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***Distribution, Ecology and Potential threats to species within section* Hydrothyriae** *Peltigera hydrothyria* – This species is endemic to and restricted to eastern North America (Fig. 5B). In the USA, it occurs from Georgia in the south as far north as Maine. About 30 occurrences are known from the states of Connecticut, Massachusetts, New Hampshire, North Carolina, Pennsylvania, Rhode Island, Tennessee, Vermont and Virginia (nine confirmed by molecular data) but there have been no estimates of the size of the populations of *P. hydrothyria* in the USA. In Canada, this lichen occurs in a single stream in Québec (the identity of four populations was confirmed by molecular data) and New Brunswick (three occurrences, one of which was confirmed by molecular data) to Nova Scotia (six occurrences, of which five were confirmed by molecular data) with an estimated total of 1,300 colonies (COSEWIC, 2013a). The species grows in and on the margins of partially shaded streams, which are silt-free and usually have a pH between 6 and 7. The streams are often sinuous and have small waterfalls or boulders that create backwaters where the lichen more easily colonizes rock surfaces out of the main flow. A high humidity seems essential to provide the necessary microclimate in summer. In Canada, *P. hydrothyria* was found growing from 10 to 720 m above the sea level (COSEWIC, 2013a) and its distributionis strongly associated with areas having a perhumid climate (Clayden et al., 2011), i.e., where there may be short periods when water loss exceeds water gains but rain/snow or melt-water in the flanking periods compensates for this.

Threats to the species come from disturbances that cause siltation of the stream or lead to a reduction in humidity or a change in water flow. Forestry operations for pulp, sawlogs or biomass (the biomass electricity generation facilities in Nova Scotia require some 500,000 tons of fuel annually; Simpson and Plourde, 2011; King, 2012; Albertstat, 2012), as well as culvert and road construction can result in siltation in the streams where *P. hydrothyria* grows. Over the longer time frame, climate change is expected to disrupt precipitation patterns with greater seasonal and yearly variations. Drier conditions may occur in inland regions as higher summer temperatures will likely cause increased evaporation (Vasseur and Cato, 2008; Clayden, 2010) and fog levels along the Atlantic coast of Nova Scotia and the Bay of Fundy may continue to decline (Beauchamp et al., 1998; Muraca et al*.*, 2001; Percy et al., 2005). Taken together this may lead to less water flow in summer and a reduction in humidity along the stream margins that could affect populations of *P. hydrothyria*, which must be moist for extended periods to photosynthesize and grow (COSEWIC, 2013a). Furthermore, *P. hydrothyria*, like other cyanolichens, is sensitive to acid rain, which can reduce the pH of stream water.

This species is rated as S1, critically endangered in Virginia and S3, vulnerable in North Carolina but it has not been ranked in Connecticut, New Hampshire, Pennsylvania, Tennessee or Vermont (NatureServe, 2012). The disappearance of this lichen from three New England States has been attributed to air pollution and to habitat destruction (Hinds and Hinds, 2007) and further south by land-use conversion, habitat fragmentation, forest management practices and sedimentation (Southern Appalachian Species Viability Project, 2002). In Canada, *P. hydrothyria* has recently been assessed as threatened as a result of disturbance due to the factors mentioned above (COSEWIC, 2013a).

*Peltigera aquatica*– This species is endemic and restricted to western USA, south of the Canadian border where it occurrs in Washington and extends south along the Cascade and Sierra ranges to central California. There are some 28 occurrences in Washington (two conformed by molecular data) and 25 in Oregon (five confirmed by molecular data), and about 100 in California (one confirmed by molecular data) with the southernmost site being in the Sequoia National Forest in California (Fig. 5A; Lesher et al*.*, 2003; Peterson, 2010; COSEWIC, 2013b), however, the identity of most records has to be confirmed based on the ITS region (Fig. 5A). *Peltigera aquatica* is found from mid to high elevations (800-2500m above the sea level) mainly in partially shaded habitats associated with old growth forests (Glavich, 2009) but occasionally in non-shaded situations (Peterson, 2010). Similar to *P. hydrothyria*, this species requires silt-free stream conditions with a pH of around 7. It typically grows in shallow water but is capable of growing at depths exceeding 1 meter (Davis, 1999). Although at one site it grows in mist from a nearby waterfall, it is intolerant of drying for extended periods, elevated water temperatures or nitrate pollution (Davis et al., 2000, 2003).

The USA Forest Service reports that this lichen has been in decline throughout its current range (Poulsen and Carlberg, 2007) and it has been speculated that logging during the gold rush era and the 20th century could have resulted in the loss of its populations. Recently an extensive account of declining populations of aquatic *Peltigera* in California (Madera County) was reported (Larson, 2013), however, there is insufficient data to confirm this hypothesis (Peterson, 2010). The range of water temperatures measured in streams where this lichen was found ranged from 2-16oC with a mean of 5.5oC (Davis et al., 2003). Climate change is expected to warm air temperatures substantiallyin California (Solomon et al., 2007), which could subsequently increase stream water temperatures. Additionally, snow-pack in the Sierra Nevada is expected to decrease, which would increase stream water temperatures and reduce stream flow rapidly during summer (Peterson, 2010). Experimental studies on the effects of water temperature revealed that if illuminated thalli were maintained in water at 5oC, there was little change in weight or photosynthetic capacity for periods as long as 400 days. However, at higher water temperatures a decline in both parameters was found and at 18oC this was evident after just 30 days. A time-tolerance relationship was observed: 100 days were tolerated at 11oC, 60 days at 15oC but only 30 days at 18oC (Davis et al., 2003). Nitrate loading in the Sierra Nevada streams via long distance transport from the Central Valley could also have an impact as this lichen has been shown to be sensitive to this ion (Davis et al., 2003; Peterson, 2010). Other threats to the population include pollution, and wildfires. These may directly impact canopy cover, increase sedimentation through removal of vegetation and a reduction of duff, enhance nutrient runoff, or even alter watershed hydrology (Peterson, 2010). The state-level rankings for *P. aquatic*a range from unranked in Oregon to S2 (imperiled) in Washington and S3.2 (vulnerable) in California (Peterson, 2010).

*Peltigera gowardii* – This species is found in the Northwest Cordillera, with three occurrences in Alaska (two confirmed by molecular data), five occurrences in British Columbia (six populations confirmed by molecular data), a single occurrence in Montana and Washington (confirmed by molecular data). This species seems to have maritime tendencies but extends inland to the Columbia Mountains of southeastern BC and to the Rocky Mountains in Montana. On Mt. Baker in Snohomish County, Washington, just south of the Canadian border, it co-occurs with *P. aquatica* (Fig. 5B; Lendemer and O’Brien, 2011). There are additional records of aquatic *Peltigera* in Washington that should be verified molecularly to disentangle *P. gowardii* from *P. aquatica*. *Peltigera gowardii* is usually found in high subalpine and alpine habitats at elevations of about 1400 to 1900 m above the sea level (COSEWIC, 2013b). In Canada, *P. gowardii* generally grows at or below water level in permanent unshaded spring-fed streams that are one meter or less in width and where the water is cold and silt free with a pH close to 7. It is estimated that the population at the five Canadian occurrences consists of about 1,000 colonies (COSEWIC, 2013b). The most northerly and westerly record for this lichen is at Denali National Park and Preserve, Skihi Creek, Alaska, at an elevation of 847 m above the see level where it grows in a creek surrounded by dwarf shrub tundra with a willow-herbaceous riparian zone (Walton and Nelson pers. comm.).

*Peltigera gowardii* is dependent upon ecological attributes at the landscape scale, i.e., enough precipitation and snow to maintain year-round, but not too much, stream-water flow with the water having a generally low temperature, close to neutral pH, and a lack of silt. Climate change is the major threat and it seems to have already an impact in Canada. The changes at timberline are clear and dramatic. For example after just 40 years, trees had encroached on the subalpine meadows in Manning Provincial Park and were rapidly filling them in (Pojar pers. comm.). Another observation is that in the early 1980s, the Cardinal Divide, on the eastern slope of the Rocky Mountains, south of Hinton, Alberta was alpine habitat but thirty years later (in 2010), subalpine vegetation had moved in and included small trees, shrubs so that fewer lichens were present (Janet Marsh pers. comm.). Thus there seems little doubt that shrubs and trees will eventually invade the subalpine habitats where *P. gowardii* is found (Pojar, 2010). Another threat for this lichen growing close to human habitation is disturbance leading to siltation of the streams where *P. gowardii* grows. Human recreation-related or communications infrastructure-related activities that lead to siltation include trail construction for hiking or mountain bikes, the use of ATVs or snowmobiles and the construction of roads to service microwave towers or recreational activities (COSEWIC, 2013b).

*Peltigera gowardii* has an S1 status (critically imperiled) in Montana. It has been given provincial status of S1S2 (Red) in British Columbia in 2010 (NatureServe 2012), and is stated to be vulnerable to trail development.In addition, the General Status Data of Species in Canada (CESCC, 2011) lists *P. gowardii* as 2 (may be at risk) in BC. Finally, *P. gowardii* has recently been assessed as special concern as a result of the threats mentioned above (COSEWIC, 2013b). The recognition of two genetically distinct species for what used to be recognized as one, further elevate the rarity of *P. gowardii*.

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