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FOOD HABITS OF NORTHERN SPOTTED OWLS IN HIGH ELEVATION FORESTS OF PELICAN BUTTE, SOUTHWESTERN OREGON

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ABSTRACT—Eighty-two northern spotted owl (*Strix occidentalis caurina*) pellets containing 129 prey items were collected from high elevation forests in southwestern Oregon. Northern flying squirrels (*Glaucomys sabrinus*) comprised 50% of prey numbers and 54% of prey biomass. Other important prey were bushy-tailed woodrats (*Neotoma cinerea*) and voles (*Clethrionomys occidentalis* and *Microtus* spp.).

In 1990, the northern spotted owl (*Strix occidentalis caurina*) was listed as a threatened species by the U.S. Fish and Wildlife Service (USDI 1990). As logging of older forests continues, it is important to identify relationships between the spotted owl and its habitat that may be critical to its survival. Loss of habitat has occurred especially at lower elevations (Thomas et al. 1990), so information on diets of owls at high elevations will be important if they become isolated. Our objective was to determine prey species composition and biomass for northern spotted owls from four high elevation sites in Klamath County, southwestern Oregon. Prey species of spotted owls were identified by analyzing pellets.

STUDY AREA

We collected pellets from four sites near Pelican Butte, 5.6 km west of Upper Klamath Lake in Klamath County, southwestern Oregon. The sites were located on the northwest, northeast, southwest, and southeast slopes of Pelican Butte. Elevation varied among sites from 1350 to 1750 m. Most (95%) of the pellets were collected above 1650 m. The site at 1350 m was dominated by Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*). Two sites at 1650 m were dominated by Shasta red fir (*Abies magnifica*) and ponderosa pine. The site at 1750 m was dominated by red fir and white fir (*Abies concolor*). A variety of timber harvest practices from clearcut logging to selective cutting occurred within 3.2 km of collection areas.

MATERIALS AND METHODS

Pellets were collected at irregular intervals between 25 April and 8 August 1988. One of the four pairs of spotted owls under observation fledged two owlets during this period. The majority of the pellets (66%) were collected at the site with owlets. Prey were identified by comparing skeletal remains in each pellet to a collection of previously identified skeletons, and by comparisons with skeletal keys written by Maser and Storm (1970) and Verts (1978). If different halves of the same prey species were found in two pellets at the same site on the same day, they were counted together as a single prey item.

Data were summarized as percent species composition and percent biomass for each site, and for all sites combined. Biomass was calculated by multiplying the number of individuals of each species by the mean weight of that species. Mean weights were obtained from Forsman et al. (1984) and Maser and Storm (1970) (see Appendix).

RESULTS

Of the 82 pellets collected, 129 individual prey items were identified. The northern flying squirrel (*Glaucomys sabrinus*) was the only prey species common to pellets at all four sites. For all sites combined, flying squirrels dominated the diet, comprising 49.6% of prey numbers and 53.5% of prey biomass (Tables 1, 2). Bushy-tailed woodrats (*Neotoma*

TABLE 1. Percent composition of prey items of northern spotted owls, Pelican Butte, Oregon, 1988.

Elevation (m)	Percent of total prey				Total
	Site 1 ^a	Site 2	Site 3	Site 4	
Number of prey items	1650 86	1750 28	1350 9	1650 6	129
N. flying squirrel	61.6	17.9	44.4	33.3	49.6
Bushy-tailed woodrat	10.5		33.3	50.0	11.6
<i>Microtus</i> spp.					
Unidentified	3.5	42.9			11.6
Montane vole	3.5	25.0		16.7	8.5
Long-tailed vole	1.2				0.8
W. red-backed vole	7.0	10.7			7.0
Deer mouse	5.8				3.9
Townsend's chipmunk	1.2				0.8
Unidentified mammal	3.5		22.2		3.9
Unidentified bird	1.2	3.6			1.6
Unidentified insect	1.2				0.8

^a Site with owlets.

cinerea) were also important in biomass (28.9%), and voles (*Clethrionomys occidentalis* and *Microtus* spp.) were important in terms of numbers (27.9%). The majority (75%) of voles were *Microtus* species.

Prey items of the pair with two owlets were dominated by flying squirrels in numbers (61.6%) and biomass (63.7%) (Tables 1, 2). The diet of the pair at the highest elevation (1750 m) was dominated by voles in terms of both numbers (78.6%) and biomass (60.2%).

DISCUSSION

Although sample size in the present study is small, some comparisons can be made to previous studies of spotted owl diets in southwestern Oregon and in other high-elevation mixed-conifer forests. Forsman et al. (1984) found that in high elevation forests (1400 to 1700 m) dominated by grand fir (*Abies grandis*), Shasta red fir, and Douglas-fir in southwestern Oregon, spotted owl diets were dominated by flying squirrels, with western red-backed voles and bushy-tailed woodrats also being important in numbers and biomass, respectively. At Lake-of-the-Woods, a high elevation (1460 to 1700 m) study area just south of Pelican Butte, Forsman et al. (1984) reported prey composition and biomass

TABLE 2. Percent biomass of prey items of northern spotted owls, Pelican Butte, Oregon, 1988.

Elevation (m)	Percent of total biomass				Total (13,759 g)
	Site 1 ^a 1650 (9575 g)	Site 2 1750 (1217 g)	Site 3 1350 (1485 g)	Site 4 1650 (1082 g)	
N. flying squirrel	63.7	35.6	31.0	21.3	53.5
Bushy-tailed woodrat	24.9		53.5	73.5	28.9
<i>Microtus</i> spp.					
Unidentified	1.3	31.2			4.6
Montane vole	1.8	24.7		5.3	4.6
Long-tailed vole	0.6				0.4
W. Red-backed vole	1.4	4.3			1.5
Deer mouse	1.1				0.8
Townsend's chipmunk	0.8				0.6
Unidentified mammal	3.6		15.5		4.2
Unidentified bird	0.7	4.3			1.0
Unidentified insect	<0.1				<0.1

^a Site with owlets.

nearly identical to our results, except that western red-backed voles were more prevalent than *Microtus* species. In contrast, studies in lower elevation (<1400 m) mixed-conifer forests throughout southwestern Oregon (Miller 1989; Forsman et al. 1984) indicated that the diet was generally dominated by dusky-footed woodrats.

In Arizona (Ganey 1988), woodrats appear to be the most important prey item of spotted owls in terms of biomass throughout the state, but seem to be less common in the diets of spotted owls inhabiting high elevation mixed-conifer forests. Voles were more common prey at higher elevations.

It has been suggested that differences in the composition of spotted owl prey items in mixed-conifer forests of California may be explained by a greater abundance of flying squirrels at high elevations and more woodrats at low elevations (Laymon 1988), but no data have been presented to support this hypothesis. In Oregon, habitat of flying squirrels coincides with habitat of bushy-tailed woodrats, but reaches much higher elevations than that of dusky-footed woodrats (Bailey 1936). This could account for the dominance of flying squirrels rather than dusky-footed woodrats in the diet of spotted owls from high elevation forests of southwestern Oregon. Similarly, the dominance of voles in the diet of one pair in this study may be due to a greater abundance of voles than flying squirrels at that particular elevation (1750 m). Additional research on the elevational distribution of flying squirrels, woodrats, and voles is needed to confirm these patterns.

In the present study, 66% of the pellets were collected at a site with a pair and two owlets. Barrows (1985) suggested that breeding pairs select larger prey items than non-breeding pairs. We do not know if breeding status influenced the selection of prey items at Pelican Butte, but this relationship would not account for the selection of flying squirrels over woodrats. Information on prey abundance at high and low elevations is necessary to conclude that diet is a direct reflection of prey availability rather than preferential selection.

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Appendix. Names and weights of prey species found in northern spotted owl pellets.^a

Common name	Scientific name	Mean weight (g)
Deer mouse	<i>Peromyscus maniculatus</i>	22.00
Long-tailed vole	<i>Microtus longicaudus</i>	54.00
Montane vole	<i>Microtus montanus</i>	57.00
Northern flying squirrel	<i>Glaucomys sabrinus</i>	115.00
Townsend's chipmunk	<i>Eutamias townsendii</i>	80.00
Western red-backed vole	<i>Clethrionomys occidentalis</i>	23.00
Woodrat species	<i>Neotoma</i> spp.	267.00
Unidentified mammal		115.00
Unidentified <i>Microtus</i> spp.		42.00
Unidentified medium-sized bird		70.00
Unidentified insect		<1.00

^a Mean weights for biomass estimates were taken from Forsman et al. (1984) and Maser and Storm (1970).

