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Fungus Consumption (Mycophagy) by Small Animals

Abstract

A review of the natural history literature of small mammal feeding habits, based on many fortuitous field observations, some analysis of stomach contents, and a few feeding experiments, shows that diverse animals feed on similarly diverse fungi. The interdependence of animals and fungi has evolved to a high degree in some cases, e.g., the loss of alternative spore dispersal mechanisms by some fungi and the strong reliance of some mammals on fungi as a primary food. Consequently, adaptation for mycophagy and the effects on mycophagy of habitat, fungal toxicity, and the food value of fungi have implications in the interpretation of ecosystem structure and function.

Introduction

Truffles and other hypogeous fungi occupy a highly specialized, protected niche as subterranean-fruiting symbionts with roots of higher plants. Such fungi depend on mammal and invertebrate mycophagy for spore dispersal. These and other fungi, in turn, are important in the diet of many animals and in some cases comprise the major food source.

These interrelationships between fungi and animals engender many questions relevant to the life histories and ecosystematic roles of both. For example, which animals depend largely on fungi for food, for water, or for vitamins? What are the behavioral implications of seeking, drying, and caching fungi? What food values do mycophagists derive from fungi? Can animals differentiate between poisonous and nonpoisonous fungi? What is the phylogenetic significance of the various fungal mechanisms evolved for attracting mycophagists? What role does mycophagy play in fungus dispersal? What impact does mycophagy have on food chain and ecosystem dynamics, and where need it be recognized in ecosystem modeling?

The following literature review is intended to aid and stimulate a search for answers to such questions with emphasis on mammals, although similar questions can be asked about other animals as well. Little comprehensive research has been done on animal mycophagy. To interpret scattered fragments of published information, we have filled some gaps with speculation in hope of fostering further research in this fascinating field. Our literature search led to compilation of the reciprocal lists of mammal mycophagists and fungi eaten, presented later in this paper. Authorities for all species mentioned in the text are given in these lists.

The Small Mammal as Mycophagist

Many fortuitous field observations, some analyses of mammal stomach contents, and

a few feeding experiments have revealed that diverse mammals feed on similarly diverse fungi. The mammals include insectivores, omnivores, herbivores, and carnivores. The fungi include saprophytes, symbionts, and parasites. The interdependence of animals and fungi has evolved to a high degree in some cases, e.g., the loss of alternative spore dispersal mechanisms by the phylogenetically advanced truffles and other subterranean-fruiting fungi (Bessey, 1935; Burnett, 1968; Christenson, 1951; Kavaler, 1965; Gäumann and Dodge, 1928; Ingold, 1953, 1961, 1966; Korf, 1973; Lilly and Burnett, 1951; Rolfe and Rolfe, 1925; Smith, 1938; Trappe, 1971) and the strong reliance of some mammals on fungi as a primary food.

The Sciuridae (chipmunks and squirrels) have been the most observed mammalian mycophagists; consequently, they are also reported to eat the greatest variety of fungi. *Tamiasciurus hudsonicus* (red squirrel) has been credited with eating 89 species of fungi, more than any other mycophagist. Other relatively small mycophagists include members of the Cricetidae (mice, rats, lemmings, voles), Zapodidae (jumping mice), Ochotonidae (pikas), Soricidae (shrews), Didelphidae (opossums), Peramelidae (bandicoots), Phascolomidae (wombats), Macropodidae (rat-kangaroos), Cynopithecinae (baboons), Dasypodidae (armadillos), Leporidae (rabbits and hares), Castoridae (beavers), and Mustelidae (weasels). The reports of fungi in stomachs of shrews may at least in part reflect predation on fungus-feeding invertebrates or other animals rather than mycophagy by the shrews themselves.

The relative importance of fungi in small mammal diets has been estimated as percent of yearly dietary volume for several species (Table 1).

TABLE 1. Yearly dietary volume of fungi (%) for nine small mammal species.

Species	Volume (%)	Source
Eutamias townsendii	72	Tevis, 1953
Eutamias quadrimaculatus	66	Tevis, 1953
Spermophilus lateralis	61	Tevis, 1953
Tamiasciurus douglasii	56	McKeever, 1964
Sciurus griseus	52	Steinecker and Browning, 1970
Eutamias speciosus	32	Tevis, 1953
Eutamias amoenus	27	Tevis, 1953
Clethrionomys glareolus	7	Drożdż, 1966
Apodemus flavicollis	1	Drożdż, 1966

Tevis (1953) suggested a direct correlation between mammal body weight and importance of fungi in the diet among the *Spermophilus* spp. and *Eutamias* spp. that he studied. Other factors of habit and habitat are undoubtedly as much or more causally related to mycophagy. However, a relationship between mammal size and size of fungus eaten does seem likely in the sense that very small fungal species appear to be eaten only by smaller mammals. For instance, sporocarps of many species of the phycomycetous family, Endogonaceae, are often less than a millimeter in diameter and rarely exceed a few millimeters. These species have been reported only in stomach contents of small mammals such as shrews, voles, mice, jumping mice, pikas, etc., but they eat larger fungi as well (Bakerspiegel, 1958; Calhoun, 1941; Hamilton, 1941a; Jameson, 1952; Whitaker, 1962, 1963a; Whitaker and Ferraro, 1963; Whitaker and Maser, 1976).

Adaptations for Mycophagy

Morphological adaptations of small mammals are probably directly related to mycophagy. Animals adapted for digging might be expected to have an advantage in the search for truffles and other hypogeous fungi. Species with weak teeth might be more impelled to eat fungi when available. Unfortunately, the data presently available are too scanty to test these hypotheses.

Mammalian food-gathering behavior has evolved for locating fungi. Tevis (1953) observed innumerable small pits left in the soil from extraction of hypogeous fungi by animals; indeed, mycologists have long used this sign to indicate when and where to seek such fungi. Small mammal mycophagists probably locate hypogeous fungi by odor. Most hypogeous fungi have a noticeable odor at maturity which is almost overwhelming to many humans (Parks, 1919). Often the presence of these fungi is not visible on the soil surface. The ability of squirrels to detect mast by odor has been reported many times (Allen, 1943; Cahalane, 1942; Cram, 1924; Dice, 1927; Ingles, 1947; Ognev, 1940). We have observed over years of extensive collecting of hypogeous fungi that sporocarp odor is not detectable on immature specimens. As some spores reach maturity, a light odor often can be noticed; as the proportion of mature spores increases, so does the intensity of odor. Thus the fungus may remain undetected at early stages of development but emits increasingly strong odors as it matures.

Bright color as well as odor may attract small mammals to epigeous mushrooms and puffballs (Ingles, 1947). Mushrooms are sometimes nibbled *in situ* but are also harvested whole. Numerous observers have reported mushrooms hung in tree branch forks by squirrels, at times the tree "appearing bedecked for Christmas," (Cram, 1924; Hatt, 1929; Krieger, 1967; Marie, 1927, Odell, 1925, 1926; Ognev, 1940; Stakhrovskii, 1932). Since dried fungi preserve indefinitely, the intent of the squirrels is presumably to dry them for caching. Hardy (1949) found a cache of sporocarps left by a *Tamiasciurus hudsonicus* in a hollow tree trunk.

Mycophagy and Habitat

The characteristics of plant communities to which small mammals have become adapted are decidedly related to mycophagy. Forests of ectomycorrhizal trees such as the Pinaceae, Fagaceae, or Betulaceae produce a greater abundance of relatively large, fleshy mushrooms and hypogeous fungi, the typical fruiting forms of ectomycorrhizal fungi (Trappe, 1962). Plant communities of vesicular-arbuscular (VA) mycorrhizal hosts such as the Cupressaceae, Aceraceae, or herbaceous plants of fields, meadows, and bogs form mycorrhizae with certain genera of the Endogonaceae, which fruit hypogeously as single spores or very small, compact sporocarps (Gerdemann and Trappe, 1974). Thus, adjacent habitat types may differ strikingly in form and biomass of sporocarps produced. The small mammals that inhabit ectomycorrhizal forests might be expected to feed more on macrofungi than inhabitants of VA-mycorrhizal meadows. Although adequate data are not available, it can be hypothesized that mycophagy in VA-mycorrhizal redwood or maple forests resembles that of meadows more closely than that of ectomycorrhizal pine or oak forests. If this hypothesis is true, the qualitative and quantitative relationships of small mammal populations between these various kinds of habitats might deserve a new look.

Estimated annual production of epigeous mushrooms is summarized for several forest types in Table 2. The data of Richardson (1970) provide the best of the estimates presented, because his estimates are based on nearly weekly visits to the study site over a period of five years. The other estimates are based on relatively scanty data.

TABLE 2. Estimated production of epigeous mushrooms per ha yr^{-1}.

Forest Type	Kg Dry Wt	Kilocalories	Source
Oak and Beech, Hungary	7-160	30,000-658,000*	Hering, 1966
Beech, near Vienna	18-170	77,400-731,000*	Hering, 1966
Beech, Poland	4-5	17,200-21,500	Drożdż, 1965
Oak on slate soil, England	12-95	53,600-407,600	Hering, 1966
Oak on limestone soil, England	3-37	12,900-158,700	Hering, 1966
Conifer, Scotland	16-30	68,600-128,700	Richardson, 1970
Conifer, xeric inland forest, Pacific Northwest, U.S.A.	3	11,200	Smith, C., 1965
Conifer, xeric inland forest, Pacific Northwest, U.S.A.	10-17*	41,200-115,800*	Cooke, 1955
Conifer, Finland	5-19	22,300-82,800	Richardson, 1970
Conifer, Sweden	180	772,200	Richardson, 1970

* Our calculation, assuming 6.4% dry wt and 4300 calories g^{-1} dry wt (cf. Table 3).

Many variables interact to account for the wide range of production estimates; two most obvious are temperature and moisture and their interaction (Smith, 1949). Consequently, each climatic region has a characteristic fruiting pattern (Bohus, 1973; Ceruti, Montacchini and Duployez, 1967; Endo, 1973; Fogel, 1976; Grainger, 1946; Wilkins and Harris, 1946). Production will vary from year to year within a region, depending on weather. Habitats within a region will vary one from another in production, depending on soils, microclimate, and vegetation.

No biomass production studies of VA-mycorrhizal fungi have been reported. However, Kessler and Blank (1972) estimated that nearly 7 million minute sporocarps of Endogonaceae occurred per ha in soil of a Michigan forest dominated by the VA-mycorrhizal *Acer saccharum* Marsh. A substantial biomass may be inferred. Fogel (1976) estimated the production of hypogeous basidiomycete and ascomycete sporocarps in a Western Oregon Douglas-fir stand to range from 11,052 to 16,753 sporocarps ha^{-1} and 2.3 to 5.4 kg dry weight ha^{-1}.

The Food Value of Fungi

Fresh, fleshy fungi range from 70 to 94 percent water by weight; large volumes therefore must be eaten to provide adequate protein and phosphorus (Miller and Halls, 1969; Winton and Winton, 1935). The drying of mushrooms by squirrels concentrates their food value. At the same time, fresh fungi might be an important source of water for animals unable to exist on bound or metabolic water when free water is unavailable (Getz, 1968; C. Smith, 1965).

Some measures of the food value of fungi are compared with those of other food sources in Tables 3-5. The data should be interpreted only in a broad sense, since several sources and differing analytical methodologies are represented in the compilation. Fresh, fleshy fungi resemble fruits and vegetables in containing substantially fewer

calories gm^{-1} than fresh nut kernels, eggs, or meat (Table 3). On a dry-weight basis, fungi compare favorably with blueberries and mast but contain about a third fewer calories than conifer seed (Table 4). Compared to nut kernels, dried mushrooms are good sources of protein, carbohydrates, and minerals but not fats (Table 5).

The net caloric value of any food to a consumer is the total caloric content digested minus the calories expended in seeking, extracting, ingesting, digesting, and excreting

TABLE 3. Caloric value of fresh foods (kcal. gm^{-1} fresh wt.).

Food	Calories	Source
FUNGI		
Agaricus bisporus	0.3-0.5	Singer, 1951; Pilát and Ŭsak, 1958
Boletus sp.	0.3	Singer, 1951
Boletus edulis	0.3-0.7	Pilát and Ŭsak, 1958; Andreotti and Casoli, 1968
Lentinus edodes	0.3	Singer, 1951
Lactarius deliciosus	0.5	Singer, 1951; Pilát and Ŭsak, 1958
Tuber melanosporum	0.4-0.6	Andreotti and Casoli, 1968
"mushrooms"	0.1-0.5	Singer, 1951; Hodgman *et al.*, 1959; Proudfit and Robinson, 1961
Mean	0.4	
NUTS		
pine kernels	6.3	Hodgman *et al.*, 1959
Beechnut kernels	6.3-7.0	Proudfit and Robinson, 1961
butternut kernels	7.1-7.4	Hodgman *et al.*, 1959; Proudfit and Robinson, 1961
chestnut kernels	7.5-7.6	Proudfit and Robinson, 1961
hazelnut kernels	6.7	Proudfit and Robinson, 1961
hickory nut kernels	1.9	Hodgman *et al.*, 1959; Proudfit and Robinson, 1961
pecan kernels	6.6	Hodgman *et al.*, 1959; Proudfit and Robinson, 1961
walnut kernels	6.7-7.0	Proudfit and Robinson, 1961
Mean	6.2	
FRUITS		
apples	0.6	Proudfit and Robinson, 1961
blackberries	0.6	Proudfit and Robinson, 1961
blueberries	0.7	Proudfit and Robinson, 1961
cherries	0.7	Proudfit and Robinson, 1961
currants	0.6	Proudfit and Robinson, 1961
plums	0.6	Proudfit and Robinson, 1961
strawberries	0.4	Hodgman *et al.*, 1959; Proudfit and Robinson, 1961
Mean	0.6	
VEGETABLES		
lettuce	0.2	Hodgman *et al.*, 1959; Proudfit and Robinson, 1961
onions	0.5	Proudfit and Robinson, 1961
water cress	0.2	Proudfit and Robinson, 1961
Mean	0.3	
EGGS and MEAT		
eggs	2.5	Proudfit and Robinson, 1961
beef	1.8-3.4	Hodgman *et al.*, 1959; Proudfit and Robinson, 1961
Mean	2.1	

the nondigested residual of that food. The relative value of fungal caloric sources for any mycophagist must be compared to other sources in terms of an energy budget. If less energy is expended per calorie gained in seeking and eating fungi than in seeds or insects, the relative value of fungi as an energy source is increased.

TABLE 4. Caloric value of dried plant parts (kcal. gm^{-1} dry wt.).

Food	Calories	Source
FUNGI		
Peridermium harknessii		
in *P. contorta* bark	5.0	Smith, C. 1965
Rhizopogon sp.	4.9	Smith, C. 1965
Russula decolorans		
gills and spores	4.8	Smith, C. 1965
pileal context	4.0	
stipe	4.2	
Suillus tomentosus		Smith, C. 1965
tubes and spores	5.2	
pileal context	4.2	
stipe	4.1	
Mean	4.5	
CONIFER SEEDS		
Abies amabilis	6.8	Smith, C. 1965
Abies lasiocarpa	7.1	Smith, C. 1965
Picea engelmanii	7.1	Smith, C. 1965
Picea excelsa	6.7	Danilov, 1938
Pinus contorta	6.8	Smith, C. 1965
Pinus silvestris	6.2	Danilov, 1938
Pinus monticola	7.4	Smith, C. 1965
Pinus ponderosa	7.6	Smith, C. 1965
Pinus pumila	6.9	Danilov, 1938
Pseudotsuga menziesii	7.1	Smith, C. 1965
Tsuga heterophylla	7.1	Smith, C. 1965
Mean	7.0	
MAST		
Acer saccharinum	4.2	Smith, C., 1970
Carya ovata	7.2	Smith, C., 1970
Juglans nigra	6.3	Smith, C., 1970
Quercus alba	4.0	Smith, C., 1970
Quercus macrocarpa	4.2	Smith, C., 1970
Quercus shumardii	5.3	Smith, C., 1970
Mean	5.2	
FRUIT		
Vaccinium deliciosum	5.3	Smith, C. 1965
BUDS		
Picea excelsa	4.0	Danilov, 1938

Unfortunately, the relative digestibility of different food sources is not known for different mammals. The large gastric caecum of many rodents has been suggested as a site of enzyme systems capable of extracting energy from β-linked carbohydrates of fungal cell walls (C. Smith, 1965). Our impression from examining stomach and fecal contents of several hundred small mammal mycophagists is that fungal cell cytoplasm is readily digested, cell walls are sometimes digested, and spores are not digested at

TABLE 5. Chemical composition of dried plant parts and meat.

Plant Species	% Dry Weight Protein	Fat	Carbohydrate	Ash	Source
FUNGI					
Agaricus bisporus	48-62	1-2	—	7	Singer, 1961
Amillaria mellea	16	—	76	8	Singer, 1961
Boletus edulis	32-35	5	58-59	6-8	Singer, 1961
Clavaria flava	19	2	47	5	Winton and Winton, 1935
Hygrophorus, Amillaria, Russula, Clitocybe, Amanita, Tricholoma, Pholiota sp.	12-27	—	—	—	Miller and Halls, 1969
Hygrophorus, Amanita sp.	23	—	—	—	Miller and Halls, 1969
Lactarius deliciosus	27	7	28	6	Singer, 1961
Lentinus edodes	19	5	54	3	Singer, 1961
Marasmius oreades	35-43	2-4	34	10	Singer, 1961
Morchella esculenta	34-35	2	46-47	9-11	Singer, 1961
Morchella sp.	30	—	—	—	Mendel, 1898
Morchella, Rhizopogon, Cortinarius, Lactarius Amanita, Clitocybe sp.	30	—	—	—	Miller and Halls, 1969
Pleurotus cretacius	21	—	—	—	Winton and Winton, 1935
Saccharomyces cerevisiae	12	<1	21	—	Hodgman, *et al.*, 1963
Suillus granulatus	14	2	70	6	Singer, 1961
Suillus grevillei	21	2	64	6	Singer, 1961
Suillus luteus	20	4	53	6	Singer, 1961
Tricholoma favovirens	15-18	—	71-78	7-11	Singer, 1961
Tuber melanosporum	25-26	2	39-46	8	Andreotti and Casoli, 1968
NUTS					
Chestnut kernels	11	7	72	2	Hodgman, *et al.*, 1963 Chapman and Baumgartner, 1939
Butternut kernels	28	61	3	3	Winton and Winton, 1932
Black walnut kernels	28-30	56-58	6	2	Winton and Winton, 1932 Chapman and Baumgartner, 1939
Pecan kernels	10-11	70-75	10	2	Winton and Winton, 1932
Hickory kernels	13-20	65-70	6-9	2	Winton and Winton, 1932
Filbert kernels	16-17	63-65	10-13	2	Winton and Winton, 1932
Beechnut kernels	22	42-57	19	3-4	Winton and Winton, 1932 Chapman and Baumgartner, 1939
MEAT					
Chipped beef	30	6	<1	—	Hodgman, *et al.*, 1963

all. Spores presumably contain concentrated energy sources, as indicated by the relatively high caloric values of gills or tubes of mushrooms as compared to the somatic parts (Table 4) and by the high lipid content seen in spores of some fungi (Gerdemann and Trappe, 1974). However, reports of squirrels eating caps and gills of mushrooms while leaving the stems (Hatt, 1929; Ognev, 1940; C. Smith, 1965) probably reflect palatability rather than selection for food value.

Aside from their caloric value, some of the diverse organic compounds of fungi may be important in small mammal physiology. For example, ergosterol, a possibly important source of mammalian hormone precursors, occurs widely in the higher fungi

and ranges from about 0.2 to 0.5 percent of the dry weight of fleshy fungi (Milazzo, 1965; Shivrina *et al.*, 1968; Catalfomo and Trappe, 1970). Fungi commonly contain other steroids, triterpenes, amines, indoles, and phenols (Catalfomo and Trappe, 1970) of unknown but potential use to mammals. Vitamins such as biotin, niacin, pantothenic acid, and riboflavin are produced in significant amounts by some fleshy fungi (Shemakhanova, 1967). On a fresh weight basis, mushrooms have higher concentrations of niacin and riboflavin than most nuts, fruits, and leaf vegetables and equal or excel most meats in this regard (Proudfit and Robinson, 1950).

Fungal tissues effectively accumulate nonmetallic and metallic elements. Stark (1972) found that sporocarps of five fungal species contained substantially higher concentrations of Cu, N, P, and Zn than did pine needles (dry wt. basis). At least some of the five also contained higher concentrations of Ca, Fe, K, Mg, and Na. Fungal rhizomorphs were also high in concentrations of these elements, e.g., 180 times as much Fe as pine needles.

The overall quality of fungi as a food source for small mammals has not been experimentally assessed. Tevis (1952) reported that *Eutamias* stomachs containing only fungi were always heavier than those of animals feeding on non-fungal material. He also found that when chipmunks began to acquire hibernation fat, those eating fungi became fat sooner. But Naumov's report of squirrels starving to death while gorged with *Polyporus betulinus* Fr. suggests that some fungi may have very little food value (Ognev, 1940), at least for some mammals.

Cyclic over-population of mammals and poor seed crops probably periodically enhance the importance of mycophagy in reducing food stress (Lampio, 1967; Ognev, 1940; Rajala and Lampio, 1963). The effect of poor mast crops, traditionally considered a key factor in regulating squirrel populations, might be moderated in good mushroom years (Baumgartner, 1939; Brown and Yeager, 1945; Stienecker and Browning, 1970; Uhlig, 1955; and others). Seasonal buildup of rodent populations, together with the seasonality of fungal fruiting, might explain the increased seasonal use of *Endogone* by *Peromyscus maniculatus, Microtus longicaudus, Clethrionomys gapperi, Phenacomys intermedius,* and *Zapus princeps* (Williams and Finney, 1964).

Fungal Toxins and Mycophagy

Feeding trials and field observations of *Amanita muscaria, Amanita phalloides, Lactarius rufus,* and *Lactarius torminosus* consumption by squirrels indicate that they and presumably other rodents can safely eat mushrooms considered poisonous to man (Ballou, 1927; Cram, 1924; Hastings and Mottram, 1916; Hatt, 1929; Klugh, 1927; Metcalf, 1925). With this evidence in mind, Walton's (1898) observation, "For thirteen years I have made use of the varieties of mushrooms selected by squirrels and wood mice as edible. . .," should be taken skeptically. He was lucky to have escaped poisoning.

We have found no reports on poisoning of small mammals by fungi in the wild. One prime reason may be that no one has seriously studied the matter. Several hypotheses might be proposed, among them that (A) no fungi are poisonous to small mammals; (B) mammals can detect toxins by taste, smell, or in some other way; or (C) mammals are poisoned by some fungi, but when poisoning occurs, they seclude themselves before symptoms become evident to observers.

Hypothesis A was supported by Ford (1908, 1910), who suggested that herbivore alimentary canals can neutralize poisons which are highly toxic if administered by subcutaneous or interperitoneal inoculation. However, chickens and a cow are reported to have died after eating sporocarps of *Amanita* sp. (Ballou, 1927). Recently it has been demonstrated that a number of toxins each with different properties are responsible for mushroom poisoning symptoms (Litten, 1975). The *Amanita* toxin phalloiden, for instance, is not toxic when given orally, but mice given *Amanita* whole toxic extract containing myriaphalloisins die in a few hours to four days.

Hypothesis B seems a reasonable possibility, considering the selective pressure against genetic lines given to feasting on poisonous fungi. Hypothesis C also seems reasonable, especially since most mycotoxins require some incubation time before symptoms are expressed: mushroom poisoning of humans often does not arouse symptoms for several hours after ingestion. Hypothesis A has been proven wrong for a limited number of mammals; B and C remain to be tested.

Mycophagists as Disseminators of Fungi

Mycophagy serves in fungal dissemination by physical transport of spores and hypothetically, at least in some cases, by breaking spore dormancy. Most epigeous fungi, even the coprophilous species, are adapted for aerial or water transport of spores; mycophagy would seem incidental to primary dispersal mechanisms (Ingold, 1953). Of course, mushrooms hung in trees by squirrels are exposed to air currents that could carry spores farther than those at the ground surface. Mycorrhizal species or root pathogens may gain some strategic advantage over aerial dissemination if spores are eaten and then excreted near susceptible host roots by burrowing mycophagists.

Hypogeous fungi, on the other hand, are clearly dependent on mycophagy for physical transport. They fruit underground, their spore-bearing tissues are typically enclosed in a persistent peridium, and for the most part they do not forcibly discharge their spores. Even those which can forcibly discharge spores, such as the truffle relative, *Geopora cooperi* Harkn. (Burdsall, 1965), must be dug up and opened above ground by an animal to release spores to air currents (Korf, 1973).

The phycomycetous fungi of the family Endogonaceae deserve special mention because they have been found so often in small rodent stomachs. The various species may be epigeous or hypogeous and may form sporocarps or be borne as individual spores in soil. At present, only the sporocarp-forming species have been found in rodent stomachs. Whether epigeous or hypogeous, the sporocarps are typically compact clusters of very large spores devoid of discharge mechanisms. Presumably, these sporocarps are strongly dependent on mycophagy for transport. Spores borne singly in soil, on the other hand, may be eaten by insects or arthropods but also can be transported by any of the forces that move soil (Gerdemann and Trappe, 1974).

The effects of passage through a digestive tract on spore germination are unknown for most fungi. In general, spores of coprophilous and xylophilous fungi germinate poorly or not at all under any circumstances (Fries, 1943; Benedict *et al.*, 1967). The relatively few reported successes in inducing germination of spores of ectomycorrhizal fungi entailed treatments such as low temperature, alternate wetting and drying, soil extracts, co-culture with other organisms, slug digestive enzymes, or exposure to living roots (Sussman and Halversen, 1966; Bowen and Theodorous, 1974; Lamb and Richards,

1974). Of the Endogonaceae, chlamydosporic species which form vesicular-arbuscular mycorrhizae germinate readily without special treatment; one species has been shown to be viable after passage through a *Microtus* digestive tract (Trappe and Maser, 1976). No one has yet succeeded in germinating spores of those that occur only in sporocarps, at least some of which are ectomycorrhizal species (Gerdemann and Trappe, 1974).

Mycophagy would subject ingested fungal spores to body heat, enzymatic action, and co-culture with the myriad microorganisms of digestive tracts and feces. The process has not been demonstrated to affect spore dormancy as yet. Indeed root exudates appear to induce germination of some hypogeous mycorrhizal fungi without mycophagy (Palenzona, 1969; Bowen and Theodorous, 1974). Since essentially no research has been reported on the physiological effects of mycophagy on spores, the question remains moot.

Mycophagy in Ecosystem Analysis

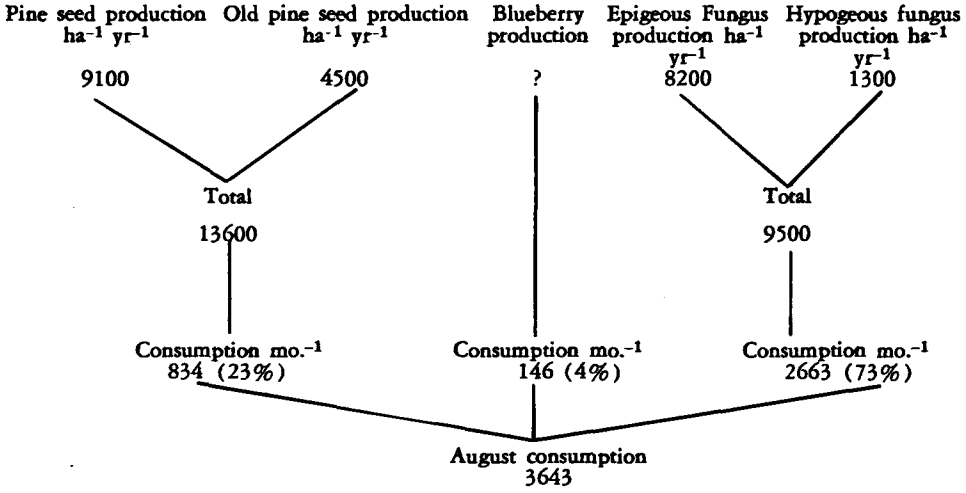
Invertebrates and vertebrates that feed wholly or in part on fungi have been arbitrarily categorized either as herbivores or fungal decomposers. No generalization fits comfortably, however, because the fungi may be saprophytes, biotrophic or necrotrophic symbionts, or predators (Harley, 1971; Lewis, 1973). Although necrotrophic symbionts may be considered "living tissue saprophytes" for purposes of ecosystem modeling, the biotrophic symbionts such as mycorrhizal fungi pose a special problem: the structural and physiological interdependence of fungus and host preclude their conceptual separation either physically or functionally.

One solution to this problem is to consider mycorrhizal fungi as extensions of the host root system, since the fungi are essential to nutrient absorption by the host and the fungi obtain their energy from the host much as if they were indeed root tissue. Thus the mycorrhizal fungi can be regarded as organs of producer plants. Mycophagists that feed on mycorrhizal fungi are then grazers. Grazing of mycorrhizal fungi accounts for about 75 percent of the small mammal mycophagy in terms of the reports listed later in this paper, evaluated as known or presumed mycorrhizal taxa (Trappe, 1962, 1971). If only reports of stomach contents are considered, the percentage is considerably higher. Mycophagy of saprophytes, necrotrophic symbionts, or predators, on the other hand, can be regarded as part of the decomposer process and accounts for about 25 percent of the reports. Many, perhaps most mycophagists feed on both categories of fungi and thereby participate in both processes.

Small mammal mycophagy seems surely to be a significant energy transfer process in ecosystems, but it remains to be quantitatively assessed. We are aware of only one paper with enough information to present a small mammal-fungus carbon budget for a short period: C. Smith (1965) estimated the caloric consumption of different food sources by the red squirrel *(Tamiasciurus hudsonicus)* for the month of August in western Washington. During this time, mycophagy accounted for about 73 percent of the squirrels' caloric intake, even though coniferous seeds and blueberries were also available (Fig. 1). Data from several other papers were not usable since percent volume and frequency values reported are useless without estimates of food consumption, weight, caloric value, stomach size, food density, etc. Modeling can not proceed until integrated studies on mycophagist food habits and fungal production are completed.

Despite inadequate information, mycophagy is clearly important to mammals and fungi alike. More extensive and definitive information is badly needed, particularly for understanding the dynamics of small mammal populations and for ecosystem modeling; nutrient flow is not a simple matter of diffusion through arbitrarily generalized functional groups such as primary producers, consumers, or decomposers.

Figure 1. *Tamiasciurus hudsonicus* caloric (kcal. 1000 gm^{-1}) consumption for August. (Smith, C., 1965) Percent of August consumption enclosed in parentheses.



The Reciprocal Lists

The literature reports of small mammal mycophagy are compiled in the following lists by taxa of both fungi and mammals. The lists are intended to provide a broad overview indexed to the original sources. Because any such listing is subject to limitations, restraint should be used in drawing detailed inferences from the lists themselves. Use them only as portals to the original literature. Keep in mind that the lists exclude lichens; that while coverage is almost complete for the North American literature, several references from other parts of the world could not be located; and that some taxa undoubtedly have been misidentified by some original authors.

No single system of taxonomy enjoys complete acceptance for either the fungi or the mammals. We have accordingly followed the classification and nomenclature of the more comprehensive compendia where possible, recognizing that many readers may prefer a somewhat different system. The fungal classification has been drawn from various sources, including Singer (1962) for Agaricales, Overholts (1953) for Polyporaceae, and Smith (1951) for Gasteromycetes. Mammal classification follows Hall and Kelson (1959), Jackson (1928), Johnson (1968), and Johnson and Ostenson (1959) for North American species and Ognev (1940, 1950) for Eurasian species.

The lists are alphabetical except for classes and orders. All known synonyms of a taxon have been cross-indexed to a single name; we do not intend any novel taxonomic decisions in this process, since the conclusions were drawn entirely from the literature, not from personal examination of types or other specimens.

Fungi listed with asterisk have been reported as demonstrated or probable mycorrhizal species in Trappe (1962, 1971), Gerdemann and Trappe (1974), or elsewhere.

Fungi and the Animals That Eat Them

CLASS PHYCOMYCETES
Unspecified taxa: *Potorous tridactylus apicalis* (Guiler, 1971).
ORDER OOMYCETALES
See Class Phycomycetes. Apparently this order has never been used.
ORDER MUCORALES
FAMILY ENDOGONACEAE
Endogone spp.: *Blarina brevicauda* (Hamilton, 1941b; Linzey and Linzey, 1973; Whitaker, 1962; Whitaker and Ferraro, 1963); *Clethrionomys gapperi gapperi* (Linzey and Linzey, 1973; Whitaker, 1962; Williams and Finney, 1964); Cricetidae (Dowding, 1959). *Eutamias* spp. Dowding, 1955, 1959; Whitaker, 1962); *Lagurus curtatus* (Whitaker, 1962); *Microtus chrotorrhinus* (Linzey and Linzey, 1973); *M. longicaudus* (Williams and Finney, 1964; *M. ochrogaster* (Zimmermann, 1965, 1966); *M. oeconomus macfarlandi* (Dowding, 1955; Whitaker, 1962); *M. pennsylvanicus* (Whitaker, 1962; Zimmermann, 1966); *M. pinetorum* (Linzey and Linzey, 1973; Whitaker, 1962); *Mus musculus* (Calhoun, 1941; Whitaker, 1962, 1966); *Napaeozapus insignis insignis* (Linzey and Linzey, 1973; Whitaker, 1962, 1963a); *Ochotona* spp. (Dowding, 1959); *O. princeps* (Whitaker, 1962; Zimmermann, 1965); *Onychomys leucogaster* (Whitaker, 1962); *Oryzomys palustris* (Negus, Gould, and Chipman, 1961); *Peromyscus gossypinus* (Calhoun, 1941; Whitaker, 1962); *P. lecucopus* (Calhoun, 1941; Linzey and Linzey, 1973; Whitaker, 1962, 1963b, 1966); *P. leucopus noveboracensis* (Hamilton, 1941b); *P. maniculatus* (Dowding, 1955; Linzey and Linzey, 1973; Whitaker, 1962; Williams and Finney, 1964); *P. maniculatus bairdii* (Whitaker, 1966); *P. maniculatus gracilis* (Hamilton, 1941b); *Phenacomys intermedius* (Williams and Finney, 1964), Rodentia (Ingold, 1961, 1966; Kessler and Blank, 1972); *Sorex* spp. (Thaxter, 1922); *S. bendirii* (Whitaker and Maser, 1976); *S. cinereus* (Whitaker, 1962); *S. fumeus* (Linzey and Linzey, 1973; Whitaker, 1962); *S. trowbridgii* (Whitaker and Maser, 1976); *S. vagrans* (Whitaker and Maser, 1976); *S. vagrans pacificus* (Whitaker and Maser, 1976); *S. vagrans yaquinae* (Whitaker and Maser, 1976); *Soricidae* (Dowding, 1959); *Synaptomys cooperi cooperi* (Conner, 1960; Hamilton, 1941a, 1942; Hatt, 1930; Linzey and Linzey, 1973; Whitaker, 1962); *S. cooperi gossii* (Burt, 1928; Hamilton, 1941b); Talpidae (Dowding, 1959); *Zapus hudsonicus* (Whitaker, 1962); *Z. princeps* (Williams and Finney, 1964); *Z. trinotatus* (Whitaker, 1962).
**E. flammicorona* Trappe and Gerdemann: *Clethrionomys californicus californicus* (Gerdemann and Trappe, 1974); *Peromyscus maniculatus* (Gerdemann and Trappe, 1974).
**E. lactiflua* Berk. and Broome: *Clethrionomys californicus californicus* (Gerdemann and Trappe, 1974); *Peromyscus maniculatus* (Gerdemann and Trappe, 1974); *Zapus trinotatus* (Gerdemann and Trappe, 1974).
E. pisiformis Link *ex* Fries: *Clethrionomys californicus californicus* (Gerdemann and Trappe, 1974); *Peromyscus maniculatus* (Gerdemann and Trappe, 1974).
E. macrospora: See *G. macrocarpa. (E. macrospora* was an erroneous citation for *E. macrocarpa).*
**Glomus caledonius* (Nicol. and Gerd.) Trappe and Gerdemann: *Peromyscus maniculatus* (Gerdemann and Trappe, 1974).
**G. fasciculatus* (Thaxt. *sensu* Gerdemann) Gerdemann and Trappe: *Clerthrionomys californicus californicus* (Gerdemann and Trappe, 1974); *Lagurus curtatus* (Dowing, 1955); *Microtus pennsylvanicus* (Bakerspigel, 1956, 1958; Whitaker, 1962); *Ochotona princeps* (Dowding, 1955); *Onychomys leucogaster* (Dowding, 1955); *Peromyscus maniculatus* (Bakerspigel, 1956, 1958; Dowding, 1955; Whitaker, 1962); *Sciurus aberti* (Stephenson, 1975); *Zapus princeps* (Bakerspigel, 1956; Whitaker, 1962); *Z. trinotatus* (Gerdemann and Trappe, 1974).
**G. macrocarpus* Tul. and Tul.: *Blarina* spp. (Hamilton, 1941b); *B. brevicauda* (Diehl, 1939); *Clethrionomys* spp. (Hamilton, 1941b); *C. gapperi gapperi* (Diehl, 1939); *Peromyscus* spp. (Hamilton, 1941b); *P. leucopus novoboracensis* (Diehl, 1939); *P. maniculatus* (Harling and McClaren, 1970); *Sorex cinereus* (Diehl, 1939; Hamilton, 1941b); *S. fumeus* (Diehl, 1939; Hamilton, 1941b); *Synaptomys cooperi cooperi* (Diehl, 1939); *S. cooperi gossii* (Hamilton, 1941b).
**G. macrocarpus* Tul. and Tul. *var.* **macrocarpus: Clethrionomys californicus californicus* (Gerdemann and Trappe, 1974); *Peromyscus maniculatus* (Gerdemann and Trappe, 1974).
**G. microcarpus* Tul. and Tul.: *Clethrionomys californicus californicus* (Gerdemann and Trappe, 1974); *Peromyscus maniculatus* (Gerdemann and Trappe, 1974).
**G. monosporus* Gerdemann and Trappe: *Clethrionomys californicus californicus* (Gerdemann and Trappe, 1974); *Zapus trinotatus* (Gerdemann and Trappe, 1974).
G. pulvinatus (Henn.) Trappe and Gerdemann: *Zapus princeps* (Dowding, 1955; Whitaker, 1962).
**Sclerocystis rubiformis* Gerdemann and Trappe: *Clethrionomys californicus californicus* (Gerdemann and Trappe, 1974); *Peromyscus maniculatus* (Gerdemann and Trappe, 1974); *Zapus trinotatus* (Gerdemann and Trappe, 1974).

CLASS ASCOMYCETES
ORDER PLECTASCALES
FAMILY ELAPHOMYCETACEAE
Elaphomyces spp.: *Neotoma fuscipes annectens* (Parks, 1922); Rodentia (Ingold, 1961, 1966; Reess and Fisch, 1887); *Sciurus aberti* (Stephenson, 1975).
**E. granulatus* Fr.: Leporidae (Hawker, 1954); Rodentia (Hastings and Mottram, 1916; Hawker, 1954; Ingold, 1953); Sciuridae (Bulle-, 1922; Dowding, 1959); *Sciurus carolinensis carolinensis* (Ingold, 1973); *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929).
ORDER DOTHIDEALES
FAMILY DOTHIDEACEAE
Dibotryon spp: *Sciurus carolinensis carolinensis* (Dudderar, 1967).
ORDER HYPOCREALES
FAMILY HYPOCREACEAE
Hypomyces spp.: *Tamiasciurus hudsonicus hudsonicus* (Seton, 1928).
ORDER PEZIZALES
FAMILY HELVELLACEAE
Helvella spp.: *Oryctolagus cuniculus* (Kumerloeve, 1956).
H. lacunosa Afz. *ex* Fr.: *Neotoma fuscipes* (Linsdale and Tevis, 1951).
H. mitra: See *H. lacunosa.*
Paxina acetabulum (L. *ex* St. Amans) Kuntze: *Neotoma fuscipes* (Linsdale and Tevis, 1951).
FAMILY MORCHELLACEAE
Tamiasciurus hudsonicus hudsonicus (Buller, 1922).
Morchella spp.: *Lepus europaeus* (Kumerloeve, 1956).
FAMILY PEZIZACEAE
**Geopora cooperi* Harkness: *Sciurus aberti aberti* (Stephenson, 1975).
Peziza spp.: *Neotoma fuscipes* (Linsdale and Tevis, 1951); *Tamiasciurus hudsonicus hudsonicus* (Buller, 1922).
P. emileia Cke: Neotoma fuscipes (Linsdale and Tevis, 1951).
ORDER TUBERALES
Peromyscus boylei (Jameson, 1952); *Spermophilus* spp. (Bessey, 1935); *Tamiasciurus douglasi* (Smith, C., 1965); *T. hudsonicus hudsonicus* (Smith, C., 1965).
FAMILY TUBERACEAE
Leporidae (Kavaler, 1965); *Neotoma* spp. (Smith, 1938); Rodentia (Christenson, 1951; Kavaler, 1965; Lilly and Barnett, 1951; Mehrotra, 1967; Smith, 1938); Sciuridae (Kavaler, 1965).
Balsamia spp.: *Clethrionomys glareolus* (Drożdż, 1966).
**B. vulgaris* Vitt.: *Sciurus carolinensis carolinensis* (Hastings and Mottram, 1916); *S. vulgaris* (DuReau, 1912; Hatt, 1929).
**Fischerula subcaulis* Trappe: *Microtus oregoni* (Trappe, 1975).
Genea spp.: *Clethrionomys glareolus* (Drożdż, 1966).
Hydnotrya spp.: *Clethrionomys glareolus* (Drożdż, 1966).
Tuber spp.: *Clethrionomys glareolus* (Drożdż, 1966); Geomyidae (Parks, 1922); *Neotoma fuscipes* (Linsdale and Tevis, 1951); Rodentia (Ingold, 1961, 1966); *Sciurus aberti aberti* (Keith, 1965; Stephenson, 1975).
**T. aestivum* Vitt.: Rodentia (Hawker, 1954).
T. candidum Harkn: see *T. rufum* var. *nitidum.*
**Tuber rufum* var. **nitdium* (Vitt.) Fischer: *Neotoma* spp. (Parks, 1921); Rodentia (Parks, 1921).
CLASS BASIDIOMYCETES
ORDER UREDINALES
Peromyscus leucopus (Calhoun, 1941).
FAMILY PUCCINIACEAE
Peridermium harknessii Moore: *Tamiasciurus hudsonicus hudsonicus* (Smith, C. 1965).
FAMILY MELAMPSORACEAE
Cronartium ribicola A. Fisch.: *Sciuridae* (Spaulding, 1922); *Tamiasciurus hudsonicus hudsonicus* (Buller, 1922).
ORDER TREMALES
FAMILY DACRYMYCETACEAE
Calocera viscosa (Fr.) Fr.: *Sciurus vulgaris* (Ognev, 1940; Stakhrovskii, 1932).
ORDER AGARICALES
Sciurus vulgaris leucourus (Barrett-Hamilton and Hinton, 1921).
FAMILY AGARICACEAE
Neotoma cinerea orolestes (Finley, 1958); *N. floridana magister* (Newcombe, 1930); *N. fuscipes annectens* (Parks, 1922); *Sciurus carolinensis carolinensis* (Styan, 1946); *S. niger niger* (Baumgartner, 1939a, 1939b).
Agaricus spp.: *Neotoma floridana magister* (Newcombe, 1930); *Sciurus aberti aberti* (Keith, 1965).
A. campestris L. *ex* Fr.: *Potorous tridactylus apicalis* (Guiler, 1971); *Sciurus vulgaris* (Ognev, 1940; Stakhrovskii, 1932); *Tamiasciurus hudsonicus hudsonicus* (Buller, 1922).
Coprinus spp.: *Blarina brevicauda* (Hamilton, 1930); *Didelphis virginiana* (Hamilton, 1958).
Lepiota spp.: *Sciurus aberti aberti* (Keith, 1965).
L. naucinoides: See *Leucoagaricus naucinus.*

Leucoagaricus naucinus (Fr.) Sing.: *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929; Klugh, 1927).
Mycena epipterygia (Scott. *ex* Fr.) S. F. Gray: *Leporidae* (Hastings and Mottram, 1916).
Psalliota campestris: See *Agaricus campestris.*
FAMILY AMANITACEAE
Amanita spp.: Mammalia (Miller and Halls, 1969); Sciuridae (Miller and Halls, 1969); *Tamiasciurus hudsonicus hudsonicus* (Buller, 1920, 1922; Hamilton, 1939, Smith, 1968); *T. hudsonicus minnesota* (Hamilton, 1943).
**A. muscaria* (L. *ex* Fr.) Pers. *ex* Hooker: Rodentia (Hastings and Mottram, 1916); Sciuridae (Hastings and Mottram, 1916); *Sciurus aberti aberti* (Keith, 1965); *S. carolinensis carolinensis* (Hastings and Mottram, 1916); *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929; Klugh, 1927; Krieger, 1967; Metcalf, 1925; Rue, 1967).
**A. phalloides* (Vaill. *ex* Fr.) Secr.: *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929).
**A. rubescens* (Pers. *ex* Fr.) S. F. Gray: Leporidae (Hastings and Mottram, 1916).
**A. vaginata* (Bull. *ex* Fr.) Vitt.: *Sciurus aberti aberti* (Keith, 1965); *Tamias striatus lysteri* (Allen, 1938, Fraleigh, 1929); *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929).
Aminitopsis vaginata varialba: See *Amanita vaginata.*
Pluteus atricapillus (Secr.) Sing.: *Neotoma fuscipes* (Linsdale and Tevis, 1951); *Sciurus carolinensis carolinensis* (Nixon, Worley, and McClain, 1968); *S. niger niger* (Nixon, Worley, and McClain, 1968).
P. cervinus: See *P. atricapillus.*
P. nanus (Pers. *ex* Fr.) Kumm.: *Sciurus vulgaris exalbidus* (Ognev, 1940).
FAMILY BOLETACEAE
Neotoma fuscipes annectens (Parks, 1922); Rodentia (Miller and Halls, 1969); Sciuridae (Miller and Halls, 1969).
Boletinus cavipes: See *Suillus cavipes.*
**B. pictus* (Peck) Peck: *Tamiasciurus hudsonicus hudsonicus* (Hardy, 1949).
Boletus spp.: *Eutamias quadrimaculatus* (Tevis, 1952); *Lemmus lemmus* (Ognev, 1948); *Neotoma floridana magister* (Newcombe, 1930; Poole, 1940); Sciuridae (Odell, 1926); *Sciurus aberti aberti* (Keith, 1965); *S. carolinensis carolinensis* (Cross, 1942; Nixon, Worley, and McClain, 1968); *S. niger niger* (Nixon, Worley, and McClain, 1968); *Tamiasciurus hudsonicus hudsonicus* (Buller, 1922; Klugh, 1927; Krieger, 1967; Seton, 1929; Smith, 1968).
B. badius: See *Xerocomus badius.*
B. bovinus: See *Suillus bovinus.*
**B. calopus* Fr.: Sciuridae (Cooke, 1890); *Sciurus carolinensis carolinensis* (Hastings and Mottram, 1916).
B. castaneus: See *Gyroporus castaneus.*
B. chrysenteron: See *Xerocomus chrysenteron.*
**B. edulis* Bull. *ex* Fr.: Rodentia (Hastings and Mottram, 1916); *Sciurus vulgaris* (Ognev, 1940).
B. flavidus: See *Suillus flavidus.*
**B. impolitus* Fr.: Sciuridae (Cooke, 1890); *Sciurus carolinensis carolinensis* (Hastings and Mottram, 1916).
B. luteus: See *Suillus luteus.*
**B. mirabilis* Murr.: *Tamiasciurus douglasi douglasi* (Smith, C., 1965); *T. hudsonicus hudsonicus* (Smith, C., 1965).
B. pachypus: See *B. calopus.*
B. pallidus Frost: *Neotoma floridana magister* (Poole, 1940).
B. piperatus: See *Suillus piperatus.*
B. rufus: See *Leccinum aurantiacum.*
B. scaber: See *Leccinum scabrum.*
B. subtomentosus: See *Xerocomus subtomentosus.*
B. variegatus: See *Suillus variegatus.*
B. versipellis Fr.: See *Leccinum versipellis.*
**Gyroporus castaneus* (Bull. *ex* Fr.) Quél.: *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929).
**Leccinum aurantiacum* (Bull.) S. F. Gray: *Sciurus vulgaris* (Ognev, 1940); *S. vulgaris exalbidus* (Ognev, 1940; Stakhrovskii, 1932).
**L. scabrum* (Fr.) S. F. Gray: Sciuridae (Massee, 1913); *Sciurus carolinensis carolinensis* (Hastings and Mottram, 1916); *S. vulgaris* (Ognev, 1940; Stakhrovskii, 1932); *S. vulgaris exalbidus* (Ognev, 1940); *Tamiasciurus hudsonicus hudsonicus* (Buller, 1920, 1922; Hatt, 1929).
**L. versipellis* (Fr.) Snell: *Tamiasciurus hudsonicus hudsonicus* (Buller, 1922).
**Suillus bovinus* (L. *ex* Fr.) Kuntze: Rodentia (Hastings and Mottram, 1916); *Sciurus carolinensis carolinensis* (Hastings and Mottram, 1916); *S. vulgaris exalbidus* (Ognev, 1940); *Tamiasciurus husonicus hudsonicus* (Hatt, 1929).
**S. cavipes* (Opat.) A. H. Sm. and Thiers: *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929).
**S. flavidus* (Fr.) Sing.: Rodentia (Hastings and Mottram, 1916).
**S. granulatus* (Fr.) Kuntze: *Tamiasciurus douglasi douglasi* (Smith, C., 1965); *T. hudsonicus hudsonicus* (Smith, C., 1965).
**S. lakei* (Murr.) A. H. Sm. and Thiers: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).
**S. luteus* (L. *ex* Fr.) S. F. Gray: *Sciurus vulgaris* (Ognev, 1940; Stakhrovskii, 1932); *S. vulgaris exalbidus* (Ognev 1940); *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).

S. piperatus (Bull. *ex* Fr.) Kuntze: *Sciurus vulgaris exalbidus* (Ognev, 1940).
S. subolivaceus A. H. Sm. and Thiers: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).
S. tomentosus (Kauffm.) Sing., Snell, and Dick: *Tamiasciurus douglasi douglasi* (Smith, C., 1965); *T. hudsonicus hudsonicus* (Smith, C., 1965).
S. variegatus (Sw. *ex* Fr.) Kuntze: Rodentia (Hastings and Mottram, 1916); *Sciurus carolinensis carolinensus* (Hastings and Mottram, 1916); *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929).
Xerocomus badius (Fr.) Kühner *ex* Gilbert: Leporidae (Buller, 1922); Rodentia (Hastings and Mottram, 1916).
X. chrysenteron (Bull. *ex* St. Amans) Quél.: Rodentia (Hastings and Mottram, 1916); *Sciurus vulgaris exalbidus* (Ognev, 1940).
X. subtomentosus (L. *ex* Fr.) Quél.: *Sciurus vulgaris* (Ognev, 1940; Stakhrovskii, 1932); *S. vulgaris exalbidus* (Ognev, 1940).

FAMILY COPRINACEAE

Hypholoma spp.: See *Psathyrella* spp.
H. fasiculare: See *Naematoloma fasiculare* in Strophariaceae.
Psathyrella spp.: *Sciurus aberti aberti* (Keith, 1965); *Tamiasciurus hudsonicus hudsonicus* (Seton, 1929).

FAMILY CORTINARIACEAE

Cortinarius spp.: *Tamiasciurus hudsonicus hudsonicus* (Buller, 1920, 1922; Hardy, 1949; Hatt, 1929; Seton, 1929; Smith, C., 1965).
C. collinitus (Pers. *ex* Fr.) Fr.: Rodentia (Hastings and Mottram, 1916).
C. distans Peck: Rodentia (Miller and Halls, 1969).
C. varius (Schaeff. *ex* Fr.) Fr.: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).
Flammula sapinea: See *Gymnopilus sapineus.*
Gymnopilus sapineus (Fr.) Maire: *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929).
Inocybe spp.: *Neotoma floridana magister* (Newcombe, 1930; Poole, 1940); *Tamiasciurus hudsonicus hudsonicus* (Hardy, 1949).
Rozites caperata (Pers. *ex* Fr.) Karst.: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).

FAMILY CREPIDOTACEAE

Crepidotus malachius: See *C. nephrodes.*
C. nephrodes (Berk. and Curt.) Sacc.: *Sciurus carolinensis carolinensis* (Nixon, Worley, and McClain, 1968); *S. niger niger* (Nixon, Worley, and McClain, 1968).

FAMILY GOMPHIDACEAE

Chroogomphus rutilus: See *Gomphidius rutilus.*
C. tomentosus: See *Gomphidius tomentosus.*
Gomphidius glutinosus (Shaeff. *ex* Fr.) Fr.: *Sciurus vulgaris exalbidus* (Ognev, 1940).
G. rutilus (Schaeff. *ex* Fr.) Lund. and Nannf.: *Tamiasciurus douglasi douglasi* (Smith, C., 1965); *T. hudsonicus hudsonicus* (Smith, C., 1965).
G. subroseus Kauffm.: *Tamiasciurus douglasi douglasi* (Smith, C., 1965); *T. hudsonicus hudsonicus* (Smith, C., 1965).
G. tomentosus Murr.: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).

FAMILY HYGROPHORACEAE

Hygrocybe miniata (Scop. *ex* Fr.) Kumm.: *Sciurus carolinensis carolinensis* (Nixon, Worley, and McClain, 1968); *S. niger niger* (Nixon, Worley, and McClain, 1968).
Hygrophorus chrysodon (Batsch *ex* Fr.) Fr.: *Tamiasciurus hudsonicus hudsonicus* (Buller, 1922).
H. hypothejus (Fr.) Fr.: Rodentia (Hastings and Mottram, 1916); *Sciurus carolinensis carolinensis* (Hastings and Mottram, 1916); *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929).
H. miniatus: See *Hygrocybe miniata.*
H. pudorinus (Fr.) Fr.: *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929; Odell, 1925).

FAMILY PAXILLACEAE

Hygrophoropsis aurantiaca (Wulf *ex* Fr.) Maire: Leporidae (Hastings and Mottram, 1916); Rodentia (Hastings and Mottram, 1916); *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929).
Paxillus atrotomentosus (Batsch *ex* Fr.) Fr.: Rodentia (Hastings and Mottram, 1916).
P. involutus (Batsch *ex* Fr.) Fr.: Leporidae (Hastings and Mottram, 1916); Rodentia (Hastings and Mottram, 1916); *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929).

FAMILY RUSSULACEAE

Clethrionomys rutilus mikado (Murata, 1976).
Lactarius spp.; Rodentia (Miller and Halls, 1969); *Tamiasciurus hudsonicus hudsonicus* (Buller, 1922).
L. deliciosus (L. *ex* Fr.) S. F. Gray: *Sciurus carolinensis carolinensis* (Barkalow and Shorten, 1973); *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).
L. lignyotus (Fr. *ex* Fr.) Fr.: *Clethrionomys gapperi gapperi* (Hamilton, 1941b).
L. necator (Bull. *em.* Pers. *ex* Fr.) Karst.: Rodentia (Hastings and Mottram, 1916).
L. piperatus (L. *ex* Fr.) S. F. Gray: Rodentia (Miller and Halls, 1969); *Tamiasciurus hudsonicus hudsonicus* (Buller, 1920, 1922; Hardy, 1949; Hatt, 1929).
L. rufus (Scop. *ex* Fr.) Fr.: Rodentia (Hastings and Mottram, 1916).
L. torminosus (Schaeff. *ex* Fr. S. F. Gray: *Sciurus vulgaris* (Ognev, 1940; Stakhrovskii, 1932).
L. turpis: See *Lactarius necator.*
L. uvidus (Fr. *ex* Fr.) Fr.: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).
Russula spp.: *Clethrionomys glareolus* (Drożdż 1966); *Lemmus lemmus* (Ognev, 1948); *Napa-*

eozapus insignis insignis (Sheldon, 1934); *Neotoma floridana magister* (Newcombe, 1930; Poole, 1940); Sciuridae (Dowding, 1955); *Sciurus aberti aberti* (Keith, 1965); *S. carolinensis carolinensis* (Cross, 1942; Dudderar, 1967; Murrill, 1910); *Tamias striatus lysteri* (Allen, 1938; Fraleigh, 1929; Sheldon, 1936); *Tamiasciurus hudsonicus fremonti* (Hatt, 1943); *T. hudsonicus hudsonicus* (Buller, 1920, 1922; Klugh, 1927).

**R. adusta* (Pers. *ex* Fr.) Fr.: *Tamiasciurus hudsonicus hudsonicus* (Hardy, 1949).

**R. alutacea* (Pers. *ex* Fr.) Fr.: *Tamiasciurus hudsonicus hudsonicus* (Hardy, 1949).

**R. bicolor* Burl.: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).

R. bicolor var. *constans:* See *Russula bicolor.*

R. bicolor var. *reticulispora:* See *Russula bicolor.*

**R. blackfordae* Peck: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).

**R. brevipes* Peck: *Tamiasciurus douglasi douglasi* (Smith, C., 1965).

**R. consobrina* (Fr. *ex* Fr.) Fr.: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).

**R. decorans* Fr.: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).

R. delica: see *R. brevipes.*

R. depallens: See *Russula pulchella.*

R. disparilis Burl.: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).

**R. emetica* (Schaeff. *ex* Fr.) Pers. *ex* Fr.: Rodentia (Hastings and Mottram, 1916); *Sciurus carolinensis carolinensis* (Hastings and Mottram, 1916); *Tamiasciurus hudsonicus hudsonicus* Hatt, 1929).

**R. emetica* ssp. **fragilis* (Pers. *ex* Fr.) Sing.: *Tamiasciurus hudsonicus* (Smith, C., 1965).

R. fragilis: See *Russula emetica* ssp. *fragilis.*

R. mariae Peck: *Tamiasciurus hudsonicus hudsonicus* (Hardy, 1949).

**R. nigricans* (Bull. *ex* Fr.) Fr.: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).

**R. ochroleuca* (Pers. *ex* Fr.: *Sciurus carolinensis carolinensis* (Hastings and Mottram, 1916).

R. pallidostraminea nom. prov.: Tamiasciurus hudsonicus hudsonicus (Smith, C., 1965).

**R. pulchella* Borsc.: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).

**R. rosea* Quél.: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).

R. rosipes (Secr.) Bres.: *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929).

**R. rubra* (Fr.) Fr.: *Tamiasciurus hudsonicus hudsonicus* (Buller, 1922).

**R. xerampelina* (Schaeff. *ex* Secr.) Fr.: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).

R. xerampelina var. isabelliniceps: See *R. xerampelina.*

FAMILY STROPHARIACEAE

Kuehneromyces mutabilis (Schaeff. *ex* Fr.) Sing. and A. H. Sm.: *Sciurus vulgaris* (Ognev, 1940; Stakhrovskii, 1932).

Naematoloma fasiculare (Huds *ex* Fr.) Karst.: *Sciurus vulgaris* (Moffat, 1923); *Tamiasciurus hudsonicus hudsonicus* (Buller, 1920, 1922; Hatt, 1929).

Pholiota spp.: *Sciurus vulgaris* (Ognev, 1940).

P. carbonaria (Fr.) Sing.: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).

P. discolor (Pk.) Sacc.: *Sciurus carolinensis carolinensis* (Nixon, Worley, and McClain, 1968).

P. lenta (Pers. *ex* Fr.) Sing.: *Tamiasciurus douglasi douglasi* (Smith, C., 1965).

P. mutabilis: See *Kuehneromyces mutabilis.*

FAMILY TRICHOLOMATACEAE

Armillaria spp.: *Sciurus vulgaris* (Ognev, 1940).

A. mellea (Vahl in Fl. Dan. *ex* Fr.) Karst.: Sciuridae (Miller and Halls, 1969); *Sciurus vulgaris* (Ognev, 1940; Stakhrovskii, 1932); *Tamiasciurus hudsonicus hudsonicus* (Buller, 1920, 1922; Hatt, 1929).

Clitocybe spp.: *Eutamias quadrimaculatus* (Tevis, 1952); *Sciurus vulgaris* (Ognev, 1940); *Tamiasciurus hudsonicus hudsonicus* (Hardy, 1949).

C. brumalis (Fr.) Quél.: Leporidae (Hastings and Mottram, 1916); *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929).

C. maxima (Fl. Wett. *ex* Fr.) Kumm.: *Tamiasciurus hudsonicus hudsonicus* (Buller, 1922).

C. monodelpha Morg.: *Tamiasciurus hudsonicus hudsonicus* (Buller, 1922).

**C. odora* (Bull. *ex* Fr.) Kumm.: *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929).

C. virens: See *C. odora.*

Collybia dryophila (Bull. *ex* Fr.) Kumm.: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).

C. maculata (A. and S. *ex* Fr.) Quél.: Rodentia (Hastings and Mottram, 1916); *Sciurus carolinensis carolinensis* (Hastings and Mottram, 1916); *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929).

C. radicata: See *Oudemansiella radicata.*

C. velutipes: See *Flammulina velutipes.*

Flammulina velutipes (Curt. *ex* Fr.) Sing.: *Sciurus carolinensis carolinensis* (Nixon, Worley, and McClain 1968).

Lentinus lepideus (Fr. *ex* Fr.) Fr.: *Tamiasciurus hudsonicus hudsonicus* (Buller, 1922).

**Lepista personata* (Fr. *ex* Fr.) Cke.: *Tamiasciurus hudsonicus hudsonicus* (Buller, 1922).

Lyophyllum ulmarium (Bull. *ex* Fr.) Kühner: *Tamiasciurus hudsonicus hudsonicus* (Buller, 1922).

Marasmius spp.: *Orcytolagus cuniculus* (Kumerloeve, 1956).

Oudemansiella radicata (Relh. *ex* Fr.) Sing.: *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929; Klugh, 1927).

Tricholoma spp.: *Tamiasciurus hudsonicus hudsonicus* (Hardy, 1949).

T. equestre: See *T. flavovirens.*

T. flavovirens (Pers. *ex* Fr.) Lund.: *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929; Odel, 1925).
T. personatum: See *Lepista personata.*
T. terreum (Schaeff. *ex* Fr.) Kumm.: *Sciurus carolinensis carolinensis* (Hastings and Mottram, 1916).
ORDER APHYLLOPHORALES
FAMILY CANTHARELLACEAE
Cantharellus aurantiacus: See *Hygrophoropsis aurantiaca* in Paxillaceae.
C. cibarius Fr.: *Sciurus vulgaris* (Ognev, 1940; Stakhrovskii, 1932); *Tamiasciurus hudsonicus hudsonicus* (Buller, 1922; Hatt, 1929; Klugh, 1927).
C. floccosus: See *Gomphus floccosus.*
Gomphus floccosus (Schw.) Sing.: *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929).
FAMILY CLAVARIACEAE
Clavaria spp.: *Neotoma floridana magister* (Newcombe, 1930; Poole, 1930); *Tamiasciurus hudsonicus hudsonicus* (Smith, 1968).
C. aurea: See *Ramaria aurea.*
C. flava: See *Ramaria flava.*
C. pyxidata: See *Clavicorona pyxidata.*
Clavicorona pyxidata (Fr.) Poty: *Tamiasciurus hudsonicus hudsonicus* (Buller, 1922).
Ramaria aurea (Fr.) Quél.: *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929; Klugh, 1927).
R. flava (Fr.) Quél.: *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929).
Sparassis crispa Fr.: Leporidae (Hastings and Mottram, 1916).
FAMILY HYDNACEAE
Hericium caput-ursi (Fr.) Banker: *Tamiasciurus hudsonicus hudsonicus* (Buller, 1922).
Hydnum spp.: *Tamiasciurus hudsonicus hudsonicus* (Smith, 1968).
H. caput-ursi: See *Hericium caput-ursi.*
H. erinaceus Bull.: *Sciurus carolinensis carolinensis* (Nixon, Worley, and McClain, 1968); *S. niger niger* (Nixon, Worley, and McClain, 1968).
H. fuligineo-violaceum Kalchb. in Fr.: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).
H. imbricatum L. *ex* Fr. *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).
H. repandum L. *ex* Fr.: *Tamiasciurus hudsonicus hudsonicus* (Buller, 1922).
FAMILY POLYPORACEAE
Sciurus griseus griseus (Grinnel and Storer, 1924).
Daedalea spp.: *Sciurus carolinensis carolinensis* (Dudderar, 1967).
Fomes fomentarius (L. *ex* Fr.) Kickx: *Tamiasciurus hudsonious hudsonicus* (Buller, 1922).
F. pinicola (Swartz *ex* Fr.) Cooke: *Tamiasciurus hudsonicus hudsonicus* (Hardy, 1949).
Pleurotus spp.: *Sciurus niger niger* (Packard, 1956).
P. ostreatus (Jacq. *ex* Fr.) Kumm.: *Sciurus carolinensis carolinensis* (Nixon, Worley, and McClain, 1968); *S. niger niger* (Nixon, Worley, and McClain, 1968); *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929; Klugh, 1927).
P. ulmarius: See *Lyophyllum ulmarium.*
Polyporus spp.: *Neotoma cinerea orolestes* (Warren, 1920); *Sciurus carolinensis carolinensis* (Dudderar, 1967; *Spermophilus lateralis* (Gordon, 1943); *Sylvilagus palustris paludicola* (Blair, 1936); *Tamiasciurus hudsonicus fremonti* (Hatt, 1943); *T. hudsonicus hudsonicus* (Hardy, 1949; Smith, 1968); *T. hudsonicus loquax* (Layne, 1954).
P. amarus Hedgc.: Sciuridae (Boyce, 1920); *Tamiasciurus hudsonicus hudsonicus* (Buller, 1922).
P. betulinus Bull. *ex* Fr.: Leporidae (Hastings and Mottram, 1916); *Sciurus vulgaris* (Ognev 1940); *Tamiasciurus hudsonicus hudsonicus* (Buller, 1922).
P. picipes Fr.: *Sciurus carolinensis carolinensis* (Nixon, Worley, and McClain, 1968); *S. niger niger* (Nixon, Worley, and McClain, 1968).
P. sulphureus Bull. *ex* Fr.: *Sciurus carolinensis carolinensis* (Nixon, Worley, and McClain, 1968); *S. niger niger* (Nixon, Worley, and McClain, 1968).
P. varius Fr.: *Neotoma fuscipes* (Linsdale and Tevis, 1951).
Polysticus spp.: See *Polyporus* spp.
FAMILY STEREACEAE
Stereum hirsutum Willdenon *ex* Fr.: *Sciurus carolinensis carolinensis* (Murrill, 1910).
ORDER HYMENOGASTRALES
FAMILY HYMENOGASTRACEAE
Rodentia (Gäumann and Dodge, 1928).
Alpova diplophloeus (Zeller and Dodge) Trappe: *Tamiasciurus douglasi douglasi* (Smith, C., 1965); *T. hudsonicus hudsonicus* (Smith, C., 1965).
Gautieria spp.: *Neotoma* spp. (Parks, 1919); *N. fuscipes annectens* (Parks, 1922); *Sciurus aberti aberti* (Stephenson, 1975); *S. griseus griseus* (Stienecker and Browning, 1970).
G. graveolens Vitt.: *Tamiasciurus douglasi douglasi* (Smith, C., 1965); *T. hudsonicus hudsonicus* (Smith, 1965; Smith, C., 1965).
G. morchelliformis Vitt.: *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929).
Hydnangium spp.: *Neotoma fuscipes annectens* (Parks, 1922).
Hymenogaster spp.: *Blarina brevicauda* (Whitaker, 1962; Whitaker and Ferraro, 1963); *Clethrionomys gapperi gapperi* (Whitaker, 1962); *C. glareolus* (Drożdż, 1966); *Microtus oeconomus macfarlandi* (Whitaker, 1962); *Napaeozapus insignis insignis* (Whitaker, 1962, 1963a);

Neotoma fuscipes annectens (Parks, 1922); Rodentia (Ingold, 1961, 1966); *Zapus hudsonius* (Whitaker, 1962).
**H. tener* Berk.: *Tamiasciurus hudsonicus hudsonicus* (Hardy, 1949).
Martellia spp.: *Sciurus aberti aberti* (Stephenson, 1975).
Rhizopogon spp.: *Clethrionomys glareolus* (Drożdż, 1966); Rodentia (Ingold, 1966; Miller and Halls, 1969); Sciuridae (Miller and Halls, 1969); *Sciurus aberti aberti* (Stephenson, 1975); S. *griseus griseus* (Stienecker and Browning, 1970).
R. diplophloeus: See *Alpova diplophloeus.*
**R. luteolus* Fr. and Nordh.: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).
**R. maculatus* Zeller and Dodge: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).
**R. occidentalis* Zeller and Dodge: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).
R. pachyphloeus: See *Alpova diplophloeus.*
R. provincialis: See *R. vulgaris.*
**R. roseolus* Corda *sensu* A. H. Sm.: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).
**R. rubescens* (Tul.) Tul.: *Tamiasciurus douglasi douglasi* (Smith, C., 1965); *T. hudsonicus hudsonicus* (Smith, C., 1965).
**R. vinicolor* Sm.: *Tamiasciurus douglasi douglasi* (Fogel, 1976).
**R. viridis* Zeller and Dodge: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).
**R. vulgaris* (Vitt.) M. Lange: *Tamiasciurus hudsonicus hudsonicus* (Smith, C., 1965).
**Truncocolumella citrina* Zeller: *Tamiasciurus douglasi douglasi* (Fogel, 1976); *T. hudsonicus hudsonicus* (Smith, C., 1965).
ORDER HYSTERANGIALES
FAMILY HYSTERANGIACEAE
Rodentia (Gaümann and Dodge, 1928).
Hysterangium spp.: *Neotoma* spp.: (Parks, 1919); *N. fuscipes annectens* (Parks, 1922); *Sciurus aberti aberti:* (Stephenson, 1975); *S. griseus griseus* (Stienecker and Browning, 1970).
FAMILY MELANOGASTRACEAE
Melanogaster spp.: *Clethrionomys glareolus* (Drożdż, 1966); *Neotoma* spp. (Parks, 1919); *N. fuscipes* (Linsdale and Tevis, 1951); *N. fuscipes annectens* (Parks, 1922); *Sciurus griseus griseus* (Stienecker and Browning, 1970).
**M. ambiguus* (Vitt.) Tul.: Sciuridae (Langham, 1916); *Sciurus carolinensis carolinensis* (Hastings and Mottram, 1916); *Tamiasciurus hudsonicus hudsonicus* (Hatt, 1929).
M. broomeianus Berk. *in* Tul.: Leporidae (Hawker, 1954).
M. variegatus (Vitt.) Tul. *emend.* Zeller and Dodge: *Microtus pennsylvanicus* (Bakerspigel, 1958); *Peromyscus maniculatus* (Bakerspigel, 1958).
M. variegatus var. *broomeianus:* See *M. broomeianus.*
ORDER LYCOPERDALES
Dasypus novemcinctus mexicanus (Kalmbach, 1944); Phascolomidae (Troughton, 1947).
FAMILY GEASTERACEAE
Geastrum spp.: *Tamias striatus griseus* (Schmidt, 1931).
FAMILY LYCOPERDACEAE
Neotoma albigula warreni (Finley, 1958); *Tamias striatus fisheri* (Tunis, 1971).
Castoreum spp.: Leporidae (Cleland, 1935); Marsupialia (Cleland, 1935).
C. radicatum Cke. and Mass.: Marsupialia (Cunningham, 1942).
Lycoperdon spp.: *Apodemus sylvaticus* (Miller, 1954); *Neotoma cinerea* (Dalquest, 1948); *N. cinerea occidentalis* (Taylor, 1920); *N. floridana magister* (Poole, 1940); *Oryctolagus cuniculus* (Kumerloeve, 1956); *Sciurus aberti aberti* (Keith, 1965); *S. carolinensis carolinensis* (Hastings and Mottram, 1916); *Tamiasciurus hudsonicus loquax* (Connor, 1960).
**L. gemmatum* Batsch: *Sciurus carolinensis carolinensis* (Nixon, Worley, and McClain, 1968); *S. niger niger* (Nixon, Worley, and McClain, 1968).
L. pyriforme Pers.: *Tamiasciurus hudsonicus hudsonicus* (Hardy, 1949).
Mesophellia spp.: Leporidae (Cleland, 1936; Cunningham, 1942); Marsupialia (Cleland, 1935; Cunningham, 1942).
M. arenaria Berk.: Leporidae (Cunningham, 1942); Macropodidae (Cunningham, 1942); Marsupialia (Cunningham, 1942); Permelidae (Cunningham, 1942).
M. pachythrix (Cke. and Mass.) Lloyd: Leporidae (Cleland, 1935).
ORDER SCLERODERMATALES
FAMILY SCLERODERMATACEAE
Scleroderma spp.: *Oryctolgus cuniculus* (Kumerloeve, 1956).
**S. citrinum* Pers.: *Neotoma floridana magister* (Newcombe, 1930).
S. hypogaeum Zeller: *Neotoma fuscipes* (Linsdale and Tevis, 1951).
S. vulgara: See *S. citrinum.*
MISCELLANEOUS REPORTS
Unnamed fungi: *Apodemus flavicollis* (Drożdż, 1966; Zemanek, 1972); *A. sylvaticus* (Hansson, 1970; 1971; Holišová, 1960; Southern, 1964); *Clethrionomys* spp. (Palmer, 1954; Walker, 1964); *C. gapperi athabascae* (Harper, 1956); *C. gapperi gapperi* (Connor, 1960; Doutt, Heppenstall, and Guilday, 1967; Jackson, 1961; Larrison, 1970; Linzey and Linzey, 1973); *C. gapperi paludicola* (Doutt, Heppenstall, and Guilday, 1967); *C. gapperi rhoadsii* (Connor, 1953); *C. gapperi rupicola* (Doutt, Heppenstall, and Guilday, 1967); *C. glareolus* (Hansson, 1969, 1971; Holišová, 1971, 1972; Miller, 1954; Ognev, 1950; Southern, 1964; Zem-

anek, 1972); *C. rufocanus* (Hansson, 1969); *Dasypus novemcinctus mexicanus* (Fitch, Goodrum, and Newman, 1952; Kalmbach, 1944; Miller and Halls, 1969); *Dicrostonyx groenlandicus* (Dunaeva and Kucheruk, 1941; Watson, 1956); *D. torquatus* (Ognev, 1948); *Didelphis virginiana* (Palmer, 1964; Sumner and Dixon, 1953); *Dipodomys* spp. (Cahalane, 1947; Palmer, 1954); *Eutamias* spp. (Cahalane, 1947; Gordon, 1943; Hamilton, 1939; Olin, 1961; Orr, 1949; Palmer, 1954; Walker, 1964); *E. cinereicollis cinereicollis* (Bailey, 1931); *E. minimus neglectus* (Hamilton, 1943); *E. minimus pictus* (Bailey, 1936); *E. quadrivittatus quadrivittatus* (Bailey, 1931; MacClintock, 1970); *E. speciosus* (Ingles, 1947; Tevis, 1953); *E. townsendii* (Larrison, 1970); *E. townsendii senex* (Bailey, 1936); *Glaucomys* spp. (Palmer, 1954); *G. sabrinus* (Cahalane, 1947; MacClintock, 1970; McKeever, 1960); *G. sabrinus fuscus* (Hamilton, 1943); *G. sabrinus macrotis* (Connor, 1960; Jackson, 1961); *G. volans* (Cahalane, 1947; Corbet, 1966; MacClintock, 1970; Ognev, 1940; Schwartz and Schwartz, 1959); *G. volans volans* (Connor, 1960); *Isoden obesulus* (Brazenor, 1950); *Lemmus lemmus* (Corbet, 1966; Marsden, 1964; Ognev, 1948); Leporidae (Rolfe and Rolfe, 1925); *Lepus europaeus* (Hansson, 1970); Macropodidae (Cleland, 1934); *Mastocomys* spp. (Walker, 1964); *Microdipodops* spp. (Cahalane, 1947); *Microtus agrestis* (Hansson, 1970, 1971); *M. pennsylvanicus* (Golley, 1960); *Neotoma* spp. (Hamilton, 1939); *N. cinerea* (Dalquest, 1948); *N. cinerea occidentalis* (Taylor, 1920); *N. cinerea orolestes* (Warren, 1942); *N. floridana* (Hall, 1955; Schwartz and Schwartz, 1959); *N. floridana attwateri* (Bailey, 1905; Rainey, 1956); *N. floridana magister* (Hamilton, 1943; Newcombe, 1930; Paradiso, 1969; Roberts and Early, 1952); *N. fuscipes* (Linsdale and Tevis, 1951); *N. fuscipes macrotis* Howel, 1926); *N. lepida lepida* (Barnes, 1922, 1927); *Papio cyncephalus* (Altman and Altman, 1970); *Perognathus parvus* (Johnson, 1961); *Peromyscus boylei* (Jameson, 1952); *P. leucopus* (Miller and Halls, 1969); *P. leucopus noveboracensis* (Hamilton, 1941b); *P. maniculatus* (Dalquest, 1948; Jameson, 1952; Miller and Halls, 1969; Schwartz and Schwartz, 1959; Walton, 1898); *P. maniculatus artemisiae* (Williams, 1959); *P. maniculatus bairdii* (Whitaker, 1966); *P. maniculatus gracilis* (Connor, 1960; Hamilton, 1941b); *P. maniculatus osgoodi* (Williams, 1959); *P. truei* (Bradford, 1974); Phascolomidae (Carter, Hill, and Tate, 1945); Peramelidae (Cleland, 1934); *Phenacomys intermedius mackenzii* (Harper, 1956); *Pitymys subterraneus* (Holišová, 1965); *P. tatricus* (Holišová, 1965); *Potorous tridactylus* (Brazenor, 1950); *P. tridactylus apicalis* (Guiler, 1971); Rodentia (Miller and Halls, 1969; Rolfe and Rolfe, 1925); Sciuridae (Brehm, 1895; Hamilton, 1939; Miller and Halls, 1969; Rolfe and Rolft, 1925); *Sciurus* spp. (Walker, 1964); *S. aberti aberti* (Bailey, 1931; Cahalane, 1947; MacClintock, 1970; Palmer, 1954; Patton, 1975; Seton, 1929; Stephenson, 1974); *S. carolinensis carolinensis* (Bailey, 1946; Ballou, 1927; Barber, 1954; Bernard, 1937; Burt, 1957; Cahalane, 1947; Cranbrook and Payn, 1962; Cross, 1942, 1946; Goodrum, 1940; Halls and Stransky, 1971; Hoffmeister and Mohr, 1957; Lyon, 1936; MacClintock, 1970; Martin *et al.*, 1951; Miller and Halls, 1969; Moore, 1943; Nelson, 1918; Palmer, 1954; Peterson, 1966; Robinson and Cowan, 1954; Schwartz and Schwartz, 1959; Shorten, 1962; Shorten and Courtier, 1955; Southern, 1964); *S. carolinensis hypophaeus* (Jackson, 1961; Larrison, 1970); *S. carolinensis pennsylvanicus* (Doutt, Heppenstall, and Guilday, 1967); *S. griseus griseus* (Cahalane, 1947; Miller and Halls, 1969; Sumner and Dixon, 1953); *S. kaibabensis* (Cahalane, 1947; Goldman, 1928; Hall, 1967; MacClintock, 1970; Nelson, 1918; Palmer, 1954); *S. niger cinerus* (Bailey, 1946); *S. niger niger* (Anthony and McSpadden, 1917; Allen, 1943; Barber, 1954; Baumgartner, 1939a, 1939b; Burt, 1957; Cahalane, 1947; Golley, 1962; Hall, 1955; Hoffmeister and Mohr, 1957; MacClintock, 1970; Matrin *et al.*, 1951; Moore, 1943; Palmer, 1954; Shafeldt, 1920); *S. niger rufiventer* (Larrison, 1970; Over and Churchill, 1941); *S. vulgaris* (Bourliere, 1956; Cranbrook and Payn, 1962; Lampio, 1967; Southern, 1964; Van Gelder, 1969); *S. vulgaris leucourus* (Shorten, 1959; 1962); *S. vulgaris orientis* (Abe, 1967); Soricidae (Martin *et al.*, 1951); *Spermophilus* spp. (Bourliere, 1956; Walker, 1964); *S. beecheyi* (Fitch, 1948; Linsdale, 1946); *S. lateralis chrysodeirus* (Bailey, 1936; Howell, 1938; Sumner and Dixon, 1953); *S. lateralis lateralis* (Bailey, 1931; Cahalane, 1947; Dalquest, 1948; Gordon, 1943; MacClintock, 1970; Seton, 1929); *S. richardsonii* (Hansen and Ueckert, 1970); *S. undulatus kennicottii* (Bee and Hall, 1956); *S. undulatus parryii* (Howell, 1938; Seton, 1971); *Spilogale* spp. (Howell, 1906); *S. putorius* (Bailey, 1946; Martin *et al.*, 1951); *Synaptomys cooperi cooperi* (Doutt, Heppenstall, and Guilday, 1967; Jackson, 1961; Martin *et al.*, 1951; Schwartz and Schwartz, 1959); *S. cooperi stonei* (Doutt, Heppenstall, and Guilday, 1967); Talpidae (Martin *et al.*, 1951; *Tamias* spp. Dalquest, 1948; Hamilton, 1939; Martin *et al.*, 1951); *T. striatus fisheri* (Bailey, 1946; Tunis, 1971); *T. striatus griseus* (Jackson, 1961); *T. striatus lysteri* (Allen, 1938; Doutt, Heppenstall, and Guilday, 1967; Gifford and Whitebread, 1951; Mearns, 1899; Seton, 1929); *T. striatus striatus* (Bailey, 1946; Cahalane, 1947; Golley, 1962; MacClintock, 1970; Schwartz and Schwartz, (1959); *Tamiasciurus* spp. (Bourliere, 1956; Palmer, 1954); *T. douglasi albolimbatus* (Bailey, 1936; Stevens, 1906); *T. douglasi douglasi* (Bailey, 1936; Broadbrooks, 1958; Cahalane, 1947; Dalquest, 1948; MacClintock, 1970; Nelson, 1918; Orr, 1949; Seton, 1929); *T. douglasi mollipilosus* (Bailey, 1936); *T. husonicus abieticola* (Golley, 1926); *T. hudsonicus dakotensis* (Over and Churchill, 1941); *T. hudsonicus fremonti* (Cahalane, 1947; Hatt, 1943; Olin, 1961); *T. hudsonicus hudsonicus* (Anthony and McSpadden, 1917; Burt, 1957; Cahalane, 1947; Cameron, 1956; Cram, 1924; Dalquest, 1948; Dice, 1921;

Hamilton, 1939; Jackson, 1931-1932; MacClintock, 1970; Marie, 1927; Martin *et al.*, 1951; Merriam, 1884; Murrill, 1902; Nelson, 1918; Peterson, 1966; Rand, 1948; Seagears, 1949, 1950; Seton, 1929; Van Gelder, 1969; Walton, 1903; Zim and Hoffmeister, 1955); *T. hudsonicus loquax* (Bailey, 1946; Connor, 1960; Doutt, Heppenstall, and Guilday, 1967; Grim and Roberts, 1950; Layne, 1954; Lyon, 1936; Paradiso, 1969; Roberts and Early, 1952); *T. hudsonicus lychnuchus* (Bailey, 1931); *T. hudsonicus minnesota* (Hamilton, 1943; Jackson, 1961; Over and Churchill, 1941); *T. hudsonicus mogollonensis* (Bailey, 1931); *T. hudsonicus preblei* (Harper, 1956); *T. hudsonicus richardsoni* (Bailey, 1936); *T. hudsonicus streatori* (Rust, 1946); *T. hudsonicus ventorum* (Barnes, 1922, 1927); *Vombatus hirsutus* (Brazenor, 1950).

Hypogoeus fungi, "truffles," hypogeous Gasteromycetes, basidiomycetous tubers, hypogeous Basidiomycetes, etc.

Apodemus sylvaticus (Watts, 1968); *Clethrionomys glareolus* (Watts, 1968); *Eutamias* spp. (Dowding, 1959); *E. amoenus* (Broadbrooks, 1958; Tevis, 1952); *E. quadrimaculatus* (Tevis, 1952, 1953); *E. townsendii* (Tevis, 1952, 1953); *Glaucomys sabrinus* (McKeever, 1960; Tevis, 1953); *Lepus europaeus* (Southern, 1964); Macropodidae (LeSouef and Burrell, 1926; Troughton, 1947); *Neotoma* spp. (Zeller, 1939); *N. cinerea* (Tevis, 1953); *Peromyscus boylei* (Tevis, 1953); *Phascolomys* spp. (LeSouef and Burrell, 1926); *Potorous* spp. (Troughton, 1943, 1944); Rodentia (Burnett, 1968; Gwynne-Vaughan, 1937); Sciuridae (Lohwag, 1932); *Sciurus griseus griseus* (Grinnel and Storer, 1924; Tevis, 1953); *Spermophilus* spp. (Dowding, 1959); *S. beecheyi* (Tevis, 1953); *Tamiasciurus douglasi douglasi* (Zeller, 1939).

Animals and the Fungi They Eat

CLASS MAMMALIA
ORDER MARSUPIALIA
Mesophellia spp.; *M. arenaria; Castoreum* spp.; *C. radicatum.*
FAMILY DIDELPHIDAE
Didelphis virginiana Kerr—opossum: *Coprinus* spp.; fungi.
FAMILY PERAMELIDAE
Mesophellia arenaria; fungi.
Isoden obesulus (Shaw)—short-nosed bandicoot: fungi.
FAMILY PHASCOLOMIDAE
Lycoperdales; fungi.
Phascolomys spp.: hypogeous fungi.
Vombatus hirsutus (Perry)—common wombat: fungi.
FAMILY MACROPODIDAE
Mesophellia arenaria; hypogeous fungi; fungi.
Potorous spp.: hypogeous fungi.
P. tridactylus Kerr—dark rat-kangaroo: fungi.
P. tridactylus apicalis (Gould): *Agaricus campestris; Oomycetales;* fungi.
ORDER INSECTIVORA
FAMILY SORICIDAE
Endogone spp.
Blarina spp.: *Glomus macrocarpus.*
B. brevicauda (Say)—short-tailed shrew: *Coprinus* spp.; *Endogone* spp.; *Glomus macrocarpus; Hymenogaster* spp.
Sorex spp.: fungi.
S. bendirii (Merriam)—Pacific water shrew: fungi.
S. cinereus Kerr—masked shrew: *Endogone* spp.; *Glomus macrocarpus.*
S. fumeus Miller—smoky shrew: *Endogone* spp.; *Glomus macrocarpus.*
S. pacificus: See *Sorex vagrans pacificus.*
S. trowbridgii Baird—Trowbridge's shrew: *Endogone* spp.
S. vagrans Baird—vagrant shrew: *Endogone* spp.
S. vagrans pacificus Coues: fungi.
S. vagrans yaquinae Jackson: *Endogone* spp.
S. yaquinae: see *Sorex vagrans yaquinae.*
FAMILY TALPIDAE
Endogone spp.; fungi.
ORDER PRIMATES
FAMILY CYNOPITHECINAE
Papio cynocephalus L.—yellow baboon: fungi.
ORDER ENDENTATA
FAMILY DASYPODIDAE
Dasypus novemcinctus mexicanus Peters—nine-banded armadillo: Lycoperdales, fungi.
D. novemcinctus texanus: See *Dasypus novemcinctus mexicanus.*
ORDER LAGOMORPHA
FAMILY LEPORIDAE

Amanita rubescens; Castoreum spp.; *Clitocybe brumadis; Elaphomyces granulatus; Hygrophoropsii aurantiaca; Melanogaster ambiguus; Mesophellia* spp.; *M. arenaria; M. pachythrix; Mycena epipterygia; Paxillus involutus; Polyporus betulinus; Sparassis crispa;* Tuberaceae; *Xerocomus badius.*

Lepus europaeus Pallus—brown hare: *Morchella* spp.; fungi.

Oryctolagus cuniculus (L.)—European rabbit: *Helvella* spp., *Lycoperdon* spp., *Marasmius* spp., *Scleroderma* spp.

Sylvilagus palustris paludicola (Miller and Bangs)—marsh rabbit: *Polyporus* spp.

FAMILY OCHOTONIDAE

Ochotona spp.: *Endogone* spp.

O. princeps (Richardson)—pika: *Endogone* spp.; *Glomus fasciculatus.*

ORDER RODENTIA

Amanita muscaria; Boletus edulis; Collybia maculata; Cortinarius collinitus; Elaphomyces granulatus; Hygrophoropsis aurantiaca; Hygrophorus hypothejus; Lactarius necator; L. rufus; Paxillus atrotomentosus; P. involutus; Russula emetica; Suillus bovinus; S. flavidus; S. variegatus; Tuber spp.; *T. aestivum; Xerocomus badius; X. chrysenteron;* fungi.

FAMILY SCIURIDAE

Amanita muscaria; Boletus spp.; *Cronartium ribicola; Elaphomyces granulatus; Hygrophorus pudorinus; Leccinum scabrum; Polyporus* spp.; *Tricholoma flavorvirens;* Tuberaceae.

Callospermophilus spp.: See *Spermophilus* spp.

Citellus spp.: See *Spermophilus* spp.

C. parryii parryii: See *Spermophilus undulatus parryii.*

C. richardsonii: See *Spermophilus richardsonii.*

Eutamias spp.; *Endogone* spp.; fungi.

E. amoenus (J. A. Allen)—yellow-pine chipmunk: Tuberales; hypogeous fungi.

E. cinereicollis cinereicollis (J. A. Allen)—gray-collored chipmunk: fungi.

E. minimus jacksoni: See *E. minimus neglectus.*

E. minimus neglectus (J. A. Allen)—least chipmunk: fungi.

E. minimus pictus (J. A. Allen): fungi.

E. quadrimaculatus (Gray)—long-eared chipmunk: *Boletus* spp.; *Clitocybe* spp.; Tuberales; hypogeous fungi; fungi.

E. quadrivittatus quadrivittatus (Say)—Colorado chipmunk: fungi.

E. speciosus (Merriam)—lodgepole chipmunk: fungi.

E. townsendii (Bachman)—Townsend's chipmunk: Tuberales, hypogeous fungi.

E. townseidii senex (J. A. Allen): fungi.

Glaucomys sabrinus (Shaw)—northern flying squirrel: hypogeous fungi; fungi.

G. sabrinus fuscus Miller: fungi.

G. sabrinus macrotis (Mearns): fungi.

G. volans volans (L.)—southern flying squirrel: fungi.

Pteromys volans: See *Glaucomys volans.*

Sciurus spp.: fungi.

S. aberti aberti Woodhouse—Abert's squirrel: *Agaricus* spp.; *Amanita muscaria; A. vaginata; Boletus* spp.; *Elaphomyces* spp.; *Gautieria* spp.; *Geopora cooperi; Glomus fasiculatus; Hysterangium* spp.; *Lepiota* spp.; *Lycoperdon* spp.; *Martellia* spp.; *Psathyrella* spp.; *Rhizopogon* spp.; *Russula* spp.; *Tuber* spp.; fungi.

S. carolinensis carolinensis Gmelin—eastern gray squirrel: Agaricaceae; *Amanita muscaria; Balsamia vulgaris; Boletus* spp.; *B. calopus; B. impolitus; Collybia maculata; Crepidotus malachias; Daedalea* spp.; *Dibotryon* spp.; *Elaphomyces granulatus; Flammulina velutipes; Hydnum erinaceus; Hygrocybe miniata; Hygrophorous hypothejus; Lactarius deliciosus; Leccinum scabrum; Lycoperdon* spp.; *Melanogaster ambiguus; Paxillus involutus; Pholiota discolor; Pleurotus ostreatus; Pluteus atricapillus; Polyporus* spp.; *P. picipes; P. sulphureus; Russula* spp.; *R. emetica; R. ochroleuca; Stereum hirsutum; Sullus bovinus; Tricholoma terreum;* fungi.

S. carolinensis hypophaeus Merriam: fungi.

S. carolinensis pennsylvanicus Ord.: fungi.

S. cinerus: See *S. carolinensis carolinensis.*

S. douglasii: See *Tamiasciurus douglasii.*

S. fremonti lychnuchus: See *Tamiasciurus hudsonicus lychnuchus.*

S. fremonti mogollonensis: See *Tamiasciurus hudsonicus mogollonensis.*

S. griseus griseus Ord—western gray squirrel: *Gautieria* spp.; *Hysterangium* spp.; *Melanogaster* spp.; Polyporaceae; *Rhizopogon* spp.; hypogeous fungi; fungi.

S. hudsonicus: See *Tamiasciurus hudsonicus hudsonicus.*

S. hudsonicus ventorum: See *Tamiasciurus hudsonicus ventorum.*

S. leucourus: See *Sciurus vulgaris leucourus.*

S. kaibabensis Merriam—Kaibab squirrel: fungi.

S. niger cinereus L.—eastern fox squirrel: fungi.

S. niger neglectus: See *S. niger cinereus.*

S. niger niger L.: Agaricaceae; *Boletus* spp.; *Crepidotus nephrodes; Flammulina velutipes; Hydnum erinaceus; Hygrocybe miniata; Lycoperdon gemmatum; Pholiota discolor; Pluteus atricapillus; Pleurotus* spp.; *P. ostreatus; Polyporus picipes; P. sulphureus;* fungi.

S. niger rufiventer E. Geoffroy St.-Hilaire: fungi.
S. vulgaris (L.)—European red or brown squirrel: *Agaricus campestris; Amanita* spp.; *Armillaria* spp.; *A. mella; Balsamia vulgaris; Boletus edulis; Cantharellus cibarius; Calocera viscosa; Kuehneromyces mutablis; Lactarius torminosus; Leccinum aurantiacum; L. scabrum; Naematoloma fasiculare; Polyporus betulinus; Suillus luteus; Xerocomus;* fungi.
S. vulgaris exalbidus Pallas: *Clitocybe* spp.; *Ganoderma* spp.; *Gomphidius glutinosus; Leccinum aurantiacum; L. scabrum; Pholiota* spp.; *Pluteus nanus; Suillus bovinus; S. luteus; S. piperatus; Xerocomus chrysenteron; X. subtomentosus.*
S. vulgaris leucourus Kerr.: Agaricales; fungi.
S. vulgaris orientis Thomas: fungi.
S. vulgaris varius: See *Sciurus vulgaris.*
Spermophilus spp.: Tuberales; hypogeous fungi; fungi.
S. beecheyi (Richardson)—California ground squirrel: hypogeous fungi; fungi.
S. lateralis (Say)—golden-mantled ground squirrel: *Polyporus* spp.; Tuberales; fungi.
S. lateralis chrysodeirus (Merriam): fungi.
S. richardsonii (Sabine)—Richardson's ground squirrel: fungi.
S. undulatus kennicottii (Ross)—arctic ground squirrel: fungi.
S. undulatus parryii (Richardson): fungi.
Tamias spp.; fungi.
T. striatus fisheri A. H. Howell—eastern chipmunk: Lycoperdaceae; fungi.
T. striatus griseus Mearns: *Geastrum* spp.; fungi.
T. striatus lysteri (Richardson): *Amanita vaginata; Russula* spp.; fungi.
T. striatus striatus (L.): fungi.
Tamiasciurus douglasi albolimbatus (J. A. Allen)—Douglas' squirrel: fungi.
T. douglasi cascadensis: See *T. douglasi mollipilosus.*
T. douglasi douglasi (Bachman): *Alpova diplophloeus; Boletus mirabilis; Gautieria graveolens; Gomphidius rutilus; G. subroseus; Pholiota lenta; Rhizopogon rubescens; R. vinicolor; Russula delica; Suillus granulatus; S. tomentosus; Truncocolumella citrina* var. *citrina;* Tuberales; fungi; hypogeous fungi.
T. douglasi mollipilosus (Aud. and Bachman): fungi.
T. fremonti: See *T. hudsonicus fremonti.*
T. hudsonicus abieticola (A. H. Howell)—red squirrel: fungi.
T. hudsonicus dakotensis (J. A. Allen): fungi.
T. hudsonicus fremonti (Aud. and Bachman): *Polyporus* spp.; *Russula* spp,. fungi.
T. hudsonicus hudsonicus (Erxleben): *Alpova diplophloeus; Amanita* spp.; *A. muscaria; A. phalloides; Amillaria mellea; Boletinus pictus; Boletus* spp.; *B. mirabilis; Cantharellus cibarius; Clitocybe* spp.; *C. brumalis; C. maxima; C. monodelpha; C. odora; Clavicorona pyxidata; Collybia dryophila; C. maculata; Cortinarius* spp.; *C. varius; Elaphomyces granulatus; Fomes fomentarius; F. pinicola; Gautieria graveolens; G. morchelliformis; Gomphidius rutilus; G. subroseus; G. tomentosus; Gomphus floccosus; Gymnopilus sapineus; Gyroporus castaneus; Hericium caput-ursi; Hydnum* spp.; *H. fuligineo-violaceum; H. imbricatum; H. repandum; Hygrophoropsis aurantiaca; Hygrophorus hypothejus; H. pudorinus; Hymenogaster tener; Inocybe* spp.; *Lactarius deliciosus; L. piperatus; L. uvidus; Leccinum scabrum; L. versipellis; Lentinus lepideus; Leucoagaricus naucinus; Lycoperdon pyriforme; Lyophyllum ulmarium; Melanogaster ambiguus; Morchella conica; M. esulenta; Naematoloma fasiculare; Oudemansiella radiacata; Paxillus involutus; Peridermium harknessii; Pholiota carbonaria; Pleurotus ostreatus; Polyporus* spp.; *P. amarus; P. betulinus; Psathyrella* spp.; *Ramaria aurea; R. flava; Rhizopogon luteolus; R. maculatus; R. occidentalis; R. roseolus; R. rubescens; R. viridis; R. vulgaris; Rozites caperata; Russula* spp.; *R. adusta; R. alutacea; R. bicolor; R. blackfordae; R. consobrina; R. decolorans; R. disparilis; R. emetica; R. emetica ssp. fragilis; R. mariae; R. nigricans; R. pulchella; R. rosea; R. rosipes; R. xerampelina; Suillus bovinus; S. cavipes; S. granulatus; S. lakei; S. luteus; S. subolivaceus; S. tomentosus; S. variegatus; Tricholoma* spp.; *T. flavovirens; Truncocolumella citrina;* Tuberales; fungi.
T. hudsonicus loquax (Bangs): *Lycoperdon* spp.; *Polyporus* spp.; fungi.
T. hudsonicus lychnuchus (Stone and Rehn): fungi.
T. hudsonicus minnesota (J. A. Allen): *Amanita* spp.; fungi.
T. hudsonicus mogollonensis (Mearns): fungi.
T. hudsonicus preblei A. H. Howell: fungi.
T. hudsonicus richardsoni (Bachman): fungi.
T. hudsonicus streatori (J. A. Allen): fungi.
T. hudsonicus ventorum (J. A. Allen): fungi.
FAMILY GEOMYIDAE
Tuber spp.
FAMILY HETEROMYIDAE
Dipodomys spp.—kangaroo rats: fungi.
Microdipodops spp.—kangaroo mice: fungi.
Perognathus parvus (Peale)—Great Basin pocket mouse: fungi.
FAMILY CASTORIDAE
Castor canadensis Kuhl—beaver: fungi.
FAMILY CRICETIDAE

Endogone spp.
Apodemus sylvaticus (L.)—wood-mouse: *Lycoperdon* spp.; *Paxillus involutus; Xerocomus badius;* fungi.
A. *flavicollis* Milch.—yellow-necked field mouse: fungi.
Clethrionomys spp.: *Glomus macrocarpus;* fungi.
C. californicus californicus (Merriam)—California red-backed vole: *Endogone flammicorona; E. lactiflua; E. pisiformis; Glomus fasciculatus; G. macrocarpus* var. *macrocarpus; G. microcarpus; G. monosporus; Sclerocystis rubiformis.*
C. gapperi athabascae (Preble)—Gapper's red-backed vole: fungi.
C. gapperi gapperi (Vigors): *Endogone* spp.; *Glomus macrocarpus; Hymenogaster* spp.; *Lactarius lignyotus;* fungi.
C. grapperi paludicola Doutt: fungi.
C. gapperi rhoadsii (Stone): fungi.
C. gapperi rupicola E. L. Poole: fungi.
C. glareolus Schreb.—European bank vole: *Balsamia* spp.; *Genea* spp.; *Hydnotrya* spp.; *Hymenogaster* spp.; *Melanogaster* spp.; *Rhizopogon spp.; Russula* spp.; *Tuber* spp.; fungi.
C. rufocanus Sund.—red-gray vole: fungi.
C. rutilus mikado Thomas—Emperor vole: Boletaceae Russulaceae.
Dicrostonyx groenlandicus (Traill)—Greenland varying lemming: fungi.
D. torquatus Pallas—collared lemming: fungi.
Lagurus curtatus (Cope)—sagebrush vole: *Endogone* spp.; *Glomus fasciculatus.*
Lemmiscus curtatus: See *Lagurus curtatus.*
Lemmus lemmus L.—Norwegian lemming: *Boletus* spp.; *Russula* spp.; fungi.
Microtus agrestis (L.)—North Europe dark vole: fungi.
M. chrotorrhinus (Miller)—rock vole: *Endogone* spp.
M. longicaudus (Merriam)—long-tailed vole: *Endogone* spp.
M. ochrogaster (Wagner)—prairie vole: *Endogone* spp.
M. oeconomus macfarlandi Merriam—tundra vole: *Endogone* spp.; *Hymenogaster* spp.
M. oregoni (Bachman)—Oregon meadow mouse: *Fischerula subcaulis.*
M. pennsylvanicus (Ord)—meadow vole: *Endogone* spp.; *Glomus fasciculatus; Melanogaster variegatus;* fungi.
M. pinetorum (Le Conte)—pine vole: *Endogone* spp.
Neotoma spp.: *Gautieria* spp.; Hymenogastrales; *Hysterangium* spp.; *Melanogaster* spp.; *Tuber rufum* var. *nitidum;* hypogeous fungi.
N. albigula warreni Merriam—white-throated wood rat: Lycoperdaceae.
N. cinerea (Ord)—bushy-tailed wood rat: *Lycoperdon* spp.; fungi; hypogeous fungi.
N. cinerea occidentalis Baird: *Lycoperdon* spp.; fungi.
N. cinerea orolestes Merriam: Agaricaeae; *Polyporus* spp.; fungi.
N. desertorum: See *N. lepida lepida.*
N. floridana attwateri Mearns—eastern wood rat: fungi.
N. floridana floridana (Ord): fungi.
N. floridana magister Baird: Agaricaceae; *Agaricus* spp.; *Boletus* spp.; *B. pallidus; Clavaria* spp.; *Inocybe* spp.; *Lycoperdon* spp.; *Russula* spp.; *Scleroderma citrinum;* fungi.
N. fuscipes annectens Elliot—dusky-footed wood rat: Agaricaceae; Boletaceae; *Elaphomyces* spp.; *Gautieria* spp.; *Hydnangium* spp.; Hymenogastrales; *Hymenogaster* spp.; *Hysterangium* spp.; *Melanogaster* spp.
N. fuscipes fuscipes Baird: *Helvella lacunosa; Melanogaster* spp.; *Morchella conica; Paxina acetabulum; Peziza* spp.; *P. emileia; Pluteus cervinus; Polyporus varius; Scleroderma hypogaeum; Tuber* spp.
N. fuscipes macrotis Thomas: fungi.
N. lepida lepida Thomas—desert wood rat: fungi.
N. magister: See *N. floridana magister.*
N. mexicana fallax Merriam—Mexican wood rat: fungi.
N. pennsylvanica: See *N. floridana magister.*
Onychomys leucogaster (Wied-Neuwied)—northern grasshopper mouse: *Endogone* spp.; *Glomus fasciculatus.*
Oryzomys palustris (Harlan)—marsh rice rat: *Endogone* spp.
Peromyscus spp.: *Glomus macrocarpus.*
P. boylii (Baird)—brush mouse: Tuberales; hypogeous fungi.
P. gossypinus (Le Conte)—cotton mouse: *Endogone* spp.
P. leucopus (Rafinesque)—white-footed mouse: *Endogone* spp.; Uredinales; fungi.
P. leucopus noveboracensis (Fisher): *Endogone* spp.; *Glomus macrocarpus;* fungi.
P. maniculatus (Wagner)—deer mouse: *Endogone* spp.; *E. flammicorona; E. lactiflua; E. pisiformis; Glomus caledonius; G. fasciculatus; G. macrocarpus; G. macrocarpus* var. *macrocarpus; G. microcarpus; Melanogaster variegatus; Sclerocystis rubiformis;* fungi.
P. maniculatus artemisiae (Rhoads): fungi.
P. maniculatus bairdii (Hoy and Kennicott); *Endogone* spp.; fungi.
P. maniculatus gracilis (Le Conte): *Endogone* spp.; fungi.
P. maniculatus osgoodi Mearns: fungi.
P. truei (Shufeldt)—piñon mouse: fungi.

Phenacomys intermedius Merriam—heather vole: *Endogone* spp.
P. intermedius mackenzii Preble: fungi.
P. ungava mackenzii: See *P. intermedius mackenzii.*
Pitymys pinetorum: See *Microtus pinetorum.*
P. subterraneus de Sél.-Long.—European ground vole: fungi.
P. tatricus Kratochvil—Tatra pine vole: fungi.
Synaptomys cooperi cooperi Baird—southern bog lemmings: *Endogone* spp.; *Glomus macrocarpus;* fungi.
S. cooperi gossii (Coues): *Endogone* spp.; *Glomus macrocarpus.*
S. cooperi stonei Rhoads: fungi.
FAMILY MURIDAE
Mastacomys spp.—broad-toothed rats: fungi.
Mus musculus L.—house mouse: *Endogone* spp.
FAMILY ZAPODIDAE
Napaeozapus insignis insignis (Miller)—woodland jumping mouse: *Endogone* spp.; *Hymenogaster* spp.; *Russula* spp.
Zapus hudsonius (Zimmermann)—meadow jumping mouse: *Endogone* spp.; *Hymenogaster* spp.
Z. princeps J. A. Allen—western jumping mouse: *Endogone* spp.; *Glomus fasiculatus; G. pulvinatus.*
Z. trinotatus Rhoads—pacific jumping mouse: *Endogone* spp.; *E. lactiflua; Glomus fasiculatus; G. monosporus; Sclerocystis rubiformis.*
ORDER CARNIVORA
FAMILY MUSTELIDAE
Spilogale spp.: fungi.
S. putorius (L.)—eastern spotted skunk: fungi.

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