

**Noteworthy range extensions of two lichens in eastern Canada: *Erioderma pedicellatum* (Pannariaceae) new to Québec and *Parmelia fraudans* (Parmeliaceae) new to Nova Scotia**

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**Abstract.** The globally rare epiphyte *Erioderma pedicellatum* is reported for the first time from Québec and the saxicolous *Parmelia fraudans*, uncommon in eastern North America, is reported for the first time from Nova Scotia.

**Key words.** Biogeography, Atlantic provinces, Eastern Canada, lichen species at risk.

## INTRODUCTION

The brief review of the history of lichen collecting in Canada included in Goward et al. (1998) reveals extensive coverage of a huge territory from the Arctic to the Atlantic and Pacific oceans, beginning in the early 1800s. After a lull in the first half of the 20<sup>th</sup> century, Eastern Canada has seen an increase in lichen surveys and collections. Since the 1950s, checklists, floras and regional studies have been compiled for Labrador, Newfoundland, New Brunswick, Nova Scotia, Prince Edward Island and Québec (Ahti 1983; Anderson 2014; Bell-Doyon et al. 2021; Cameron & Richardson 2006; Cameron et al. 2010; Clayden 2010; Deduke et al. 2019; Gowan & Brodo 1988; Kraichak et al. 2009; Lepage 1958; MacDonald et al. 2011; McCarthy et al. 2015; McMullin 2009, 2012, 2015; McMullin & Arsénault 2016, 2019; McMullin & Dorin 2016; McMullin & Wiersma 2016, 2017; McMullin et al. 2008; 2012, 2017; Paquette & McMullin 2020; Richardson et al. 2009; Seaward et al. 1997; Selva 2013, 2014; Sirois et al. 1988; Tumur & Richardson 2017, 2019; Walker 2007).

Recognition of the ecological importance of lichens and the availability of information on species identification, distribution, and habitat requirements have also expanded the documentation of species presence in many provinces in the last 20 years. Internet access to worldwide herbarium collections has enhanced the accuracy of species rarity assessments and distribution. BioBlitzes and Tuckerman workshops (Buck 2016) have also contributed, as have provincial and federal government requirements for environmental assessments prior to landscape disturbance. However, despite this increase in survey activity, two notable species range extensions of *Erioderma pedicellatum* (Hue) P.M. Jørg. (Québec) and *Parmelia fraudans* (Nyl.) Nyl. (Nova Scotia) were discovered during incidental rather than targeted surveys.

## METHODS

The Québec *Erioderma* specimen was collected during a botanical survey in 2001 and identified using a stereomicroscope in 2020. Live thalli were subsequently identified in the field in 2021 and were photographed with a Canon EOS Rebel SL1 using a 100mm macro lens. The

location details for *Erioderma pedicellatum* have been omitted to protect the new find of the globally rare species, though habitat details appear in the **Discussion** below. The specimen will be sent to the Louis-Marie herbarium at Laval (QFA) Quebec. The Nova Scotia *Parmelia fraudans* specimen (personal herbarium, Frances Anderson) was verified with microscopy and thin-layer chromatography (TLC) using solvent C (Orange et al. 2001) to confirm the presence of usnic acid, atranorin, salazinic acid and protolichesterinic acid (Clayden, pers. comm. 2021).

## DISCUSSION

**Québec (*Erioderma pedicellatum*):** A recent identification of a twenty-year-old collection of *Erioderma pedicellatum* from Québec extends the range of this globally rare cyanolichen (Scheidegger 2003; IUCN 2021).

In North America, only the provinces of Nova Scotia and Newfoundland on the Canadian east coast (Environment and Climate Change Canada 2018) and the state of Alaska on the United States west coast (Nelson et al. 2009; Stehn et al. 2013) record current populations of *E. pedicellatum*. First reports of *E. pedicellatum* in North America were published as *Erioderma boreale* Ahlner by Ahti and Jørgensen (1971) from a Newfoundland collection made by Ahti in 1956. Early reports (1902) of *E. pedicellatum* on Campobello Island, Maine at the United States/New Brunswick border are believed to be part of a population no longer extant (COSEWIC 2014; Maass and Yetman 2002).

Listed as Critically Endangered by IUCN since 2003 (Scheidegger 2003), *E. pedicellatum* is considered nearly extirpated in Europe with only two extant sites in Norway (Holien 2016). As of 2019, there were reports of substantial populations from the Kamchatka peninsula of eastern Siberia (Tagirdzhanova et al. 2019) resulting in a designation as Vulnerable for the east Asian population.

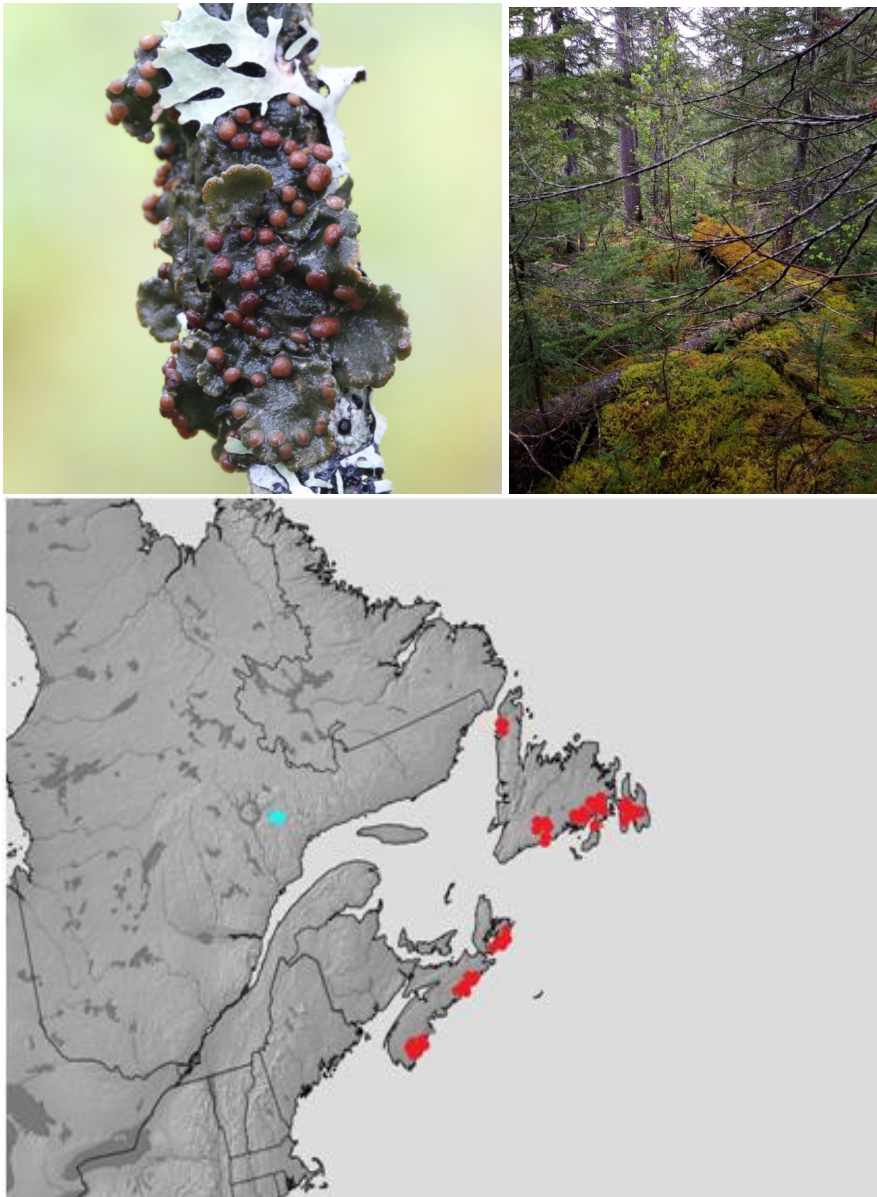
In Canada, two populations have been described: the Atlantic population and the Boreal population (COSEWIC 2014). The Atlantic population includes the sparse and widely scattered individuals in the province of Nova Scotia at the southernmost reaches of its range. This population is listed nationally and provincially as Endangered (COSEWIC 2014). The Boreal population describes the more frequent and densely clustered individuals found on the island of Newfoundland where it is designated Special Concern (COSEWIC 2014).

The “new” Quebec population was found in boreal forests located on the north shore of the St. Lawrence River, about 40 km southeast of the Manicougan Reservoir (Fig. 3). It is the northernmost known location in Canada. *Erioderma pedicellatum*’s usual habitat is described as cool, humid, old-growth oceanic coniferous forests (COSEWIC 2014; Scheidegger 2003). While the Atlantic population occurs in old forests primarily within 30 km from the Atlantic Ocean, the Newfoundland Boreal population inhabits coastal forests, lakeshores, and inland ravines up to 75 km inland. The Québec site is the furthest from a coastline, at ca. 130 kilometers inland from the St. Lawrence River.

The identification of the 2001 specimen in 2020 prompted a revisit to the site by one of the authors, M.B., in 2021. Though the original tree was not relocated, a single tree was found in the area with four small thalli in apparent good health on multiple branches (Fig. 1). The tree was in a riparian buffer strip (60 m wide), between large clearcuts dating from 2001.

The 2001 specimen was collected from a white spruce (*Picea glauca* (Moench) Voss) branch in a predominantly balsam fir (*Abies balsamea* (L.) Mill.) stand. The 2021 thalli were also on branches, at a height of 2-3 m from the ground, on a 10 cm-dbh fir. In Newfoundland (Boreal population), close to 50% of known thalli are on branches, mostly fir, with some on black spruce (*Picea mariana* (Mill.) Britton, Sterns & Poggenb.) (Hanel, pers. comm. 2021). Atlantic individuals (Nova Scotia) occur mainly on fir trunks, with only three known instances where white spruce and balsam fir branches were host substrates (Maass and Yetman 2002; Pepper, pers. comm. 2021). Atlantic and Boreal individuals are most often associated closely with the liverwort

*Frullania* Raddi (Environment Canada 2010; Maass & Yetman 2002). This was not verified in Québec.



**Figure 1** (upper left): Wet *Erioderma pedicellatum* thallus on branch, c. 2.5 cm long, Quebec 2021. **Figure 2** (upper right): Quebec *Erioderma pedicellatum* habitat. **Figure 3** (bottom): Distribution map for *Erioderma pedicellatum* in Canada. Red dots are the previously known distribution; the new Quebec location is the blue dot.

The forest landscape of the area in Québec where the lichens were discovered contains old, unmanaged spruce-fir forests in a relatively cold climate (mean annual temperature  $-1.5^{\circ}\text{C}$ ) with a total annual precipitation around 1050 mm. The somewhat mountainous topography ranges from 500-850m elevation. Deep moss carpets cover the forest floor (Fig. 2). *Erioderma pedicellatum* was found near the bottom of a valley at approximately 650m elevation on a north-northwest facing

slope where the largest spruce trees may reach a height of >20m. This elevation exceeds that of known Atlantic and Boreal sites by more than 400 meters. Relatively recent clear-cuts occur in the general area, but the remaining forest landscape is still dominated by old trees.

The numbers of viable thalli of *E. pedicellatum* are declining in the Atlantic and Boreal populations (Cameron & Toms 2016; Environment and Climate Change Canada 2018; Goudie et al. 2011; Toms 2021). So far, it is unknown if there are other instances of *E. pedicellatum* in the area around the recent discoveries in Québec but, considering that large tracts of virgin spruce-fir forests are present in the vicinity, this seems likely. The main potential threat to this population appears to be habitat loss due to logging, which is common in Québec's boreal forests, or natural disturbances such as insect outbreaks (of the spruce budworm, in particular) and wildfire (Bouchard et al 2008; Bouchard and Poirier 2010). However, it is difficult to assess the status of this population until more complete inventories are carried out to evaluate its distribution and abundance in Quebec.

**Nova Scotia (*Parmelia fraudans*):** In North America, *Parmelia fraudans* is considered a saxicolous, boreal/arctic species that occurs primarily in continental biogeographic regions (Ahti 1964; Hinds 1998; Nash and Elix 2002).

Though rare east of the Great Plains in the United States (Fig. 3), it has been known from scattered concentrated locations around Lake Superior and in eastern Canada in northern regions of Ontario, Labrador, Nunavut and Quebec, and a few locations in southern Ontario and Quebec. (CNALH 2021; Hinds 1998; Thomson 1984). It was not known from New England at the time of the publication of *Macrolichens of New England* (Hinds and Hinds 2007), where only locations in southern Québec, north of Maine, were noted. Subsequently, new records from Maine surfaced from two older collections (CNALH 2021; Hinds, pers. comm. 2021). One is in northern Maine, the other in Washington County, Maine at latitude 45.5°. To date there are few to no reported records south of the 45<sup>th</sup> parallel, east of the Central Plains states (CNALH 2021 Hinds 1998). At 44°16'N, a 2020 discovery of *P. fraudans* in Nova Scotia represents the southernmost known location in the east (Fig. 3).

It also represents the only verified specimen of *P. fraudans* in the Atlantic Provinces of Canada (New Brunswick, Prince Edward Island, Nova Scotia, and the island of Newfoundland) (ACCDC 2021; Ahti 1974, 1983; CNALH; Gowan & Brodo 1988; McMullin et al. 2012) and is a new record for Nova Scotia (ACCDC 2021; Anderson 2014; Lamb 1954). Specimens reported from Labrador (Kallio & Kärenlampi 1966; Thomson 1984) are not included in this range extension assessment for the Atlantic Provinces, because although Newfoundland and Labrador were declared a single political unit (province) in 2001, Labrador is not usually referred to as an Atlantic Province. Floristically, insular Newfoundland and continental, boreal Labrador comprise distinct physiographic land masses which are separated by the cold Labrador current flowing south along the Labrador coast through the Strait of Belle Isle.

The distribution map in Hinds' treatment of the genus *Parmelia* sensu stricto in eastern North America shows a collection just off the southwestern tip of the island of Newfoundland on the French island of Miquelon, which lies over 640 km away (Hinds 1998). Ernest Delamare, a resident medical doctor, collected extensively on Miquelon in the 1880s (LeGallo 1948). His records of *P. fraudans* as *Imbricaria saxatilis* f. *fraudans* (Nyl.) are doubtful. Delamare et al. (1888) listed it as a form of *Imbricaria* but on an unusual substrate:

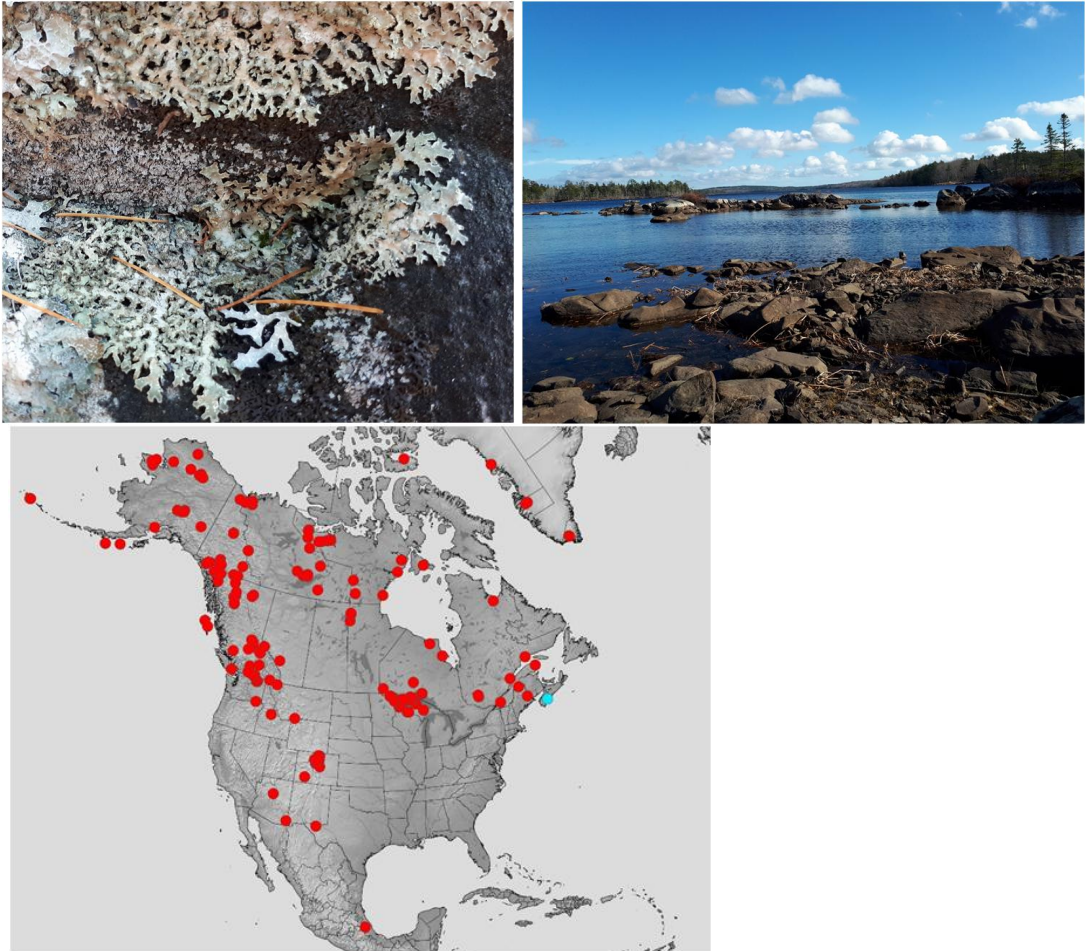
“La sous-espèce *sulcata* se trouve en abondance sur les bardeaux des vieilles maisons et les branches de l'*Abies canadensis*. Il faut noter encore la forme *fraudans* Nyl.”

(The subspecies *sulcata* is found in abundance on shingles of old houses and the branches of *Abies canadensis*. It should be noted as well the form *fraudans* Nyl.)

Delamare's specimens were determined by both Ferdinand Arnold (Munich) and by L' Abbé Hue (Paris), and the substrate is variously recorded as being from branches of conifers (*Abies*, *Pinus*) (Arnold 1888; Delamare et al. 1888; Hue 1888, LeGallo 1952), highly unlikely substrates for a saxicolous species. A corticolous specimen collected in 1980 by Wolfgang Maass at Gros

Morne (Gros Morne National Park) on the west coast of Newfoundland and identified as *P. fraudans* has proven not to be that species.

Eckfeldt (1895) included *P. fraudans* as part of a list of collections made by the Rev. A.C. Waghorne in Newfoundland and Labrador. Eckfeldt noted that some of the lichens were identified by Arnold and some by Hulting, but their names are not connected to individual specimens on the list. A Waghorne *P. fraudans* specimen from Trinity Bay, Newfoundland resides in the Walter Kiener Memorial Lichen Collection at the Herbarium, University of Nebraska State Museum. Photographic examination of the specimen showed it to be clearly *Parmelia saxatilis* (L.) Ach., not *P. fraudans*. It is not entirely clear who identified it. There is no note on the packet and there are no accompanying field notes.



**Figure 4** (upper left): *Parmelia fraudans*, top and bottom; *Parmelia saxatilis*, lower and upper left (hb. Anderson 16626). **Figure 5** (upper right): *Parmelia fraudans* habitat in Nova Scotia. **Figure 6** (bottom): *Parmelia fraudans* distribution in North America. Red dots are collection sites from CNALH; the new Nova Scotia location is the blue dot.

None of the other eastern *Parmelia sensu stricto* species contains usnic acid (Hinds 1998). Its yellowish color and isidioid marginal soredia are also distinctive (Fig. 4) in combination with its substrate—*P. fraudans* is known only as saxicolous (Ahti, pers. comm. 2021; Nash and Elix 2002; Thomson 1984). The Nova Scotia collection was made along a lakeshore on an acidic boulder which is constantly surrounded by water (Fig. 5). The mature, mixed forest along the lake is within a watershed area where human disturbance has been minimal. Lakeshores have been understudied

in Nova Scotia, so the prospect of further discoveries is promising. An updated distribution map for this lichen is given in Figure 6.

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