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Food of Vagrant Shrews (Sorex vagrans) from Grant County, Oregon, as Related to Livestock Grazing Pressures

Abstract

Major foods of the vagrant shrew (*Sorex vagrans*) in a relatively non-grazed portion of a mountain meadow in Grant County were earthworms, spiders, crickets, caterpillars, moths, slugs and snails, and June beetles and their larvae. In two similar areas subjected to greater recent grazing, flightless forms (except caterpillars) were much less used; they were replaced primarily by caterpillars and flying insects. The hypothesized cause for these changes was that grazing trampled and compressed the ground, thus decreasing the populations of some forms.

Introduction

Range management strategies are most often designed and implemented specifically for the purpose of increasing the output of a harvestable crop (forage or animal unit months, AUMs). Foraging or grazing by domestic cattle has direct effects on the vegetation and soil and indirect effects on wildlife of different habitat and trophic levels (Ames 1977). This study, part of a larger project dealing with the effects of forest and range management practices on selected insectivorous wildlife, attempts to describe the differences in food habits of vagrant shrews (*Sorex vagrans*) under different range (mountain meadow) management regimes.

Vagrant shrews were trapped at three closely situated mountain meadow sites in the Blue Mountains, Grant County, Oregon. The three sites, although occurring along only a 1.6 km segment of stream, had different recent management histories and thus provided conditions for comparing the effects of grazing on invertebrate fauna as reflected by shrew feeding habits.

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Methods and Study Sites

The study area, 26.5 km SE of the town of Long Creek, was in the *Abies grandis* zone (Franklin and Dyrness 1973) of the Blue Mountains. Three study sites were situated in the riparian zone along Camp Creek near Eagle Rock (T11S, R32E, S34 and 35).

The specific sites, upstream to downstream, and the respective recent grazing histories were:

1. Upper "fish" pasture (UFP), approximately 8 ha, was fenced in 1963, planted with willow cuttings along the stream, and rested for 2 years. Beginning in 1965, light late-season (after 15 August) cattle stocking was permitted. About 1970, this was changed to light late-season horse use on an intermittent basis.
2. Lower "fish" pasture (LFP), approximately 7.5 ha, was fenced in 1964 and rested for 3 years. Beginning in 1968, moderate late-season (after 1 August) cattle grazing was permitted on an annual basis. Here the objective was to remove about 20 AUMS of forage (1 Ac./AUM) each season.
3. Eagle Meadow (EM). The riparian habitat along Camp Creek, beginning at Eagle Rock and proceeding down Camp Creek, north and west for 3.2 km, was isolated by wire and pole fence in 1975 and protected from cattle grazing. Before that year, the meadow bottom had been grazed season long under a heavy level of stocking. In the spring of 1975, 3000 shrub cuttings were planted along Camp Creek from the north of Eagle Rock Creek on down Camp Creek for about 3.2 km.

Shrews were captured in pitfall traps set in the meadow adjacent to the stream in July and August 1978. The traps consisted of empty five-pound plastic food containers buried in grassland runways, openings flush with the ground, and filled with sufficient water to drown the captured animals. The water prevented escape and cannibalism and increased the chances of obtaining animals with full stomachs. The shrews were collected daily, frozen, and later aged, sexed, and dissected to remove the individual stomachs. Stomachs were preserved in 10 percent formalin for food analysis. Attempts were made to obtain approximately equal sample sizes from the three study sites. Stomach contents were identified, and the percent volume and frequency of each food item in each stomach were visually estimated with a zoom dissecting microscope.

Results and Discussion

Results of stomach analyses are shown in Table 1.

In the Eagle Meadow area, earthworms were the major food, forming 29.4 percent of the volume of food in the sample, whereas in the upper and lower "fish" pastures, earthworms formed only 6.6 and 5.3 percent, respectively.

The most important item in stomachs from the UFP, forming 35.0 percent of the volume, and one of the two most important items (28.0 percent volume) in the LFP was caterpillars. Another food, abundant in these areas, was a white, fatty, amorphous material; it was the top item in the LFP but unfortunately could not be identified.

The second and third most abundant items in EM were spiders and crickets, both being non-flying forms. Spiders were not found in stomachs in either of the fish pasture areas; crickets were found at a lower rate in the upper fish pasture area than in Eagle Meadow, and they were not found at all in stomachs from the lower fish pasture.

TABLE 1. Food from stomachs of shrews, **Sorex vagrans**, from Grant County, Oregon, including 31 from an area with no grazing, 28 from an area lightly grazed (by cows only at the end of each summer), and 32 from an area heavily grazed (by horses for several years, all year).

	No grazing		Light grazing		Heavy grazing	
N =	31		28		32	
	Percent		Percent		Percent	
	Volume	Frequency	Volume	Frequency	Volume	Frequency
Earthworms	29.4	32.3	6.6	10.7	5.3	6.3
Spider	14.5	22.6			3.3	6.3
Cricket	6.5	6.5	3.6	3.6		
Unidentified white material	6.5	6.5	9.3	10.7	29.4	46.9
Caterpillars	6.3	9.7	35.0	39.3	28.0	56.3
Moths	6.0	6.5	12.9	17.9	6.1	6.3
Slug and snail	5.2	6.5				
Unidentified insect	5.0	16.1	3.2	14.3	1.1	3.1
June beetle grubs	4.2	6.5				
Insect larvae	3.2	3.2	5.4	10.7		
Ladybird beetles	2.9	3.2				
Insect eggs	2.4	3.2				
June beetles	2.1	3.2				
Beetle larvae	1.8	3.2	12.1	17.9	3.4	9.4
Centipedes	0.8	3.2	3.0	10.7	1.9	6.3
Ants	0.8	6.5	0.4	3.6	1.6	6.3
Unidentified beetles	0.5	3.2	1.3	7.1	1.6	12.5
Flower parts	0.5	3.2				
Other vegetation	0.5	6.5	0.5	7.1	0.3	3.1
Cranefly	0.5	3.2				
Unidentified flies	0.3	3.2	2.7	10.7	9.0	15.6
Grass seeds	0.3	3.2	0.5	3.6		
Endogone (fungus)	—	—	3.2	3.6	2.8	3.1
Harvestmen	—	—	0.4	3.6		
Aphids	—	—	—	—	2.8	6.3
Moth cocoons	—	—	—	—	2.0	3.1
Hemipteran (bugs)	—	—	—	—	1.1	3.1
Grasshoppers	—	—	—	—	0.3	3.1
Unidentified bees and wasps	—	—	—	—	0.2	3.1
	100.2		100.1		100.2	

Other flightless forms found in stomachs in EM, but lacking in the other areas, were slugs and snails and June beetle grubs. Adult June beetles fly, but they were lacking in the other areas—apparently because of the lack of larvae. Thus, non-flying items living on or in the soil serve as food in the EM site but are less important or are not found in stomachs in the other areas.

The major types of foods eaten by shrews in the recently grazed UFP and LFP areas are flying insects. Total insects eaten by shrews in the recently non-grazed EM site (excluding crickets and June beetles and their larvae) formed 29.7 percent of the volume. On the UFP and LFP sites comparable figures were 73.0 percent and 57.2 percent.

We have no direct data on relative availability of foods between the three study sites. Terry (1978) suggested that *Sorex vagrans*, as well as other sympatric Insectivora in western Washington, are generalists with respect to food; she further suggested that it is selectively advantageous for them to eat anything that is available which provides sufficient nutrition or energy. Availability has both intrinsic and extrinsic components. Intrinsic components include the various adaptations (morphological, physiological, behavioral) that allow an individual or species to obtain and process food. Included are those specialized characteristics that reduce competition through resource partitioning.

Extrinsically, availability is determined by such things as abundance (both absolute and relative), cover, and activity of food items. All of these, in turn, may be influenced by both biological and physical environmental factors. Food preference, which may be influenced by palatability and ease of attainment of the various possibilities, is very important when food supplies are more than adequate. With diminishing supplies, food eaten probably more closely approaches the proportions actually present. Assuming that *S. vagrans* is more of a generalist than a specialist, its diet should reflect differences in abundance and/or attainability of food. Both of these factors are extrinsic components of availability with potential for impact from environmental change.

Although the three study sites were in close proximity and the macrohabitats similar, the shrew food habits were different at each of the sites. Table 2 shows two quantitative comparisons that illustrate these differences. To compare similarity of food species composition among areas, a coefficient of community (quotient of similarity, Sorenson 1948) was calculated for all possible pairwise combinations of grazing sites: $\frac{2C}{A+B}$, where $C =$ no. of species common to both sites and A or $B =$ no. of species at a site. All the areas are moderately similar (where $1.0 =$ complete similarity), with EM and LFP the least similar to one another. To compare the relative amounts of various food items in the diets of shrews from the three study sites, they were ranked according to decreasing percent volume and a Spearman rank correlation coefficient (Zar 1974) calculated for the possible pairwise combinations of grazing sites. Again, all sites have a relatively low correlation coefficient, and EM and LFP showed the lowest correlation, if all food items are considered, or next to lowest if just the top 10 food items are considered. In either case, the EM site shows the lowest correlation with the other two, and the UFP and LFP show the highest correlation with each other.

TABLE 2. Pairwise quantitative comparison of the similarity measured by coefficient of community (CC) and ranking measured by Spearman rank correlation (SRC) of food items taken at the three study sites.

	Sites compared		
	EM and UFP	UFP and LPF	EM and LFP
CC	.737	.705	.600
SRC (all)	.324	.410	.207
SRC (top 10)	.173	.422	.238

These data indicate that differing grazing regimes have resulted in changes in the invertebrate fauna, as reflected by shrew feeding habits. One plausible explanation for the cause of the differences is that the trampling of the ground by livestock compressed the soil to the point that the organisms normally living in or on it were less abundant. Replacing them as shrew foods in the more heavily grazed areas were caterpillars, moths, and a number of flying insects. Soil compaction readings support this view. Fifty measurements randomly distributed around the shrew trap sites within 1.0 m of the creek were taken in August 1979 in each of the three study areas with a Soil Test pocket pentrometer. A spring calibrated from 0 to 4.5 units was compressed, while a blunt rod, 6.0 mm in diameter, was gradually pushed into the soil. The index value measured in kg/cm^2 ($tons/ft^2$) was in direct proportion to the soil strength. The results showed the Eagle Meadow site to be the least compacted ($x = 2.00$ kg/cm^2, S = 1.15), whereas the upper fish pasture ($\overline{X}$ = 2.18 kg/cm^2, S = .96) and lower fish pasture ($\overline{X}$ = 2.50 kg/cm^2, S = .97) had higher readings, possibly the result of higher grazing pressure. Further support came from the higher soil strength readings ($\overline{X}$ = 2.61 kg/cm^2, S = 1.08) obtained from the heavily grazed stock watering corridor between UFP and LFP.

In summary, the site with the least amount of recent grazing pressure (EM) had the least compacted soil and the greatest amount of soil-dwelling organisms, such as eathworms, in the shrew diets. Additionally, this site showed the least similarity of food items and least correlation of ranked food items as compared to the other two sites.

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