

Food Habits of the Northern Spotted Owl (*Strix occidentalis caurina*) at Six Nest Sites in Washington's East Cascades

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Abstract.—This paper reports on 245 pellet samples containing 479 identified prey items collected at six Northern Spotted Owl (*Strix occidentalis caurina*) breeding sites in the eastern portion of its range. The majority of prey (biomass) came from four species; northern flying squirrels (*Glaucomys sabrinus*), bushy-tailed woodrats (*Neotoma cinerea*), northern pocket gopher (*Thomomys talpoides*), and pika (*Ochotona princeps*). Flying squirrels were the most important dietary item, similar to the food habits of spotted owls in more mesic forests of Oregon and Washington.

The Northern Spotted Owl (*Strix occidentalis caurina*) is a medium-sized owl weighing 650-800 g, that inhabits low to mid-elevation mature conifer forests in the Pacific Northwest of the United States. On the east flanks of the Cascade Range, precipitation adequate to support closed canopy forest determines the eastern extent of its range.

This owl has been the subject of intense scientific scrutiny, especially since being designated "threatened" under the Endangered Species Act in 1990. Current research indicates a habitat preference for old-growth and mature forests across its range (Forsman *et al.* 1984, King 1993, Pidgeon 1995, Thomas *et al.* 1990). One of the significant ecological bases for this selection is thought to involve prey availability.

Previous published reports of spotted owl diet focused primarily on habitats in the western, more mesic portions of the species' range (Barrows 1985, Cutler and Hays 1991, Forsman *et al.* 1984). This paper presents results from an analysis of pellets from two study sites east of the Cascade's crest, in drier habitats closer to the margin of the species range.

METHODS

Owls regurgitate the undigested portions of their food in the form of pellets; balls of hair and bones which can be recovered from the ground under roosts or nest sites. These can be broken apart and prey species identified, thus yielding useful information about their food habits.

Pellets, prey remains, and bones remaining after pellets had disintegrated, were collected around nest trees and from the immediate vicinity of known spotted owl nest sites. Items were placed in plastic bags and labeled (site, date collected and number of pellets in each sample). Visual observations of prey items captured or being held by individual owls, were recorded.

Pellets were gathered in 1986 from four nesting sites in the Swauk Creek drainage, approximately 20 km northeast of Cle Elum, Washington. Pellets and prey observations were collected on the Yakama Indian Reservation (YIR) in south-central Washington from 1992-1996 (fig. 1). Diet from two sites on the YIR are analyzed in this paper, with data from six other sites included in the overall totals for the YIR.

Habitats used by spotted owls were similar on both study areas. Nest stands were in mid-elevation (1,000-1,370 m) Grand fir (*Abies grandis*) stands (Franklin and Dyrness 1973).

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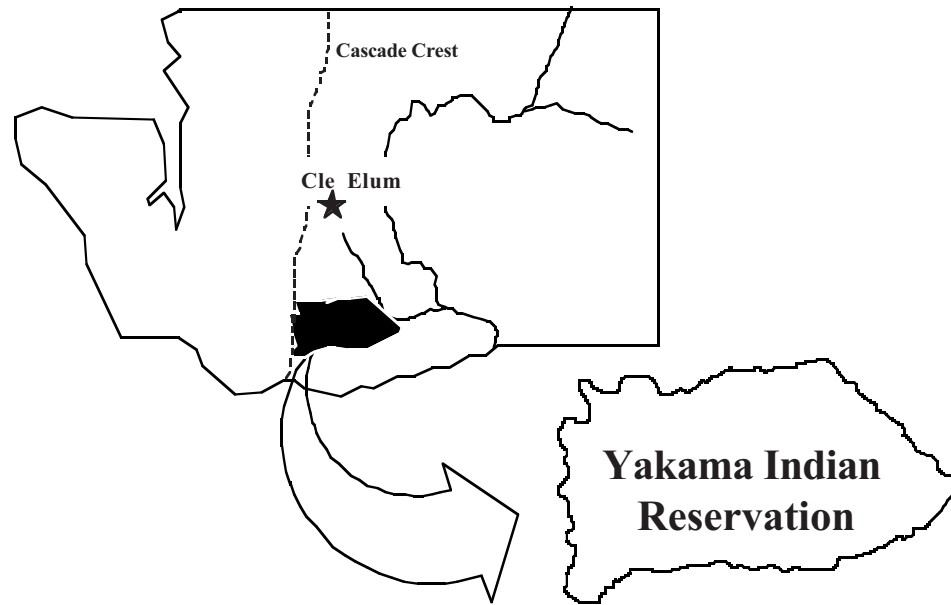


Figure 1.—Washington State with location of Cascade crest (approximate) and study areas.

Pellet samples collected from both study areas were treated similarly. Each pellet was placed in a secure numbered fabric bag and soaked in hot soapy water for 24 hours. The Cle Elum pellet bags were machine-washed, rinsed and dried (after large bones were removed), while processing of the YIR pellets was by hand. Identifiable bone and insect pieces were separated using dental tools and tweezers. The hair remains were discarded from the YIR pellets. Microscopic hair analyses were conducted on 27 Cle Elum pellets, with samples mounted on slides using a toluene-based fixative.

Teeth and bones were identified to the lowest possible taxon, usually species, sometimes genus, or at a minimum, to large (>10 0g) or small (<100 g) prey item (Barrows 1985). Skulls and jaws were most diagnostic, though not always present. A key was devised to identify skulls and teeth, based on species expected or known to occur in the study area (Burt and Grossenheider 1980, Hall and Kelson 1959, Hanson 1978, Ingles 1965, Maser and Storm 1970). Richards performed the Cle Elum analyses in 1986 at Colorado State University, Ft. Collins, with the assistance of the Composition Analysis Laboratory and reference skeletons. The YIR specimens were

analyzed in the summer and fall of 1996 by four observers using keys and reference skeletons. Identification of remains in YIR pellets were verified by L. James and S. Rigden.

For each sample, the minimum number of prey items was determined from a count of like skeletal pieces for each species represented. Mean prey weights used to calculate biomass were adopted from existing literature (Burt and Grossenheider 1980, Forsman *et al.* 1984), or calculated from local data. In the case of flying squirrels, average weight was calculated from weights of animals live-trapped on the YIR in 1996. Weights used for large and small prey item analysis were a weighted average of all identified prey. Weights used for biomass calculations for birds were a similar weighted average of identified bird prey items. Insects were identified as prey items, but were not included in calculations due to inability to count individuals, and their estimated small contribution to total biomass consumed.

Diet data were summarized by site, with relative frequency and biomass of prey species calculated for each of the six nest sites. Finally, calculations were repeated with sites pooled by study area.

RESULTS AND DISCUSSION

An analysis of 245 samples yielded 479 individual prey items in 20 vertebrate species (table 1). This list indicates that a wide variety of prey items is eaten by spotted owls in the study areas. Relative frequency (table 2) was used to describe the general make up of the observed prey items by study area.

Table 1. —Northern spotted owl prey species identified from six nest sites in eastern Washington.

Size category	Common name	Species
Major large (≥ 100 g) prey species	Northern flying squirrel	<i>Glaucomys sabrinus</i>
	Northern pocket gopher	<i>Thomomys talpoides</i>
	Bushy-tailed woodrat	<i>Neotoma cinerea</i>
	Pika	<i>Ochotona princeps</i>
Minor large (≥ 100 g) prey species	Douglas squirrel	<i>Tamiasciurus douglasii</i>
	Snowshoe hare	<i>Lepus americana</i>
	Townsend mole	<i>Scapanus townsendii</i>
Major small (< 100 g) prey species	Red-backed vole	<i>Clethrionomys gapperii</i>
	Deer mouse	<i>Peromyscus maniculatus</i>
	Long-tailed vole	<i>Microtus longicaudus</i>
Minor small (< 100 g) prey species	Mountain phenocomys	<i>Phenacomys intermedius</i>
	Townsend's chipmunk	<i>Tamias townsendii</i>
	Yellow-pine chipmunk	<i>Tamias amoenus</i>
	Pacific mole	<i>Scapanus orarius</i>
	Shrew	<i>Sorex</i> spp.
	Western tanager	<i>Piranga ludoviciana</i>
	Evening grosbeak	<i>Coccothraustes vespertinus</i>
	Dark-eyed junco	<i>Junco hyemalis</i>
	Red-breasted nuthatch	<i>Sitta canadensis</i>
	Hermit thrush	<i>Catharus guttatus</i>
	Large beetles/crickets	

Table 2.—Relative frequencies of prey species by study area.

Species	Cle Elum (n=352)	YIR (n=113)
<i>G. sabrinus</i>	0.35	0.55
<i>T. talpoides</i>	.08	.05
<i>N. cinerea</i>	.08	.03
<i>O. princeps</i>	.07	.02
Other large	.07	.05
<i>P. maniculatus</i>	.07	.04
<i>C. gapperii</i>	.04	.10
<i>Microtus</i> spp.	.04	.01
Other small	.14	.10
Birds	.06	.06



Table 2 shows an overall similarity in diet on the two study areas. Subtle differences, however, could offer insight into dietary variation across eastern Washington. Flying squirrels were the largest item by proportion on both study areas, with a higher relative frequency on the YIR. Pocket gopher, bushy-tailed woodrat, pika, and other large prey items made up a greater share of the diet on the Cle Elum. More deer mice were taken on Cle Elum, but more red-backed voles were identified on the YIR.

Biomass is considered the best method for comparing dietary information, because it provides a better indication of importance of prey items in meeting individuals' caloric needs. Table 3 summarizes the weights used in this analysis for obtaining biomass estimates.

Table 3.—Weights used for biomass calculations.

Species	Weight grams	Source
<i>G. sabrinus</i>	140	YIR 1996
<i>N. cinerea</i>	265	Forsman <i>et al.</i> 1984
<i>T. talpoides</i>	100	Burt and Grossenheider 1990
<i>O. princeps</i>	158	Forsman <i>et al.</i> 1984
Other large	150	Weighted avg.
<i>P. manicula</i>	22	Forsman <i>et al.</i> 1984
<i>C. gapperii</i>	29	Maser and Storm 1970
<i>Microtus</i> spp.	54	Maser and Storm 1970 (<i>M. longicaudus</i>)
Other small	31	Weighted avg.
Birds, Yakama	43	Avg. of known bird kills on YIR
Birds, Cle E.	21	Richards 1989

On all six breeding sites, large prey comprised the majority of biomass consumed (table 4). Over each study area, large prey items made up 90.5 percent of the biomass on the Cle Elum study area and 91.1 on the YIR (table 5). This indicates that although spotted owls are foraging on small prey items, larger prey are most important for meeting their dietary needs.

These results are similar to other spotted owl diets reported from the Pacific Northwest, with flying squirrels indicated as the dominant food

item (Allen and Bicknell 1985, Forsman *et al.* 1984, Thomas *et al.* 1990, Cutler and Hays 1991). The presence in the diet of other large prey items, particularly pocket gopher and pika, suggest varying degrees of opportunistic hunting. For example, on Cle Elum's Green site, a large proportion of the owls' diet was composed of pika. This is probably a reflection of availability of large areas of talus in this area. The high proportion of pocket gopher at Green, and at Vessey on the YIR, may indicate foraging in open forests or meadows where gophers occur (Ingles 1965). These sites contrast to owl sites such as Howard on the YIR, with an extensive closed canopy forest setting, where flying squirrels are the dominant prey item.

This analysis suggests that selection for flying squirrels is taking place. Northern Spotted Owls prefer mature forest habitats, perhaps because flying squirrels reach their greatest densities in these habitats (Carey 1991).

MANAGEMENT AND RESEARCH RECOMMENDATIONS

Protecting habitat for prey species is undoubtedly an important element of spotted owl conservation, especially in landscapes subject to logging. Further work is needed on the habitat needs of these species, particularly the flying squirrel. This work should focus on stand structure attributes needed by these prey species, such as snags, logs, and dwarf mistletoe. With a greater understanding of owl prey ecology, we might better provide for the needs of the Northern Spotted Owl into the future.

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Table 4.—Prey species as percent biomass of diet at six Northern Spotted Owl nest sites on the east slope of the Washington Cascades.

Species	Cle Elum				YIR	
	Swauk (n ¹ =139)	Liberty (n ¹ =66)	Hovey (n ¹ =109)	Green (n ¹ =38)	Howard (n ¹ =50)	Vessey (n ¹ =45)
<i>Glaucomys sabrinus</i>	59	37	41	28	68	65
<i>Thomomys talpoides</i>	9	7	4	13	2	12
<i>Neotoma cinerea</i>	12	23	25	12	4	6
<i>Ochotona princeps</i>	5	10	9	35	5	0
Other Large ²	3	16	11	7	15	0
Combined Small ³	13	7	9	6	6	15

¹Total number of prey items identified from each site.

²Includes *Lepus americana* and unidentified bones of prey items >100 g.

³All prey species <100 g.

Table 5.—Prey species as percent biomass of Northern Spotted Owl diet by study area on the east slope of the Washington Cascades.

Species	Cle Elum (n ¹ =352)	YIR (n ¹ =95)
<i>Glaucomys sabrinus</i>	45	70
<i>Thomomys talpoides</i>	8	5
<i>Neotoma cinerea</i>	19	6
<i>Ochotona princeps</i>	11	3
Other large ²	9	7
Combined small ³	9	9

¹Total number of prey items identified on all sites within study area.

²Includes *Lepus americana* and unidentified bones of prey items >100 g.

³All prey species <100 g.

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