth and survival. Forbs also are an important source of protein to sage grouse chicks. From plant samples taken during spring, several primary forbs (hawksbeard, mountain dandelion, milkvetch) from the 2 study areas had higher crude protein levels (20–38%) than sagebrush (13–17%) (Barnett 1993). Differences in availability of primary foods on the study areas also may have influenced mortality of chicks. Hens with broods had larger home ranges at Jackass Creek than at Hart Mountain (Drut 1993), presumably because hens had to range widely to locate the relatively less available food supplies Jackass Creek. Broods with larger home ranges may be more susceptible to predation and other mortality factors (Potts 1986:87).

Availability of forbs and arthropods is influenced by natural and human-related factors, including land-use practices, which may have differential effects on primary foods. For example, some palatable species, such as hawksbeard, are reduced in availability by grazing during the growing season (Rickard 1985), whereas others, such as mountain dandelion, may be enhanced (Tueller 1962). Reintroduction of fire may increase availability of milkvetch, microsteris, mountain dandelion, common dandelion, daisy, and ants (Evans and Young 1970, Nimir and Payne 1978, Kuntz 1982, Humphreys 1984, 14 Winter 1984, Koniak 1985) but negatively affect sagebrush and darkling beetles (Harniss and Murray 1973, Winter 1984). Although an understanding of the factors that influence availability of sage grouse foods is incomplete, a useful management goal to enhance survival and recruitment of young would be to employ those practices that result in relatively abundant forb and insect foods while simultaneously providing for other life-history needs, such as grasses and sagebrush for cover.

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