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Natural History Occasional Paper No. 21

The Lichen Genus *Peltigera* (Lichenized Ascomycetes)
in Alberta

Bernard Goffinet
Ross I. Hastings



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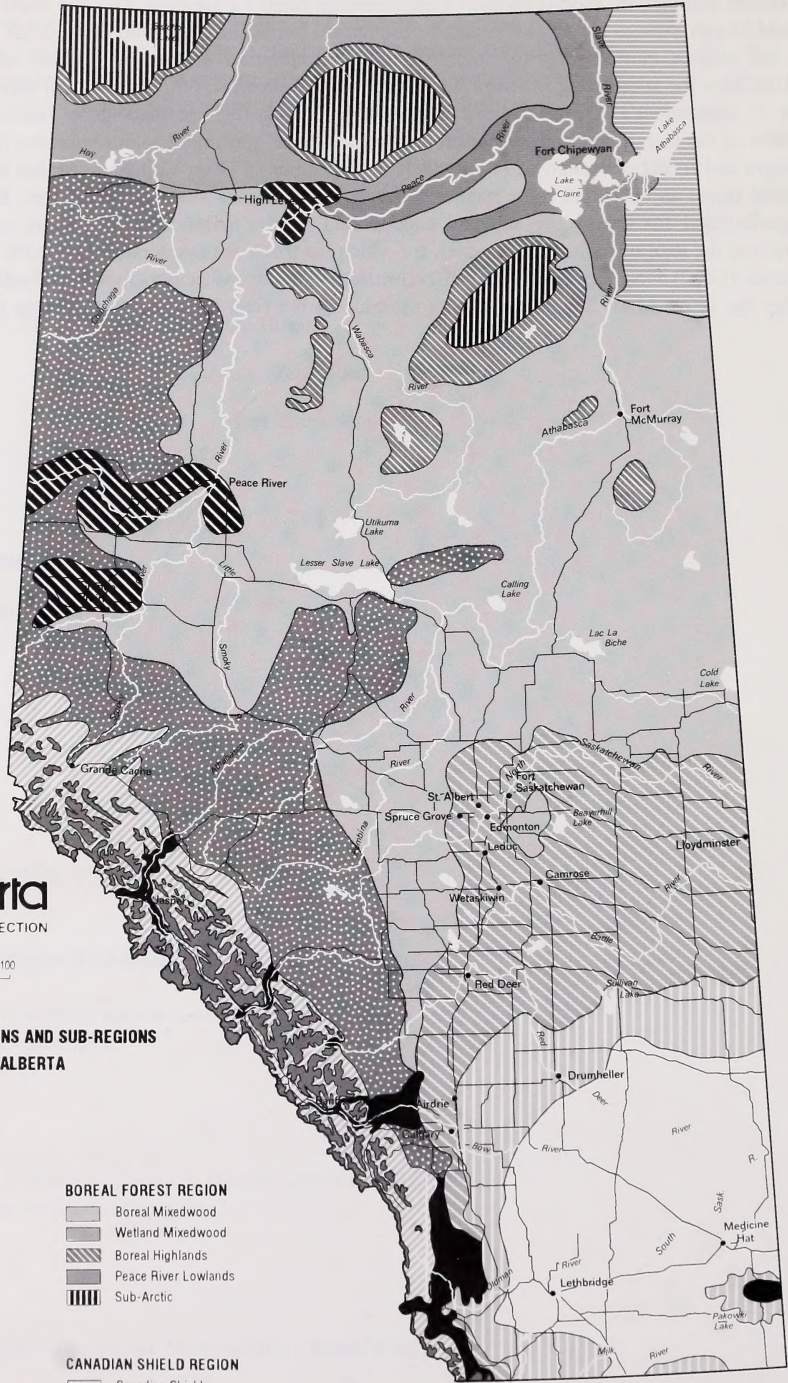
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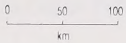
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Alberta

ENVIRONMENTAL PROTECTION



NATURAL REGIONS AND SUB-REGIONS OF ALBERTA

GRASSLAND REGION

- Mixedgrass
- ▨ Fescue Grassland

PARKLAND REGION

- ▨ Central Parkland
- ▩ Peace River Parkland

FOOTHILLS REGION

- ▨ Foothills

ROCKY MOUNTAIN REGION

- Montane
- ▨ Sub-Alpine
- ▩ Alpine

BOREAL FOREST REGION

- ▨ Boreal Mixedwood
- ▩ Wetland Mixedwood
- ▨ Boreal Highlands
- ▩ Peace River Lowlands
- ▩ Sub-Arctic

CANADIAN SHIELD REGION

- ▨ Canadian Shield

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Introduction

Species of the genus *Peltigera* are among the most conspicuous lichens in Alberta, as their lobes can reach 6 cm in width. They are easily recognized at the generic level by the noncorticate lower surface which bears characteristic veins. The genus probably "belongs to a particularly ancient group of ascomycetes" as suggested both by the high number of lichenicolous fungi reported only from its species (Hawksworth 1980) and by its worldwide distribution. It occurs in montane habitats in the tropics to the antipodal arctic tundra environments. The large species, such as *P. apthosa* or *P. neopolydactyla*, find their optimum on moist shaded forests floors and only a few, like *P. collina* and *P. horizontalis*, are reported as occasional epiphytes (outside Alberta). The smaller species, such as *P. lepidophora* and *P. didactyla*, grow often on bare mineral soil along trails or road sides.

At present the genus consists of about 60 species worldwide, but the taxonomy is poorly known. More extensive revisionary work over wider ranges, will certainly contribute to elucidating the full diversity of *Peltigera*. In his monograph of the genus for North America, Thomson (1950) recognized 35 taxa including 12 species, seven of which were subdivided into 30 infraspecific entities. With Ozenda and Clauzade's (1970) and Poelt's (1974) keys to the European lichens, attempts were made to recognize some of these varieties at the species level, even though the changes proposed in these two floras applied to different groups (*P. polydactyla* group and *P. canina* group, respectively). In the early 1980s, Vitikainen (1981) accepted 21 species in the European *Peltigera* flora (suggesting one new species, *P. kristinssonii*, that he would describe in 1985), and no infraspecific taxa. In the following decade, six additional species were reinstated or described from Europe and North America (Holtan-Hartwig 1988, Tønberg and Holtan-Hartwig 1983, Vitikainen 1985) and others await formal recognition (Goward et al. in prep., Holtan-Hartwig 1993). Considering the recent additions to the North American lichen flora (Brodo et al. 1987; for Weber 1990 see note under *P. didactyla* in text) 25 species of *Peltigera* are presently known from continental North America north of Mexico (Egan 1987), with *P. pacifica* being the sole endemic. Within North America, the genus reaches its highest diversity in British Columbia; its flora includes at least one new taxon in addition to all other taxa reported from the continent north of Mexico (Goward et al. in prep.).

Ostafichuk (1966), following Thomson's (1950) taxonomic concepts, reported 17 taxa including nine species,

three atypical varieties, and six forms from Alberta. Twenty three species (including two potentially new taxa) and one variety are here reported from Alberta; they occur mainly in the montane and boreal parts of the province and are almost lacking in the drier grasslands to the southeast. Most of these taxa were previously known from Alberta (Anonymous 1993, Brodo et al. 1987, Goffinet and Hastings *in press*, Ostafichuk 1966, Thomson 1950, Vitikainen 1985), except *P. neckeri* which is here reported as new to the province. The blue-green phototypes, *P. apthosa* and *P. venosa*, are reported for the first time for the province (the most continental localities known at present in North America). *Peltigera polydactyla* has its occurrence restricted to three localities. *Peltigera occidentalis*, reported from Alberta by Ohlsson (1973), is excluded from the flora.

The present floristic treatment is the first attempt made in light of recent taxonomic developments to summarize the diversity of the *Peltigera* species occurring in Alberta and to make available a comprehensive key to the local species of this taxonomically difficult genus. A morphological description is provided for all species and each is illustrated by photographs (based mostly on herbarium material). All Albertan specimens examined have been mapped. A discussion on variation and some information regarding ecology and distribution in Alberta follows each description. General distribution patterns for North America are based on literature and additional North American collections that were examined.

This is not a type-based revision and species concepts are defined largely on morphology. Chemical analysis was restricted to *P. didactyla s. lat.* (Goffinet and Hastings in press) and the *P. polydactyla* group *s. lat.* The chemical diversity of *Peltigera*, as revealed by Holtan-Hartwig's (1993) study of the Norwegian taxa, suggests that extensive research will be required to define chemotypes for the North American flora.

Methods

This study was based on traditional herbarium taxonomy. Approximately 1500 specimens from ALTA, CAFB, CANL, PMAE, and the personal herbaria of B. Goffinet and S. Harris, were examined. The range of the spore size indicates the mean length \pm 1 standard deviation based on measurements of 60 spores (except where otherwise stated) from three independent apothecia from Albertan material only; extreme observations are

in parentheses. Only mature spores, those ejected from the ascus through squashing in water, were measured. Species distribution in Alberta follows a format slightly modified from the "Natural Regions and Subregions of Alberta" developed by Achuff (1992).

How to use the key

Much of the terminology in the key will be unfamiliar if you are not used to working with lichens and even if you are, our interpretation of the characters may vary somewhat from what you are used to. Therefore, to familiarize yourself with the terminology used to describe *Peltigera* you should review the section "Taxonomic characters of the genus" before you attempt to use the key. When using the key, it is important to refer back to this section. Critical characters which appear in the key are printed in bold and described. Similar characters are described together so you can easily choose the correct character from a suite of alternatives. Many of the structures are illustrated with photographs.

Habit shots of all *Peltigera* which we recognize in Alberta are included with the species descriptions. These photos should be examined when using the key, not only to get a general idea of the form of a species but also because the photos often clearly illustrate critical taxonomic features.

Many *Peltigera* cannot be separated easily based on a single or small set of contrasting characters as presented in the key. We suggest that after using the key to make an initial determination, you should read the appropriate "Species Account." Here we give a more detailed analysis of the critical characters which define the species and we discuss other species with which it may be confused. A final determination can best be made after reviewing this discussion.

We have provided two appendices, one for the *canina* group, the other for the *polydactyla* group. These appendices should be consulted when a specimen has been determined to be a species from one of these two groups. The appendices provide a ready reference comparing and contrasting the character complexes which separate the species.

Although, for most part, the key is strictly dichotomous, we have occasionally provided a third alternative when a complex of characters makes separation of three species difficult. The third choice always leads directly to a species name. In such a situation, you should read the descriptions of all three species carefully, before making a final determination.

The tomentum and scabrosity of *P. kristinssonii* are often scarce and difficult to see. Therefore, we have included that species on each of the glabrous and tomentose as well as the smooth and scabrous paths.

Taxonomic characters of the genus

Upper cortex

In *Peltigera* the upper cortex is of the paraplectenchymatous type; the hyphae form a tissue-like layer. In most species of the *P. polydactyla* group, these superficial cells form an even layer, giving the cortex a **smooth** appearance. In *P. scabrosa*, clusters of hyphae continue to grow, forming little "warts" (Jahns 1973) and give the cortex a rough appearance; the upper surface is said to be **scabrous**. Individual cortical hyphae may further extend through the upper surface and form a **tomentum** of either erect (e.g., *P. malacea*) or branched (e.g., *P. rufescens*) glassy "hairs." In the absence of such tomentum, the upper surface is said to be **glabrous** (*P. polydactyla* group). The presence of tomentum is a critical taxonomic character. It should always be carefully checked as it is sometimes restricted to the extreme tip of the lobe.

Algal layer and cephalodia

The algae form a distinct layer below the upper cortex in most species of *Peltigera* (the thallus is **heteromerous** - layered); only in the blue-green phototype of *P. venosa* is the photobiont scattered (the thallus is then **homoimerous** - not layered). In the latter case, the thallus, when wet, becomes somewhat gelatinous and resembles a small species of *Leptogium*. The photobiont can either be a green algae, producing an apple green color to the thallus when wet (e.g., *P. aphthosa*) or a cyanobacteria, in which case the thallus is a bluish-grey color when wet (e.g., species of the *P. polydactyla* group). In the *P. aphthosa* group the association can involve three symbionts: the fungus and green algae make up the main thallus whereas cyanobacteria are concentrated in external structures called **cephalodia**. These corticate "warts" arise as cortical hairs growing around the "algal" cells they contact (Jahns 1973). Cephalodia can occur on the upper cortex (e.g., *P. aphthosa*, Fig. 15) or on the lower surface, in which case they are found on the veins (*P. venosa*, Fig. 88). Mature cephalodia can be flat, concave, or convex. In the latter case they are either **wart-shaped** with only their margins incised (e.g., *P. aphthosa*) or **cerebriform** (brain-like, *P. leucophlebia*) with incisions across the whole surface (Holtan-Hartwig 1993). The advantage for these species to develop cephalodia, mainly for nitrogen fixation, must be of crucial importance as all taxa with green algae

develop them. The mycobiont involved in these triple symbioses can develop two distinct phototypes. In the typical **green phototype** the thallus is made up mainly by the fungus and green algae, the cyanobacteria being restricted to the cephalodia. By contrast, in the rare **blue-green phototype**, the fungus and cyanobacteria form small lobules or lobes attached to the green thallus, or even an independent thallus which may or may not bear lobules, or lobes, of the green phototype. These blue-green counterparts are thought to be an alternative life history strategy for the lichen (Brodo and Richardson 1978, Ott 1988). Blue-green phototypes of *P. aphthosa*, *P. britannica*, and *P. venosa* are known from North America and Europe (Goward et al. in prep., Tønsberg and Holtan-Hartwig 1983). Armaleo and Clerc (1991) studied similar phototypes in southern temperate species of *Pseudocyphellaria* and *Sticta*. Their molecular analysis strongly suggests that the same mycobiont is involved in each of these symbioses. In British Columbia (Goward et al. unpubl. data), the blue-green phototypes of *P. aphthosa* and *P. britannica* appear to be restricted to extremely humid localities. So far, only two collections of blue-green phototypes are known from Alberta (see discussion under *P. aphthosa* and *P. venosa*).

The algal layer can be discontinuous in some taxa. The zones lacking the algal component are called **maculae**. The extent of the maculae is variable; they often form a rather inconspicuous network of whitish lines which are best seen through the cortex when the thallus is wet. In Western Canada, this situation is known to occur only in the blue-green phototypes of *P. britannica*, *P. aphthosa*, and in a few specimens from Vancouver Island belonging to the *P. polydactyla* group. Among Albertan taxa, some specimens included here under *P. neckeri* are somewhat maculate, whereas the blue-green phototype of *P. aphthosa* always has a distinctly maculate upper surface.

Veins and rhizines

Lobes of *Peltigera* lack a lower cortex; the medullary hyphae remain exposed. These hyphae can resume growth either extensively or locally and form **veins**. In the former case, the veins often anastomose, giving the appearance of a **veinless** lower surface with only a few scattered pits or **interstices**, (e.g., *P. malacea* or typical *P. aphthosa*). More often, however, a network (**reticulation**) of distinct veins forms. The veins can be narrow and raised (e.g., *P. membranacea*) or be broad and flat (e.g., *P. scabrosa*). Raised veins can either be rounded in section and have a ropy appearance (*Peltigera* sp. 1) or be rather angled and look like ridges (typical *P. aphthosa* or *P. retifoveata*). The hyphae making up the veins are either oriented along the axis of the veins (the veins are **glabrous**; e.g.,



Figure 1. Thread-like rhizines (*Peltigera praetextata*, Martiny July 1992, herb. Goffinet).

P. canina) or they can appear as short erect hairs covering the veins (the veins are **tomentose**; e.g., *P. membranacea*). Some hyphae from these veins may continue to grow and become organized into **rhizines** which attach the thallus to the substrate. We distinguish several types of rhizines. **Thread-like** rhizines (Fig. 1) represent the simplest form; they are unbranched and distinctive. **Fasciculate** rhizines are simple rhizines of various length organized into tight bundles (Fig. 2). **Penicillate** rhizines are arranged as short, spreading bundles that resemble a shaving brush (Fig. 3). More often the rhizines are branched. The degree and kind of branching varies among, but also within, species. In typical *P. canina*, a conspicuous central strand **abundantly branches** in all directions. Sometimes the branches are longest near the base and



Figure 2. Fasciculate rhizines (*Peltigera elisabethae*, Goffinet 3083, herb. Goffinet).



Figure 3. Penicillate rhizines (*Peltigera scabrosa*, Nyland 140, CAFB).

become gradually shorter towards the apex of the rhizine; at other times the rhizines only branch apically (Fig. 4). In *P. retifoveata*, the rhizines also branch abundantly, but the branches are shorter and more or less at right angles to the main axis (Fig. 5). These rhizines are **squarrosely branched** or tomentose. Finally, the rhizines may be poorly defined and appear only as loosely branching hyphae (e.g., *P. didactyla* var. *extenuata*, Fig. 6); these rhizines are **fibrillose**. The rhizines can be scattered (e.g., *P. membranacea*) or anastomose in which case they become **confluent** and either form rows or a more or less dense hyphal mat on the lower surface (e.g., *P. rufescens*, Fig. 83).

The hyphae which form veins and rhizines are often pigmented, their color varies from whitish (technically an absence of pigments) through grades of brown to black. Even within a species the color may change from the margin toward the centre and may vary with

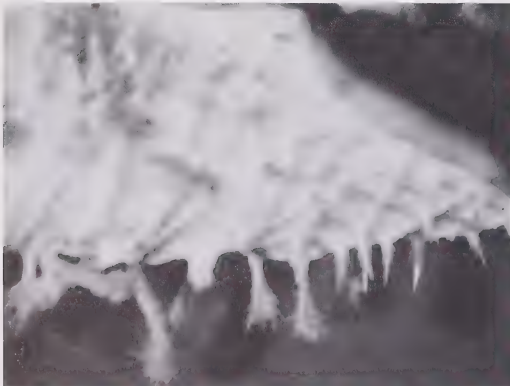


Figure 4. Apically branched rhizines (*Peltigera canina*, Goffinet 1557-2; herb. Goffinet).

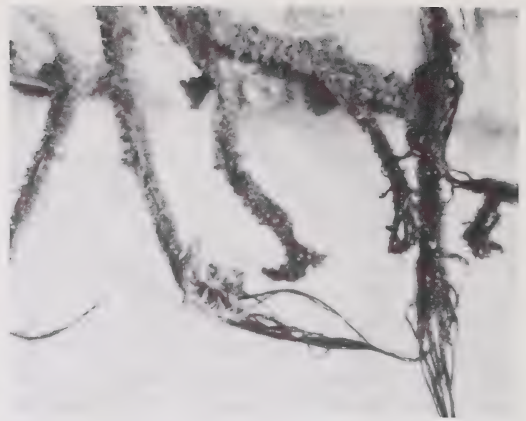


Figure 5. Squarrosely branched rhizines (*Peltigera retifoveata*, Goward 81-1533, ALTA).

locality. It is not yet clear if these variations can be accounted for by the nature of the substrate the lichen colonizes, as has been suggested by Olech and Alstrup (1988) for *P. lactucifolia*.

Lobe shape

The lobes of most species appear rather broad and rounded, only rarely do they seem elongate (as in some forms of *P. praetextata*). Most taxa have spreading lobes but some species, particularly the more xerophytic ones, have strongly concave (*P. lepidophora*) or even erect lobes (*P. rufescens* and some forms of *P. malacea*). In some species the fertile lobes are erect and supported by strong, ropy veins. These often differ from veins found on mature, sterile lobes. This phenomenon is particularly obvious in *P. rufescens*. The thickness of the thallus varies from extremely thick (in which case the lobes are often stiff and brittle; e.g., *P. aphthosa*) to membranous or papery (the



Figure 6. Fibrillose rhizines (*Peltigera didactyla* var. *extenuata*, Hastings C90.5.20b, PMAE).

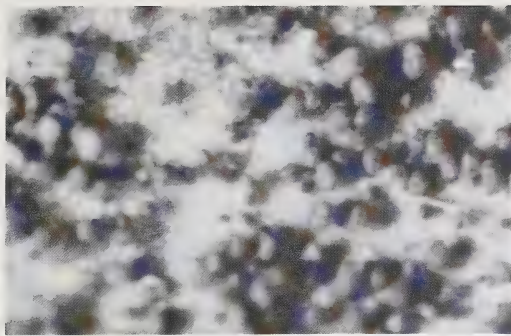


Figure 7. Granular isidia (*Peltigera evansiana*, Goffinet 3464, herb. Goffinet).

lobes are then rather fragile; e.g., *P. membranacea*). Lobe width is a taxonomically useful character (e.g., to segregate taxa within the *P. canina* group). It is measured between two adjacent sinuses at the base of a lobe.

The margin is a critical character among species of the *P. canina* group. As distinguished here, a margin may either be **plane** (e.g., *P. elisabethae*), **down-turned** (e.g., *P. membranacea*), or **up-turned** (e.g., *P. rufescens*). In some cases, the lobe can be deeply concave giving the impression of an overall upright margin, but even in these specimens the extreme tip of the lobe can be pointing downwards (e.g., *P. canina*, Fig. 20). The margin is considered plane when the lobe is deeply concave and the margin does not form a distinct angle with the lobe, but appears to extend it.

Isidia, phyllidia and regeneration lobules.

Isidia occur in three species: *P. evansiana*, *P. lepidophora*, and *P. praetextata*. Their development in the latter two species has been investigated by Lindahl (1960) and Linkola (1913, 1923). In *P. evansiana* the isidia are mostly erect, **club-shaped** or **granular**, and corticate all around (Fig. 7). These isidia are radially symmetrical. In the two other taxa, the isidia are mainly dorsiventral, with the lower surface being ecor-

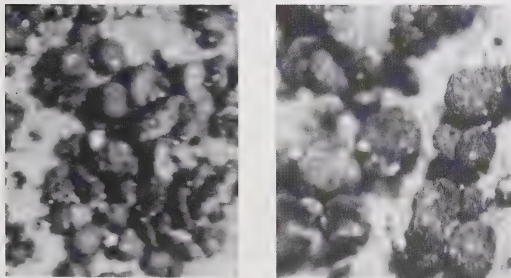


Figure 8. Peltate isidia (*Peltigera lepidophora*, Marsh, B86.141.123, PMAE).

ticate. In *P. lepidophora*, the isidia are peltate. They are disc-shaped, attached at the centre and thus mostly horizontal (Fig. 8). In *P. praetextata*, the isidia are squamulose, constricted at their base, and mostly erect; they are often referred to as **phyllidia** (Fig. 9).

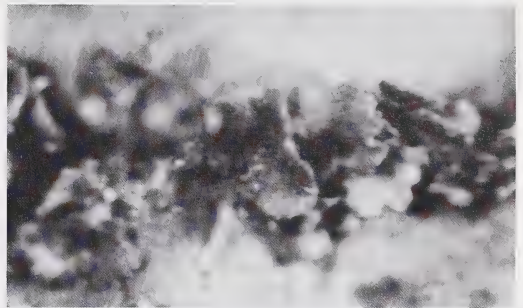


Figure 9. Phyllidia (*Peltigera praetextata*, Martiny July 1992, herb. Goffinet).

Regeneration lobules differ from phyllidia by their rather knobby appearance and seem to develop only in response to damage or stress. These structures appear similar to the isidia of *P. evansiana*, but differ by being more robust and restricted to cracks and wounds (Fig. 10). Recent observations (Goffinet 1992 and pers. obs.; Goward et al. in prep.; Holtan-Hartwig 1993) suggest that all species of *Peltigera* may develop these lobules.

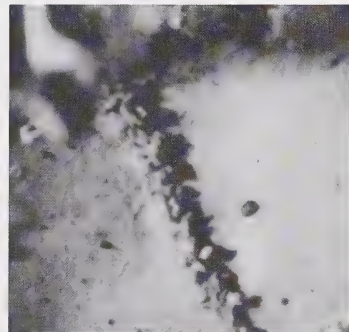


Figure 10. Regeneration lobules (*Peltigera elisabethae*, Goffinet 3083, herb. Goffinet).

Soralia

Soredia are granular, non-corticate outgrowths of the algal layer that are organized into **soralia**. In Alberta, these structures occur in two species: in *P. collina*, the soralia develop mainly along the lobe margin (Fig. 11), whereas in *P. didactyla* they are exclusively laminal (**maculiform** soralia; Fig. 12). Soredia can develop into isidia while still on the soralia; in this case the soralia are said to be **isidiferous** (e.g., *P. didactyla*).

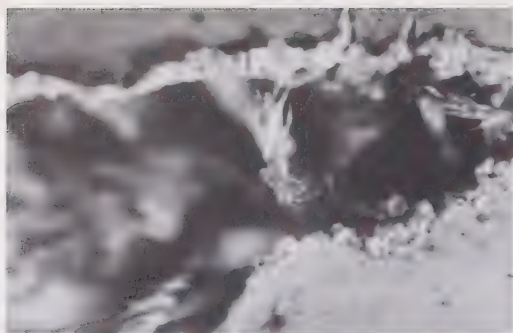


Figure 11. Marginal soredia (*Peltigera collina*, Pegg B88.2.55, PMAE).

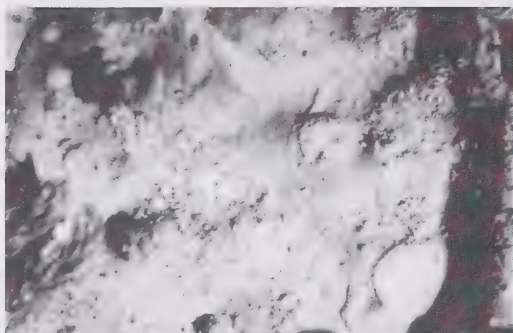


Figure 12. Laminal soredia (*Peltigera didactyla* var. *extenuata*, Hastings C90.5.20b, PMAE).

Soredia are not produced invariably by either of these taxa and cannot be used as a sole taxon-specific character.

Schizidia

Schizidia are found only in *P. elisabethae* (Fig. 13). The cortex, the underlying algal layer, and part of the medulla all peel off near the lobe tip or along cracks, leaving the remaining medullary hyphae exposed. In some specimens of *P. praetextata* with narrow and somewhat lacerate lobes, the medulla is often exposed along the margin. Such observations have been related to the development of schizidia (Purvis et al. 1992). However, it seems that these features are due to the "contortion" of the lobes, as large specimens (atypical for Alberta) with wide spreading lobes, are lacking such patches of exposed medulla. The cortex of *P. neckeri* is often cracked as well and the upper layers are slightly raised but do not split off to form schizidia.



Figure 13. Schizidia (*Peltigera elisabethae*, Goffinet 3083, herb. Goffinet).

Apothecia and spores

Apothecia are commonly produced by most species of *Peltigera*. The roundish disk is either **horizontal** (e.g., *P. horizontalis*), **finger nail-shaped** (e.g., *P. neckeri*) or even **saddle-shaped** (e.g., *P. rufescens*). Their color varies from brown to almost black. Jahns and Frey (1982) have shown that the thallus must reach a minimum size for the formation of the first apothecial primordia, "after which the development of the fruit bodies inhibits the growth of the supporting thallus lobes." Typically, the apothecia are developed on elongating lobes. The lobe length seems to be genetically determined, making it of taxonomic use (e.g., in the *P. polydactyl* group). The lower surface of the apothecia typically lacks a cortex. However, all species of the *P. aphthosa* group are characterized by the development of at least a patchy cortex on the lower surface of the apothecia (Fig. 14).

Each ascus produces eight colorless spores. The ascus apex and spore release have been thoroughly described by Honegger (1978). The spores can be acicular in shape (e.g., *P. neckeri*) or narrowly elliptical

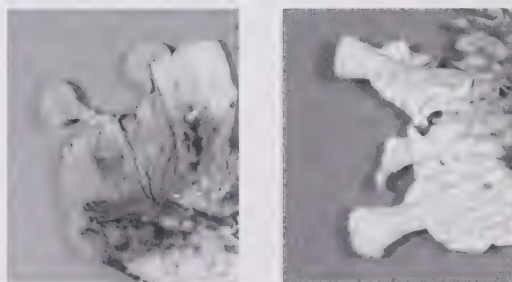


Figure 14. Lower surface of apothecia. Left - continuous cortex (*Peltigera aphthosa* Turner 11257, ALTA), right - patchy cortex (*Peltigera leucophlebia* Kennedy Sept. 6, 1961, ALTA).

(*P. venosa*). They vary in size, from 20-125 x 2.5-5 µm, and are most often four-celled. In some species (e.g., *P. aphthosa*) the protoplasm commonly appears "constricted," probably through pressure by the vacuole. In such cases the constriction resembles a septum and can be misleading when determining the number of cells per spore. Taxonomically, the use of spore characters is limited to distinguishing groups of species (*P. horizontalis*-*P. elisabethae* versus *P. polydactyla s. lat.*), rather than individual species.

Chemistry.

The genus *Peltigera* is characterized by its diverse secondary metabolites. Holtan-Hartwig (1993) in a revision of the Norwegian taxa containing secondary substances, reports 43 compounds, including 30 unidentified terpenoids and depsides. Chemical patterns can be species specific (e.g., *P. neckeri*) or be shared by closely related taxa (e.g., *P. elisabethae* & *P. horizontalis*), in which case their taxonomic use is lim-

ited to separating groups of species (Holtan-Hartwig 1993). In the present study, only a restricted number of taxa were analyzed by thin layer chromatography, mainly specimens of *P. polydactyla s. lat* and *P. didactyla s. lat*. More work is needed before a specific chemical description will be available and useful taxonomically for the identification of Albertan *Peltigerae*. Spot tests are not very useful for distinguishing species of *Peltigera*. The only positive test observed so far, is the C+ or KC+ red reaction due to the presence of gyrophoric acid in species of the *P. polydactyla* group and certain taxa or forms in the *P. canina* group. The spot test is, nevertheless, unreliable as gyrophoric acid is often only present in trace amounts. Goffinet & Hastings (in press) suggest that this depsidone may not accumulate in the thallus because it is rapidly processed into methyl gyrophorate, which is often produced in addition to gyrophoric acid in *Peltigera* species.

Artificial Key to the Species

1. Thallus homoiomerous, containing cyanobacteria, attached to the green phototype of *P. venosa*; resembling a small *Leptogium*; veins always absent *P. venosa* (blue-green phototype)
 Thallus heteromerous, containing green algae and/or cyanobacteria; veins often distinct 2

2. Photobiont green algae; cephalodia containing cyanobacteria present on lower or upper surface 3
 Photobiont cyanobacteria; cephalodia absent 5

3. Thallus small, 1 to 1.5 cm in diameter; apothecia marginal, on non-elongated lobes and horizontal or slightly concave; cephalodia on veins on the lower surface *P. venosa*
 Thallus broad, lobes 2 to 3 cm wide; apothecia on elongate lobes, saddle-shaped; cephalodia laminal on upper surface 4

4. Lower surface with a distinct network of dark veins contrasting with whitish elongate interstices; cortex on the underside of apothecia never continuous; thallus thin in the centre *P. leucophlebia*
 (if lower surface has pale broad veins extending toward centre, see snow-form of *P. aphthosa*)
 Lower surface with no distinct veins, or with broad anastomosing veins, separated by few pale to dark, deep, lenticular interstices, whitish near margin and black toward centre; cortex on lower surface of apothecia continuous or not; thallus thick in the centre *P. aphthosa*

5. Thallus attached to lobes of *P. aphthosa*, or bearing lobules with green algae, or growing independently; cortex distinctly maculate (best seen when wet); erect hairs present on at least some lobe tips *P. aphthosa* (blue-green phototype)
 Thallus never attached to or bearing lobes containing green algae; cortex not distinctly maculate, if so, then lobes glabrous 6

6. Thallus bearing soralia 7
 Thallus lacking soralia 9

7. Soralia mainly marginal *P. collina*
 Soralia exclusively laminal 8

8. Thallus small, brownish-dark grey, when young usually a single deeply concave lobe; veins whitish to brownish towards centre; rhizines mostly simple; older thalli abundantly fertile with apothecia on erect elongated lobes; medulla KC- *P. didactyla* var. *didactyla*
 Thallus broad, light grey, flat; lower surface with whitish veins; rhizines fibrillose; apothecia extremely rare; medulla KC+ red (flashing, best seen when soredia are removed from young soralia) *P. didactyla* var. *extenuata*

9. Thallus with isidia, phyllidia, or schizidia 10
 Thallus lacking isidia, phyllidia, and schizidia 13

10. Thallus glabrous; lobe margin with schizidia; lower surface blackish with a few white dots, without distinct veins	<i>P. elisabethae</i>
Thallus tomentose; lobe margin without schizidia; lower surface with distinct white to brown veins	11
11. Thallus small, 1 cm wide, rarely larger than 2 cm, concave, often unilobate; with peltate (rarely erect) isidia	<i>P. lepidophora</i>
Thallus broad, more than 2 cm wide, always multilobate; with phyllidia or club-shaped to granular isidia	12
12. Thallus with isidia; these exclusively laminal and diffuse, becoming dense toward lobe apices and mostly lacking toward centre; isidia globular and short, constricted at the base, occasionally somewhat squamulose toward centre of lobe; thallus flat, light grey when dry; lobe margin typically downturned	<i>P. evansiana</i>
Thallus with phyllidia; these in laminal clusters or in rows both along margins and cracks (lobules) toward the centre of the thallus; thallus crisped, brown when dry; lobe margin often upturned or plane	<i>P. praetextata</i>
13. Thallus tomentose	14
Thallus glabrous	24
14. Tomentum of erect hairs (best seen near margin, look for sheltered lobe tips)	15
Tomentum of appressed, branched hairs	16
15. Lower surface with broad anastomosing veins and few if any interstices, abruptly darkening from a whitish margin; upper surface smooth	<i>P. malacea</i>
Lower surface with dark, distinct veins throughout; upper surface scabrous at least near lobe tip	<i>P. kristinssonii</i>
16. Lobes broad, wider than 1.5 to 2 cm	17
Lobes smaller, never exceeding 1.5 to 2 cm in width	21
17. Lower surface with flat, soft veins, these almost as broad as interstices; interstices deep and lenticular; rhizines densely squarrosely branched	<i>P. retifoveata</i>
Lower surface with somewhat rounded, compact veins, these much narrower than interstices; interstices diamond shaped and shallow; rhizines variously branched, if squarrosely branched then veins narrow and raised and thallus papery	18
18. Veins typically very narrow, sharp and strongly raised, at least patchily covered with erect hairs, loosely reticulate, whitish throughout, rarely becoming dark brown; rhizines squarrosely branched rarely thread-like, scattered; thallus very thin, papery	<i>P. membranacea</i>
Veins broad and somewhat raised, never strongly so on sterile lobes, rarely covered by erect hairs and, if so, only near margin, rather neatly reticulate, pale, rusty or dark brown, if whitish then thallus thick and robust; rhizines variously branched but never squarrose, anastomosing or not; thallus variously thick, but never papery	19

19. Rhizines densely branched or thread-like (near margin), at least patchily anastomosing and mat-forming; tomentum typically extending to centre of lobe *P. canina*
 Rhizines thread-like or somewhat branched, never confluent; tomentum almost always thinning toward centre of lobe 20
20. Rhizines thread-like, never branched; veins becoming distinctly rusty cinnamon-colored toward thallus center, without hairs; phyllidia absent; margin mostly plane *P. cinnamomea*
 Rhizines thread-like or branched; veins pale to dark brown, but never cinnamon-colored, occasionally covered with erect hairs near margin; phyllidia frequent on mature lobe surface and along cracks and margin (lobules); margin wavy and often upturned *P. praetextata*
21. Lower surface with black, short, densely branched, and typically anastomosing rhizines (if rhizines simple then mostly blackish); veins dark brown to almost black; upper surface with thick tomentum often extending toward lobe centre, encrusted or pruinose in the centre; apothecia saddle-shaped *P. rufescens*
 Lower surface with white to brown rhizines; veins pale throughout or darkening only gradually toward centre, scattered, if anastomosing then rhizines fibrillose; upper surface with thin tomentum gradually disappearing toward centre, never encrusted or pruinose; apothecia finger nail-shaped or horizontal 22
22. Lower surface with white, thick, typically strongly raised veins; apothecia plane; rare *P. ponojensis*
 Lower surface with white and gradually darkening, flat to somewhat raised veins (on sterile lobes); apothecia saddle-shaped or finger nail-shaped; common 23
23. Thallus small, to 5 cm across, typically strongly concave, mostly unilobate or with erect apothecia bearing lobes, sterile branched lobes rare, when young usually a single deeply concave lobe, older thalli abundantly fertile, with apothecia bearing lobes erect and clustered as finger-like projections; soredial scars often present toward centre of main lobe, phyllidia never developed. *P. didactyla* var. *didactyla*
 Thallus large, to 15 cm across, appressed, mostly abundantly branched, apothecia bearing lobes not clustered, less abundant than sterile ones; thallus often bearing phyllidia toward centre, soredial scars absent. *P. praetextata*
 (if phyllidia absent and rhizines densely fibrillose see *P. didactyla* var. *extenuata*)
24. Upper surface scabrous; veins darkening gradually; rhizines penicillate *P. scabrosa*
 Upper surface smooth, sometimes pruinose near margin; veins and rhizines various; if upper surface scabrous then rhizines thread-like and/or veins soon becoming dark brown to almost black 25
25. Lower surface pale throughout or only darkening gradually toward centre; veins strongly raised. *P. sp.1*
 Lower surface mostly dark throughout (except near margin), if gradually darkening toward centre, then veins only somewhat raised but more often flat 26
26. Specimen bearing apothecia 27
 Specimen lacking apothecia 32

27. Apothecia horizontal; spores less than 45 μm long, almost always triseptate; rhizines in concentric lines at least near margin	28
Apothecia finger nail-shaped or saddle-shaped; spores longer than 45 μm , tri- to pluriseptate; rhizines scattered	29
28. Lower surface with a distinct network of dark brown veins, upper surface often with pits opposite the rhizines; schizidia absent; rare	<i>P. horizontalis</i>
Lower surface blackish with a few white dots, without distinct veins, upper surface smooth but with numerous cracks; lobe margin with schizidia; common	<i>P. elisabethae</i>
29. Upper surface dull, scabrous, and with sparse erect tomentum near margin (look at sheltered tips); lower surface with a distinct network of dark brown, tomentose veins; rhizines fasciculate to abundantly branched	<i>P. kristinssonii</i>
Upper surface shiny, smooth and glabrous, but sometimes pruinose; veins distinct or not, never tomentose; rhizines thread-like to penicillate, never abundantly branched	30
30. Thallus large, to 15 cm across; lobes up to 3 cm wide; upper surface typically dull; rhizines thread-like, 7-10 mm long, especially near the centre	<i>P. neopolydactyla</i>
Thallus medium-sized, to 10 cm across; lobes less than 2 cm wide; upper surface typically very shiny; rhizines short, to 5 mm long	31
31. Apothecia brown, on elongate and somewhat canaliculate lobes; lobe margin not pruinose; veins brownish, remaining distinct almost to centre; rare	<i>P. polydactyla</i>
Apothecia black, on short lobes; lobe margin often pruinose; veins blackish, broad, and often anastomosed; common	<i>P. neckeri</i>
32. Rhizines near margin fasciculate and arranged in concentric lines; schizidia present or absent	33
Rhizines near margin fasciculate or not, not arranged in concentric lines; schizidia always absent	34
33. Lower surface abruptly turning blackish; veins indistinct; upper surface smooth, with numerous cracks; schizidia and/or regeneration lobules; margin often pruinose	<i>P. elisabethae</i>
Lower surface rather gradually turning brown; veins distinct, at least toward margin; upper surface with pits opposite rhizines; cracks (except in excessively pressed specimens), schizidia, and regeneration lobules absent; margin not pruinose	<i>P. horizontalis</i>
34. Upper surface scabrous, bearing erect hairs (check sheltered lobes); veins dark brown to almost black, tomentose, distinct, highly contrastive with pale interstices	<i>P. kristinssonii</i>
Upper surface smooth, glabrous; veins indistinct, glabrous, if contrastive with interstices then veins brown but not dark brown or black	35
35. Upper surface dull; rhizines to 7 mm long, thread-like; lobes typically to 3 cm wide	<i>P. neopolydactyla</i>
Upper surface very shiny; rhizines short, to 5 mm long, thread-like, fasciculate, or somewhat branched; lobes less than 2 cm wide	36
36. Lower surface with indistinct veins, soon turning blackish; cortex often pruinose near margin; common .	<i>P. neckeri</i>
Lower surface with distinct, brown veins; cortex not pruinose; rare	<i>P. polydactyla</i>

Species Accounts

Peltigera aphthosa (L.) Willd.

Illustrations: Figs. 15-18, map: Fig. 19.

A. The green phototype

Morphology: *Thallus* medium to large, loosely appressed to the substrate; lobes to 5 cm wide, branching, most often strongly concave, thick, brittle when dry, margin entire, rarely somewhat crenulate, plane to upturned, often bordered by a white line corresponding to the probably faster growing medulla. *Upper surface* typically shiny (dull in exposed habitats), apple green when wet, greenish- to bluish-grey when dry, often with brownish tint toward centre, typically wavy, covered with partly erect hairs near margin only, cephalodia to 2 mm wide, adnate, flat to convex, sometimes lobulate (with marginal incisions) but always attached through their whole surface to the cortex. *Lower surface* typically turning abruptly dark brown to blackish from a whitish cottony marginal zone, rarely pale throughout, with very broad, raised, somewhat angled, veins (ridges), separated by a few, lenticular to elliptic and deep, whitish, greyish to dark interstices, veins rarely distinct to the margin; rhizines to 5 mm, blackish throughout, rarely pale, typically confined to mature part of the lobes, densely branched and often anastomosing. *Photobiont*, green algae. *Apothecia* common, with chestnut to dark brown disk, to 1.4 cm wide, with at least somewhat revolute to



Figure 15. *Peltigera aphthosa* lower surface (left) and upper surface (right) of lobes and apothecia. The cephalodia appear as dots on the upper surface. (Turner 11257, ALTA.)

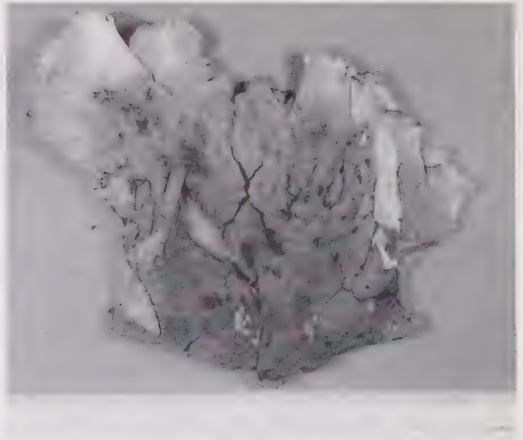


Figure 16. *Peltigera aphthosa* lower surface with no interstices, veins anastomosed throughout. (Ostafichuk 227-2, ALTA.)

saddle-shaped margins, on narrow, elongate lobes, lower surface continuously corticate or not, cortex pruinose-scabrous; spores acicular, (53-) 61-75 (-86) x 3.5-5 μm , mostly four-celled.

Variation: *Peltigera aphthosa* is among the most plastic species in the genus. Typically, in mesic habitats, the lower surface appears veinless or nearly so,



Figure 17. *Peltigera aphthosa* lower surface with interstices conspicuous and lenticular. (Marsh 1342, ALTA.)

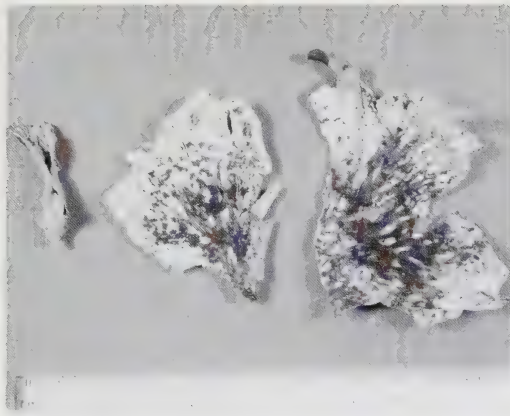


Figure 18. *Peltigera apthosa* lower surface of atypical form with veins pale, rather distinct and only gradually darkening toward centre. Referred to in text as snow-form. (Goffinet 1417, herb. Goffinet.)

with a distinct transition from the whitish marginal zone to the blackish central part of the thallus (Figs. 16-17). A line could almost be drawn along this transition. In habitats with heavy snow cover, however, the veins are mostly pale and extend toward the centre; they darken only gradually (Goward et al. in prep.) (Fig. 18). In Alberta, these "snow forms," which may represent a distinct taxon (Goward et al. in prep.), are restricted to the Rocky Mountains and Swan Hills. *Peltigera leucophlebia* is similar to these chionophilous morphotypes, but can be distinguished by its patchy lower cortex of the apothecia and its veins. These veins are typically distinct throughout the lobe and dark almost to the margin; they contrast highly with the wide and elongate interstices (see discussion under that species). Further, the two species can be segregated by the shape of the cephalodia (Holtan-Hartwig 1993). In *P. apthosa* the cephalodia are flat to wart-shaped compared to cerebriform in *P. leucophlebia*. However, we have refrained from using this as a sole taxonomic character.

Thomson (1984) has suggested that *P. leucophlebia* is a variety of *P. apthosa* (*P. apthosa* var. *leucophlebia* Nyl.) due to the transitional forms found between the two typical extremes. However, intermediate morphotypes between *P. apthosa* and *P. leucophlebia* may represent varying degrees of introgression between these two species (Goward et al. in prep.). Further, whereas Thomson (1984) and Gowan and Brodo (1988) do not refer to the difference in the cortex layer on the lower surface of the apothecia, Vitikainen (1981) and Holtan-Hartwig (1993) consider it to be a species-specific character—the layer being continuous in *P. apthosa* versus patchy in *P. leuco-*

phlebia (Figs. 15 & 50 respectively). In Alberta, we have found specimens which have characters typical of *P. apthosa* (abrupt transition in color of the lower surface, rather indistinct ridges) but with a patchy, warty cortex on the underside of the apothecia. It could either be argued that such apothecia are not yet mature, and thus the algal layer has not yet been completely developed, or that these specimens result from hybridization. Until the extent of the cortex on the lower surface of the apothecia can be related to chemical patterns, or until the development of the lower cortex is studied during apothecia maturation, we consider such forms to belong to *P. apthosa*. Thus, in *P. apthosa*, we consider the cortex of the lower surface of the apothecia to be typically continuous, but occasionally patchy. By contrast, it is invariably patchy in *P. leucophlebia*.

Ecology: Widespread and common in moist to wet boreal and montane forests. Growing in moist shrublands in boreal forest to alpine sites, Black Spruce and larch wetlands, and in moist hollows in drier forests such as spruce-pine on dunes. Commonly growing over feathermosses and often on litter, only very rarely on soil.

Distribution in Alberta: Occurring from the northern and western edge of the Central Parkland, *P. apthosa* is abundant in the Foothills, Montane, Subalpine, and Alpine natural regions (Fig. 19). North from the Parklands, it has also been collected throughout the Boreal Mixedwood. In the far north, scattered collecting sites indicate its presence in Wetland Mixedwood, Peace River Woodlands, and Canadian Shield, as well as the higher elevation Boreal Highlands and Subarctic subregions. *Peltigera apthosa* is probably more common in the northern part of the province than indicated. This species is among the most common *Peltigera* in Alberta; it is abundant over its range.

Distribution in North America: This circumpolar species is widespread throughout boreal, arctic, and alpine North America (see also map in Thomson 1984, under *P. apthosa* var. *apthosa*). *Additional specimens seen (ALTA):* Canada: British Columbia, Manitoba, Newfoundland, Northwest Territories, Ontario, Quebec, Saskatchewan, and the Yukon Territory; U.S.A.: Alaska, Colorado, Michigan, Minnesota, New Hampshire, Washington, and Wyoming.

B. The blue-green prototype

In Alberta, the blue-green counterpart of *P. apthosa* is known from a single specimen collected recently in the mountains (Harris 328, UAC). The material consists of small blue-green lobes only and does not allow a formal morphological description. Neverthe-

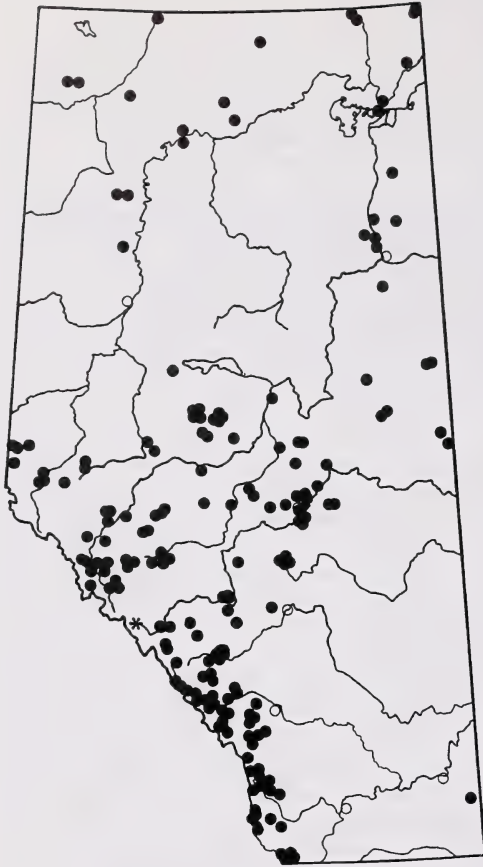


Figure 19. Distribution of *Peltigera aphthosa* in Alberta (solid dots: green phototype; star: blue-green phototype).

less, based on the distinct maculate cortex, there is little doubt as to the identity of the specimen. Typical material, as it is known from British Columbia, is either attached to lobes or bears lobules containing green algae (typical, green phototype of *P. aphthosa*). The blue-green lobes can either be glabrous or slightly tomentose towards the tip, in which case the glassy hairs are erect. In the former case, the phototype could be mistaken for either *P. neckeri* or *P. elisabethae*, whereas tomentose specimens would seem similar to *P. malacea* or *P. kristinssonii*. In either case, the blue-green phototypes can be correctly identified based on the connections to green lobes or lobules, and when the thallus is independent on the distinct maculate cortex.

Distribution in Alberta: This phototype is known only from a single locality in the Montane subregion of the Rocky Mountains (Fig. 19).

Distribution in North America: Blue-green phototypes of *P. aphthosa* are so far only known from humid localities in British Columbia, Oregon, and Washington (Goward et al. in prep.). The locality in Alberta is the most continental site known for this phototype.

Peltigera canina (L.) Willd.

Illustrations: Figs. 20-22, map: Fig. 23. Appendix I.

Morphology: *Thallus* medium to large, to 30 cm wide, rather loosely attached to the substrate; lobes to 3.5 cm wide, branching, flat to concave near margin, robust when dry, margin entire and downturned, rarely plane. *Upper surface* dull, light grey, greyish-brown, or more rarely brown, smooth, with thick, appressed tomentum typically extending toward centre of thallus, and occasionally encrusted or pruinose near centre. *Lower surface* pale whitish near margin, gradually turning brownish to dark brown toward centre, rarely remaining pale throughout, veins distinct, glabrous, broad and flat, often raised near margin, interstices whitish, elongate to diamond-shaped; rhizines to 8 mm, concolorous with veins, thread-like near margin but typically soon abundantly branching (bushy), sometimes only apically (Fig. 4), or penicillate, only observed once as being tomentose, often anastomosing near margins. *Photobiont*, cyanobacteria. *Apothecia* common, disk chestnut brown, between 4 and 9 mm wide, rarely larger (12 mm), saddle-shaped, on narrow

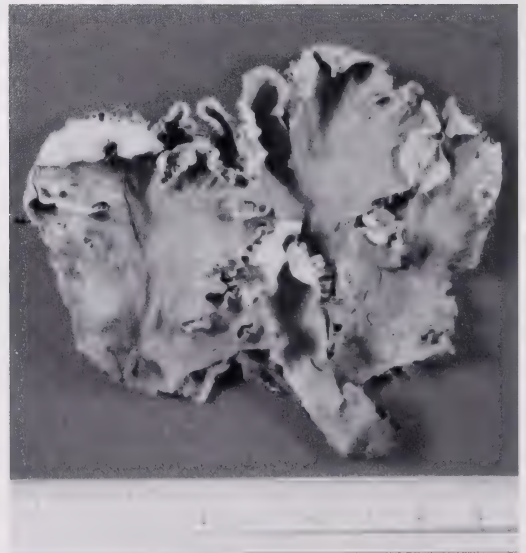


Figure 20. *Peltigera canina* habit. The lobes are strongly concave with a downturned margin. (Goffinet C90.4.172, herb. Goffinet.)

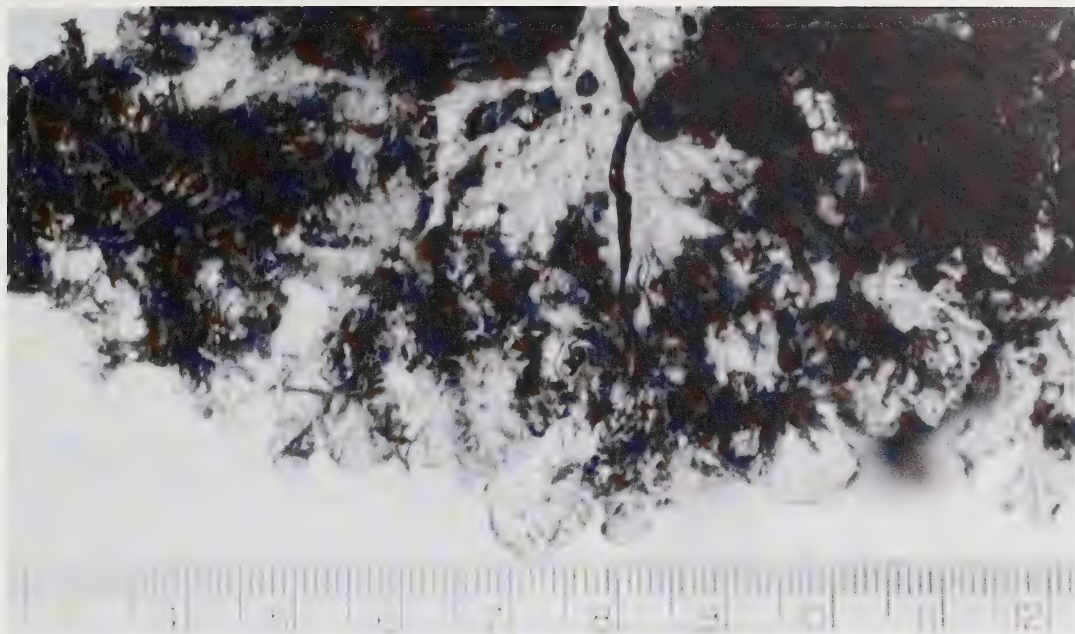


Figure 21. *Peltigera canina* lower surface. It has pale veins and scattered, branched rhizines near the margin. (Sérusiaux July 1990, herb. Goffinet.)

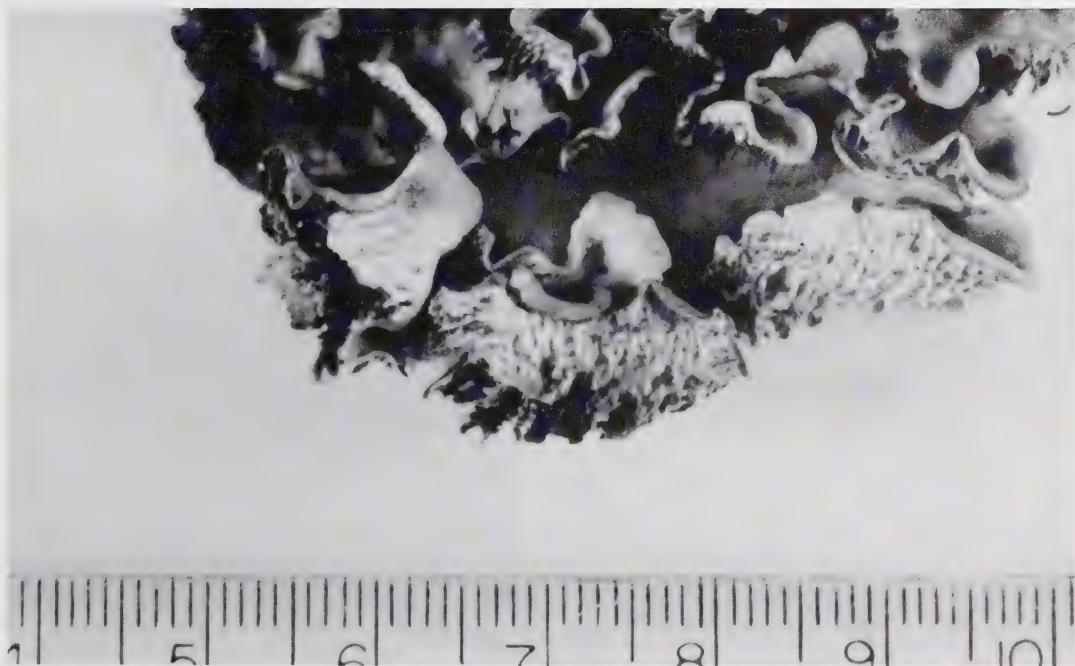


Figure 22. *Peltigera canina* lower surface near margin. Note the variation in the degree of branching and color of the rhizines; scattered and whitish on the right and anastomosed and dark on the left. The veins of the apothecia bearing lobes are strong and rosy. (Goffinet 1557-2, herb, Goffinet.)

elongate lobes; spores acicular (39-) 44-54 (-59) x 3-4 μ m, invariably four-celled.

Variation: The *Peltigera canina* group *s. lat.* includes eight species. Most of these show high phenotypic plasticity making it the most difficult group taxonomically. *Peltigera retifoveata* (with its foveate lower surface) and *P. didactyla* (typically bearing soredia) are easily recognized. The remaining taxa (*P. canina*, *P. cinnamomea*, *P. membranacea*, *P. ponojensis*, *P. praetextata*, and *P. rufescens*) are often split between two groups according to the size of their lobes. This character, however, is unreliable when immature specimens are collected. The species differ significantly in

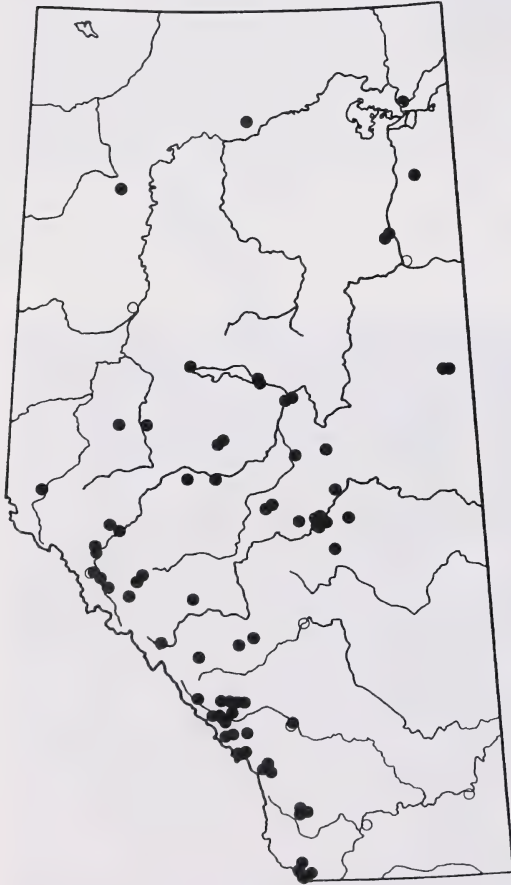


Figure 23. Distribution of *Peltigera canina* in Alberta.

the morphology of their lower surface, and further, with field experience, habitat and growth form can often prove useful for separating the species (Appendix 1).

Typical material of *P. canina* differs from related species by its downturned margin, the low and glabrous veins, and the abundantly branched and anastomosing rhizines (Figs. 21 & 22). *Peltigera canina* is most commonly mistaken for *P. rufescens*. The latter species, however, has an upturned margin, typically dark and abundantly branched rhizines even near the margin, and its lobes never extend beyond 1.5 cm. As is probably true for all species of *Peltigera*, *P. canina* can sometimes produce regeneration lobuli. In Alberta, these were observed only once (Ostafichuk 260-8, ALTA), but characters such as the branching of the rhizines allowed for no confusion with *P. praetextata* (see discussion under that species). Another collection from the alpine zone (Pegg B88.2.41 PMAE) had strongly raised veins as well as strongly tomentose rhizines. This collection was nevertheless kept as *P. canina* because of its broad veins and thick lobes, characters that distinguish it from *P. membranacea*.

Ecology: Occurring in dry to moist sites ranging from roadside embankments to pine-spruce forests. Common on litter and mosses in pine, pine-spruce, and White Spruce-Balsam Fir forests. Also on dry soil and burned or rotten wood. Occasionally occurring on moist litter in alpine shrublands, and rarely in Black Spruce and Aspen Poplar forests.

Distribution in Alberta: This species has been most commonly collected along the northern edge of the Central Parkland and in the southern part of the Boreal Mixedwood (Fig. 23). It extends westwards into the Foothills, Montane, and Subalpine subregions, occasionally reaching upwards into the Alpine. *Peltigera canina* appears to be uncommon north of Lesser Slave Lake. There are a few sites in the low elevational Wetland Mixedwood, Peace River Lowlands, and Canadian Shield regions, but it is apparently unknown in the Boreal Highlands and Subarctic of northern Alberta. *Peltigera canina* is common over its range.

Distribution in North America: This circumpolar species is widespread throughout North America. **Additional specimens seen (ALTA):** Canada: British Columbia, Manitoba, Northwest Territories, Quebec, Saskatchewan, and the Yukon Territory; U.S.A.: Alaska, Minnesota, New Mexico (herb. Goffinet) and Wyoming.

Peltigera cinnamomea Goward ined.

Illustrations: Figs. 24-25, map: Fig. 26.
Appendix 1.

Morphology: *Thallus* large, to 30 cm across, loosely appressed to the substrate; lobes to 3 cm wide, branching, wavy, flat to concave near margin, fragile when dry, margin entire and downturned, rarely plane. *Upper surface* shiny to rarely dull, greyish-brown to light brown, typically with some cinnamon colored patches, smooth, tomentum restricted to margin. *Lower surface* pale whitish near margin, gradually darkening and becoming cinnamon colored, veins distinct, narrow and

slightly raised near margin becoming broad and flat toward centre, interstices concolorous with veins, diamond-shaped to elongate; rhizines to 5 mm, pale to light brown, thread-like to sometimes apically fibrillose but otherwise unbranched. *Photobiont*, cyanobacteria. *Apothecia* common, disk chestnut brown, to 8 mm wide, slightly saddle-shaped, on narrow, elongate and somewhat canaliculate lobes; spores acicular, (38-) 40-50 (-55) x 3-5 μm (50 spores measured), invariably four-celled.

Note: *Peltigera cinnamomea* has not yet been validly described, and is thus taxonomically an invalid name.

Variation: This species differs from *P. membranacea* and *P. praetextata* by the lack of tomentum on its veins. However, some specimens of *P. praetextata* have glabrous veins. *Peltigera cinnamomea* can be segregated from these both by the color of the lower

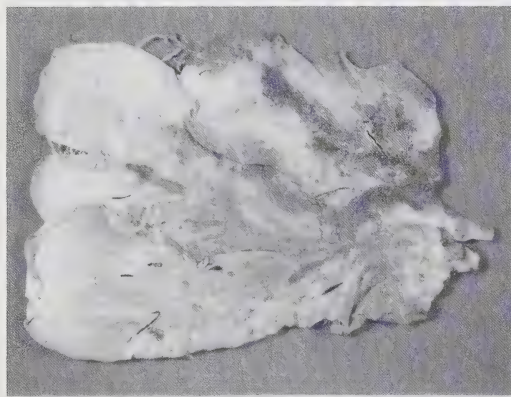


Figure 24. *Peltigera cinnamomea* upper surface. (Seymour Sept. 1966, ALTA.)

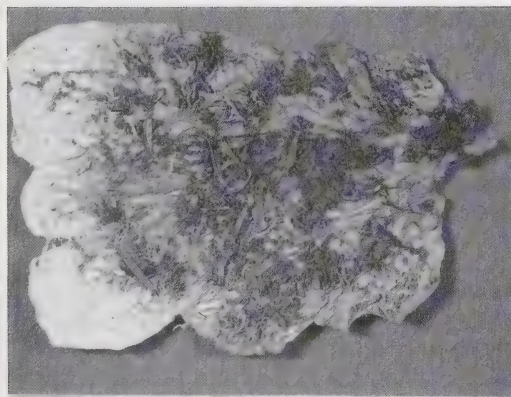


Figure 25. *Peltigera cinnamomea* lower surface. (Seymour Sept. 1966, ALTA.)

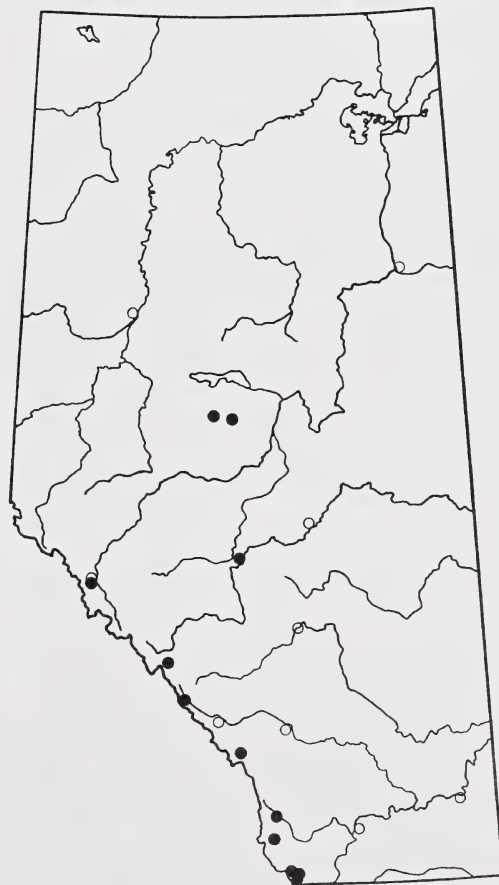


Figure 26. Distribution of *Peltigera cinnamomea* in Alberta.

surface, which is never dark brown in *P. cinnamomea*, and by its plane margin which contrasts with the rather wavy upturned margin of *P. praetextata*. *Peltigera cinnamomea* differs from *P. canina* by having strictly simple and sparse rhizines, and tomentum that does not extend toward the centre of the upper cortex (Figs. 24-25; Appendix 1).

Ecology: Occurring in the upper Foothills to Subalpine in spruce and fir forests where it grows most commonly on litter and/or mosses. It is also occasionally found on rotten wood.

Distribution in Alberta: *Peltigera cinnamomea* is largely restricted to foothills and mountain habitats with long-lasting snow cover (Fig. 26). The species is uncommon in Alberta.

Distribution in North America: *Peltigera cinnamomea* is currently known only from the Pacific Northwest and Alberta. *Additional specimens seen (ALTA):* Canada: British Columbia; U.S.A.: Washington.

***Peltigera collina* (Ach.) Schrad.**

Illustrations: Fig. 27, map: Fig. 28.

Morphology: *Thallus* medium, to 10 cm across, closely attached to the substrate; lobes small, about 1 cm broad, rarely 1.5 to 2 cm, branching, rather thick and robust, margin plane and often dissected. *Upper surface* brownish-grey when dry, bluish to dark blue when moist, smooth to rarely slightly scabrous near margin, glabrous, margin rarely pruinose, ascending; soredia bluish-grey, sometimes developing into isidia, marginal but some also laminal, maculiform, and along cracks. *Lower surface* with ochraceous to brown, flat, anastomosing veins, with white interstices; rhizines to 4 mm, brown, scattered to confluent, aciculate to slightly branched. *Photobiont*, cyanobacteria. *Apothecia* rare, disk dark brown to black, to 3 mm long, finger nail-shaped, on short, narrow lobes, almost sessile; spores acicular, (48) 55-70 (84) x 3-4 μm , mostly four-celled (rarely to eight).

Variation: *Peltigera collina* is usually easily recognized by its marginal soredia (these were developed in all examined Albertan material). In the absence of soredia, however, it may resemble *P. elisabethae* or *P. neckeri* by the color of the cortex and the marginal pruinosity. *Peltigera collina* differs from the former by the absence of schizidia, and also by having a distinct network of brown veins, short finger nail-shaped

apothecia, and a dull upper surface (Fig. 27). *Peltigera neckeri* has a very shiny thallus and the blackish veins are often confluent and indistinct. Thomson (1950) and Krog (1968) described *P. collina* as seemingly quite variable with regards to the color of the thallus and the presence of soredia. In Alaska, it is frequently fertile (Krog 1968). Alberta specimens from Glenevis (Pegg 1385, PMAE) and Hinton (Marsh JE788, ALTA) are abundantly fertile, but this appears to be atypical.

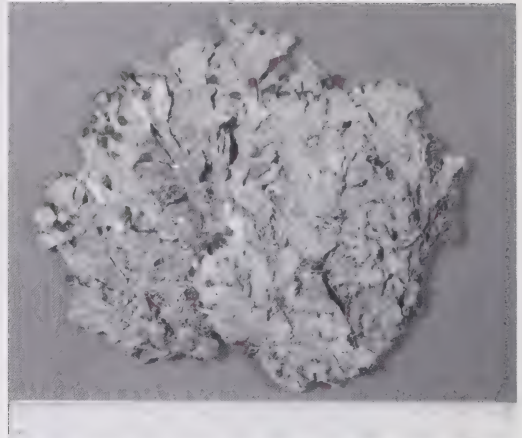


Figure 27. *Peltigera collina* upper surface with cracks and scattered atypical laminal soredia. (Pegg s.n., B88.2.55, PMAE.)

Ecology: *Peltigera collina* occurs on litter or rotten wood in Subalpine Lodgepole Pine-spruce-Subalpine Fir forests. It is occasionally found growing in similar habitats in the southern Boreal Mixedwood subregion. It is among the taxa considered characteristic of old woodlands in Europe (Coppins 1976). In moist oak woodlands in Oregon it is a major component of the epiphytic flora on moderately old branches (Stone 1989).

Distribution in Alberta: *Peltigera collina* is mainly found in the Rocky Mountains but protrudes eastward along the southern edge of the boreal forest (Fig. 28). The species is extremely rare in Alberta.

Distribution in North America: This typically oceanic (Wirth 1987), circumpolar species shows a predominantly western North America-western Europe distribution, but is also reported from Newfoundland, Ontario, Quebec, Greenland, and Iceland (Thomson 1984). *Additional specimens seen (ALTA):* Canada: British Columbia and the Yukon Territory; U.S.A.: Washington.

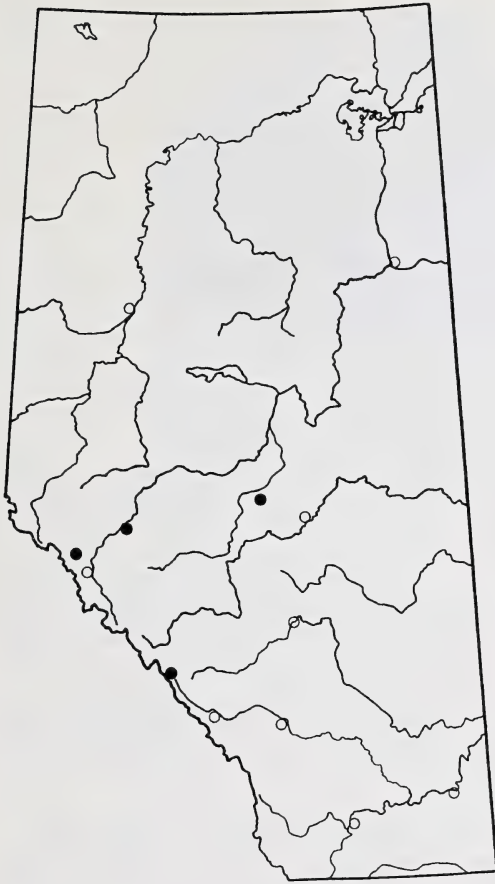


Figure 28. Distribution of *Peltigera collina* in Alberta.

***Peltigera didactyla* (With.) Laundon
var. *didactyla***

Illustrations: Fig. 29, *map:* Fig. 30.
Appendix 1.

Morphology: *Thallus* small, to 5 cm broad; lobes to 1 cm broad, somewhat branching in mesic conditions, concave or flat with plane to slightly downturned, entire margins, thin, fragile when dry. *Upper surface* greyish-brown to dark brown when dry, with thick appressed tomentum often becoming loose and detached from cortex, glabrous toward the centre, sometimes tomentum sparse and restricted to lobe tip or, more rarely, absent, with maculiform, sometimes weakly isidiferous and confluent, 2 mm wide soralia. *Lower surface* whitish sometimes becoming greyish to brown toward centre, veins flat and narrowly reticulate, with whitish, rounded, lenticular or irregular interstices;

rhizines to 5 mm, white, simple to somewhat fibrillose often restricted to mature part of lobes, becoming darker and sparser toward centre. *Photobiont*, cyanobacteria. *Apothecia* common, disk chestnut to dark brown, to 6 mm wide, finger nail-shaped to saddle-shaped, on erect, narrow, elongate lobes; spores acicular, (42-) 47-58 (-67) x 2.5-3.5 µm, invariably four-celled.

Variation: Recently, Weber (1990) reported *P. erumpens* (Taylor) Elenkin as new for North America. This species is characterized by a small unilobate, tomentose thallus bearing laminal soredia and no apothecia. However, both field (Dahl 1950, under *P. spuria*) and laboratory (Stocker-Wörgötter and Türk 1990) observations suggest that such forms represent only a developmental stage of *P. didactyla*. Therefore, such specimens do not deserve taxonomic recognition and *P. erumpens* should be kept as a synonym of *P. didactyla* as was suggested earlier by Vitikainen (1981).

We have proposed another sorediate taxon, *P. didactyla* var. *extenuata* to account for the morphological, ecological, and chemical divergences found within *P. didactyla* s. lat. (Goffinet and Hastings in press). Variety *extenuata* grows in forested sites and most often develops broad, spreading lobes bearing numerous and abundantly fibrillose rhizines, whereas var. *didactyla* occurs mainly in dry habitats where its thallus often remains unilobate (unless apothecia are produced) and its lobes are strongly concave and attached to the substrate by scattered central rhizines. In addition, var. *extenuata* typically produces methyl gyrophorate and gyrophoric acid (the latter often in trace amounts, or occasionally seemingly absent); the production of the latter tripeptide results in a characteristic KC+ red (flashing) reaction of the medulla. As mentioned earlier, the amount of gyrophoric acid can be variable, probably because of the metabolic link of the two chemicals. As a result the C+ or KC+ red spot test is seemingly negative. Methyl gyrophorate, however, appears to be constant among all specimens of *P. didactyla* var. *extenuata*, whereas both chemicals are invariably absent from the var. *didactyla*. However, some specimens could not be placed satisfactorily in either variety. We argue (Goffinet and Hastings in press) that such specimens could be the result of hybridization. This is likely to occur in localities where the two taxa are sympatric, considering that their predominant way of propagation involves soredia, and that fusion of different soredia is required to initiate thallus formation (Stocker-Wörgötter & Türk 1990).

Fertile specimens of var. *didactyla* may be mistaken for fertile *P. rufescens*, as both develop erect apothecia



Figure 29. *Peltigera didactyla* var. *didactyla* habit. It has erect apothecia bearing lobes. (Goffinet 1846, herb. Goffinet.)

bearing lobes supported by strong, ropy, whitish veins. The latter species however, invariably lacks soredia or their scars, and has, at least on the lower surface of mature sterile lobes, dark, abundantly branched rhizines. Further, in *P. rufescens*, the mature part of the lobes is often covered by a white crust

Ecology: Occurring in a wide range of dry to mesic forest sites but almost always in disturbed sites such as trail edges and roadcuts. Also found on sand, fine gravel, and boulders.

Distribution in Alberta: *Peltigera didactyla* var. *didactyla* is most common in the Central Parkland subregion (Fig. 30). To the north it occurs in scattered localities in the Boreal Mixedwood and to the west it occurs in the Foothills, Montane, and upwards into the Subalpine subregions. It has also been collected in the southeast corner of the province in Montane uplands of the Cypress Hills and even in the Mixedgrass subregion. This variety is common in Alberta.

Distribution in North America: This ubiquitous, cosmopolitan species is widespread throughout North America (see specimen data in Thomson 1950 under *P. canina* var. *spuria* and *P. canina* var. *spuria* f. *sorediata*). *Additional specimens seen (ALTA & CANL):* Canada: New Brunswick, Newfoundland, Nova Scotia, Ontario, Prince Edward Island, Quebec, Saskatchewan, and the Yukon Territory; U.S.A.: Washington.

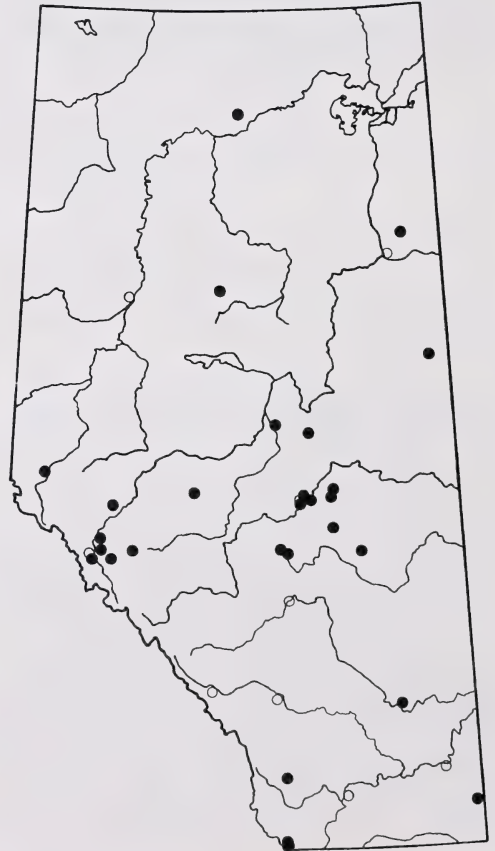


Figure 30. Distribution of *Peltigera didactyla* var. *didactyla* in Alberta.

***Peltigera didactyla* (With.) Laundon
var. *extenuata* (Nyl. ex Vainio)
Goffinet & Hastings**

Illustrations: Figs. 31-32, map: Fig. 33.

Appendix 1.

Morphology: *Thallus* medium-sized, to 8 cm broad; lobes to 1-1.5 cm broad, concave or flat, with plane to slightly upturned margins, thin and fragile, with maculiform, sometimes confluent, 2 mm wide soralia, developing isidia even in early stages. *Upper surface* with thick appressed tomentum often becoming loose and detached toward centre, glabrous toward the centre; color of dry thallus light to greyish-brown. *Lower surface* whitish becoming greyish to brown toward the centre, veins flat and narrow with large whitish rounded to slightly elongate interstices; rhizines to 5 mm, white, fibrillose, rarely simple or slightly branched, forming a dense mat near margin, becoming darker and sparser toward centre. *Photobiont*, cyanobacteria. *Apothecia* rare (only one apothecia seen), on short elongate lobes, finger nail-shaped, to 5 mm long; spores acicular, "(many spores not clearly septate), 41-60 x 3-4 µm" (Goffinet & Hastings in press).

Note: the new combination *P. didactyla* var. *extenuata* has been proposed by Goffinet and Hastings (in press).

Variation: This variety is best recognized by its broad lobes, the numerous, fibrillose, whitish rhizines, and veins that remain pale throughout. Further, the thallus is branched and the mature parts of the lobes do not disintegrate as they often do in lobed, fertile material of var. *didactyla*. By contrast, sterile thalli of the latter variety often remain unilobate, small, and bear scat-

tered rather thread-like rhizines mostly confined to the centre of the lower surface (for further discussion see var. *didactyla*). Variety *extenuata* produces soralia almost invariably; so far only a single esorediate thallus has been found. The latter was somewhat similar to *P. praetextata* but was segregated by its characteristic fibrillose, pale rhizines and the KC+ red reaction of the medulla.

Ecology: *Peltigera didactyla* var. *extenuata* occurs in mesic to moist sites on mosses or on mosses over rotten wood. In the boreal forest it is found in sites ranging from Black Spruce-Swamp Birch wetlands, larch fens, and lakeside willow swamps. In the mountains it grows in Lodgepole Pine-White Spruce forests up to the alpine tundra. Only rarely does it grow on mineral soil.

Distribution in Alberta: This variety has been collected in a number of localities scattered throughout northern and western Alberta (Fig. 33). It is probably most common in the Boreal Mixedwood subregion. To the north, it has been collected in the Subarctic and Canadian Shield. Towards the mountains, it has been collected in the Foothills, Montane, and in moist sites in the Subalpine and Alpine subregions. This variety is common throughout its range.

Distribution in North America: This circumboreal variety is widespread throughout boreal North America. Its distribution is documented in Goffinet and Hastings (in press). *Additional specimens seen* (ALTA & CANL): *Canada:* British Columbia, Labrador, New Brunswick, Newfoundland, Ontario, Prince Edward Island, Quebec, Saskatchewan, and the Yukon Territory; *U.S.A.:* Colorado.

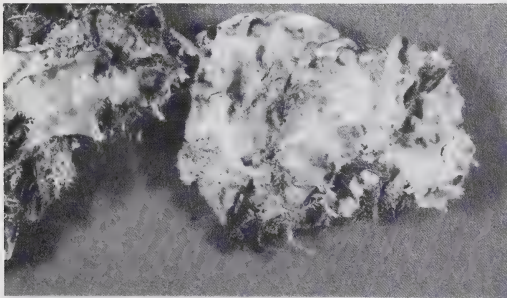


Figure 31. *Peltigera didactyla* var. *extenuata* upper surface. (Hastings C90.5.20b, PMAE.)

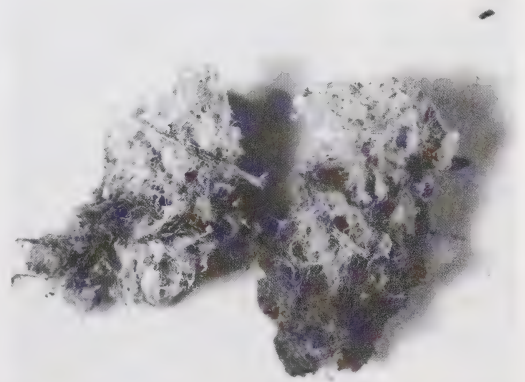


Figure 32. *Peltigera didactyla* var. *extenuata* lower surface, note the fibrillose rhizines. (Hastings C 90.5.20b, PMAE.)

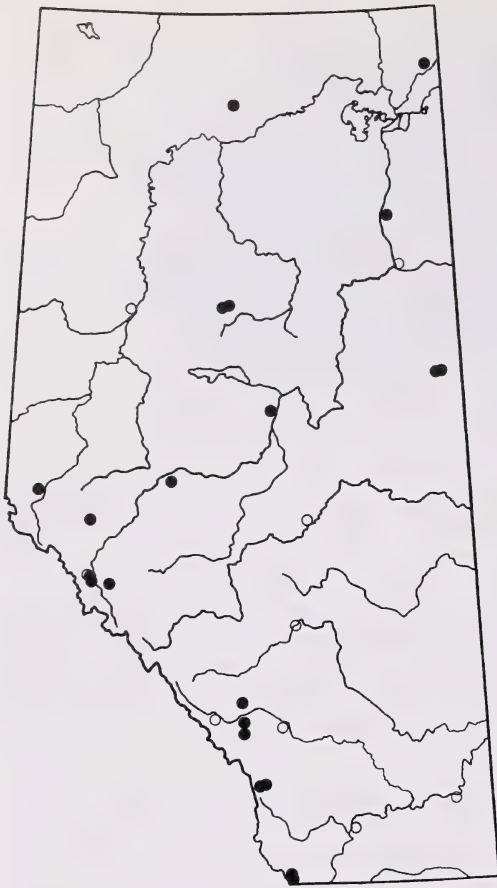


Figure 33. Distribution of *Peltigera didactyla* var. *extenuata* in Alberta.

Peltigera elisabethae Gyelnik

Illustrations: Figs. 34-35, map: Fig. 36.
Appendix 2.

Morphology: *Thallus* medium to large, moderately to closely attached to the substrate; lobes 1 to 3 cm, branching, crisped or flat, rather thick, robust when dry, margin entire and plane. *Upper surface* grey to brownish-grey toward centre when dry (sometimes with a bluish tint when growing along streams in extremely wet habitats) and dark brown to blackish when wet, shiny, glabrous, smooth, often pruinose toward margin, with numerous cracks exposing the white medulla; regeneration lobules isidia-like, knobby to slightly flattened, developing along cracks, schizidia

often present along margin and cracks. *Lower surface* cottony, appearing veinless, abrupt transition from a whitish to ochraceous margin to a dark brown to black inner part, only a few light, deep, elongate to rounded interstices near margin; rhizines to 5 mm, dark brown, fasciculate, short, sparse, in concentric lines. *Photobiont*, cyanobacteria. *Apothecia* occasional, disk brown to black, to 7 mm across, horizontal or with slightly recurved margins but never strongly finger nail-shaped, on short lobes; spores long-elliptical, (27-) 30-41 (-47) x 4-6 μm , invariably four-celled (90 spores measured).

Variation: *Peltigera elisabethae* is most closely related to *P. horizontalis*; both have horizontal apothecia producing small, four-celled spores. However, *P. elisabethae* is distinguished by its broad anastomosing veins, giving the appearance of a veinless lower surface (Fig. 35), and characteristic marginal schizidia (Fig. 14). In addition, *P. horizontalis* is never pruinose. *Peltigera pacifica* Vitik. is another glabrous species developing "isidioid propagules" (Vitikainen 1985). It differs from *P. elisabethae* by its distinct veins, phyllidia, longer spores, and by its chemistry. *Peltigera pacifica* is, at present, known mainly from coastal British Columbia but might "extend farther inland in oceanic areas in North America" (Vitikainen 1985). Based on the lower surface, *P. elisabethae* can also be mistaken for *P. malacea*. However, *P. malacea* lacks vegetative propagules and develops erect tomentum near the margin. When sterile, *P. elisabethae* is similar to *P. neckeri*. The latter, however, develops no schizidia, has a black lower surface with conspicuous pale interstices, at least near the margins, and its rhizines are not arranged in concentric lines (compare Figs. 35 & 62; for further comparisons see Appendix 2). When fertile, *P. elisabethae* can be distinguished from the latter three species by its shorter spores which almost never exceed 45 μm in length (two spores out of 90 were 46 & 47 μm long). For further discussion see *P. collina* and *P. polydactyla*.

Following Thomson's (1950) treatment, specimens of *P. elisabethae* bearing regeneration lobules, would key to *P. horizontalis* var. *zopfii* (Gyelnik) Thomson. Pruinose thalli would be identified as *P. horizontalis* var. *pruinosa* Gyelnik. Ostafichuk (1966) adopted the same taxonomy and most specimens he named *P. horizontalis* var. *zopfii* (ALTA) are *P. elisabethae*. The name "zopfii" actually applies to forms of *P. horizontalis* bearing regeneration lobuli, and has consequently been reduced to synonymy with the latter (Clauzade and Roux 1985; see discussion under *P. horizontalis*).

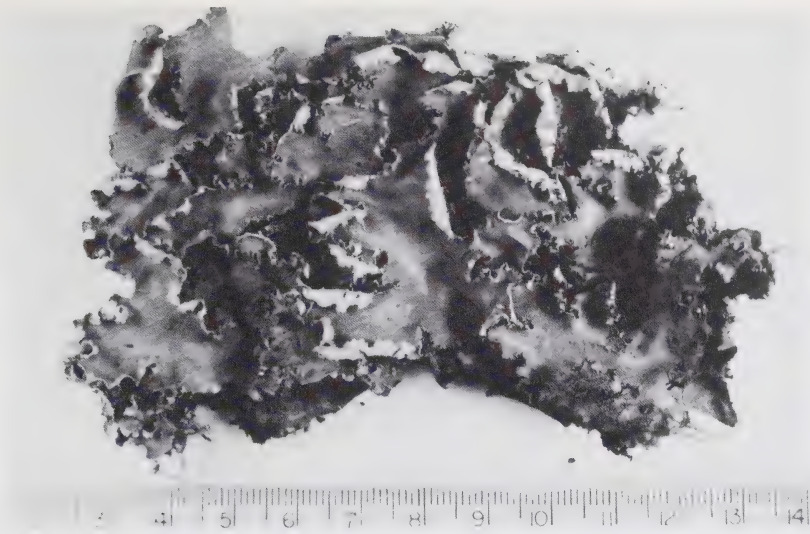


Figure 34. *Peltigera elisabethae* habit. (Goffinet 3083, herb. Goffinet.)

Ecology: Most commonly occurring on mosses, litter, and rotten wood in mesic, mixed White Spruce-Aspen Poplar forests to mature White Spruce/*Ledum*/feathermoss stands. Growing in similar microhabitats in foothill and mountain Lodgepole Pine-White Spruce forests. Rarely and sporadically growing on moist soil in more open areas such as roadcuts through the forest, alluvium along river channels, or on open but moist rocky areas in the subalpine.

Distribution in Alberta: *Peltigera elisabethae* is common from the northern and western portions of the Central Parkland, northwards through the Boreal

Mixedwood, and into the Wetland Mixedwood (Fig. 36). It has been collected in the Peace River Parkland and Peace River Lowlands. Westwards from the Central Parkland, it ranges through the Foothills and Montane subregions. It reaches into the Subalpine in moist sites. In southeast Alberta it has been collected in the Cypress Hills. *Peltigera elisabethae* is common over its range.

Distribution in North America: The distribution of this species is not well documented for North America as it was, until recently, not distinguished from *P. horizontalis*. The species is probably widespread

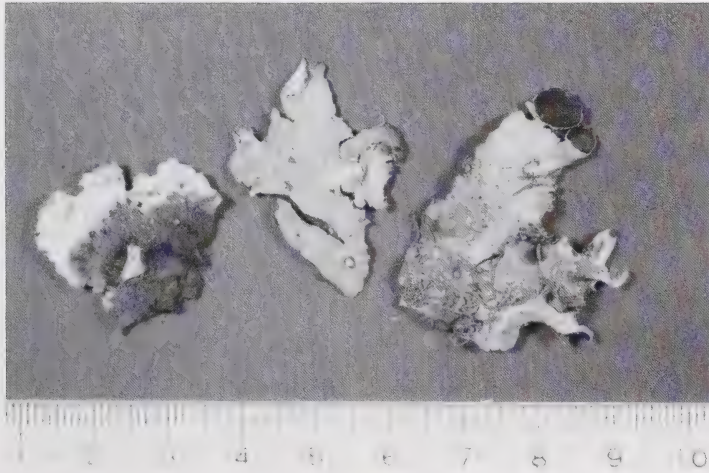


Figure 35. *Peltigera elisabethae*. Left - lower surface showing concentric arrangement of rhizines (dark dots), and anastomosed veins giving a veinless appearance. Middle - upper surface with cracks and schizidia. Right - fertile lobe with horizontal apothecia. (Goffinet C90.4.70, PMAE.)

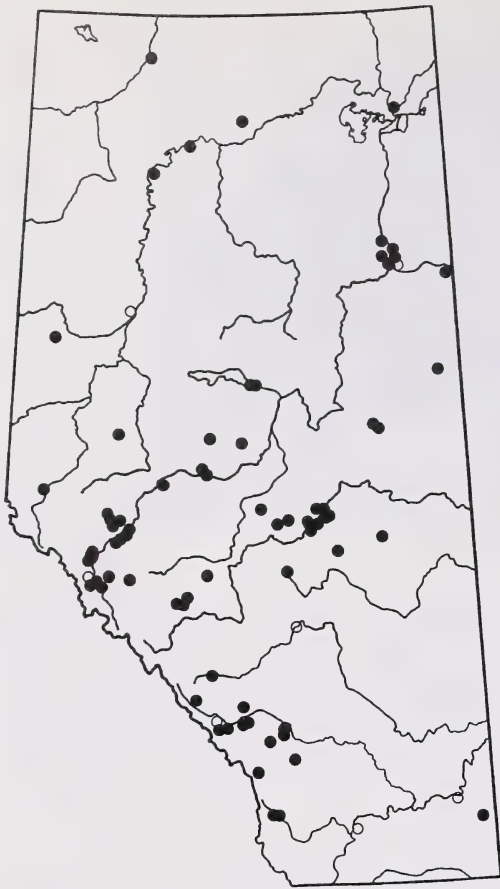


Figure 36. Distribution of *Peltigera elisabethae* in Alberta.

throughout boreal, alpine, and arctic North America as is suggested by its northern range in Europe (Vitikainen 1987, Wirth 1987). *Additional specimens seen (ALTA):* *Canada:* British Columbia, Northwest Territories, Ontario, Quebec, Saskatchewan, and the Yukon Territory; *U.S.A.:* Colorado, Michigan, Minnesota, New Mexico (herb. Goffinet), and South Dakota.

Peltigera evansiana Gyelnik

Illustrations: Figs. 37-38, map: Fig. 39.

Morphology: *Thallus* medium, several cm across, often loosely attached to the substrate; lobes to 2 rarely 3 cm wide, branching, flat or slightly ascending, thin, fragile when dry, margin entire, plane to up-turned. *Upper surface* light grey to dark greyish-

brown when dry, dark brown when wet, tomentose, strongly pruinose near margin, to rarely slightly scabrous near edge, covered toward lobe tip with erect globular, or sometimes coralloid isidia and occasionally with dorsiventral isidia toward mature part of lobes. *Lower surface* with sparse, low, narrow, whitish to ochraceous veins, becoming brown toward centre; rhizines to 6 mm, white or brown toward centre, simple, rarely fibrillose. *Photobiont,* cyanobacteria. *Apothecia* rare, disk light to chestnut brown, to 4 mm long, slightly saddle-shaped, on short lobes; spores acicular, (39-) 43-55 (-58) x 2.5-4 μ m, mostly four-celled, but pentaseptate spores occasionally seen.

Variation: Some herbarium specimens were identified as *P. lepidophora*, which resembles *P. evansiana* by having laminal isidia. In *P. lepidophora* the isidia are typically peltate versus being erect, granular, or club-shaped to coralloid in *P. evansiana*. In both taxa, isidia on mature parts of lobes can become somewhat atypical, i.e., erect and dorsiventral respectively. However, in Alberta, dorsiventral isidia have been seen only on a single specimen of *P. evansiana* (Fig. 38). *Peltigera praetextata* differs from *P. evansiana* by its invariably dorsiventral and erect phyllidia that are restricted to mature parts of the lobes. When dry, *P. evansiana* is easily recognized because "the isidia stand out darkly against the greyish tomentum-covered upper side of the thallus" as the algae shine through the rather thin cortex of the isidia (Lindahl 1960) (Fig. 37). The species has been considered glabrous by some authors (e.g., Thomson 1950). This confusion arose from the marginally restricted tomentum which is often hidden in a pruinose layer. These hairs seem to be necessary for the development of the isidia on the upper cortex (Lindahl 1960).

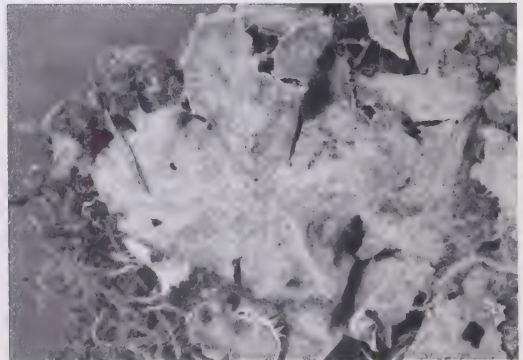


Figure 37. *Peltigera evansiana* habit. The granular isidia appear as small dots. (Lindsay B77.24.30, PMAE.)

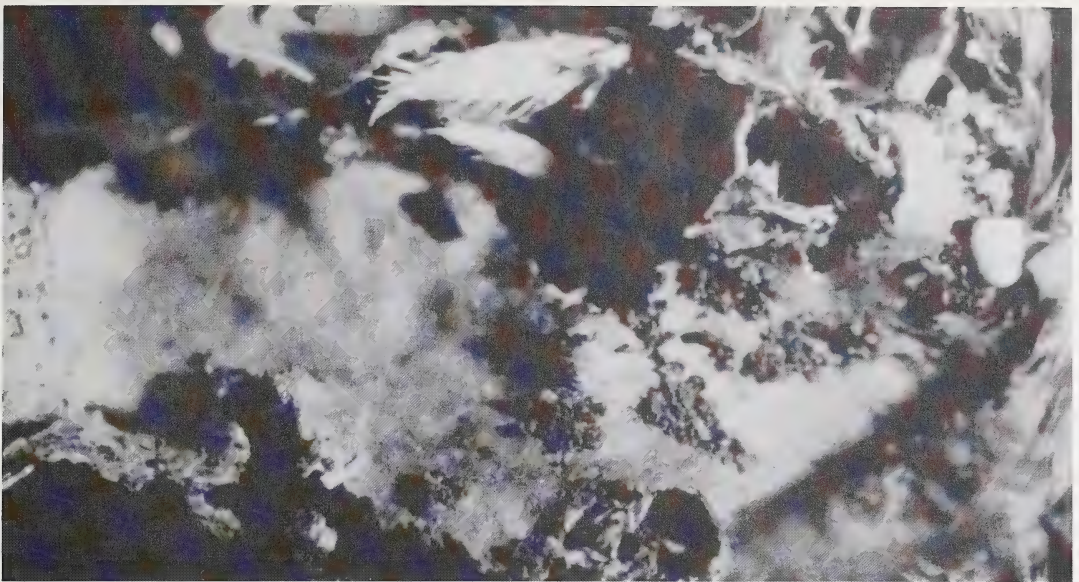


Figure 38. Variation in shape of isidia in *P. evansiana*. They are club-shaped to the left, near the lobe tip and squamulose-peltate near the centre of the lobe. (Crites 12 June 1993, herb. Goffinet.)

Ecology: *Peltigera evansiana* grows most commonly on rotten wood, moss covered rotten wood, or moss covered tree roots in Aspen Poplar, Balsam Poplar, or mixed Aspen Poplar-White Spruce forests. It occurs rarely in White Spruce-Balsam Fir forests. Gyelnik (1931a) and Thomson (1950) mentioned it as also growing over saxicolous mosses.

Distribution in Alberta: This species is known only from the northern edge of the Central Parkland subregion and from a few scattered localities in the southern part of the Boreal Mixedwood (Fig. 39). Turner collected numerous specimens around Fort Saskatchewan, but in the last 30 years it has only been collected occasionally in the Edmonton region. The species is rare but locally abundant.

Distribution in North America: This species was originally described by Gyelnik (1931a) from New England and was known only from North America (where it is mainly eastern in distribution, Thomson 1950) until its discovery in Eurasia (Blum et al. 1975, Xi-Ling 1986). In western North America it occurs in Alberta and in boreal British Columbia (Noble et al. 1987), but is rare in both provinces. *Additional specimens seen (ALTA):* Canada: Ontario; U.S.A.: Michigan, Minnesota, and New York.

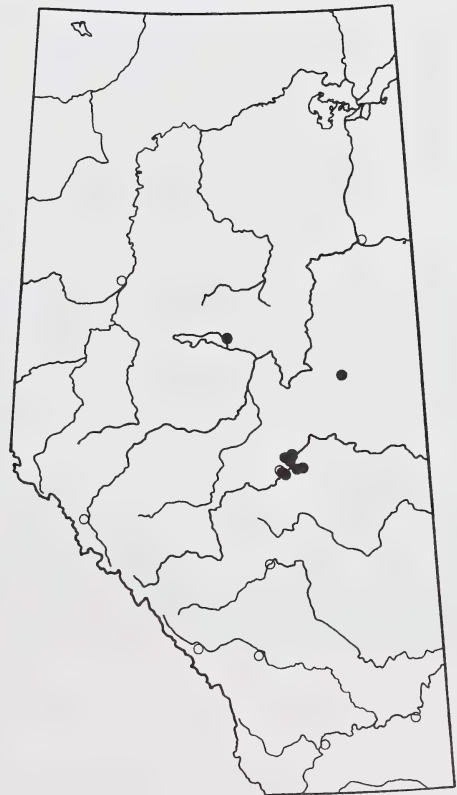


Figure 39. Distribution of *Peltigera evansiana* in Alberta.

Peltigera horizontalis (Huds.)
Baumg.

Illustrations: Figs. 40-41, map: Fig. 42.
Appendix 2.

Morphology: Thallus medium, rather firmly attached to the substrate; lobes to 2 cm broad, branching, moderately thin, fragile when dry, margin entire, usually plane, but sometimes also with narrow crisped lobes. *Upper surface* smooth, glabrous, somewhat shiny, not pruinose, bluish to brown-grey to chestnut brown, dark when moist, often pitted near margin (these pits are low depressions of the thallus found opposite the rhizines). *Lower surface* with a distinct network of ochraceous marginal veins becoming dark brown and anastomosing toward centre, with distinct, elongate, light interstices at least toward margin; rhizines sparse, to 5 mm, brown, fasciculate, in concentric lines at least near margin. *Photobiont*, cyanobacteria. *Apothecia* apparently frequent (all four specimens from Alberta were fertile), disk chestnut brown, horizontal, to 1 cm across, on short lobes; spores long-elliptical to (22-) 29-39 (-44) x 4-6 μ m, four-celled except for one spore which was three-celled (90 spores measured).

Variation: *Peltigera horizontalis* can be easily recognized by its horizontal apothecia in combination with the distinct network of veins (Figs. 40 & 41). As was noted while revising the genus in Belgium (Goffinet et al. in prep.), some thalli of *P. horizontalis* do produce laminar regeneration lobules (e.g., Ostafichuk 530, ALTA). These specimens can still be differentiated from the closely related *P. elisabethae* by the distinctly veined

lower surface and absence of schizidia (see *P. elisabethae*). Based only on his description, it appears that Gyelnik (1927) considered these lobulate forms as a separate taxa, *P. zopfii*. We consider this latter species to represent only a regeneration form of *P. horizontalis*. It does not, therefore, deserve taxonomic recognition. We agree with the synonymy of *zopfii* and *horizontalis* as proposed by Clauzade and Roux (1985; see also note under *P. elisabethae*).

In the past, sterile material of *P. horizontalis* was often mistaken for *P. polydactyla* or even thought to be unidentifiable. However, when sterile, the two species can be distinguished as follows: *P. horizontalis* has rhizines that are arranged along concentric lines and its thallus often bears marginal "pits" opposite the rhizines (Fig. 40); *P. polydactyla* has rhizines that are randomly distributed and has a smooth upper surface. When fertile, the two species differ by the shape of the apothecia. They are typically horizontal in *P. horizontalis* versus finger nail-shaped in *P. polydactyla*. In *P. horizontalis* the supporting lobe is short and rather plane, versus elongate and canaliculate in *P. polydactyla* (see Appendix 2 for further comparisons).

Ecology: *Peltigera horizontalis* grows on terricolous mosses in mixed moist forests. According to Rose (1976), *P. horizontalis* appears "to be a faithful species to old hardwood forest in lowland Britain." The species was recently collected in Edmonton (Hastings C93.6.3, PMAE), where large thalli grew over mosses in an Aspen Poplar-White Spruce woodland in a moist and steep ravine.

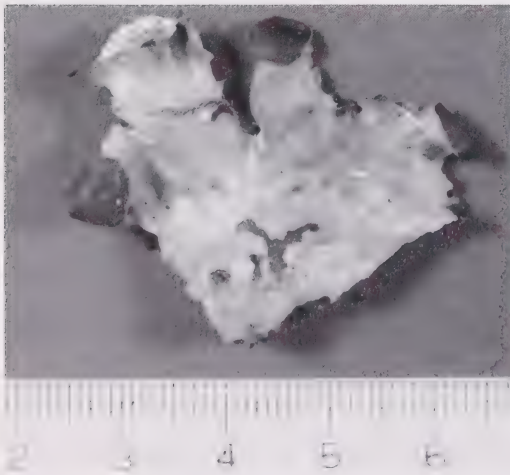


Figure 40. *Peltigera horizontalis* upper surface of fertile lobe. The apothecia are flat and the pits occur along a concentric line opposite the rhizines. (Goffinet 1315, herb. Goffinet.)

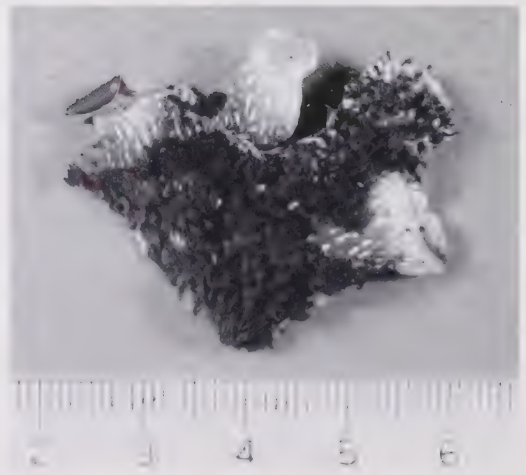


Figure 41. *Peltigera horizontalis* lower surface. The veins are distinct and the rhizines are aligned. (Goffinet 1315, herb. Goffinet.)

Distribution in Alberta: *Peltigera horizontalis* is known from scattered localities in the Central Parkland, Foothills, and Subalpine subregions (Fig. 42). The species is extremely rare in Alberta; only four collections (five specimens) are known. It has been collected only once since 1971.

Distribution in North America: In light of recent taxonomic changes, the distribution of this species is not well known. Therefore, descriptions given by Thomson (1950, 1984) and Krog (1968) should be considered suspect for they certainly include *P. elisabethae*. From Europe, however, we know that the species is missing from arctic and boreal regions (Wirth 1987). *Additional specimens seen (ALTA):* Canada: British Columbia; U.S.A.: Michigan, New Mexico (herb. Goffinet; dupl. ALTA) and New Hampshire.

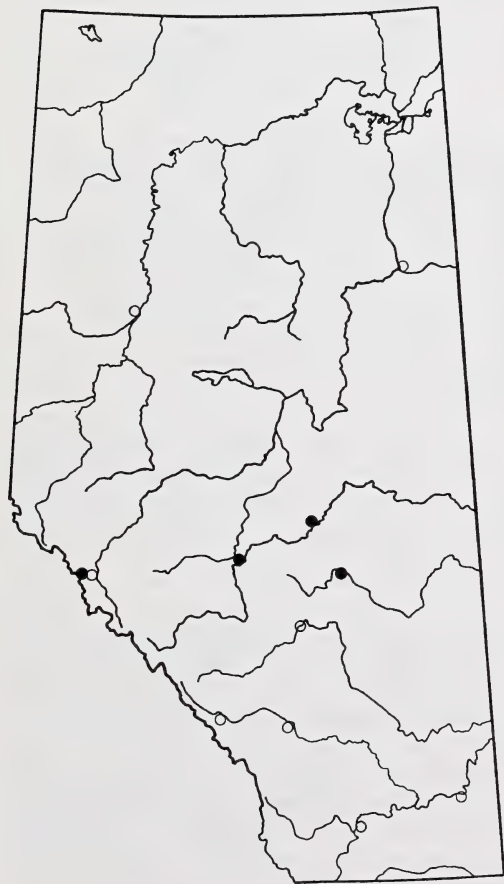


Figure 42. Distribution of *Peltigera horizontalis* in Alberta.

Peltigera kristinssonii Vitik.

Illustrations: Figs. 43-44; map: Fig. 45.

Morphology: *Thallus* medium, several cm across, often closely attached to the substrate; lobes 1 to 1.5 cm wide, branching, moderately thin, robust when dry, with entire margins. *Upper surface* light brown, grey-brown or bluish-grey "often with yellowish tint" (Vitikainen 1985), erect tomentum near margin, scabrous at least toward edge, smooth in the centre. *Lower surface* ochraceous at the margins with a distinct network of dark brown, tomentose, flat to slightly raised veins contrasting with pale, conspicuous, elliptical, sharp interstices; rhizines to 3 mm, dark brown, fasciculate to mainly squarrosely branched. *Photobiont*, cyanobacteria. *Apothecia* rare, disk dark brown, "with revolute margins, to 8-10 mm in diameter, on slightly ascending lobes; spores (40-) 44-59 (-73) x (2.6-) 3-4 (-5.2) μ m, four-celled" (Vitikainen 1985).

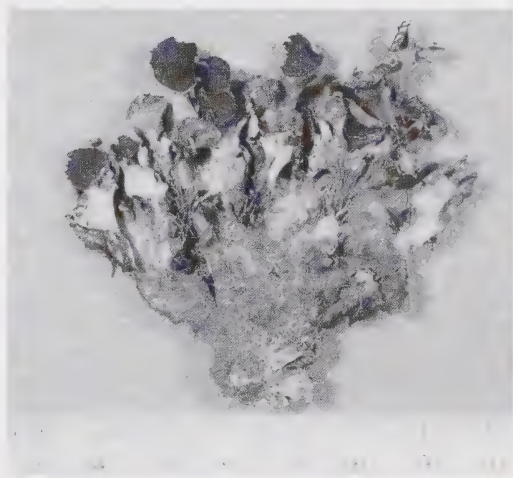


Figure 43. *Peltigera kristinssonii* habit. (Hastings C89.12.22, PMAE.)

Variation: *Peltigera kristinssonii* has been described recently by Vitikainen (1985). By its erect tomentum it might be mistaken for *P. malacea*, from which it differs by its lower surface bearing distinct veins (Fig. 44), by lacking chemical compounds, and by its squarrosely branched rhizines. Sometimes the tomentum is very sparse and *P. kristinssonii* would then key out in the *P. polydactyla* group. However, the distinct network of dark tomentose veins throughout and the scabrous upper surface (at least near the margin), segregates it from the *P. polydactyla* group. Specimens that are only slightly scabrous look similar to *P. rufescens*; they also share a lack of lichen substances. However,



Figure 44. *Peltigera kristinssonii* lower surface. The distinct dark veins contrast with the pale interstices throughout. (Hastings C89.12.22, PMAE.)

P. kristinssonii can be distinguished based on its erect versus appressed tomentum, tomentose veins, and its scattered fasciculate to squarrosely branched rhizines.

Thomson (1984) referred specimens that have the combination of erect marginal hairs and a scabrous upper cortex to *P. occidentalis* (Dahl) Krist. However, as discussed by Vitikainen (1985), *P. occidentalis* and *P. kristinssonii* represent two distinct taxa that differ by their morphology and their chemistry. *Peltigera occidentalis* has a glabrous upper surface and produces several depsides and hopane triterpenoids. *Peltigera kristinssonii* has a tomentose and scabrous upper surface and lacks lichen substances. Based on his morphological data, the collections examined by Thomson (1984) actually belong to *P. kristinssonii*. Further, the chemistry he reports for *P. occidentalis* was probably based on data provided by Ohlsson (1973) but the specimens referred to as *P. occidentalis* in that publication actually belong to *P. retifoveata* (Vitikainen 1985; see under "Excluded species" for further discussion on *P. occidentalis*).

Ecology: *Peltigera kristinssonii* is found on rocks, mosses, and humus in moist to dry habitats ranging from upland White Spruce forests and Lodgepole Pine woodlands to exposed sandstone and shale outcrops and solifluction lobes in the alpine.

Distribution in Alberta: *Peltigera kristinssonii* is a mountain-dwelling species. It is known only from the Montane, Subalpine, and Alpine subregions (Fig. 45). The species is uncommon over its range.

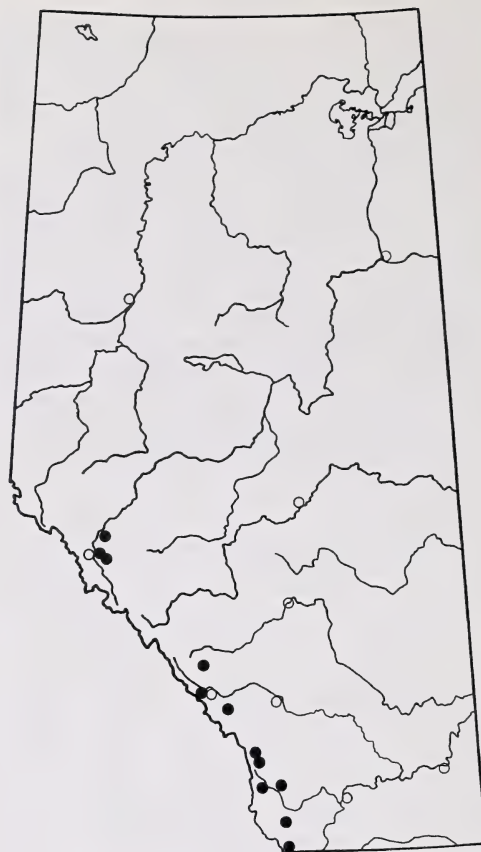


Figure 45. Distribution of *Peltigera kristinssonii* in Alberta.

Distribution in North America: *Peltigera kristinssonii* is distributed in the arctic and boreal zones and in their altitudinal counterparts in North America (Vitikainen 1985). **Additional specimens seen (ALTA):** U.S.A.: Colorado and Washington.

***Peltigera lepidophora* (Nyl. ex Vainio) Bitter**

Illustration: Fig. 46, map: Fig. 47.

Morphology: *Thallus* small, rarely larger than 2-3 cm, more or less rounded, firmly attached to the substrate; lobes rarely to 2 cm, rarely branching, strongly concave, rather robust when dry, margin entire and rather plane. **Upper surface** light to dark brown, tomentose, dull, covered with peltate or rarely erect dorsiventral isidia (never globular or coralloid). **Lower surface** light, ochraceous at the margins, brown toward centre, veins flat and somewhat anastomosing; rhizines to 2

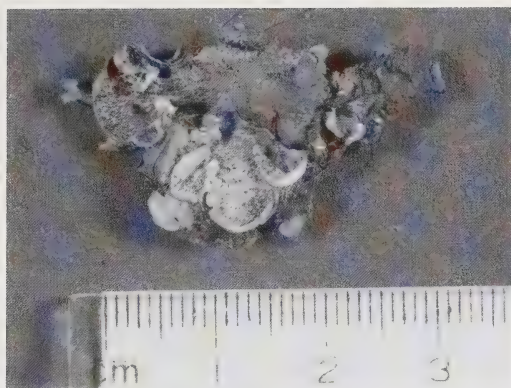


Figure 46. *Peltigera lepidophora* habit. The isidia appear as dark dots. (Ostafichuk 3598, ALTA.)

mm, pale, simple to fibrillose. *Photobiont*, cyanobacteria. *Apothecia* unknown in Alberta, but described as being "small, 1.5-4.5 mm across on extended lobules, the margins crenate; disk brown; ...spores acicular, 55-85 x 4-4.5 μm " (Thomson 1950, 1984).

Variation: *Peltigera lepidophora*, like *P. evansiana*, has laminal isidia and is tomentose. However, unlike the latter species, its isidia are peltate and never globular and coralloid. Further, the thallus of *P. lepidophora* is often unilobate or hardly branched, small and strongly concave (Fig. 46). It commonly grows with *P. didactyla*, which is also deeply concave and often unilobate, but the latter bears laminal soredia.

Ecology: This xerophytic lichen is most common along roadcuts and other dry habitats. It grows on mosses over soil, on sandy soil, and on quartzitic sandstone boulders from open grasslands, Aspen Poplar and pine forests on dunes, to exposed, rocky alpine tundra. It is occasionally found on exposed peat.

Distribution in Alberta: Most commonly occurring in more upland sites, *P. lepidophora* is found from the Foothills and Montane upwards into the Alpine subregions (Fig. 47). However, it has been collected occasionally in the southern part of the Boreal Mixedwood and in the Central Parkland. At present, this species is not known to occur north of the town of Whitecourt. However, *Peltigera lepidophora* is easily overlooked in the field and may be more common than is known currently.

Distribution in North America: Even though it has not been collected north of Whitecourt in Alberta, it shows a circumpolar arctic to temperate distribution in North America (Thomson 1984). *Additional specimen seen* (ALTA): Canada: British Columbia.

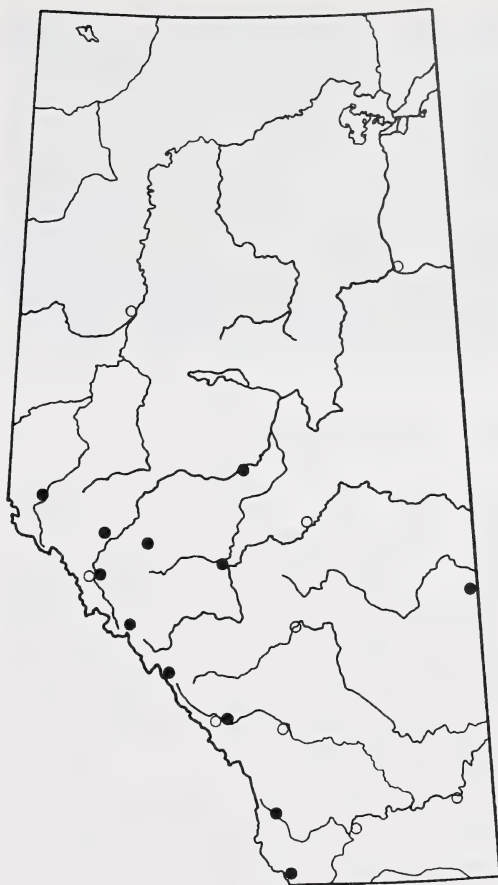


Figure 47. Distribution of *Peltigera lepidophora* in Alberta.

Peltigera leucophlebia (Nyl.) Gyelnik

Illustrations: Figs. 48-52, map: Fig. 53.

Morphology: *Thallus* medium to large, loosely appressed to the substrate; lobes to 3 cm wide, branching, mostly spreading and flat, thin, fragile when dry, margin crisp to crenulate, flat to upright, rarely bordered by a white line. *Upper surface* typically shiny (dull in exposed habitats), apple green when wet, greenish-grey when dry, often with brownish tint toward centre, typically wavy, covered with partly erect hairs only near margin, cephalodia to 2 mm wide, adnate, convex, and most often cerebriform, attached through their whole surface to the cortex. *Lower surface* with raised and rounded or flat, smooth veins becoming gradually dark brown to blackish toward

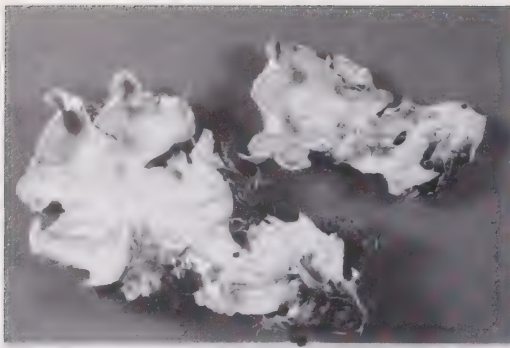


Figure 48. *Peltigera leucophlebia* habit. (Sérusiaux 10955, herb. Goffinet, duplicate LG.)

centre, these distinct throughout the lobe, typically highly contrastive, at least near margin with pale elongate, elliptical interstices; rhizines to 5 mm, blackish throughout, scattered, densely branched and often anastomosing. *Photobiont*, green algae. *Apothecia* common, with chestnut to dark brown disk, to 1.2 cm wide, with revolute margins, on narrow and somewhat elongate lobes, lower surface with patchy smooth cortex or cortex lacking; spores acicular, (48-) 51-65 (-74) x 3.5-5 µm, mostly four-celled.

Variation: *Peltigera leucophlebia* is typically characterized by the mostly cerebriform cephalodia, the apothecia which are only discontinuously corticate on their lower surface, and by the highly conspicuous veins contrasting with the pale interstices almost throughout the lobes (Figs. 49-50). Specimens with

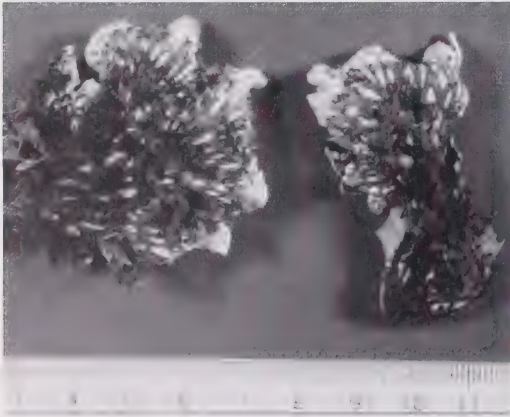


Figure 49. *Peltigera leucophlebia*. Typical lower surface with distinct veins throughout. (Sérusiaux 10955, herb. Goffinet, duplicate LG.)



Figure 50. *Peltigera leucophlebia* lower surface. Note the patchy cortex on the lower surface of the apothecia. (Kennedy Sept. 6, 1961, ALTA.)

this pattern of venation on the lower surface are uncommon in Alberta, but the species can still be distinguished from *P. aphthosa* by its usually rather crenulate margin (Fig. 52) and thin and fragile lobes. Some forms of *P. aphthosa* have a lower surface which becomes only gradually darker toward the centre, with a broad, pale marginal zone, much like *P. leucophlebia* (compare Figs. 18 & 50). Such specimens are only known from localities with a heavy snow cover and can be distinguished by the continuous cortex on the lower surface of the apothecia (all such specimens show this character) and by its veins which are indistinct throughout and not contrastive with the interstices (see *P. aphthosa* for further discussion).



Figure 51. *Peltigera leucophlebia* lower surface, showing degree of variation in differentiation of veins within a single specimen. (Kennedy Sept. 6, 1961, ALTA.)

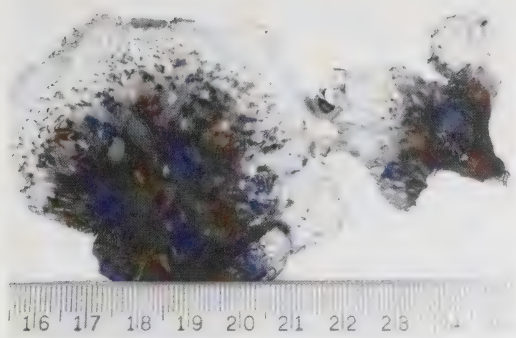


Figure 52. *Peltigera leucophlebia* lower surface. Note the crenulate margin of the sterile lobe. (Goffinet C90.4.223, PMAE.)

Ecology: Mostly occurring on mosses or litter in wet to moist forests. In the boreal forest it ranges from Black Spruce/*Ledum* wetlands to mesophytic Aspen Poplar-White Spruce forests. In mountainous areas it occurs in mesic Lodgepole Pine woodlands to subalpine Engelmann Spruce-Subalpine Fir forests. Occasionally, it is found in the alpine tundra where it grows both on mosses over soil and, more rarely, directly on soil. It is a rare inhabitant of xeric Jackpine-lichen woodlands in the northeast corner of the province.

Distribution in Alberta: *Peltigera leucophlebia* is found most commonly in the foothills and mountain areas (Fig. 53). It has been collected in a few localities in the Boreal Mixedwood and to the north in the subarctic of the Caribou Mountains and on the Canadian Shield. This species is common over its range.

Distribution in North America: This circumpolar species is widespread in the boreal, arctic, and alpine of North America (see map in Thomson 1984, under *P. aphthosa* var. *variolosa*). *Additional specimens seen (ALTA):* Canada: British Columbia, Manitoba, Northwest Territories, Saskatchewan, and the Yukon Territory; U.S.A.: Colorado, New Mexico (herb. Goffinet), and Wyoming.

***Peltigera malacea* (Ach.) Funk.**

Illustrations: Figs. 53-54, map: Fig. 56.

Morphology: *Thallus* moderately attached to the substrate, often thick and robust when dry; in dry habitats (rocks or roadsides) small to medium with lobes about 1 cm broad, branching, short and mostly erect and disintegrating in the centre, margin entire and strongly

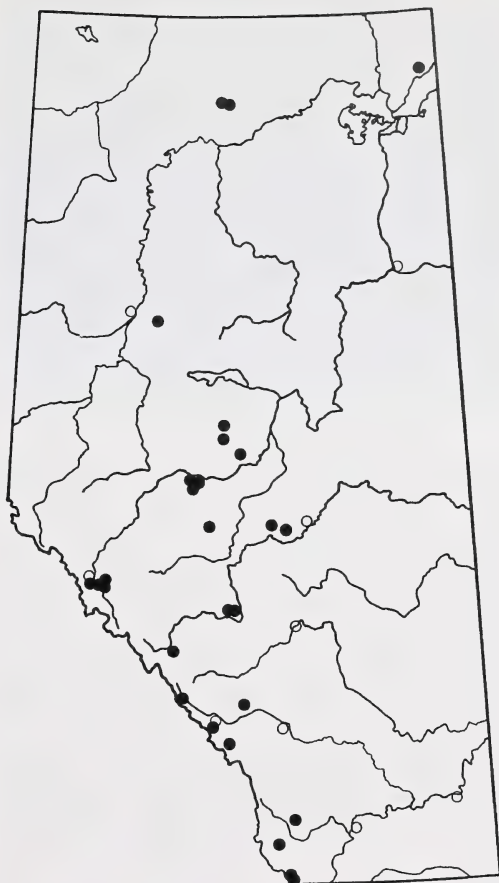


Figure 53. Distribution of *Peltigera leucophlebia* in Alberta.

upturned; upper surface brown to dark brown, dull; in moist habitats (bogs) medium to large with lobes to 3 cm wide, branching, margin entire and flat; upper surface grey to bluish-grey when dry and turning deep green when wet, dull. *Upper surface* always with erect tomentum near margin, sometimes pruinose. *Lower surface* lacking distinct veins, cottony, whitish, ochraceous to yellowish near margin, becoming abruptly black toward centre; rhizines poorly differentiated, to 2 mm, black, sparse, fasciculate. *Photobiont*, cyanobacteria. *Apothecia* common, disk brown to blackish brown, to 5 mm across, saddle-shaped, on erect, narrow, and elongate lobes; spores acicular, (42-) 52-57 (-79) x 3.5-5.5 μ m, invariably four-celled (90 spores measured).

Variation: By the strongly anastomosing veins (only a few, if any, clear elongate interstices are apparent on



Figure 54. *Peltigera malacea* typical habit in xeric habitats. (Scotter 60768, ALTA.)

the dark brown to black lower surface, Fig. 55) and the erect marginal hairs, *P. malacea* resembles *P. aphthosa* but is clearly differentiated by its blue-green photobiont. The seemingly veinless lower surface is similar to that of *P. elisabethae*, which, however, lacks tomentum and has vegetative propagules. *Peltigera kristinssonii* also has erect tomentum near the margin, but it differs by its lower surface having distinct chestnut brown tomentose veins and a scabrous upper marginal cortex. In his treatment, Thomson (1950) recognized two infraspecific taxa. The variety *polyphylla* Flot. apud Sturm, was characterized by erect, thick, overlapping lobes; the combination is not retained here as it probably represents a xero-ecotype of the species (Fig. 54). The second infraspecific taxa, forma *prolifera* Thomson, was based on Gyelnik's (1931a and 1932) descriptions of the "isidiate" *P. avenosa* which actually represents the blue-green prototype



Figure 55. *Peltigera malacea* lower surface. There is an abrupt transition between the pale margins and the blackish, mature parts of lobes. The anastomosed veins give the appearance of a veinless lower surface. (Vitikainen 10957, ALTA.)

of *P. britannica* Holtan-Hartwig & Tønsberg (Goward et al. in prep.; see also Tønsberg & Holtan-Hartwig 1983).

When growing in mesic to somewhat xeric conditions *P. malacea* is often found among acrocarpous and feather mosses. Maybe, due to the competition from these, the lobes are mostly erect and often disintegrate in the centre. By contrast, in moist conditions, i.e., in peatlands, it develops large, spreading lobes and its thallus remains intact.

Ecology: *Peltigera malacea* occurs in a wide range of habitats from wet subarctic Black Spruce bogs, mesic mixed Aspen Poplar-White Spruce forests, and open pine forests on dunes. It is also common in pine forests in the foothills and mountains, subalpine spruce-Subalpine Fir forests, and dry, rocky alpine sites. Most commonly it grows on litter, but is also

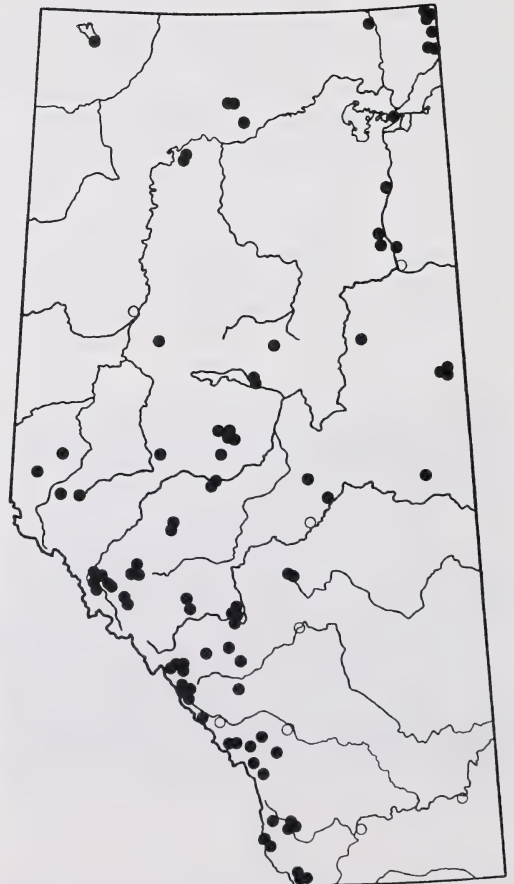


Figure 56. Distribution of *Peltigera malacea* in Alberta.

often found on mosses and occasionally even on exposed dry sand on dunes, or rocks in the alpine tundra.

Distribution in Alberta: This eurytopic species grows throughout the forested and alpine natural regions in the province, being absent only from the grasslands (Fig. 56). It appears to be most common in the Boreal Mixedwood and Foothills subregions. The species is common over its range.

Distribution in North America: Krog (1968) reports *P. malacea* to be "a high arctic-temperate, circumpolar species." Thomson (1984) adds that it is, however, rare in the Arctic Islands. *Additional specimens seen (ALTA):* *Canada:* British Columbia, Manitoba, Quebec, Northwest Territories, Saskatchewan, and the Yukon Territory; *U.S.A.:* Alaska, Colorado, and Washington.

***Peltigera membranacea* (Ach.) Nyl.**

Illustrations: Figs. 57-59, map: Fig. 60.
Appendix 1.

Morphology: Thallus medium to large, rather loosely attached to the substrate; lobes 2 to 3 cm broad, branching, sometimes concave, very thin, fragile when dry, margin entire and downturned. *Upper surface* grey, rarely with brownish tint, smooth, tomentum usually restricted to margin. *Lower surface* with distinct, narrow, raised, and tomentose veins throughout, these typically whitish but sometimes darkening and becoming almost blackish (rare) toward centre, interstices wide, diamond-shaped to polygonal; rhizines to 8 mm, typically whitish, but commonly brownish or even blackish, simple to more often densely and short squarrosely branched. *Photobiont,* cyanobacteria. *Apothecia* occasional, on elongate lobes, disk hazelnut brown, to 8 mm long, with somewhat revolute margins, on short lobes; spores acicular, (31-) 41-61 (-76) x 3-4 µm, mostly four-celled, occasionally more than tri-septate.

Variation: *Peltigera membranacea* belongs to the *P. canina* group but differs from these related species by its narrow, widely reticulate veins (Fig. 58) and its membranous lobes with downturned margins. *Peltigera canina* also has downturned lobe tips but differs by its thick and robust thallus, the absence of tomentum on veins, and its mostly branched, dark rhizines that are at least patchily anastomosing. *Peltigera praetextata* also has long, simple rhizines but differs from *P. membranacea* by a network of usually flat and brown veins and a typically upturned margin. In addition, its

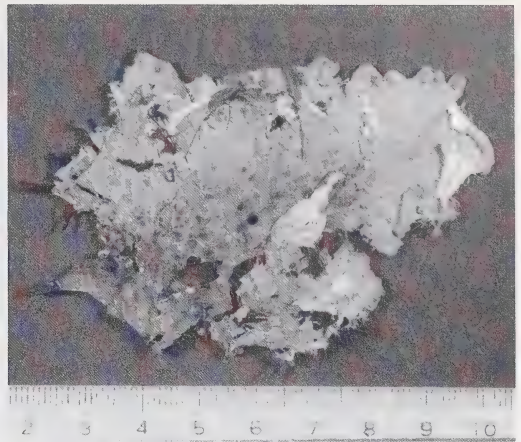


Figure 57. *Peltigera membranacea* upper surface. (Goffinet 412, herb. Goffinet.)

upper cortex often bears phyllidia, which are never developed in *P. membranacea* (Appendix 1). We have included in the present concept of *P. membranacea* specimens with veins forming an atypically neat reticulate network (Fig. 59 right) and rhizines squarrosely to abundantly branched (bushy); in such cases, the thallus is papery and the veins and rhizines are either dark brown or whitish, and tomentose almost throughout. The taxonomic placement of such specimens remains uncertain, and these morphologically intermediate thalli might be of hybrid origin.



Figure 58. *Peltigera membranacea* lower surface. The distinct, narrow veins form a loosely reticulate network. (Goffinet 412, herb. Goffinet.)

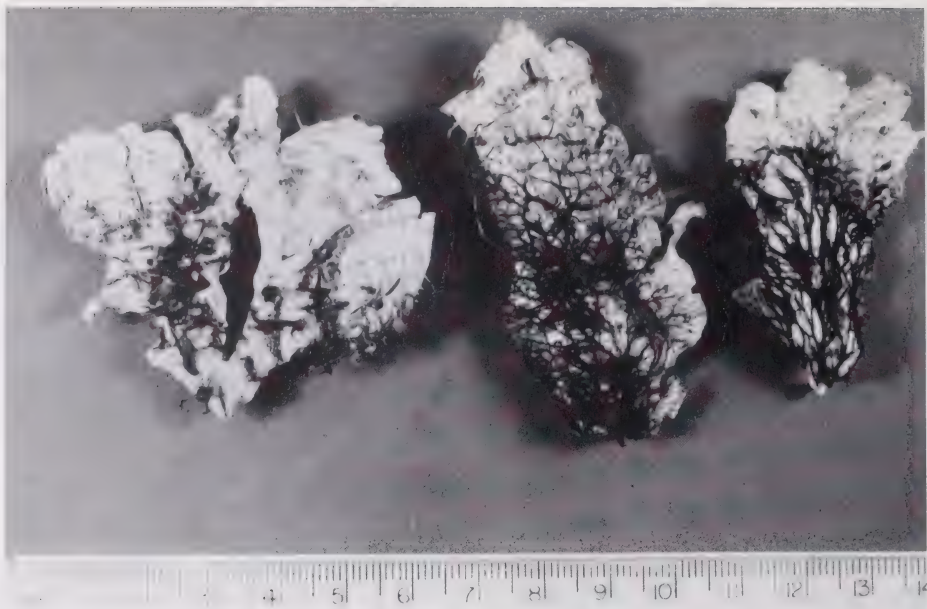


Figure 59. *Peltigera membranacea* variation in color of veins. (left to right: Goffinet 412, Goffinet 1505, both herb. Goffinet; Goffinet C90.4.176, PMAE.)

Ecology: *Peltigera membranacea* occurs most commonly on mosses or humus in mesic, mixed White Spruce-Aspen Poplar forests. It also grows on mosses in mesic to moist sites in subalpine spruce-Subalpine Fir forests and in mesic alpine tundra meadows. Occasionally it is found on rotten logs in mesic forests and, more rarely, directly on mineral soil.

Distribution in Alberta: This lichen is widely distributed but uncommon in Alberta; it appears to be found mostly in moist sites within the Boreal Mixedwood subregion (Fig. 60). It also occurs within the Subarctic subregion on the Caribou Mountains and in the Peace River Lowlands. Towards the west it has been collected in the Foothills, Montane, and Subalpine subregions.

Distribution in North America: *Peltigera membranacea* is known from a few continental localities but has an essentially oceanic to suboceanic distribution in North America and Europe (Ahti and Vitikainen 1977, Thomson 1950 and 1984, Vitikainen 1987). *Additional specimens seen (ALTA):* *Canada:* British Columbia, Newfoundland, and Nova Scotia; *U.S.A.:* Alaska, California, Idaho, and Oregon.

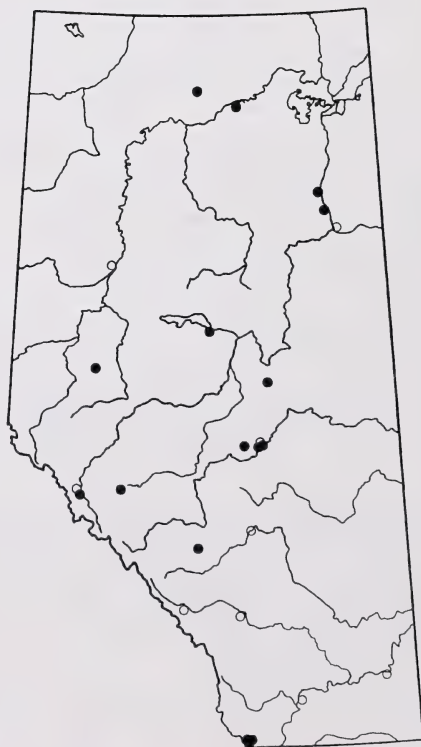


Figure 60. Distribution of *Peltigera membranacea* in Alberta.

Peltigera neckeri Hepp. ex Müll.
Arg.

Illustrations: Figs. 61-62, map: Fig. 63.
Appendix 2.

Morphology: *Thallus* medium, several cm across, moderately appressed to the substrate; lobes to 1.5 cm broad, rarely 2 cm, branching, rather thin, fragile when dry, margin plane to raised and slightly dissected. *Upper surface* usually with numerous cracks, dull to rarely shiny, occasionally somewhat maculate, grey to greyish-brown to sometimes bluish-grey, rarely entirely brown, smooth and glabrous, margin often pruinose. *Lower surface* ochraceous near margin, but often turning quickly dark brown, veins broad, more or less distinct only near margin, may be absent, some white interstices often remaining in the centre (the whitish margin can be broad in some specimens); rhizines to 5 mm, dark brown rarely pale near margin, short fasciculate to almost simple, often sparse and almost absent. *Photobiont*, cyanobacteria. *Apothecia* frequent, disk black, strongly finger nail-shaped, rarely reaching 6 mm in length (8 mm in the Yukon Territory material), on short lobes, appearing almost sessile; spores acicular, (34-) 44-59 (-68) x 3-4 µm, mostly four-celled but occasionally six-celled (90 spores measured).

Variation: *Peltigera neckeri* was recently reinstated and distinguished from *P. polydactyla* based on its distinct morphology (Vitikainen 1981) and chemistry (White and James 1985, see Appendix 2 for further comparisons). The species does not vary greatly, it is best characterized by its black apothecia that are supported by short, narrow lobes (Fig. 62). *Peltigera neckeri* can be confused with *P. elisabethae* when

sterile; both have often pruinose margins, a seemingly veinless lower surface (Fig. 62), and numerous cracks on the upper cortex. However, the lobe margin of *P. elisabethae* may bear schizidia, and lobules are often developed along the cracks. *Peltigera neckeri* invariably lacks specialized vegetative propagules and rarely produces regeneration lobules. When fertile, *P. neckeri* differs from *P. elisabethae* by its apothecia with revolute margins and spores that are longer than 45 µm. The two species also differ chemically (Goward et al. in prep., Holtan-Hartwig 1993).

Because of its usually indistinct veins, *P. neckeri* collections will key to *P. polydactyla* var. *crassoides* Gyelnik in both Thomson's (1950) and Ostafichuk's (1966) monographs. Both authors stress the similarities between specimens of *P. polydactyla* var. *crassoides* and *P. malacea*. Considering that *P. neckeri* has a lower surface with indistinct veins, this may indicate that their collections actually belong to *P. neckeri*. Ahti and Vitikainen (1977) and Vitikainen (1981) considered the combination *P. polydactyla* var. *crassoides* to be synonymous with *P. lactucifolia* (With.) Laundon (= *P. hymenina* (Ach.) Del.). This species, however, differs from *P. neckeri* by its ochraceous, anastomosing veins and by its brown apothecia supported by moderately long lobes. This contrasts with the black and almost sessile apothecia in *P. neckeri*. *Peltigera lactucifolia* is currently known only from the eastern coast of North America (Ahti and Vitikainen 1977) and from scattered hyper-maritime localities in British Columbia (Goward et al. in prep.).

Recently, Holtan-Hartwig (1988) described *P. frippii* from Norway. It differs from *P. neckeri* by its distinctly maculate upper cortex, crisped and narrow lobes, rather distinct veins, and chemistry. The species

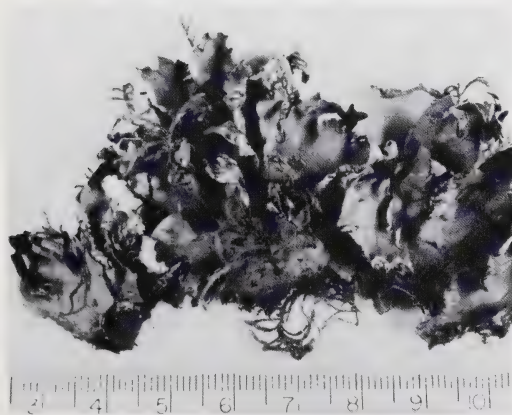


Figure 61. *Peltigera neckeri* habit. (Goffinet 3469, herb. Goffinet.)



Figure 62. *Peltigera neckeri*. Left: upper surface, note the small, blackish apothecia on short, narrow lobes. Middle and right: lower surface, note the broad veins and the few whitish interstices. (Hastings C91.5.54, PMAE.)

is currently not known from North America but it may be expected from higher elevations or latitudes.

Ecology: *Peltigera neckeri* occurs most commonly on mosses or humus in mesic, mixed White Spruce-Aspen Poplar stands in the boreal forest, and occasionally on rotten logs in mature Aspen Poplar forests. In drier sites, it grows on humus and in the shade. It is fairly common on mosses and humus in mountainous Lodgepole Pine forests; rarely in similar microhabitats in the alpine tundra.

Distribution in Alberta: *Peltigera neckeri* is here reported as new to Alberta. Most collections of *P. neckeri* are from the Central Parkland and Boreal Mixedwood subregions in the central part of the province (Fig. 63). It also occurs commonly in the Foothills, Montane, and Subalpine subregions. Towards the north, it has been collected at low elevations near the

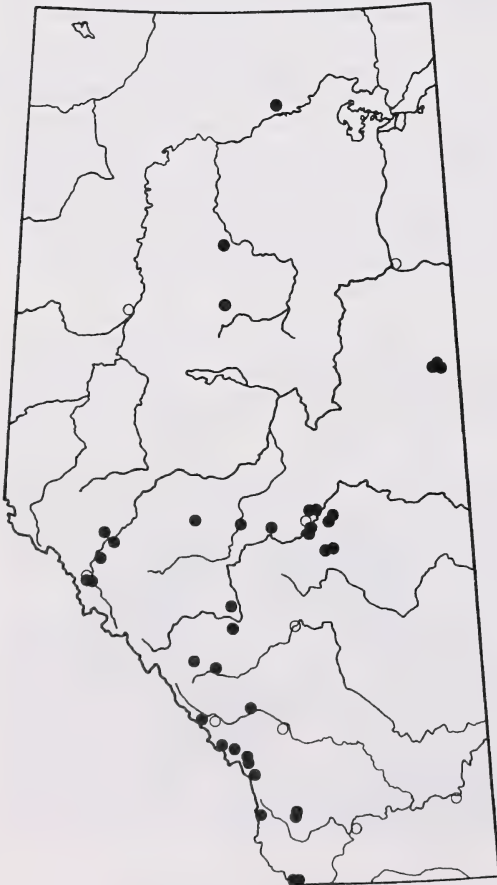


Figure 63. Distribution of *Peltigera neckeri* in Alberta

Buffalo Head Hills and Caribou Mountains. It is common over its range.

Distribution in North America: The distribution of this species is not well documented for North America but can be expected to follow a ubiquitous pattern similar to that observed in Europe (Vitikainen 1987). *Additional specimens seen (ALTA):* Canada: Ontario, and the Yukon Territory; U.S.A.: Minnesota and South Dakota.

Peltigera neopolydactyla (Gyelnik) Gyelnik

Illustrations: Figs. 64-66, map: Fig. 67. Appendix 2.

Morphology: *Thallus* large, to 15 cm across, often loosely attached to the substrate; lobes 3 to 4 cm wide, light brown to grey when dry, branching, moderately thin, robust to fragile when dry, margin entire, plane and somewhat crenulate. *Upper surface* smooth, glabrous, dull, faintly pruinose near margin, grey, bluish-grey to brownish-grey when wet, often brown toward centre when dry. *Lower surface* with ochraceous to dark brown broad veins anastomosing toward centre, interstices pale, rounded to elongate; rhizines particularly long in the centre to 7 mm, dark brown, simple, rarely fasciculate, somewhat branched towards centre. *Photobiont*, cyanobacteria. *Apothecia* common, disk chestnut brown, saddle-shaped, small, to 4 mm long, on narrow lobes rarely longer than 5 mm; spores acicular, (50-) 65-81 (-90) x 3-4 μm , four-celled to ten-celled (in one specimen, all spores were four-celled, whereas another had mostly spores with more than four cells; 90 spores measured).

Variation: *Peltigera neopolydactyla* can be distinguished by its large size; none of the other glabrous species develop lobes reaching 3 to 4 cm across (Fig. 64). However, one should always consider the possibility of small specimens representing young thalli; these can still be correctly identified based on the rhizines reaching 7 mm in length (check near mature part of lobes). We found most collections of this species under *P. polydactyla*, which differs from typical *P. neopolydactyla* by its narrow lobes, narrow veins, and short rhizines. It has also often been mistaken for *P. scabrosa*, from which *P. neopolydactyla* differs by its smooth upper surface and the absence of short, fasciculate, dark brown, marginal rhizines. Some specimens from the west coast have a slightly scabrous upper cortex (Goward et al. in prep.), but this variation is not known from Alberta. The lower surface of *Peltigera neopolydactyla* varies considerably: it can be pale



Figure 64. *Peltigera neopolydactyla* habit. (Horton 1755, ALTA.)

brown or ochraceous throughout or show an abrupt transition between a pale margin and a dark brown centre; the veins can be anastomosing near the margin or remain distinct almost throughout (Figs. 65-66). If Thomson's (1950) taxonomic concepts are followed, Albertan specimens would be identified as *P. polydactyla* var. *dolichorrhiza* Nyl. Ahti and Vitikainen (1977), however, point out that this taxon represents an entity different from *P. neopolydactyla* and subsequently rejected this variety from the North American flora. Whereas Albertan specimens of *P. neopolydactyla* are relatively homogenous, collections from British Columbia suggest that further studies may lead to the recognition of several taxa based on divergent morphology and chemical patterns (Goward et al. in prep.).

Ecology: This species prefers microhabitats with mesic to wet moisture regimes. It grows commonly



Figure 65. *Peltigera neopolydactyla* lower surface. (Horton 3510, ALTA.)

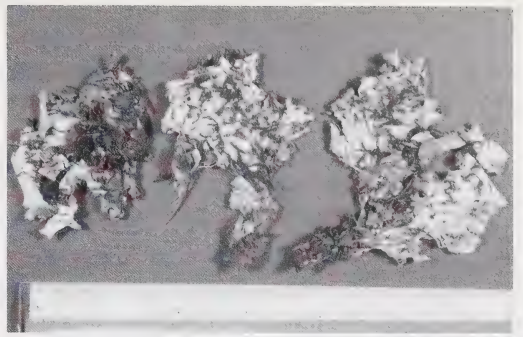


Figure 66. *Peltigera neopolydactyla* lower surface. There is considerable variation in the distinctness of the veins. (Vitt s.n., April 25 1984, ALTA.)

over mosses, humus, or on rotting logs in Black Spruce wetlands ranging from moderately rich to poor fens, and bogs. It is occasionally found on rotting logs in mesic montane forests and in wet alpine meadows where it grows on mosses.

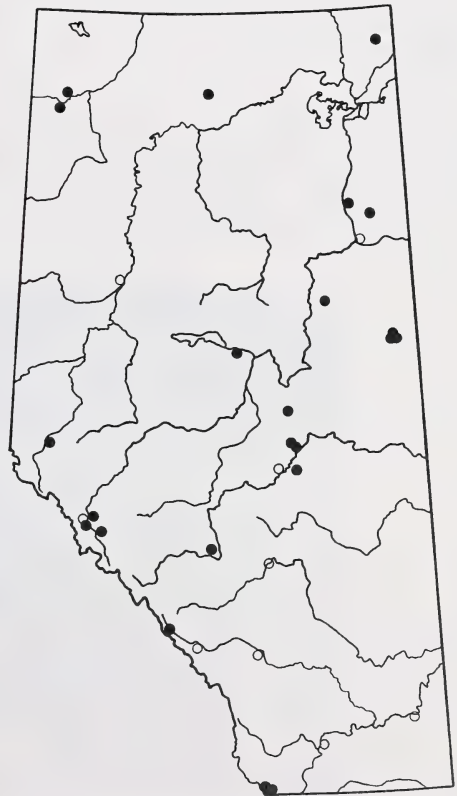


Figure 67. Distribution of *Peltigera neopolydactyla* in Alberta.

Distribution in Alberta: *Peltigera neopolydactyla* has been collected in scattered localities in the northern Central Parkland, Boreal Mixedwood, Subarctic, and Canadian Shield subregions (Fig. 67). Towards the west, it has been collected in the Foothills and Montane subregions upwards in elevation to lower parts of the Alpine. The species is common over its range.

Distribution in North America: This species has been recently reported from several provinces in Canada (Brodo et al. 1987), extending its range throughout northern North America from Alaska and Washington to Newfoundland and New York. Further taxonomic investigation may lead to the recognition of additional taxa and thus to a revision of the presently known range. *Additional specimens seen (ALTA):* Canada: British Columbia, Labrador, Newfoundland, Northwest Territories, and Saskatchewan; U.S.A.: Michigan, Minnesota, New York, and Washington.

***Peltigera polydactyla* (Neck.) Hoffm.**

Illustrations: Figs. 68-70, map: Fig. 71.
Appendix 2.

Morphology. *Thallus* medium, to 10 cm across, rather firmly attached to the substrate; lobes to 1 cm wide, branching, thin, fragile when dry, margin plane to upturned, irregular, crisped, becoming almost squamulose. *Upper surface* light brown when dry, smooth, very shiny, glabrous, not pruinose, with cracks, vege-

tative propagulae lacking, but short knobby regeneration lobules sometimes present. *Lower surface* with distinct veins near margins, abruptly turning dark brown and anastomosing toward centre, interstices pale, roundish to elongate; rhizines to 4 mm, dark brown, simple to somewhat branched apically, confluent near margin. *Photobiont*, cyanobacteria. *Apothecia* strongly finger nail-shaped, disk brown to dark brown, to 7 mm long, on ascending and somewhat canaliculate lobes reaching 1 cm in length, spores acicular, (51-) 58 -70 (-75) x 3-4 μ m, invariably four-celled (60 spores from two apothecia were measured; in the apothecia from the third specimen only immature spores with no clear septa were found).

Variation. *Peltigera polydactyla* was reported as widespread in Alberta by Thomson (1950, 1984), Ostafichuk (1966), and Vitt et al. (1988). Most Albertan specimens examined, however, belong to *P. neopolydactyla*, *P. neckeri*, or *P. elisabethae*. The former has broad lobes reaching 3-4 cm across, the broad veins vary in color and pattern, but the rhizines are always simple and to 7 mm long. *Peltigera neckeri* and *P. elisabethae* segregate by their blackish lower surface appearing veinless and with few pale interstices, and by a rather greyish upper cortex which is often pruinose near the margin (see Appendix 2 for further comparisons). The three specimens of *P. polydactyla* known so far from Alberta have numerous apothecia. *Peltigera polydactyla* can be distinguished from *P. elisabethae* and *P. horizontalis* by its strongly finger nail-shaped disk, and from *P. neckeri* by its long, narrow, apothecia-bearing lobes. When sterile, *P. poly-*

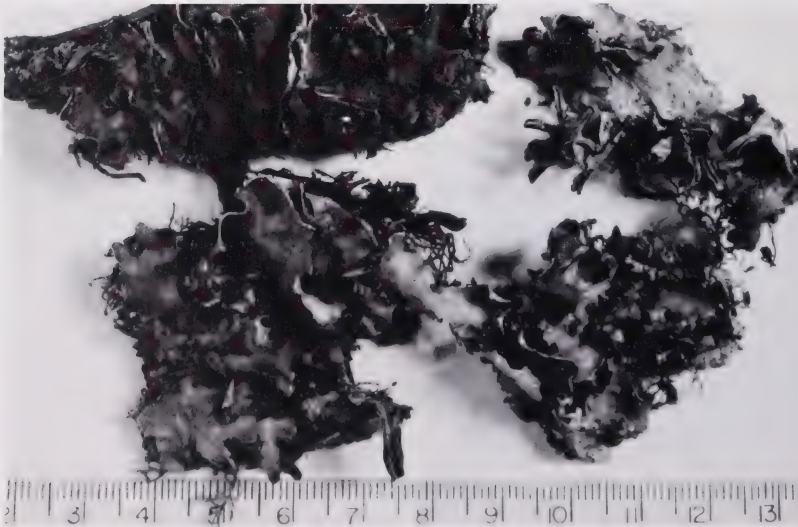


Figure 68. *Peltigera polydactyla* habit. The margins are upturned and the apothecia bearing-lobes are upright and narrowly elongate. (Goffinet 3246, ALTA.)

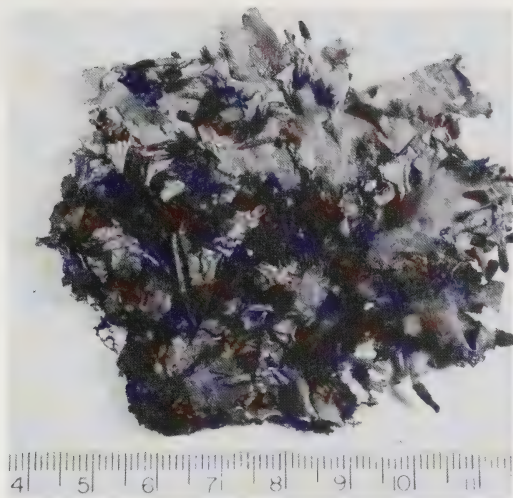


Figure 69. *Peltigera polydactyla* upper surface. (Scotter 46009, ALTA.)

dactyla is most similar to *P. horizontalis* (they have long been considered indistinguishable from each other when sterile) but differs by its crisped margin, lack of sub-marginal depressions on the upper surface, and scattered rhizines (Appendix 2).

Ecology. The three specimens known from Alberta were collected in mesic forests with poplar and White Spruce; they were growing over humicolous mosses.

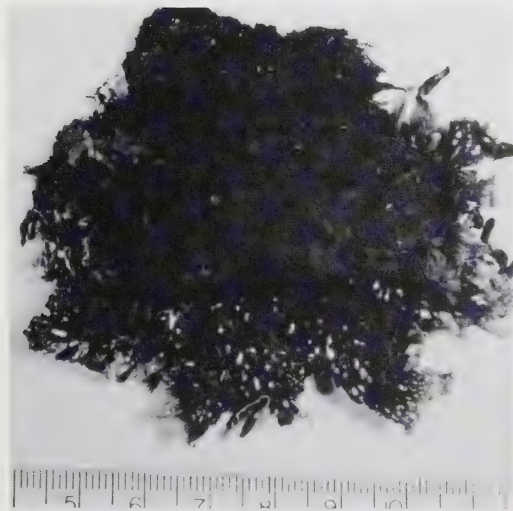


Figure 70. *Peltigera polydactyla* lower surface. Note the distinct veins. (Scotter 46009, ALTA.)

Distribution in Alberta: This rare species is known from only three localities, all between Edmonton and Lesser Slave Lake (Fig. 71). Two sites are in the Boreal Mixedwood and one is in the Central Parkland.

Distribution in North America. The distribution of this species is not well documented for North America as the mapped records certainly include specimens of *P. neckeri*, *P. neopolydactyla*, and *P. lactucifolia*. In Canada, *P. polydactyla* seems, so far, to have a temperate, oceanic distribution; the Albertan collections are the most continental localities yet recorded with certainty. *Additional specimens seen (ALTA):* Canada: British Columbia and Ontario. U.S.A.: Colorado (herb. Goffinet), Minnesota, and New Mexico (herb. Goffinet).

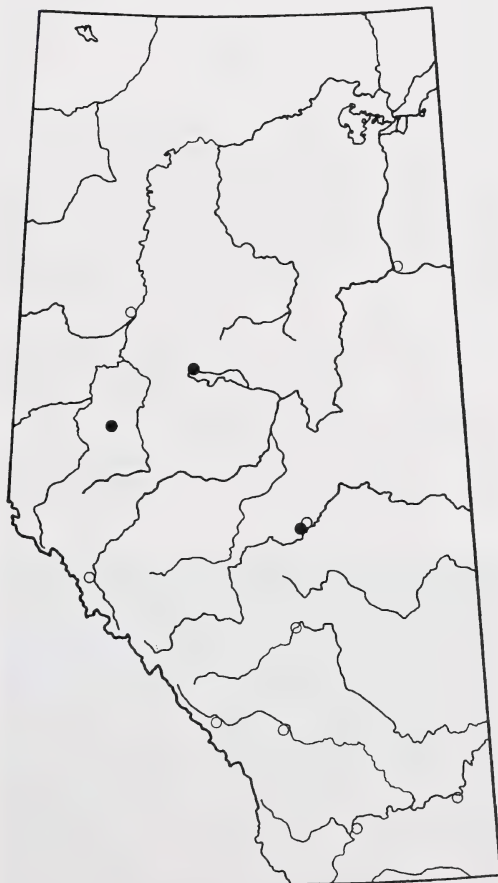


Figure 71. Distribution of *Peltigera polydactyla* in Alberta.

Peltigera ponojensis Gyelnik

Illustrations: Figs. 72-73, map: Fig. 73.

Appendix 1.

Morphology: *Thallus* small to medium, rarely reaching 10 cm, appressed to the substrate; lobes to 1 cm wide, branching, flat to crisped, thin, fragile when dry, margin entire, typically upturned, sometimes appearing somewhat lobulate. *Upper surface* grey, tan to brownish-grey, dull, tomentum typically restricted to the margin but sometimes extending toward centre, *Lower surface* with prominent and raised, glabrous veins, these pale rarely darkening gradually toward centre; rhizines to 7 mm, pale to brown, simple to scarcely branched, not confluent. *Photobiont*, cyanobacteria. *Apothecia* rare (only one fertile specimen seen), disk chestnut brown, to 1.3 cm wide, flat or with somewhat revolute margins, on short lobes; spores acicular, (38-) 41-54 (-60) x 3-4 μ m (20 spores measured), invariably four-celled.

Variation: *Peltigera ponojensis* can be mistaken for *P. rufescens* as both are tomentose and form small thalli. However, the two species can be distinguished by the following characters: *P. ponojensis* has a pale lower surface with simple rhizines and the tomentum on the upper cortex typically thins toward the centre of the lobes (Figs. 72 & 73); *P. rufescens* has a blackish lower surface with branched and confluent rhizines (if rhizines simple, then blackish), and its upper cortex is typically covered by a thick tomentum and a white crust in the centre. *Peltigera ponojensis* can also be mistaken for small specimens of *P. praetextata*, but can be separated by the absence of phylidia, the invariably glabrous ropy veins, and its rather xeric habitat preferences (Appendix 1). In his original descrip-

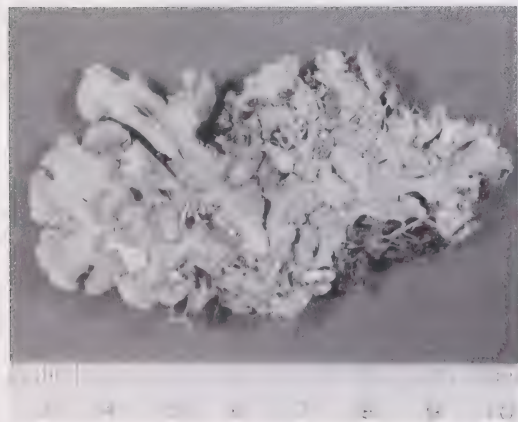


Figure 72. *Peltigera ponojensis* upper surface. (Pegg 1324, PMAE.)

tion, Gyelnik (1931b) considered *P. ponojensis* as closely related to *P. didactyla* (under *P. spuria* which, at that time, was considered to be a non-soresiate but fertile species with erect tomentose lobes). Although both taxa belong to the *P. canina* group, the modern concept of *P. didactyla* distinguishes them on the basis of the presence of soralia (or their scars) which are absent in *P. ponojensis*, the veins of the sterile lobes (raised in *P. ponojensis* and flat in *P. didactyla*), and the shape of the apothecia (wide and plane in *P. ponojensis* versus narrow and finger nail-shaped to saddle-shaped in *P. didactyla*).

Ecology: *Peltigera ponojensis* grows on soil and humus in exposed and cold microsites including open areas in forests, trail edges, and on boulders and rock-slides. It is found in a variety of habitat types ranging from Black Spruce wetlands and Aspen Poplar forests to exposed rock outcrops in the alpine tundra.

Distribution in Alberta: The distribution of this species appears to be controlled by the availability of a very specific microhabitat. It occurs in the Central and Peace River Parklands, Boreal Mixedwood, Foothills, and Alpine subregions but only in exposed, cold sites (Fig. 74). It can be characterized as a widespread but rare species.

Distribution in North America: Based on numerous collections, Brodo et al. (1987) reported *P. ponojensis* from most of northern North America. However, further taxonomic research is expected to lead to the recognition of an additional taxon (see *Peltigera* sp. 1) thus reducing the range of *P. ponojensis* in North America. *Additional specimen seen (ALTA): U.S.A.: Arizona.*

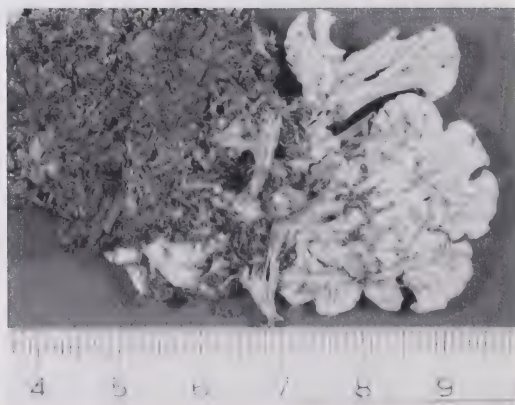


Figure 73. *Peltigera ponojensis* lower surface. The veins remain pale throughout. (Pegg C88.2.57, PMAE.)

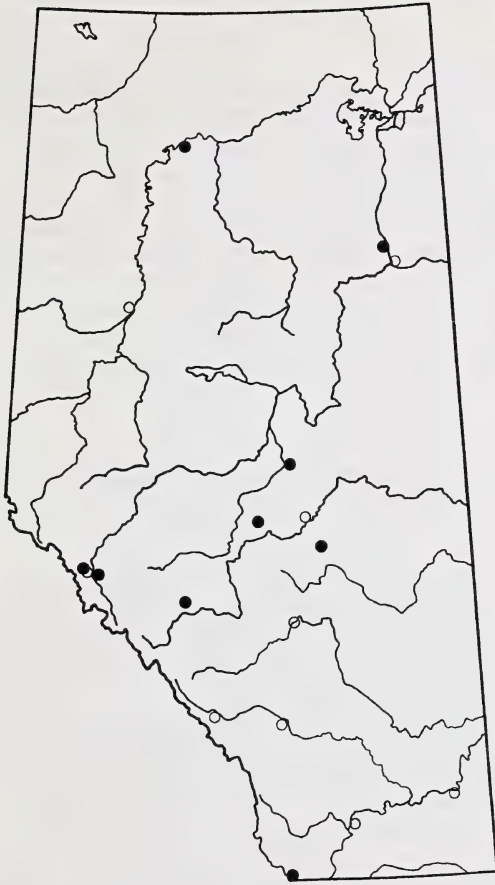


Figure 74. Distribution of *Peltigera ponojensis* in Alberta.

***Peltigera praetextata* (Sommerf.) Zopf**

Illustrations: Figs. 75-76, map: Fig. 77. Appendix 1.

Morphology: Thallus large, to 15 cm across, firmly attached to the substrate; lobes 0.7 to 2.0 cm wide, abundantly branching, margins somewhat dissected, plane to upturned and crenulate or sometimes somewhat downturned, thin, fragile when dry. *Upper surface* light to dark brown, smooth, dull, with appressed tomentum lacking toward centre, often with numerous cracks, phyllidia and lobules common, clustered on lobe surface or developing along cracks and margins. *Lower surface* with distinct network of brownish, somewhat raised to centrally flat veins, these some-

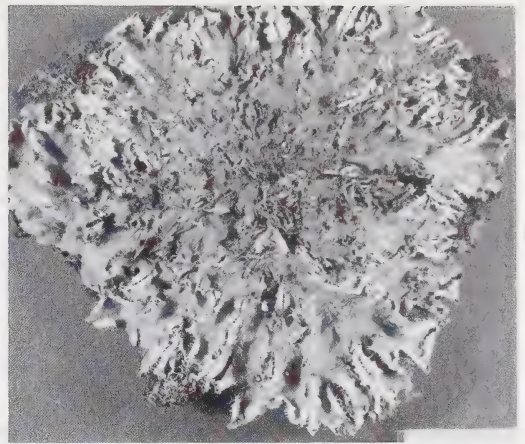


Figure 75. *Peltigera praetextata* habit (Hastings C91.5.10, PMAE.)

times covered with erect hairs near margin and overlapping toward centre, interstices whitish and diamond-shaped; rhizines to 9 mm, pale near margin and gradually darkening toward centre, simple to sparsely or squarrosely branched or even flocculent. *Photobiont*, cyanobacteria. *Apothecia* common, disk light to dark brown, to 9 mm across, saddle-shaped, on elongate lobes; spores acicular, (28-) 36-56 (-70) x 3.5 -5 µm, invariably four-celled.

Variation: Until recently, *P. praetextata* has been ranked at the infraspecific level (e.g., Ozenda and Clauzade 1970, Thomson 1950) or even as representing only a regeneration form without taxonomic status (Thomson 1984). *In situ* experimental work by Thomson (1948) questioned the taxonomic validity of the 'regeneration lobuli' used to segregate this species

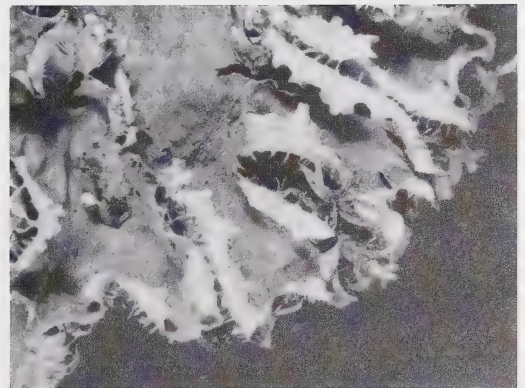


Figure 76. *Peltigera praetextata* habit. Close-up of lower right corner of Fig. 75. Note the typical upturned margins and thread-like rhizines. (Hastings C91.5.10, PMAE.)

within the *canina* complex. Thomson suggested that virtually all species of *Peltigera* can produce these lobules under stress. However, field studies carried out by Lindahl (1953) suggested that, of the three species *P. canina*, *P. rufescens*, and *P. praetextata*, only the latter regularly produces "isidia" when cut or wounded. As a result, he concluded these propagules could be used as a taxonomic character, and were, in fact, the only valid species specific character separating the taxa.

Further research has revealed additional characters segregating *P. praetextata* from *P. canina* and *P. rufescens* (Goward et al. in prep., Vitikainen 1981). *Peltigera praetextata* differs from related species by its upturned lobe tips, mainly simple rhizines (Fig. 76), and typical phyllidia. Based on these concepts, we could readily distinguish *P. praetextata* specimens in Alberta (Appendix 1). Mature specimens are similar to *P. canina*, *P. cinnamomea*, and *P. membranacea*, but none of these commonly produces phyllidia or regeneration lobules and all three taxa have a plane to downturned margin compared to a rather upturned margin in *P. praetextata* (Appendix 1). Further, *P. canina* rarely has simple rhizines and never has tomentose veins. *Peltigera cinnamomea* lacks erect hairs on its typically rust-brown veins. *Peltigera membranacea* has a very thin thallus, the rhizines are typically squarrosely branched, and the veins are typically extremely narrow and raised. Small specimens of *P. praetextata* are commonly mistaken for *P. rufescens*, but the latter typically has confluent, densely branched, blackish rhizines and rather erect lobes. *Peltigera rufescens* is also a more xeric species not growing in mesic forests on mossy rotten logs as *P. praetextata* commonly does.

Ecology: This eurytopic lichen is found in habitats from Black Spruce bogs, mesic mixed White Spruce-Aspen Poplar stands, to dry pine woodlands. Forested sites range from deep-shaded to exposed. While commonly growing over mosses, on litter, and on burned or rotten logs, it occasionally has been collected on sandy soil. Extreme forms, which we referred to as *P. praetextata*, have been collected from the rocky alpine tundra of the Mountain Park area (Hastings C89.6.89 PMAE; Scopera 8568 ALTA).

Distribution in Alberta: This lichen is most commonly found in the Central Parkland and Boreal Mixedwood subregions (Fig. 77). It has been collected in the Foothills and Montane subregions, including an outlier on the Cypress Hills. It is apparently rare in tundra environments including the subarctic to the

north and the alpine to the west. *Peltigera praetextata* is common over its range.

Distribution in North America: The distribution of this species in North America is not well documented as it has, until recently, often been considered as a regeneration form of *P. canina* var. *rufescens* (Ostafichuk 1966, Thomson 1950). Based on Thomson's data, however, it can be expected to be widespread, following a ubiquitous pattern similar to that observed in Europe (Vitikainen 1987). **Additional specimens seen (ALTA):** Canada: Newfoundland, Northwest Territories, and the Yukon Territory; U.S.A.: Colorado, Michigan, Minnesota, Missouri, New Mexico (herb. Goffinet), New York, Utah, and Washington.

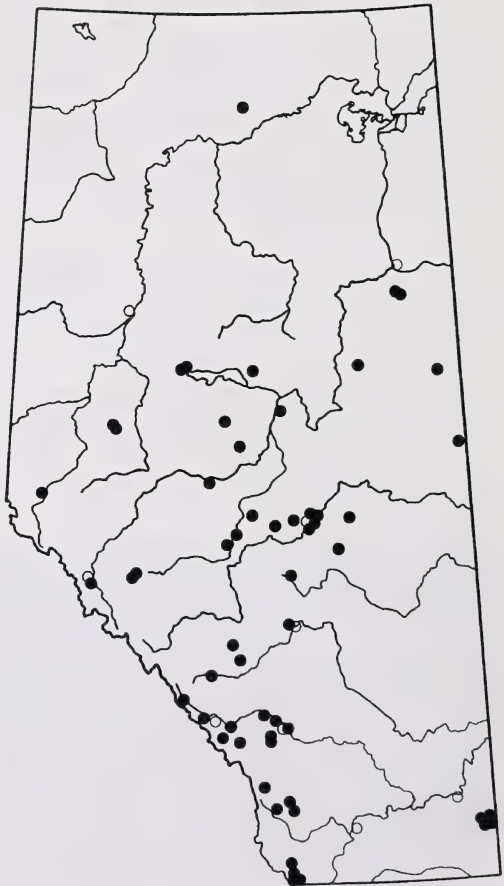


Figure 77. Distribution of *Peltigera praetextata* in Alberta.

Peltigera retifoveata Vitik.

Illustrations: Figs. 78-80, map: Fig. 81.

Morphology: *Thallus* medium to large, to 20 cm across, rather loosely attached to the substrate; lobes 1 to 2 cm wide, branching, margins entire, upturned or plane, moderately thin, fragile when dry. **Upper surface** light grey, grey-brown to brown, with thick appressed tomentum thinning toward centre. **Lower surface** with a network of distinct to often anastomosing, tomentose, loose (soft) veins (rarely without erect hairs), ochraceous to dark brown toward centre, with pale, elongate to rounded, deep interstices; rhizines to 7 mm, dark brown to black even near margin, simple to fasciculate, squarrosely to regularly branched. **Photobiont**, cyanobacteria. **Apothecia** occasional, disk brown to dark brown, almost black, small, saddle-shaped, on elongate lobes; spores acicular, (32-) 36-47 (61) x 3.5-4 μm , almost invariably four-celled (90 spores measured).

Variation: *Peltigera retifoveata* was recently described from North America and Europe by Vitikainen (1985). Most of the collections belonging to this species were initially identified as *P. scabrosa* (under *P. pulverulenta* auct. eur.) from which it differs by its tomentum and smooth upper surface. One collection (Nyland 168, CAFB) had developed numerous regeneration lobules along cracks, which made it look like *P. praetextata*. From the latter species and from all members of the *canina* group, *P. retifoveata* can, however, be easily distinguished morphologically by its cottony lower surface with deep interstices (Figs. 79-80) and chemically by the presence of depsides and

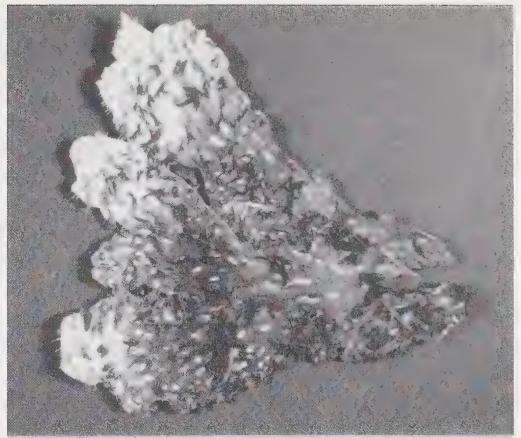


Figure 79. *Peltigera retifoveata* lower surface. It has elliptical interstices and thick, tomentose rhizines. (Horton 271, ALTA.)

triterpenoids (Vitikainen 1985). Holtan-Hartwig (1993) suggests placing *P. retifoveata* in "a group of its own" as the species differs further from the taxa of the *P. canina* group by the morphology of the hyphae making up the veins.

Ecology: *Peltigera retifoveata* occurs most commonly on litter and mosses in dry, coniferous habitats and in disturbed and/or exposed situations such as road banks. In natural conditions, it prefers pine-spruce forests and pine-lichen woodlands, especially on stabilized dunes. Occasionally it is found on mineral soil in disturbed coniferous forests.

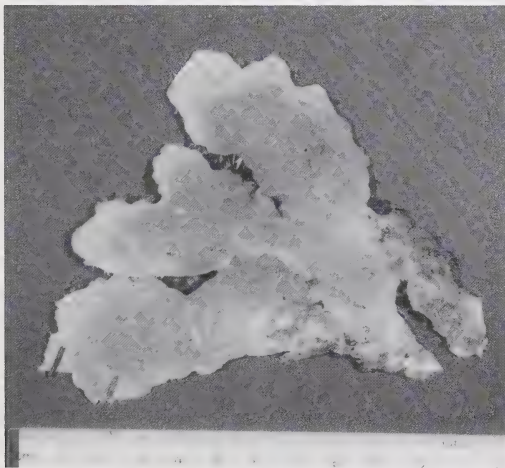


Figure 78. *Peltigera retifoveata* upper surface. (Horton 271, ALTA.)

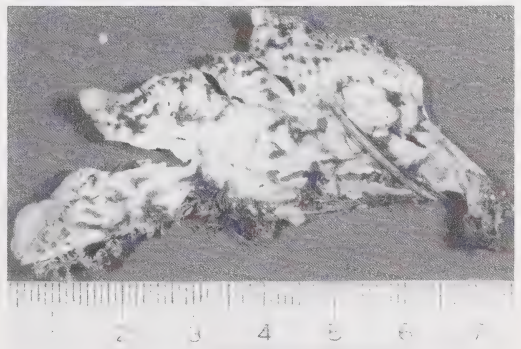


Figure 80. *Peltigera retifoveata* lower surface. Note the difference in color of the veins, these remain pale throughout, but are otherwise identical to Fig. 79. (Ostafichuk 1027, ALTA.)

Distribution in Alberta: *Peltigera retifoveata* has been collected mostly from the Foothills subregion where it prefers upland sites (Fig. 81). It is also locally abundant in Lodgepole Pine woodlands in the Montane subregion. In the northern part of the province, it occurs in scattered localities in the Boreal Mixedwood, Peace River Parkland, Peace River Lowlands, and in the Subarctic on the Caribou Mountains. This species is uncommon over its range.

Distribution in North America: This essentially disjunct circumboreal species (Vitikainen 1985) has a north western distribution in North America and was recently reported from the continental United States (Goffinet 1992). Additional specimens seen (ALTA): *Canada:* British Columbia, Manitoba, Northwest Territories, Saskatchewan, and the Yukon Territory; *U.S.A.:* Alaska and Washington.

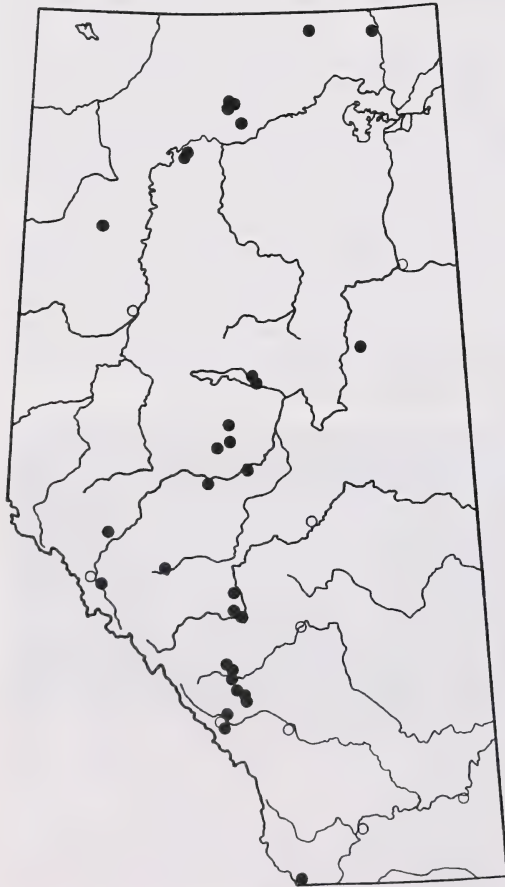


Figure 81. Distribution of *Peltigera retifoveata* in Alberta.

Peltigera rufescens (Weis.) Humb.

Illustrations: Figs. 82-83, map: Fig. 84.
Appendix 1.

Morphology: *Thallus* small to medium, to 10 cm in diameter, closely appressed to the substrate; lobes commonly less than 1 cm wide, rarely reaching 1.5 cm, branching, densely overlapping in dry habitats, margin entire, upturned to more rarely flat, rather thick and robust when dry. *Upper surface* grey to greyish-brown to brown, smooth, covered by a thick tomentum often extending toward centre and commonly with a white to light grey crust spreading to the margin. *Lower surface* with a network of distinct veins, these often anastomosing in the centre, veins dark brown to black, flat and glabrous; rhizines short, rarely to 8 mm, black, rarely pale near margin, typically confluent and densely branching near margin, rarely simple almost throughout. *Photobiont,* cyanobacteria. *Apothecia* common, disk dark brown, saddle-shaped, to 6 mm long and 1 cm wide, typically on erect, elongate lobes with strong, raised, whitish veins; spores acicular (44-) 47-57 (-72) x 2-4 µm, mostly four-celled.

Variation: *Peltigera rufescens* has long been considered a variety of *P. canina* (e.g., Ozenda and Clauzade 1970, Thomson 1950). However, it differs from the latter by its upright margin and by its narrow lobes (to 1.5 cm, Fig. 82). Some specimens of *P. rufescens* have simple to scarcely branched rhizines similar to those found in *P. ponojensis* or *P. praetextata*. *Peltigera ponojensis* can be distinguished by its typically pale lower surface, whitish rhizines, raised veins, and apothecia with flat margins. *Peltigera praetextata* segregates by its pale to brownish veins and rhizines, and by often developing its typical phyllidia or lobules. An



Figure 82. *Peltigera rufescens* habit. The erect, fertile lobes have strongly saddle-shaped apothecia. Magnification 1.1X. (Goffinet C90.4.167, PMAE.)

Albertan specimen collected by MacNeil (3149, CANL) bears numerous regeneration lobuli, which is very unusual for *P. rufescens*. *Peltigera kristinssonii*, another species sometimes mistaken for *P. rufescens*, differs by its marginally scabrous and erect-tomentose cortex, fasciculate to squarrosely branched rhizines, and tomentose veins.

Fertile specimens of *P. didactyla* var. *didactyla* can also resemble *P. rufescens* as both thalli are often small and the apothecia-bearing lobes have strong, pale, raised veins. However, *P. didactyla* develops soralia and, in fertile specimens, one can often find their scars. In addition, *P. didactyla* has rather pale, simple rhizines, often confined to the centre, whereas *P. rufescens* bears abundantly branched, blackish, and anastomosing rhizines at the base of its fertile lobes (Fig. 83).



Figure 83. *Peltigera rufescens* lower surface. Note the abundantly branched and anastomosing rhizines (left) and the distinct dark veins (right, rhizines removed). (Goffinet C90.4.167, PMAE.)

Ecology: *Peltigera rufescens* occurs commonly on mineral soil or thin humus over mineral soil in dry coniferous dominated forests. It grows on stabilized sand dunes in pine-lichen woodlands, mineral soil in montane grasslands and pine forests, and in exposed, rocky alpine tundra. *Peltigera rufescens* is also common in natural and man-made disturbed sites such as alluvial gravel flats and roadside cutbanks. Rarely has it been collected on litter or humus in mesic White Spruce forests. In North America and Europe, this species is probably the most calciphilic member of the genus.

Distribution in Alberta: *Peltigera rufescens* is common in the forested central and southern parts of the province in Boreal Mixedwoods, Foothills, and Montane subregions (Fig. 84). It is also prevalent in the

Subalpine and Alpine. North of Lesser Slave Lake it becomes less common, being collected in scattered Boreal Mixedwood, Subarctic, and Canadian Shield localities where dry or disturbed microsites are available. In southeastern Alberta, *P. rufescens* has been collected in the Montane subregion of the Cypress Hills. This species is common in Alberta.

Distribution in North America: The species is widespread throughout North America. The map presented by Thomson (1984), under *P. canina* var. *rufescens* may represent the overall range of the species but some specimens may have been *P. ponojensis* which was not reported from North America until recently (see discussion under that species). **Additional specimens seen (ALTA):** **Canada:** British Columbia, Newfoundland, Northwest Territories, Ontario, Quebec, Saskatchewan, and the Yukon Territory; **U.S.A.:** Alaska, Arizona (herb. Goffinet), Colorado, Minnesota, South Dakota, Utah, Washington, and Wyoming.

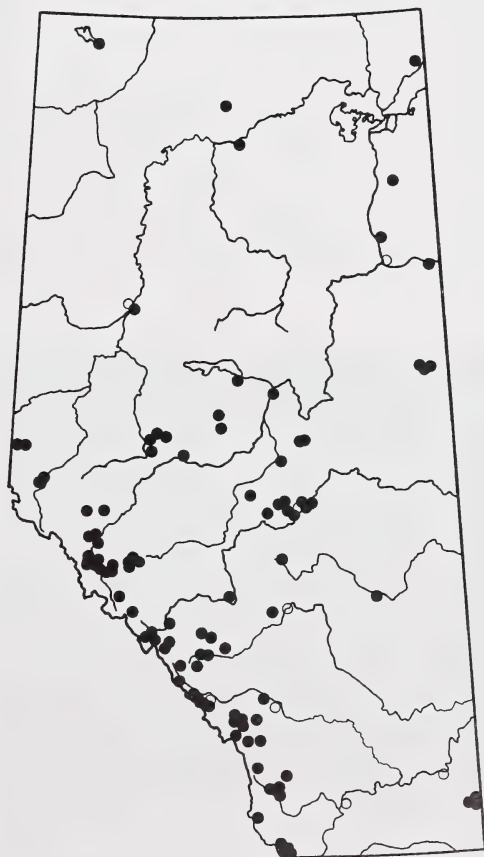


Figure 84. Distribution of *Peltigera rufescens* in Alberta.

Peltigera scabrosa Th. Fr.

Illustrations: Figs. 85-86, map: Fig. 87.

Morphology: *Thallus* medium to large, loosely attached to the substrate; lobes to 3-4 cm across, branching, margin entire, plane to upturned, rather thin, fragile when dry. *Upper surface* light greenish-grey, grey-brown, brown to dark blue, sometimes with yellowish tint, scabrous at least toward margin, glabrous. *Lower surface* ochraceous to whitish, veins ochraceous or light brown to dark brown toward the centre, overlapping or more or less distinct, interstices small, whitish, sometimes absent in the centre; rhizines to 4 mm, dark brown even near margin, mostly penicillate near margin, to densely branched and fibrillose, or even simple toward centre, soon anastomosing. *Photobiont*, cyanobacteria. *Apothecia* occasional, disk chestnut brown, saddle-shaped, to 6 mm across, on elongate lobes; spores linear (53-) 62-78 (-84) x 3-4 μm , mostly four-celled but sometimes to eight-celled.

Variation: *Peltigera scabrosa* is defined by its scabrous and glabrous upper surface and is easily recognized by its penicillate, dark brown rhizines which contrast with the ochraceous margin on the lower surface (Fig. 86). *Peltigera kristinssonii* is also slightly scabrous, but has erect tomentum toward the margin, tomentose veins, and does not produce any lichen substances. Specimens of *P. neopolydactyla* and *P. retifoveata* have often been mistaken for *P. scabrosa* (for points of separation see discussion under those spe-

cies). Holtan-Hartwig (1988) described *P. scabrosella* from oceanic northern Europe and Greenland. *Peltigera scabrosella* segregates from *P. scabrosa* by its narrow lobes and pale brown to whitish marginal rhizines.

Ecology: This lichen most commonly grows on mosses and humus in moist to mesic coniferous dominated forests. It has been collected in boreal Black Spruce-Swamp Birch wetlands to subalpine Engelmann Spruce-Subalpine Fir forests. Rarely it is found in drier pine forests and, if so, it grows on mosses or humus in mesic microsites.

Distribution in Alberta: *Peltigera scabrosa* is found mostly in upland subregions. It is most common in the Foothills and occasionally extends into the lower reaches of the Subalpine subregion (Fig. 87). Towards the north, it has been collected in scattered localities in the Boreal Mixedwood, Boreal Highlands, Subarctic, and Canadian Shield. It apparently is rare in the southern part of the province, our only record south of Jasper National Park being a single collection from Waterton Lakes National Park (Fig. 87). The species is uncommon over its range.

Distribution in North America: This circumpolar species is found throughout arctic, boreal, and alpine North America (Thomson 1984). *Additional specimens seen* (ALTA): *Canada:* Labrador, Ontario, Saskatchewan, and the Yukon Territory; *U.S.A.:* Alaska and Minnesota

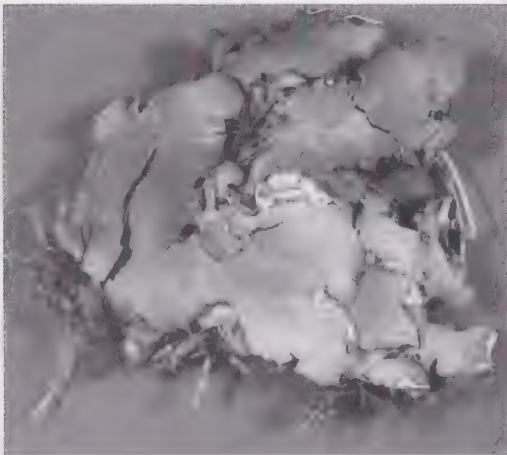


Figure 85. *Peltigera scabrosa* upper surface. (Vitikainen 9743, ALTA.)

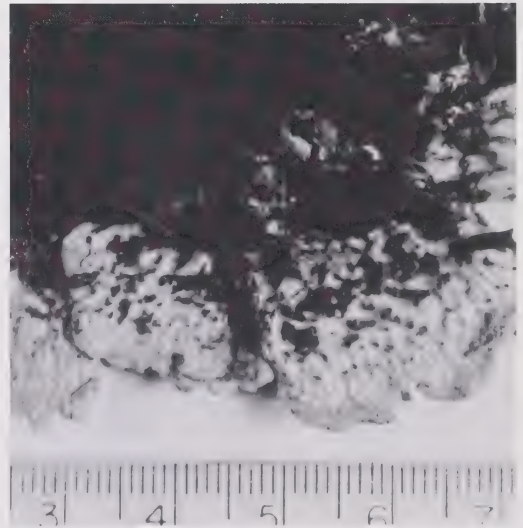


Figure 86. *Peltigera scabrosa* lower surface. The rhizines are dark, scattered, and penicillate. (Scotter 16573, CANL.)

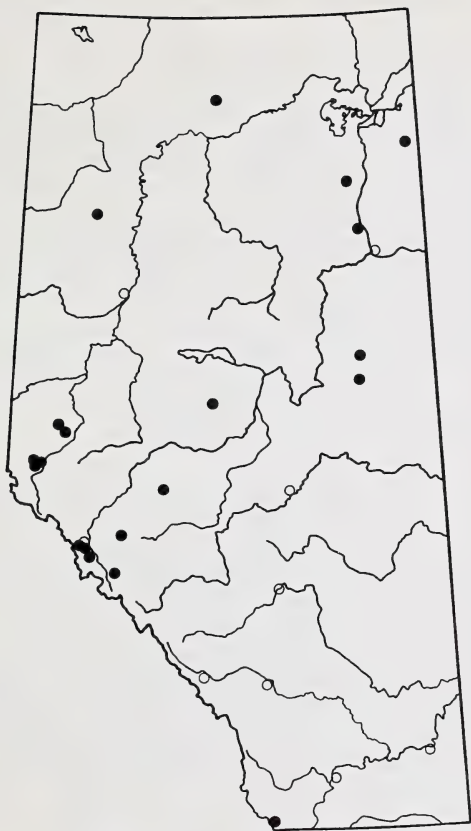


Figure 87. Distribution of *Peltigera scabrosa* in Alberta.

Peltigera venosa (L.) Hoffm.

Illustrations: Fig. 88, map: Fig. 89.

A. The green phototype

Morphology: Thallus small, fan shaped, often unilobate, firmly attached to the substrate; lobes 1 to 1.5 cm wide, scarcely branching, flat to concave, rather thin, fragile, margin entire and plane. *Upper surface* smooth, shiny, glabrous, light green to light brown when dry and bright, apple green when moist. *Lower surface* with a distinct network of brown, raised, and to 3 mm broad tomentose veins that become confluent toward the centre, interstices elongate, white and deep; rhizines to 7 mm, dark brown, forming a thick bundle restricted to a single submarginal position; cephalodia dark blue, verrucose to flat and peltate on the veins. *Photobiont*, green algae. *Apothecia* frequent, usually numerous, dark brown to black, horizontal to slightly concave, circular, to 6 mm wide, on non-elongated lobes and thus appearing marginal, lower surface not corticate; spores narrowly elliptic, (23-) 28-38 (-41) x 5-8 μ m, mostly

four-celled, but three- or five-celled spores occasionally found.

Variation: *Peltigera venosa* segregates readily from the other taxa having a green photobiont by its small size, its cephalodia that are located on the lower surface, and its marginal, horizontal apothecia (Fig. 88).

Ecology: *Peltigera venosa* commonly grows in mesic microsites on mineral soil or on thin humus over mineral soil. It is found in naturally disturbed but humid and mesic sites such as stream banks and near waterfalls in montane to subalpine pine-spruce-fir forests. Sometimes it is in montane Balsam Poplar-White Spruce forests along stream banks or on mineral soil exposed by uprooted trees. It also grows in man-made areas such as mesic roadcuts and trail edges. In the alpine tundra it occurs on mosses and humus over mineral soil.

Distribution in Alberta: This species is restricted to upland sites in western Alberta where it ranges from the Foothills to the Alpine subregions (Fig. 89). It is uncommon over its range.

Distribution in North America: This circumpolar species occurs throughout arctic, boreal, and alpine western and northeastern North America (Thomson 1950, 1984). In Europe, *P. venosa* is now restricted to higher elevations (Vitikainen 1981) and is threatened with extinction due to a lack of suitable habitats as a result of poor forest management (drainage and general lowering of the water table; Sérusiaux 1989). *Additional specimens seen (ALTA):* Canada: Northwest Territories and the Yukon Territory; U.S.A.: Colorado, Montana, and Oregon.

B. The blue-green phototype

This phototype of *P. venosa* is known in Alberta from only a single locality. The material is small and

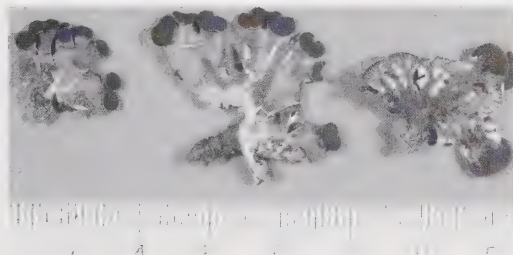


Figure 88. *Peltigera venosa*. Left and middle, upper surface showing numerous marginal, plane apothecia and single holdfast. Cracks formed on the middle specimens as the concave thallus was pressed for the photograph. Right, lower surface with distinct veins throughout. Note the cephalodia attached on veins. (Goffinet 1559, herb. Goffinet.)

consists of a single thallus attached to the green phototype. Morphologically and anatomically the lobes with cyanobacteria look similar to those of a small species of *Leptogium*. The material was too small to allow for a thorough description without damaging the specimen. A detailed description of the development of the blue-green phototype is provided by Ott (1988) and, as already noted by Tønsberg and Holtan-Hartwig (1983), no chemical substances were detected by TLC in the blue-green lobes. In contrast with other blue-green phototypes of the *Peltigera aphthosa* group, the blue-green phototype of *P. venosa* has, so far, been reported from Europe (Ott 1988, Purvis et al. 1992, and Tønsberg and Holtan-Hartwig 1983) and British Columbia (Goward et al., in prep.). The locality from Alberta is the most continental site yet reported from North America.

Distribution in Alberta: This phototype is known only from a single locality in the Montane subregion of Jasper National Park (Harris 1060, Harris pers. herb.; Fig. 89)

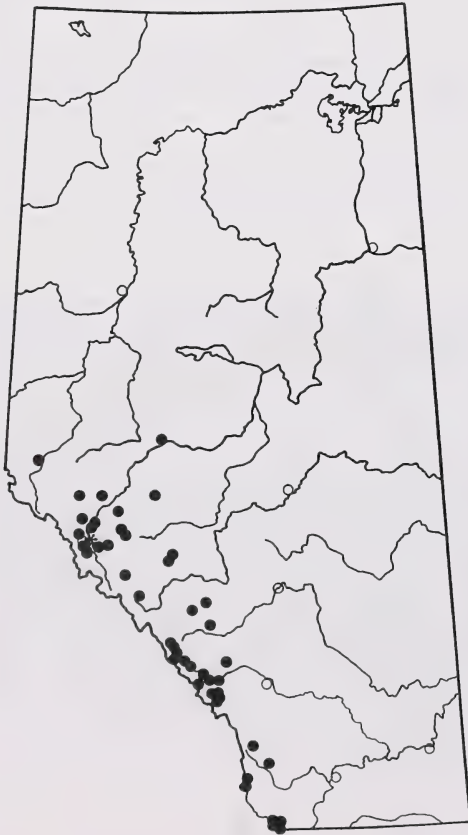


Figure 89. Distribution of *Peltigera venosa* in Alberta (solid dots: green phototype; star: blue-green phototype).

Peltigera sp. 1

Illustrations: Fig. 90, map: Fig. 91.

Morphology: Thallus medium, to 10 cm across, rather firmly appressed to the substrate; lobes to 2 cm wide, branching, moderately thin and fragile, margin plane. *Upper surface* grey to brownish-grey, glabrous, often somewhat pruinose near margin. *Lower surface* pale, darkening gradually toward centre or remaining pale throughout, veins raised, thick and ropy, smooth, interstices lenticular to elliptic, deep; rhizines to 5 mm, pale to dark brown, penicillate, slender or stout, sparse. *Photobiont*, cyanobacteria. *Apothecia* uncommon, disk chestnut brown, to 5 mm wide, strongly saddle-shaped, on short narrow lobes; spores acicular, (53-) 55-67 (-74) x 3.5-5 µm, four-celled.

Variation: Four specimens from Alberta could not be identified to any species presently known. Their morphology is somewhat similar to *P. ponojensis*, but differ by the glabrous cortex and apothecia with revolute margins. The absence of tomentum and the lack of secondary metabolites could lead to *P. degenii* Gyelnik, but the latter has membranous lobes, narrow veins, phyllidia, and is restricted to oceanic and temperate localities. Similar specimens are known from British Columbia where they were treated within *P. ponojensis*. The species is pending further studies (Goward et al. in prep.).

Ecology: This species grows over mosses on soil, in alpine vegetation dominated by *Salix arctica* and over epixylic mosses in montane forests.

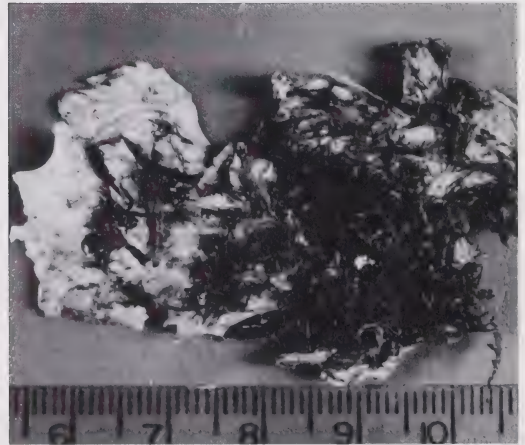


Figure 90. *Peltigera* sp. 1 lower surface. Note the ropy veins remaining pale throughout. (Goffinet C90.4.65, PMAE.)

Distribution in Alberta: This lichen is restricted to the Rocky Mountains (Fig. 91).

Distribution in North America: Unknown but apparently restricted to western North America. *Additional specimens seen (CANL):* Canada: British Columbia; U.S.A.: Washington.

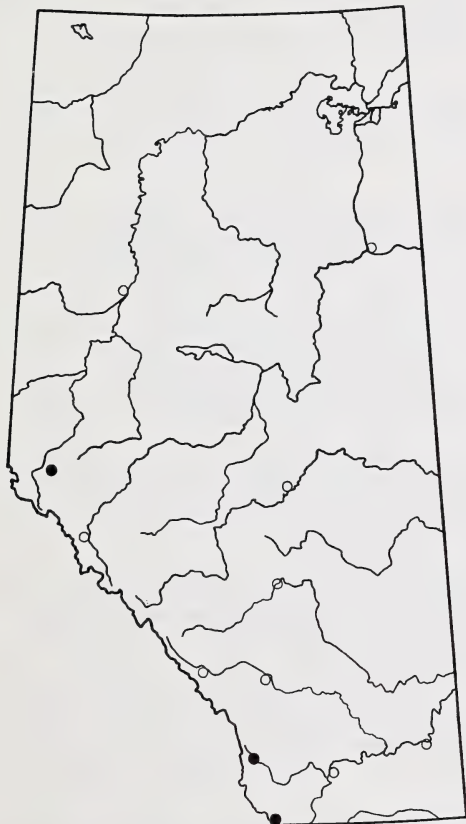


Figure 91. Distribution of *Peltigera* sp. 1. in Alberta.

Excluded species

Peltigera occidentalis (Dahl) Krist.

This species is characterized by a thick thallus with broad anastomosed veins and short rhizines (Goward et al. in prep). It would here key to *P. neckeri* from which it differs by its thick and leathery thallus and its chemistry (Goward et al. in prep., Vitikainen 1985). Ohlsson (1973) reports *P. occidentalis* from Alberta, based on two collections by Ostafichuk. We have only been able to examine one of the samples (Ostafichuk 1014, CANL) and agree with Vitikainen (1985) who referred both specimens, based on the chemistry reported by Ohlsson (1973), to *P. retifoveata*. No additional specimens have been found matching the description of *P. occidentalis*. Therefore, *P. occidentalis* should be deleted from the Albertan *Peltigera* flora even though it might be expected from higher elevations as it is known to occur in British Columbia (Goward et al. in prep.).

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Appendix 1. Comparison of the Albertan species of the *P. canina* group (excluding *P. retifoveata*)

	<i>P. canina</i>	<i>P. cinnamomea</i>	<i>P. didactyla</i>	<i>P. membranacea</i>	<i>P. ponoiensis</i>	<i>P. praetextata</i>	<i>P. rufescens</i>
Thallus	thick and robust	thin and fragile	thin and fragile	very thin (papery) and fragile	thin and fragile	thin and brittle	rather thick and robust
Lobe width	>1.5 cm	>1.5 cm	<1.5 cm	>1.5 cm	<1.5 cm	>1.5 cm (occasionally narrower)	<1.5 cm
Upper surface	grey to brown	brown to cinnamon	grey to brown	grey	light to dark brown	light to dark brown	grey to dark brown
Pruinosity	occasional	absent	absent	absent	absent	absent	common
Margin	plane to mostly downturned	plane	plane to downturned	downturned	upturned	plane to upturned	upturned
Tomentum	extending to lobe centre	thinning towards centre	thinning towards centre	restricted to lobe tip	thinning towards centre	thinning towards centre	extending to lobe centre
Veins (on sterile lobes)	whitish to dark brown, partly raised, flat toward centre, glabrous	whitish to cinnamon, partly raised, flat toward centre, glabrous	whitish to brown, flat, glabrous	whitish to pale brown, typically raised, tomentose	whitish to pale brown, typically raised, glabrous	pale to dark brown, partly raised, flat toward centre, glabrous to tomentose	dark brown to blackish, flat, glabrous
Rhizines	abundantly branched, patchily anastomosed	simple, scattered	simple to fibrillose, scattered to confined to centre	simple to squarrosely branched, scattered	simple, glabrous, scattered	simple to abundantly branched, scattered	abundantly branched, patchily anastomosed
Regeneration lobules or phyllidia	extremely rare (lobules)	not seen	not seen	not seen	not seen	common (phyllidia)	extremely rare (lobules)
Habitat	xeric to mesic	mesic and long snow cover	xeric to mesic	mesic and moist	xeric	mesic	xeric

Appendix 2. Comparison of the Albertan species of the *P. polydactyla* and *P. horizontalis* groups.

	<i>P. elisabethae</i>	<i>P. horizontalis</i>	<i>P. neckeri</i>	<i>P. neopolydactyla</i>	<i>P. polydactyla</i>
Lobe width	<3 cm	<2 cm	<1.5 (2) cm	<4 cm	<1.5 cm
Upper surface	grey to brownish-grey, shiny,	brownish-grey to chestnut brown, somewhat shiny,	grey to greyish-brown, dull to somewhat shiny,	light to dark brown, dull,	light brown very shiny
Pruinosity	smooth	pitted	smooth	smooth	smooth
Vegetative propagules	frequent	absent	frequent	occasional	absent
Regeneration lobules	schizidia	none	none	none	none
	common	occasional	none	none	none
Veins	indistinct, anastomosing,	distinct and narrow at least toward margin,	indistinct except near margin, anastomosing, blackish	distinct, broad, and often anastomosing toward centre, pale to dark brown	distinct and narrow at least toward margin, brown
Rhizines	blackish	brown	blackish	pale to dark brown	brown
	fasciculate,	fasciculate,	fasciculate to almost penicillate,	simple to somewhat branched,	simple to somewhat branched apically;
	blackish, to 5 mm	brown, to 5 mm	to 5 mm	pale to dark brown, to 7 mm	brown to dark brown, to 4 mm
Arrangement of rhizines	outermost in concentric circles	outermost in concentric circles	scattered	scattered	scattered
Apothecia	horizontal, on elongate lobes	typically horizontal rarely somewhat saddle-shaped, on elongate lobes	strongly saddle-shaped, on short lobes	saddle-shaped, on long narrow lobes	strongly saddle-shaped, on elongate and canaliculate lobes
Disk	brown	brown	black	brown	brown

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