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Small Mammal Mycophagy near Woody Debris Accumulations in the Stehekin River Valley, Washington

Abstract

The digestive tracts of 32 small mammals (*Sorex monticolus, Peromyscus maniculatus, Microtus longicaudus,* and *Clethrionomys gapperi*) trapped near woody debris piles were examined for presence and abundance of spores of hypogeous, epigeous and wood-inhabiting fungi. All animals contained fungal spores, usually in abundance high enough to suggest that each animal had recently consumed fungi. Spores of hypogeous fungi were the most abundant, especially those of genera *Alpova* and *Rhizopogon.*

Introduction

Fungi are important in the diet of many small mammals (Dowding 1955, Williams 1959, Whitaker 1962, Williams and Finney 1964, Martell 1981, Martell and Macaulay 1981, Ure and Maser 1982, Gunther *et al.,* 1983, McIntire 1984). Small mammals readily consume fruiting bodies of fungi in feeding trials. Hypogeous (subterranean-fruiting) fungi are most commonly consumed, often being preferred foods (Fogel and Trappe 1978, Trappe and Maser 1978, Maser *et al.,* 1978). Also, there is close co-adaptive dependence of some hypogeous fungi and the mammals that consume them (Talbot 1952, Trappe and Maser 1976). Many of these same studies have shown that epigeous (above-ground-fruiting) and wood-inhabiting fungi and lichens are also eaten by small mammals.

Observations in the Stehekin River Valley, Washington suggested that the fungi which inhabit woody debris accumulations (*e.g.* log jams and piles) are sometimes eaten by small mammals; tooth marks were found on sporocarps of *Coriolus sp.*. Small mammals along the river are concentrated in areas of woody debris accumulation (Mason and Koon 1985). The present study was undertaken to assess the importance of wood-inhabiting fungi in the diet of small mammals in the area.

Methods

This study was a part of the Stehekin Woody Debris Accumulation Project (Mason and Koon 1985) along the lower Stehekin River, within the Lake Chelan National Recreation Area, Washington. In the course of monitoring the activity of small mammals along the river with live traps, a number of animals were trapped dead, particularly from the months December to June. Thirty-two carcasses, including representatives of montane shrew (*Sorex monticolus,* 5 examined), deer mouse (*Peromyscus maniculatus,* 21 examined), long-tailed vole (*Microtus longicaudus,* 5 examined) and Gapper's red-backed vole (*Clethrionomys gapperi,* 1 examined), were frozen and later processed. The contents of the alimentary tracts were macerated with a scalpel in about 5 ml of 10 percent formaldehyde solution. The suspension was allowed to settle for several minutes and drops of the settled debris were examined under 400X. At least three drops of the settled material were examined from each animal. Records were made on the characteristics and the abundance of all fungal spores seen in each animal. Other recognizable food materials were noted.

A list was compiled of the characteristics of spores from 122 species and genera of fungi thought to be common in the Stehikin River Valley. This list included fungi previously collected or suspected to be present in the area as well as fungi that were reported in the diet of small mammals of the Pacific Northwest.

Spore characteristics were stored in a computerized synoptic key which allows character-by-character comparison of the unknown spores with characters of the suspected species. Using this key, the spores were identified to species, genus, or unknown spore-type and put into five groups: (1) known hypogeous fungi, (2) probable hypogeous fungi not definitively identified (those spores that were relatively large and/or thick-walled and were not otherwise assignable), (3) uniquely wood-inhabiting fungi, (4) epigeous

fungi definitely non-wood-inhabiting and their wood-inhabiting relatives, and (5) unknown, non-hypogeous fungi.

Results and Discussion

All animals investigated contained spores. All but three animals had spore-types at an abundance which would suggest that sporocarps had been consumed relatively recently (Table 1). Spores were usually the most conspicuous part of the contents, with the exception of starch grains from plant food and trap bait. In addition, there was often a variety of single spores which might have been residual from previous fungal meals or random "spore rain" on other food. Recent feeding experiments show that, following a meal of fungi, fungal spores are observed in digestive tract and/or feces for up to two weeks after the meal (J.M. Trappe, personal communication).

The largest portion of the fungal diet consists of hypogeous fungi, as has been shown for small mammals in other habitats. Small hyaline spores without hilar appendages almost certainly are from any of four species of *Rhizopogon* or from *Alpova diplophloeus* (Table 1). The spores of the other genera of hypogeous fungi recognized are relatively large and/or thick-walled or have other distinctive characters. A number of spores with thick walls and/or larger size, not otherwise assignable, were often abundant. Further evidence supporting the assignment of most spores to hypogeous fungi, is the relatively low abundance of fungal hyphae which are characteristic of epigeous and wood-inhabiting fungal sporocarps.

A few wood-inhabiting-fungal spores were found in the digestive tracts. Spores were assigned to several wood-inhabiting species (*Coriolus hirsutus, Fomitopsis pinicola, Merulius* sp., *Hormomyces aurantiacus*—the conidial state of a jelly fungus and *Xylosphaera hypoxylon*—conidial state or *Hymenoscyphus* sp.). The five species of wood-inhabiting fungi were not particularly abundant in collections of fungi made in the area during the time of the study. Noticeably absent were spores from the more common species of "polypores" (*Cerrena unicolor,* and *Coriolus versicolor, Funalia hispida, Gloeophyllum sepiarum, Osmoporus odoratus, Schizophyllum commune*) and other

TABLE 1. Contents of alimentary canals of small mammals trapped near woody debris accumulations in the Stehekin River Valley. Numbers of animals examined containing spores classified to spore type and abundance class.

Abundance Class*	5	4	3	2
Spores Types**				
1. *Hypogeous*				
Aldi		2		
Endo			1	2
Gaut				2
Glom		1		2
Hymg				3
Rhiz	4	2	5	5
2. *Unknown Hypogeous*	2	3	2	8
3. *Wood-Inhabiting*				
Cohi				1
Fopi			1	1
Hoau		1	1	1
Meru				1
Xyhy/Hyms		1	1	1
4. *Epigeous*				
Aman				1
Copr		1		
Cort			1	1
Gale				1
Pezi				1
Russ				1
Suil			1	
5. *Unknown Epigeous or Wood*	1	2	9	13

**Abundance classes (at least 10 fields viewed in 3 drops of contents under 400X):*
5—In every field, usually extremely abundant
4—Often seen, but not in every field
3—In 1/2 to 1/4 of fields viewed, or locally concentrated
2—occasional: more than one time in 1/4 of the fields viewed

***Species codes of spore types*
Aldi *Alpova diplophloeus* (Zeller and Dodge) Trappe and Smith
Endo *Endogone* spp.
Gaut *Gautieria* spp.
Glom *Glomus* spp.
Hymg *Hymenogaster* spp.
Rhiz *Rhizopogon parksii* Smith (these four
Rhiz *R. smithii* Hosford species have
Rhiz *R. subareolatus* Smith spores of the
Rhiz *R. subsalmonius* Smith size observed)
Epigeous and Wood-Inhabiting Fungi
Aman *Amanita* spp.
Cohi *Coriolus hirsutus* (Wulf. ex Fr.) Quél
Copr *Coprinus* spp.
Cort *Cortinarius* spp.
Gale *Galerina* spp. or *Crepidotus* spp.
Fopi *Fomitopsis pinicola* (Fr.) Karsten
Hoau *Hormomyces aurantiacus?* (imperfect state of *Tremella* sp.)
Hyms *Hymenoscyphus* spp.
Meru *Merulius* spp.
Pezi *Peziza* spp.
Russ *Russula* spp.
Suil *Suillus* spp. or other "boletes"
Xyhy *Xylosphaera hypoxylon* (L. ex Hooker) Dumortier

fungi (*Hericium ramosum, Pholiota destruens, Pleurotus* spp.) which commonly fruit on woody debris in the area.

Several epigeous genera (*Coprinus, Cortinarius, Galerina, Russula* and *Suillus*) were identified from distinguishable shape, ornamentation, and/or pigmentation of their spores.

Teeth marks were observed on sporocarps of *Coriolus* spp. during field work, particularly in late summer and early fall when sporocarps first mature, and are less "woody" in texture. However only one case of consumption of *Coriolus hirsutus* was confirmed.

Fungi fruit seasonally epigeous and wood-inhabiting fungi occur whenever temperatures are warm enough and there is suitable moisture in their substrates. Sporocarps from wood-inhabiting polypores would be most palatable when first fresh, since they become woodier as they mature. Fresh polypores might not have identifiable spores. Larger, fleshy, wood-inhabiting sporocarps are likely to be more palatable, and are abundant in the area for relatively short periods. In the Stehekin River Valley, the peak of fruiting of these species occurs from May to early June and late August to early November, depending on seasonal weather patterns. Although hypogeous fungi fruit all year long, peak times of fruiting generally occur between November and June (Fogel 1976, 1981). The absence in the digestive tracts of the most common wood-inhabiting species of fungi may be explained in part by the fact that most of the animals examined were trapped during winter and spring months, when such fungi are absent or less common.

Of the four genera of mammals studied, *Clethrionomys* is considered the most selective in its preference for fungi over other types of food, but species in all four genera have been shown to consume fungi in previous studies (Master *et al.* 1978, Fogel and Trappe 1978). The four species of animals observed showed no individual preferences for different types of fungi.

One hypogeous fungus tentatively identified from spores as *Alpova diplophloeus,* shows restricted mycorrhizal host preference for species of alder (*Alnus,* Molina 1981). Since both red alder (*A. rubra*) and Sitka alder (*A. sinuata*) are common locally, it is possible that this fungus is important in small mammal diets in the study area.

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