Notes on the Ecology of the Fungi of Mount Shasta

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1. Biological Factors

Morphological aspects.—In the vegetative condition, most fungi, consisting as they do of a mycelium which penetrates the substratum as a network of more or less anastomosing, hyaline or colored threads, look much alike. The hyphae may be coenocytic or composed of long or short cells, may bear specialized structures such as clamp connections, may produce oidia or chlamydospores and may be organized into rhizomorphs. But whether the mycelium be located in living host tissues, in rotting organic remains or on decomposed matter on the surface or in the soil, the special characteristics which may be noted permit identification, for the most part, only so far as the major group to which any species belongs. Only in the fruiting condition can differences between less than major groups be distinguished. A number of ecological adaptations have been evolved in the fructifications of the higher fungi, the Ascomycetes and Basidiomycetes. In the Ascomycetes, the Pyrenomycetes produce perithecia or hysterothecia which are imbedded either in a stroma or in host tissues and which are rarely truly superficial; in the larger number of species they are carbonaceous and thus possibly protected from drought. Most of the operculate Discomycetes produce fleshy apothecia which are soon putrescent. In most of the inoperculate Discomycetes the apothecia are more or less leathery; the ability of such apothecia to fold up during brief periods of unfavorable conditions is a response to drought which may also be a protection to the fructification. In the Basidiomycetes, three modifications of the fructifications appear to be ecologic. In the Tremellales, the basidiocarps are usually highly gelatinous. One which has not shed all its spores may dry up, without disintegrating, at the end of a favorable period, resuming activity again when sufficient moisture is present. The boletes and most of the agarics are fleshy, the basidiocarps purtrefying rapidly within a few days after their emergence. In the other groups, the fructifications usually have a leathery or woody consistency and are sometimes perennial. In these groups, spores may be produced over long periods, the intervals of active spore production separated by times of short to prolonged drought (cf. A. H. Reginald Buller, Researches on Fungi, Vol. 1, 1909).

The classification of the life forms of the fungi must be based on either the vegetative or fruiting condition. Because of the nature of the vegetative condition, emphasis must of necessity be on the latter.

Physiological aspects.—The adjustment of a heterotrophic organism to its source of food has long been discussed. Whether fungi began as pathogens and some became saprogens or the reverse has never been decided. Certainly,

at the present time some are pathogens, some saprogens, and some so weakly pathogenic that it is difficult to classify them in either category. Another problem which has long been of interest is the adjustment of a number of species of fungi to a single host or substratum. The succession of species of fungi on dung has often been noted, as has the succession on logs. The death of a tree may be caused by the weakening effect of one or more heart or butt rots. After falling, the log may be invaded by additional heartwood rots, by the penetration of sapwood rots and finally by a number of other fungi whose activities may be wide-spread or localized. Certainly, there is some relationship between these various fungi, either of antagonism, of communism or of indifference.

All fungi require water both for vegetative growth and for rapid elaboration of fructifications, except those of carbonaceous or woody texture. Thus, the appearance of the fructification may be a measure of the precipitation of a region at a particular time. It follows that the mycobiota of a given region need not be identical in two successive seasons, either in the case of saprogens or pathogens. There are no data available as to the percentage of annual as contrasted with perennial fungi. Certainly, some wood rots live for many years, as evidenced by the fructifications or by the extent of the invasion of standing timber. Again, many soil or humus fungi fruit only at long intervals (apparently in coordination with climatic cycles), which indicates the perennial character of the mycelium. On the other hand, in the case of certain leaf spots the perfect stage is found in the spring on the fallen host leaves. Since there is no evidence of a perennial mycelium within the twigs and branches of the host, these may be considered annual fungi. In regions where the ground is covered with snow during long periods of the year, certain fungi inhabiting dead remains of the previous year's vascular flora produce mature perfect fructifications by the following spring. This is also true of related fungi in regions where the snow is replaced by rain, but it is most striking in the snow country.

Methods of spore dispersal.—The spores of most of the fungi found on Mt. Shasta are wind-borne, but some are dispersed by other means. The spores of some, perhaps all, of the hypogaeous fungi are dispersed by rodents. When fresh, these fungi emit an odor which is usually noticeable before they are dug out of the duff or humus in which they are imbedded, although to human senses it may be merely what is referred to as a "fungus" odor. Representatives of several hypogaeous species have been found lying on stumps and logs, apparently left to dry for winter storage after some rodent had taken a few nibbles out of them. *Secotium nubigenum* is commonly found partly eaten or left whole on tops of logs drying in the sun. Specimens of an undetermined species of *Russula* have been found in similar positions. *Boletus albidus* ssp. *eupachypus* in its ordinary habitat under the top layer of duff is rarely in perfect condition because tooth marks of rodents indicate parts of the sporophore have been eaten away. In other cases it is evident that deer also eat this species of *Boletus*, for no rodent on the mountain is large enough to eat entire caps or dig large holes to reach them. In collecting this species it is

usually a race between the collector and its mammalian mycophagists. It has not been demonstrated that passage through the mammalian alimentary canal is necessary for the germination of these spores. In some cases beetles possibly assist in the dissemination of fungus spores, as in the case of the bark fungus, *Cryptoporus volvatus*.

2. Ecological Factors

Lack of correlation with life zones.—The life zone concept of Merriam was based largely on the temperature requirements of vascular plants and zones were delimited on the basis of fairly constant plant associations found in certain broad latitudinal and comparable altitudinal regions. It is demonstrable that fungi do not follow these zonal areas with as great regularity as do the vascular plants, at least in temperate and arctic or alpine areas. Diehl has noted the restriction of most Xylariaceae and Phallales to the tropics, and no representative of these groups has so far been found above 4000 feet on Mt. Shasta. However, many of our fungi are not restricted by elevation or life zones, as is demonstrated by the accompanying list.

Snowline fungi.—One of the most interesting phases of the problem of the ecology of Mt. Shasta fungi is that of saprobic species growing in duff and on logs close to melting snow banks. Except for such melting as may take place on their under sides during the winter, the melting of these snow banks during the warm weather of early summer provides the only moisture available to these fungi. The infrequent summer rains evaporate or percolate so rapidly that they can do no more than revive dry sporophores. The only reservoir of moisture which fungi can utilize, therefore, is that provided by melting snow banks. This reservoir is available for several weeks after melting since, if much snow has fallen, percolation takes a long time and duff and logs hold the moisture longer than open soil and the top layers of newly fallen leaves.

Where a large quantity of duff has accumulated and is augmented by chips, rotting stumps and similar debris, several saprogenic fungi occur. At the time the snow banks are melting away from such a place, it is possible to study the areas of activity of the saprogens as represented by their sporophores. Within a few feet of the snow bank *Pseudoplectania fulgens* and *Paxina nigrella* are receiving enough moisture from their mycelia to be turgid and apparently active. But even within ten feet of the snow bank the sporophores, although with quantities of undischarged spores, are dry and shrunken and difficult to find. At intervals of about four days one such location was visited several times in late June and early July, 1941. Here it was found that as the snow bank retreated the area of sporophore activity advanced, so that over twenty sporophores were collected on each of three visits, each of the colonies being in a different location and each about the same distance from the snow bank.

In the case of larger sporophores, such as those of the subfleshy *Secotium nubigenum*, a somewhat similar condition was observed. Although occasional specimens were found elsewhere, the best collecting occurred on rotting logs

in the vicinity of snow banks. Another factor favoring the greater abundance of these fructifications in such places is that squirrels do not usually cross snow banks in order to get their food. Whenever possible, rodents — golden-mantled squirrels mostly, and probably also the Tahoe chipmunk and the Douglas tree squirrel — dry them and store them for food. *Mycena griseoviride* is another fungus whose fructifications are found close to melting snow banks or even growing up through thin patches of snow. This species fruits only where logs and rotting wood are kept wet by the run-off from the snow banks. As soon as the substratum dries, the sporophores also dry.

On rotting logs near snow banks the fructifications of two polypores occur. These may become activated by occasional rare rains but only for short periods of time. *Polyporus (Aurantioporellus) alboluteus* is nearly resupinate, bright orange-red and occurs on the under side of logs. It is rarely found in good condition more than a week or ten days after the snow has melted. After this time usually all that is left is a heap of red dust and a few inedible fragments left by the small beetles which feed on it by hundreds. *Polyporus (Spongiporus) leucospongia* is rarely attacked by beetles and its dried sporophores are found throughout the summer on the higher parts of the mountain wherever wood occurs. It is fresh only when watered by melting snow, although occasional light summer rains appear to revive it. Other fungi may be producing active sporophores on the same log during the dry season, and the mycelium of this species may be active, but the sporophores remain dried out.

Another series of fungi, common to coniferous hosts throughout a wide range, is found on the rotting wood of Shasta fir in the upper portions of its altitudinal range on Mt. Shasta. Among these are: *Coniophora olivacea, Corticium roseum, Dacrymyces deliquescens, Oxydontia alboviride, Pellicularia flavescens, Cristella candidissima, Poria lenis, Solenia candida* and *Tremellodon gelatinosus*. Of course, some of these species are not confined to coniferous wood, or even to wood. They are not confined to any altitudinal limits, occurring as commonly at sea level as at 8000 feet.

Still another series of fungi is confined, more or less, to higher elevations and is usually found in association with melting snow banks. Probably there is a close relationship between the physiological requirements of these fungi and the conditions found in the immediate proximity of melting snow. These fungi include: *Stereum rugisporum, Mycena griseoviride, Polyporus alboluteus, Polyporus leucospongia, Secotium nubigenum, Pseudoplectania fulgens, Paxina nigrella* and others. The range of these fungi, so far as known, is mostly in the higher elevations of the Sierra Nevada, Cascade and Rocky Mountain ranges.

Host restriction.—A number of species in the Mt. Shasta mycobiota are restricted to certain hosts. This restriction is either artificial or real. If it is artificial, we have as yet no evidence, through cross inoculations, for that fact. Such inoculations can furnish the answer to the question as to whether morphologically similar species growing on different hosts and hence listed as

distinct species, are in reality the same. To the extent to which their hosts are restricted to certain life zones, these fungi are likewise restricted and in certain cases the range of the fungi is less than that of the hosts. When this occurs in the same life zone, it can possibly be explained on the basis of barriers to the distribution of the fungus. These would include up-drafts or down-drafts which would be restricted to certain valleys and the presence of ridges between the several communities of plants across which fungus spores would have no normal means of passage.

3. An Ecological Classification of Mt. Shasta Fungi

The ecological classification of fungi on the basis of the water content of the substratum or medium into xerophytes, mesophytes, hydrophytes and halophytes is of very limited application. A fungus may have concealed sources of water supply which are not easily determined except in the case of certain soil fungi growing in deserts, the water molds and the parasites of aquatic organisms. The classification of fungi on the basis of their life form has been referred to. For the present purpose, fungi may be classified on the basis of their relationship to their hosts or habitats:

1. *Saprogens.* Annual or perennial fungi which live in the soil or on dead organic remains.

2. *Weak pathogens.* Mostly annual fungi, at least so far as their living host is involved, which attack leaves of vascular plants and cause minor local infections. In most cases, the perfect stage is unknown or poorly understood.

3. *Strong pathogens.* Annual or perennial fungi which live all or part of their lives within the living or dead tissues of living plants. In the case of the leaf spots due to imperfect fungi, the perfect stage is commonly developed after the diseased part of the host has died. For instance, numbers of hyphal knots which appear to be pycnidial or perithecial initials are found in the sori of *Ramularia Senecionis* var. *carniolica,* although no spores have been observed in these structures. Possibly these mature after the short-lived host tissues have died. Heartwood and butt rots can be included here because of the eventual damage due to their action in the dead tissues of the tree trunks.

4. Geographic Relationships

Cosmopolitan species.—A number of the fungi collected on Mt. Shasta are of extremely wide distribution. Wood rots such as *Porodaedalia Pini,* humus species, such as *Polyporus (Coltricia) perennis,* molds, such as *Pleospora herbarum,* pathogens, such as *Scoletotrichum graminis* and many other species are of world-wide or continent-wide distribution wherever suitable hosts and growth conditions occur.

Western species.—Throughout the western states a number of fungi are common pathogens, weak pathogens or saprogens on wide-spread species, groups of species or whole orders of vascular plants. Among these are the

more common heartwood and sapwood rots, and a number of secondary rots and molds.

Local species.—A third group of fungi is composed of those in which the range is incompletely known. This includes cases in which the fungus is known from but a single collection or from few collections, or from a host which, so far as collections indicate, has a wider range than its pathogens. On Mt. Shasta, *Aleurodiscus fruticetorum, Boletus frustosus, Merulius atropurpureus, Oidium magnisporum, Phyllosticta Fritillariae, Phyllosticta Monardellae, Galeropsis polytrichoides, Septoria shastense* and *Ustilago shastense* are among the species not yet known elsewhere.

In connection with geographic distribution, it has commonly been noted that many fungi have strikingly discontinuous ranges. In some cases, species are fairly well known in Europe and are not to be found again except in the western United States. Two cases of such discontinuous distribution may be cited: *Hymenogaster Remyi,* known only from mountains in France and from Mt. Shasta; *Hysterangium Darkeri,* known only from the Wasatch Mountains near Salt Lake City and from Mt. Shasta. The unintentional collection of fungi by collectors of vascular plants when they include diseased leaves in their collections has done much to increase the known range of some fungi when such collections have been examined with the purpose of detecting the fungi. In the case of other fungi, neglect of areas by both plant collectors and mycologists has left large discontinuous unknown areas.

According to Bisby: "The distribution of the fungi is primarily controlled by the distribution of their hosts and substrata." The writer prefers to restate this proposition as follows: The distribution of fungi is primarily controlled by their adaptability to hosts and substrata regardless of the relationship of these latter organisms to each other and regardless of the altitudinal distribution of these host organisms.

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TABLE 1.—List of Mount Shasta Fungi According to Host and Altitudinal Range.

Column 1.—List of Fungi found on Mt. Shasta to September, 1942
2.—List of hosts on which these fungi are found. If no definite host is involved appropriate substratum notes are given.
3.—Elevations at which hosts are found.
4.—Elevations at which fungi are found.
5.—S—Sabrobe; P—Pathogen; W—Weak Pathogen.
6.—A—Annual; P—Perennial. Observations in this column based on longevity of parts of host on which fungus is found.

Abstoma reticulatum	hypogaeous		8000	S	P
Agaricus arvensis	humus		8000	S	P
Aleurodiscus amorphus	*Abies concolor*	4–6000	55–6000	S	P
	Abies magnifica shastensis	5–8500	6–7000	S	P
diffissus	*Arctostaphylos nevadensis*	5–9000	8000	S	P
	Arctostaphylos patula	4–8000	6000	S	P
fruticetorum	*Arctostaphylos patula*	4–8000	6000	S	P
	Ceanothus velutinus	4–8500	6000	S	P
Amanitopsis vaginata	humus		5000	S	P
Aposphaeria mollis	*Juncus parryi*	7–8500	7000	S	A
Archangeliella lactarioides	hypogaeous		8000	S	P
Armillaria mellea	*Abies magnifica shastensis*	55–8500	5–8000	P	P
	Pinus lambertiana	4–6000	5500	P	P
Ascochyta oudemannsii	*Stipa occidentalis*	4–8500	7000	W	A
Barssia oregonensis	hypogaeous		8000	S	P
Boletus albidus eupachypus	humus		7–8000	S	P
frustosus	humus		7500	S	P
miniato-olivaceus	humus		5000	S	P
Bovista pila	humus		8000	S	P
Calodon amicus	humus		7000	S	P
Calvatia sculpta	humus		6–7000	S	P
Cintractia caricis	*Carex multicaulis*	7–8000	75–8000	P	A
	Carex nigricans	75–8500	8000	P	A
	Carex spectabilis	75–8500	75–8500	P	A
externa	*Carex spectabilis*	75–8500	8000	P	A
Cladosporium herbarum	*Agrostis* sp.		8000	S	A
	Carex sp.		8000	S	A
	Juncus sp.		8000	S	A
	Phleum sp.		8000	S	A
	Trisetum sp.		8000	S	A
Clavaria obtusissima	humus		5500	S	P
pinicola	*Abies magnifica shastensis*	55–8500	8000	S	P
Clitocybe metachroa	humus		7500	S	P
Coniophora olivaceus	*Abies magnifica shastensis*	55–8500	8000	S	P
Coleosporium madiae	*Madia gracilis*	4–5500	5000	P	A
solidaginis	*Aster shastensis*	4–9000	45–5000	P	A
Coprinus comatus	humus		8250	S	P
Corticium cremoricolor	*Abies magnifica shastensis*	55–8500	8000	S	P
roseum	*Abies magnifica shastensis*	55–8500	8000	S	P
scutellare	*Abies magnifica shastensis*	55–8500	8000	S	P
Cortinarius cotaneus	humus		7500	S	P
Cristella candidissima	*Abies magnifica shastensis*	55–8500	8000	S	P
Cronartium comptoniae	*Pinus contorta murrayana*	6–7000	6000	P	P
Crucibulum vulgare	humus		8000	S	P
Cryptoporus volvatus	*Abies magnifica shastensis*	55–8500	55–8000	P	P

Cryptostictis arbuti	*Arctostaphylos nevadensis*	5–9000	4–7500	P A
	Arctostaphylos patula	4–8000	4–5500	P A
Cumminsella sanguinea	*Berberis piperiana*	4–5500	5000	P A
Cylindrocolla sp.	*Abies magnifica shastensis*	55–8500	8000	S P
Cystopus candidus	*Sisymbrium altissimum*	4–5000	4–5000	P A
Dacrymyces deliquescens	*Abies magnifica shastensis*	55–8500	8000	S P
Darluca filum	*Puccinia rubigo-vera*	3500	3500	P A
	Uromyces fabae	5000	5000	P A
Dasyscypha agassizii	*Abies magnifica shastensis*	55–8500	8000	S P
	Tsuga mertensiana	65–8500	7800	S P
arida	*Abies magnifica shastensis*	55–8500	8000	P P
	Pinus albicaulis	7–10000	8000	P P
Dendrogaster elasmomycetoides	hypogaeous		8000	S P
Dendryphium sp.	*Poa pratensis*	4–8000	5000	S A
Dimerium sp.	*Penstemon menziesii davidsonii*	85–9500	85–9500	P P
Discina ancilis	humus		8000	S P
Dothidella castanicola	*Castanopsis chrysophylla*	4–6500	4–6500	P A
junci	*Juncus parryi*	7–8500	75–8000	S A
Duplicaria acuminata	*Juncus parryi*	7–8500	8000	S A
Echinodontium tinctorium	*Abies concolor*	4–6000	6000	P P
	Abies magnifica shastensis	55–8500	6000	P P
Elasmomyces echinosporus	hypogaeous		8000	S P
Endogone lactiflua	hypogaeous		8000	S P
Endogone sp.	hypogaeous		8000	S P
Epochnium isthomorphum	*Chrysothamnus nauseosus occidentalis*	4–9000	5000	P A
Erysiphe cichoracearum	*Cryptantha affinis*	5–5700	4–5000	P A
	Erigeron inornatus	4–5000	4–5000	P A
graminis	*Agrostis exarata*	5–6000	57–8000	P A
	Poa pratensis	4–8000	5–8000	P A
	Sitanion hystrix	5–9000	8000	P A
polygoni	*Eriogonum marifolium*	7–9000	57–7500	P A
	Vicia americana	5–6000	5–6000	P A
Exobasidium vaccinii	*Arctostaphylos nevadensis*	5–9000	5000	P A
vaccinii-uliginosii	*Arctostaphylos nevadensis*	5–9000	45–6000	P A
	Arctostaphylos patula	4–8000	4–5500	P A
Flammula graveolens	humus		7000	S P
penetrans	*Abies magnifica shastensis*	55–8500	8000	S P
Fomes annosus	*Abies magnifica shastensis*	55–8500	8000	P P
officinalis	*Abies magnifica shastensis*	55–8500	5–8000	P P
	Pinus lambertiana	4–6000	5500	P P
pinicola	*Abies magnifica shastensis*	55–8500	6000	P P
subroseus	*Abies magnifica shastensis*	55–8500	8000	P P
Galeropsis cucullata	humus		5700	S P
polytrichoides	humus		8000	S P
Ganoderma oregonensis	*Abies magnifica shastensis*	55–8500	7–8000	P P
Gautieria monticola	hypogaeous		8000	S P
Gloeosporium pteridis	*Pteridium aquilinum pubescens*	4–6500	5700	P A
Gloniella lapponica	*Arctostaphylos nevadensis*	5–9000	8000	S P
Godronia sp.	*Arctostaphylos patula*	4–8000	5–6000	S P
	Castanopsis chrysophylla	4–6500	6000	S P
Guepiniopsis alpinus	*Abies magnifica shastensis*	55–8500	7–8000	S P
	Pinus albicaulis	7–10000	8000	S P
	Tsuga mertensiana	65–8500	7–8000	S P
Gymnosporangium libocedri	*Amelanchier alnifolia*	4–6000	35–5000	P A
	Crataegus douglasii	3500	3500	P A
	Libocedrus decurrens	4–5000	4–5000	W P

Helminthosporium vagans	*Poa pratensis*	4–8000	8000	W A
Helvella californica	humus		5700	S P
caroliniana	humus		5000	S P
Hendersonia distans	*Carex* sp.	8000	8000	S A
sp.	*Agrostis thurberiana*	75–8500	8350	S A
Herpotrichia nigra	*Abies magnifica shastensis*	55–8500	8–8500	W P
	Tsuga mertensiana	65–8500	8–8500	W P
Heteropatella alpina	*Aster shastensis*	4–9000	6–8500	S A
	Castilleja miniata	5–8500	8200	S A
	Pentstemon gracilentus	7–9000	8000	S A
	Juncus sp.	8000	8000	S A
	Ligusticum grayi	5–8500	8–8500	S A
Heterosporium alii	*Tritelia ixioides analina*	5–6000	5500	P A
Hyalopsora polypodii	*Cystopteris fragilis*	55–6000	5700	P A
Hydnangium parksii	hypogaeous		8000	S P
Hygrophorus gliocyclus	humus		7500	S P
russula	humus		7000	S P
vernalis	humus		8000	S P
Hymenochaete rugispora	*Abies magnifica shastensis*	55–8500	7–8000	S P
tabacinia	*Ceanothus velutinus*	4–8500	6500	S P
Hymenogaster remyi	hypogaeous		8000	S P
Hypholoma fasciculare	humus		5700	S P
Hypoderma robustum	*Abies concolor*	4–6000	5000	P A
Hypomyces aurantius	*Ganoderma oregonense*	7–8000	8000	P A
Hysterangium darkeri	hypogaeous		8000	S P
phillipsii	hypogaeous		8000	S P
separabile	hypogaeous		8000	S P
Hysterium acuminatum alpinum	*Abies magnifica shastensis*	55–8500	8000	S P
	Tsuga mertensiana	65–8500	7800	S P
magnosporum	*Athyrium americanum*	75–8500	8000	S P
Hysterographium formosum	*Abies magnifica shastensis*	55–8500	8000	S P
	Pinus albicaulis	7–10000	8000	S P
Lachnellula chrysophthalma	*Abies magnifica shastensis*	55–8500	8000	S P
Lasiosphaeria vermicularis	*Abies magnifica shastensis*	55–8500	8000	S P
Lentinus lepideus	*Pinus albicaulis*	7–10000	8200	S P
	Pinus ponderosa	4–7000	4–5000	P P
Lenzites sepiaria	*Abies magnifica shastensis*	55–8500	7000	S P
Leptosphaeria caricinella	*Juncus balticus montanus*	5–8000	8000	S A
culmorum	*Juncus orthophyllus*	75–8250	8000	S A
doliolum	*Arnica viscosa*	8–8500	8250	S A
junciseda	*Juncus balticus montanus*	5–8000	8000	S A
	Juncus orthophyllus	75–8250	8000	S A
michotii	*Juncus orthophyllus*	75–8250	8000	S A
microscopica	*Agrostis thurberiana*	8–8250	8000	S A
	Trisetum spicatum	8–8500	8–8500	S A
vagans	*Agrostis* sp., *Carex* sp.	8000	8000	S A
	Phleum alpinum	8–8500	8000	S A
	Trisetum spicatum	8–8500	8–8500	S A
sp.	*Juncus balticus montanus*	5–8000	8000	S A
	Lupinus obtusilobus	7–8500	8000	S A
Lophium sp.	*Juncus balticus montanus*	5–8000	8000	S A
Lophodermium nitens	*Pinus albicaulis*	7–10000	8000	W A
phloxii	*Phlox douglasii*	5–9000	8000	P A
Lophodermina juniperina	*Juniperus communis montanus*	82–9500	8200	W A
Macowanites magnus	hypogaeous		8000	S P
Macrophoma cylindrospora	*Phlox douglasii*	5–9000	8000	P A
Macrosporium puccinioides	*Lathyrus lanszwertii aridus*	4–6000	5000	P A
Marssonia potentillae	*Potentilla glandulosa nevadensis*	4–6000	5–6000	P A

Melampsora arctica	*Salix sitchensis*	5500	5500 P A
lini	*Linum micranthum*	4–5000	4000 P A
ribesii-purpureae	*Salix scouleriana*	4–6500	4–5500 P A
Melampsorella cerastii	*Stellaria longipes*	5000	5000 P A
Melanogaster variegatus	hypogaeous		8000 S P
Merulius atropurpureus	*Abies magnifica shastensis*	55–8500	7000 S P
bellus	*Abies magnifica shastensis*	55–8500	8000 S P
ceracellus	*Abies magnifica shastensis*	55–8500	8000 S P
Metasphaeria sepalorum	*Juncus parryi*	7–8500	8000 S A
Montagnea arenarius	humus		4000 S P
Morchella esculenta	humus		5000 S P
Mycena griseovirida	*Abies magnifica shastensis*	55–8500	8000 S P
Mycosphaerella agrostidis	*Agrostis* sp.	8000	8000 S A
aquilegiae	*Lupinus obtusilobus*	7–8500	8000 S A
Mycosphaerella tulasnei	*Juncus balticus montanus*	5–8000	8000 S A
	Phleum alpinum	8–8500	8000 S A
	Trisetum spicatum	8–8500	8250 S A
Naemosphaera shastensis	*Streptanthus orbiculàris*	8–8250	8000 S A
Neopeckia coulteri	*Pinus albicaulis*	7–10000	8–9000 P A
Nyssopsora echinata	*Ligusticum grayi*	5–8500	8–8500 P A
Odontotrema minus	*Abies magnifica shastensis*	55–8500	8000 S P
Oidium magnisporum	*Abies magnifica shastensis*	55–8500	8000 S P
Ollula pezizoides	*Abies magnifica shastensis*	55–8500	8000 SA?
Oxydontia alboviride	*Abies magnifica shastensis*	55–8500	8000 S P
Paxillus panuoides	*Abies magnifica shastensis*	55–8500	8000 S P
Patella scutellata	*Abies magnifica shastensis*	55–8500	5–6000 S P
	Libocedrus decurrens	4–5000	5000 S P
Paxina nigrella	humus		7–8000 S P
Pellicularia flavescens	*Abies magnifica shastensis*	55–8500	8000 S P
Phlebia merismoides	*Abies magnifica shastensis*	55–8500	7–8000 S P
Pholiota trachyspora	humus		7000 S P
Phoma harknessii	*Pinus albicaulis*	7–10000	8000 S A
herbarum	*Castilleja arachnoidea*	7–8500	8000 S A
Phragmidium ivesiae	*Potentilla gracilis nuttallii*	4–5000	4–5000 P A
occidentale	*Rubus occidentalis*	4–5000	4–4500 P A
rosae-californicae	*Rosa gymnocarpa*	5–9000	7500 P A
Phyllosticta amicta	*Arctostaphylos nevadensis*	5500	5500 S A
caricis	*Carex bolanderi*	4–8000	7500 P A
ferax	*Lupinus albicaulis shastensis*	5–9000	5700 P A
fritillariae	*Fritillaria atropurpurea*	4–8500	6000 P A
monardellae	*Monardella odoratissima*	55–8500	6000 P A
nigrescens	*Viola purpurea*	4–8500	8000 S A
Placosphaeria shastensis	*Monardella odoratissima*	4–8000	7500 S A
Pleospora amplispora	*Lupinus albicaulis shastensis*	8–8500	8250 S A
anthyllidis	*Arnica viscosa*	4–8000	7–8000 S A
balsamorhizae	*Lupinus albicaulis shastensis*	7–8500	8000 S A
	Lupinus obtusilobus	7–8500	8000 S A
elynae	*Carex spectabilis*	75–8500	8500 S A
gigaspora	*Lupinus albicaulis shastensis*	4–8000	7–8000 S A
	Lupinus obtusilobus	7–8500	8000 S A
herbarum	*Agrostis thurberiana*	8–8250	8250 S A
	Arnica viscosa	8–8500	8250 S A
	Eupatorium occidentale	5–7000	5500 S A
permunda	*Anemone occidentalis*	7–9000	8500 S A
	Arabis platysperma	6–9000	7000 S A
	Castilleja pinetorum	5–8500	5000 S A
	Cycladenia humilis	6–8500	7500 S A

	Ligusticum grayi	5–8500	8000	S	A
	Monardella odoratissima	4–8500	8000	S	A
	Pentstemon gracilentus	7–8500	8000	S	A
trichostoma	*Juncus balticus montanus*	5–8000	8000	S	A
Pleurotus petaloides	*Abies magnifica shastensis*	55–8500	8000	S	P
Polythrincium trifolii	*Trifolium involucratum fimbriatum*	45–5000	5000	P	A
Polyporus abietinus	*Abies magnifica shastensis*	55–8500	8000	P	P
alboluteus	*Abies magnifica shastensis*	55–8500	75–8000	S	P
elegans	*Prunus emarginata*	4–6000	5000	S	P
	Chaparral sticks		4–7000	S	P
leucospongia	*Abies magnifica shastensis*	55–8500	6–9000	S	P
	Arctostaphylos patula	4–8500	5500	S	P
	Pinus albicaulis	7–10000	8–9000	S	P
	Tsuga mertensiana	65–8500	7800	S	P
perennis	humus		55–7500	S	P
Poria lenis	*Abies magnifica shastensis*	55–8500	8000	S	P
rufa	*Pinus ponderosa*	4–7000	7000	S	P
vaporaria	*Tsuga mertensiana*	65–8500	7500	S	P
Pseudoplectania fulgens	humus		6–8000	S	P
Puccinia calochortii	*Calochortus nudus*	5–5700	5500	P	A
caricis	*Carex amplectens*	45–5700	45–5000	P	A
	Carex kelloggii	4–6000	4–6000	P	A
chamaesarachae	*Chamaesaracha nana*	45–8000	45–6000	P	A
cruciferearum	*Cardamine bellidifolia pachyphylla*	8–9500	9000	P	A
extensicola	*Carex brainerdii*	5500	5500	P	A
glumarum	*Bromus carinatus*	4–5000	4–5000	P	A
	Elymus glaucus	4–6000	4–5000	P	A
	Elymus glaucus jepsonii	5000	5000	P	A
	Sitanion hansenii	4–6000	4–6000	P	A
	Sitanion hystrix	4–9000	4–8000	P	A
harknessii	*Stephanomeria lactucina*	4–6000	4–5500	P	A
hieracii	*Agoseris scorzoneriaefolia*	80–9000	9000	P	A
	Hieracium albiflorum	4–7000	4–6000	P	A
heucherae	*Mitella pentandra*	45–8000	4500	P	A
jonesii cymopteri	*Cymopterus terebinthinus*	4–8000	5000	P	A
ligustici	*Ligusticum grayi*	5–8500	7500	P	A
mellifera	*Salvia sonomensis*	4–5000	4–4500	P	A
menthae	*Monardella odoratissima*	4–8500	5–6000	P	A
monoica	*Arabis platysperma*	6–9000	6–7000	P	A
oxyriae	*Oxyria digyna*	75–10000	9500	P	A
palmeri	*Pentstemon menziesii davidsonii*	75–9000	8500	P	A
	newberryi	5–8000	5–6000	P	A
pattersoniana	*Sitanion hansenii*	4–6000	5700	P	A
pentstemonis	*Pentstemon deustus typicus*	4–5500	4500	P	A
pimpinellae	*Osmorhiza nuda*	5–5700	5000	P	A
poae-sudeticae	*Poa pratensis*	4–8000	5000	P	A
pseudocymopteri	*Cymopterus terebinthinus*	4–8000	5000	P	A
rubigo-vera	*Holcus lanatus*	3500	3500	P	A
	Trisetum spicatum	8–8500	8250	P	A
rufescens	*Pedicularis densiflora*	4–5000	5000	P	A
scandica	*Epilobium clavatum*	8–8500	8500	P	A
subdecora	*Brickellia grandiflora*	5–5500	5250	P	A
vagans	*Godetia quadrivulnera*	4–5500	4500	P	A
vagans gayophyti	*Gayophytum ramosissimum*	4–8000	4–8000	P	A
Pucciniastrum goeppertianum	*Vaccinium caespitosum*	75–8500	75–8000	P	P
myrtillii	*Vaccinium caespitosum*	75–8500	7500	P	A
pustulatum	*Epilobium adenocaulon*	4000	4000	P	A
sparsum	*Arctostaphylos patula*	4–8000	4–5500	P	A

Pyrenophora fenestrata	*Castilleja pinetorum*	4–5000	5000	S A
hispida	*Aster shastensis*	4–9000	6000	S A
Ramularia delphinii	*Delphinium pauciflorum*	5700	5700	P A
obducens	*Pedicularis densiflora*	35–5000	3500	P A
senecionis carniolica	*Senecio aronicioides*	5–7500	5–6000	P A
Rhizopogon brunescens	hypogaeous		8000	S P
exiguus	hypogaeous		8000	S P
occidentalis	hypogaeous		8000	S P
provincialis	hypogaeous		8000	S P
separabilis	hypogaeous		8000	S P
Rhynchospora exasperans	*Lupinus obtusilobus*	75–8500	8000	S A
Sarcosphaera coronaria	humus		4–8000	S P
Scelobelonium melanosporum	*Anemone occidentalis*	7–9000	8500	S A
	Juncus balticus montanus	5–8000	8000	S A
	Pentstemon gracilentus	7–9000	8000	S A
Scolecotrichum graminis	*Bromus marginatus*	4–5000	4500	W A
	Elymus glaucus	4–6000	5000	W A
	Glyceria elata	5–5700	5000	W A
	Sitanion hansenii	4–6000	5700	W A
	Stipa occidentalis	4–8500	5000	W A
Secotium nubigenum	*Abies magnifica shastensis*	55–8500	8000	S P
pingue	*Abies magnifica shastensis*	55–8500	8000	S P
Sedecula pulvinata	hypogaeous		7500	S P
Selenophoma donacis obtusa	*Elymus glaucus*	4–6000	5000	W A
	Sitanion hansenii	4–6000	4–6000	W A
	Sitanion hystrix	4–9000	4–9000	W A
Sepedonium chrysospermum	*Abies magnifica shastensis*	55–8500	8000	S A
Septoriella sp.	*Lupinus obtusilobus*	7–8500	8000	S A
Septoria marginata	*Acer glabrum*	5–6500	5500	P A
?petroselini	*Ligusticum grayi*	5–8500	5500	P A
pruni	*Prunus demisa*	35–5000	4500	P A
shastensis	*Aster shastensis*	4–9000	4500	P A
Serpula americana	*Abies magnifica shastensis*	55–8500	75–8000	S P
Solenia candida	*Abies magnifica shastensis*	55–8500	8000	S P
Sphaeridium luteum	*Abies magnifica shastensis*	55–8500	8000	S P
Sphaeropsis microscopicum	*Castilleja arachnoidea*	7–8500	8000	S A
Stemphyllium sp.	*Monardella odoratissima*	4–8500	8000	S A
Sphaerotheca epilobii	*Epilobium hornemanii*	5700	5700	P A
	Epilobium lactiflorum	8000	8000	P A
humuli	*Viola purpurea*	55–8000	6000	P A
humuli fuliginea	*Arnica mollis*	7–8500	7500	P A
Synchytrium asari	*Asarum hartwegii*	4–8500	5000	P A
?aureum	*Ligusticum grayi*	5–8500	5500	P A
Taphrina castanopsidis	*Castanopsis chrysophylla*	4–6500	4-6500	P A
confusa	*Prunus demisa*	35–5000	5000	P A
flectens	*Prunus emarginata*	4–6000	4–5000	P P
potentillae	*Potentilla glandulosa nevadensis*	4–6000	5–5700	P A
pruni-subcordatae	*Prunus subcordata*	4–4500	4500	P P
Teichospora megastega	*Chrysothamnus bloomeri angustatus*	4–9000	8000	S A
Tilachlidium tomentosum	*Abies magnifica shastensis*	55–8500	8000	S A
Titaea sp.	*Arnica viscosa*	8–8500	8000	S A
Torula crustacea	*Salix scouleriana*	4–6500	6500	S A
Trametes pini abietis	*Abies magnifica shastensis*	55–8500	8000	S P
Tremellodon gelatinosus	*Abies magnifica shastensis*	55–8500	8000	S P
Trichosphaeria solaris	*Abies magnifica shastensis*	55–8500	8000	S P
Tulasnella fuscoviolacea	*Abies magnifica shastensis*	55–8500	8000	S P

Tulostoma tuberculatum	humus		6500	S	P	
Tympanis pinastri	*Abies magnifica shastensis*	55–8500	8000	S	P	
	Pinus albicaulis	7–10000	8000	S	P	
Typhula sp.	*Castilleja miniata*	5–8500	8500	S	P?	
	Hulsea nana	85–9500	9500	S	P?	
	misc. herbage		8–8500	S	P?	
Urocystis agropyri	*Elymus glaucus*	4–6000	5500	P	A	
sorosporioides	*Anemone occidentalis*	7–9000	7000	P	A	
Uromyces amoenus	*Anaphalis margaritacea*	5–6000	5500	P	A	
aureus	*Allium validum*	55–8500	55–7500	P	A	
fabae	*Lathyrus lanzswertii aridus*	4-6000	5000	P	A	
	Vicia americana	5–6000	5000	P	A	
hyperici	*Hypericum formosum scouleri*	4000	4000	P	A	
intricatus	*Eriogonum latifolium nudum*	4–5500	4–5000	P	A	
	Eriogonum marifolium	7–9000	75–8000	P	A	
	Eriogonum umbellatum polyanthum	5–7000	5500	P	A	
junci	*Juncus parryi*	7–8500	7500	P	A	
proëminens	*Euphorbia crenulata*	4500	4500	P	A	
spragueae	*Calyptridium umbellatum*	4–9000	7–9000	P	A	
Ustilago bromivora	*Bromus carinatus*	4–5000	5000	P	A	
	Bromus tectorum	4–6000	5000	P	A	
hypodytes	*Sitanion hansenii*	4–6000	57–6000	P	A	
	Sitanion hystrix	5–9000	7–9000	P	A	
	Stipa californica	4–8500	57–8000	P	A	
	Stipa occidentalis	4–8500	57–8000	P	A	
minima	*Sitanion hystrix*	5–9000	8000	P	A	
shastense	*Polygonum shastense*	7–9000	8000	P	A	

It may be noted that this table includes records of 154 genera of fungi including 274 species and 358 records of saprogenic and pathogenic activity on the part of fungi on more than half of the nearly 500 known species of vascular plants on Mount Shasta.