Figure 1. One-month-old Goshawk chicks. The adult female is in the background.

FEEDING ECOLOGY OF THE SPOTTED OWL IN CALIFORNIA

by
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Abstract

The Spotted Owl (*Strix occidentalis*) from the Coast Range of northern California and the Peninsular Range of southern California preys heavily on forest-dwelling mammals, especially the dusky-footed woodrat (*Neotoma fuscipes*). Meadows are not regularly hunted by these owls, despite large numbers of prey there. Indexes of prey biomass diversity indicate a relatively narrow prey base for the Spotted Owl in California. The Screech Owl (*Otus asio*) is an uncommon but regular prey item of the Spotted Owl; mobbing by Screech Owls in response to imitated Spotted Owl calls is described.

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Introduction

Forsman (1975) provided a very complete analysis of Spotted Owl (*Strix occidentalis*) prey in Oregon, but comprehensive regional food data from other locations are nearly absent. Prior to Forsman's study, Marshall (1942) reported prey contents of two Spotted Owl stomachs together with several pellets from one location in the Sierra Nevada, California, and three owl stomach contents from the northern Cascades, Oregon. Other published accounts have described less than 20 prey items from a single location, in most cases from only one stomach (Richardson 1906; Daggett 1913; Dickey 1914; Huey 1932; Miller 1933; Johnson and Russell 1962; Smith 1962; Maser 1965; Kertell 1977).

I present prey data from nine pairs of Spotted Owls in California. These data are then compared to those presented by Forsman (1975) for Oregon. Measures of prey species diversity and biomass diversity are also considered. This comparison permits the elucidation of patterns in Spotted Owl prey selection over a wide geographic area.

Study Site and Methods

Prey data from the North Coast Range of northern California were gathered from four pairs of Spotted Owls from June through August 1977. Two pairs were in the Nature conservancy's Northern California Coast Range Preserve, Mendocino County. Another pair was on Point Reyes Peninsula, Marin County, and a fourth pair at San Geronimo, Marin County.

In the Peninsular Range of southern California data were collected from five pairs of owls between June 1978 and November 1979: one pair each in the San Jacinto Mountains, Riverside County; Santa Ana Mountains, Orange County; Palomar Mountain, San Diego County; and two pairs in the Cuyamaca Mountains, San Diego County.

Vegetation at all locations was typical of the mixed evergreen forest (Sawyer et al. 1977). A more complete description of the habitat characteristics at each site is given in Barrows and Barrows (1978) and Barrows (1980).

All prey items identified were recovered from Spotted Owl pellets, totalling 250 pellets from the North Coast Range and 200 pellets from the Peninsular Range. The accuracy of using owl pellets in a determination of prey consumption was discussed by Errington (1930). Mammalian prey items were identified using the keys of Ingles (1965) and Glass (1973). Small mammal densities in meadows were estimated by observing visual signs of activity (i.e., runways). Other prey species were identified by comparison with museum specimens and, in the case of insects, with living individuals. Prey weight measurements used in the calculation of percent biomass are from Forsman (1975). Prey biomass diversity was calculated as the product of the number of individuals of a particular species multiplied by that species' mean weight.

Results and Discussion

The prey species and their relative proportion in the Spotted Owls' pellets are shown in table 1. Calculations of percent biomass are also included as a more descriptive measure of the value of each prey species in meeting the owls' energetic requirements. Table 1 shows two major trends: there is a clear preference by the owls for forest-dwelling species; and the dusky-footed woodrat (*Neotoma fuscipes*) accounts for a significant proportion of the total biomass consumed by Spotted Owls.

The only nonforest species listed in table 1 is the California meadow mouse (*Microtus californicus*) whose preferred habitat is meadows. Spotted Owl hunting ranges occasionally encompassed meadows which were found to harbor large numbers of meadow mice.

Table 1. Spotted Owl Prey Items from the North Coast and Peninsular Mountain Ranges of California.

Species	North Coast Range (N = 375) N	Percent Occurrence	Percent Biomass	Peninsular Range (N = 296) N	Percent Occurrence	Percent Biomass
Mammals						
Neotoma fuscipes	112	29.9	69.2	98	33.1	79.3
Arborimus longicaudus	64	17.1	4.0	0	0.0	0.0
Glaucomys sabrinus	56	14.9	14.8	0	0.0	0.0
Peromyscus sp.	48	12.8	2.4	91	30.7	6.0
Scapanus latimanus	4	1.1	0.5	1	0.3	0.2
Microtus californicus	2	0.5	0.1	3	1.0	0.2
Lasiurus cinereus	2	0.5	0.05	0	0.0	0.0
Mustela erminea	1	0.3	0.1	0	0.0	0.0
Sylvilagus sp.	1	0.3	0.8	1	0.3	1.0
Eutamias sp.	1	0.3	0.2	1	0.3	0.2
Thomomys bottae	0	0.0	0.0	23	7.8	6.0
unident. mammals	2	0.5	0.1	0	0.0	0.0
Birds						
Cyanocitta stellari	10	3.1	2.7	5	2.1	2.0
Otus asio	5	1.3	1.6	3	1.0	1.3
Glaucidium gnoma	1	0.3	0.1	0	0.0	0.0
other birds[a]	21	5.6	3.4	18	6.1	3.8
Arthropods[b]	45	12.0	0.2	52	17.6	0.3

a. Includes *Melanerpes formicivorus, Colaptes auratus, Turdus migratorius, Junco hyemalis,* unidentified species.

b. Includes largely insects (Orthoptera, Coleoptera), with a minor representation of Scorpionida and Diplopoda.

The low numbers of this species in Spotted Owl pellets in both regions suggest that the owls rarely hunt in such open areas. My observations of Spotted Owls during twilight hours showed them to hunt exclusively from elevated perches; the absence of such perches in open meadows may account for their low utilization of these areas.

The remaining prey species commonly inhabit forested areas. Of these species, the dusky-footed woodrat, the western flying squirrel (*Glaucomys sabrinus*), the red-backed tree mouse (*Arborimus longicaudus*), and the deer mouse (*Peromyscus* sp.) make up the largest portion of the diet in areas examined.

In the North Coast and Peninsular Ranges, California, and in the eastern Siskyou Mountains of southern Oregon (Forsman 1975), the dusky-footed woodrat comprises over 69 percent of the Spotted Owl prey biomass. In other regions of Oregon reported by Forsman (1975) the dusky-footed woodrat constitutes only a minor portion, or is absent, as a prey item in the Spotted Owls' diet. In those regions, the flying squirrel and the bushy-tailed woodrat (*Neotoma cinerea*) were the most common prey species.

Prey diversity (table 2) gives a further characterization of the Spotted Owl's prey base. Numbers and proportions of prey species in each region are roughly similar, hence the consistent values for the species diversity index. However, prey biomass diversity index, which emphasizes relative mass of individual prey items, is lower for California areas and the eastern Siskyou Mountains than for any other Oregon sites. Lower prey biomass diversity values indicate a relatively narrow prey base, in this case a reflection

of the large numbers of heavy dusky-footed woodrats in the diet. Prey biomass diversity may be a more descriptive method of depicting the prey base because it does not compute a woodrat and a beetle to be of equal importance.

Table 2. Regional Comparison of Spotted Owl Prey Diversity.

Location	N	Prey Species Diversity[a]	Prey Biomass Diversity[a]
Oregon (7 areas)[b]	2,453	2.43–1.18	2.20–1.50
Oregon, eastern Siskyou Mountains[b]	176	1.81	1.02
Northern California Coast Range	375	1.97	1.15
Southern California Peninsular Range	296	1.62	0.87

a. Shannon-Wiener diversity index, H' = - pi log pi.

b. Calculated from Forsman 1975; (tables 1–8).

In regions where dusky-footed woodrats commonly occur, such as those reported from California and the eastern Siskyou Mountains, these mammals appear to be preferentially taken by Spotted Owls. Forsman (1975) suggested that Spotted Owls prey selectively on larger, arboreal mammals over more abundant, smaller, terrestrial species. It is unclear, however, whether it is larger size or semiarboreal habits or a combination of these factors that stimulate Spotted Owls to select such a high proportion of dusky-footed woodrats.

Future research might examine the possible relationship between woodrat populations and the reproductive biology and/or habitat selection of Spotted Owls in California. Other studies have revealed a correlation between prey numbers and the reproductive success of owls (Craighead and Craighead 1956; Southern 1970; Adamcik et al. 1978), and of other raptors (Hamerstrom 1979). Spotted Owls do not breed every year (Forsman 1975; Barrows unpubl. data). The dominance of woodrats in Spotted Owl diets from the areas reported in this study and the knowledge that woodrat populations can fluctuate greatly from year to year (Linsdale and Tevis 1951) suggest a possible cause and effect relationship in Spotted Owl breeding patterns.

Of the nonmammalian prey (table 1), the occurrence of the Screech Owl (*Otus asio*) in the Spotted Owls' diet warrants particular mention. So-called cannibalism by Spotted Owls was reported by Richardson (1906) and Daggett (1913) after finding remains of the Pygmy Owl (*Glaucidium gnoma*) in Spotted Owl stomachs. Forsman (1975) reported the Screech, the Pygmy, and the Saw-Whet Owl (*Aegolius acadicas*) as Spotted Owl prey items. While calling for Spotted Owls during summer nights, using vocal imitations of their calls, I was frequently "mobbed" by Screech Owls. Immediately following my imitation of a Spotted Owl call, Screech Owls in the near vicinity frequently began calling in a raucous, chattering manner. The Screech Owls were usually in family groups of one or two adults accompanied by several owlets. Both adults and immatures used the chattering calls. Adult Screech Owls moved sporadically through the trees surrounding me while calling; the owlets remained more or less stationary. The adult and immature

Screech Owls were easily located with a flashlight while engaged in this mobbing behavior. A high proportion of Screech Owl remains in the Spotted Owl pellets were recovered during July, the same period when the mobbing behavior of Screech Owl family groups was most pronounced. The chattering call by Screech Owls in response to a Spotted Owls' call was also heard, but at a lower intensity, throughout the late summer and fall months. The effect of the Screech Owls' mobbing behavior on Spotted Owls is unknown, but it certainly made my detection of these small owls easier.

Conclusions

General conclusions which can be drawn from this analysis of Spotted Owl feeding ecology are:

1. The owls' diet consists largely of forest-dwelling mammalian species, with prey items averaging more than 100 g.
2. Meadows or large open expanses were not regularly used by Spotted Owls for hunting, despite potentially large numbers of prey there.
3. When available, the dusky-footed woodrat comprises a high proportion of Spotted Owls' diet in California and may be preferentially selected by the owls.

I have no prey data from the Sierra Nevada or data on temporal variation in prey selection. The need for more data pertaining to the relationship between prey and Spotted Owl breeding patterns is discussed above. These gaps need to be filled before our knowledge of Spotted Owl feeding ecology is complete.

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ANNOUNCEMENTS

REQUEST FOR OBSERVATIONS

Please report any fall/winter sightings of adult Harlan's race Red-tailed Hawk (*Buteo jamaicensis harlani*). Include plumage description or photographs along with sighting locations. Historical information is also welcome.

Send information to: David Mindell, c/o Bureau of Land Management, 4700 E. 72nd, Anchorage, AK 99507.

CONFERENCE FOR INTERNATIONAL ASSOCIATION FOR FALCONRY AND CONSERVATION OF BIRDS OF PREY

The International Association for Falconry and Conservation of Birds of Prey is organizing a conference, 'Understanding the Goshawk', to be held in Oxford, Great Britain, from 29th September to 1st October 1981. This follows the 1977 conference on 'Bird of Prey Management Techniques', which was attended by ornithologists, vets and falconers from 20 countries.

Goshawk populations have recently increased in some parts of Europe, following restrictions on pesticide usage, and there is renewed controversy between hunting and protection interests about goshawk control. This conference will present recent research findings on goshawk population dynamics, predation and management, thus providing a basis for formal and informal discussion of how some of the conflicts might be resolved. The program will be of ½-hour papers by main speakers, with some shorter contributions and no late-night sessions! Proceedings will be published.

Those interested in giving papers or otherwise participating please contact: Dr. Robert Kenward, Institute of Terrestrial Ecology, Monks Wood, Abbots Ripton, HUNTINGDON, Great Britain.