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DIET SHIFTS IN BREEDING AND NONBREEDING SPOTTED OWLS

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ABSTRACT.—Shifts in the diets of breeding and nonbreeding Spotted Owls (*Strix occidentalis*) are compared. Breeding owls prey more on larger rodents, and statistical differences in the percentage of large mammalian prey between breeding and nonbreeding owls are apparent only after feeding of young begins. Whether these diet shifts reflect prey availability or in part prey selection is not conclusively determined. However, seasonal diet differences and diet shifts immediately following breeding failures suggest prey selection plays a role.

The Spotted Owl (*Strix occidentalis*) feeds primarily on a wide range of mammalian prey (Barrows 1980; Forsman et al. 1984). Breeding performance appears to vary with diet, with a preponderance of large prey species taken during successful breeding years (Barrows 1985). Herein, I describe diet shifts in Spotted Owls and suggest whether the shifts are a reflection only of prey availability or of availability and preferential prey selection.

Distinguishing in the field between prey availability and preference or selection of certain prey types by Spotted Owls presents a difficult problem. Sampling methods for estimating densities of major prey species such as Dusky-Footed Woodrats (*Neotoma fuscipes*), Northern Flying Squirrels (*Glaucomys sabrinus*) and Red Tree Voles (*Phenacomys longicaudis*) vary considerably. I did not quantify prey populations; without such data any effort to clarify the importance of preferential predation falls short. I was able, however, through natural occurrences such as nesting failures and by examining seasonal changes in diet to imply a role of differential prey selection in the Spotted Owl diet.

STUDY AREA AND METHODS

Prey data presented here were from ten Spotted Owl territories (A–I). Territories A–F were at or in areas adjacent to the Nature Conservancy's Northern California Coast Range Preserve in Mendocino County, California; G and H were at Butte Creek, Humboldt County; I and J were in Cuyamuca State Park, San Diego County, California. Prey data in this study are from regurgitated pellets I collected weekly between 1977 and 1985 during spring and summer months below diurnal roosts and in nest cavities. On this basis, 1829 individual prey items were identified. Skulls and jaws were used to enumerate total prey/sample, providing a conservative estimate of prey numbers but eliminating double counts of large prey items that occurred in two or more pellets.

Mammalian prey items were grouped into two size classes: large (>100 g) and small (<100 g), corresponding to a natural gap in prey sizes taken by Spotted Owls (Table 1). Only mammalian prey were considered in this analysis as they constitute >90% of the biomass consumed by Spotted Owls (Barrows 1980). Seasonal comparisons of diet were divided between spring (courtship/incubation) and summer (nestling/fledgling) phases of the breeding cycle.

RESULTS

Spotted Owls took larger prey when successfully breeding than in years when they did not breed. Year-to-year prey size variation in relation to breeding performance by owls in two territories provides an example of this trend (Fig. 1). Difference in percentage of large prey in the diet of all breeding Spotted Owls compared with non-breeders included in this study was significant (Mann-Whitney U- Test (11,17) = 143; $P < 0.02$) (Fig. 2).

Fewer large prey items appeared in diets of nonbreeding owl pairs in summer compared to spring (Fig. 2). Differences between the two seasons was not significant (Mann-Whitney U-Test (8,8) = 46, $P < 0.20$), although a reduction occurred in seven of eight nonbreeding owl pairs. Pair B did not reduce large prey in their diet in summer of 1984 but had shown a seasonal reduction in their diet in each of three previous nonbreeding years.

In contrast breeding pairs significantly increased the percentage of large prey in their diet between spring and summer (Mann-Whitney U-Test (5,5) = 25; $P < 0.05$). Spring diets of breeding and nonbreeding Spotted Owls had no significant difference between proportions of large and small prey ($U(5,8) = 15.5$; $P > 0.20$). However, the difference in summer diets of breeding and nonbreeding owls was highly significant ($U(5,8) = 40$; $P < 0.002$).

In 1983 and again in 1985 after two–three wks incubation the breeding effort of Spotted Owls in territory B failed due to an undetermined cause. Comparison of this pair's diet preceeding and following breeding failures (Fig. 3) indicates a clear

Table 1. Frequencies of prey species taken by eight Spotted Owl pairs in California.

		OWL TERRITORIES									
WEIGHT[a] (g)	SPECIES	A	B	C	D	E	F	G	H	I	J
300	*Sylvilagus bachmani*	0	0	0	3	0	0	1	4	1	0
269	*Neotoma fuscipes*	28	9	20	28	22	42	15	17	31	47
115	*Glaucomys sabrinus*	14	15	18	21	3	5	8	4	0	0
100	*Thomomys bottae*	0	0	0	0	0	0	1	3	11	9
60	*Eutamias speciosus*	0	0	0	0	0	0	0	0	1	0
56	*Scapanus latimanus*	0	1	1	0	0	0	0	0	1	0
39	*Microtus californicus*	2	2	4	1	1	0	12	5	0	0
28	*Lasiurus cinereus*	0	0	1	1	0	0	1	0	0	0
27	*Phenacomys longicaudus*	23	36	16	21	22	31	26	34	0	0
22	*Peromyscus maniculatus*	14	16	21	8	37	16	26	5	37	25
11	*Neurotrichus gibbsi*	0	0	0	0	0	0	0	2	0	0
9	*Sorex trowbridgei*	1	1	0	0	0	0	4	0	0	0
	Birds	8	8	3	0	0	0	1	2	4	11
	Arthropods	11	11	15	17	12	21	3	20	13	7
Sample Size		406	672	114	91	32	37	225	100	97	55

[a] $\bar{x}$; From Burt and Grossenheider (1976) and Forsman et al. (1984).

and significant shift from primarily large to smaller prey ($\chi^2 = 11.6, 12.6$; df = 1; $P < 0.001$).

A single owlet produced in territory A in 1984 died the day it fledged. Again, a significant reduction of large prey taken by the adults followd ($\chi^2 = 11.6$; df = 1; $P < 0.001$). The owlet weighed >20% less (325 g) than the fledging weights of two successful owlets from previous years (410 g and 420 g).

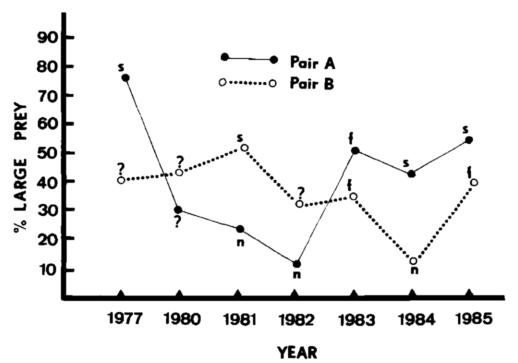

Figure 1. Yearly frequency (1977–1985) of large prey in the diet of two Spotted Owl pairs, including yearly variation in breeding status. s = successful breeding; ? = not breeding (whether or not breeding was attempted was not determined); n = no attempt at breeding; f = failed breeding attempt.

DISCUSSION

Evidence of nonselective (random) predation by owls comes from general diet descriptions and correlations between owl numbers or breeding success and fluctuations in primary prey populations (Craighead and Craighead 1956; Wendland 1984).

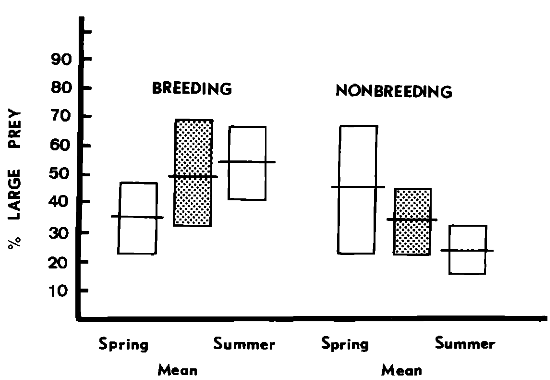

Figure 2. Seasonal variation and total mean variation in frequency of large prey in the diets of breeding and nonbreeding Spotted Owls. Horizontal bars = $\bar{x}$; vertical bars = ± one SD.

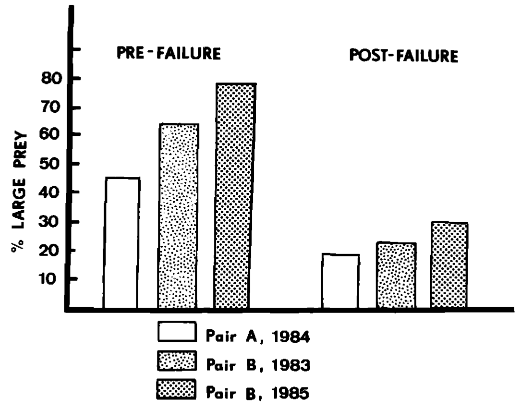

Figure 3. Frequency of large prey in the diets of two pairs (A and B) of Spotted Owls which had failed breeding attempts.

Forsman et al. (1984) described the occurrence of various prey species in the diet of Spotted Owls in Oregon and noted close similarity with seasonal availability of some prey such as Botta Pocket Gophers (*Thomomys bottae*) or Coast Moles (*Scapanus orarius*). Unquestionably, prey availability is a factor in determining the diet of predators. My objective here was to examine whether preferential predation also plays a part in the diet of breeding Spotted Owls.

Some measure of prey availability would provide a clearer assessment of Spotted Owl predation preferences. In lieu of these data I have used diet shifts following breeding failures and overall diet patterns in breeding and nonbreeding owls to postulate the occurrence of preferential predation. Shifts by breeding Spotted Owls to larger prey items post-hatching is in contrast with the opposite trend in nonbreeding owls, supporting a hypothesis of preferential predation on larger prey by breeding pairs. One test of the hypothesis would involve altering the breeding status of pairs which had already committed to breeding. A significant shift in predation pattern involving frequency of larger prey could be taken as support of the hypothesis. Breeding failures observed in territories A and B were natural "tests" of this kind. The observed, significant shift away from large prey was consistent with preferential predation hypothesis predictions.

While observations are in accordance with the hypothesis that breeding Spotted Owls preferentially prey on large rodents, this, or an alternative hypothesis was not rigorously tested. Concurrent studies of Dusky-Footed Woodrat and Northern Flying Squirrel population dynamics with Spotted Owl diets and breeding success are needed before conclusions can be reached.

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