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PREY SELECTION AND FOOD HABITS OF BURROWING OWLS IN COLORADO

David L. Plumpton[1,2] and R. Scott Lutz[1]

ABSTRACT.—Food habits of Burrowing Owls (*Speotyto cunicularia*) were studied during the breeding seasons of 1990 and 1991 in central Colorado. Concurrent insect availability studies were conducted to determine selection for specific insect families. Analysis of 1445 castings indicated use of only one insect family, the carrion beetles (Silphidae), at a rate greater than expected based on availability in one year. Castings and prey remains showed different dietary components. Prey remains showed greater use of small mammals, moths, amphibians, and passerines, and castings indicated greater use of mice and beetles. Methodology in raptor food habits studies may therefore bias results.

Key words: Speotyto cunicularia, *Burrowing Owl, food habits, casting, prey remains, Colorado.*

Much of the diet literature for Burrowing Owls (*Speotyto cunicularia*) consists solely of studies based on casting analysis. Study of Burrowing Owl food habits based on prey remains found near burrows has shown prey items not detected from casting analysis (Thomsen 1971, MacCracken et al. 1985). Most food habits studies lack concurrent quantitative studies of prey populations. This deficiency is also apparent in raptor food habits studies (Brown 1974, Olendorff and Stoddart 1974).

In 1987 the Rocky Mountain Arsenal (RMA) was established as an Environmental Protection Agency superfund site, and cleanup operations were initiated. Cleanup of RMA may require alterations to existing habitats, possibly affecting the Burrowing Owl prey base. The primary objective of this study was to determine the food habits of Burrowing Owls nesting at RMA, and how use of insects by Burrowing Owls is related to availability. This will allow a better understanding of the effects of environmental cleanup at RMA on Burrowing Owls. Our second objective was to investigate potential differences in diet from analyses of castings and prey remains.

STUDY AREA

RMA is located in south central Adams County, Colorado, and encompasses 6900 ha. As part of the High Plains district of the Northern Great Plains province in the North Temperate Grassland Biome, RMA has a semiarid climate and features low humidity, light rainfall, and moderate to high winds. Average annual precipitation is about 38 cm. Elevation ranges from 1564 m to 1625 m above sea level (Environmental Science and Engineering 1989).

Vegetation is represented by five major communities: weedy forbs, cheatgrass (*Bromus* spp.)/weedy forbs, cheatgrass/perennial grassland, native perennial grassland, and crested wheatgrass (*Agropyron cristatum*). Minor communities include sand sagebrush (*Artemisia filifolia*) shrubland, rubber rabbitbrush (*Chrysothamnus nauseosus*) shrubland, yucca (*Yucca* spp.) grassland, cottonwood (*Populus deltoides*), and willow (*Salix* spp.) (Environmental Science and Engineering 1989).

MATERIALS AND METHODS

Food Habits

Food habits were studied by analysis of regurgitated castings and prey remains. Castings were collected and prey remains recorded at burrows biweekly from 14 June to 9 August 1990 (n = 19 burrows), and from 5 April to 26 July 1991 (n = 28 burrows). Castings were separated by date of collection and by burrow. Castings were soaked overnight in a 2 molar (8%) NaOH solution, leaving only bone and chitin (Degn 1978). Contents were

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separated and enumerated to the lowest possible taxon, usually family. Burrowing owls normally consumed only a portion of many prey items. For this reason, the percentage of a given prey item in the diet was based on frequency of occurrence, rather than an estimate of percent biomass.

Data were tested within years for among-burrows variation in use of each insect family found in castings. Wilcoxon ranked-sum tests were used (SAS Institute, Inc. 1988).

Insect Use and Availability

Pitfall traps were used to determine relative abundances of insects near occupied burrows (Wolda 1990). Traps consisted of six 10-oz clear plastic cups buried flush with the soil surface, placed at 1-m intervals from all burrows ($n = 47$) in a randomly selected azimuth. This ensured that insect sampling occurred in the birds' foraging microhabitat (Hutto 1990). Traps were set for one week and were filled to a depth of about 4 cm with a 25% solution of ethylene glycol to act as a preservative. Two trapping intervals were used, separated by one month.

Data were tested for differences between trapping intervals and years using Kruskal/Wallis and Wilcoxon 2-sample tests (SAS Institute, Inc. 1988). No differences ($P < .05$) were detected between trapping intervals, so data were pooled. A year effect ($P < .05$) was detected for both insect use and availability, so data were analyzed by year. A X^2 goodness-of-fit test was used to test for overall differences in use and availability. When significant differences were detected, Bonferroni confidence intervals were used to identify differences within individual insect family classes (Neu et al. 1974, Byers et al. 1984).

Castings Versus Prey Remains

Frequency of occurrence of prey items in castings and as prey remains was tested for between-year differences. Yearly differences and differences in contents of castings and prey remains were tested using Kruskal/Wallis and Wilcoxon 2-sample tests (SAS Institute, Inc. 1988).

RESULTS

Food Habits

In 1990, 765 dissected castings contained 759 prey individuals from 11 families in 4 orders. In 1991, 680 castings contained 944 prey individuals from 9 families in 3 orders. Invertebrates made up 48.4% of diets in 1990, and 61.2% in 1991 based on casting analysis (Table 1). Prey remains for 1990 and 1991 included 187 individuals from 18 families in 6 orders (Table 2).

Use of only tiger beetles (Cicindelidae) differed ($P = .001$) among burrows in 1990. No differences ($P > .05$) were found among burrows in 1991.

Insect Use and Availability

In 1990, 705 insects from 10 families were captured in pitfall traps, and 7 families were represented in castings, including 1 family not captured in pitfall traps. The X^2 test indicated a difference between owl use of insects and pitfall-trapped insects ($X^2 = 11{,}963$, $P < .0001$, 10 df), implying that Burrowing Owls selected insect families disproportionately to numbers captured in pitfall traps. Specifically, differences ($P < .05$) were found in use of short-horned grasshoppers (Acrididae), ground beetles (Carabidae), camel crickets (Gryllacrididae), and carrion beetles (Silphidae) in 1990 (Table 3).

In 1991, 4692 insects from 13 families were captured in pitfall traps, and 7 families were represented in castings. As in 1990, the X^2 test indicated a difference between owl use of insects and pitfall-trapped insects ($X^2 = 643$, $P < .0001$, 12 df), but we found no differences ($P > .05$) in use of specific insect families (Table 4). Although more than 20% of categories contained less than five expected observations (Dixon and Massey 1969:238), the average expected observation was well over six for all categories, which made the use of this approximation appropriate (Roscoe and Byars 1971).

Castings Versus Prey Remains

Differences were detected in castings and prey remains for both 1990 and 1991. During both years combined, spadefoot toads (Salientia) and thirteen-lined ground squirrels (*Spermophilus tridecemlineatus*) occurred exclusively ($P < .05$) as prey remains, as did all moths (Lepidoptera) ($P < .0001$). Passerine remains were found once in castings, but more often ($P < .0001$) as prey remains in both years. During 1990 black-tailed prairie dog (*Cynomys ludovicianus*) occurred exclusively

TABLE 1. Frequency and percent occurrence of prey items in castings of Burrowing Owls at the Rocky Mountain Arsenal, Colorado, 1990–91.

	1990		1991		Total	
Prey item	N	%N	N	%N	N	%N
Vertebrates						
RODENTIA						
Cricetidae						
Cryptotis parva	1	0.1	0	0.0	0	0.0
Microtus ochrogaster	40	5.3	66	6.9	106	6.2
Peromyscus maniculatus	272	35.8	192	20.3	464	27.2
Passeriformes	1	0.1	0	0.0	0	0.0
Subtotal	314	41.4	258	27.2	570	33.4
Invertebrates						
COLEOPTERA						
Carabidae	1	0.1	20	2.1	21	1.2
Cicindelidae	54	7.1	41	4.3	95	5.6
Scarabeidae	55	7.2	80	8.5	135	7.9
Silphidae	109	14.3	124	13.1	233	13.7
Tenebrionidae	84	11.1	273	28.9	357	21.0
ORTHOPTERA						
Acrididae	63	8.3	36	3.8	99	5.8
Gryllacrididae	2	0.3	5	0.5	7	0.4
Subtotal	368	48.4	579	61.2	947	55.6
Other						
Rocks	52	6.8	104	11.0	156	9.2
Glass	1	0.1	0	0.0	1	tr[a]
Vegetation	17	2.2	1	0.1	18	1.0
Eggshell	7	0.9	2	0.2	9	0.5
Subtotal	77	10.1	107	11.3	184	10.7
Total	759	99.9	944	99.7	1703	99.7

[a]tr = <0.1%.

as prey remains ($P < .005$), while darkling (Tenebrionidae), scarab (Scarabeidae), and tiger beetles occurred exclusively in castings ($P < .05$). Carrion beetles occurred in castings and prey remains, but in greater numbers ($P < .005$) in castings. During 1991, Ord's kangaroo rat (*Dipodomys ordii*) was recorded exclusively as prey remains ($P < .05$). Short-horned grasshoppers occurred in castings and prey remains, but to a greater extent ($P < .0001$) as prey remains. Deer mice also occurred in both, but to a greater extent ($P < .001$) in castings.

DISCUSSION

Food Habits

While Burrowing Owls took large numbers of several families of Coleopterans, we believe that these prey items were taken opportunistically by day and mammalian prey were hunted exclusively at night. Haug and Oliphant (1990) never observed Burrowing Owls foraging diurnally for mammals. Likewise, in over 200 hours of observation, mammalian prey deliveries to the burrow during daylight were witnessed only twice at RMA in 1990 and 1991 (Plumpton 1992). Use of insect families varied little between nesting burrows. Both castings and prey remains revealed that deer mice were the single most important prey species on this site.

Insect Use and Availability

Burrowing Owls at RMA took insects in the families Acrididae, Carabidae, and Gryllacrididae at a rate less than expected, while preying on the family Silphidae more than expected based on pitfall trap results in 1990. In 1991 Burrowing Owls preyed on insect

TABLE 2. Food habits of Burrowing Owls based on prey remains found during biweekly searches at the Rocky Mountain Arsenal, 14 June–9 August 1990, and 5 April–26 July 1991.

	1990		1991		Total	
Prey item	N	%N	N	%N	N	%N
Vertebrates						
RODENTIA						
Cricetidae						
Microtus ochrogaster			11	8.5	11	5.9
Peromyscus maniculatus	40	67.8	10	7.8	50	26.7
Sciuridae						
Cynomys ludovicianus	1	1.7			1	0.5
Spermophilus tridecemlineatus	1	1.7	1	0.8	2	1.1
Heteromyidae						
Dipodomys ordii			1	0.8	1	0.5
PASSERIFORMES						
Alaudidae						
Eremophila alpestris	4	6.8	5	3.9	9	4.8
Emberizidae						
Sturnella neglecta	3	5.1	3	2.3	6	3.2
Icterus galbula			1	0.8	1	0.5
Muscicapidae						
Catharus spp.			1	0.8	1	0.5
Unknown spp.	1	1.7	8	6.2	9	4.8
SQUAMATA						
Viperidae						
Crotalus viridis			1	0.8	1	0.5
SALIENTIA						
Scaphiopus spp.	1	1.7	2	1.5	3	1.6
Subtotal	51	86.5	44	34.2	95	50.6
Invertebrates						
COLEOPTERA						
Carabidae			1	0.8	1	0.5
Cicindelidae			2	1.5	2	1.1
Scarabeidae			2	1.5	2	1.1
Silphidae	2	3.3	8	6.3	10	5.3
Tenebrionidae	2	3.3	25	19.5	27	14.4
LEPIDOPTERA						
Citheroniidae						
Hyalophora cecropia			1	0.8	1	0.5
Saturniidae						
Antheraea polyphemus	1	1.7			1	0.5
Sphingidae						
Celerio lineata			8	6.3	8	4.3
Noctuidae	2	3.3	3	2.3	5	2.7
ORTHOPTERA						
Acrididae	1	1.7	34	26.6	35	18.7
Subtotal	8	13.3	84	65.6	92	49.2
Total	59	99.8	128	99.8	187	99.7

families as expected based on pitfall trap results.

Castings Versus Prey Remains

Castings indicated greater use of deer mice and beetles (Coleoptera), while prey remains indicated greater use of mammals larger than deer mice, toads, and passerines, from which bones may not have been ingested. We suspected that larger items, such as prairie dog and prairie rattlesnake (*Crotalus viridis*), were scavenged from roadsides. Other authors have recorded organisms from prey remains that were not evident from castings (Thomsen 1971, MacCracken et al. 1985). Recording prey remains while collecting castings

TABLE 3. Use of insect prey by Burrowing Owls at the Rocky Mountain Arsenal, Colorado, 1990.

Insect family	Observed proportion in castings	Expected proportion in castings	Bonferroni interval on proportion
Acrididae	.171	.235	.115 ≤ P ≤ .227[a]
Carabidae	.002	.404	−.005 ≤ P ≤ .010[a]
Cicindelidae	.147	.0	.094 ≤ P ≤ .199[a]
Coccinelidae	.0	.001	0 ≤ P ≤ 0
Curculionidae	.0	.005	0 ≤ P ≤ 0
Elateridae	.0	.001	0 ≤ P ≤ 0
Gryllacrididae	.005	.167	−.005 ≤ P ≤ .016[a]
Lygaeidae	.0	.001	0 ≤ P ≤ 0
Scarabeidae	.149	.078	.096 ≤ P ≤ .202[a]
Silphidae	.296	.004	.228 ≤ P ≤ .364[a]
Tenebrionidae	.228	.101	.165 ≤ P ≤ .291[a]

[a]Significant at $P < .05$.

TABLE 4. Use of insect prey by Burrowing Owls at the Rocky Mountain Arsenal, Colorado, 1991.

Insect family	Observed proportion in castings	Expected proportion in castings	Bonferroni interval on proportion
Acrididae	.062	.176	.130 ≤ P ≤ .222
Carabidae	.034	.092	.057 ≤ P ≤ .127
Cicindelidae	.071	.075	.044 ≤ P ≤ .108
Cerambycidae	.000	.001	−.001 ≤ P ≤ .002
Coccinelidae	.000	.001	−.003 ≤ P ≤ .004
Curculionidae	.000	.001	−.003 ≤ P ≤ .005
Elateridae	.000	.003	−.004 ≤ P ≤ .010
Gryllacrididae	.008	.021	.004 ≤ P ≤ .039
Lygaeidae	.000	.014	.010 ≤ P ≤ .029
Mantidae	.000	.001	−.001 ≤ P ≤ .002
Scarabeidae	.138	.371	.313 ≤ P ≤ .429
Silphidae	.214	.089	.055 ≤ P ≤ .124
Tenebrionidae	.471	.154	.110 ≤ P ≤ . 197

requires little additional effort and may reveal use of prey items beyond those found in castings.

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LITERATURE CITED

BROWN, L. 1974. Data required for effective study of raptor populations. Pages 9–20 *in* F. E. Hamerstrom, Jr., B. E. Harrell, and R. R. Olendorff, eds., Management of raptors. Raptor Research Foundation, Vermillion, South Dakota.

BYERS, C. R., R. K. STEINHORST, AND P. R. KRAUSMAN. 1984. Clarification of a technique for analysis of utilization-availability data. Journal of Wildlife Management 48: 1050–1053.

DECN, H. J. 1978. A new method of analyzing pellets from owls, etc. Dansk Ornithologisk Forenings Tidsskrift 72: 143.

DIXON, W. J., AND F. J. MASSEY. 1969. Introduction to statistical analysis. McGraw-Hill, New York. 370 pp.

ENVIRONMENTAL SCIENCE AND ENGINEERING. 1989. Environmental setting, section 2.0. Rocky Mountain Arsenal biota remedial investigation-draft final report, version 2.2.

HAUG, E. A., AND L. W. OLIPHANT. 1990. Movements, activity patterns, and habitat use of Burrowing Owls in Saskatchewan. Journal of Wildlife Management 54: 27–35.

HUTTO, R. L. 1990. Measuring the availability of food resources. Studies in Avian Biology 13: 20–28.

MACCRACKEN, J. G., D. W. URESK, AND R. M. HANSEN. 1985. Burrowing Owl foods in Conata Basin, South Dakota. Great Basin Naturalist 45: 287–290.

NEU, C. W., C. R. BYERS, AND J. M. PEEK. 1974. A technique for analysis of utilization-availability data. Journal of Wildlife Management 38: 541–545.

OLENDORFF, R. R., AND J. W. STODDART. 1974. The potential for management of raptor populations in western grasslands. Pages 47–88 *in* F. N. Hamerstrom, Jr., B. E. Harrell, and R. R. Olendorff, eds., Management of raptors. Raptor Research Foundation, Vermillion, South Dakota.

PLUMPTON, D. L. 1992. Aspects of nest site selection and habitat use by Burrowing Owls at the Rocky Mountain Arsenal, Colorado. Unpublished master's thesis, Texas Tech University, Lubbock. 72 pp.

ROSCOE, J. T., AND J. A. BYARS. 1971. An investigation of the restraints with respect to sample size commonly imposed on the use of the chi-square statistic. Journal of the American Statistical Association 66: 755–759.

SAS INSTITUTE, INC. 1988. SAS/STAT user's guide, release 6.03 edition. Cary, North Carolina. 1028 pp.

THOMSEN, L. 1971. Behavior and ecology of Burrowing Owls on the Oakland Municipal Airport. Condor 73: 177–192.

WOLDA, H. 1990. Food availability for an insectivore and how to measure it. Studies in Avian Biology 13: 38–43.

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