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ECTOMYCORRHIZAL FUNGI AT TREE LINE IN THE CANADIAN ROCKIES

GAVIN KERNAGHAN and R. S. CURRAH
Department of Biological Sciences, University of Alberta
Edmonton, AB, T6G 2E9, Canada.

Abstract

Sporocarps of fungi belonging to ectomycorrhizal genera were collected between 1993 and 1997 at two sites at the upper elevational limit of the subalpine forest in montane Alberta. Host plants include *Abies lasiocarpa, Picea engelmannii, Larix lyallii, Betula glandulosum,* and *Dryas* and *Salix* spp. Eighty one species in 29 genera and 13 families were collected, 22 of which are new records for Canada, 35 for western Canada and 40 for Alberta. The community of ectomycorrhizal fungi in the transition zone between the subalpine forest and the alpine zone was composed mainly of conifer associates. Arcto-alpine angiosperm associates and generalists were also present. Although the subalpine/alpine ecotone was richest in terms of ectotrophic plant genera, mycorrhizal fungi were richest in the subalpine forest. Taxa collected are annotated with information on host association and distribution, and are described where appropriate.

Key words: alpine, subalpine, montane, ecotone, *Abies, Picea, Salix, Dryas*

Introduction

Montane ecosystems are often rich in ectomycorrhizal fungi which may fruit abundantly and include species endemic to high elevation environments. European records of montane ectomycorrhizal fungi include those from *Picea*-dominated subalpine forests (Favre 1960, Treu 1990, Rücker *et al.* 1990, Bieri *et al.* 1992) and the well documented *Salix*-dominated alpine habitats (Favre 1955, Lamoure 1977, 1978, 1987, Horak 1960, 1987, Kühner and Lamoure 1986, Senn-Irlet 1988, 1993, Bon 1992, Graf 1994). In North America, montane ectomycorrhizal fungi are less known, but the number of species collected with subalpine conifers (Overholts 1919, Kauffman 1921, Cázares 1992, Moser *et al.* 1995a, Moser and Ammirati 1996) and alpine *Salix* (Moser and McKnight 1987, Moser 1993) is increasing.

At higher elevations in the Front Range of the Canadian Rockies, the mature, subalpine forests of *Picea engelmannii* and *Abies lasiocarpa* begin to give way to the

low growing shrubs which dominate the alpine vegetation. At the ecotone, or zone of transition between these habitats, conifers form discrete, stunted, multi-stemmed islands or krummholz (Wardle 1968) resulting in a mosaic of alpine and subalpine vegetation.

Ecotones are potentially species rich, because of the unique combination of components from adjacent habitats (Risser 1995). Although the mycota of subalpine/alpine ecotones has received some attention in Europe (Moser 1967a, Gulden and Lange 1971, Moser 1982, Jacobsson 1984), the composition of ectomycorrhizal fungi at tree line in North America is essentially unknown.

This paper presents a list of ectomycorrhizal fungi collected at tree line, annotated with information on habitat, host associations and distributions. Taxonomic problems and morphological features are also discussed where pertinent. Many of the species identified represent new records for Alberta or Canada.

Materials and Methods

Sporocarps were collected between 2,000 and 2,200 m asl on the southeast slope of Mt. Tripoli, in the Nikanassin Range, Alberta (117° 17'W, 52° 52'N) and between 2,300 and 2,500 m asl on the southwest slope of Mt. Rae, Peter Lougheed Provincial Park (114° 59'W, 50° 36'N)(Fig.1). Sites were approx. 10 ha and covered by equal areas of the three vegetation types: (1) subalpine forest, co-dominated by *Picea engelmannii* Parry and *Abies lasiocarpa* (Hook.) Nutt. (at least 100 years old, based on increment cores), with closed canopies and sparse understory vegetation, (2) krummholz (stunted) *Picea* and *Abies*, forming islands separated by areas dominated by ericaceous species and the ectomycorrhizal species, *Salix barrattiana* Hook., *S. glauca* L., *S. arctica* Pallas, *Dryas octopetala* L., *D. integrifolia* M.Vahl, *Polygonum viviparum* L. and *Kobresia myosuroides* (Vill.) Fiori and Paol., and (3) alpine vegetation, similar to krummholz zone but without conifers. Because Mt. Tripoli is located 350 km northwest of Mt. Rae, it receives more precipitation (see below) and has lower temperatures, and, as a result, has a lower (300 m) tree line. Other differences include the occurrence of *Betula glandulosum* Michx. between krummholz conifers on Mt. Tripoli and scattered *Larix lyallii* Parl. in the subalpine forest and krummholz zone on Mt. Rae.

Soils are Dystric and Eutric Brunisols and Orthic and Orthic Humic Regosols (Trottier 1972, Mortimer 1978). Average monthly snowfall reaches 28 cm in June and 47 cm in September. During July and August the ground is relatively snow-free, and mean daily temperatures range from 6 to 10° C. Mean monthly precipitation during this period averages 97 mm at Mt. Tripoli and 72 mm at Mt. Rae (Environment Canada, Archives of Climatological Data).

Sites were visited monthly between June and Sept. 1994-97. Sporocarps of all fungi in putatively ectomycorrhizal genera were collected. Corticioid fungi were found by rolling logs and sporocarps of the hypogeous taxa collected were partially erumpent. Representative collections are deposited in the University of Alberta Cryptogamic Herbarium (ALTA). Microscopic examinations were made under high magnification in H_20, Melzer's reagent or sulphovanillin where appropriate. To determine spore size, 20-30 mature spores were measured in H_2O under oil.

Only published accounts that include habitat (host) data or important

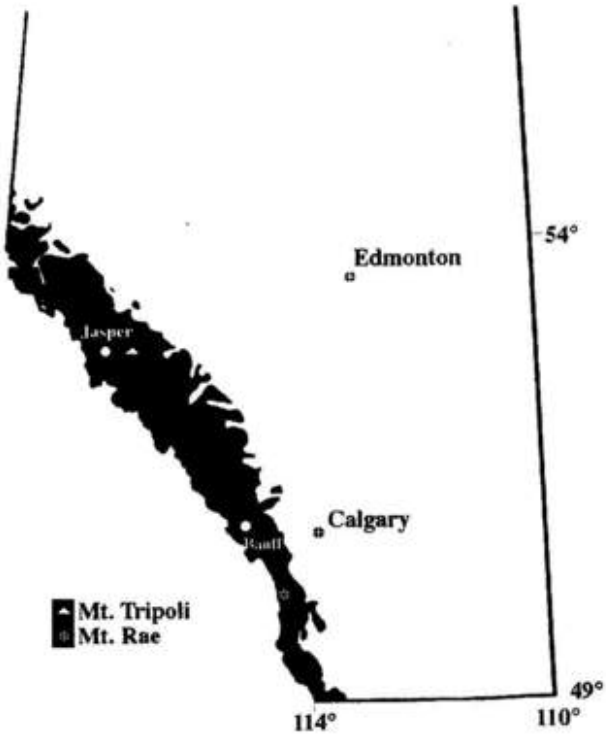

Figure 1. Map of southern Alberta showing locations of collecting sites. Darkened areas represent montane habitats.

information on distributions are included in annotations. Herbarium records and foray lists are not included. Salient characters are described for taxa when discrepancies exist in the literature. Determination of new records for Alberta and western Canada was based (in part) on Ginns and Lefebvre (1993) and databases of Canadian macrofungi compiled by S.A. Redhead (Redhead 1997, Redhead unpublished data).

Results

A total of 81 species in 29 genera and 13 families were documented. Twenty two species are new to Canada, 35 to western Canada, and 40 to Alberta. Two genera are new records for Alberta. Species richness decreased with elevation: 65 species in 28 genera were collected in the subalpine forest, 41 species in 17 genera in the krummholz zone and 14 species in seven genera in the alpine zone. Taxa identified from the krummholz zone fell into three major assemblages with respect to host associations (Table 1): (1) 20 conifer associates, many with circumboreal distributions, likely to form ectomycorrhizae with krummholz *Abies*, *Picea* and (or) *Larix*, (2) 7 angiosperm associates, many with circumpolar and alpine distributions, likely to form ectomycorrhizae with dwarf *Salix, Betula* or *Dryas* spp. and (3) 14 species with little host specificity which are likely to form mycorrhizae with both the angiosperms and gymnosperms present at tree line.

Table 1. Habitats and probable hosts of taxa collected. Hosts are determined from literature review and location of sporocarps. + = literature report of symbiosis, ? = possible association.

	Probable host(s)					
Fungal species	*Betula*	*Dryas*	*Salix*	*Abies*	*Larix*	*Picea*
Alpine only						
Inocybe lanuginella		+				
Tomentella sublilacina		+	?			
Alpine and krummholz						
Cortinarius albonigrellus			+			
C. favrei			+			
C. galerinoides			+			
C. inops		+	+			
Inocybe lacera	+		+	?		+
Krummholz only						
Amanita vaginata	+		+			
Cortinarius clandestinus				?		?
C. evernius	+		+	?		+
C. hinnuleus		+	+			
Hydnellum suaveolens				?		+
Inocybe whitei				?		+
Lactarius pubescens	+					
Russula brevipes	+	+		+		+
R. torulosa						+
Krummholz and forest						
Boletopsis subsquamosa						+
Catathelasma imperiale				+		+
Cortinarius delibutus	+		+	?		+
C. fulminoides						+
C. multiformis				+		+
C. triformis				?		+
Cortinarius sp.				?		?
Dermocybe crocea	+		+			+
Hygrophorus chrysodon						+
H. korhonenii						+
H. speciosus					+	
Inocybe flocculosa	+		+	?		+
I. rimosa		+	+	+	+	+
Lactarius caespitosus				+		
L. deliciosus				+	+	+
L. luculentus				?		?
Russula integra				+		?
R. silvicola				+		?
Sarcodon sp.				?		?
Suillus aeruginascens					+	
Tricholoma saponaceum				+		+
T. virgatum				?		+

Fungal species	Probable host(s)					
	Betula	*Dryas*	*Salix*	*Abies*	*Larix*	*Picea*
Forest only						
Albatrellus flettii				?		?
Camarophyllus pratensis				?		?
Cortinarius brunneus						+
C. calochrous				?		+
C. chrysomallus						+
C. colus				?		+
C. crassus				?		+
C. dilutus						+
C. glaucopus				?		+
C. muscigenus				+		+
C. orichalceus				+		+
C. paragaudis						+
C. percomis						+
C. scandens				+		+
C. traganus				?		+
C. uraceus				+		+
C. venetus						+
C. zinziberatus				?		+
Gomphidius largus						+
Hebeloma insigne				?		?
Hydnellum caeruleum						+
Hydnotrya cubispora				?		+
Hydnum repandum				?		+
Hygrophorus erubescens						+
H. pudorinus				+		+
H. pustulatus				+		+
Hysterangium separabile				?		?
Lactarius alnicola				?		+
Pseudotomentella tristis				?		?
Rhizopogon rubescens				+	+	+
Sarcodon scabrosus				?		+
Suillus cavipes					+	
Thaxterogaster pingue				+		+
Thelephora caryophyllea				?		+
Tricholoma myomyces				?		+
T. vaccinum						+
Alpine and forest						
Amphinema byssoides	?	+	+	+	?	+
Cenococcum geophilum	+	+	+	+	+	+
Laccaria montana	+		+	+		+
Hebeloma crustuliniforme	+	+	+	+		+
H. cf. subfastigiatum		?	?	?		?
Inocybe dulcamara	+	+	+	?		?
Tomentella ellisii	?	+	?	?	?	?

Discussion

Vegetation at the alpine-subalpine ecotone in the Canadian Rockies is a mosaic of gymnosperms and low growing angiosperms and combines species from the subalpine forest with those from the alpine zone. Obligately ectomycorrhizal host genera include *Abies, Larix, Picea, Salix, Dryas* and *Betula*, as well as *Kobresia* and *Polygonum* to a lesser extent. This is twice the number of common ectotrophic host genera of either of the adjacent habitats and is comparable to the number found at lower elevations in Alberta (see Moss 1983). Only at ecotones, however, do they occur together in close proximity.

As the specificity of ectomycorrhizal fungi often operates at the level of host genus (Molina and Trappe 1982), we might expect the community of ectomycorrhizal fungi at tree line to reflect vegetational patterns and exhibit greater richness than in the adjacent habitats. Although ectomycorrhizal fungi at the ecotone included both associates of subalpine gymnosperms and alpine angiosperms (Table 1), richness was not positively correlated with that of the host plants, but instead decreased steadily with elevation. This pattern is likely due to the rich subalpine community combining with the more depauperate alpine community to give an intermediate richness at the ecotone. This is in contrast to the subalpine and alpine plant communities, which are more similar to each other in species number, and combine to give the relatively high plant richness seen at the ecotone.

The overall decrease in ectomycorrhizal sporocarps across tree line fits the general trends of decreasing species diversity (Chapin and Körner 1995) and decreasing fructification (Gardes and Dahlberg 1996) with elevation. Comparisons of ectomycorrhizae across tree line reveal a similar pattern with increasing elevation (Kernaghan and Currah, unpublished data) Lower richness in the alpine zone may be due to less amenable climatic and edaphic factors, particularly soil temperature and moisture (Peredo *et al.* 1983, Vogt *et al.* 1992), less carbon production from dwarf vegetation (Newman 1988) and (or) fewer ectomycorrhizal symbioses with angiosperms than with gymnosperms (Richardson 1970, Bieri *et al.* 1992).

Of the species collected, approximately 86% are also known from Europe, while only 14% appear to be endemic to North America (i.e. not found in the European literature). If we delineate North American varieties, the percentages are 84 and 16, respectively. The amount of overlap varies considerably among genera, however, with *Lactarii* representing mainly North American taxa, and *Russula* representing mainly species with circumboreal distributions. Among the *Cortinarii* collected, only *C. clandestinus* (and possibly the unidentified *Cortinarius*) is endemic to North America. This is in contrast to the 50% similarity between European and North American *Cortinarius* species estimated by M. Moser (pers. comm. 1994).

It is possible that the lack of endemic species in genera such as *Russula* and *Cortinarius* is a reflection of the lack of North American monographic treatments of these genera, and that in time, more endemics will be delineated. It is also possible that with more years of collecting, more endemic species may have been encountered. Arnolds (1992) estimates that with monthly visits, 80% of macrofungi would be seen in four years and Richardson (1970) continued to see new species in the fifth year of intensive monitoring of small plots. Our results appear similar, with 13 taxa (16%) being collected for the first time during the fourth year. Four of these, however, were

either hypogeous, secotioid or resupinate, and may have been simply overlooked in previous years.

It seems more likely however, that the low level of endemism found during this study is due to the dominance of *Picea* and *Salix* as ectomycorrhizal hosts at tree line. The occurrence of these genera throughout the taiga and arcto-alpine zones allows for the circumboreal or circumpolar distribution of many of the fungi collected. At lower elevations or latitudes, e.g. coastal British Columbia, higher levels of vascular plant endemism are encountered (Pojar 1993). With less floristic similarity to European forests, we would expect these regions to exhibit less overlap in species of ectomycorrhizal fungi.

Species richness of ectomycorrhizal fungi was not higher at the alpine/subalpine ecotone as might have been expected on the basis of ectotrophic host genera richness. The documentation of ectomycorrhizal fungi from this zone has however, extended many distributional ranges and revealed many new associations.

Species collected

Ascomycota

Cenococcum geophilum Fr.: Fr., Syst. Mycol. III: 66. 1830.

Common throughout the northern hemisphere. Mycorrhizal with all Pinaceae, Betulaceae, Fagaceae and Salicaceae, and some species of Rosaceae, Myrtaceae and Tiliaceae (Trappe 1962, 1964). Distinctive sclerotia and ectomycorrhizae are formed, but its precise position within the Ascomycota is unknown (Lobuglio *et al.* 1996). **Material examined**: Collected repeatedly at both sites in all habitats (ALTA 10361).

Hydnotrya cubispora (Bessey & B. E. Thompson) Gilkey, Oregon State Monogr., Stud. Bot. 1: 23. 1939.

A widely distributed but uncommon North American conifer associate. Hypogeous under *Picea, Pinus, Pseudotsuga* and (or) *Tsuga* in northern and northwestern North America (Abbott and Currah 1997). Under *Tsuga, Abies, Betula* and *Acer* in Maine and Michigan (Bessey and Thompson 1920) and in the southeastern U.S. under *Tsuga* (Miller and Miller 1982). Also with introduced *Picea sitchensis* in the U.K. (Pegler *et al.* 1993). The genus *Hydnotrya* has not been reported previously from Alberta.

Material examined: Mt. Tripoli: 09 07 97 (ALTA 10373).

Basidiomycota

Amanitaceae

Amanita vaginata (Bull.:Fr.) Vittad., Tent. Mycol. Amanitarum Illustr. p. 30. 1826. *sensu lato*

A widespread and variable angiosperm associate. Common and widely distributed in North America and Europe in mixed coniferous and deciduous forests (Jenkins 1986), also well known from arctic (Lange 1955, Miller 1982, Petersen 1977) and alpine habitats (Favre 1955, Kühner and Lamoure 1986, Bas 1982), where it is associated with *Salix* and *Betula*. Many forms and varieties are recognized (see

Bas 1977), some of which are found with *Betula* near tree line (Lange and Skifte 1967, Gulden and Lange 1971, Jacobsson 1984, Watling 1987). Our material, collected near *Betula glandulosum*, *Salix barrattiana* and *Dryas octopetala*, has a fawn-coloured pileus drying to pale grey, up to 6 cm in diam., a white stipe up to 10 cm long and globose to subglobose spores, 8.7-12.0 x 8.7-12.6 μm, **Q** = 1.06.
Material examined: Mt. Tripoli: krummholz zone 08 05 94 (ALTA 10359); 08 30 97 (ALTA 10360). Devon, AB: S. Abbott 07 26 88 (UAMH 8576).

Boletaceae

Rhizopogon rubescens (Tul. & Tul.) Tul.& Tul., Giorn. Bot. Ital. 2: 58. 1844.

A common and widespread hypogeous conifer associate. Widely distributed in North America, usually the most common species of the genus in the north (Harrison and Smith 1968), also in Europe. Associated with Pinaceae, especially 2- and 3-needle pines (Miller 1986), but also with *Abies, Picea, Pseudotsuga, Tsuga* and *Quercus* (Molina and Trappe 1994). Ectomycorrhizae synthesized *in vitro* on *Pinus radiata, Pinus sylvestris* (Molina and Trappe 1994) and *Larix laricina* (Sampson and Fortin 1988). Although the spores of our material (7.0 - 9.9 x 3.0 - 3.7 (4.2)μm) are slightly smaller than those described by most authors, Smith and Zeller (1966) noted similar spores in some of their western collections.
Material examined: Mt. Rae: subalpine forest 07 21 94 (ALTA 10362); 07 25 95 (ALTA 10363); 09 29 95 (ALTA 10364); 08 16 97 (ALTA 10365). Smith Dorrian Valley, AB: 08 17 97 (ALTA 10366).

Suillus aeruginascens (Fr.) Snell, Lloydia 7: 25. 1944.

Circumboreal with *Larix* spp. Common in northern North America; Idaho, Michigan, New York, Oregon, and Québec with *L. laricina* and *L. occidentalis* (Pomerleau and Smith 1962), as well as Finland with *L. sibirica* (Heikkilä 1982) and the Austrian Alps with *L. decidua* (Moser 1982). Ectomycorrhizae have been synthesized on *Larix laricina* (Sampson and Fortin 1988) and *L. occidentalis*, *Pseudotsuga menziesii* and *Picea sitchensis* (Molina and Trappe 1982). Synonymous with *Fuscoboletinus aeruginascens* (see Kretzer *et al.*1996). Our material is the first report of this species with *Larix lyallii*.
Material examined: Mt. Rae: krummholz zone 08 4 95 (ALTA 10374); subalpine forest 08 04 95; 08 16 97 (ALTA 10375).

Suillus cavipes (Opat.) A. H. Sm. & Thiers, Contrib. Monogr. North Am. spec. *Suillus* 30. 1964.

Circumboreal, with *Larix* spp. Following the range of *L. laricina* and *L. occidentalis* (Smith and Thiers 1964, Thiers 1975) and with *L. sibirica* in Northern Finland (Heikkilä 1982) and *L. decidua* in the Alps (Moser 1982)(as *Boletinus cavipes*). This is the first report with *L. lyallii*.
Material examined: Mt. Rae: subalpine forest 08 16 97 (ALTA 10377).

Chaetoporellaceae

Amphinema byssoides (Pers.:Fr.) J. Erikss., Symb. Bot. Upsal. 16: 112. 1958.

Widely distributed in North America and Europe, fruiting on rotting wood of a

variety of angiosperms and gymnosperms (Eriksson and Ryvarden 1973, Ginns and Lefebvre 1993). Reported to form ectomycorrhizae with *Pinus strobus* (Fassi and De Vecchi 1962), *P. banksiana* Lamb. (Danielson 1984), *Picea glauca, P. pungens* (Danielson and Pruden 1989), *P. abies* (Weiss 1991) and *P. sitchensis* (Ingelby 1990), as well as with *Picea engelmannii*, *Abies lasiocarpa*, *Dryas octopetala* and *Salix* spp. (Kernaghan and Currah, unpublished data). Much of our material is from dead wood and prostrate branches of krummholz *Abies lasiocarpa*.
Material examined: Mt. Rae: alpine zone 09 19 97 (ALTA 10276); krummholz zone 08 16 95 (ALTA 10350). Mt. Tripoli: krummholz zone 08 05 94 (ALTA 10351); 08 05 94 (ALTA 10352); subalpine forest 08 30 97 (ALTA 10353).

Cortinariaceae

Cortinarius albonigrellus Favre, Rés. rech. sci. entr. Parc Nat. suisse, 5: 127. 1955. (subgenus *Telamonia*)

An arcto-alpine *Salix* associate. With dwarf alpine *Salix* in the Alps (Favre 1955, Lamoure 1977, Kühner and Lamoure 1986), Wyoming (Moser and McKnight 1987, Moser 1993), and the Greater Yellowstone Area (Moser *et al.* 1995b). Our material agrees with Horak's (1987) description of Favre's original material and with the description of Lamoure (1977). Pileus 1.5-2.0 cm, dark grey-black, glabrous. Stipe with persistent, peronate white veil; young lamellae and context pale yellow brown. Spores variable in size, 7.7-9.5 (11.0) x 4.0-5.6 μm, subcylindric to ellipsoid, finely verrucose, not all subcylindric as described by Horak (1987). Moser and McKnight (1987) describe *C. albonigrellus* from Wyoming with spores 8.8-12.3 x 5.3-7.0μm. Not previously reported from Canada.
Material examined: Mt. Rae: alpine zone 08 16 95 (ALTA 10138); krummholz zone 08 16 95 (ALTA 10139); 09 29 95 (ALTA 10140).

Cortinarius brunneus Fr., Epicr. Syst. Mycol., p. 298. 1838. (subgenus *Telamonia)*

With northern and coastal conifers and (rarely) with alpine vegetation. Known from central and northern Europe, in mixed boreal and montane coniferous forests, usually in oligotrophic *Picea* forests (Brandrud *et al.* 1992, Gulden *et al.* 1992, Arnold 1993). Also with subalpine *Betula* and *Salix* in northern Norway (Lange and Skifte 1967), *Pinus sylvestris* in northern Finland (Väre *et al.* 1996) and in the Austrian Alps up to timberline (Moser 1982). In North America, more common under conifers in the Pacific Northwest than elsewhere (Smith *et al.* 1979). In Washington, under second growth *Pseudotsuga menziesii* (Smith 1944) and in arctic tundra, northern Québec (Hutchison *et al.* 1988). Not previously reported from western Canada.
Material examined: Mt. Rae: subalpine forest 07 25 95 (ALTA 10145). Mt. Tripoli: subalpine forest 07 08 94 (ALTA 10146); 07 18 95 (ALTA 10147). Wildhay River AB: 08 06 95 (ALTA 10148).

Cortinarius calochrous (Pers.: Fr.) Fr., Epicr. Syst. Mycol., p. 267. 1838. subsp. *coniferarum* (M. M. Moser) Brandrud, Nord. J. Bot. **10**: 536. 1990. (subgenus *Phlegmacium*)

A circumboreal conifer associate. Known from European boreal and montane forests with *Abies*, *Picea* and (or) *Pinus* (Moser 1960, Brandrud *et al.*1990, 1994). In

North America, collections of *C. calochrous* in coniferous forests from Washington (Smith 1944, Stuntz 1981) are likely subsp. *coniferarum*. Also in the Greater Yellowstone Area (Moser *et al.* 1995b)(as *C. calochrous fo. caroli* Vel.) and the Canadian Rockies (Schalkwijk-Barendsen 1991). Mycorrhizae are described on *Picea engelmannii* (Kernaghan and Currah, unpublished data).

C. calochrous s.l. forms one of the most difficult taxonomic complexes in the subgenus *Phlegmacium* (Brandrud *et al.* 1990). Moser (1960) recognized var. *calochrous* from deciduous forests, var. *coniferarum* M. M. Moser (with larger spores) from coniferous forests and *fo. caroli* (also with larger spores and with violaceus stipe pigments), mainly from deciduous forests. Brandrud *et al.* (1992) elevated these varieties to subspecies and described subsp. *calochrous* from deciduous forests, subsp. *coniferarum* (M. M. Moser) Brandrud (with larger spores) from conifer forests, and varieties of each. Our material has consistently violaceus stipe apices and spores measuring 9.8-11.5 (13) x (5.6) 6-7 μm
Material examined: Mt. Rae: subalpine forest 08 16 95 (ALTA 10185). Mt. Tripoli: subalpine forest 08 04 95 (ALTA 10186); 08 15 95 (ALTA 10187).

Cortinarius chrysomallus Lamoure, Trav. Sci. Parc Nat. Vanoise 8: 135. 1977. (subgenus *Telamonia*)

An alpine *Salix* associate, also with subalpine *Picea*. Collected with dwarf alpine *Salix* in the Alps (Lamoure 1977, Kühner and Lamoure 1986, Senn-Irlet 1993, Bon 1992, Graf 1994), Sweden and Norway (Lamoure 1977). In Wyoming, Montana, California and Washington with shrubby and dwarf *Salix* and *Picea engelmannii* (Moser and McKnight 1987, Moser 1993, Moser *et al.* 1995b). Our material agrees well with the description of Lamoure (1977). Pileus up to 3.5 cm, red brown, glabrous. Stipe dingy greyish, booted with bright yellow universal veil remnants, which turn red in 5% KOH. Young lamellae pale grey-brown with mauve tones. Context with distinct mauve tint. Spores (7.4-8.8 x 4.1-5.6 μm) are slightly smaller than reported by Lamoure (1977), but those depicted by Moser and McKnight (1987) show similar variation among collections. *Cortinarius chrysomallus* appears to be a predominantly alpine species but it has been collected at lower elevations (Lamoure 1977) and near *Picea* (Moser and McKnight 1987). Our material was collected under *Picea engelmannii* and *Abies lasiocarpa*. Not previously reported from Canada.
Material examined: Mt.Tripoli: subalpine forest 08 04 95 (ALTA 10234). Jasper National Park: 07 15 95 (ALTA 10149).

Cortinarius clandestinus Kauffman, North American Flora 10: 324. 1932 (subgenus *Leprocybe*)

A North American conifer associate. Associated with *Tsuga* and *Pseudotsuga* in Washington (Kauffman 1932, Stuntz 1981), also in Colorado, Idaho, Oregon, Michigan and New York (Kauffman 1925, Kauffman and Smith 1933). *C. cotoneus* is well known from European deciduous forests (Høiland 1980, Brandrud *et al.* 1992) and is morphologically similar to *C. clandestinus* (Stuntz 1981, Arora 1986). Reports of *C. cotoneus* from coniferous forests in North America (e.g. Smith 1939, 1944, Phillips 1991) may be based on collections of *C. clandestinus*. Not previously reported from Canada.
Material examined: Mt. Rae: krummholz zone 08 16 97 (ALTA 10215).

Cortinarius colus Fr., Monographia, p. 102. 1851. (subgenus *Telamonia*)

A circumboreal *Picea* associate, also with *Pinus*. Associated with *Picea excelsa* in central Europe and Scandinavia (Moser 1965). Also in northern Finland, with *Pinus sylvestris* (Väre *et al.* 1996), and Germany, with conifers, especially *Picea* (Arnold 1993). Also collected in Washington (Smith 1944). Smith (1939) tentatively identified a *Telamonia* from northern California under *Abies* as *C. colus* (violet stipe apex and purple-red or vinaceous universal veil and spores 6-7 X 4-5 μm). Our material has a red brown, hygrophanous pileus, 2-4 cm in diam., pale grey-brown lamellae, greyish white stipe, 3-5 x 0.7-1.5 cm, white cortina and bright orange universal veil (purple in 5% KOH) forming persistent boot at stipe base. Spores (7.4) 7.8-9.0 x 4.7-5.8 μm. Not previously reported from Canada.

Material examined: Mt. Rae: subalpine forest 08 16 95 (ALTA 10150); 08 16 97 (ALTA 10151). Mt. Tripoli: subalpine forest 08 15 95 (ALTA 10152).

Cortinarius crassus Fr., Epicr. Syst. Mycol., p. 257. 1831. *sensu* A. H. Sm.. (subgenus *Phlegmacium*)

A montane conifer associate. Well known from European conifer forests up to montane elevations, especially with *Picea* (Moser 1960, Henry 1984, Brandrud *et al.* 1992, Gulden *et al.* 1992), but also with *Pinus* and *Betula* in Finnish Lapland (Kallio and Kankainen 1964). In North America it is found in northern conifer forests and not uncommon in the western mountains, especially at higher elevations (Smith 1939, 1944, Smith *et al.* 1979, Stuntz 1981, Arora 1986), but differs from European material in lacking filiform cheilocystidia (see Moser 1960). Not previously reported from Canada.

Material examined: Mt. Tripoli: subalpine forest 09 11 94 (ALTA 10179); 09 07 97 (ALTA 10180).

Cortinarius delibutus Fr., Epicr. Syst. Mycol., p. 276. 1838. (subgenus *Myxacium*)

Associated with angiosperms (especially *Betula*) at higher elevations and latitudes and with conifers elsewhere. In northern Europe, with subalpine *Betula* and *Fagus*, and at higher elevations with dwarf *Salix* and *Betula nana* (Lange and Skifte 1967, Gulden and Lange 1971, Jacobsson 1984, Brandrud *et al.* 1994), also with *Picea* (Gulden *et al.* 1992, Brandrud *et al.* 1994, Bieri 1995) and *Pinus* (Favre 1960). Also known from Britain with *Fagus* and *Betula* (Orton 1955). In North America, it is reported from New York, Nova Scotia and Ontario in mixed woods (Pomerleau 1980) and in the west from Colorado with montane conifers (Kauffman 1921, 1932) and in the Greater Yellowstone Area (Moser *et al.* 1995b). Also with *Salix* and *Betula* in Alaskan tundra (Ammirati and Laursen 1982) and in Greenland (Lange 1957). Ectomycorrhizae have been synthesized *in vitro* between *C. delibutus* and *Tsuga heterophylla* (Kropp and Trappe 1982).

Cortinarius griseoluridus Kauff. is a similar species, also associated with *Picea* and *Abies* in the Rocky Mountains (Smith *et al.* 1979). It differs from *C. delibutus* in having violaceus tones to the pileus and larger spores (8-10 x 6.5-8 μm) (Smith *et al.* 1979). The spores of our material measure 7.5-8.5 x 6.5-7.5 μm.

Material examined: Mt. Rae: subalpine forest 08 12 94 (ALTA 10199); 08 16 95 (ALTA 10200); 07 25 95 (ALTA 10201); 08 16 97 (ALTA 10202); 09 19 97 (ALTA 10203). Mt.Tripoli: krummholz zone 08 04 95 (ALTA 10204); 08 15 95 (ALTA

10205); subalpine forest 08 4 95 (ALTA 10206); 08 15 95 (ALTA 10207); 09 11 94 (ALTA 10208). Bruderheim, AB: E. Nagasawa 1982 (CFB 21211).

Cortinarius dilutus Fr., Epicr. Syst. Mycol. p. 305. 1838. (subgenus *Telamonia*)

A northern associate of *Picea*. In central Europe and throughout the Alps, primarily with *Picea* but also in mixed woods, especially in swampy areas (Moser 1984, Arnold 1993). Also in Fennoscandia, in coniferous or *Betula* forests (Hansen and Knudsen 1992). With montane conifers, Colorado, Washington, Oregon and Adirondaks (Kauffman 1921, 1932, Smith 1944) and with *Picea engelmannii* in the Greater Yellowstone area (Moser *et al.* 1995b). In Greenland with *Salix* (Lange 1957) (as *C. saturninus*) and Nova Scotia with *Picea* (Gourley 1983) or *Fagus* and *Abies* (Smith and Wehmeyer 1936) and *Picea* in northern Québec (Hutchison *et al.* 1988) (as *C. saturatus*). Synonymous with *C. saturatus* Lge. *fide* Moser (1984). Not previously reported from western Canada.

Material examined: Mt. Tripoli: subalpine forest 08 14 95 (ALTA 10153).

Cortinarius evernius (Fr.:Fr.) Fr., Epicr. Syst. Mycol., p. 294. 1838. (subgenus *Telamonia*)

Circumboreal, generally with *Picea* up to subalpine elevations, often in hygric areas. In central Europe with *Picea* (Gulden *et al.* 1992, Arnold 1993) and in Fennoscandia, with *Picea*, subalpine *Betula* or mixed *Picea* and *Fagus* (Brandrud *et al.* 1990, Kallio and Kankainen 1966, Moser 1967b). In northern U.S. and Canada with conifers in wet or mossy habitats, not common (Kauffman 1932, Smith *et al.* 1979). Reported from Washington with *Abies lasiocarpa, A. amabilis* and *Tsuga heterophylla* (Moser and Ammirati 1996). Not previously reported from western Canada.

Material examined: Mt. Rae: krummholz zone 09 29 95 (ALTA 10154); 09 19 97 (ALTA 10155).

Cortinarius favrei M. M. Moser ex Henderson, Notes Roy. Bot. Gard. Edinb., 22: 593. 1958. (subgenus *Myxacium*)

A circumpolar and alpine *Salix* associate. With dwarf alpine *Salix* spp. in Norway (including Svalbard) (Ohenoja 1971, Gulden *et al.* 1985, Gulden and Lange 1971), the Alps (Favre 1955, Senn-Irlet 1988, 1993, Graf 1994, Kühner and Lamoure 1986), Scotland (Watling 1987) and Greenland (Petersen 1977). Also reported with *Betula* in Swedish alpine heaths (Jacobsson 1984). With dwarf alpine *Salix* in North America; Wyoming (Moser and McKnight 1987, Moser 1993), Alaska (Kobayashi *et al.* 1967, Ammirati and Laursen 1982), and the Greater Yellowstone Area (Moser *et al.* 1995b). Synonymous with *C. alpinus* Boud. *fide* Ohenoja (1971). Not previously reported from Canada.

Material examined: Mt. Tripoli: alpine zone 09 07 97 (ALTA 10209); krummholz zone 08 15 95 (ALTA 10210); 09 11 95 (ALTA 10211).

Cortinarius fulminoides (M. M. Moser) M. M. Moser, in Gams, Kleine Kryptogamenflora, II, b/2, Basidiomyceten II, Ed. 3, p. 284. 1967. (subgenus *Phlegmacium*)

A montane *Picea* associate. Reported from the Austrian Alps with *Picea*

excelsa (Moser 1960). Our material fits Moser's (1960) description closely. Pileus fulvus-orange, up to 8 cm in diam., slightly fibrillose towards margin, spotting green, reddening in 5% KOH. Young lamellae pallid grey brown. Cortina white, scant. Stipe white, up to 5 x 2 cm., with a bulbous base. Context thick, yellowish, localized areas becoming green. Spores amygdaliform (7.6) 8.0-9.0 x 5-5.5 (5.9) μm. The context of our material did not become orange-brown in KOH as in Moser's description. A previous Canadian report by Currah *et al.* (1989) is based on misidentified material (UAMH M0457, M0487).
Material examined: Mt. Tripoli: krummholz zone 09 11 94 (ALTA 10181); subalpine forest 09 11 94 (ALTA 10182).

Cortinarius galerinoides Lamoure, Trav. Sci. Parc Nat. Vanoise, 8: 133. 1977. (subgenus *Telamonia*)

A circumpolar and alpine *Salix* associate. Reported from the French Alps (Kühner and Lamoure 1986, Lamoure 1977) with dwarf alpine *Salix* and from Wyoming with shrubby alpine *Salix* (Moser 1993). Our material fits the description of Moser (1993). Sporocarps resembling *Galerina* in habit, pileus up to 1.2 cm, red brown, hygrophanous, black in 5% KOH. Stipe more or less concolorous with pileus. Lamellae rust brown. Cortina white, very scant. Spores ellipsoid (7.0) 7.6-10.3 x (4.2) 4.6-5.5 (5.9) μm. Not previously reported from Canada.
Material examined: Mt. Tripoli: alpine zone 08 15 95 (ALTA 10156); krummholz zone 08 15 95 (ALTA 10157).

Cortinarius glaucopus Fr., Epicr. Syst. Mycol., p. 264. 1838. (subgenus *Phlegmacium*)

A common conifer associate. Throughout Europe with *Picea* and *Pinus* up to 1900 m (Moser 1960), rarely in deciduous woods (Brandrud *et al.* 1994). In Britain with conifers (Orton 1955) and in the eastern United States with deciduous trees (Kauffman 1932). In western North America it is one of the most common *Cortinarii* along the coast (Smith 1939, Stuntz 1981), often in large troops under *Pseudotsuga menziesii* (Smith 1939) or *Abies* and *Picea* (Smith *et al.* 1979). Also with *Picea* in the Rockies (Arora 1986, Currah *et al.* 1989). Moser (1960) recognized *C. glaucopus* var. *acyaneum* M. M. Moser, which lacks blue pigments, and var. *olivaceum* M. M. Moser, with strong green tones towards the centre of the pileus. Smith (1939) reported a green form from California as did Stuntz (1981) from the Pacific Northwest. Our material corresponds to the typical variety, lacking green tones.
Material examined: Mt. Tripoli: 08 30 97 (ALTA 10183); 09 07 97 (ALTA 10184).

Cortinarius hinnuleus (Sowerby: Fr.) Fr., Epicr. Syst. Mycol., p. 296. 1838. var. *favreanus* Bon, Doc. Mycol. 22: 52. 1992. (subgenus *Telamonia*)

Circumpolar and alpine. *Cortinarius hinnuleus s.l.* is common in Europe (Brandrud *et al.* 1990, Arnold 1993) and North America (Kauffman 1932, Pomerleau 1980) with woody angiosperms including *Quercus, Betula* and *Fagus* as well as with conifers. *Cortinarius hinnuleus* var. *favreanus* is a circumpolar and alpine associate of *Salix* and *Dryas*, known from the Swiss and French Alps with dwarf *Salix* or *Dryas* (Favre 1955, Kühner and Lamoure 1986, Lamoure 1977, Senn-Irlet 1988), Greenland with *Salix* (Lange 1957) and Wyoming with alpine *Salix* (Moser 1993). Our material

agrees well with the description of Moser (1993). Pileus hygrophanous to yellow-brown, up to 3.5 cm in diam., lamellae subdistant, pale ochre, stipe yellow brown, partial veil whitish to pale ochre, spores 8.3-9.7 (-10.4) x (4.8) 5.2-6.4 μm, smell slightly earthy, gregarious with *Salix* spp. Synonymous with *C. hinnuleus* var. *gracilis* R. Maire *fide* Moser (1993). Not previously reported from Canada.
Material examined: Mt. Rae: krummholz zone 07 25 95 (ALTA 10158); 08 16 95 (ALTA 10159); 07 08 94 (ALTA 10160).

Cortinarius inops Favre, Rés. rech. sci. entr. Parc Nat. suisse 5: 136. 1955. *sensu* Møller. (subgenus *Telamonia*)

Circumpolar and alpine. With dwarf alpine *Salix* or *Dryas*; in the Swiss, French and Italian Alps (Kühner and Lamoure 1986, Lamoure 1978, Favre 1955), Scandinavia (Lamoure 1978, Hansen and Knudsen 1992), Faeröe islands (Möller 1945), Greenland (Lange 1957), Iceland (Larsen 1932), Wyoming (Moser 1993) and the Greater Yellowstone Area (Moser *et al.* 1995b). Our material agrees well with Möller's (1945) description (as *C. pusillus*). Pileus up to 2 cm in diam., convex with an involute margin and prominent umbo, dark brown, radially fibrillose, hygrophanous, sometimes splitting to reveal pallid context. Lamellae ochre to cinnamon. Stipe up to 2.5 cm long, hollow, ochre-brown and covered with white fibrils, sometimes with a pinkish cast or pinkish basal hyphae. Spores 6.8-9.0 x 5.0-6.5 μm, broadly elliptic to ovoid, coarsely verrucose. The purple-blue tints described by Möller (1945) were not observed. Although short clavate cheilocystidia are described by Favre (1955), Lamoure (1977) and Moser (1993), the sterile cells along the edge of the lamellae in our material are more or less undifferentiated, as described by Möller (1945). Synonymous with *C. pusillus fide* Moser (1993). Not previously reported in Canada.
Material examined: Mt. Rae: alpine zone 07 25 95 (ALTA 10161). Mt. Tripoli: krummholz zone 07 8 94 (ALTA 10162); 07 18 95 (ALTA 10163).

Cortinarius multiformis (Fr.) Fr., Epicr. Syst. Mycol., p. 263. 1838. var. *coniferarum* (M. M. Moser) Nezdoimïnogo, Shlyapochnye Griby SSSR Rod *Cortinarius* Fr.: 39. 1983. (subgenus *Phlegmacium*)

Circumboreal. *C. multiformis s.l.* occurs in Europe throughout the range of *Picea* (Brandrud *et al.* 1990), also with *Betula*, *Salix* and *Pinus* in Finnish Lapland (Kallio and Kankainen 1966) and Greenland with *Salix* (Lange 1957). Also common and widely distributed under conifers, in the Rocky Mountains, northern U.S. and Canada (Kauffman 1932, Smith *et al.* 1979); under *Abies* in Washington (Smith 1939) and *Picea* and *Pinus* in the Canadian Rockies (Schalkwijk 1991). Moser (1960) recognized *C. multiformis* var. *coniferarum* (as *Phlegmacium multiforme* var. *coniferarum*), with *Picea excelsa* and *Pinus,* up to subalpine elevations in Germany, and var. *multiformis* with *Fagus* throughout Europe, with the exception of the Alps. He also refers to material from the Greater Yellowstone Area as *C. multiformis* var. *coniferarum* (Moser *et al.* 1995b). Our material fits the descriptions of Moser (1960) and Smith *et al.* (1979).
Material examined: Mt. Rae: krummholz zone 09 19 97 (ALTA 10189); subalpine forest 08 16 97 (ALTA 10190); 09 19 97 (ALTA 10191). Mt. Tripoli: subalpine forest 08 15 95 (ALTA 10192).

Cortinarius muscigenus Peck, Ann. Rep. N.Y. State Mus. 41: 71. 1888. (subgenus *Myxacium*)

A circumboreal conifer associate. Known from northern Europe in nutrient-poor *Picea* forests (Brandrud *et al.* 1990, Hansen and Knudsen 1992). Also in coniferous forests in New York, New England and New Jersey (Kauffman 1932) and Washington (Smith 1944). Under *Abies*, New York (Smith *et al.* 1979). Synonymous with *C. cylindripes* Kauffman *fide* Bendiksen *et al.* (1992). *C. muscigenus* may also be conspecific with *C. collinitus* Fr. (Bendiksen *et al.* 1992, Brandrud *et al.* 1990), but nomenclatural problems make the interpretation of *C. collinitus* difficult. Not previously reported from Canada.

Material examined: Mt. Rae: subalpine forest 08 16 97 (ALTA 10212); 09 19 97 (ALTA 10213). Smith Dorrian Valley, Kananaskis: 08 17 97 (ALTA 10214).

Cortinarius orichalceus Fr., Epicr. Syst. Mycol., p. 267. 1838. var. *olympianus* A. H. Smith, Lloydia 7: 184. 1944. (subgenus *Phlegmacium*)

A montane conifer associate. *C. orichalceus s.l.* is associated with *Picea excelsa* in Europe (Moser 1960), in mountainous areas of Britain with conifers or *Fagus* (Orton 1955), in western North American mountains with *Picea engelmannii* and *Abies lasiocarpa* (Kauffman 1921, 1932, Smith 1939, 1944), and in Nova Scotia (Gourley 1983). Known from the Greater Yellowstone Area (Moser *et al.* 1995b). Smith (1944) recognized var. *olympianus* A. H. Smith and var. *xanthocephalus* A. H. Smith from Washington.

Our material has a brick red-brown pileus with a greenish margin. Gills at first yellow green, quickly turning blue after collection. Stipe white with green tones and a reddening, marginate base. Context white with blue, then green, suffusing pigments. Cortina white. In one collection (ALTA 10193), green pigment suffused throughout the sporocarps (including gills and cortina) after collection. Sporocarps drying purple. All parts, including pileus, greenish-yellow in 5% KOH. Spores amygdaliform to citriniform, 9.7-11.6 x 5.5-7.0 (-7.4) μm. This seems closest to var. *olympianus* A. H. Smith, which is also the variety collected in Colorado by Kauffman (Smith 1944). *C. orichalceus s.l.* has not been reported previously in western Canada.

Material examined: Mt. Rae: subalpine forest 09 16 95 (ALTA 10193); 09 19 97 (ALTA 10194). North Kananaskis Pass, AB: 09 21 97 (ALTA 10195).

Cortinarius paragaudis Fr., Monographia, p. 79. 1851. subsp. *oenochelis* Lindstr., *Cortin.*, Fl. Photogr. 2: 33. 1992. (subgenus *Telamonia*)

A northern *Picea* and *Pinus* associate. *C. paragaudis s.l.* is known from northern Finland with *Pinus sylvestris* (Väre *et al.* 1996), Sweden, mainly with *Picea* (Soop 1990) but also *Pinus* (Brandrud *et al.* 1990, Soop 1993), Norway in oligotrophic *Picea* forests (Gulden *et al.* 1992), alpine Scandinavia with *Picea excelsa* and (or) *Pinus sylvestris* (Moser 1965) and in the Pacific Northwest and Rocky Mountains (J. Ammirati pers. com. 1998). Moser (1965) separated *C. paragaudis* from the closely related *C. haematochalis* (Bull.: Fr.) Fr. in central Europe and Scandinavia mainly on the basis of spore size and shape. Brandrud *et al.* (1992) further separated *C. paragaudis* from Swedish spruce forests into subsp. *paragaudis* from lowland Sweden, and subsp. *oenochelis* Linst. from northern montane Sweden, with larger spores. Our material fits the descriptions of subsp. *oenochelis* of Soop

(1990) and Brandrud *et al.* (1992). Pileus dark red brown, convex, then almost plane with a low umbo and involute margin, up to 6.0 cm in diam., slightly hygrophanous. Lamellae pale grey-brown. Stipe clavate, up to 7 cm long, tapering towards a base of up to 1.5 cm. Universal veil forming greyish-pink belts on stipe, which turn purple in 5% KOH (see Soop 1992). Cortina white. Spores (8.2) 8.8-9.6 (10.0) x 5.7-7.0 μm, Q= 1.25-1.76, **Q**=1.44. *C. paragaudis s.l.* has not previously been reported from Canada.

Material examined: Mt. Tripoli: subalpine forest 08 04 95 (ALTA 10164); 08 15 95 (ALTA 10165). Wildhay River AB: 08 06 95 (ALTA 10166).

Cortinarius percomis Fr., Epicr. Syst. Mycol., p. 260. 1838. (subgenus *Phlegmacium*)

A *Picea* associate. In central and northern Europe, in mixed, boreal and montane conifer forests, mainly with *Picea* on calcareous soils (Moser 1960, 1983, Brandrud *et al.* 1994). In Washington and Colorado, in montane *Picea*, *Abies* and *Tsuga* forests (Kauffman 1921, 1932) and Oregon and California under *Picea* (Smith 1939). Associated with *Picea abies* (Trappe 1962). Not previously reported from Canada.

Material examined: Mt. Rae: subalpine forest 09 29 95 (ALTA 10196); 09 19 97 (ALTA 10197). Mt Tripoli: 09 07 97 (ALTA 10198).

Cortinarius scandens Fr., Epicr. Syst. Mycol., p. 312. 1838. *sensu* M. M. Moser. (subgenus *Telamonia*)

A widespread generalist. Found in damp coniferous woods and alder bogs in Europe (Moser 1983), with *Picea* or other conifers in California and Washington (Smith 1939, 1944), montane conifers in Colorado (Kauffmann 1921) and in deciduous and coniferous woods from New York (Adirondaks) to Michigan (Kauffman 1932). Associated with *Pinus sylvestris* or *Salix glauca* (Trappe 1962). Arnold (1993) considers *C. obtusus* Fr. a synonym. *C. obtusus* is widely distributed and has a broad host range (Molina *et al.* 1992); found in northern and central Europe under *Picea*, *Pinus, Fagus, Salix* and *Betula* into the alpine zone (Brandrud *et al.* 1994, Gulden *et al.* 1992, Moser 1982, Scherfose 1990), but especially with *Picea* (Arnold 1993). Also with *Salix* in the U.K. (Watling 1981) and Greenland (Lange 1957, Petersen 1977). In Alaska with *Salix* and *Betula nana* (Ammirati and Laursen 1982)(as *C.* aff. *obtusus*) and in the Greater Yellowstone Area (Moser *et al.* 1995b). Smith (1939) recognized *C. obtusus* under *Pinus* and *C. scandens* under *Picea* in California. The ectomycorrhizae of *C. obtusus* have been described on *Picea abies* (Agerer 1987a).

C. scandens has been separated from *C. obtusus* by smaller spores and less robust habit (Moser 1983). Arnold (1993) gives a spore size of (6.5) 8-10 x 5-6 μm for *C. obtusus* Fr. (= *C. scandens* Fr.). Spore size in our material is (6.3) 6.8-7.4 (8.4) x (4.4) 5.0-5.6 μm, and is therefore closer to *C. scandens* described by Kauffman (1932), Moser (1983) and Dähnke (1993). Not previously reported from western Canada.

Material examined: Mt. Tripoli: subalpine forest 08 04 95 (ALTA 10167). Mt. Rae: 09 19 97 (ALTA 10168).

Cortinarius traganus (Fr.:Fr) Fr., Epicr. Syst. Mycol., p. 281. 1838. (subgenus *Sereciocybe*)

A common conifer associate. Frequent and widespread in European coniferous forests under both *Picea* and *Pinus* (Brandrud *et al.* 1994), Norway with *Picea abies* (Gulden *et al.* 1992) and northern Finland with *Pinus sylvestris* (Väre *et al.* 1996). Not uncommon in old growth conifer forests in the Pacific Northwest (Smith *et al.* 1979) and frequent under *Abies* and *Picea* in Nova Scotia (Smith and Wehmeyer 1936). Also known from mixed conifer-deciduous forests (Ammirati *et al.* 1995)
Material examined: Mt. Rae: subalpine forest 08 16 97 (ALTA 10224); 09 19 97 (ALTA 10225).

Cortinarius triformis Fr., Hymen. Eur., p. 382. 1874. (subgenus *Telamonia*)

Associated with conifers, especially *Picea*. In central and northern Europe with *Picea* (Hansen and Knudsen 1992, Arnold 1993); to tree line in the Austrian Alps with *Picea*, *Pinus,* and *Larix* (Moser 1982). Also in California with *Quercus* (Arora 1986), in the Greater Yellowstone Area (Moser *et al.* 1995b) and in the Rocky Mountain Foothills with *Picea* (Currah *et al.* 1989). Arnold (1993) proposes moving conifer-associated material to *C. fusco-pallens* (Fr.) N. Arnold, and reserving the name *C. triformis* Fr. for deciduous forest material, although they are morphologically similar. Our material agrees well with Arnold's (1993) description of *C. fusco-pallens*, but the epithet *triformis* has been retained until we have a better understanding of North American *Telamonia*. Pileus 2.5-6.0 cm in diam., dark red brown, strongly hygrophanous, often with a fatty texture. Lamellae pale grey-brown. Stipe whitish with a bulbous base. Universal veil white, forming a thin, peronate sheath on the stipe. Context dingy white to pale brown. Spores ellipsoid, 8.0-9.5 x (5.0) 5.4-6.3 μm. Sporocarps often caespitose. The faint blue tint at stipe apex described by Arnold (1993) was not noted. Not previously reported from Canada.
Material examined: Mt. Rae: krummholz zone 08 16 95 (ALTA 10169); 09 29 95 (ALTA 10170); 08 16 97 (ALTA 10171); subalpine forest 09 14 96 (ALTA 10172). Mt. Tripoli: subalpine forest 08 4 95 (ALTA 10173); 08 15 95 (ALTA 10174); 08 16 97 (ALTA 10175); 09 07 97 (ALTA 10176). Rocky-Clearwater Forest AB: S. Abbott, 08 20 87 (UAMH M0487).

Cortinarius uraceus Fr., Epicr. Syst. Mycol., p. 309. 1838. (Subgenus *Telamonia*)

A northern conifer associate. Widespread in European coniferous and mixed woods, often with *Picea*, also *Abies*, *Quercus,* and *Fagus* (Arnold 1993, Brandrud *et al.* 1994) or *Pinus* (Kallio and Kankainen 1966, Arnolds *et al.* 1995). Found near timberline in the Austrian (Moser 1982) and Swiss Alps with *Picea* (Favre 1960). Also with montane conifers in Colorado and the Adirondacks (Kauffman 1921, 1932), Washington (Smith 1944) and the Greater Yellowstone Area (Moser *et al.* 1995b). Also in Wyoming, with alpine *Salix* and *Picea engelmannii* (Moser and McKnight 1987) and boreal (Hutchison *et al.* 1988) and southern Québec (Pomerleau 1980). Not previously reported from western Canada.
Material examined: Mt. Tripoli: subalpine forest 08 15 95 (ALTA 10177). Mt. Rae: subalpine forest 08 16 95 (ALTA 10178).

Cortinarius venetus (Fr.) Fr., Hymen. Eur., p. 374. 1874. var. *montanus* M. M. Moser, Zeitschr. F. Pilzk. 36: 43. 1970. (subgenus *Leprocybe*)

A *Picea* associate, normally in montane to subalpine habitats (Moser 1983). Associated with *Picea* in the Alps (Moser 1970), Fennoscandia (Høiland 1980, Hansen and Knudsen 1992) and the Netherlands (Arnolds *et al.* 1995). Also in the Greater Yellowstone Area (Moser *et al.* 1995b). *C. venetus* var. *montanus* differs from var. *venetus* in its association with *Fagus,* and in having a darker green pileus (Moser 1970). Our material has bright yellow fluorescence under UV (especially the stipe base), small clavate cheilocystidia and subglobose spores [5.5-7.5 x 4.5-6.0 (6.5) μm, **Q** = 1.20]. Ectomycorrhizae are described on *Picea abies* by Agerer (1987b). Not previously reported from Canada.

Material examined: Mt. Tripoli: subalpine forest 07 25 95 (ALTA 10216); 09 07 97 (ALTA 10217).

Cortinarius zinziberatus (Fr.) Fr., Hymen. Eur., p. 392. 1874. (subgenus *Leprocybe*)

A montane conifer associate. Known from central Europe and the Italian Alps in montane and subalpine forests with *Picea* or with *Fagus* (Moser 1969) and Fennoscandia with *Picea*, fruiting early in the season (Høiland 1980, Hansen and Knudsen 1992). Known from the Greater Yellowstone Area (Moser *et al.* 1995b). *Cortinarius ahsii* McKnight, found with conifers in the central Rockies, is likely *C. zinziberatus* (J. Ammirati pers. comm.1997). Our material fits the descriptions of Moser (1969) and McKnight (1975). Pileus yellow-brown, 2-5 cm in diam. Stipe pale brown, up to 6 cm. Lamellae ± concolorous with pileus. Cortina greenish-yellow becoming orange-red in 5% KOH. Spores ellipsoid to amygdaliform, 6.5-9.5 x 4.5-5.5 μm. Tissue of all collections fluorescing bright greenish-yellow in UV (especially velar tissue, stipe base and basal hyphae). Fruiting soon after snow melt. The violet tint to the young gills and stipe base as described in Høiland (1980) was not observed. Not previously reported from Canada.

Material examined: Mt. Tripoli: subalpine forest 07 18 95 (ALTA 10218); 08 04 95 (ALTA 10219); 09 07 97 (ALTA 10220). Mt. Rae: subalpine forest 07 25 95 (ALTA 10221); 08 16 95 (ALTA 10222); 07 27 96 (ALTA 10223).

***Cortinarius* sp.** (subgenus *Sericeocybe*)

Pileus up to 4 cm in diam., pallid cream to off-white, drying to pale tan, convex, glabrous with faint pale tan fibrils toward margin, merely darkening in 5% KOH. Lamellae pallid tan to dingy white. Stipe up to 6 x 2 cm with base enlarged up to 3 cm, concolorous with pileus. Context whitish, no reaction in 5% KOH. Universal veil white, heavy, forming a boot at stipe base. Cortina white. Spores amygdaliform, strongly verrucose, especially at apex, 9.1-10.8 x 5.7-6.8 μm. This *Cortinarius* seems best placed in the subgenus *Sericeocybe* Orton, based on pileus texture, pallid colours and KOH reaction of the pileipellis. It seems close to *C. traganus,* but has larger spores and lacks the violet colours and unpleasant odour.

Moser (in Singer 1986) states that members of the subgenus *Sericeocybe* may be eventually placed into either *Phlegmacium* or *Telamonia*, and Brandrud *et al.* (1990-94) already treat *Sericeocybe* as a section of *Telamonia*. Once the subgeneric classification of *Cortinarius* has stabilized, this species may be best placed in *Telamonia*.

Material examined: Mt. Rae: subalpine forest 08 16 95 (ALTA 10226); 08 15 97 (ALTA 10227); krummholz zone 08 16 95 (ALTA 10228).

Dermocybe crocea (Schaeff.:Fr.) M. M. Moser, Schweiz. Z. Pilzk. 52: 98. 1974. *sensu lato.*

Circumpolar, with conifers or arcto-alpine vegetation. Common in Fennoscandia with lowland and boreal *Picea* and *Pinus* and in low and middle arctic regions with *Betula nana* (Høiland 1984, Brandrud *et al.* 1992, Väre *et al.* 1996). Also in Iceland (Lange 1955)(as *Cortinarius cinnamomeus*), the Faeröes (Møller 1945)(as *C. malicorius* according to Høiland 1984), Scotland with montane vegetation (Watling 1987), the Swiss Alps with dwarf alpine *Salix* (Graf 1994), and the Rocky Mountain Foothills, with *Pinus contorta* and *Picea glauca* (Currah *et al.* 1989). Mycorrhizae have been described on *Pinus sylvestris* by Uhl and Agerer (1987).

Our material [spores 6.4-9.1 x 4.2-5.6 (6.4) μm] agrees well with the concept of Høiland (1984), but Moser (1974) describes smaller sporocarps and smaller spores. North American material appears to constitute an unresolved complex which includes *Dermocybe incognitis* Ammirati and A. H. Sm. and its western variants (J. Ammirati pers. comm. 1997).

Material examined: Mt. Rae: krummholz zone 08 16 95 (ALTA 10229); 07 25 95 (ALTA 10230); subalpine forest 08 16 97 (ALTA 10231). Mt. Tripoli: subalpine forest 08 04 95 (ALTA 10232); 08 15 95 (ALTA 10233). Rocky Clearwater Forest AB: R. Currah 08 6 86 (UAMH M0131); S. Abbott 08 20 87 (UAMH M0493); 09 02 87 (UAMH M0497).

Hebeloma crustuliniforme (Bull.) Quél., Flor. mycol. Fr., p. 92. 1888. *sensu lato.*

Cosmopolitan and common with a wide range of coniferous and angiosperm hosts. Often associated with *Corylus* and *Fraxinus* in Europe (Hacskaylo and Bruchet 1972, Bruchet 1970). Ectomycorrhizae have been described on *Abies* (Acsai and Largent 1983) and synthesized *in vitro* on *Picea abies* (Brunner *et al.* 1991), *Pinus virginiana* (Hacskaylo and Bruchet 1972) and *Populus tremuloides* (Godbout and Fortin 1985). *H. crustuliniforme* is a highly variable and poorly understood taxon.

Material examined: Mt. Tripoli: alpine zone 09 07 97 (ALTA 10279); krummholz zone 09 11 94 (ALTA 10280); 09 07 97 (ALTA 10281). Mt. Rae: subalpine forest 08 16 97 (ALTA 10282); 09 19 97 (ALTA 10283).

Hebeloma insigne A. H. Sm., V. S. Evenson & D. H., Veiled species of *Hebeloma* in western U.S., p 132. 1983.

A montane conifer associate. In *Picea, Abies* and *Pinus* forests in Colorado (Smith *et al.* 1983) and under conifers and *Populus* in Colorado and New Mexico (Arora 1986). *H. insigne* is similar in appearance to *H. sinapizans* (Paul.: Fr.) Gillet, but can be distinguished by dextrinoid spores, vinaceous brown pileus and positive $FeSO_4$ reaction on stipe base (Smith *et al.* 1983). Not previously reported from Canada.

Material examined: Mt. Tripoli: subalpine forest 08 15 95 (ALTA 10284).

Hebeloma cf. subfastigiatum A. H. Sm., V. S. Evenson & D. H. Mitchel, Veiled species of *Hebeloma* in western U.S., p 180. 1983.

Pileus up to 3 cm in diam., red-brown, fading to pale tan, convex, glabrous except for faint brown veil remnants on margin, no reaction in 5% KOH. Lamellae ± concolorous with pileus. Stipe up to 4 x 0.5 cm, fibrous, yellow-brown, with brown velar remains toward the apex, base green in $FeSO_4$. Context buff, taste and smell raphinaceous. Cortina brownish. Spores inequilateral, slightly roughened, slowly dextrinoid, 9.7-12.4 (13) x (5.1) 5.8-7.1 (8.2) μm, Cheilocystidia abundant, fusoid-ventricose to lageniform, some with extended necks (40-75 x 5.5-7.0 μm, up to 12 μm at base), similar to those of *H. fastibile* (Pers.:Fr.) Kumm. Although Smith *et al.* (1983) describe many *Picea*-specific veiled *Hebelomas* from high elevation western forests, our material seems closest to *H. subfastigiatum*, described from a recently burned-over hardwood forest in Michigan.
Material examined: Mt. Rae: subalpine forest 08 16 95 (ALTA 10285); 08 14 95 (ALTA 10286); Mt. Tripoli: alpine zone 09 07 97 (ALTA 10287).

Inocybe dulcamara (Alb.& Schwein.) Kumm., Führ. Pilzk., p 79. 1871. *sensu lato.*

Widespread and common in arctic and alpine habitats, generally with dwarf *Salix* and *Dryas*, or with *Betula* or *Populus* at lower elevations or latitudes. Reported from the French, Swiss and Austrian Alps (Favre 1955, Horak 1960, Senn-Irlet 1988, 1993), Fennoscandia (Lange and Skifte 1967, Jacobsson 1984), the Netherlands (Arnolds *et al.* 1995), Greenland (Petersen 1977), the Faeröes (Möller 1945) Iceland (Larsen 1932), Scotland (Watling 1981, 1987), Washington with subalpine *Abies* and *Pinus* (Stuntz 1947), California (Nishida 1989) and in Canada in arcto-alpine or boreal habitats (Malloch 1973, Miller 1987, Hutchison *et al.* 1988). Favre (1955) recognized six forms of *I. dulcamara,* which should be regarded as a species complex. Our material fits the description of Malloch (1973). Pileus up to 4.5 cm in diam., ochraceous, finely fibrillose. Stipe up to 4 cm, concolorous with pileus or paler, pruinose at apex, becoming hollow, without an abrupt bulb but base may be slightly enlarged. Cortina whitish. Lamellae ochraceous, yellow marginate. Context dingy buff, without distinctive smell. Spores smooth, phaseoliform to broadly ellipsoid, (8.0) 9.0-10.8 x 5.0-6.7 μm. Cheilocystidia numerous, clavate to pyriform, 15-30 x 8-20 μm. Pleurocystidia absent.
Material examined: Mt. Rae: krummholz zone 08 16 95 (ALTA 10288). Mt. Tripoli: alpine zone 08 04 95 (ALTA 10311); krummholz zone 08 04 95 (ALTA 10312); subalpine forest 09 11 94 (ALTA 10313); 08 15 95 (ALTA 10314); 08 30 97 (ALTA 10315); 09 07 97 (ALTA 10316).

Inocybe flocculosa (Berk.) Sacc., Syll. Fung. 5: 768. 1887.

A cosmopolitan generalist. Widespread in Europe and North America, associated with *Betula, Salix, Populus, Alnus, Quercus, Fagus, Picea* and *Pinus* (Kuyper 1986). Known from the Swiss Alps, with dwarf alpine *Salix* (Favre 1955), and from Greenland with *Betula*. Also with conifers in California (Nishida 1989) and in subalpine forests of mixed *Picea, Abies* and *Pinus* in Washington (Stuntz 1947) and Colorado (Kauffman 1921). Also reported from arctic Canada (Dearness 1923) and Québec (Pomerleau 1980). Our material corresponds well to Stuntz's (1947) description of *Inocybe lucifuga* (Fr.) Quél. from a subalpine *Abies-Pinus* forest in Washington, which is now considered a yellow variant of *I. floccosus* (Kuyper 1986). Not previously reported from western Canada.

Material examined: Mt. Tripoli: subalpine forest 08 15 95 (ALTA 10317); 09 07 97 (ALTA 10318); krummholz zone 09 11 94 (ALTA 10319).

Inocybe lacera (Fr.:Fr.) Kumm., Führ. Pilzk. p. 79. 1871.

A cosmopolitan generalist. Widespread in Europe and North America, not uncommon in subalpine and alpine areas, associated with *Betula, Castanea, Salix, Quercus, Alnus, Picea* and *Pinus* (Kuyper 1986, Arnolds *et al.* 1995). With *Salix* in the French and Swiss Alps (Kühner and Lamoure 1986, Favre 1955, Graf 1994), Scotland (Watling 1987), and the Faeröes (Möller 1945). In Greenland and Norway with *Betula* (Petersen 1977, Lange 1957, Gulden and Lange 1971) and with *Pseudotsuga menziesii* (Jansen 1991), *Picea abies* (Bieri 1995), or *Pinus sylvestris* (Scherfose 1990, Termorshuizen 1991, Väre *et al.* 1996) in northern Europe. Found throughout North America in various habitats but especially under *Populus* in northern U.S. and Canada (Kauffman 1924, Smith *et al.* 1979). Ectomycorrhizae of *I. lacera* have been described on *Populus tremuloides* (Cripps and Miller 1995). This taxon is extremely variable, especially arctic and alpine material. Forms such as *I. lacera* var. *heterosperma* Grund and Stuntz fit within the normal range of variation of *I. lacera* (Kuyper 1986). Not previously reported from western Canada.
Material examined: Mt. Tripoli: alpine zone 08 16 95 (ALTA 10320); krummholz zone 08 04 95 (ALTA 10321).

Inocybe lanuginella (Schroet.) J. E. Lange, Dansk Bot. Arkiv 2: 45. 1917.

An alpine *Dryas* associate. Reported from Switzerland with *Dryas* (Favre 1955)(as *Inocybe decipiens* and *I. decipientoides*), Norway at subalpine elevations (Gulden and Lange 1971), and Denmark (Lange 1917), Greenland and Lapland with *Salix* (Lange 1957). Horak (1987) maintains that *I. lanuginella* (as *Astrosporina lanuginella*) is specific to *Dryas* on calcareous soil, which brings the material collected with *Salix* into doubt. Synonymous with *Inocybe decipientoides* Peck and *I. globocystis* Vel. *fide* Horak (1987). Our material was collected with *Dryas octopetala*. Not previously reported from Canada.
Material examined: Mt. Rae: alpine zone 08 16 95 (ALTA 10322).

Inocybe rimosa (Bull.:Fr.) Kumm., Führ. Pilzk. p. 79. 1871.

A cosmopolitan generalist. Widespread in Europe and North America, associated with a wide range of coniferous and angiosperm hosts including alpine vegetation (Kuyper 1986). Common throughout the Alps (Favre 1955, Kühner and Lamoure 1986, Graf 1994, Senn-Irlet 1988), Scandinavia (Gulden and Lange 1971, Jacobsson 1984), Scotland (Watling 1987), Greenland (Lange 1957, Petersen 1977) and Svalbard (Ohenoja 1971) with *Salix* and *Dryas*. Also associated with *Pinus sylvestris* in Germany (Scherfose 1990), with conifers or *Quercus* in California (Nishida 1989) and throughout the U.S. and Canada in a wide variety of habitats (Kauffman 1924, Grund and Stuntz 1981). Synonymous with *I. fastigiata* (Schiff.: Fr.) Quél. *fide* Kuyper (1986).
Material examined: Mt. Tripoli: krummholz zone 08 04 95 (ALTA 10323). Mt. Rae: subalpine forest 09 07 97 (ALTA 10324).

Inocybe whitei (Berk. & Broome) Sacc., Syll. Fung. 5: 790. 1887.

A western conifer associate. Widespread in central Europe, usually with *Picea* or *Pinus* but also rarely with deciduous trees (Kuyper 1986, Arnolds *et al.* 1995). Known from California with conifers or *Quercus* (Nishida 1989) and from mixed forests in Nova Scotia (Gourley 1983) and British Columbia (Bandoni 1977) (both as *I. pudica*). Very common with conifers on the west coast of North America but rare east of the Rockies (Smith *et al.* 1979, Grund and Stuntz 1981). Synonymous with *I. pudica fide* Kuyper (1986). Not previously reported from Alberta.
Material examined: Mt. Tripoli: krummholz zone 09 11 94 (ALTA 10325); 09 07 97 (ALTA 10326).

Thaxterogaster pingue Sing. & A. H. Sm., Brittonia 10: 211. 1958.

A montane conifer associate; under *Abies lasiocarpa* as well as *Pinus* and *Pseudotsuga* spp. from the Pacific Northwest to Colorado and California (Singer and Smith 1958). Especially at higher elevations, under *Picea* in the Rockies, *Abies* in the Sierra Nevada and Cascade Mountains (Arora 1986) and under mixed conifers in British Columbia (P. Kroeger pers. comm. 1998). The genus *Thaxterogaster* has not been previously reported from Alberta.
Material examined: Mt. Rae: subalpine forest 09 19 97 (ALTA 10349).

Gomphidiaceae

Gomphidius largus O. K. Miller, Mycologia 63:1159. 1971.

A montane conifer associate. Under *Picea engelmannii* in Idaho, and *Populus* and *Picea* spp. in New Mexico, at high elevations (up to 3,000 m)(Miller 1971). Distinguished from *G. glutinosus* (Fr.) Fr. by the presence of inflated cellular gill trama. Gill trama cells in our material are up to 43 μm wide. Not previously reported from Canada.
Material examined: Mt. Rae: subalpine forest 08 17 97 (ALTA 10378).

Hydnaceae

Hydnum repandum Fr., Syst. Mycol. 1: 400. 1821.

Cosmopolitan, with a broad host range (Molina *et al.* 1992). In Europe with deciduous trees or *Pinus* or *Picea* up to subalpine elevations (Breitenbach and Kränzlin 1986, Scherfose 1990, Gulden *et al.*1992). Associated with *Picea abies, Pseudotsuga menziesii, Fagus* and *Corylus* (Trappe 1962). Widely distributed throughout the U.S. and Canada (Smith and Smith 1973); under *Picea engelmannii* and *Abies lasiocarpa* in Colorado (Kauffman 1921), *Quercus* and *Pinus* in southern Oregon (Kauffman 1929) and *Picea glauca* and *Populus* in central Alberta (Schalkwijk 1989, 1991, Currah *et al.* 1989).
Material examined: Mt. Rae: subalpine forest 09 29 95 (ALTA 10278).

Hysterangiaceae

Hysterangium separabile Zeller, Mycologia 33: 201. 1941.

Hypogeous under conifers, deciduous trees and shrubs. Common in the

mountains of western North America but widely distributed (Smith and Smith 1973). Known from Europe, South America, New England, New York, Arizona, California, Oregon and Wyoming (Zeller 1941). With conifers and *Quercus* in California (Arora 1986) and *Tsuga canadensis, T. heterophylla* and *T. mertensiana* in the Pacific Northwest (Kropp and Trappe 1982). Under *Pinus, Populus, Pseudotsuga, Alnus* and (or) *Picea* spp. in the Rocky Mountain foothills (Currah *et al.* 1989).
Material examined: Mt. Rae: subalpine forest 07 21 95 (ALTA 10198); 08 16 95 (ALTA 10379).

Russulaceae

Lactarius alnicola A. H. Sm., Brittonia 12: 319. 1960.

A western conifer associate. Known from Michigan, California, Oregon, Idaho and Wyoming (Hesler and Smith 1960). Common in the northern Rockies (Hesler and Smith 1979) and their foothills with mixed *Picea* and *Pinus contorta* (Currah *et al.* 1989). Originally collected under *Alnus,* but now recognized as a conifer associate (Hesler and Smith 1979). Ectomycorrhizae on *Picea engelmannii* are described by Kernaghan *et al.* (1997).
Material examined: Mt. Tripoli, subalpine forest 09 11 94 (ALTA 9870); 08 30 97 (ALTA 10248); 09 07 97 (ALTA 10249).

Lactarius caespitosus Hesler & A. H. Sm., N. Am. sp. *Lactarius*, p. 349. 1979

An *Abies* associate. Common in the spruce-fir zone of the Rocky mountains, rare west of the crest of the Cascade Mountains (Hesler and Smith 1979). Ectomycorrhizae described on *Abies lasiocarpa* by Kernaghan *et al.* (1997) are probably restricted to that host. Not previously reported from Canada.
Material examined: Mt. Rae: subalpine forest 09 24 94 (ALTA 9871); 08 16 95 (ALTA 10250); 09 29 95 (ALTA 10251); 09 19 97 (ALTA 10252); krummholz zone 08 16 95 (ALTA 10253). Mt. Tripoli: subalpine forest 09 11 94 (ALTA 10254); 08 15 95 (ALTA 10255); 09 07 97 (ALTA 10256); krummholz zone 08 04 95 (ALTA 10257).

Lactarius deliciosus var. *areolatus* A. H. Sm., Brittonia 12: 135. 1960.

A western conifer associate. In Europe, *L. deliciosus s.l.* (an unresolved complex) is normally found with *Pinus* (Hesler and Smith 1979, Arnolds *et al.* 1995). In North America, *L. deliciosus s.l.* has been reported from a wide range of habitats, including Nova Scotia with *Picea* and *Abies* (Smith and Wehmeyer 1936), boreal forest and tundra in northern Québec (Hutchison *et al.* 1988) and northern Alberta with *Pinus banksiana* (Visser 1995). Ectomycorrhizae have been synthesized on *Larix occidentalis, Picea sitchensis, Pseudotsuga menziesii, Tsuga heterophylla* and a number of *Pinus* spp. (Molina and Trappe 1982). *L. deliciosus* var. *areolatus* is the most common variant in the west and is abundant in the Rocky Mountains; reported from Alaska to New Mexico under mixed conifers (Hesler and Smith 1979). Ectomycorrhizae on *Abies lasiocarpa* have been described by Kernaghan *et al.* (1997). This variety has not been previously reported from western Canada.
Material examined: Mt. Rae: krummholz zone 08 16 95 (ALTA 10258); 09 19 97 (ALTA 10259); subalpine forest 08 16 95 (ALTA 10260); 09 19 97 (ALTA 10261).

Mt. Tripoli: krummholz zone 08 05 94 (ALTA 9872).

Lactarius luculentus Burl., Mycologia 28: 260. 1936. *sensu lato.*

A western conifer associate. Under *Pseudotsuga menziesii* in Oregon, Colorado and Alaska (Burlingham 1936, Hesler and Smith 1979). Kauffman's (1921) report of *L. subdulcis* under *Pinus* in Colorado may have been *L. luculentus*, because *L. subdulcis* is a similar European species not recognized from North America in the most recent monograph (Hesler and Smith 1979). Hesler and Smith (1979) describe *L. luculentus* var. *luculentus* and var. *latetus* Hesler and Smith from North America. These fungi are part of a complex of small, reddish orange *Lactarii* with white unchanging latex (or latex which becomes yellow on white paper), which also includes *L. mitissimus* (Fr.) Fr. and *L. aurantiacus* Fr. Our material has glabrous, papillate, dark apricot coloured pilei, slightly paler towards margin, up to 3 cm in diam. Pileus cuticle an ixotrichoderm, lacking incrusting material. Stipe concolorous, very finely fibrillose, stuffed becoming hollow, ± equal, up to 3.5 cm. Lamellae slightly paler, slightly decurrent. Context whitish, taste slightly acrid. Latex scant, white, unchanging. No parts reacting in 5% KOH. Spores (6.5) 7.0-8.5 (9.5) x 5.5-6.7 (7.3) μm, ornamentation a broken reticulum with isolated warts. Not previously reported from Canada.

Material examined: Mt. Rae: krummholz zone 09 19 97 (ALTA 9875); subalpine forest 09 19 97 (ALTA 10262). Mt. Tripoli: subalpine forest 09 11 94 (ALTA 10263).

Lactarius pubescens Fr., Epicr. Syst. Mycol., p. 335. 1838.

Associated with *Betula* and members of the Salicaceae. Reported from northern Europe with *Betula* (Kallio and Kankainen 1966, Jacobsson 1984, Arnolds *et al.* 1995), Greenland with *Betula* or *Salix* (Lange 1957, Knudsen and Borgen 1982), Alaska with *Betula nana* and *B. papyrifera* (Miller 1982) and *Salix alaxensis* (Laursen and Ammirati 1982) and central Alberta with *Betula papyrifera* (Schalkwijk 1989). Common throughout the boreal forest (Rendall 1980). Mycorrhizae have been synthesized *in vitro* with *Populus tremuloides* (Godbout and Fortin 1985). Hesler and Smith (1979) also recognize *L. pubescens* var. *betulae*, with yellowing latex and smaller spores than var. *pubescens*.

Material examined: Mt. Tripoli: krummholz zone 08 05 94 (ALTA 9874); 09 11 94 (ALTA 10264); 08 15 95 (ALTA 10265); 08 30 97 (ALTA 10266); 09 07 97 (ALTA 10267).

Russula brevipes Peck, 43rd Rep. N.Y. St. Mus. p. 20. 1890.

Common and widely distributed, mainly with conifers but also with angiosperms. Also in arctic and alpine habitats. Known from northeastern North America with *Abies, Picea, Pinus, Populus* and *Betula* (Shaffer 1964, Stanis 1979, Pomerleau 1980), Alaska (Kobayashi *et al.* 1967), the Pacific Northwest with *Pseudotsuga, Abies, Picea, Pinus, Tsuga* (Trappe 1962, Shaffer 1964), and Alberta with *Picea glauca* (Schalkwijk 1989, Currah *et al.* 1989). Ectomycorrhizae described on *Abies lasiocarpa* (Kernaghan *et al.* 1997). Shaffer (1964) describes *R. brevipes* var. *acrior* Shaffer, which has a blue-green tint to stipe apex and (or) lamellae and a similar distribution to var. *brevipes*. *Russula delica* Fr. is a similar species commonly

reported from Europe in temperate areas with *Pinus, Quercus, Fagus* and other deciduous trees, also with montane *Picea* and in alpine regions with *Dryas* (Romagnesi 1967, Einhellinger 1987, Arnolds *et al.* 1995). It is unclear if *R. delica* and *R. brevipes* are conspecific, but Shaffer (1964) suggests rejecting the name *R. delica* and using *R. brevipes* for North American material.
Material examined: Mt. Tripoli: krummholz zone 09 11 94 (ALTA 9878); 08 04 95 (ALTA 10235).

Russula integra (Vittad.) Fr., Epicr. Syst. Mycol., p. 360. 1838.

A montane conifer associate, restricted to Pinaceae (Molina *et al.* 1992). Common in central and northern Europe in montane and subalpine *Picea-Abies* forests, or with *Pinus sylvestris,* also at lower elevations in mixed forests (Romagnesi 1967, Einhellinger 1987, Hansen and Knudsen 1992). Reported with *Pseudotsuga* in California (Arora 1986) and *Abies* in Nova Scotia (Smith and Wehmeyer 1936). Mycorrhizae described on *Abies lasiocarpa* (Kernaghan and Currah unpublished data). Not previously reported from western Canada.
Material examined: Mt. Tripoli: krummholz zone 09 11 94 (ALTA 9880); 08 04 95 (ALTA 10236); 09 07 95 (ALTA 10237); subalpine forest 09 11 94 (ALTA 10238); 08 04 95 (ALTA 10239).

Russula silvicola Shaffer, Beih. Nova Hedwigia 51: 229. 1975.

Associated with coniferous and deciduous trees, often with *Abies*. Known from eastern North America in deciduous, coniferous or mixed forests (Shaffer 1975); from Ontario and Québec under *Abies, Picea* and mixed deciduous trees (Nantel and Neumann 1992, Stanis 1979). Ectomycorrhizae described on *Abies lasiocarpa* (Kernaghan *et al.* 1997). *R. emetica* (Schaeff.:Fr.) Pers. ex S.F. Gray var. *silvestris* Sing., which may be conspecific (see Shaffer 1975), is known from Europe with *Pinus sylvestris, Picea abies* and in mixed forests (Einhellinger 1987, Kühner and Romagnesi 1953) and Colorado (Kauffman, 1921). Not previously reported from western Canada.
Material examined: Mt. Rae: krummholz zone 08 16 95 (ALTA 10240); 09 19 97 (ALTA 10241); subalpine forest 09 14 96 (ALTA 10242); 09 19 97 (ALTA 10243). Mt. Tripoli: krummholz zone 08 05 94 (ALTA 9881); subalpine forest 09 11 94 (ALTA 10244); 09 07 97 (ALTA 10245).

Russula torulosa Bres., Iconogr. Mycol. 9: 433. 1929.

A conifer associate, usually with *Pinus*. Known from central and northern Europe with *Pinus*, more rarely under *Picea* (Romagnesi 1967, Hansen and Knudsen 1992, Arnolds *et al.*1995). Also from Washington with *Tsuga mertensiana* and *Pseudotsuga menziesii* (Grund 1965). Moser and McKnight (1987) report the closely related *R. queletii* from tree line in Wyoming with *Picea engelmannii*. Not previously reported from Canada.
Material examined: Mt. Rae: krummholz zone 09 24 94 (ALTA 9877); 09 29 95 (ALTA 10246); 09 07 97 (ALTA 10247).

Scutigeraceae

Albatrellus flettii Morse ex Pouz., Česka Mycol. 26: 198. 1972.

A western conifer associate. Known from Alaska, Alberta, British Columbia, California, Idaho, New Mexico, Oregon, Washington and Wyoming, typically with *Tsuga*, but *Abies*, *Picea*, *Pinus*, *Pseudotsuga*, *Taxus*, *Alnus* and *Salix* also reported in the vicinity (Gilbertson and Ryvarden 1986, Ginns 1997). Restricted to the Pinaceae (Molina *et al.* 1992) and associated with *Tsuga heterophylla* (Kropp and Trappe 1982).

Material examined: Mt. Rae: subalpine forest 08 16 95 (ALTA 10380).

Thelephoraceae

Boletopsis subsquamosa (Fr.) Kotlaba & Pouz., Česka Mycol. 11: 164. 1957.

A circumboreal conifer associate. Known from northern U.S. and Canada, uncommon (Gilbertson and Ryvarden 1986). Reported from Nova Scotia with *Picea* and *Pinus* (Gourley 1983). Ectomycorrhizae described on *Picea abies* by Agerer (1992), [as *B. leucomelaena* (Pers.: Fr.) Fayod].

Material examined: Mt. Rae: krummholz zone 08 12 94 (ALTA 10354); subalpine forest 09 24 94 (ALTA 10355); 08 16 95 (ALTA 10356); 09 14 96 (ALTA 10357); 09 19 97 (ALTA 10358).

Hydnellum caeruleum (Hornem.) P. Karst., Medd. Soc. Fauna Fl. Fenn. 5: 41. 1879.

Associated with conifers in the north and broadleaved trees in the south. Known from Europe with *Pinus sylvestris* (Scherfose 1990, Väre *et al.* 1996, Arnolds *et al.* 1995) or in mixed forests (Breitenbach and Kränzlin 1986). In California with *Quercus*, *Lithocarpus* and *Arbutus* (Arora 1986) and in Florida (Baird and Kahn 1986). Also common in northern conifer forests (Nova Scotia, Québec), especially with *Pinus* (Harrison 1961, 1968, Pomerleau 1980), and in Alberta with *Picea glauca* and *P. engelmannii* (Currah *et al.* 1989, Schalkwijk 1991). Mycorrhizae described on *Picea engelmannii* (Kernaghan and Currah unpublished data).

Material examined: Mt. Rae: subalpine forest 08 12 94 (ALTA 10272); 09 24 94 (ALTA 10273); 08 16 97 (ALTA 10274); 09 19 97 (ALTA 10275).

Hydnellum suaveolens (Scop.:Fr.) P. Karst., Medd. Soc. Fauna Fl. Fenn. 5: 41. 1879.

A northern and montane conifer associate. Known from Europe with montane *Picea* (Breitenbach and Kränzlin 1986) and in North America from New Mexico to British Columbia and from the Appalachian Mountains to Nova Scotia (Harrison 1968, Kauffman 1921). With *Picea abies* in North Carolina (Baird 1986) and with *Picea engelmannii* and *Abies lasiocarpa* in Alberta (Schalkwijk 1991).

Material examined: Mt. Tripoli: krummholz zone 08 05 94 (ALTA 10277).

Pseudotomentella tristris (P. Karst.) M. J. Larsen, Nova Hedwigia 22: 613. 1971.

Widely distributed throughout the northern Hemisphere (Kõljalg 1996). In North America, from British Columbia to New Mexico and New Jersey (Larsen

1971). Commonly fruiting on a wide variety of decaying coniferous and deciduous wood (Larsen 1971, Ginns and Lefebvre 1993, Kõljalg 1996).
Material examined: Mt. Tripoli: subalpine forest ALTA 09 06 97 (ALTA 10276).

Sarcodon scabrosus (Fr.) P. Karst., Rev. Mycol. 3: 20. 1881.

Widespread, associated with conifers in the north and broadleaved trees in the south. In Switzerland and the Netherlands with *Fagus, Quercus* and *Castanea* and in Scandinavia with *Pinus* (Breitenbach and Kränzlin 1986, Arnolds *et al.* 1995). With *Liriodendron* and *Quercus* in southeastern North America (Baird 1986, Baird and Khan 1986), conifers or hardwoods in California (Arora 1986), conifers in Nova Scotia (Harrison 1961), *Tsuga heterophylla* in the Pacific Northwest (Hall and Stuntz 1972) and *Picea glauca* in the Rocky Mountain foothills (Currah *et al.* 1989).
Material examined: Mt. Rae: subalpine forest 09 19 97 (ALTA 10268).

***Sarcodon* sp.**

Sporocarps gregarious, solitary or fused, pileus 2-15 cm in diam., pale argillaceous when young, then pale tan to greenish yellow, older parts olivaceous, bruising purple, concave, undulating to nearly plane, with persistently incurved margin, matted fibrillose at first, soon forming coarse scales with dark vinaceous brown edges, slightly olivaceous in 5% KOH. Teeth 3-17 mm in length, crowded, gray with paler tips, bruising lavender from the tip, decurrent to halfway down the stipe, strongly olivaceous in 5% KOH. Stipe 5-9 x 1.5-4.5 cm, central or eccentric, often fused, ± equal with pointed base, pale orange, lower portion olivaceous, bruising purple, olivaceous in KOH. Context, white, fibrous, no reaction in KOH. Spores small, tuberculate, 3.7-5.0 x 2.8-3.6 μm. These collections appear similar to *S. versipellis* (Fr.) Quél. but differ in colour, length of teeth and bruising reaction.
Material examined: Mt. Rae: subalpine forest 09 29 95 (ALTA 10269); 08 18 95 (ALTA 10270). Mt. Tripoli: krummholz zone 09 06 97 (ALTA 10395); subalpine forest 09 11 94 (ALTA 10271).

Thelephora caryophyllea Fr., Syst. Mycol. 1: 430. 1821.

A north temperate species, on sandy soil under conifers (Corner 1968). Known from Finnish Lapland with *Pinus* and *Betula* (Kallio and Kankainen 1964), the Netherlands with *Pinus* or *Picea* (Arnolds *et al.* 1995), Germany with *Pinus sylvestris* (Scherfose 1990) and the Swiss Alps with dwarf alpine *Salix* spp. (Senn-Irlet 1988). In Colorado with montane conifers (Kauffman 1921), central Alberta under *Populus tremuloides* (Schalkwijk 1989) and northern Alberta with *Pinus banksiana* (Visser 1995).
Material examined: Mt. Tripoli: subalpine forest 08 15 95 (ALTA 10392).

Tomentella ellisii (Sacc.) Jülich & Stalpers, Verh. K. Ned. Akad. Wet. 74: 236. 1980.

Distributed throughout the temperate northern hemisphere (Jülich and Stalpers 1980). Commonly fruiting on a wide variety of decaying coniferous and deciduous wood (Kõljalg 1996, Ginns and Lefebvre 1993). Not previously reported from Alberta. Some of our collections were from alpine soil supporting *Dryas octopetala*.
Material examined: Mt. Rae: alpine zone 08 16 97 (ALTA 10393); 09 19 97 (ALTA

10396). Mt. Tripoli: subalpine forest 09 07 97 (ALTA 10395).

Tomentella sublilacina (Ellis & Holw.) Wakef., Mycologia 52: 931. 1960.

Distributed throughout the temperate northern hemisphere (Larsen 1974, Jülich and Stalpers 1980). Commonly fruiting on a wide variety of decaying coniferous and deciduous woods (Larsen 1974, Ginns and Lefebvre 1993, Kõljalg 1996). Mycorrhizal with *Pinus muricata* in California (Gardes and Bruns 1996). Reported from Kootenay National Park, British Columbia, on deciduous wood and from Banff National Park, Alberta, on coniferous wood (Larsen 1975, as *T. kootenaiensis* Larsen). Our collections were from alpine soil with *Dryas octopetala*.
Material examined: Mt. Rae: alpine zone 08 16 97 (ALTA 10394); 09 19 97 (ALTA 10397).

Tricholomataceae

Camarophyllus pratensis (Fr.) Kumm., Führ. Pilzk., p. 117. 1871.

Cosmopolitan, often in open grassy areas or forest edges (Breitenbach and Kränzlin 1991) but also in thickets or dense forests (Hesler and Smith 1963, Smith *et al.* 1979, Bird and Grund 1979). Reported with subalpine *Betula* in Sweden (Jacobsson 1984).
Material examined: Mt. Tripoli: subalpine forest 08 15 95 (ALTA 10342); 08 30 97 (ALTA 10381); 09 07 97 (ALTA 10382). Mt. Rae: subalpine forest 08 16 95 (ALTA 10344); 09 19 97 (ALTA 10383).

Catathelasma imperiale (Fr.) Sing., Rev. Mycol. 5: 9. 1940.

A circumboreal conifer associate. Known from Europe, Asia and the west and east coasts of North America, mainly with *Picea,* but also *Pseudotsuga, Tsuga, Abies* and rarely *Pinus* (Hutchison 1992). Restricted to Pinaceae (Molina *et al.* 1992).
Material examined: Mt. Rae: subalpine forest 09 24 94 (ALTA 10367); 09 29 95 (ALTA 10368); 09 14 96 (ALTA 10369); 09 19 97 (ALTA 10370). Mt. Tripoli: krummholz zone 09 08 96 (ALTA 10371); subalpine forest 09 07 97 (ALTA 10372). Rocky-Clearwater Forest AB: R. Currah, 08 06 86 (UAMH 5451).

Hygrophorus chrysodon (Fr.) Fr., Epicr. Syst. Mycol., p. 320. 1838.

Widely distributed in North America, associated with conifers and angiosperms. Common in western North America but apparently rare in the east (Hesler and Smith 1963); with *Lithocarpus* and *Arbutus* in coastal California (Arora 1986), *Pseudotsuga menziesii* in the Pacific Northwest (Trappe 1962), montane conifers in Colorado (Kauffman 1921), *Betula nana* and *Dryas octopetala* in Alaska (Miller 1982) and *Picea* or *Pinus* spp. in Alberta (Currah *et al.* 1989, Danielson 1984, Visser 1995).
Material examined: Mt. Rae: krummholz zone 09 24 94 (ALTA 10327); 09 29 95 (ALTA 10328); 09 19 97 (ALTA 10329); subalpine forest 09 19 97 (ALTA 10329). Mt. Tripoli: subalpine forest 09 11 94 (ALTA 10330); 08 15 95 (ALTA 10331); 09 07 97 (ALTA 10332).

Hygrophorus erubescens (Fr.) Fr., Epicr. Syst. Mycol., p. 322. 1838.

Circumpolar, usually with *Picea*. Restricted to Pinaceae (Molina *et al.* 1992). In Fennoscandia and Switzerland with *Picea*, especially at montane to subalpine elevations (Breitenbach and Kränzlin 1991, Gulden *et al.*1992, Hansen and Knudsen 1992, Bieri 1995). In northern U.S. and Canada with *Pinus*, *Picea* and *Tsuga* (Hesler and Smith 1963, Smith *et al.* 1979, Bird and Grund 1979); in Alberta under *Picea glauca*, *Pinus contorta* (Currah *et al.* 1989, Schalkwijk 1991) and *Pinus banksiana* (Visser 1995).

Material examined: Mt. Tripoli: subalpine forest 09 11 94 (ALTA 10333); 08 15 95 (ALTA 10334); 09 07 97 (ALTA 10335). Mt. Rae: subalpine forest 09 19 97 (ALTA 10336).

Hygrophorus korhonenii Harmaja, Karstenia 25: 42. 1985.

A circumboreal *Picea* associate. Known from Fennoscandia and Québec, always with *Picea*. (Harmaja 1985, Hansen and Knudsen 1992). Harmaja (1985) states that *H. olivaceoalbus* (Fr.) Fr. *sensu* Hesler & A. H. Sm. does not fit the European concept of *H. olivaceoalbus*, but does fit the description of *H. korhonenii*. *H. olivaceoalbus sensu* Hesler & A. H. Sm. and is widely distributed in northern and western North America as well as France and the former U.S.S.R. with *Picea* (Hesler and Smith 1963). Distinctive features of *H. korhonenii* include a gelatinous outer veil covering a dark, fibrillose, inner veil, dark fibrillose veil remnants on the sitpe, spores measuring 10-14 x 5.2-7.5 μ m and a northern distribution. Not previously reported from western Canada, but has probably been collected and referred to as *H. olivaceoalbus sensu* Hesler and A. H. Sm., e.g. Schalkwijk (1991).

Material examined: Mt. Rae: subalpine forest 09 29 95 (ALTA 10337); 09 19 97 (ALTA 10338); krummholz zone 09 29 95 (ALTA 10339); 09 19 97 (ALTA 10340). Mt. Tripoli: subalpine forest 08 30 97 (ALTA 10341).

Hygrophorus pudorinus (Fr.) Fr., Epicr. Syst. Mycol., p. 322. 1838.

A circumboreal conifer associate. Often with *Abies* in Europe (Kühner and Romagnesi 1953, Breitenbach and Kränzlin 1991, Arnolds *et al.* 1995), but with *Picea* in Sweden (Hansen and Knudsen 1992) and the former U.S.S.R. (Hesler and Smith 1963). Under *Picea*, *Abies* or *Tsuga* in northern and western U.S. and Canada (Smith *et al.* 1979, Bird and Grund 1979, Arora 1986). With *Picea engelmannii*, *Abies lasiocarpa* and *Pinus contorta* in Colorado (Kauffman, 1921), in boreal forest in northern Québec (Hutchison *et al.* 1988) and *Picea* and *Pinus* in the Canadian Rockies (Schalkwijk 1989).

Material examined: Mt Tripoli: subalpine forest 09 11 94 (ALTA 10343). Mt. Rae: subalpine forest 09 19 97 (ALTA 10345).

Hygrophorus pustulatus (Fr.) Fr., Hymen. Eur., p. 411. 1874.

A widespread conifer associate. Throughout European *Picea* forests, up to subalpine elevations (Breitenbach and Kränzlin 1991, Arnolds *et al.* 1995). Under *Abies* and *Sequoia* in Michigan, Colorado, Wyoming, Idaho, California and Washington (Hesler and Smith 1963) and with *Picea* in Nova Scotia (Bird and Grund 1979). Not previously reported from western Canada.

Material examined: Mt Rae: subalpine forest 09 19 97 (ALTA 10346)

Hygrophorus speciosus Peck, N.Y. State Mus. Ann. Rept. 29: 43. 1878.

A circumboreal *Larix* associate (Hesler and Smith 1963). Known from montane to subalpine Switzerland (Breitenbach and Kränzlin 1991), up to tree line the Austrian Alps with *Larix decidua* (Moser 1982) and with *Larix laricina* in Nova Scotia (Bird and Grund 1979) and Québec (Hutchison *et al.* 1988, Pomerleau 1980). Reported from the southwest U.S. with *Pinus ponderosa* (Arora 1986). Not previously reported from western Canada or in association with *Larix lyallii*.
Material examined: Mt. Rae: krummholz zone 07 25 95 (ALTA 10347); subalpine forest 09 19 97 (ALTA 10348).

Laccaria montana Sing., Sydowia 7: 89. 1973.

Circumpolar and alpine, with conifers and angiosperms. Restricted to arctic, boreal or montane habitats; Switzerland, the Faeröes, Colorado, Idaho, Montana, Washington, Wyoming, Alaska, and British Columbia with members of the Pinaceae, *Betula* and *Salix* (Mueller 1992). Also reported from Iceland and Norway (including Svalbard) (Hansen and Knudsen 1992) with *Salix* (Gulden 1988). Not previously reported from Alberta.
Material examined: Mt. Tripoli: krummholz zone 08 04 95 (ALTA 10384); 08 15 95 (ALTA 10385); 09 07 97 (ALTA 10386); subalpine forest 07 18 94 (ALTA 10387). Mt. Rae: alpine zone 08 16 95 (ALTA 10388); subalpine forest 08 16 95 (ALTA 10389).

Tricholoma myomyces (Fr.) Lange, Dansk. Bot. Ark. 8: 21. 1933.

A widespread conifer associate. In northern Europe, often with *Pinus* (Hansen and Knudsen 1992, Arnolds *et al.* 1995) or on sand dunes with *Pinus* and *Salix* (Moser 1983). Under planted *Picea* and *Pinus* in the Great Lakes region with variations found throughout northern U.S. and Canada (Smith *et al.* 1979); in Sweden, Michigan, Minnesota, Pennsylvania, Wisconsin, and Ontario under most species of *Pinus* and *Picea* as well as *Tsuga canadensis* (Ovrebo 1980, 1989). In Alberta with *Picea* and *Pinus* (Currah *et al.* 1989).
Material examined: Mt. Tripoli: subalpine forest 08 15 95 (ALTA 10288); 08 04 95 (ALTA 10289); 09 07 97 (ALTA 10290). Mt. Rae: subalpine forest 07 25 95 (ALTA 10291); 09 19 97 (ALTA 10292).

Tricholoma saponaceum (Fr.) Staude, Schwämme Mitteldtsch., p. 127. 1858.

Widespread, associated with conifers and angiosperms. Known from northern Europe with *Picea* (Gulden *et al.*1992), *Pinus sylvestris* (Väre *et al.* 1996), *Fagus* or *Quercus* (Arnolds *et al.* 1995). In northeastern North America with *Abies, Picea, Tsuga* or *Pinus* spp. (Ovrebo 1980), northern Alberta with *Pinus banksiana* (Visser 1995), Nova Scotia with *Picea* (Smith and Wehmeyer 1936), Colorado with *Picea engelmannii* and *Pinus contorta* (Kauffman 1921), central Alberta with *Populus tremuloides* (Schalkwijk 1989) or *Pinus contorta* (Currah *et al.* 1989), and California with *Lithocarpus* and *Arbutus* (Arora 1986).
Material examined: Mt.Tripoli: subalpine forest 09 11 94 (ALTA 10293); 09 07 97 (ALTA 10294). Mt. Rae: krummholz zone 09 24 94 (ALTA 10295); subalpine forest 07 21 94 (ALTA 10296); 07 25 95 (ALTA 10297); 08 16 95 (ALTA 10298); 08 16 97 (ALTA 10299).

Tricholoma vaccinum (Pers.: Fr.) Staude, Schwämme Mitteldtsch., p. 128. 1858.

A circumboreal *Picea* associate, also reported with *Pinus*. In central and northern Europe with *Picea* up to subalpine elevations (Breitenbach and Kränzlin 1991, Hansen and Knudsen 1992, Bieri 1995). Widely distributed in northern U.S. and Canada with *Picea* and (or) *Pinus* (Smith *et al.* 1979, Ovrebo 1980); with *Pinus* in northern California (Arora 1986), *Picea glauca* in N.W.T (Bigelow 1959) and *Picea glauca, Picea engelmannii* and *Pinus contorta* in the Canadian Rockies (Currah *et al.* 1989, Schalkwijk 1991). Ectomycorrhizae are described on *Picea abies* by Agerer (1987b).

Material examined: Mt. Rae: subalpine forest 09 29 95 (ALTA 10300); 09 19 97 (ALTA 10301); 09 19 97 (ALTA 10302). Mt. Tripoli: subalpine forest 09 11 94 (ALTA 10303); 09 07 97 (ALTA 10304).

Tricholoma virgatum (Fr.) Kumm., Führ. Pilzk., p. 134. 1871. var. *vinaceum* Ovrebo and Tylutki, Mycologia 67: 79. 1975.

Probably a montane conifer associate. *T. virgatum* var. *virgatum* is common in Europe with conifers and *Fagus* (Bon 1984) and throughout the northern forests of North America with *Pinus* and *Picea* (Ovrebo 1989). *T. virgatum* var. *vinaceum*, also a conifer associate, has a vinaceous flush to the stipe with age or upon bruising, and is known from Idaho, Oregon and Washington (Ovrebo 1975). Bon (1984) describes *T. virgatum fo. rosipes* Bon in Europe, also with a reddening stipe and growing with montane conifers. Given this, and the locations of the North American collections, it is likely that *T. virgatum* var. *vinaceum* is a montane or northern variety. In our collections all but lamella tissue became vinaceous upon handling. *T. virgatum* var. *vinaceum* has not been previously reported from Canada.

Material examined: var. *vinaceum* - Mt. Rae: subalpine forest 09 24 94 (ALTA 10305); 09 29 95 (ALTA 10306); 09 19 97 (ALTA 10307); krummholz zone 09 24 94 (ALTA 10308). Mt. Tripoli: subalpine forest 09 11 94 (ALTA 10309); 09 07 97 (ALTA 10310). Priest Lake Idaho: C. Ovrebo, 11 05 72 (CO 90). Var. *virgatum* - Idaho: E. Tylutki (EET 6600). Muskoka Dist., Ontario: L. Hutchison 19 09 86 (LH-96-86); 09 17 94 (LH-93-94). Devon, Alberta: S. Abbott (M0272, M05576, M0366).

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