

**John O. Whitaker, Jr.**

Department of Life Sciences  
Indiana State University  
Terre Haute, Indiana 47809

**Chris Maser**<sup>1</sup>

Puget Sound Museum of Natural History  
University of Puget Sound  
Tacoma, Washington 98416

and

**Richard J. Pedersen**

Oregon Department of Fish & Wildlife  
Range and Wildlife Habitat Laboratory  
Route 2, Box 2315  
La Grande, Oregon 97850

## Food and Ectoparasitic Mites of Oregon Moles<sup>2</sup>

### Abstract

The major food in stomach samples of Oregon coast moles (*Scapanus orarius*), Townsend moles (*S. townsendi*), and shrew-moles (*Neurotrichus gibbsi*) was earthworms. Other important foods were adult and larval insects, centipedes, molluscs, and vegetation. The more abundant mites found in the fur were *Euryparasitus* sp. and *Haemogamasus occidentalis* on all three species of moles, and *Haemogamasus reidi*, *Pygmephorus* sp., and *Eulaelaps stabularis* on Townsend moles.

### Introduction

There is a paucity of information on food habits and parasitic mites of western North American moles, *Scapanus* and *Neurotrichus*. The purpose of this paper is to extend existing knowledge and to present new information on food habits and fur mites of these moles.

### Methods and Materials

Moles collected from 1961 through 1963 were taken in Tillamook County near the coast, whereas those trapped from 1970 through 1972 came from the following locations: (1) shrew-moles and coast moles were trapped along the coast in Curry, Coos, Douglas, Lane, and Lincoln Counties; (2) most of the Townsend moles were trapped in the same areas, but a few were collected in Benton County in the Willamette Valley; (3) the broad-footed mole (*Scapanus latimanus*) was taken near the California border in Klamath County.

Stomach contents of 182 Townsend moles caught from 1961 through 1963 had wet

<sup>1</sup>Present address: USDI Bureau of Land Management, Range and Wildlife Habitat Laboratory, Route 2, Box 2315, La Grande, Oregon 97850.

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weights recorded prior to the identification of the contents. Stomach contents of the 182 moles examined by Pedersen are reported separately because they were not analyzed in as much detail as were those in Table 1. Stomach contents of moles that were trapped from 1970 through 1973 were preserved, without being weighed, in 10 percent formalin. The contents were identified and the percent volume by food type in each stomach was visually estimated using a 10 to 70 power zoom dissecting microscope.

Mites collected from all moles were preserved in 70 percent ethanol, cleared and stained in Nesbitt's solution containing acid fuchsin, and mounted in Hoyer's solution; cover slips were ringed with Euparal. When necessary, identity of representative specimens of mites was verified by specialists.

TABLE 1. Food of moles from Oregon.

Number examined	Neurotrichus gibbsi 11		Scapanus orarius 25		Scapanus townsendi* 28	
	% vol	% freq	% vol	% freq	% vol	% freq
Earthworms (Annelida)	48.5	81.8	56.2	92.0	54.9	92.9
Centipedes (Chilopoda)	4.3	54.5	6.3	48.0	1.4	32.1
Millipedes (Diplopoda)			0.4	8.0		
Snails & Slugs (Mollusca)	4.1	9.1	1.7	28.0	1.6	17.9
Spider (Araneida)			0.6	4.0	trace	3.6
Mite (Acarina)						
Insect larvae						
Lepidoptera			1.2	12.0	0.5	14.3
Tipulidae (Diptera)	7.5	9.1	0.6	4.0	2.1	14.3
Unidentified Diptera	2.4	36.4	1.5	16.0	4.9	14.3
Scarabaeidae (Coleoptera)			0.6	8.0		
Carabidae (Coleoptera)			0.2	8.0	0.3	7.1
Elateridae (Coleoptera)			1.0	12.0		
Unidentified Coleoptera	10.0	27.2	1.0	20.0	2.9	35.7
Unidentified insects			1.3	2.4		
Pupae						
Formicidae (Hymenoptera)			3.9	20.0	0.1	7.1
Earthworm (Annelida)					0.1	3.6
Unidentified pupae			1.3	16.0		
Insect Adult						
Scarabaeidae (Coleoptera)			1.7	16.0		
Chrysomelidae (Coleoptera)			0.2	4.0	0.2	3.6
Chauliognathus (Coleoptera)			0.3	8.0		
Unidentified Coleoptera	1.4	18.2	0.1	4.0	0.4	10.7
Formicidae (Hymenoptera)			6.1	44.0	0.3	10.7
Halictidae (Hymenoptera)					0.2	3.6
Unidentified Hymenoptera			0.2	4.0		
Gryllidae (Orthoptera)					0.1	3.6
Unidentified insects	3.6	18.2	0.1	4.0	0.8	21.4
Insect internal organs	10.0	18.2				
Mammal						
Shrew or mouse remains			6.0	8.0	2.1	7.1
Vegetation						
Endogonaceae (fungus)			0.4	12.0		
Unidentified fungi			trace	4.0		
Seeds			2.0	4.0	6.8	10.7
Clover flowers					0.1	3.6
Moss					0.2	3.6
Unidentified vegetation	0.6	18.2	1.9	28.0	9.1	53.6
Unidentified material	7.7	18.2	3.5	16.0	11.0	42.9
	100.1		100.3		100.1	

\*Only the 28 *Scapanus townsendi* that were trapped from 1970 through 1973 have been included in this table.

### Description of Study Area

Moles, with the exception of the single broad-footed mole, were trapped in the Coast Range and Willamette Valley physiographic provinces as described by Franklin and Dyrness (1973). The broad-footed mole was collected in the Basin and Range physiographic province (Franklin and Dyrness, 1973).

Townsend moles and shrew-moles occur throughout most of western Oregon in the following major vegetational zones as defined by Franklin and Dyrness (1973): (1) Sitka Spruce (*Picea sitchensis*) Zone, (2) Western Hemlock (*Tsuga heterophylla*) Zone, (3) Willamette Valley, (4) Umpqua and Rogue Valleys, and (5) Mixed Conifer and Mixed Evergreen Zones.

Coast moles occur throughout western, extreme west-central, and northeastern Oregon in all vegetational zones.

Broad-footed moles inhabit the eastern flank of the Cascade Mountain Range from mid-state southward through south-central Oregon into California (Bailey, 1936). The single specimen was trapped in the shrub-steppe (with big sagebrush, *Artemisia tridentata*) Zone (Franklin and Dyrness, 1973).

### Results and Discussion

#### Food

Stomach contents were examined from four species of moles: 11 shrew-moles, 25 coast moles, 28 Townsend moles, and a broad-footed mole. The stomach of the broad-footed mole, allopatric to the other species, contained 80 percent molluscs and 20 percent unidentified Coleoptera. Data for the other three species are summarized in Table 1.

Except for the broad-footed mole, earthworms were the most important food item for moles in this study. Wight (1928) found nearly 75 percent of the food in 306 Townsend mole stomachs to be earthworms, whereas Moore (1933) found earthworms to comprise 69.9 percent of the contents of 8 coast mole stomachs and 76.1 percent of 42 Townsend mole stomachs. Dalquist and Orcutt (1942) found earthworms to comprise 42 percent of the stomach contents of 39 shrew moles. Earthworms are also frequently the major food item in the diets of eastern moles—the star-nosed mole (*Condylura cristata*) (Hamilton, 1931) and the eastern mole (*Scalopus aquaticus*) (Whitaker and Schmeltz, 1974).

Moles occasionally feed on vegetation (Dalquest and Orcutt, 1948; Silver and Moore, 1941): vegetation represented 15.9 percent of the stomach contents of Townsend moles and 1.2 percent of the stomach contents of coast moles (Moore, 1933). All moles in this study, except the broad-footed mole, fed on some vegetation (Table 1).

The shrew-mole is active on the surface and also is a shallow burrower in the humus of western Oregon forests and the surface soils of meadows. They also spend much time around rotten logs on the forest floor, which probably accounts for the high frequency (54.5 percent) of centipedes in their diet. This species commonly captures large insects and eats only the internal organs, which comprised 10 percent of the volume. Other important foods were coleopteran and tipulid larvae and molluscs. Maser and Franklin (1974) identified the centipede (*Scolopocryptos sexpinosa*), pill bugs (*Armadillidium vulgare*), sow bugs (*Porcellio scaber*), and termites as food items of shrew-moles. In addition, Dalquest and Orcutt (1942) identified isopods, various unidentified insect larvae and pupae, and springtails as food items of shrew-moles in Washington. Since

it is the smallest mole in North America, size and durability of prey are probably limiting factors in the variety of food items this mole can use: note, for example, the relative absence of beetles with hard elytra in its diet (Table 1).

Coast moles, geographically the most wide-ranging species in Oregon, show a correspondingly varied diet (Table 1). Primarily inhabitants of western coniferous forests, these moles tend to be shallow burrowers in both forests and forest/meadow ecotones. They also are active on the surface of the forest floor, especially around large rotten logs. Their wide latitude in habitat use allows them to exploit a great diversity of food items.

Townsend moles, the largest of the western moles, are primarily inhabitants of meadows and pastures, a more limited habitat than that enjoyed by the other two species, and which appears to impose some restrictions on the variety of food items available (Table 1). This point is further illustrated by food-habit data collected on Townsend moles by one of us (Pedersen) from 1961 through 1963. Stomachs of 182 Townsend moles trapped in Tillamook County pasturelands contained two major food items—earthworms and roots from pasture grasses.

Stomach contents of 106 males averaged 63.7 percent earthworms by volume; those of 76 females averaged 65.8 percent. The weight of earthworms in 79 percent of the stomachs ranged from 200 mgs to 4000 mgs. The largest amount of earthworms found in a single stomach was 9700 mgs.

Stomach contents of 106 males averaged 36.3 percent grass roots, whereas those of 76 females averaged 39.2 percent roots. The highest weight of grass roots found in a single stomach was 3870 mgs. "Root balls" were found in 36 stomachs. The root balls were cylindrical, 10 mm x 5 mm, dark brown, and compacted. Neither the cause nor the function of these root balls is known. In contrast, only six stomachs contained traces of insect exoskeletons, and one stomach contained 100 percent mollusca (slugs).

Differences in habitat orientation, depth of burrowing, and size of shrew-moles, coast moles, and Townsend moles suggest a partitioning of the available food resources (Table 1) which should tend to decrease interspecific competition for food where these species are sympatric.

#### Mites

Mites were found on shrew-moles, coast moles, and Townsend moles, but no mites were found on the single broad-footed mole (Table 2). The more abundant mites on moles of Oregon were *Haemogamasus occidentalis* and *Euryparasitus* sp., both of which were found on all three species. *Haemogamasus reidi* and *Pygmephorus* sp. were found on four Townsend moles and *Eulaelaps stabularis* on three. Otherwise no species of mite was found on more than two moles of any one species. The myobiid mite, *Eadiea scapanus*, was found during the present study and described as new (Fain and Whitaker, 1975). *Androlaelaps fabrenholzi*, a very common and widespread species, was found on two coast and two Townsend moles. The mites from coast moles, listed as *Hirstionyssus obsoletus*? (variant), are undergoing further study, but have been found on several species of Oregon mammals.

Mites previously reported from shrew-moles, but not found during the present study, were *Haemogamasus keegani*, *H. liponyssoides*, and *Hirstionyssus utahensis*. Those previously found on Townsend moles but not found during the present study were

*Haemogamasus ambulans* and *Hirstionyssus obsoletus*. Only *Haemogamasus occidentalis* had been previously reported from coast moles.

TABLE 2. Mites of the fur of moles from Oregon.

No. examined	Neurotrichus gibbsi Hosts				Scapanus orarius Hosts				Scapanus townsendi Hosts			
	Total	x	No.	%	Total	x	No.	%	Total	x	No.	%
	(26)				(16)				(24)			
Parasitic Forms												
Laelapidae												
<i>Haemogamasus occidentalis</i>	13	0.50	8	30.8	114	7.13	15	93.8	167	6.96	18	75.0
<i>H. reidi</i>	—	—	—	—	1	0.06	1	6.3	13	0.54	4	16.7
<i>H. ambulans</i>	—	—	—	—	1	0.06	1	6.3	—	—	—	—
Androlaelaps												
<i>fahrenholzi</i>	—	—	—	—	6	0.38	2	12.5	12	0.50	2	8.3
<i>A. casalis</i>	—	—	—	—	1	0.06	1	6.3	—	—	—	—
<i>Eulaelaps stabularis</i>	—	—	—	—	2	0.13	2	12.5	4	0.17	3	12.5
<i>Hirstionyssus obsoletus</i> (variant)	—	—	—	—	7	0.44	1	6.3	—	—	—	—
<i>Laelaps kochi</i>	1	0.04	1	3.8	—	—	—	—	—	—	—	—
Myobiidae												
<i>Eadiea scapanus</i>	—	—	—	—	—	—	—	—	23	0.96	2	8.3
<i>E. breviamata</i>	9	0.35	1	3.8	—	—	—	—	—	—	—	—
<i>Eutalpaccarus peltatus</i>	5	0.19	2	7.6	—	—	—	—	—	—	—	—
<i>Protomyobia brevisetosa</i>	—	—	—	—	—	—	—	—	1	0.04	1	4.2
Glycyphagidae												
<i>Glycyphagus hypudaei</i>	—	—	—	—	—	—	—	—	1	0.04	1	4.2
Listophoridae												
<i>Listophorus mexicanus</i>	—	—	—	—	—	—	—	—	1	0.04	1	4.2
Pygmephoridae ( <i>Pygmephorus</i> is probably parasitic)												
<i>Pygmephorus horridus</i>	—	—	—	—	1	0.06	1	6.3	—	—	—	—
<i>Pygmephorus</i> sp.	1	0.04	1	3.8	1	0.06	1	6.3	5	0.21	4	16.7
<i>Bakerdania</i> sp.	11	0.42	2	7.6	—	—	—	—	8	0.33	2	8.3
Non-parasitic Forms												
Cyrtolaelapidae												
<i>Euryparasitus</i> sp.	9	0.35	4	15.4	3	0.19	2	12.5	8	0.33	8	33.3
Ascidae												
<i>Proctolaelaps</i> sp.	—	—	—	—	—	—	—	—	7	0.29	2	8.3
<i>Pseudoparasitus</i> sp.	3	0.12	1	3.8	—	—	—	—	—	—	—	—

New host records for mite species (see Whitaker and Wilson, 1974) are as follows: (1) shrew-moles—*Laelaps kochi* and *Eadiea breviamata*, (2) coast moles—*Haemogamasus ambulans*, *H. reidi*, *Androlaelaps fahrenbolzi*, *A. casalis*, *Eulaelaps stabularis*, *Hirstionyssus obsoletus*, and *Pygmephorus horridus*, and (3) Townsend moles—*Haemogamasus reidi*, *H. keegani*, *Eulaelaps stabularis*, *Protomyobia brevisetosa*, and *Glycyphagus hypudaei*. Above mites not previously reported from Oregon are *Protomyobia brevisetosa*, *Eutalpaccarus peltatus*, *Eadiea breviamata*, and *Glycyphagus hypudaei*.

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