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The taxonomy and ecology of the fleshy fungi of Mount Rainier National Park

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THE TAXONOMY AND ECOLOGY OF THE FLESHY FUNGI OF MOUNT RAINIER NATIONAL PARK

By

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The Taxonomy and Ecology of the Fleshy Fungi of Mount Rainier National Park (57 pp.)

Director: Melvin L. Thornton *Melvin L. Thornton*

The study was undertaken to determine as far as possible the kinds of fleshy fungi to be found within Mount Rainier National Park and to integrate this information with species occurrence records of previous investigators. The southwest corner of the park, the area of greatest visitor use, was surveyed. Fungal floristics and time of emergence of sporocarps was investigated. The southwest area includes the four major vegetation zones characterizing the park: Western Hemlock (Tsuga heterophylla), Pacific Silver Fir (Abies amabilis), Mountain Hemlock (Tsuga mertensiana), and Alpine. The trail system that was used to survey the forest zones for fungi constituted a modified transect through the four zones.

Between early June and late November 1974, 222 species were collected in the park. Nine seasonal "aspects" were identified at the generic level. An additional nine genera are listed as possible aspects. Although four of the thirteen common species found in Mount Rainier appeared in three of the vegetation zones, nine had more limited altitudinal ranges. Precipitation as it relates to soil moisture appears to play a key role in triggering sporocarp emergence.

ACKNOWLEDGMENTS

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CHAPTER I

INTRODUCTION

The flora of higher fungi in Mount Rainier National Park has not been well studied and information about the fungi is not available to the public. The park is unique because it represents a geographical area which is little disturbed by man's influence and thus is a remnant of the original Cascade Mountains ecosystem.

Studies of Fleshy Fungi in Mount Rainier National Park

Mount Rainier was established as a national park in 1899 and incorporated into the National Park Service when the latter was established in 1916. One of the first Chief Naturalists, C. Frank Brockman, was an avid collector of all natural things including fungi. He added much to the knowledge of the area, but his collections of fungi were not extensive and were poorly preserved. Few of his collections are accompanied by adequate collection data. No one else studied the fungi within the park until Alexander H. Smith, Daniel Stuntz, H. A. Imshaug, and E. G. Simmons collected extensively on the University of Michigan Expedition to the park in 1948 (appendix I). According to their collection labels they collected extensively in the Longmire (850 m, lat. 46°45'N, long. 121°49'E) and Kazama Ridge (1600 m) areas during the latter part of July, August, and the early part of September. Thus, they missed the most productive portion of the year for sporocarp emergence which is normally late September through November. They were able to collect 216 species of fleshy fungi among which the major genera were Amanita, Armillaria, Boletus, Suillus, Cantharellus, Clitocybe, Mycena, Cortinerius, Hygrophorus, Lactarius, and Russula. Fred Van de Bogart, Jr., a graduate student studying under Dr. Stuntz at the University of Washington, collected from Tahoma Creed (910 m) to Round Pass (1200 m) on the West Side Road in October 1973 (Appendix I). He added 33 new species to those already recorded for the park, but his specimens were not added to the park's herbarium as were those of Brockman and the University of Michigan Expedition. Dr. Stuntz, who was a member of the University of Michigan Expedition, recognizes the need for further collection in Mount Rainier because of the lack of data from the park (personal communication 1973).

In most areas there is far more literature available on the vascular plants than on the fungi in the same locale. Regional distribution of fungal species in the U. S. has not been well documented and adequate taxonomic guide is available for the Pacific Northwest. As a park ranger in Mount Rainier National Park for two years, I was acutely aware of the lack of literature on the fungal flora. There is almost no information on the fungi in Mount Rainier's literature or nature guides. Bishop and Franklin (1969) in their Notes on the Natural History of Mount Rainier National Park briefly discuss the trees, shrubs, wildflowers, ferns, mosses, and liverworts of the park without any mention of the fungi. There are only two floristic treatments of the fungi of the Northwest, both of which are designed for the amateur mycologist. These are Guide to the Common Mushrooms of British Columbia by Bandoni and Szczawinski (1971) and Margaret McKenny's The Savory Wild Mushroom (1971).

The former guide lists 178 species and the latter only 156. There is no species list for the State of Washington and one can only guess at the total number. Miller (personal communication 1974) estimates 1200 species while Bandoni (personal communication 1975) estimates the number of species to be closer to 2000.

Although there are three fungal collections in the park's herbarium, they are not based on a consistent form of sampling and there had been no attempt to integrate the existing collection data. Many parts of the park have never been sampled at all. Upon talking with the Chief Naturalist, Harry Wills, I learned that he was interested in a project to survey the fungi of Mount Rainier. He gave his approval to collect during the summer and fall of 1974. In view of these deficiencies he has requested that a small mushroom nature guide be drafted for the park upon completion of this study. He also favors development of a slide presentation on the fungal flora in the Longmire Visitor Center during the fall months.

Ecology of Fleshy Fungi

There is little agreement among investigators (mycologists or plant ecologists) as to the relationship between fungi and vascular plant communities. However, the relationships between certain groups of fungi and some higher plants have been well understood. The role of mycorrhizae is well known for some fungal species. Fungal parasitism has been well studied because of the great emphasis placed upon agricultural and forest crops.

It is commonly assumed that bacteria and fungi are the major decomposer groups of organic material in the soil. The relationships of saprophytic fleshy fungi to plant communities are not well understood and the difficulty of observing and identifying the vegetative portions of fungi <u>in situ</u> has so far precluded their use in surveys. Therefore, surveys of fungi continue to use reproductive structures for identification and sampling in ecological studies. Unfortunately, the abundnace and distrubition of reproductive bodies do not give an accurate picture of the abundance or productivity of vegetative structures beneath the soil. Furthermore, there is no way as yet to determine with certainty whether a fungus is absent from a particular forest community. Only presence is a recordable datum. The fruiting bodies of a particular species may not have been seen, but its mycelium may be present in the substratum ready to fruit in following years (Lisiewska 1972). This suggests that several years of observation in any one area are needed to provide an accurate picture of the mycoflora and mycoecology. Perhaps the best statement of the problem is Hering's (1966):

> Fungi are only to be observed at certain seasons, some of them only in certain years, and what is observed are reproductive structures, giving only a vague indication of the extent of the mycellium which bears them. Compared with the vascular plants, the fruiting bodies are relatively scarce, so that larger areas must be surveyed. A survey extensive enough to overcome all these difficulties would be very cumbersome and time consuming, and for this reason few such surveys have been undertaken.

There is much uncertainty among investigators as to how many species of the macromycetes, if any, have a close relationship with forest communities—aside from mycorrhizal and phytopathological relations—and whether there is any interaction between species of fungi. One theory is that the presence of certain species may be correlated with forest community type, others with type of soil, and still others with the surface litter layer (Haas 1933, cited by Cooke 1953). One problem is how to classify fungi of forest communities. Should they be classified as part of the forest community or separately as fungal communities? If they are classified as fungal communities, are they dependent upon or independent of the forest communities? Höfler (1937, cited by Cooke 1948) has suggested that fungal communities can be studied and named independently of other communities, and that different fungal communities may occur in the same forest communities. He based his ecological classification of the fungi on niche, i.e. parasite, saprophyte, and mycorrhiza. Cooke (1955) prefers to classify fungi as to specific habitats they occupy exclusively, i.e. cones, rotten wood, surface litter, duff, roots, etc. Hering (1972) uses the term "fungal association" instead of "fungal community." The latter he believes cannot be defined at this time. He defines a fungal association as "a collection of fungi sharing a common substrate." Thus, fungi in close spatial relation may not all belong to the same association. For example, species of Russula, Mycena, Armillaria, Inocybe, and Tricholomopsis can be found growing in the same area, but not sharing substrates. Most species of Russula are mycorrhizal; the genus Armillaria contains species which are parasitic; species of Tricholomopsis grow on buried wood, those of Inocybe on deep organic material, and many species of Mycena occur on surface litter. Bondartseva's (1972) system of "life forms" classification of fungi is essentially the same as Hering's. He classified fungi in terms of the substrate on which they grow. However, to this he adds another criterion, spore formation and dispersal, i.e. whether the spores are dispersed into a water, air, or soil environment. Lisiewska (1972) concludes that indicator species of fungi may be used to characterize forest communities and Wilkins, et al, (1937, cited by Cooke 1948) in a five-year study of five forest communities, found that 1/10 to 1/4 of the fungal species were to be found exclusively in one particular forest community. Since fungi are some of the most important organisms of the decomposer group their relationship to the forest communities in which they occur needs to be more completely understood.

This study was undertaken to determine the kinds of fleshy fungi to be found within the park. This was approached by collecting throughout an entire growing season and integrating this information with the data on species occurrence recorded by previous investigators. In addition, I gathered data concerning fungal distribution as it related to forest communities and altitude. Finally, data will form the basis for achieving my ultimate goal of producing a book on Mount Rainier fungi for the public.

CHAPTER II

MATERIALS AND METHODS

Site of Research

Mount Rainier National Park is located 130 km (80 mi.) southeast of Seattle, Washington, in Pierce and Lewis Counties. The park comprises 950 km^2 (370 sq. mi.) with Mount Rainier at 4390 m (14,410 ft.) the major attraction. Because the peak rises 2130 m (7000 ft.) above the upper vegetation zone and has 28 major glaciers on its slopes, it is often said that Mount Rainier resembles an arctic island in a temperate zone. Above 2290 m (7500 ft.) are found mostly barren rocks, permanent snowfields, glaciers and some soil with sparse vegetative growth occurring.

The climate is determined primarily by weather patterns of the area. Wind drives wet Pacific air inland following a path from southwest to northeast across the park. As the moist air masses rise over Mount Rainier and cool, precipitation takes place. The area from 1520 m to 2130 m (5000–7000 ft.) on the southwestern shoulder of Mount Rainier receives well over 250 cm (100 in.) of precipitation per year, most of it in the form of snow during the months of November through June. Within this area is Paradise Ranger Station at 1675 m (5500 ft.) which holds the world's record for snowfall. During the winters of 1970–71, 1971–72, and 1973–74 Paradise received approximately 23 m (94 ft.) of snow each winter with a snowpack on the ground of 9 m (30 ft.). A normal year in Paradise produces 15 m (50 ft.) of accumulated snow and 6 m to 8 m (20 to 25 ft.)

of snowpack. On the northeastern slopes of Mount Rainier there is a rain shadow effect. Thus, at the Sunrise Ranger Station located in that area at 1950 m (6400 ft.) there is considerably less snowfall and precipitation. Winter temperatures are relatively warm in Longmire and Paradise, seldom dipping below -4° C to -1° C (25°F to 30°F).

The park includes four major plant communities (Franklin and Dyrness 1969) which represent remnants of the original ecosystem on the western slopes of the Cascade Mountains. The four major plant communities (Fig. 1) fit within an altitudinal gradient ranging from approximately 610 m (2000 ft.) at park boundaries to 2290 m (7500 ft.). The Western Hemlock (Tsuga heterophylla) Zone (Fig. 2) from 610 m to 850 m (2000 ft. to 2800 ft.) consists of stands of giant western hemlock, douglas fir (Pseudotsuga menziesii), and western red cedar (Thuja plicata). These stands are composed of trees often over 75 m (250 ft.) in height and 200 to 250 cm (80 to 100 in.) in dbh. Other tree species present, pacific yew (Taxus brevifolia), vine maple (Acer circinatum), red alder (Alnus rubra), bigleaf maple (Acer macrophyllum) and grand fir (Abies grandis), are of smaller stature. Much of the Western Hemlock Zone outside the park has been logged within the last 150 years and has been replanted with douglas fir.

The Pacific Silver Fir (Abies amabilis) Zone from 850 to 1370 m (2800 to 4500 ft.) is the largest of the forest zones in Mount Rainier National Park. Dominating this zone are pacific silver fir, noble fir (Abies procera), western hemlock, douglas fir, and engelmann spruce (Picea engelmannii). The western hemlock and douglas fir are found at the lower

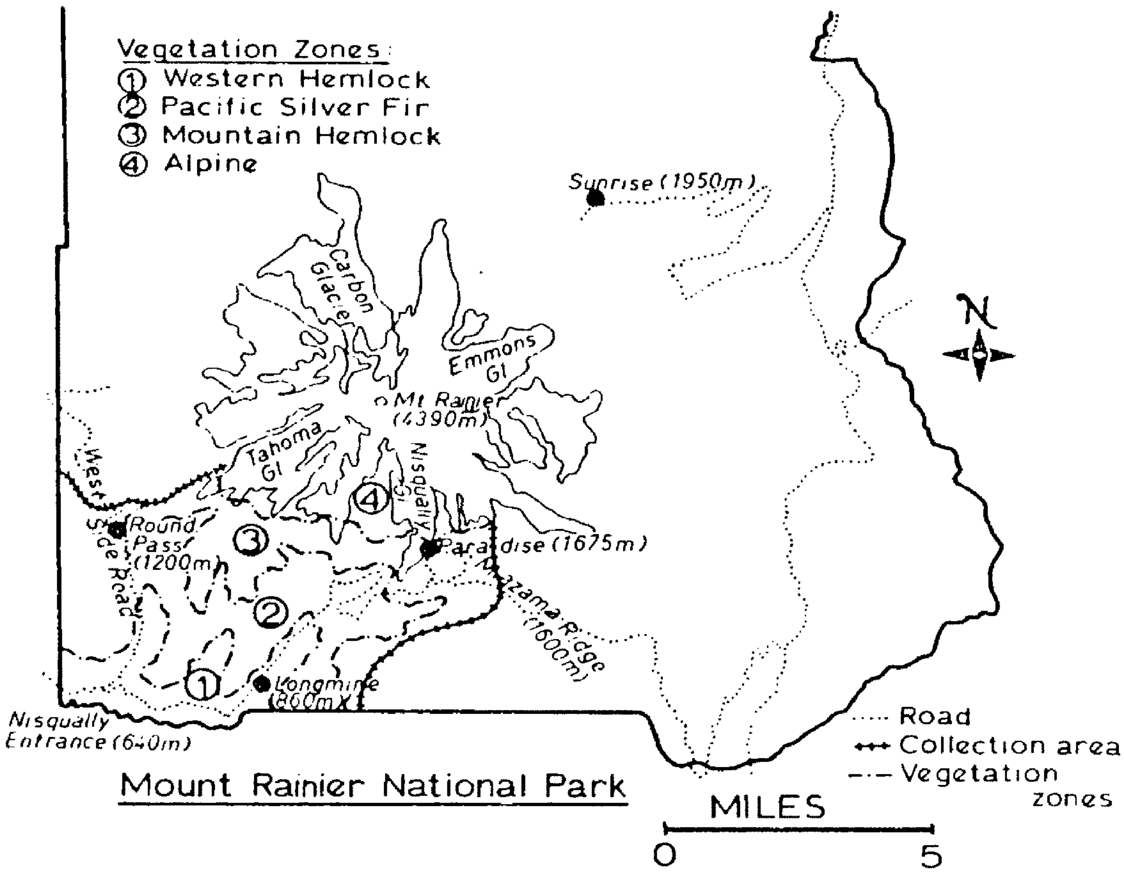


Figure 1

Map of Mount Rainier National Park

Altitude (meters)	Vegetation Zones
	Alpine
1890	
	Parkland Subzone (Upper)
	Tsuga mertensiana (mountain hemlock)
	Continuous Forest Canopy Subzone (Lower)
1370	
	Abies amabilis (pacific silver fir)
850	
	Tsuga heterophylla (western hemlock)
610	

Figure 2

Forest Communities Found in
Mount Rainier National Park
(Franklin and Dyrness 1969)

elevations of the zone while engelmann spruce is found in the upper region.

The Mountain Hemlock (Tsuga mertensiana) Zone from 1370 m to 1890 m (4500 to 6200 ft.), which is dominated by mountain hemlock, subalpine fir (Abies lasiocarpa), and engelmann spruce, also includes alaska cedar (Chamaecyparis nootkatensis) and whitebark pine (Pinus albicaulis). This zone is divided into two subzones, the Continuous Forest Canopy Subzone (lower) and the Parkland Subzone (upper). The latter consists of clumps of trees in the flower meadows (Franklin and Bishop 1969).

The final zone, the Alpine Zone from 1890 m to 2290 m (6200 to 7500 ft.), comprises flowering plants primarily and is basically devoid of trees. The great majority of the flowering plants are the same as those found in the subalpine meadows of the upper Parkland Subzone, although a few are restricted to this zone.

The entire park is far too extensive for one person to sample and collect in a single season. For this and other reasons discussed below I chose to limit collecting to the southwest corner of the park which includes Longmire, the park headquarters, and Nisqually, the park entrance through which most visitors arrive (Fig. 1). Since this area receives the largest volume of visitors the choice is consistent with my long-range objective, the production of a field guide to the mushrooms of the park. It should also be noted that the road from Nisqually to Paradise passes through the three major forest communities on a nearly constant altitudinal gradient. Furthermore, I was employed at Longmire as a part-time park ranger for the summer and fall of 1974 and had ready access to sample areas. Finally, since the southwest corner is in the path of major storms it could be expected to be a highly productive environment.

Collection and Laboratory Procedures

Collection procedures were governed primarily by the need to survey the fungal flora as quickly and thoroughly as possible. Vegetation off the trails is dense and there is considerable blowdown. Since the number of species seen is correlated with the distance traveled, use of the existing trail system seemed the most practical method of sampling. This enabled me to travel easily and often over a larger area than would have been possible otherwise and increased my opportunity to survey the fungi on a broad altitudinal gradient which included all four forest communities. I returned to Longmire each night and identified the specimens while they were in fresh condition. Since the trails in the park are narrow, they affect neither the overstory canopy nor the understory vegetation.

There is no one method of sampling fungi accepted by all mycologists. Sample plots are used by many investigators, but there is a great deal of variation in size and number of plots used. Jules Favre (1948, cited by Cooke 1953) did not use plots to sample mushrooms because he believed that a fungus may be a characteristic species of a vascular association even though it appears sporadically either spatially or phenologically. Lange (1948) noted that a fungus may fruit outside a quadrat one year and inside the next. He also stated that a three-year study he had conducted using plots was inadequate for generalizations. Plot sampling may be a valid approach if a statistical analysis of the forest communities is desired.

However, I felt that plot sampling was not satisfactory for my study since my research was neither primarily statistical in nature nor of sufficient duration to draw any conclusions from this method. The trail systems I used passed through the four forest communities resulting in a modified line transect. I made a complete circuit of the trail system approximately once a month which I felt would insure collecting most of the major species in the area as they appeared.

Both immature and mature sporocarps were sampled, if possible, as both are needed in most cases for positive identification. For example, the caps of the genus Collybia are inrolled in the immature form and the colors of the genus Cortinarius fade upon reaching maturity. Most of the fungi were photographed and identified while in fresh condition. During identification a work sheet was completed on each new species and a collection number assigned (Appendix II). The specimens were then dried and stored in labeled brown paper bags. After returning to the University of Montana, I transferred the dried specimens to herbarium boxes and deposited them in the mycological herbarium.

The parasites and saprophytes of trees, the conks, were not emphasized in my collection for two reasons: 1) they are usually host restricted and probably would not indicate any special relationship to the forest communities that the tree species themselves would not indicate (Cooke 1955), and 2) they appear to evoke little excitement in the visitors to Mount Rainier National Park.

Not only has mycological nomenclature changed since the time of the early collectors in the park, but it is, of course, still fluctuating. I chose to use the nomenclature with which I was most familiar from study at the University of Montana Biological Station under Dr. Orson K. Miller. I used the following authors in order to cross-reference the species and prevent duplication of species under different names. For fleshy agarics I used Singer's The Agaricales in Modern Taxonomy, for boletes The Boletes of Michigan by Smith and Thiers. Dennis' British Ascomycetes was used for ascomycetes and Mushrooms of North America by Miller for the polypores. In addition to these texts I found The Gilled Mushrooms of Michigan and the Great Lakes Region by Kauffman to be very useful for identifying the fungi. Also of considerable help were the reference books A Monograph on the Genus Galerina Earle by Smith and Singer and Hygrophorus by Hesler and Smith. Occasionally useful were the books A Guide to Mushrooms and Toadstools by Lange and Hora, The Savory Wild Mushroom by McKenney, and Guide to Common Mushrooms of British Columbia by Bandoni and Szczawinski. I also used A Mycological Colour Chart (Rayner 1970) in order to arrive at objective values for sporocarp and spore colors.

CHAPTER III

RESULTS AND DISCUSSION

The 1974 season was poor for mushroom production. Although temperatures during the summer were nearly normal (Fig. 3), the precipitation at Longmire was much lower than average for the months of August, September, October, and November (Fig. 4). Paradise was probably similarly affected, but weather records are incomplete and show no data for previous years. In addition to dry weather, the snowpack from the previous winter was so extensive that snow lingered a full month longer than normal in the subalpine meadows of Paradise. The usually spectacular array of alpine flowers during the months of July and August was severely reduced. This, however, is based on subjective impression rather than on quantitative data. Because of the dry season it is probable that diversity and numbers of fungi were also greatly reduced as compared with more typical years.

Soil moisture is considered one of the most important factors in sporocarp emergence, and more attention has been focused on this factor than any other. Friedrich (1936, cited by Cooke 1948) reported that soils with similar water relations have similar fungal populations which vary from year to year as soil moisture varies. Rainfall seems to play a role only to the extent that it is reflected in soil moisture (Wilkins and Patrick 1940, cited by Cooke 1948). McMinn (1952) has proposed that different fungal associations correlate with the extent of the soil drought

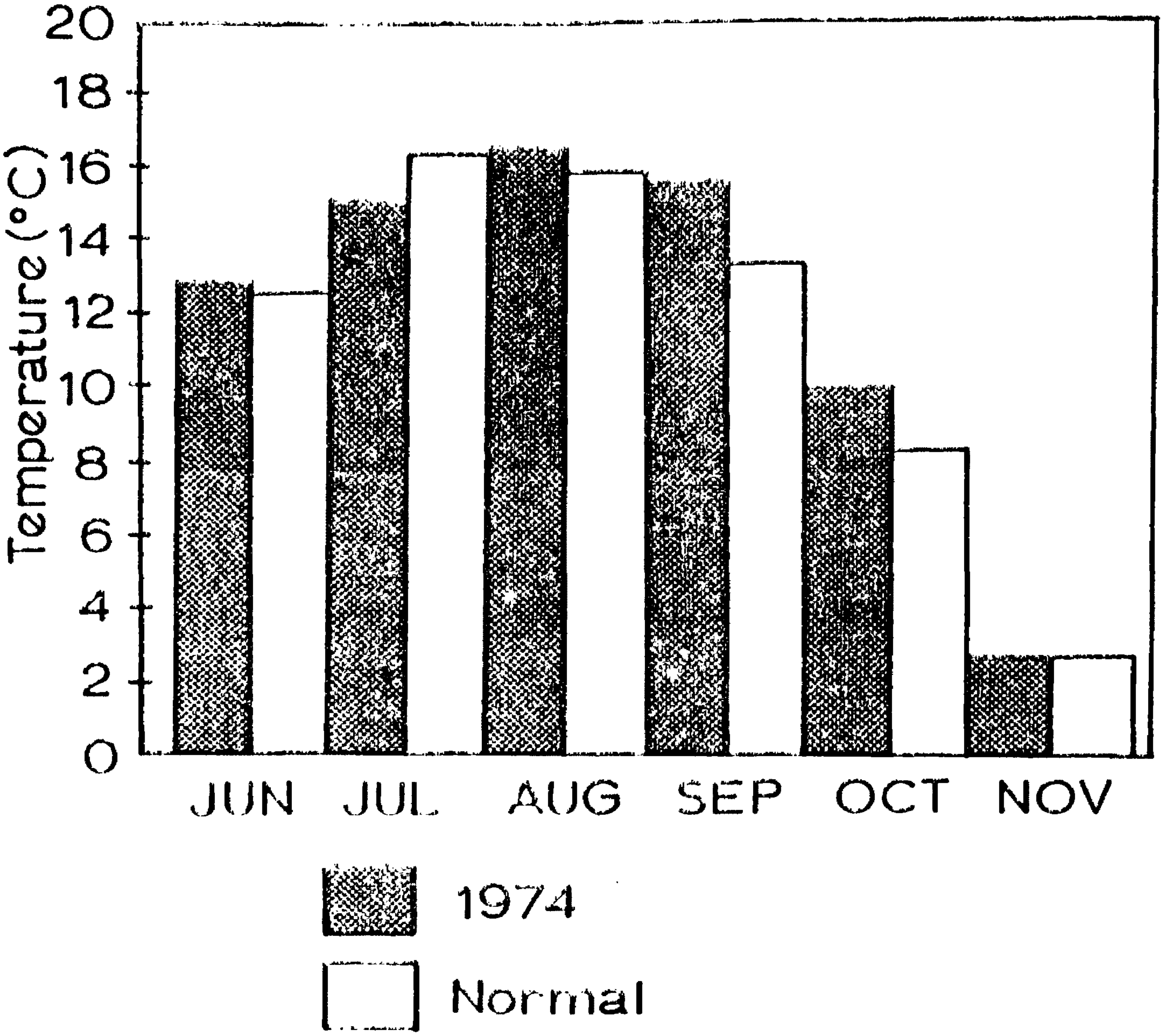


Figure 3

Average Monthly Temperatures at
Longmire, Washington

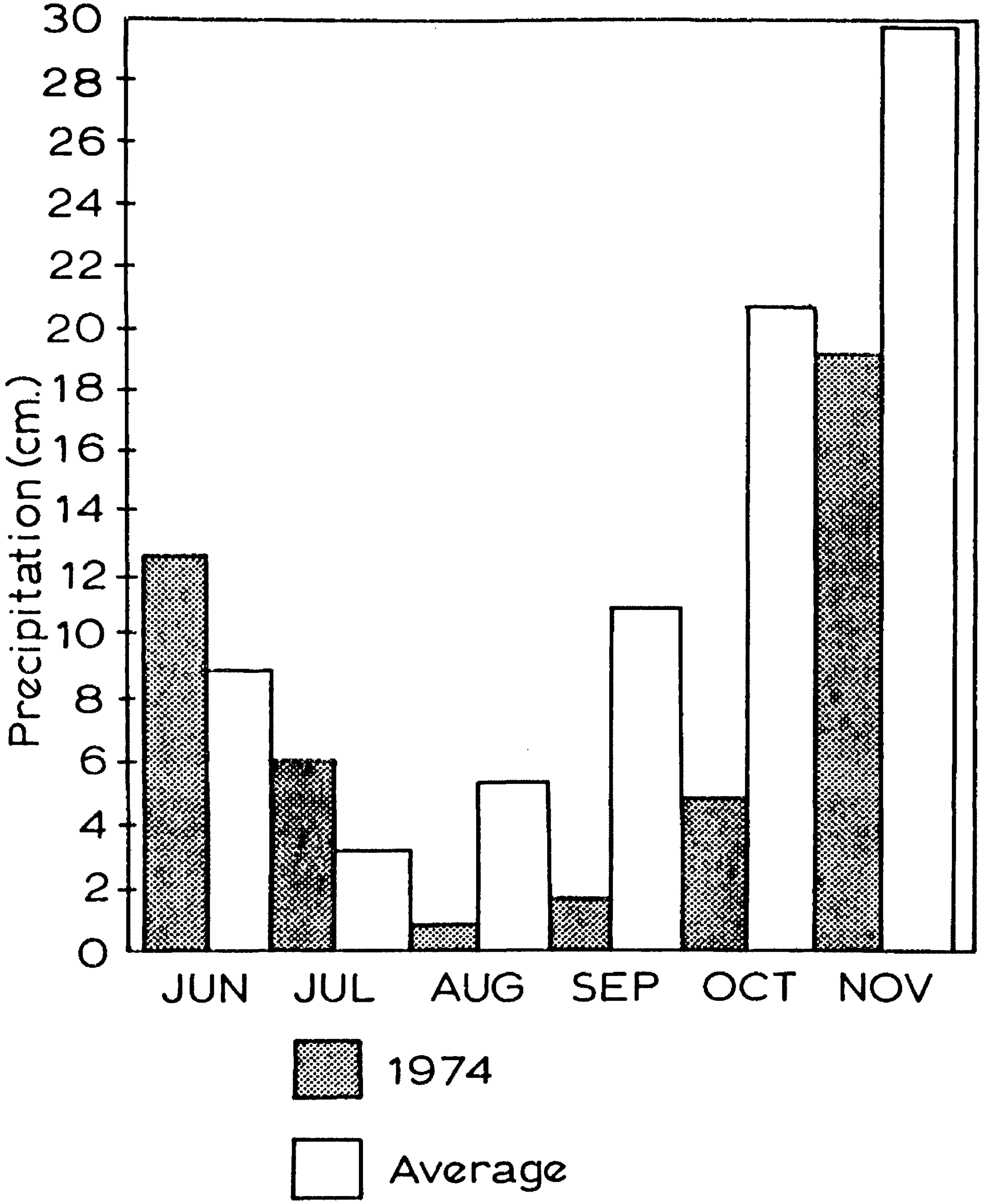


Figure 4

Monthly Precipitation at Longmire, Washington in a particular season, for example, summer in northern latitudes. Cooke (1955) agrees that fungi are limited by drought in summer. Cold, he believes, is the governing factor in the winter.

Collection Data

My field research—June 17 to November 27, 1974—yielded a total of 453 collections of mushrooms representing 222 different species. The included species belong to 63 different genera. Basidiomycetes are represented by 55 genera and ascomycetes by 8. As would be expected, genera included in my collection correlate closely with those of the Michigan group (Appendix I). Correlation at the species level, however, is very low. Between the 218 species gathered by the Michigan group and the 222 in my data, there are only 50 records of the same species. I am in agreement with Brockman on 20 species and with Van de Bogart on 15. In fact, all the collections overlap on only 35 species. Of these the following 13 species are included by three of the groups: Cantharellus cibarius, Gyromitra californica, Cortinarius cinnamomeus, Ganoderma oregonense, Laccaria laccata, Lactarius deliciosus, Mycena pura, Ganoderma applanatum, Naematoloma capnoides, Paxillus atrotomentosus, Pleurotus ostreatus, Stropharia ambigua, and Tricholomopsis platyphylla. Only Gomphidius oregonensis and Pluteus cervinus are listed by all four groups of investigators.

Much of this variation is due to inconsistency of sampling objectives and techniques. There are at least five variables which have affected the content of the species lists: 1) year(s) of collection, 2) season, 3) elevation, 4) location(s), and 5) the particular focus of the investigator. Brockman collected in the 1920's presumably during all seasons and at many elevations. His collection data, however, does not include this information. Many of his specimens are conks. The Michigan group collected in July, August, and September of 1948 in the Longmire and Paradise areas only. Their emphasis was on the fleshy fungi and they did not collect any conks. Van de Bogart collected twice during October of 1973 on a two-mile stretch along the West Side Road. He was searching primarily for species of Coprinus because he was writing a monograph on this genus. My project covered an entire season at as many locations and elevations as possible. The emphasis of my study was the fleshy fungi although I did note the common species of conks.

The total number of species collected among the four groups is 436. As mentioned earlier, there may be as many as 2000 species within the park boundaries. This clearly illustrates how little the fungal flora of Mount Rainier has been studied. It also suggests that no individual has succeeded in collecting a majority of the fungal species to be found in the park.

The lack of a spring flora of fungi was surprising. However, the spring flora may usually be rather insignificant in Mount Rainier becuase of the late melting of the snow. Even at the lower elevations the snow is slow to depart. Guepiniopsis alpinus, which is the predominant spring species, appeared throughout most of the summer at progressively higher elevations as the snow disappeared. Thus, conditions were essentially those of spring.

Snowbank fungi were unexpectedly rare also. I had expected to find some twenty species in the Paradise area based on my own observations at Logan Pass in Glacier National Park and Miller's (1966) observations in the Three Sisters Wilderness Area in Oregon's Cascades. I particularly searched for snowbank fungi in the Parkland Subzone (approximately 1770 m to 2000 m). This is about the same elevation as that at which Miller collected. Adverse conditions caused by the late melting snowpack apparently reduced the number. Six snowbank related species were found:

Guepiniopsis alpinus
Gyromitra gigas
Hygrophorus camarophyllus
Hygrophorus subalpinus
Peziza sp. (varia?)
Cortinarius sp.

Seasonal Aspects

One feature of the distribution of the fleshy fungi is the existence of aspects. "Aspect" is a European term denoting the appearance of a certain genus or species of fungus in relative abundance during a season. Abundance of a genus may be measured either by the number of species or the number of individual sporocarps. Friedrich (1940, cited by Cooke 1948) while studying fungi near Vienna, Austria, distinguished three major aspects: Russula in mid-summer, Lactarius vellereus in late summer, and Mycena in late autumn. Cook's studies (1972) of Mount Shasta and Lassen National Park list Cortinarius, Russula, Amanita, Tricholoma, Boletus, and Ramaria as the prominent genera after the fall rains. Only Tricholoma is not prominent in my collection or in the collections of the other investigators.

Identification of aspects of genera appears to be a valid approach to characterization of fungal phenology. Many genera are represented by a few common species, but when total numbers of individual sporocarps are considered as a generic aspect they comprise a considerable element of the fungal flora. For example, I made 36 collections representing 28 species in the genus Cortinarius. No single species—few species of Cortinarius were collected more than once or twice—is conspicuous by itself. However, taken together the species of Cortinarius create a strong impression that the genus is common.

Study of the collection dates of the genera I found in Mount Rainier shows two obvious patterns of distribution (Fig. 5). Nine genera have a clustering of ten or more collections during which there is no week without a collection. I consider these genera to be definite aspects at least during the 1974 season (Fig. 6). Nine genera have a clustering of seven or more collections during which there is no three-week period without a collection. These genera I consider possible aspects. These are certainly generous limits and after several years of comparative studies could be restricted to define fewer and more meaningful aspects.

Using the criteria for generic aspects, Guepiniopsis is the only definite spring aspect. As mentioned earlier, Guepiniopsis alpinus, which is the only species represented in this aspect, appeared near retreating snowbanks throughout much of the summer. Pholiota which is a possible spring aspect also includes only one species, Pholiota vernalis.

Three definite aspects (Amanita, Russula, and Lycoperdon) and one possible aspect (Paxina) appear in late August (Fig. 6). Although this month was very dry—more than 4 cm below the average—the entire precipitation for the month fell during the third week. This increase in soil moisture preceded sporocarp emergence by one week. In addition, the late melting of the snowpack and the above-normal precipitation in July

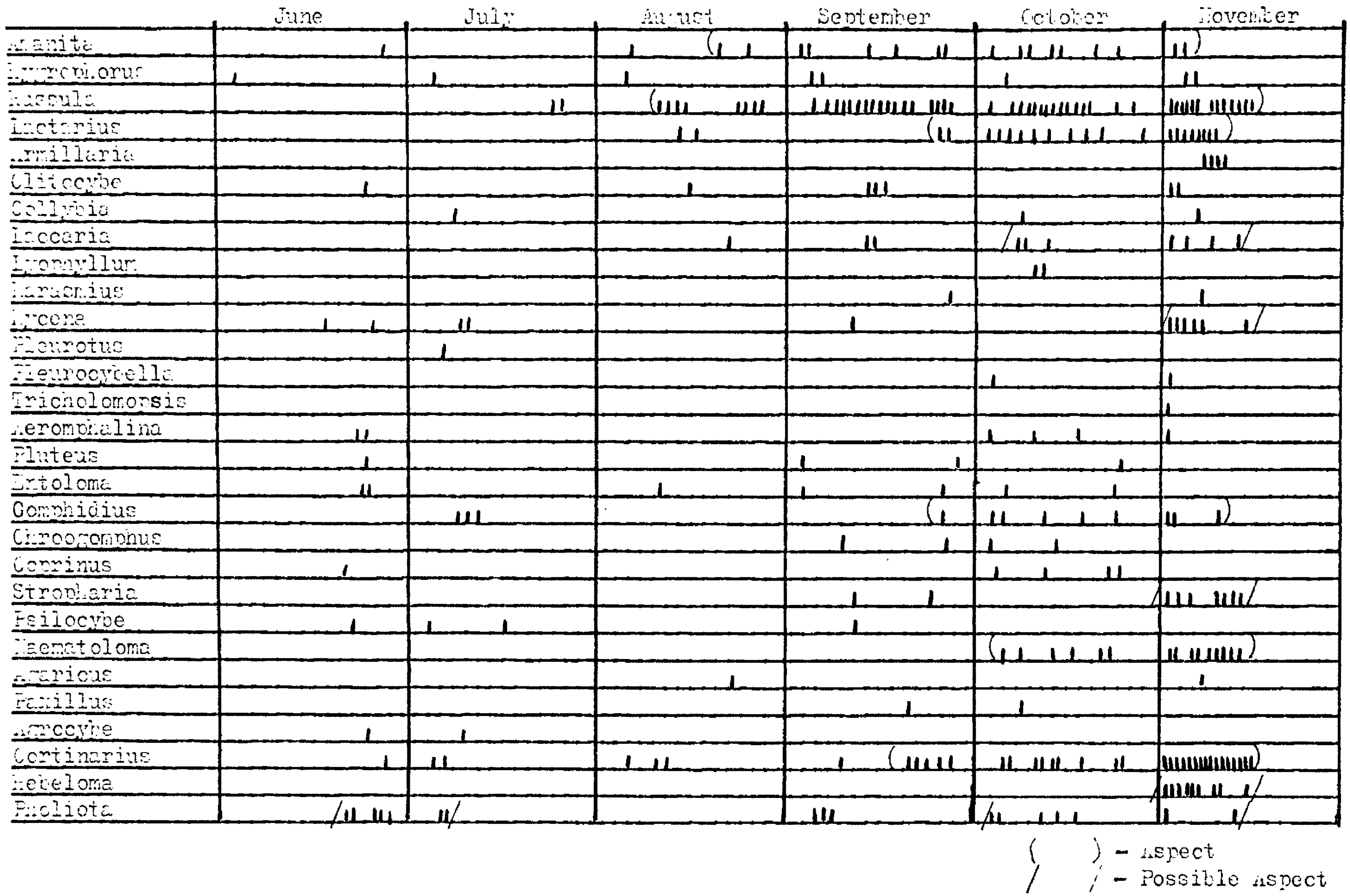


Figure 5

Collection Dates by Genus

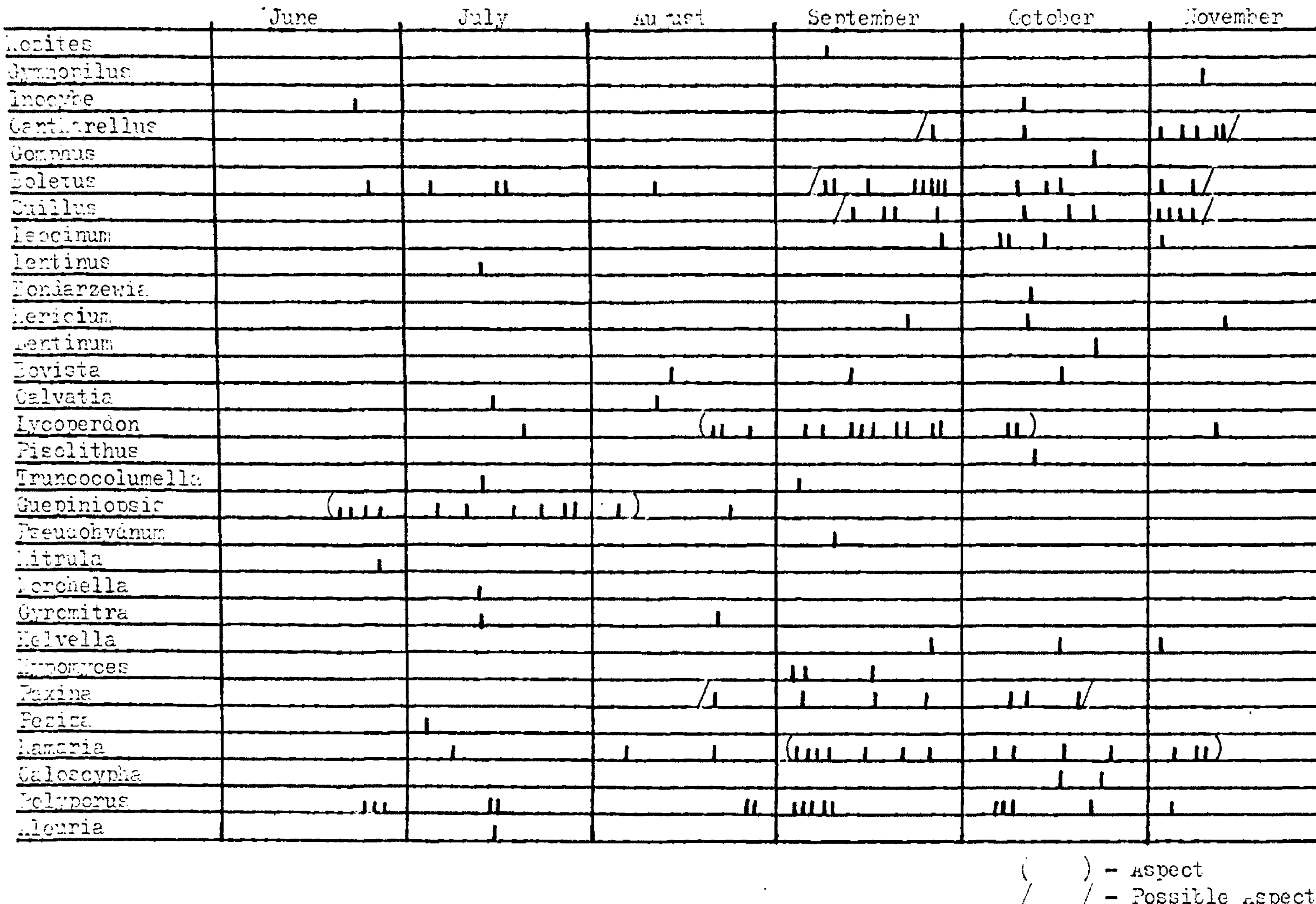
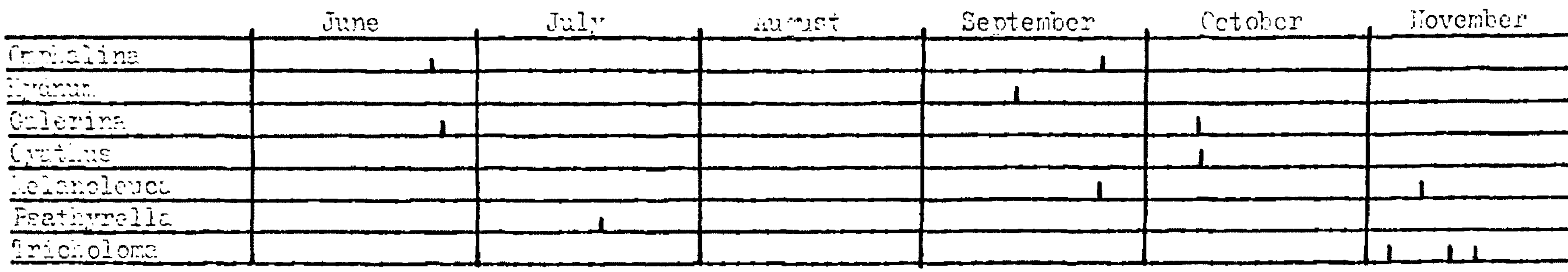


Figure 5 (cont'd)

Collection Dates by Genus



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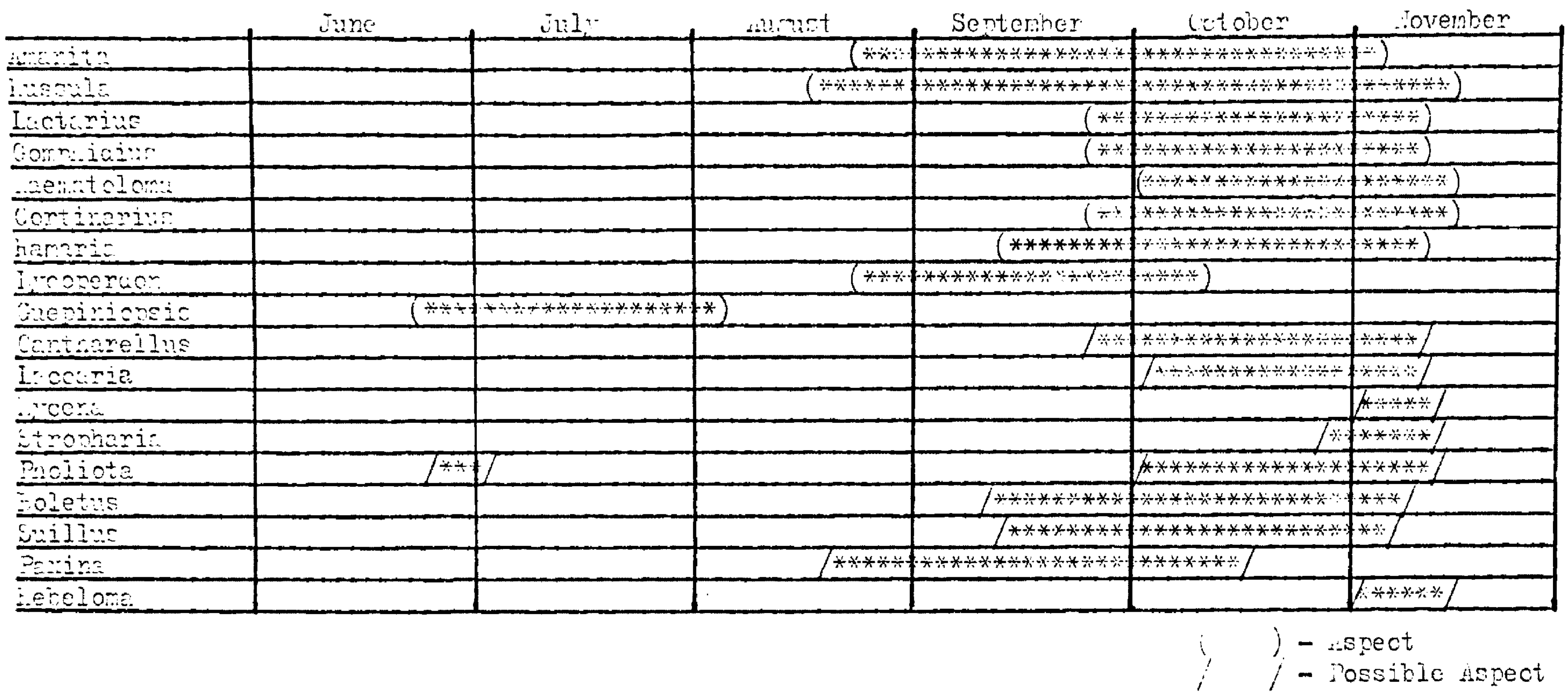

Figure 6

Definite and Possible Seasonal Aspects

may have prevented soil moisture levels from becoming too low for fructification. Species of all four of these aspects first appeared in direct sunlight in open areas among conifers. Many of the Amanita and Russula species which started to emerge in late August aborted after reaching 2 to 6 cm in height. Apparently soil moisture conditions were proper for growth at this time, but low relative humidity may have prevented continued emergence. Amanita muscaria, Russula brevipes and Russula cascadensis were species that often aborted.

Early September continued to be abnormally dry--9 cm below average. Almost all of the precipitation fell during the first ten days of the month. Boletus, Suillus, and Ramaria aspects emerged during this period. These species, however, were found in the densely forested areas where temperatures were several degrees cooler than in the more open areas. Since Amanita, Russula, Boletus, Suillus, and Ramaria are thought to have mycorrhizal relationships with various conifers, it is possible that these five genera are benefited during dry seasons by these associations. Lycoperdon was found in very dry duff under conifers while Paxina was collected from sandy soil in open dry sites. These genera seem to be particularly well suited for the dry period in August and September.

Lactarius, Gomphidius, Naematoloma, and Cortinarius aspects emerged around the first of October. Three possible aspects also emerged at this time: Cantharellus, Laccaria, and Pholiota. Again there was a brief period of precipitation at this time which may have been enough to trigger the emergence of these aspects.

The aspects and possible aspects which emerged during August, September, and October were not distinguished numbers of sporocarps.

Only in the latter half of October and the first half of November did the number of sporocarps greatly increase as the amount of precipitation also increased. Three possible aspects emerged at this time: Mycena, Stropharia, and Hebeloma. All three apparently require a high soil moisture level and high relative humidity.

Cooke (1955) mentions that sporocarp emergence in the fall correlates with the amount of precipitation or with a precipitation/temperature ratio rather than temperature alone. Since temperatures were very close to normal in Rainier in 1974 (Fig. 3) the main factor affecting any variance in the emergence of sporocarps would probably be precipitation. This is consistent with the climatological graph shown in Figure 7. On this graph of precipitation versus temperature are plotted the monthly averages for all previous years and the averages for the summer and fall of 1974. Lange's aspects (1948) show a decrease in the number of species in early August with the number of species increasing in late August and early September. Based on this information the aspects he detected would appear somewhere above 0° C and 7.5 cm. of precipitation on the climatological graph. The plot of 1974 precipitation and temperatures did not reach these optimum values until late October. Although isolated specimens of each genus were collected during the normal season, sporocarp emergence became prolific only in late October. Sixteen of the aspects continued to fruit until mid-November when night temperatures neared 0° C. Thus, my collection data is consistent with the precipitation/temperature ratio suggested by Cooke.

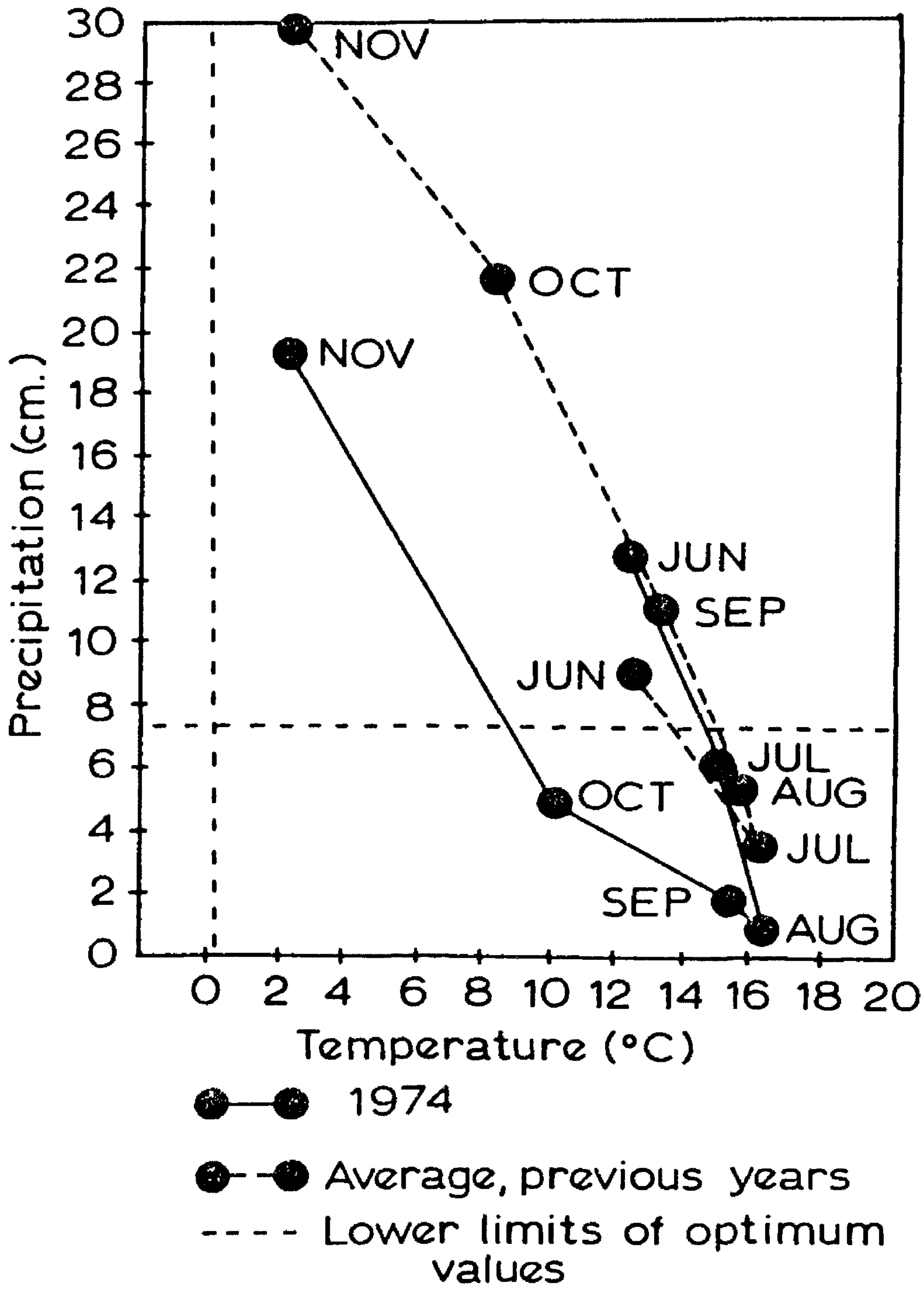

Figure 7

Precipitation/Temperature Graph for Longmire, Washington

Altitudinal Distribution

Since the precipitation during the 1974 collecting season was so low, abundance of each species will have been altered. I detected three groupings of relative abundance—infrequent, frequent, and common. In the infrequent group were 136 species collected only once and 37 species collected twice. Those species considered frequent appeared three to five times at different times or locations. There were 14 species gathered three times, 14 found four times, and 8 found five times. Those species collected six or more times were categorized as common. This group included three species discovered six times, four that appeared seven times, one collected eight times, and five that were found ten times or more (Appendix I).

In order to determine a distributional pattern of species I have used only those which I consider common (Fig. 8). As mentioned earlier, the presence of certain species or genera of fungi may correlate with a forest community, others with the surface litter layer, and still others with type of soil (Haas 1932, cited by Cooke 1953). Thus, some species will be restricted to a forest community if mycorrhizal, while some species will appear quite cosmopolitan in thier distribution. Gomphidius oregonensis was collected only in the Western Hemlock Zone. Laccaria laccata, Naematoloma fasciculare, Russula xerampelina, Russula placita, and Polyporus schweinitzii were found primarily in the Pacific Silver Fir Zone. Since many species of Russula, Gomphidius, and Laccaria are considered mycorrhizal, it is possible that these species are mycorrhizal with western hemlock, pacific silver fir, or some other altitudinally limited tree species and thus would be indicative of a particular zone.

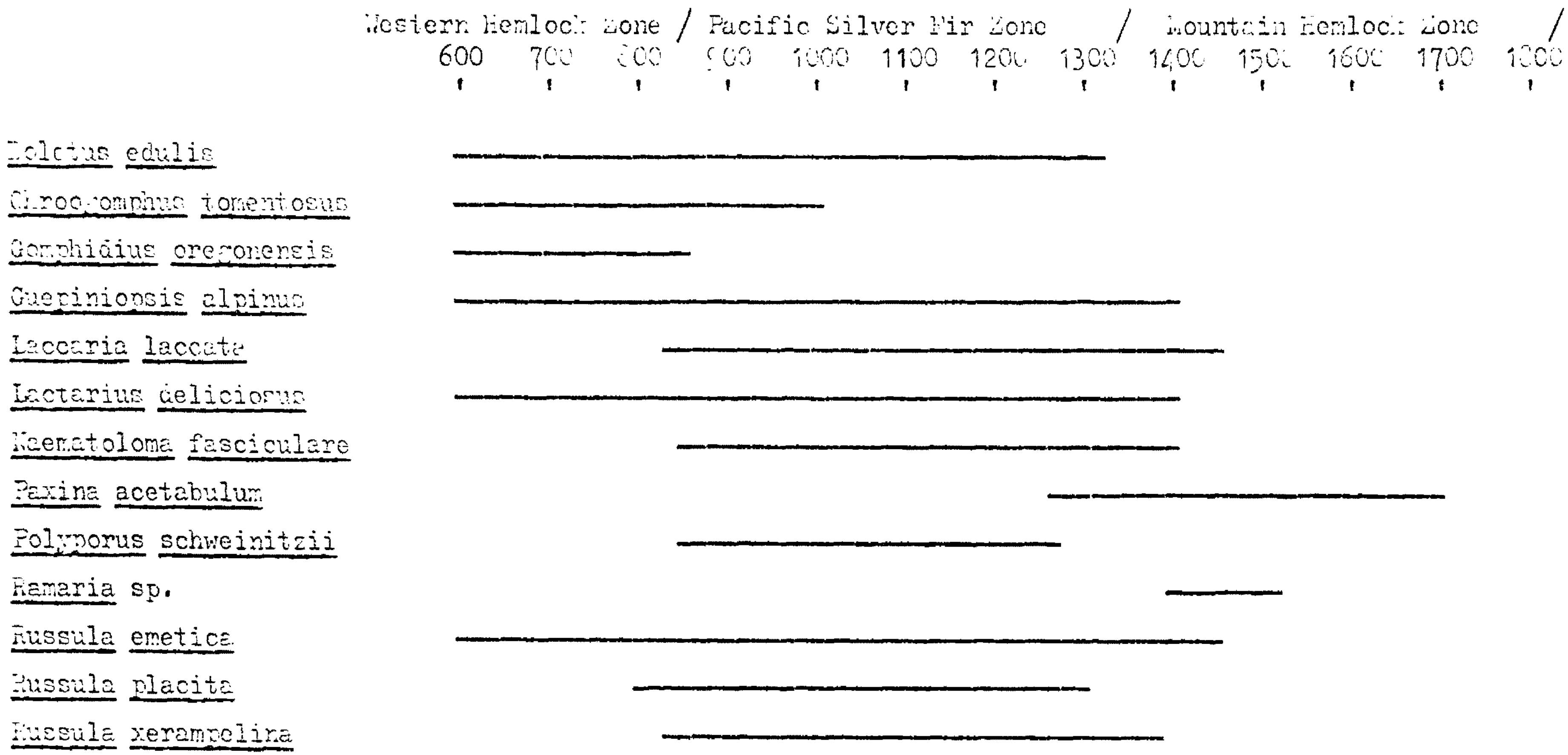

Figure 8

Altitudinal Distribution of Common Species of Fungi

Russula emetica, however, appeared throughout the Western Hemlock and Pacific Silver Fir Zones. One common species of _Ramaria_ was collected only in the Mountain Hemlock Zone.

The Alpine Zone was considered in this study, but the snow did not leave the zone during the collection period. Presumably in normal years it would be possible to collect in the area. However, Miller (1966) suggests that fruiting bodies may be infrequent in this zone due to harsh climate and thin soil and duff layers. Friedrich (1940, cited by Cooke 1948) also stated that with increasing altitude, density of terrestrial fungi decreases. Above 1700 m (5600 ft.) he found only scattered specimens of particularly cold resistant species.

CHAPTER IV

CONCLUSION

Since the Nisqually River drainage in the southwest corner of Mount Rainier National Park is the only part of the park that has been carefully collected, future studies should concentrate on other sections of the park. Hopefully, such studies would be conducted during years of normal precipitation. Even with minimal amounts of rain three periods of aspects appear to have occurred—one in mid-August, one in early September, and one in early October. With future data collection it may be determinable whether, given adequate soil moisture, three periods of aspects will always emerge at these times, whether they will emerge sooner with normal rainfall, or whether the aspects will emerge in a steady progression without major breaks. It could also be expected that a more prominent spring flora will occur with a normal winter's snowpack. Further studies will indicate whether the largest number of sporocarps emerge in November or in October as outlined by Lange (1948). According to Friedrich's (1940, cited by Cooke 1948) statement that fungal populations vary as soil moisture varies, many of the aspects will change both in dominance (that is, numbers of sporocarps present) and in species composition. This will also alter the altitudinal distributions of some species. It is impractical to correlate altitudinal distribution with forest community until at least three to five more seasons are researched. At that time it may be determinable whether distribution is based on altitude alone or whether some species are associated with certain forest communities (in addition to the known mycorrhizal relationships).

Abundance values will vary with a change in soil moisture as well. With normal precipitation a fourth grouping of fungi could probably be added--species which are abundant. These will be species with 15, 20 or more collections at different times and/or locations. It is likely many of the species will be classified in a higher abundance rating, e.g. those in the frequent group may be rated as common.

In future studies further elaboration of the precipitation/temperature ratio should be pursued. This appears to have some validity for general sporocarp emergence such as occurred in November in Mount Rainier.

Finally, fungal phenology should be studied in the Longmire meadows area where a variety of fungi succeed one another as the bog-like area dries out throughout the summer and early fall.

APPENDIX I

COLLECTION DATA FROM MOUNT RAINIER NATIONAL PARK

Collection Data from Mount Rainier National Park

	Harrison	Smith et al	Brockman	Van de Bogart
Agaricus crocodilinus	I*			
" silvicola	I			
Agrocybe pediades	I			
" praecox	I			
Aleuria aurantia	I			
Aleurodiscus sp.				X
Alpova cinnamomeus			X	
Amanita aspera		X		
" chlorinosma		X		
" cokeri	I			
" gemmata	I			
" inaurata	F			
" junquillea		X		
" muscaria	F	X		
" pantherina	F			
" porphyria	I	X		
" silvicola	I			
" spissa	I			
Armillaria albolanaripes		X		X
" graveolens			X (as Gauteria)	

*Frequency categories are denoted as follows:
I = Infrequent
F = Frequent
C = Common

	Harrison	Smith *et al*	Brock-man	Van de Bogart
Armillaria luteovirens		X		
" *mellea*	I	X		
" *ponderosa*		X		
" *zelleri*	I	X		
Boletus calopus		X		
" *chrysenteron*	F			
" *eastwoodiae*		X		
" *edulis*	C	X		
" *granulatus*		X		
" *luteobrunneus*		X		
" *mirabilis*	F	X		
" *piperatus*	I	X		
" *pleumbea*			X	
" *prophyrosporus*			X	
" *sibiricus*		X		
" *subluteus*		X		
" *subtomentosus*	I			
" *zelleri*		X		
" sp. (#1345)	I			
" sp. (# 1231)	I			
" sp. (# 1239)	I			
Bondarzewia berkeleyi	I			
Bovista pila	F			
Caloscypha fulgens	F			
Calvatia fumosa	I			
" *oregonensis*			X	
Cantharellus cibarius	I	X	X	
" *floccosus*	F	X		
" *infundibuliformis*		X		
" *kauffmanii*		X		

	Harrison	Smith et al	Brock-man	Van de Bogart
Cantharellus multiplex		X		
" tubaeformis	I			
" sp.			X	
Chroogomphus tomentosus	C			X
Clitocybe altrialba		X		
" aurantiaca	I			
" avellaneialba		X		
" cerussata		X		
" clavipes				X
" dealbata	F			
" dilatata	I			X
" extypoides		X		
" gibba	F			
" irina	I			
" nebularis		X		
" odora		X		
" olida		X		
" parilis		X		
" rivularis				X
" sinopica	I			
" sp. (# 1339)	I			
Collybia acervata		X		
" albiflavida	I			
" bakerensis		X		
" colorea		X		
" conigenoides	I			
" dryophyla	I	X		
" myriadophylla		X		
" nitellina		X		
" racemosa		X		
" tuberosa		X		

	Harrison	Smith et al	Brock-man	Van de Bogart
Collybia sp. (#1177)	I			
sp. (#1277)	I			
Coprinus atramentarius	I	X		
" comatus	I			
" micaceus	I			
Coriolus hirsutus				X
" sp.				X
Cortinarius acutus		X		
" alboviolaceus	I	X		
" angelsianus		X		
" anomalus	I	X		
" argentatus	I			
" brunneus	I	X		
" callisteus	I	X		
" calochrous	I			
" camphoratus	I	X		
" cinnamomeus	F	X	X	
" communis	I			
" cotoneus		X		X
" crassus		X		
" croceifolius		X		X
" cyanites		X		
" dilutus		X		
" elatior		X		
" erugatus	I			
" evernius		X		
" firmis		X		
" fuscoviolaceus		X		
" gentilis		X		
" glabrellus	F			
" glaucopus	I			[illegible]

		Harrison	Smith et al	Brock-man	Van de Bogart
Cortinarius	griseoviolaceus		X		
"	haematochelis		X		
"	helvelloides		X		
"	hemitrichus		X		
"	iodes	I			
"	laniger		X		
"	lucorum		X		
"	malicorius		X		
"	miniatopus		X		
"	montanus		X		
"	morrisii		X		
"	multiformis		X		
"	muscicola		X		
"	muscigenus	I			
"	mutabilis		X		
"	obtusus		X		
"	paleaceus		X		
"	pallidifolius		X		
"	phoeniceus		X		
"	pseudoarcuatus		X		
"	punctatus		X		
"	purpureophyllus	I			
"	pyroidorus		X		
"	ribratilis		X		
"	salor		X		
"	scaurus		X		
"	semisanguineus	I	X		
"	splendens		X		
"	stemmatus		X		
"	subaustralis		X		
"	subcuspidatus		X		
"	subolivescens		X		

	Harrison	Smith et al	Brock-man	Van de Bogart
Cortinarius subpurpurascens		X		
" substratus		X		
" torrus		X		
" traganus	I	X		
" uraceus	I			
" variecolor		X		
" vibratilis		X		
" violaceus	I	X		
" sp. (#1124)	I			
" sp. (#1136, 1365)	I			
" sp. (#1334)	I			
" sp. (#1333)	I			
" sp. (#1332)	I			
" sp. (#1238)	I			
" sp. (#1275)	I			
" sp. (#1312)	I			
" sp. (#1310)	I			
Crepidotus sp.				X
Cyathus vernicosus			X	
" sp. (#1264)	I			
Cystoderma amianthinum				X
" cinnabarinum		X		
" fallax		X		
" granulosum		X		
Dentinum repandum	I			
Entoloma grayanum	I			
" peckianum	F			
" sericeum	I			
" scabrinellum	I			
" sp. (#1[illegible]5)	I			

	Harrison	Smith et al	Brock-man	Van de Bogart
Fomes igniarius			X	
" *laricis*			X	X
" *pini*	I		X	
" *pinicola*	F			
Galerina autumnalis				X
" *insignis*	I			
" *mutabilis*		X(as *Kuehneromyces*)		
" sp. (#1259)	I			
Ganoderma applanatum	F		X	X
" *oregonense*	I		X	X
Geaster triplex			X	
Gomphidius glutinosus	F			
" *oregonensis*	C	X	X	X
" *smithii*		X		
" *subroseus*	F	X		
Gomphus pseudoclavatus	I	X		
Guepiniopsis alpinus	C			
Gymnopilus penetrans	I			
" *punctifolius*		X		
" *sapineus*	I			
" *spectabilus*		X		
" sp. (#1203)	I			
Gyromitra californica	I	X	X(Both as *helvella*)	
" *gigas*	I			
Hebeloma crustuliniforme	F	X		
" *mesophaeum*	F			
" sp.				X
Helvella elastica		X		
" *infula*	I			

	Harrison	Smith et al	Brock-man	Van de Bogart
Helvella lacunosa	I			A
Hericium coralloides	I		A	
" weirii	I			
Hydnum fennicum			A	
" floriforme			A	
Hygrophorus albidus		A		
" camarophyllus	I			
" cantharellus	I			
" conicus	I	A		
" lattus		A		
" marginatus		A		
" miniatus	F	A		
" purpurascens		A		
" saxatilis		A		
" subalpinus	I			
Hypomyces lactifluorum	F			
Inocybe fastigiata	I			
" floccolosa	I			
" leptophylla	I			
" [illegible]	I			
" trechispora	I			
" sp. (# 1256)	I			
" sp. (# 12[illegible])	I			
Laccaria laccata	C	A		A
Lactarius affinis	I			
" alpinus		A		
" aurantiacus		A		
" aurantiodes		A		
" deliciosus	F	A		A
" insulsus	I			

	Harrison	Smith et al	Brock-man	Van de Bogart
Lactarius lignyotus		X		
" muscidus		X		X
" rufus	I	X		
" sanguifluus		X		
" scrobiculatus	F	X		
" trivialis	F			X
" uvidus	I	X		
" zonarius	I	X		
" sp.				X
Leccinum aurantiacum	I	X		
" scabrum	I			
" sp. (#1229)	I			
" sp. (#1341)	I			
Lentinus omphalodes			X	
" ponderosa	I			
Lepiota acutesquamosa		X		
" clypeolarioides		X		
Leucopaxillus albissimus		X		
" amarus		X		
Limacella glioderma		X		
" lenticularis		X		
Lycoperdon candidum	I			
" perlatum	F			
" pusillum	F			
" pyriforme	F		X	
" umbrinum	F			
Lyophyllum decastes	I			
" multiceps				X
" sp. (#1145)	I			

	Harrison	Smith et al	Brock-man	Van de Bogart
Marasmius androsaceus	I	X		
" *confluens*		X		
" *umbilicatus*		X		
" *urens*		X		
" *velutipes*	I			
Melanoleuca sp. (#1253)	I			
" sp. (1327)	I			
Merulius niveus				X
" *tremulloides*				X
Mitrula paludosa	I			
Morchella esculenta	I			
Mycena alcalina		X		
" *algeriensis*		X		
" *amicta*		X		
" *atroalboides*		X		
" *aurantiidisca*	F	X		
" *capillaripes*		X		
" *cinerella*		X		
" *clavicularis*		X		
" *delectabilis*		X		
" *epipterygia*		X		X
" *galericulata*	I	X		
" *haematopus*	I	X		
" *hudsoniana*		X		
" *inclinata*	I			
" *insignis*		X		
" *leptocephala*		X		
" *lilacifolia*		X		
" *maculata*		X		
" *marginella*		X		

	Harrison	Smith et al	Brock-man	Van de Bogart
Mycena monticola		X		
" *pura*	I	X		X
" *radicatella*		X		
" *rorida*		X		
" *rosella*		X		
" *strobilinoides*		X		
" *stylobates*		X		
" *swartzii*		X		
" *subplicosa*		X		
" sp. (*alcalina*?, #1131)	I			
" sp. (#1120)	I			
" sp.				X
Naematoloma capnoides	F	X		X
" *dispersa*	I			
" *fasciculare*	C			
" *humidicola*		X		
" *subochraceum*		X		
" sp. (#1276)	I			
Naucoria centuncula		X		
" *cidaris*		X		
" *strictus*		X		
Omphalina ericetorum	I			
" *fibuloides*	I			
" *luteocolor*				X
" *umbellifera*		X		
Otidea alutacea		X		
" *leporina*		X		
" *onotica*		X		
" *smithii*		X		
Panus stypticus		X		

	Harrison	Smith et al	Brock-man	Van de Bogart
Paxillus atrotomentosus	I	X	X	
Paxina acetabulum	C			
" hispida		X		
" macropus		X		
Peziza badia			X	
" sp. (varia?)	I			
Pholiota albavelata				X
" astragalina				X
" aurea	I	X		
" erebia		X		
" kauffmaniana		X		
" lubrica	I	X(as Flammula)		
" scamba		X(as Flammula)		
" spumosa	I	X(as Flammula)		
" squarroso-adiposa	I	X		
" squarrosoides		X		
" terrestris	I			
" togularis	I			
" vernalis	F	X(as Kuehneromyces)		
" sp. (#1329)	I			
" sp. (#1330)	I			
" sp. (#1331)	I			
Phylloporus rhodoxanthus		X		
Pisolithus tinctorius	I			
Pleurocybella porrigens	I	X		
Pleurotus ostreatus	I	X	X	
Pluteus cervinus	F	X	X	X
" tomentosulus		X		
Polyporus arcularius				X

	Harrison	Smith *et al*	Brock-man	Van de Bogart
Polyporus brumalis	I			
" *cinnamomeus*			A(as *Polystrictus*)	
" *elegans*	I			
" *fissus*			A(as *Polystrictus*)	
" *hirsutus*			A	
" *leucospongia*			A	
" *perenoid*			A	
" *picipes*	I		A	
" *schweinitzii*	C		A	
" *sulphureus*	I		A	
" *unicolor*			A	
" *versicolor*	I		A	
" sp. (#1254)	I			
" sp. (#1190, 1193, 1293)	I			
Poria marginella			A	
" *subacida*		A		
" *umbeta*			A	
" *weirii*			A	
Pralliota aimunitina	I			
Psathyrella spadiceogrisea	I			
" sp.				A
Pseudohyunum gelatinosum	I			
Psilocybe atrofuga	I			
" *elongatum*	I			
" *foenisecii*	I			
" *pelliculosa*				A
" sp. (#1128)	I			
" sp.				A
[illegible] sp. (#1212) (*botrytis*?)	I	A		
" sp. (#1137)	C			

	Harrison	Smith *et al*	Brock-man	Van de Bogart
Ramaria sp. (#1243)	I			
" sp. (#1268)	I			
" sp. (#1328)	I			
" sp. (#1278)	I			
" sp. (#1315)	I			
Rozites caperata	I	A		
Russula aeruginea	I	A		
" *atrovinosa*				A
" *bicolor*				A
" *brevipes*	I			
" *cascadensis*	F			
" *crassotunicata*		A		
" *cyanoxantha*	F			
" *decolorans*		A	A	
" *densifolia*	I	A		
" *emetica*	F			
" *flavida*	I			
" *foetans*	F	A		
" *fragilis*	F			
" *nigricans*	I			
" *olivaceus*	I		A	
" *pectinata*	I			
" *placita*	C			
" *purpurea*			A	
" *rosacea*	I			
" *subcarminea*				A
" *xerampelina*	C			
" sp. (#1313)	I			
Schizophyllum commune			A	
Sparassis radicata			A	

	Harrison	Smith et al	Brock-man	Van de Bogart
Stropharia albonitens	I			
" ambigua	F	X		X
" hornemannii	F	X		
" squamosa		X		
" stercoraria			X	
Suillus brevipes	I			
" caerulescens	I			X
" lakei	C	X		
" luteus	I			
" sp. (# 1244)	I			
Thaxterogaster pinque			X	
Tremella lutescens			X	
Tricholoma decorum		X		
" sejunctum	I	X		
" terreum	I			
" virgatum		X		
" sp. (# 1306)	I			
Tricholomopsis platyphylla	I	X	X	
" rutilans		X		X
Truncocolimella citrina	I		X	
Tyromyces guttulatus				X
Xeromphalina brunneola	F			
" campanella		X		
" fulvipes	I			
" pubescentipes		X		

APPENDIX II

ASCOMYCETE AND BASIDIOMYCETE WORKSHEETS

ASCOMYCETE WORKSHEET

PART A—FIELD

[illegible]
[illegible] NAME: [illegible] Patrick Harrison NUMBER:
[illegible]
  Relation to substratum:
  Color:
ASCOCARP
  Structure or type:
  Fruiting habit:
  Accessory structures (Clypeus, etc.):
  Substratum:
  Relation to substratum or stroma:
  Relation to soil surface (when on soil):
  Shape:
  Profile:
  Color:
  Surface:
  Dimensions:

  Dehiscence:
ANT[illegible] STRUCTURES
  Subiculum:
  Sclerotium:
  Stroma:
    Color:
    Relation to substratum or sclerotium:

NOTES AND SKETCHES:

PART B—LAB

[illegible]
  Paraphyses:
  Shape of [illegible]:
  Structure of subhymenial tissue:
  Color:
ASCUS
  Stuctural layers:
  Dehiscence type:
  Arrangement of hymenial asci:
  Arrangement of non-hymenial asci:
  Ascus shape:
  Ascospore arrangement:
  Asci/locule:
  Ascospores/ascus:
  Apex characteristics:
ASCOSPORE:
  Shape:
  Number [illegible] cells:
  Color:
  Ornamentation:
  Structure:
  Dimensions:
  Melzer's reaction:
A[illegible] [illegible]
  Conidium bearing structure:
  Conidium:
    Structural type:
    Shape:
    Color:
    Dimensions:
    Number of cells:
    Ornamentation:

NOTES AND SKETCHES:

BASIDIOMYCETE WORKSHEET

PART A—FIELD

SPECIMEN:
COLLECTOR'S NAME: R. Patrick Harrison
FRUITING BODY TYPE: agaric-stem, agaric-sessile, polypore-stem, polypore-sessile,
    tooth-fungi, bolete, coral-fungi, chanterelle, stinkhorn, bird's nest,
    earthstar, puffball, jelly-fungi, other:
HABITAT: N/A
    Substratum: soil, dung, decayed organic matter, parasitic (host:),
        mycorrhizal(host plant:), other:
    Surrounding vegetation:
        overstory:
        understory:
    Fruiting habit: pileus-sessile, pileus-stem, conk, other:
    Flesh Color: Stains: Texture: brittle, pliant, revives in H_2O
    Odor: lacking, mild, normal, strong, disagreeable, similar to:
    Taste: lacking, mild, strong, peppery, similar to:
    Growth: single, gregarius, caespitose, imbricate, other:
PILEUS: N/A
    Shape: concave, convex, convex-umbonate, convex-depressed, broadly convex,
        bell-shaped, conic, flat, other:
    Surface:
        Color: light, medium, dark; dull, shiny; white, cream, brown, red, pink,
            orange, yellow, green, blue, purple, violet; other:
            striated: yes, no, notes:
        Viscidity: dry, moist, viscid, slimy viscid, hygrophanous, other:
        Texture: smooth, rough; Ornamentation: warts, scabers; Other:
    Margin: straight, rolled, sculptured, striated, other:
    Dimensions: thickness:
        diameter:
HYMENIAL SURFACE:
    LAMELLAE or PORES: N/A
        Dimensions: breadth:
            thickness:
            length:
        Relation to stipe: adnate, adnexed, free, decurrent, other:
        Edge: smooth, serrate, ragged, other:
        Spacing: crowded, medium, widely spread, other:
        Intermediate gill: yes, no, notes:
        Deliquescent: yes, no
        Color: light, medium, dark; dull, shiny; white, cream, brown, red, pink,
            orange, yellow, green, blue, purple, violet, other:
            striated: yes, no, notes:
        Latex: yes, no, color: color change(latex):
        Stains: yes, no, color: color change:
        Pore shape if applicable: circular, diamond, labyrinth, other:
    GASTEROMYCETES: N/A
        Glebal color:
            description:
        Peridium: thickness:
            rays: N/A, smooth, cracked, wrinkled, curved on tips, other:
        Spore sac: N/A, smooth, cracked, wrinkled, other:
        Sterile base: yes, no, notes:
        Ostiole: N/A, number: location:
        Peridioles: N/A, number: location:
    OTHER: note under space for notes.

STIPE: N/A
    Position: center, eccentric, lateral, other:
    Dimensions: width:
        height:
    Shape: symmetrical, bisymmetrical, crooked, decurrent, other:
    Surface:
        Texture: smooth(T M B), striated (T M B), fibrils (T M B)-color:
            scabers (T M B), rings of tissue above base: yes, no, color:
                number:
            other (T M B):
        Color: light, medium, dark; dull, shiny; white, cream, brown, red, pink,
            orange, yellow, green, blue, purple, violet, other:
            striated: yes, no, notes:
        Viscidity: dry, moist, viscid, slimy viscid, hygrophanous, other:
    Annulus: yes, no, notes:
    Bulb: yes, no,
        whole, cleft, other:
        smooth, rough, scales, other:
        color:
    Volva: yes, no
        cup, flattened, other:
        color:
VEIL: N/A
    Kinds present: pileus warts, pileus margin, annulus, volva, other:
    Consistancy:
    Persistancy:
    Annulus if applicable:
        type:
        position: superior, central, inferior, number:
SKETCH and NOTE SPACE:

BASIDIOMYCETE WORKSHEET (cont'd)

PART B—LAB

BASIDIUM
Type:
Shape:
BASIDIOSPORE
Spore print color:
Surface ornamentation:
Melzer's reaction:
Capillitium N/A
Color:
Shape:
Ornamentation:
Width:
CYSTIDIUM
Locational type:
Morphological type:
Length:
Width:
TRAMA
Pileus: parallel, convergent, divergent, woven, other:
Stipe: parallel, convergent, divergent, woven, other:
CUTICLE
Type:
Number of layers:
NOTES AND SKETCHES:

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