Wilson Bull., 108(1), 1996, pp. 123–128

DIETS OF NORTHERN PYGMY-OWLS AND NORTHERN SAW-WHET OWLS IN WEST-CENTRAL MONTANA

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Abstract.—One hundred ninety-four prey from 31 Northern Pygmy-Owls (*Glaucidium gnoma*) and 388 prey from 23 Northern Saw-whet Owls (*Aegolius acadicus*) were compared. Thirty-six percent of the pygmy-owl's prey was birds, whereas, 98.0% of the saw-whet owl's prey was small mammals, particularly voles. Food niche breadth and dietary evenness was 10.6 and 0.69 for pygmy-owls vs 3.3 and 0.89 for saw-whet Owls. Body mass of prey killed by both species was about 38 g. Dietary overlap between these two owl species was 37.0%, indicating that they fed on different prey assemblages. *Received 4 April 1995, accepted 28 Aug. 1995.*

Northern Pygmy-Owls (*Glaucidium gnoma*) and Northern Saw-whet Owls (*Aegolius acadicus*) overlap throughout much of their range in the western United States (AOU 1983). The natural history of Northern Pygmy-Owls is poorly known (Holt and Norton 1986, Holt et al. 1990), while that of Northern Saw-whet Owls is more certain (Cannings 1993).

In west-central Montana, Northern Pygmy-Owls and Northern Saw-whet Owls occur sympatrically from mixed deciduous and coniferous forested valley bottoms (975 m) to higher elevation (1584 m) coniferous forests (Holt and Hillis 1987). Both species are obligate cavity nesters, dependent upon woodpeckers or natural sites for nests. Both species forage similarly, using a perch and pounce technique. Northern Pygmy-Owls are crepuscular or diurnal, and Northern Saw-whet Owls are nocturnal. The diet of Northern Pygmy-Owls has been reported at the class level, while that of Northern Saw-whet Owls has been specific and thoroughly reviewed (Marks and Doremus 1988, Holt et al. 1991, Swengel and Swengel 1992). Several authors have compared the diets of sympatric owl's (Maser et al. 1970, Knight and Jackman 1984, Marks and Marti 1984, Nilsson 1984, Bosakowski and Smith 1992), but Herrera and Hiraldo (1976) in Europe, and Hayward and Garton (1988) in North America, have compared the diet of small cavity nesting forest owls. Herein, we compare their diet, prey biomass, food niche breadth (FNB), dietary evenness (DE), and dietary overlap (DO).

Pellets and pellet fragments from Northern Pygmy-Owls and Northern Saw-whet Owls were collected below roost trees near Missoula, Montana, during the non-breeding season—October through February 1987 to 1992. Pellets were dissected by hand, and prey species were identified

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and quantified using skulls and mandibles. Diurnal field observations of hunting Northern Pygmy-Owls with prey were also included. To evaluate these owls' trophic niches, we first compared prey species frequencies and percentages. We then computed the Shannon-Weaver diversity index to compare their FNB: where $H' = -\Sigma p_i \log p_i$ and p_i represents the proportion of each species in the prey sample (see Marti 1987). These values range from one to N, with larger values suggesting a broader food niche breadth. Dietary evenness was calculated using the equation; $F = (N_2 - 1)/(N_1 - 1)$, where N_1 is the antilog of the Shannon-Weaver index (H'), and N_2 is the reciprocal of Simpson's index (1/D) (Marti 1987). The dietary evenness values range from zero to one. As prey proportions become more equal, evenness values approach unity. To compare dietary overlap, we used the equation; $O = \Sigma p_{ij}p_{ik}/\sqrt{\Sigma p_{ij}^2 \Sigma p_{ik}^2}$, where p_{ij} and p_{ik} are proportions of prey species in the diets of owls j and k, respectively (Marti 1987). The dietary overlap value ranges from zero to one, with zero meaning no dietary overlap and one meaning complete dietary overlap. We multiplied the values by 100 and report them as percentages for easier interpretation. Body mass of prey was set as the midpoint of the range. We did this because of inconsistencies with using the mean body mass from the literature, and age differences among prey species are not always delineated (Marti 1987, Holt et al. 1991, Holt 1993). Prey body mass data were taken from Dunning (1984) for birds and from Burt and Grossenheider (1976) for mammals. Prey was identified to species for the FNB, DE, and DO equations.

One hundred ninety-four prey items were recorded from 31 Northern Pygmy-Owls. Thirteen bird and four mammal species were eaten (see Table 1 for list and scientific names of prey items). Mammals represented 60.8% of the prey and birds at least 36.6%. *Microtus* voles represented 53.6% of the total prey eaten and 88.1% of the mammals eaten (Table 1). House Sparrows (*Passer domesticus*) represented 13.9% of the total prey eaten and 35.5% of the total birds eaten (Table 1). Food niche breadth was 10.6 (N = 99), and this value suggests a wide trophic niche. Dietary evenness was 0.69, which suggests that few prey species were evenly distributed in the diet. Prey body mass ranged from 3–167 g, $\bar{x}$ = 38.4 g.

Three hundred eighty-eight prey items were recorded from 23 Northern Saw-whet Owls. Six mammals and one bird species were eaten (see Table 2 for list and scientific names of prey items). Mammals represented at least 98.5% of the total prey, with deer mice, montane voles, and meadow voles, representing 92.0% (Table 2). When combined, *Microtus* species were more frequently eaten then *Peromyscus,* 57.9% vs 34.8%. Birds were numerically insignificant. Food niche breadth was 3.3 (N = 366)

TABLE 1
PREY SPECIES FROM 31 NORTHERN PYGMY-OWLS

Species	No.	%	MP	Range	Biomass (g)
BIRDS					
House Sparrow (*Passer domesticus*)	27	13.9	27	20–34	729
Pine Siskin (*Carduelis pinus*)	11	5.7	15	10–20	165
Evening Grosbeak (*Coccothraustes vespertinus*)	9	4.6	62	38–86	558
House Finch (*Carpodacus mexicanus*)	7	3.6	22	19–25	154
Dark-eyed Junco (*Junco hyemalis*)	5	2.6	20	14–26	100
Bohemian Waxwing (*Bombycilla garrulus*)	4	2.1	58	46–69	232
Northern Flicker (*Colaptes auratus*)	2	1.0	144	121–167	288
Black-capped Chickadee (*Parus atricapillus*)	2	1.0	11	8–13	22
Song Sparrow (*Melospiza melodia*)	2	1.0	20	11–29	40
Mountain Chickadee (*P. gambeli*)	1	tr.[a]	11	8–14	11
American Robin (*Turdus migratorius*)	1	tr.	83	63–103	83
American Goldfinch (*Carduelis tristis*)	1	tr.	14	8–20	14
Long-billed Marsh Wren (*Cistothorus palustris*)	1	tr.	11	9–13	11
Waxwing spp. (*Bombycilla* spp.)	1	tr.	—	—	—
Bird spp.	2	1.0	—	—	—
subtotal	76	36.6	—	8–167	2407
MAMMALS					
Vole spp. (*Microtus* spp.)	88	45.4	57	8–85	5016
Meadow Vole (*Microtus pennsylvanicus*)	13	6.7	49	28–70	637
Montane Vole (*M. montanus*)	3	1.5	57	28–85	171
Deer Mouse (*Peromyscus maniculatus*)	8	4.1	27	18–35	216
Vagrant Shrew (*Sorex vagrans*)	2	1.0	4	3–6	8
Mammal spp.	4	2.1	—	—	—
subtotal	118	60.8	—	3–85	6048
Total	194	100.0	—	3–167	8455

[a] tr. = trace amounts <1%.

suggesting a narrow trophic niche. Dietary evenness was 0.89, suggesting few species were eaten in similar proportions. Prey body mass ranged from 3 to 130 g, $\bar{x}$ = 37.7 g. Mean mammalian prey was 38.4 g.

Food niche breadth of the two species was strikingly different, with Northern Pygmy-Owls feeding on greater than three times as many species as Northern Saw-whet Owls (10.6 vs 3.3). Evenness values were also strikingly different (0.69 vs 0.89), and suggested that Northern Pygmy-Owls were not as restricted in their diet as Northern Saw-whet Owls. Thus, Northern Pygmy-Owls in our study area fed on a wider assemblage of prey than did Northern Saw-whet Owls. Dietary overlap was 37.0%, again indicating that these two species used different prey assemblages. At the generic level for mammals however, *Microtus* voles represented

TABLE 2
PREY OF 23 NORTHERN SAW-WHET OWLS

Species	No.	%	MP	Range	Biomass (g)
MAMMALS					
Deer Mouse (*Peromyscus maniculatus*)	134	34.5	27	18–35	3618
Montane Vole (*Microtus montanus*)	122	31.4	57	28–85	6954
Meadow Vole (*M. pennsylvanicus*)	101	26.0	49	28–70	4949
Vole spp. (*Microtus* spp.)	10	2.6	57	28–85	570
Shrew Spp. (*Sorex* spp.)	10	2.6	5	3–7	50
Vagrant Shrew (*S. vagrans*)	5	1.3	4	3–6	20
Masked Shrew (*S. cinereum*)	1	tr.	4	3–7	4
Northern Pocket Gopher (*Thymomas talpoides*)	2	tr.	104	78–130	208
subtotal	385	98.5	—	3–130	16,373
BIRDS					
Cedar Waxwing (*Bombycilla cedrorum*)	1	tr.	33	25–40	33
Bird Spp.	2	tr.	—	—	—
subtotal	3	tr.	—	—	—
Total	388	100.0	—	3–130	16,406

53.6% of the Northern Pygmy-Owl's diet and 60.1% of the Northern Saw-whet Owl's diet. This comparison suggests that *Microtus* voles were almost equally important to both species of owls.

Northern Pygmy Owls ate prey that averaged 38.4 g, with the smallest being a shrew spp. (4 g) and the largest a Northern Flicker (*Colaptes auratus*; 142 g). Northern Saw-whet Owls ate prey that averaged 37.7 g, with the smallest being a shrew (4 g) and the largest a northern pocket gopher (104 g). Yet the Northern Pygmy-Owl is the smaller of these two species. Indeed, average body mass for museum specimens of both species are Northern Pygmy-Owls: males 61.9 g, range 54–74 (N = 42) and females 73.0 g, range 64–87 (N = 10) and Northern Saw-whet Owls: males 74.9 g, range 54–96 (N = 27) and females 90.8 g, range 65–124 (N = 18) (Earhart and Johnson 1970), but also see Cannings (1993) for live weights.

This is the first quantitative review of the Northern Pygmy-Owls diet in North America and the first to compare its diet with another small sympatric forest owl. Previous authors (Holman 1926, Norton and Holt 1982, Holt and Norton 1986, Bull et al. 1987) have reported dietary data for Northern Pygmy-Owls. In these studies however, sample sizes were small (<35), and prey species were not always identified. An interesting similarity arises from these studies however. The percentages of birds in the Northern Pygmy-Owls diet were about 25 to 50% of the total prey, 26.0%, 32.0%, 47.0%, 36.0%, respectively. These data are similar to our results, and we know of no other North American owl species that shows such a preponderance of birds in its diet. During the breeding season however, Holman (1926) reported 42.0% lizards, and Norton and Holt (1982) and Bull et al. (1987) also reported 3.2% and 30.0% insects, respectively.

Diet of Northern Saw-whet Owls was consistent with other studies reporting their feeding ecology (Marks and Doremus 1988, Holt et al. 1991, Swengel and Swengel 1992). Prey body mass reported here (37.7 g) was in the upper limits of those reported by Cannings (1993). We believe this reflects the high proportions of *Microtus* voles in the owls diet from our study area.

Marks and Marti (1984) compared the trophic niche of breeding Long-eared Owls (*Asio otus*) and Barn Owls (*Tyto alba*). They concluded that competition could not be stated as shaping the owl's FNB. Hayward and Garton (1988) compared the diets of Boreal Owls (*Aegolius funereus*), Northern Saw-whet Owls, and Western Screech-Owls (*Otus kennicottii*). These owls ate similar sized prey, but sample sizes were too small for meaningful conclusions to be drawn. Bosakowski and Smith (1992) compared the trophic niche of Eastern Screech-Owls (*O. asio*), Barred Owls (*Strix varia*), and Great Horned Owls (*Bubo virginianus*) and concluded that the low dietary overlap was a result of size differences and habitat use between these owl species.

There is little conclusive proof about which mechanisms structure communities. Wiens (1989) listed two conditions that must be met for interspecific competition to exist (1) species must share resources, and (2) joint exploitation of those resources must negatively effect one or all species involved. We cannot conclude that diet is shaping the sympatric distribution of Northern Pygmy-Owls and Northern Saw-whet Owls in western Montana. Perhaps diel activity rhythms contribute to these owls' sympatry and reduced dietary overlap—Northern Pygmy-Owls are diurnal or crepuscular and Northern Saw-whet Owls are nocturnal. Prey activity rhythms may also influence spatial overlap between these species, and these type of data need to be incorporated into future studies of owl feeding ecology.

ACKNOWLEDGMENTS

We thank Charles Blem, Mike Maples, and Scott Swengel for comments on the manuscript.

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