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Food Habits of Five Western Oregon Shrews[2]

Abstract

The five most important foods, by decreasing percentage volume, among 158 Trowbridge shrews, *Sorex trowbridgii,* were centipedes, spiders, internal organs of larval invertebrates (probably mostly beetles), slugs and snails, and unidentified invertebrates. Among 30 vagrant shrews, *S. vagrans,* the five most important foods were insect larvae, slugs and snails, unidentified invertebrates, *Endogone,* and spiders. In 30 Pacific shrews, *S. pacificus,* the five most important foods were slugs and snails, centipedes, amphibian flesh, insect larvae, and unidentified invertebrates. In 27 Yaquina shrews, *S. yaquinae,* the five most important foods were invertebrate internal organs, unidentified insect larvae, slugs and snails, coleopterous larvae, and unidentified invertebrates. Among 24 marsh shrews, *S. bendirii,* the foods were insect larvae, slugs and snails, Ephemeroptera naiads, unidentified invertebrates, and earthworms.

There is little information on the food habits of western shrews despite the following studies: (1) Trowbridge shrew—Jameson (1955); (2) Vagrant shrew—Broadbooks (1939), Eisenberg (1964), Maser (1966); (3) Pacific shrew—Maser and Hooven (1974); and (4) Marsh shrew—Langeman (1947), Pattie (1969). These studies focused primarily on captive individuals. The purpose of this paper is to present information on the food habits of wild shrews in western Oregon. Because of unresolved taxonomic problems with shrews of the genus *Sorex* in the Pacific Northwest, we are following the recommendations of Johnson and Ostenson (1959) with respect to their nomenclature.

Methods and Materials

The shrews were trapped over a period of three years; most were caught in unbaited snap traps. Many of the snap-trapped shrews had empty stomachs and most of the live-trapped shrews had stomach contents which were contaminated with trap bait, accounting for the small sample size of four of the five species studied. Stomach contents were preserved in 10 percent formalin. Reference materials were also collected in the field for comparative purposes. Stomach contents were identified and the volume percentages of each food in each stomach were visually estimated using a 10 to 70 power zoom dissecting microscope.

Description of Study Area

Most of the shrews in this study were captured along the Oregon coast from the Cascade Head Experimental Forest, near Otis, Lincoln County, southward to the California border.

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A few were caught in the H. J. Andrews Experimental Forest, Lane County, which lies on the western flank of the Cascade Mountain Range.

The shrews along the coast were taken in the Sitka spruce, *Picea sitchensis,* zone of Franklin and Dyrness (1973) whereas those taken on the western flank of the Cascades were taken in the western hemlock, *Tsuga heterophylla,* zone.

Results and Discussion

The results of the food-habit analysis are given in Table 1.

TABLE 1. Foods eaten by five species of shrews of the genus *Sorex* from Oregon.

Food Items	*S. trowbridgii* Vol.	Freq.	*S. vagrans* Vol.	Freq.	*S. pacificus* Vol.	Freq.	*S. yaquinae* Vol.	Freq.	*S. bendirii* Vol.	Freq.
Chilopoda	15.4	33.5	0.6	6.7	10.7	50.0	0.2	3.7	1.7	8.3
Spider	11.6	24.7	4.7	13.3	0.8	6.7	4.6	18.5	6.3	16.7
Invertebrate internal organs	10.5	18.4	0.5	3.3	0.8	3.3	28.6	37.0	----	----
Slugs and snails	9.4	17.1	14.0	30.0	28.0	46.7	7.0	11.1	14.9	37.5
Unidentified invertebrate	8.1	34.2	13.8	40.0	6.1	23.3	5.2	18.5	12.3	45.8
Unidentified insect larvae	3.7	8.2	17.8	23.3	8.7	26.7	7.9	18.5	16.3	29.2
Hemiptera	3.6	9.5	0.8	6.7	0.9	10.0	1.1	3.7	----	----
Phalangida	3.3	9.5	0.5	3.3	3.2	10.0	----	----	1.7	12.5
Coleoptera	3.3	13.3	4.2	16.7	0.7	3.3	0.9	7.4	1.0	12.5
Dipterus larvae	2.7	5.7	3.2	10.0	2.8	10.0	5.0	11.1	----	----
Vegetation	2.0	9.5	2.3	3.3	0.8	6.7	2.4	3.7	0.2	4.2
Diptera	2.0	10.8	0.7	3.3	0.7	6.7	0.4	3.7	0.6	8.3
Lygaeidae	1.8	7.0	----	----	----	----	----	----	----	----
Earthworms	1.7	6.3	3.8	13.3	1.8	6.7	0.2	3.7	7.9	8.3
Coleopterous larvae	1.7	9.5	4.3	10.0	3.3	10.0	5.4	7.4	0.6	8.3
Scarabaeidae	1.6	3.8	4.0	6.7	0.5	3.3	0.6	3.7	----	----
Cicadellidae	1.4	3.2	----	----	----	----	----	----	----	----
Unidentified material	1.4	2.5	----	----	3.3	3.3	5.0	3.7	----	----
Lepidoptera	1.3	2.5	----	----	----	----	----	----	----	----
Lepidopterous larvae	1.3	2.5	2.0	3.3	----	----	1.9	7.4	----	----
Hymenoptera	1.3	5.1	0.7	3.3	----	----	3.7	14.8	0.2	4.2
Sowbug	1.3	4.4	----	----	----	----	0.6	7.4	----	----
Tipulidae	1.2	1.9	----	----	----	----	----	----	----	----
Endogone	1.2	5.1	6.7	4.0	2.2	10.0	1.5	7.4	0.6	4.2
Gryllidae	0.9	4.4	----	----	1.8	10.0	----	----	----	----
Ichneumonidae	0.9	3.2	----	----	----	----	----	----	----	----
Pentatomidae	0.9	1.3	----	----	----	----	----	----	----	----
Mast	0.6	0.6	----	----	----	----	----	----	----	----
Cerastium-flowers & seeds	0.6	0.6	----	----	----	----	----	----	----	----
Tenebrionidae	0.6	0.6	----	----	----	----	1.3	3.7	----	----
Moss	0.4	1.9	----	----	0.8	3.3	----	----	----	----
Formicidae	0.4	2.5	1.8	3.3	----	----	0.4	3.7	0.6	4.2
Collembola	0.4	2.5	0.5	3.3	----	----	----	----	0.2	4.2
Carabidae	0.3	1.3	3.3	3.3	1.5	6.7	1.5	3.7	1.0	4.2

Curculionidae	0.3	1.9	3.5	6.7	1.5	10.0	1.7	3.7	---- --	---- --
Lycidae	0.2	1.3	---- --	---- --	---- --	---- --	---- --	---- --	---- --	---- --
Tipulid larvae	0.2	0.6	---- --	---- --	3.2	6.7	3.7	3.7	4.2	8.3
Pseudoscorpions	0.1	0.6	---- --	---- --	---- --	---- --	---- --	---- --	---- --	---- --
Sarcophagidae	0.1	0.6	---- --	---- --	---- --	---- --	---- --	---- --	---- --	---- --
Scarabaeid larvae	0.1	0.6	0.5	3.3	---- --	---- --	3.1	3.7	---- --	---- --
Phoridae	0.1	0.6	0.5	3.3	---- --	---- --	---- --	---- --	---- --	---- --
Tingidae	0.1	1.9	---- --	---- --	---- --	---- --	---- --	---- --	---- --	---- --
Termites	0.1	0.6	---- --	---- --	---- --	---- --	---- --	---- --	---- --	---- --
Elaterid larvae	0.1	0.6	---- --	---- --	---- --	---- --	---- --	---- --	---- --	---- --
Sciaridae	0.1	0.6	---- --	---- --	---- --	---- --	---- --	---- --	---- --	---- --
Carabid larvae	0.1	0.6	---- --	---- --	---- --	---- --	1.1	3.7	---- --	---- --
Myctetophilidae	trace	0.6	---- --	---- --	---- --	---- --	---- --	---- --	---- --	---- --
Homoptera	---- --	---- --	2.4	13.3	---- --	---- --	---- --	---- --	---- --	---- --
Chauliognathus larvae	---- --	---- --	1.0	6.7	---- --	---- --	---- --	---- --	---- --	---- --
Aphididae	---- --	---- --	0.8	6.7	---- --	---- --	---- --	---- --	---- --	---- --
Syrphidae	---- --	---- --	0.7	6.7	---- --	---- --	---- --	---- --	---- --	---- --
Reduviidae	---- --	---- --	0.5	3.3	---- --	---- --	---- --	---- --	---- --	---- --
Amphibian flesh	---- --	---- --	---- --	---- --	6.1	13.3	---- --	---- --	---- --	---- --
Seeds	---- --	---- --	---- --	---- --	3.3	3.3	---- --	---- --	---- --	---- --
Diplopoda	---- --	---- --	2.7	3.3	2.7	6.7	---- --	---- --	---- --	---- --
Insect eggs	---- --	---- --	---- --	---- --	1.8	3.3	---- --	---- --	---- --	---- --
Fungi	---- --	---- --	---- --	---- --	1.5	6.7	---- --	---- --	---- --	---- --
Ant eggs	---- --	---- --	---- --	---- --	0.2	6.7	---- --	---- --	---- --	---- --
Tick	---- --	---- --	---- --	---- --	trace	3.3	---- --	---- --	---- --	---- --
Flesh	---- --	---- --	---- --	---- --	---- --	---- --	3.9	7.4	---- --	---- --
Staphylinid larvae	---- --	---- --	---- --	---- --	---- --	---- --	0.6	3.7	---- --	---- --
Cydnidae	---- --	---- --	---- --	---- --	---- --	---- --	0.6	3.7	---- --	---- --
Hemerobiidae	---- --	---- --	---- --	---- --	---- --	---- --	0.2	3.7	---- --	---- --
Ephemeroptera naiads	---- --	---- --	---- --	---- --	---- --	---- --	---- --	---- --	12.6	29.2
Bittacomorpha clavipes	---- --	---- --	---- --	---- --	---- --	---- --	---- --	---- --	4.2	8.3
Stratiomyid larvae	---- --	---- --	---- --	---- --	---- --	---- --	---- --	---- --	4.2	4.2
Tettigoniidae	---- --	---- --	---- --	---- --	---- --	---- --	---- --	---- --	4.2	4.2
Plecoptera naiads	---- --	---- --	---- --	---- --	---- --	---- --	---- --	---- --	1.5	8.3
Sialidae larvae	---- --	---- --	---- --	---- --	---- --	---- --	---- --	---- --	1.5	8.3
Gerridae	---- --	---- --	---- --	---- --	---- --	---- --	---- --	---- --	0.6	4.2
Asilidae	---- --	---- --	---- --	---- --	---- --	---- --	---- --	---- --	0.6	4.2
Chironomid larvae	---- --	---- --	---- --	---- --	---- --	---- --	---- --	---- --	0.4	8.3
TOTAL	100.4		100.1		99.7		100.3		100.1	

Specific habitat and food considerations.

Sorex trowbridgii, Trowbridge shrew: Trowbridge shrews are strictly nocturnal. They are the most common and adaptable species of western forest shrews. Occurring in all forest habitats, they are most abundant around and under logs in the Alder/Salmonberry community (Maser and Franklin, 1974). The five major foods were centipedes, spiders, internal organs of invertebrates (probably mostly beetles), slugs and snails, and un-

identified invertebrate materials. Forty-seven types of foods were eaten. Total volumes of adults of some of the predominant orders of insects were Coleoptera 6.5 percent, Hemiptera 6.3 percent, Diptera 3.5 percent, Hymenoptera 2.6 percent. Insect larvae, collectively comprised 9.9 percent of the volume although lepidopterous larvae, often a common insectivore dietary item, comprised only 1.3 percent. Higher vegetation made up only 3.2 percent of the volume, whereas the subterranean fungus, *Endogone,* often common as a shrew food (particularly *Blarina*) in the eastern United States, made up only 1.2 percent

Sorex vagrans, Vagrant shrew: Vagrant shrews are active throughout the 24-hr cycle. They are inhabitants of coastal prairies, meadows, fields, and grassy areas adjacent to streams; they also occur in the deflation plains of the costal sand dunes. (For a discussion of sand-dune anatomy refer to Wiedemann *et al.,* 1969.) These small shrews are most abundant and spend most of their time in the runways of voles, *Microtus.* Insect larvae, slugs and snails, unidentified invertebrates, *Endogone,* and spiders were the five major foods; a total of 30 categories of foods were identified. Total volumes of some of the major orders of insects were Coleoptera 15.0 percent, Hemiptera 1.3 percent, Diptera 1.9 percent, and Hymenoptera 2.5 percent.

Sorex pacificus, Pacific shrew: Pacific shrews are nocturnal; they are the second largest of the western Oregon shrews. In Oregon, Pacific shrews are confined to the southwestern corner of the state from the general vicinity of Gardiner, Lane County, southward into northwestern California. They are primarily inhabitants of the Riparian Alder/Small Stream and Skunkcabbage Marsh habitats (as defined by Maser and Franklin, 1974) of the flat, coastal, marine terraces. Most abundant around and under ground cover, they burrow extensively where such cover is absent. The five major foods of Pacific shrews were slugs and snails, centipedes, amphibian flesh, unidentified insect larvae, and unidentified invertebrates. Twenty-nine types of foods were eaten by these large shrews. Total volumes of adults of some of the major orders of insects were Coleoptera 4.2 percent, Hemiptera 0.9 percent, Diptera 0.7 percent, Hymenoptera 0 percent. Larval insects, collectively, made up 18.0 percent of this sample. Vegetative matter made up 4.1 percent of the volume, primarily as a result of the occurrence of seeds filling the stomach of one individual. Fungal foods formed 3.7 percent of the total volume.

Sorex yaquinae, Yaquina shrew: these medium-sized nocturnal shrews occur along the coast from the vicinity of Oceanlake, Lincoln County, southward to the vicinity of the Siltcoos River and Siltcoos Lake, Lane County, and eastward into the H. J. Andrews Experimental Forest. Although forest-dwellers, Yaquina shrews along the coast are primarily inhabitants of the Alder/Salmonberry, Riparian Alder, and Skunkcabbage Marsh habitats (Maser and Franklin, 1974). Invertebrate internal organs were the top food in this species, approaching one-third of the diet. The other four top foods consisted of unidentified insect larvae, slugs and snails, coleopterous larvae, and unidentified invertebrates. Diversity of food items included 30 categories. Total volumes of adults of some of the major orders of insects were Coleoptera 6.0 percent, Hemiptera 1.7 percent, Diptera 0.4 percent, and Hymenoptera 4.1 percent. Vegetation formed 2.4 percent of the material, while the fungus *Endogone* made up 1.5 percent.

Sorex Bendirii, Marsh shrew: the Marsh shrew is the largest species within the genus *Sorex* and is the most aquatically oriented species in western Oregon. Operating

throughout the 24-hr cycle, marsh shrews are largely constrained to the Skunkcabbage Marsh and Riparian Alder/Small Stream habitats throughout most of the year (Maser and Franklin, 1974). A total of twenty-six types of foods composed the diet of the marsh shrew, including nine types of food not found in the other species examined. At least 25 percent of the material found in stomachs was aquatic, and probably some of the material listed as slugs and snails, unidentified invertebrates, and unidentified insect larvae was also aquatic. The top foods in this species were unidentified insect larvae, slugs and snails, Ephemeroptera naiads, unidentified invertebrates, and earthworms. Total volumes of some of the major orders of insects were Coleoptera 2.0 percent, Hemiptera 2.6 percent, Diptera 1.2 percent, and Hymenoptera 0.8 percent. Vegetation formed only 0.2 percent of the food, and fungus 0.6 percent.

Comparative habitat and food considerations.

The five species of shrews along the Oregon coast can be separated into four basic habitat orientations, related to successional stage vegetation. The marsh shrew is the most specialized in habitat requirements; its orientation is primarily aquatic. The Pacific and Yaquina shrews are both forest-dwellers, but their basic orientation is toward marshy areas and the moist banks of small, relatively slow-flowing streams. The vagrant shrew is the only western Oregon shrew with a truly grass-meadow orientation. Only the Trowbridge shrew is adaptable enough to populate climax forest communities thoroughly. Although its basic orientation is toward the coniferous forest in general, in extreme southwestern Oregon it occurs in the tanoak, *Lithocarpus densiflorus*/madrone, *Arbutus menziesii,* forest.

Of the five species of shrews examined, the most common food was insect larvae in *Sorex vagrans* and *S. Bendirii* (different types of larvae were probably involved); slugs and snails, primarily *Haplotrema vancouverense,* in *S. pacificus;* centipedes in *S. trowbridgii;* and internal organs of large insects in *S. yaquinae.*

Eleven of the 47 food categories occurred as one of the five top foods of at least one of the species of shrews. Five of these 11 items occurred as a major food in only one species: *Endogene* in *S. vagrans.* Amphibian flesh in *S. pacificus,* coleopterous larvae in *S. yaquinae,* and Ephemeroptera naiads and earthworms in *S. bendirii.* Centipedes were the most important food (15.4 percent volume) of *S. trowbridgii* and second in importance for *S. pacificus* (10.7 percent volume); but were of little importance in the other three species. Spiders were of little consequence in the diet of *S. pacificus,* but were major foods of the other four species. Invertebrate internal organs were the main food of *S. yaquinae* (28.6 percent volume), third in importance (10.5 percent volume) for *S. trowbridgii,* but were seldom eaten by other shrews. Mayfly (Ephemeroptera) naiads, important in the diet of *S. bendirii,* were not found in any of the other species. Larval insects, collectively, varied greatly between species, ranging from 9.9 percent by volume in *S. trowbridgii* to 45.5 percent by volume in *S. bendirii.*

The fact that centipedes were the most important food of *S. trowbridgii* is understandable since they both are most abundant around and under logs. Furthermore, the diet of *S. trowbridgii* reflects its adaptability to the wide range of microhabitats that it occupies; it was the only shrew to consume all 47 types of foods. Slugs and snails formed nearly a third of the diet of *S. pacificus.* These large shrews can easily handle the snails that are so abundant in their habitat as evidenced by the numerous snail shells left as refuse in the areas occupied by this shrew. The Pacific shrew appears to

feed fairly often on amphibians (amphibian flesh was found in four out of 30 individuals —6.1 percent by volume). There were three common amphibians small enough as adults for a Pacific shrew to be able to kill—the Pacific treefrog, *Hyla regilla,* the clouded salamander, *Aneides ferreus,* and the Oregon salamander, *Ensatina eschscholtzi.* Although no amphibian flesh was found in the stomachs of *S. yaquinae,* other flesh (probably mammal or bird) made up 3.9 percent of the volume. Insect larvae totaled 28.6 percent of the volume of material in the stomachs of this species. *Sorex pacificus* is an inhabitant of a gentler, more moderate habitat and climate than is *S. yaquinae,* which may, in part, account for differences in food habits. However, snails are more abundant along the southern Oregon coast and *S. pacificus* is also larger than *S. yaquinae* and has stronger teeth. *Sorex bendirii* is the most specialized in food habits, having eaten only 26 of the 47 types of food. *S. bendirii* is the only shrew of the five that had either mayfly naiads or earthworms as a top food, reflecting the aquatic habits of the species. The total volume of insect larvae and naiads was 45.5 percent by volume, far higher than in any other species of shrew examined.

Conclusions

A study of the habitat interrelationships of shrews in western Oregon, particularly along the coast, reveals that the shrews are primarily inhabitants of successional-stage plant communities; however, micro-habitat selection as well as the partitioning of the available food supply allows these small mammals to co-exist with a minimum of direct competition.

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