

# Recovery Strategy for the Crumpled Tarpaper Lichen (*Collema coniophilum*) in Canada

## Crumpled Tarpaper Lichen



2022



Government  
of Canada

Gouvernement  
du Canada

Canada

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For copies of the recovery strategy, or for additional information on species at risk, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the [Species at Risk \(SAR\) Public Registry](#)<sup>1</sup>.

**Cover illustration:** Tim Wheeler

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<sup>1</sup> [www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html](http://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html)

# RECOVERY STRATEGY FOR THE CRUMPLED TARPAPER LICHEN (*Collema coniophilum*) IN CANADA

2022

Under the Accord for the Protection of Species at Risk (1996), the federal, provincial, and territorial governments agreed to work together on legislation, programs, and policies to protect wildlife species at risk throughout Canada.

In the spirit of cooperation of the Accord, the Government of British Columbia has given permission to the Government of Canada to adopt the *Recovery Plan for the Crumpled Tarpaper (Collema coniophilum) in British Columbia* (Part 2) under Section 44 of the *Species at Risk Act* (SARA). Environment and Climate Change Canada has included a federal addition (Part 1) which completes the SARA requirements for this recovery strategy.

The federal recovery strategy for the Crumpled Tarpaper Lichen in Canada consists of two parts:

Part 1 – Federal Addition to the *Recovery Plan for the Crumpled Tarpaper (Collema coniophilum) in British Columbia*, prepared by Environment and Climate Change Canada.

Part 2 – *Recovery Plan for the Crumpled Tarpaper (Collema coniophilum) in British Columbia*, prepared by the British Columbia Ministry of Environment and Climate Change Strategy.

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Part 2 – *Recovery Plan for the Crumpled Tarpaper (Collema coniophilum) in British Columbia*, prepared by the British Columbia Ministry of Environment and Climate Change Strategy.



**Part 1 – Federal Addition to the *Recovery Plan for the  
Crumpled Tarpaper (Collema coniophilum) in  
British Columbia*, prepared by Environment and  
Climate Change Canada**

## Preface

The federal, provincial, and territorial government signatories under the [Accord for the Protection of Species at Risk \(1996\)](#)<sup>2</sup> agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of recovery strategies for listed Extirpated, Endangered, and Threatened species and are required to report on progress within five years after the publication of the final document on the Species at Risk Public Registry.

The Minister of Environment and Climate Change is the competent minister under SARA for the Crumpled Tarpaper Lichen and has prepared the federal component of this recovery plan (Part 1), as per section 37 of SARA. To the extent possible, it has been prepared in cooperation with the Province of British Columbia as per section 39(1) of SARA. SARA section 44 allows the Minister to adopt all or part of an existing plan for the species if it meets the requirements under SARA for content (sub-sections 41(1) or (2)). The Province of British Columbia provided the attached recovery plan for the Crumpled Tarpaper Lichen (Part 2) as science advice to the jurisdictions responsible for managing the species in British Columbia. It was prepared in cooperation with Environment and Climate Change Canada.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by Environment and Climate Change Canada, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Crumpled Tarpaper Lichen and Canadian society as a whole.

This recovery strategy will be followed by one or more action plans that will provide information on recovery measures to be taken by Environment and Climate Change Canada and other jurisdictions and/or organizations involved in the conservation of the species. Implementation of this strategy is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

The recovery strategy sets the strategic direction to arrest or reverse the decline of the species, including identification of critical habitat to the extent possible. It provides all Canadians with information to help take action on species conservation. When critical habitat is identified, either in a recovery strategy or an action plan, SARA requires that critical habitat then be protected.

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<sup>2</sup> [www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html#2](http://www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html#2)

In the case of critical habitat identified for terrestrial species including migratory birds SARA requires that critical habitat identified in a federally protected area<sup>3</sup> be described in the *Canada Gazette* within 90 days after the recovery strategy or action plan that identified the critical habitat is included in the public registry. A prohibition against destruction of critical habitat under ss. 58(1) will apply 90 days after the description of the critical habitat is published in the *Canada Gazette*.

For critical habitat located on other federal lands, the competent minister must either make a statement on existing legal protection or make an order so that the prohibition against destruction of critical habitat applies.

For any part of critical habitat located on non-federal lands, if the competent minister forms the opinion that any portion of critical habitat is not protected by provisions in or measures under SARA or other Acts of Parliament, or the laws of the province or territory, SARA requires that the Minister recommend that the Governor in Council make an order to prohibit destruction of critical habitat. The discretion to protect critical habitat on non-federal lands that is not otherwise protected rests with the Governor in Council.

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<sup>3</sup> These federally protected areas are: a national park of Canada named and described in Schedule 1 to the *Canada National Parks Act*, The Rouge National Park established by the *Rouge National Urban Park Act*, a marine protected area under the *Oceans Act*, a migratory bird sanctuary under the *Migratory Birds Convention Act, 1994* or a national wildlife area under the *Canada Wildlife Act* see ss. 58(2) of SARA.

## **Acknowledgements**

Development of this recovery strategy was coordinated by Environment and Climate Change Canada, Canadian Wildlife Service (ECCC CWS) – Pacific Region staff: Kimberly Dohms, Megan Harrison, and Kella Sadler. Christopher Lewis and Duncan McColl (B.C. Ministry of Forests, Lands, Natural Resource Operations and Rural Development), Alana Nasadyk and Karen Stefanyk (B.C. Ministry of Environment and Climate Change Strategy), and Emma Pascoe (ECCC CWS-National Capital Region) provided helpful editorial advice and comment. Danielle Yu (ECCC CWS-Pacific Region) provided additional assistance with critical habitat identification, mapping and figure preparation.

## Additions and Modifications to the Adopted Document

The following sections have been included to address specific requirements of the federal *Species at Risk Act* (SARA) that are not addressed in the *Recovery Plan for the Crumpled Tarpaper (Collema coniophilum) in British Columbia* (Part 2 of this document, referred to henceforth as “the provincial recovery plan”) and/or to provide updated or additional information. This species is listed under SARA as Crumpled Tarpaper Lichen (*Collema coniophilum*) and is referred to as Crumpled Tarpaper (*Collema coniophilum*) provincially (as per [B.C. Conservation Data Centre](#)). Both refer to the same species.

Under SARA, there are specific requirements and processes set out regarding the protection of critical habitat. Therefore, statements in the provincial recovery plan referring to protection of survival/recovery habitat may not directly correspond to federal requirements. Recovery measures dealing with the protection of habitat are adopted; however, whether these measures will result in protection of critical habitat under SARA will be assessed following publication of the final federal recovery strategy.

### 1. Species Status Information

This section replaces the information on SARA legal designations and conservation status for Crumpled Tarpaper Lichen in Canada in “Section 2: Species Status Information” in the provincial recovery plan.

The legal designation of Crumpled Tarpaper Lichen on SARA Schedule 1 is Threatened (2017).

**Table 1.** Conservation Status of Crumpled Tarpaper Lichen (from NatureServe 2020, and B.C. Conservation Data Centre 2020).

Global (G) Rank*	National (N) Rank*	Sub-national (S) Rank*	COSEWIC Status	B.C. List
G2 (2019)	Canada (N2)	British Columbia (S2) Alberta (SU) Northwest Territories (not ranked)	Threatened (2010)	Red List**

\*Rank 1– critically imperiled; 2– imperiled; 3- vulnerable to extirpation or extinction; 4- apparently secure; 5– secure; H– possibly extirpated; NR – status not ranked, SU – Under Review

\*\* Red List is [defined by the B.C. Conservation Data Centre](#) as “Any species or ecosystem that is at risk of being lost (extirpated, endangered or threatened).”

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### 2. Species Population and Distribution

This section replaces the information summary for known populations of Crumpled Tarpaper Lichen in Canada (Table 1, Section 3.2) in the provincial recovery plan.

The information summary below (Table 2) describes the updated distribution of Crumpled Tarpaper Lichen populations in Canada. Element occurrence (EO) numbers

indicated align with those provided in the provincial recovery plan, with the exception of new occurrences discovered since the provincial recovery plan was written. Each locality is considered a separate population as they are more than 1 km apart. Of the 18 recorded Crumpled Tarpaper Lichen populations, 16 are considered extant and two are of unknown status. The current known population size is  $\geq 188$  thalli<sup>4</sup>. Two potential populations of Crumpled Tarpaper Lichen have been recently reported from Alberta and Northwest Territories, however their identification has not yet been formally verified, and details regarding habitat associations and threats are currently unknown.

**Table 2.** Summary of Crumpled Tarpaper Lichen populations in Canada. Information for each Element Occurrence (EO) number includes notes on status (N = new, not described in the adopted B.C. recovery plan, U = updated thalli numbers relative to B.C. plan), site location name, year of last observation (Last obs.), population size at year of last observation (NR = not recorded), location uncertainty associated with the B.C. Conservation Data Centre EO data, and/or estimated location error from Global Positioning System (GPS) units, and population status.

Site Location Name	EO #	Last obs.	Population size (# thalli)	Location uncertainty (m)	Population Status <sup>a</sup>
Sugarbowl Creek	EO1 (U)	2017	3	15	Extant <sup>b</sup>
Tumtum Lake, Upper Adams River	EO2	1998	4	1000	Unknown
Kenneth Creek, Viking Ridge	EO3	1999	4	1000	Unknown
Hiyu Creek	EO4	2006	140	100	Extant
Robson Valley, Amanita Creek	EO5	2006	17	100	Extant
South of Huble Creek	EO6	2006	6	100	Extant
Southwest of Aleza Lake	EO7 (U)	2006	1	100	Extant
Upper Fraser Bridge, McGregor	EO8 (U)	2012	2	100	Extant
Dawson Falls, Wells Gray PP	EO9 (N)	2012	NR ( $\geq 1$ )	100	Extant
Northwest of Red Mountain Creek, Penny	EO10 (N)	2016	NR ( $\geq 1$ )	15	Extant
Southwest of Red Mountain Creek, Penny	EO11 (N)	2016	NR ( $\geq 1$ )	15	Extant
Muskwa River	EO12 (N)	2016	NR ( $\geq 1$ )	15	Extant
Driscoll Creek	EO13 (N)	2016	NR ( $\geq 1$ )	15	Extant
Table River	EO14 (N) <sup>c</sup>	2016	NR ( $\geq 1$ )	15	Extant
Hominka River	EO15 (N)	2016	NR ( $\geq 1$ )	15	Extant

<sup>4</sup> The “body” or “vegetative tissue” is called the thalli (singular: thallus)

Site Location Name	EO #	Last obs.	Population size (# thalli)	Location uncertainty (m)	Population Status <sup>a</sup>
Hungary Creek	EO16 (N)	2017	2	15	Extant
Caswell Creek	EO17 (N)	2017	NR (≥1)	15	Extant
Crooked River	EO18 (N)	2017	NR (≥1)	15	Extant

<sup>a</sup> The status of Crumpled Tarpaper Lichen occurrences is as follows: Extant - Occurrence has been recently verified (< 25 years); Unknown – sites were revisited within last 25 years, but population/occurrence was not relocated.

<sup>b</sup> Reported as extirpated in B.C. Strategy, but relocated in 2017 by C. Björk.

<sup>c</sup> UTM coordinates indicate two different locations ~400m apart were observed on the same day; lumped as a single EO by CDC.

### 3. Species Needs

Table 3 below provides a summary of “Section 3.3: Needs of Crumpled Tarpaper” in the provincial recovery plan.

**Table 3.** Summary of essential features, functions, and attributes of Crumpled Tarpaper Lichen habitat.

Life stage(s)	Function <sup>a</sup>	Feature(s) <sup>b</sup>	Attributes <sup>c</sup>
All life history stages	Establishment, growth, asexual reproduction, dispersal	Old-growth forests in wet subzones of the Interior- Cedar Hemlock and Sub-Boreal Spruce Biogeoclimatic zones	<p><i>Site context:</i></p> <p><i>Forest age:</i> &gt;100 years</p> <p><i>Elevation:</i> &lt;1000 m</p> <p><i>Moisture regime:</i> humid</p> <p><i>Light levels:</i> high, associated with relatively more open stand structure of older forests</p> <p><i>Substrate:</i> calcareous lake sediment or other high level of calcium enrichment in soil</p> <p><i>Air quality:</i> low levels of airborne pollutants</p> <p><i>Growing location:</i></p> <p><i>Host trees with partially-defoliated lower limbs:</i> Subalpine Fir (<i>Abies lasiocarpa</i> var. <i>lasiocarpa</i>), Western Hemlock (<i>Tsuga heterophylla</i>), Spruce species (<i>Picea</i> spp.), Willow species (<i>Salix</i> spp.), Mountain Alder (<i>Alnus incana</i> var. <i>tenuifolia</i>), Black Cottonwood (<i>Populus trichocarpa</i>), Western Red Cedar (<i>Thuja plicata</i>), or Trembling Aspen (<i>Populus tremuloides</i>).</p> <p><i>Deciduous overstory tree species for nutrient leaching in dripzone:</i> optimally Trembling Aspen or Black Cottonwood</p>

<sup>a</sup> Function: a life-cycle process of the species.

<sup>b</sup> Feature: the essential structural components of the habitat required by the species.

<sup>c</sup> Attribute: the building blocks or measurable characteristics of a feature.

## **4. Threats**

### **4.1 Threat Assessment**

Table 4 (below) replaces Table 2 of the “Threats Assessment” (Section 4.1) in the provincial recovery plan, to provide updated information on the threats to all known Crumpled Tarpaper Lichen populations in Canada.

The Crumpled Tarpaper threat assessment is based on the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system. Threats are defined as the proximate activities or processes that have caused, are causing, or may cause in the future the destruction, degradation, and/or impairment of the entity being assessed (population, species, community, or ecosystem) in the area of interest (global, national, or subnational). Limiting factors are not considered during this assessment process. Historical threats, indirect or cumulative effects of the threats, or any other relevant information that would help understand the nature of the threats are presented in the Description of Threats section.



**Table 4.** Threat classification table for Crumpled Tarpaper Lichen in Canada. IUCN Threat numbers are in accordance with the IUCN-CMP (International Union for Conservation of Nature – Conservation Measures Partnership) unified threats classification system (<https://www.iucnredlist.org/resources/threat-classification-scheme>).

Threat # <sup>a</sup>	Threat description	Impact <sup>b</sup>	Scope <sup>c</sup>	Severity <sup>d</sup>	Timing <sup>e</sup>
4	Transportation & service corridors	Medium	Restricted	Extreme	High
4.1	Roads & railroads	Medium	Restricted	Extreme	High
5	Biological resource use	Very High	Pervasive	Extreme	High
5.3	Logging & wood harvesting	Very High	Pervasive	Extreme	High
9	Pollution	Low	Restricted	Moderate	Moderate
9.5	Air-borne pollutants	Low	Restricted	Moderate	Moderate
11	Climate change & severe weather	Unknown	Unknown	Unknown	High-Moderate
11.2	Droughts	Not Calculated	Large	Unknown	Low
11.3	Temperature extremes	Unknown	Unknown	Unknown	High-Moderate

<sup>a</sup> Threat numbers are provided for Level 1 threats (i.e., whole numbers) and Level 2 threats (i.e., numbers with decimals).

<sup>b</sup> **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

<sup>c</sup> **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

<sup>d</sup> **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or 3-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

<sup>e</sup> **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [ $< 10$  years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

## 4.2 Description of Threats

The information below replaces content of the “Description of Threats” (Section 4.2) in the provincial recovery plan to include updated threats information for all known Crumpled Tarpaper Lichen populations in Canada. Best available information on additional threats that are not described below are described in the provincial recovery plan (e.g. IUCN-CMP Threat 11.2 Drought). Current threats are listed in Table 4 and additional threats that are no longer deemed applicable are not included below.

The overall Threat Impact for this species is Very High. Threat descriptions are provided in decreasing order of Threat Impact levels, as per classification in Table 4 above.

### IUCN-CMP Threat 5.3 (Logging & Wood Harvesting)

Logging directly effects Crumpled Tarpaper lichen through removing or degrading populations and the habitat features that support them. Seven of the 18 populations (EOs 1-2, and 4-8) occur in Timber Supply Areas, where logging and wood harvesting activities are likely. An additional four populations (EOs 10-11, 14, and 18) are on land of unknown tenure, meaning that the threat of logging and forestry remains possible for these populations. The remaining seven populations (EOs 3, 7, 12-13, and 15-17) have some measure of protection from wood harvesting through the legal provisions of the *Parks Act* or the *Environment and Land Use Act*.

### IUCN-CMP Threat 4.1 (Roads & Railroads)

Roads that are developed for logging will directly affect Crumpled Tarpaper Lichen, in particular since both the species and mainline logging roads generally occur in level toe-slope<sup>5</sup> areas (Trevor Goward, personal communication 2020). Fragmentation of habitat by logging roads also decreases the amount of suitable habitat available for the species to colonize and may increase edge effects, changing required microhabitat characteristics such as moisture and air flow. Note that at one location (Hiyu Creek population (EO4)) a higher than normal number of thalli were originally found along gravel logging roads that were formerly subject to considerable calcareous road dust. It is possible that some populations may benefit from being located in close proximity to logging roads or other trails that produce calcareous dust.

### IUCN-CMP Threat 9.5 (Airborne Pollutants)

Lichens have demonstrated sensitivity to airborne pollutants from industry (Coxson et al. 2014), though this research has not been done for Crumpled Tarpaper Lichen. An approved plan to build a limestone quarry and smelter at Giscome, B.C. (Giscome Quarry and Lime Plant approved in 2016) could represent a large point source of acidic emissions immediately upwind of several Robson Valley populations (E05, 07, and 08). Depending on the fuel source, airborne pollutants could pose risks to Crumpled

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<sup>5</sup> Toe-slope: in the context, refers to a distinct topographic area of alluvial deposition.

Tarpaper Lichen populations in the region east of the smelter and in the upper Robson Valley (Coxson et al. 2014).

### **IUCN-CMP Threat (11.3 Temperature Extremes)**

Lichens are sensitive indicators of climate change and are known to respond to extreme fluctuations in temperature (Benítez et al. 2018). However, not enough is understood about the physiology of Crumpled Tarpaper Lichen to understand how temperature extremes may impact this species.

## **5. Population and Distribution Objectives**

This section replaces “Section 5.1 Recovery (Population and Distribution) Goal” and “Section 5.2 Rationale for the Recovery (Population and Distribution) Goal”.

### **Population and Distribution Objective**

To increase the resilience<sup>6</sup> of Crumpled Tarpaper Lichen populations at all known extant sites throughout its range in Canada, including any new sites that may be discovered, by ceasing or mitigating human-caused threats causing decline in the area, extent, and quality of suitable habitat.

### **Rationale**

Crumpled Tarpaper Lichen is a Canadian endemic<sup>7</sup> species, that is found over a relatively large range, but sparsely within a specific habitat. The species is found in nutrient rich sites in humid old growth forests on a diverse range of host trees. Sixteen populations are currently known to be extant in British Columbia. As there is no historical population and distribution information for this species, it is unknown whether it was more widespread prior to impacts of human activity; as such, the focus of the objective is on increasing the resilience (population size) at extant sites through ceasing or mitigating human-caused threats, rather than attempting to deliberately increase population size via augmentation or restoration activities. Crumpled Tarpaper Lichen’s small overall population size ( $\geq 188$  mature individuals, as represented by number of thalli) has led to its assessment as Threatened<sup>8</sup> in Canada. The population size threshold separating designations of Threatened and Special Concern is  $>1000$  mature individuals. With the rediscovery of an extant population that was previously thought to be extirpated (EO1 – Sugarbowl Creek), and 11 new populations discovered in B.C.

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<sup>6</sup> Resilience is a characteristic that contributes to a species’ likelihood of survival: a species that has a large enough population size(s) to rebound from periodic disturbance and avoid demographic and genetic collapse is more likely to survive over the long term.

<sup>7</sup> Native to and restricted to Canada

<sup>8</sup> Assessed as “Threatened” in 2010 based on COSEWIC criteria D1; may also meet C2a(i) criteria for EN based on inferred continuing decline in numbers of mature individuals, and no known population estimated to contain  $>250$  mature individuals.

since 2013, as well as the potential new observations in Alberta and the Northwest Territories, it is likely that the total number of mature individuals is significantly higher than previously known. If new populations continue to be found, it is possible the species could be reassessed as Special Concern as a consequence of improved and more comprehensive surveys.

## 6. Critical Habitat

This section replaces the entirety of “Section 7: Information on Habitat Needed to Meet Recovery Goal” in the provincial recovery plan.

Section 41 (1)(c) of SARA requires that recovery strategies include an identification of the species’ critical habitat, to the extent possible, as well as examples of activities that are likely to result in its destruction. More precise boundaries may be mapped, and additional critical habitat may be added in the future if additional research supports the inclusion of areas beyond those currently identified. A primary consideration in the identification of critical habitat is the amount, quality, and locations of habitat needed to achieve the population and distribution objectives.

Critical habitat for Crumpled Tarpaper Lichen is identified in this recovery strategy to the extent possible based on the best available information. It is recognized that the critical habitat identified below is insufficient to achieve the population and distribution objectives for the species. A schedule of studies (Section 6.2) has been developed to provide the information necessary to complete the identification of critical habitat that will be sufficient to meet population and distribution objectives. The identification of critical habitat will be updated in a revised recovery strategy when the information becomes available.

### 6.1 Identification of the Species’ Critical Habitat

Critical habitat for Crumpled Tarpaper Lichen is identified at known or presumed extant sites where the population has been observed within the last 25 years (i.e., since 1995) and where the location uncertainty distance is less than 100 m. The geospatial areas containing critical habitat for Crumpled Tarpaper Lichen (totalling 136.38 ha<sup>9</sup>) are presented in Figures 1-13. Within these geospatial areas, critical habitat is identified wherever the following biophysical attributes occur.

#### **Biophysical attribute description:**

A description of the essential features and attributes of habitat for Crumpled Tarpaper Lichen that are required to support life history functions are provided in this document in Section 3 Species Needs. The geospatial areas containing critical habitat represent the minimum areas required to sustain both the suite of features that contribute to the

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<sup>9</sup> Critical habitat identified for Crumpled Tarpaper does not occur within any Federal Protected Areas.

broader site context (necessary to sustain the occurrence) as well as the very specific growing location(s). As such, within these geospatial polygons, critical habitat includes all natural features, including associated vegetation and substrates. Within these polygons, only unsuitable areas that do not possess any of the features and attributes required by Crumpled Tarpaper at any time are excluded from identification as critical habitat. Examples of these excluded areas include: existing buildings, roadways, parking lots, railways, gravel pits, as well as all non-forested or treeless areas. The 1 km x 1 km universal transverse mercator (UTM) grid overlay shown on these figures is a standardized national grid system that highlights the general geographical area containing critical habitat for land use planning and/or environmental assessment purposes.

### **6.1.1 Information and methods used to identify critical habitat**

The geospatial area containing critical habitat for Crumpled Tarpaper Lichen is based on the following additive components:

- (1) Point occurrences representing individuals or patches of lichen that were recorded within the last 25 years;
- (2) An additional distance around each point to accommodate the potential location error associated with the occurrence (ranging from 5 m to 100 m uncertainty distance; Table 2); and
- (3) A minimum critical function zone<sup>10</sup> of 100 m (beyond the point location of each occurrence and the associated potential location error), to support the production and maintenance of suitable microhabitat conditions required by Crumpled Tarpaper Lichen.

Crumpled Tarpaper Lichen requires humid old-growth forests to create suitable microhabitat conditions. While there is no species-specific information available regarding the threshold forest patch area that is required to maintain Crumpled Tarpaper Lichen at a site, recent research on epiphytic lichens in temperate rainforests of Pacific British Columbia has shown that viability increased up to 120 m from forest edges (Gauslaa et al. 2018). Likewise, prior research on edge effects from Pacific Northwest forests have found that the influence of edge on microclimate, including humidity and solar and wind exposure, extended 100-150 m into intact forests (Kremsater and Bunnell 1999). Application of a 100 m critical function zone distance for Crumpled Tarpaper Lichen is consistent with best available information, as well as the approach taken for other lichen species (e.g., Boreal Felt Lichen, Environment and Climate Change Canada 2018).

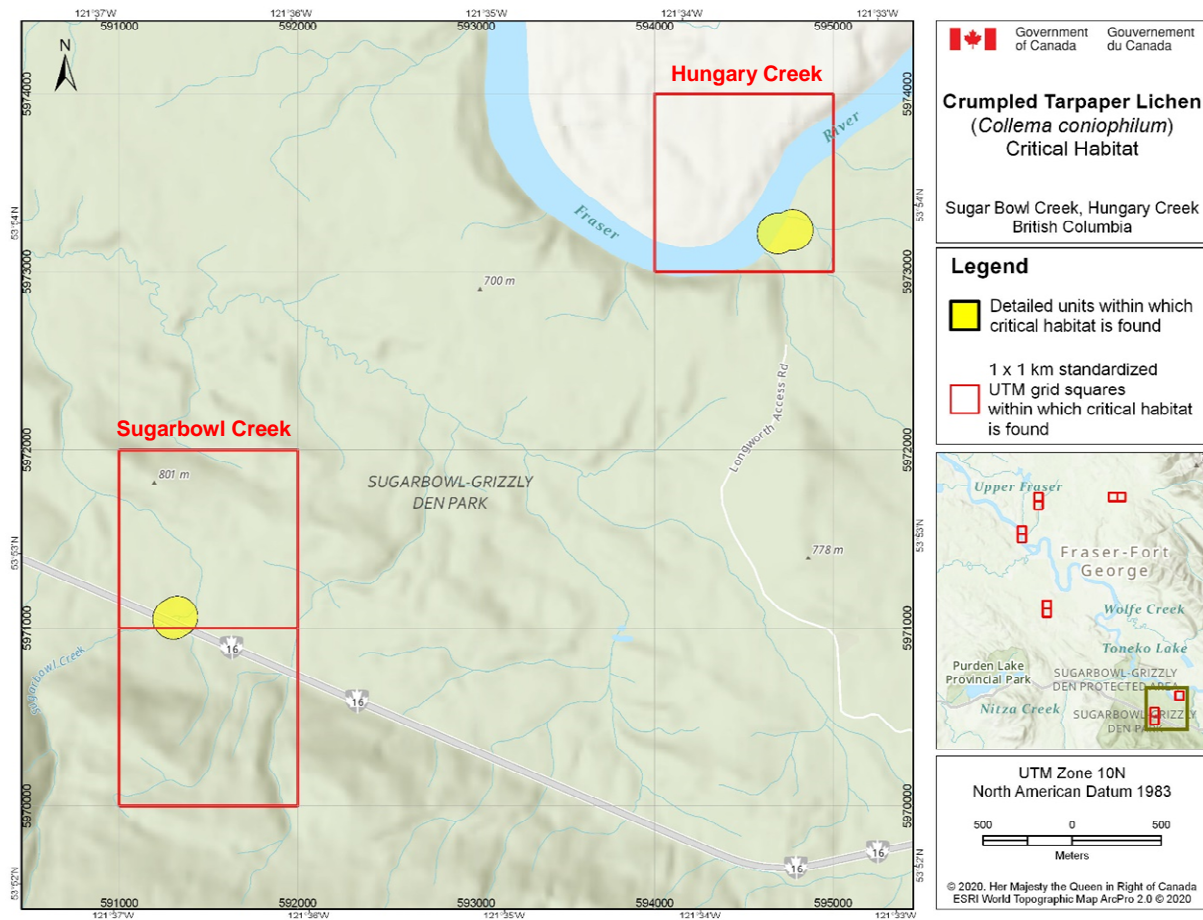
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<sup>10</sup> Critical function zone distance has been defined as the threshold habitat fragment size required for maintaining constituent microhabitat properties for a species (e.g., critical light, moisture and humidity levels necessary for survival).

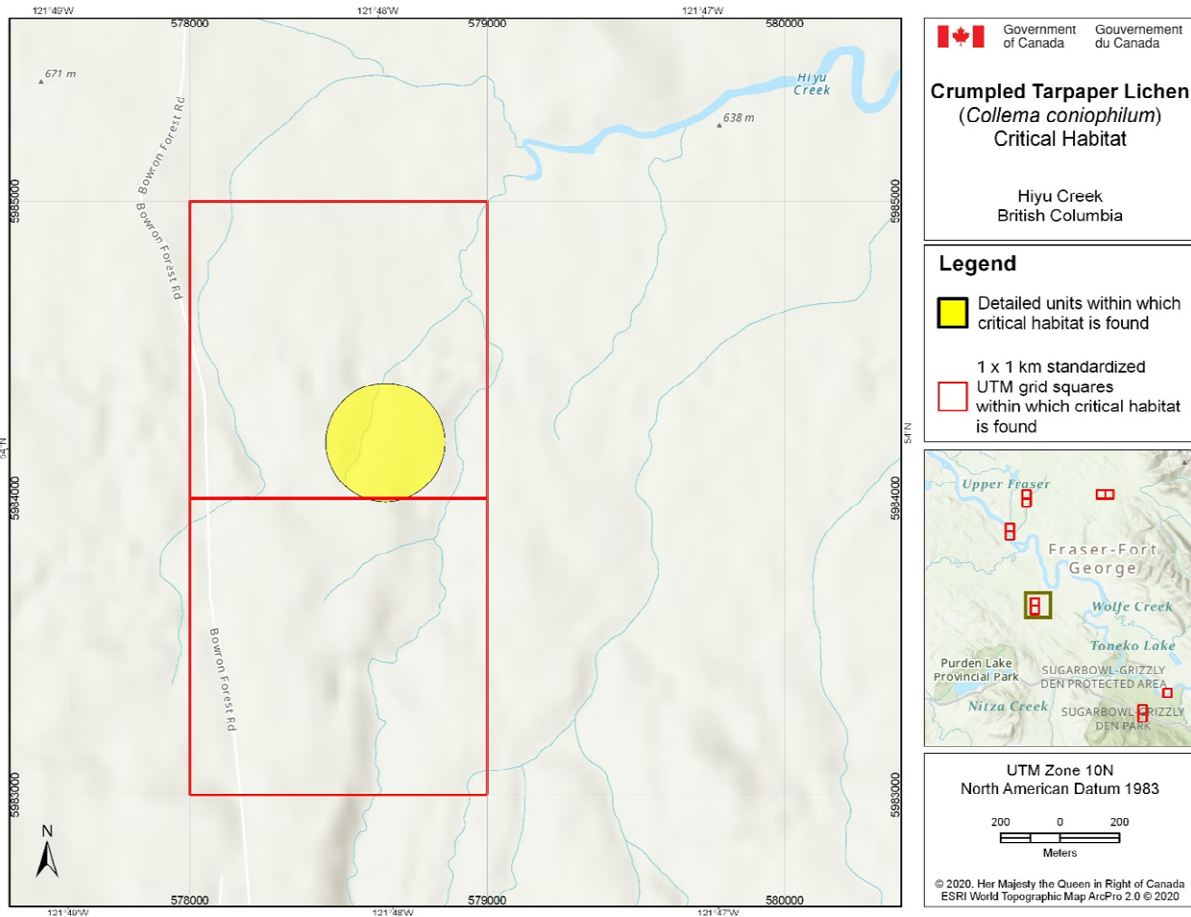
### **6.1.2 Geospatial Location of Areas Containing Critical Habitat**

Critical habitat for Crumpled Tarpaper Lichen is identified for 16 confirmed populations in British Columbia (Figures 1-13); these are linked with the element occurrence numbers provided in Table 2:

- Sugarbowl Creek (EO1) - Figure 1
- Hiyu Creek (EO4) - Figure 2
- Robson Valley, Amanita Creek (EO5) - Figure 3
- Huble Creek (EO6) - Figure 4
- Aleza Lake (EO7) - Figure 5
- Upper Fraser Bridge, McGregor (EO8) - Figure 3
- Dawson Falls, Wells Gray Provincial Park (EO9) - Figure 6
- Northwest Red Mountain Creek, Penny (EO10) - Figure 7
- Southwest Red Mountain Creek, Penny (EO11) - Figure 7
- Muskwa River (EO12) - Figure 8
- Driscoll Creek (EO13) - Figure 9
- Table River (EO14) - Figure 10
- Hominka River (EO15) - Figure 11
- Hungary Creek (EO16) - Figure 1
- Caswell Creek (EO17) - Figure 12
- Crooked River (EO18) - Figure 13

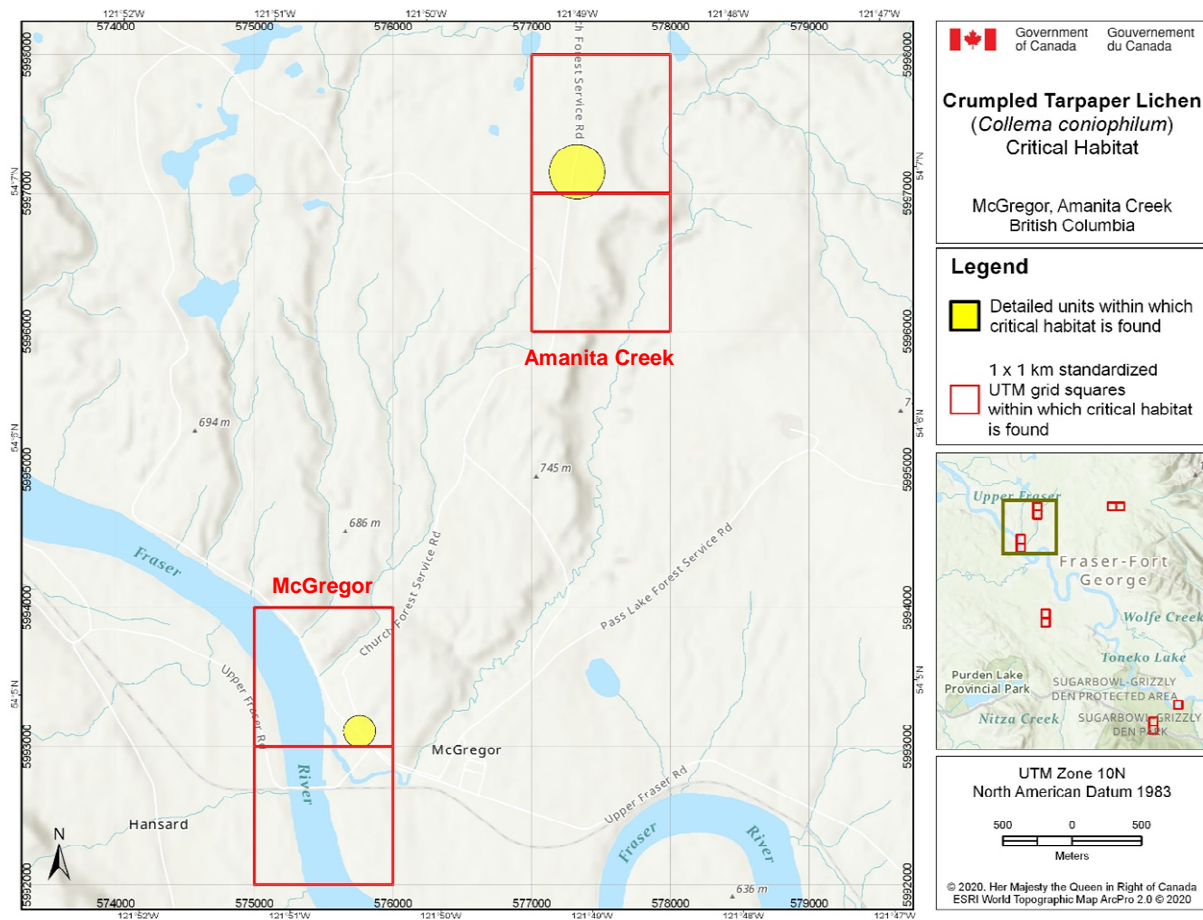


**Figure 1.** Critical habitat for Crumpled Tarpaper Lichen at Sugarbowl Creek (EO1) and at Hungary Creek (EO16), B.C., is represented by the shaded yellow polygons, except where excluded areas (as described in section 6.1) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid systems used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.

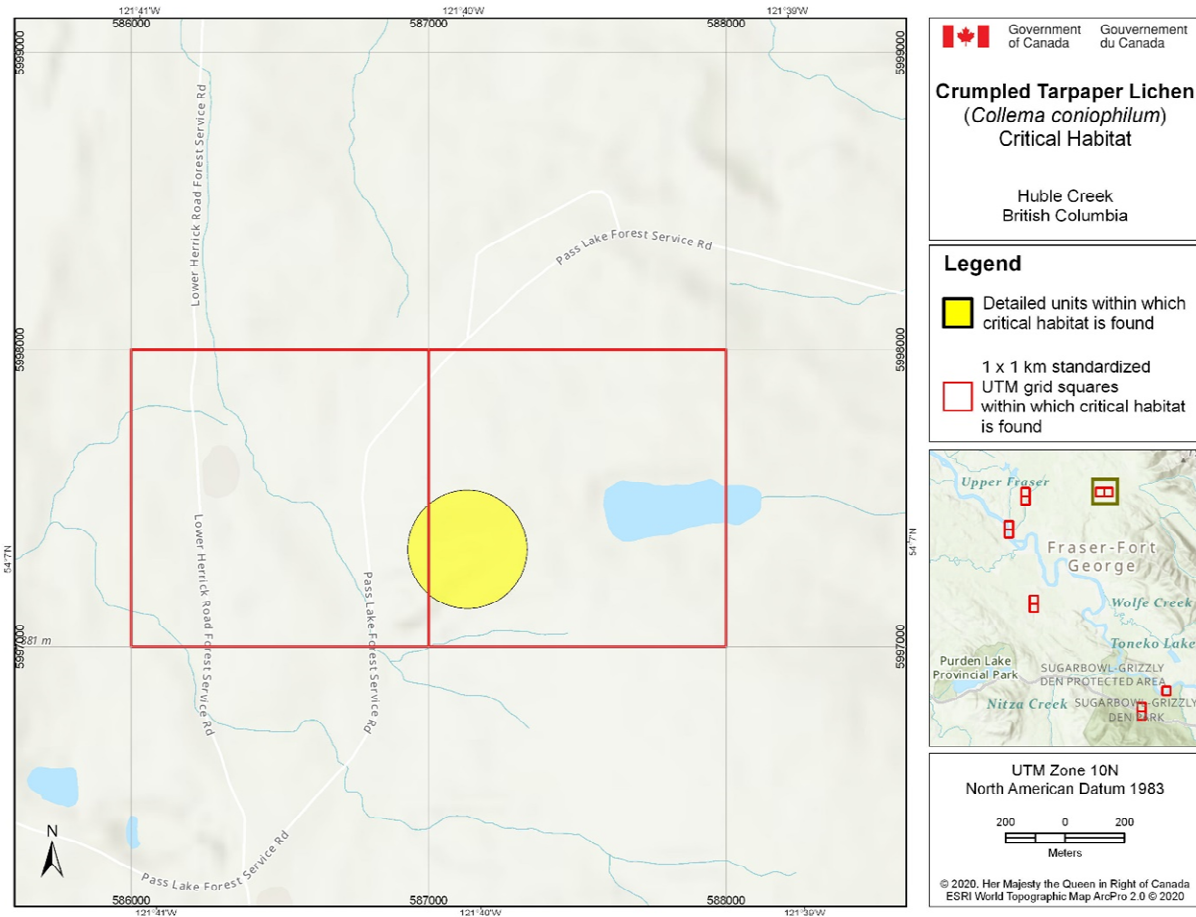


**Figure 2.** Critical habitat for Crumpled Tarpaper Lichen at Hiyu Creek (EO4) east of Prince George, B.C., is represented by the shaded yellow polygons, except where excluded areas (as described in section 6.1) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid systems used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.

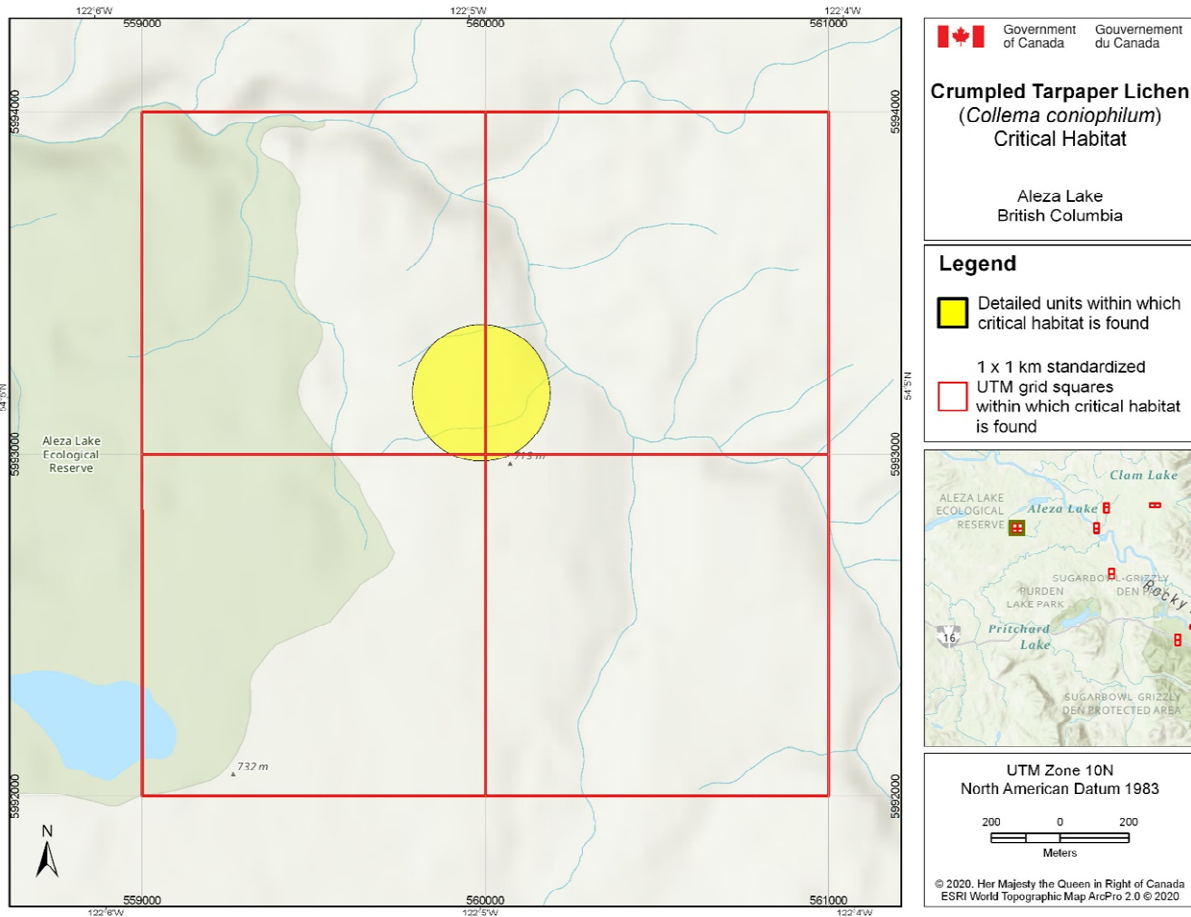




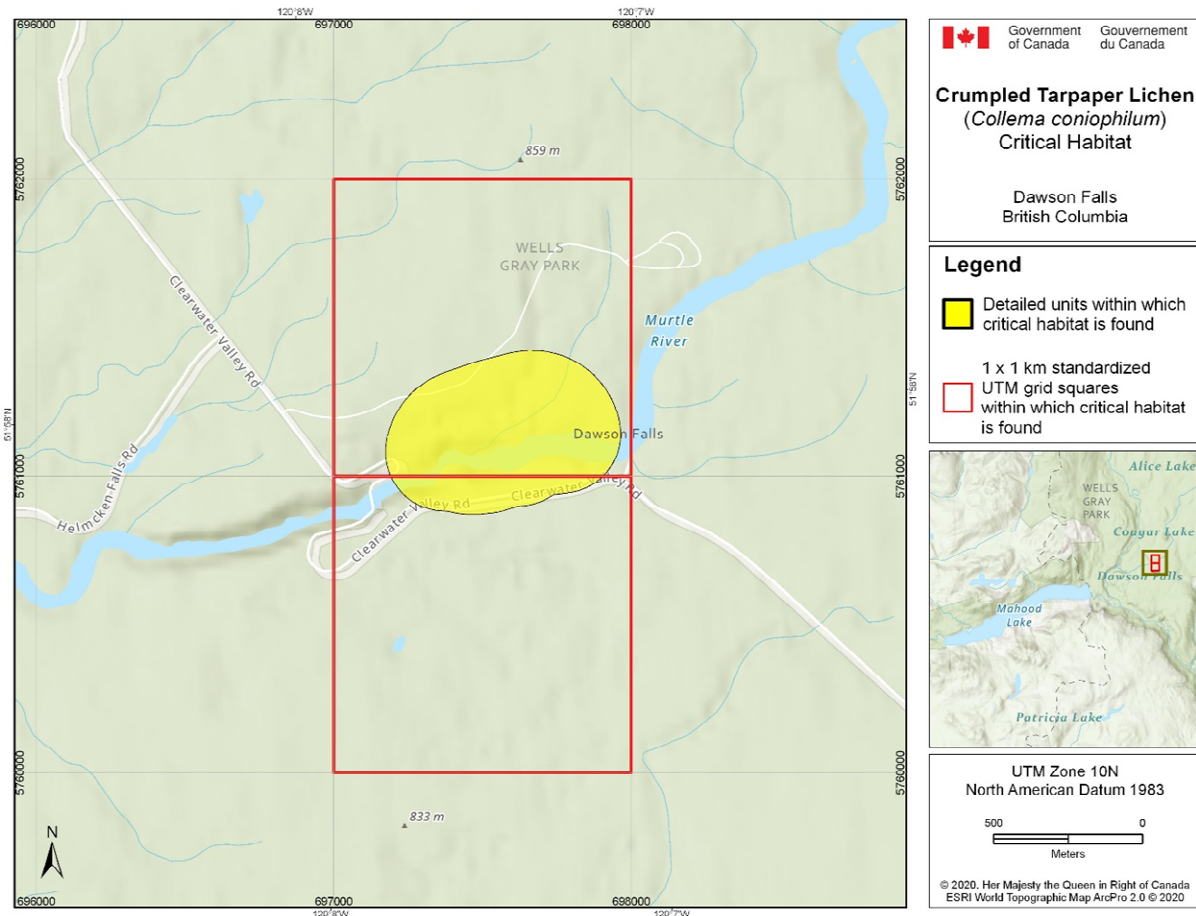
**Figure 3.** Critical habitat for Crumpled Tarpaper Lichen at Upper Fraser Bridge, McGregor (EO8) and Robson Valley, Amanita Creek (EO5), B.C., is represented by the shaded yellow polygons, except where excluded areas (as described in section 6.1) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid systems used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.



**Figure 4.** Critical habitat for Crumpled Tarpaper Lichen at Huble Creek (EO6), northeast of Prince George, B.C., is represented by the shaded yellow polygons, except where excluded areas (as described in section 6.1) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid systems used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.

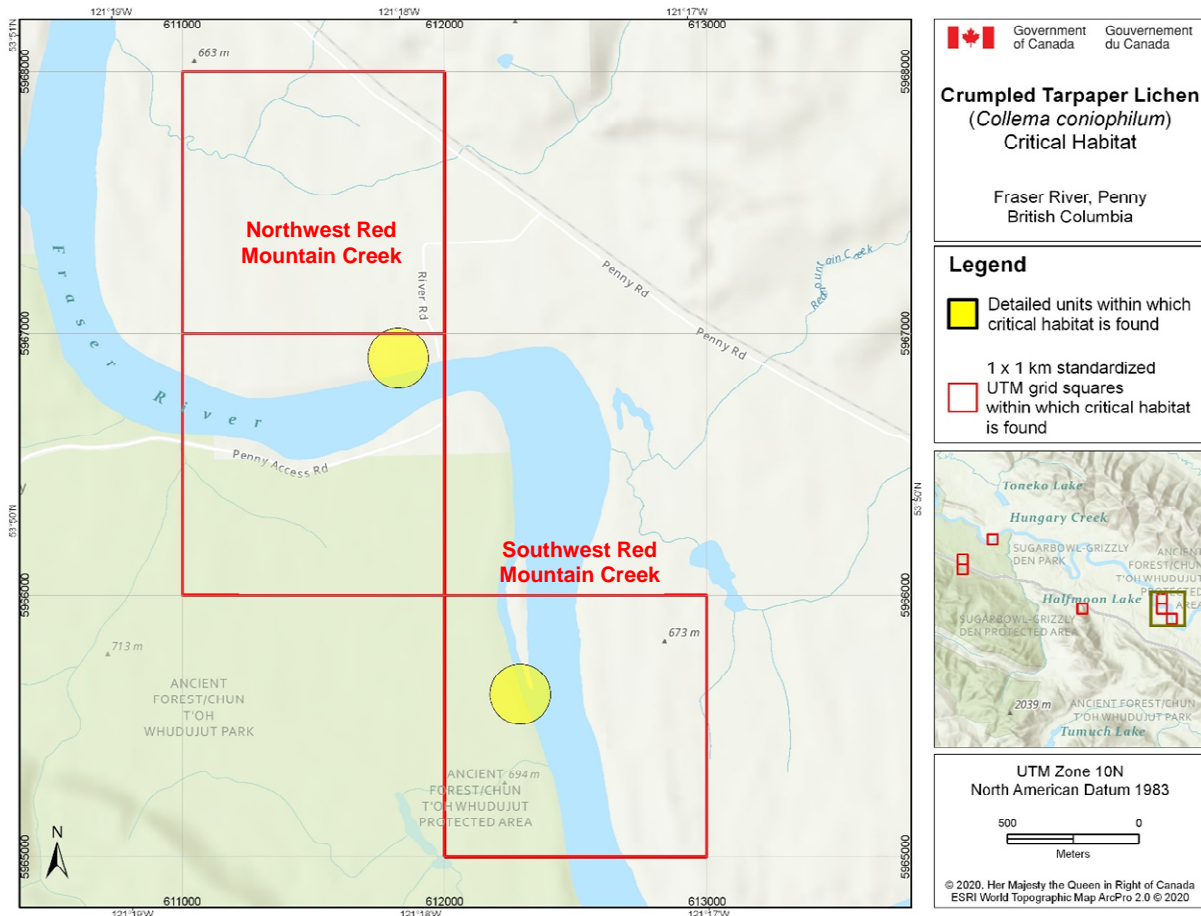


**Figure 5.** Critical habitat for Crumpled Tarpaper Lichen at Aleza Lake (E07) east of Prince George, B.C., is represented by the shaded yellow polygons, except where excluded areas (as described in section 6.1) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid systems used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.

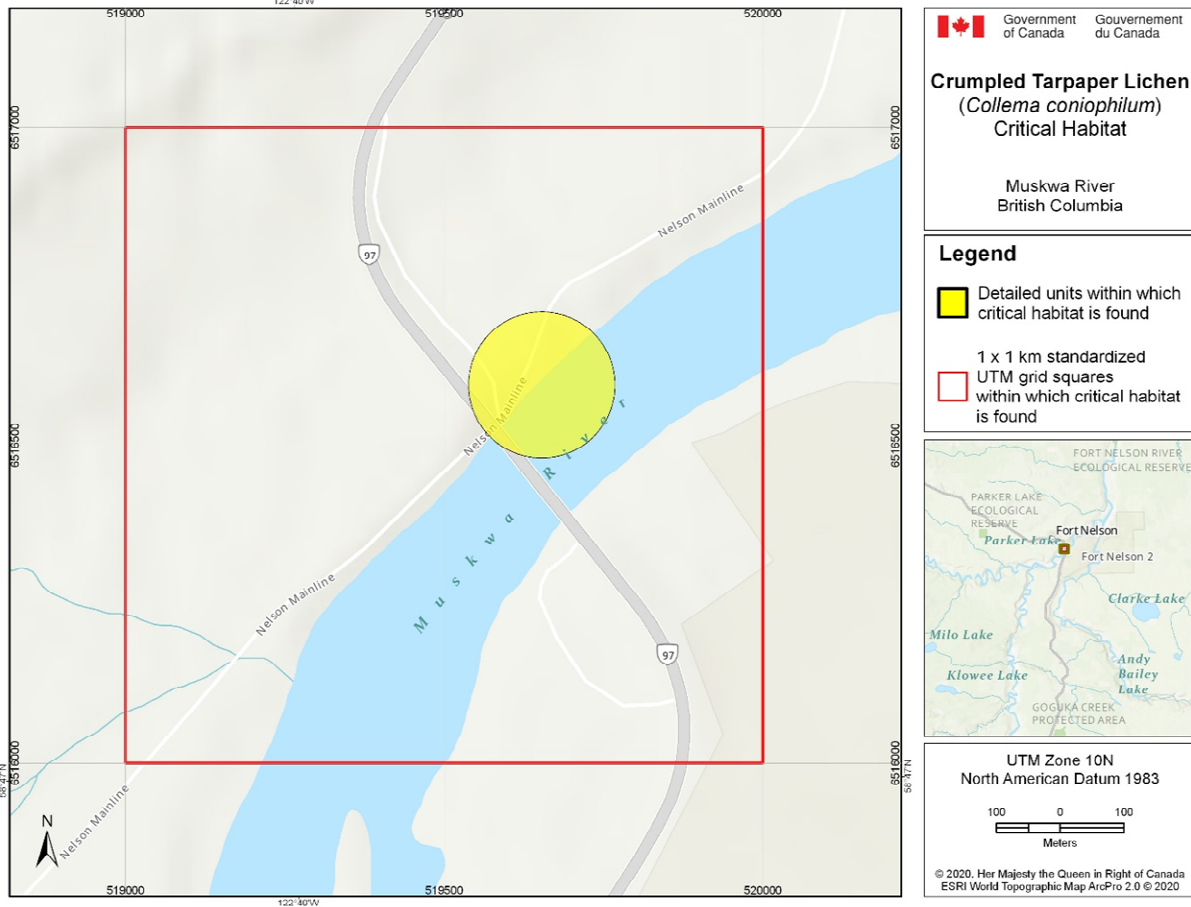


**Figure 6.** Critical habitat for Crumpled Tarpaper Lichen at Dawson Falls (EO9) in Wells Gray Provincial Park, B.C., is represented by the shaded yellow polygons, except where excluded areas (as described in section 6.1) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid systems used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.

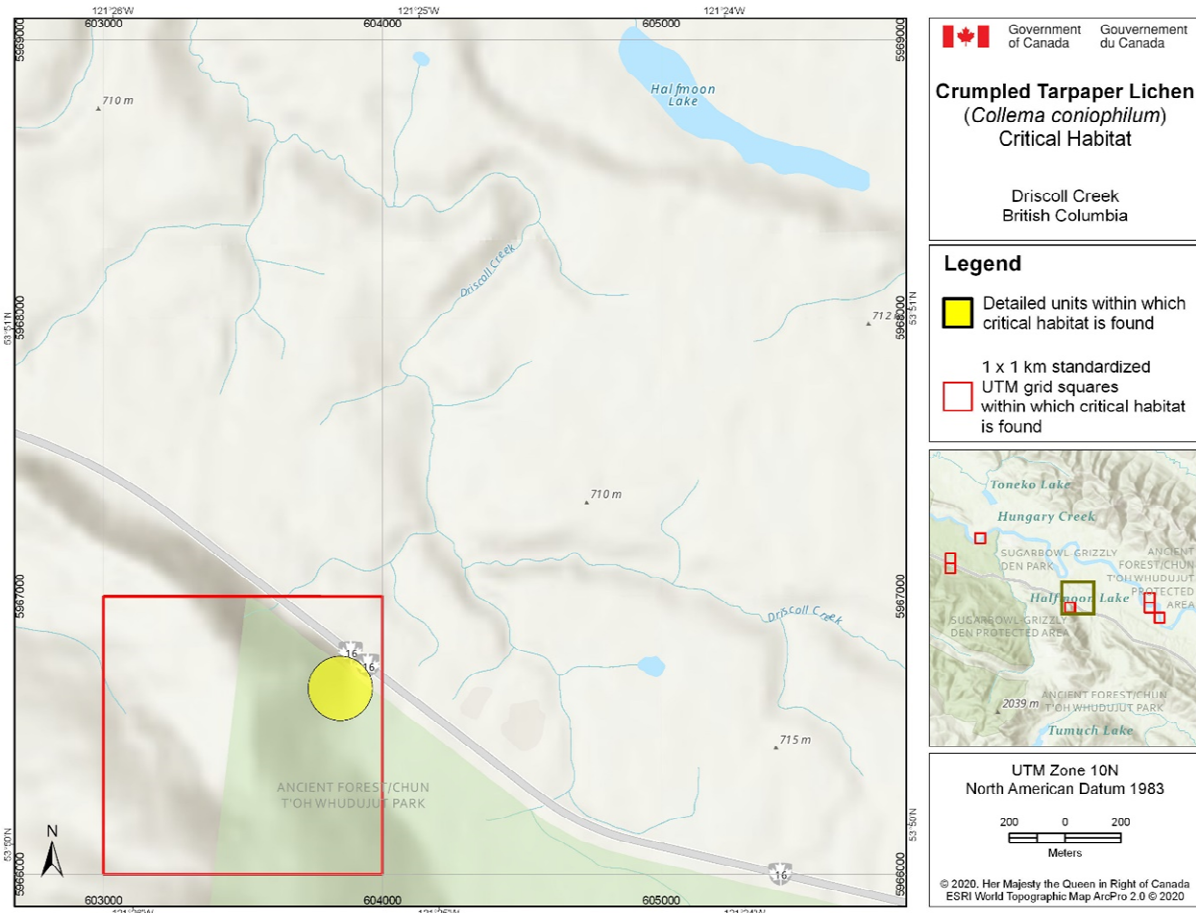




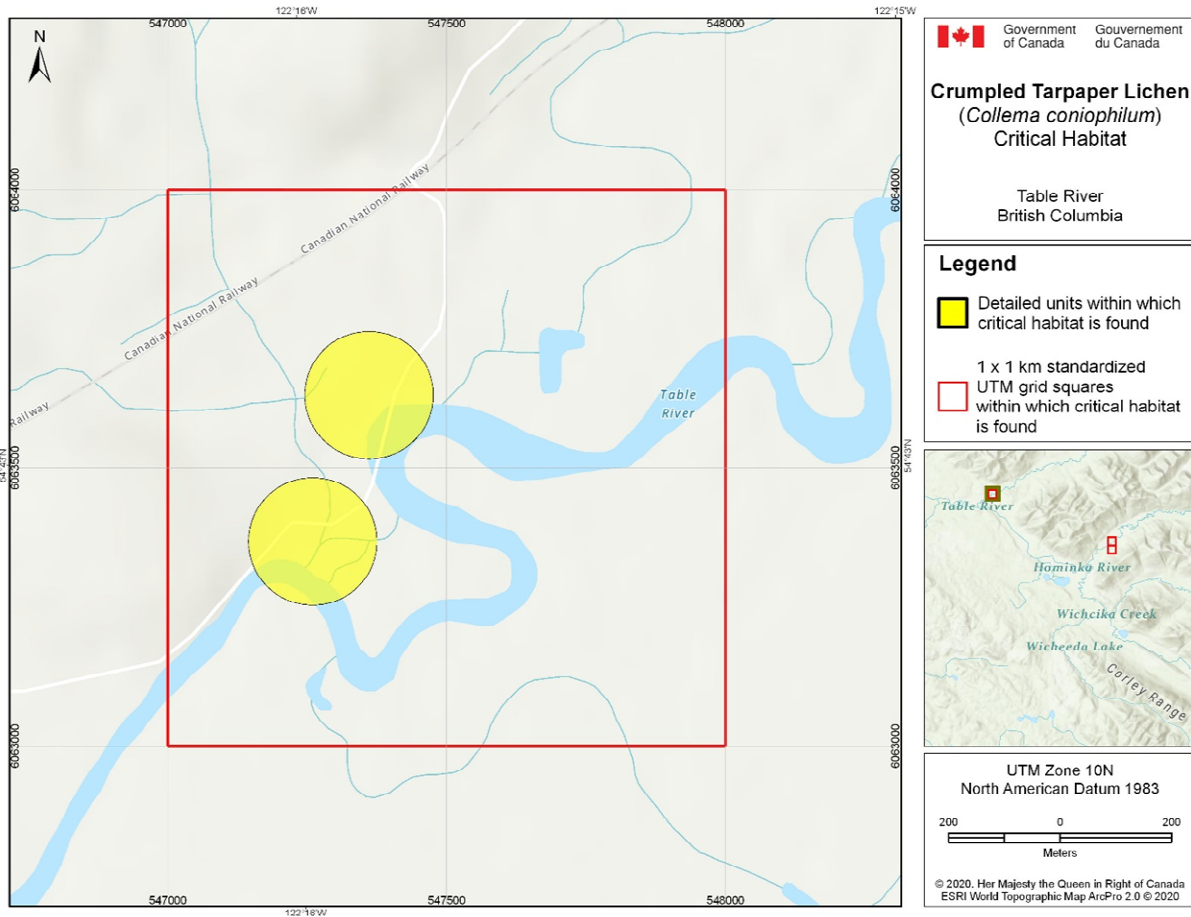
**Figure 7.** Critical habitat for Crumpled Tarpaper Lichen at Northwest Red Mountain Creek (EO10) and Southwest Red Mountain Creek (EO11), near Penny, B.C., is represented by the shaded yellow polygons, except where excluded areas (as described in section 6.1) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid systems used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.



**Figure 8.** Critical habitat for Crumpled Tarpaper Lichen at Muskwa River (EO12) southeast of Fort Nelson, B.C., is represented by the shaded yellow polygons, except where excluded areas (as described in section 6.1) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid systems used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.

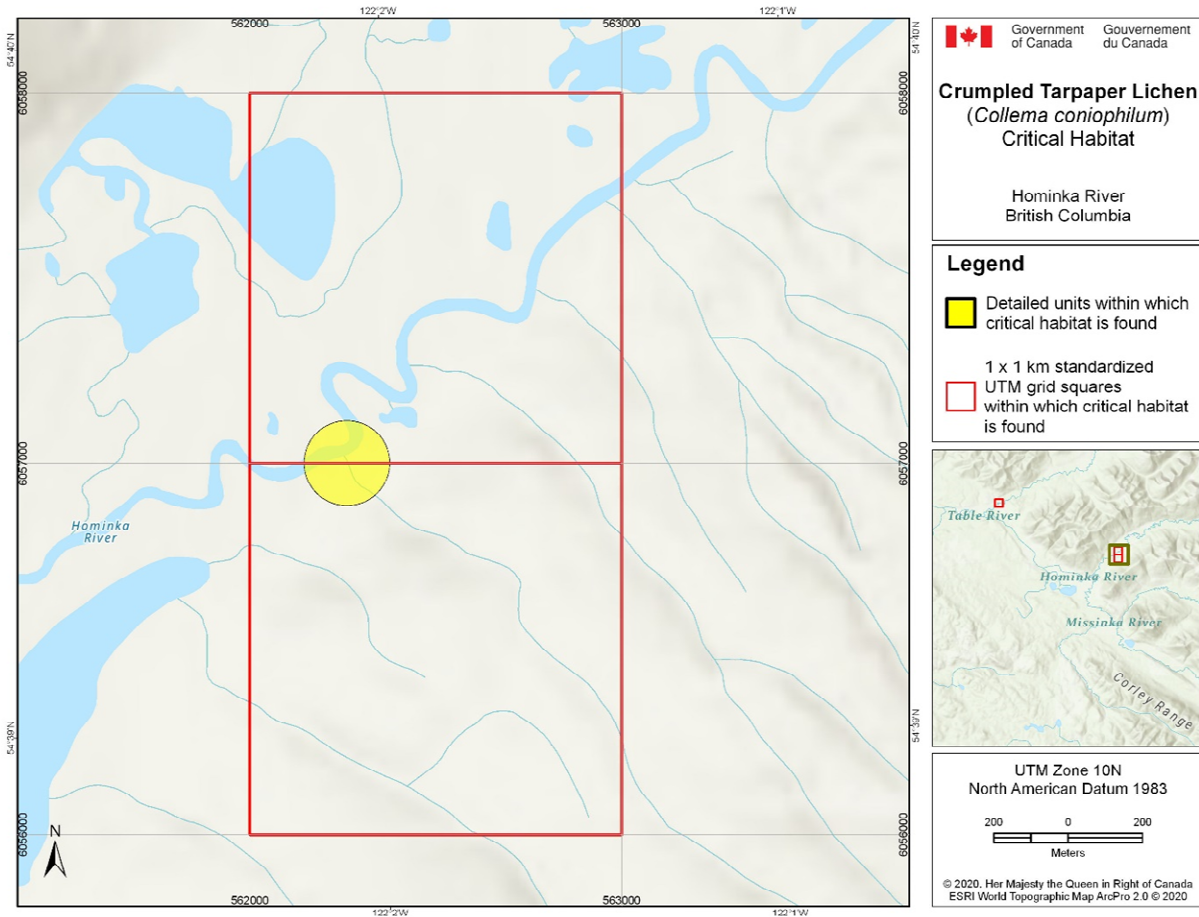


**Figure 9.** Critical habitat for Crumpled Tarpaper Lichen at Driscoll Creek (EO13) in Ancient Forest/Chun T'oh Whudujut Provincial Park, B.C., is represented by the shaded yellow polygons, except where excluded areas (as described in section 6.1) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid systems used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.

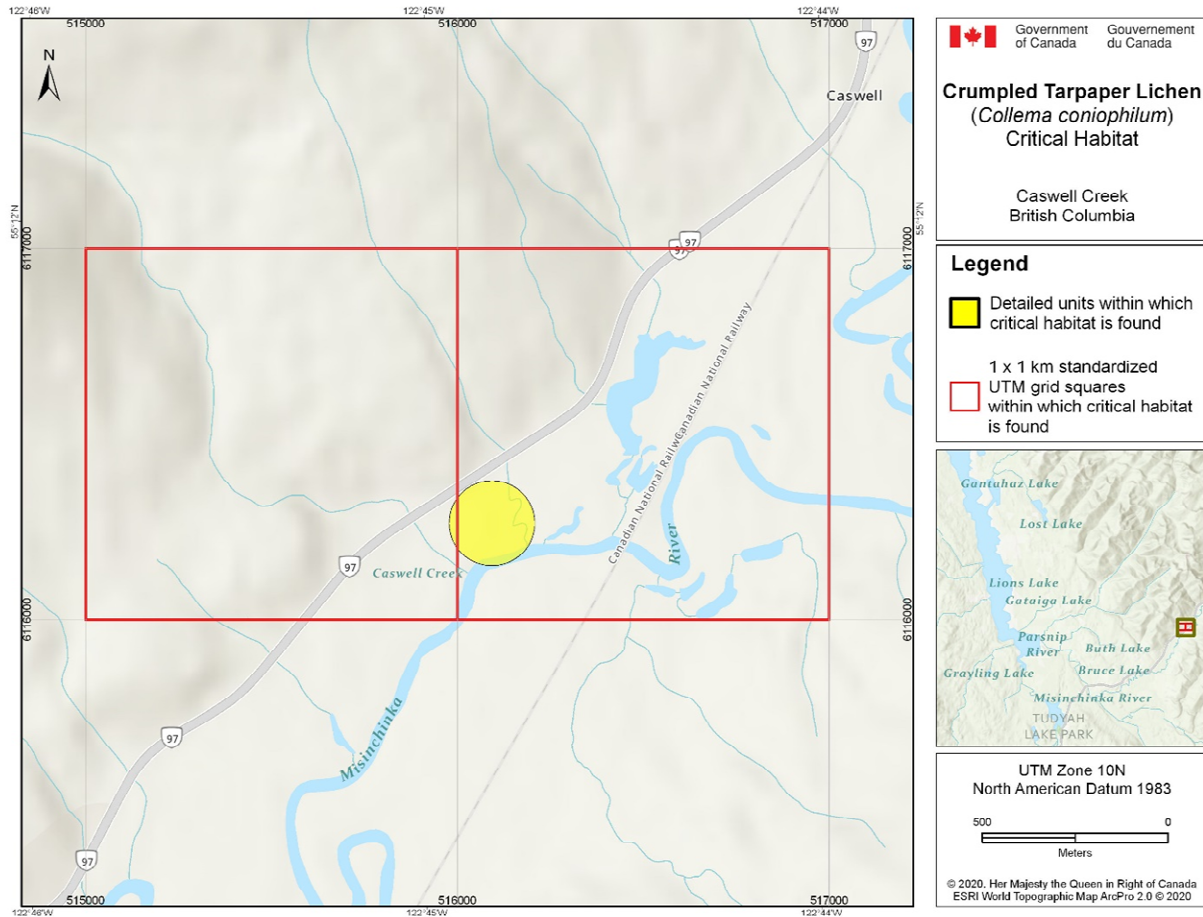


**Figure 10.** Critical habitat for Crumpled Tarpaper Lichen at Table River (EO14) northeast of Prince George, B.C., is represented by the shaded yellow polygons, except where excluded areas (as described in section 6.1) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid systems used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.

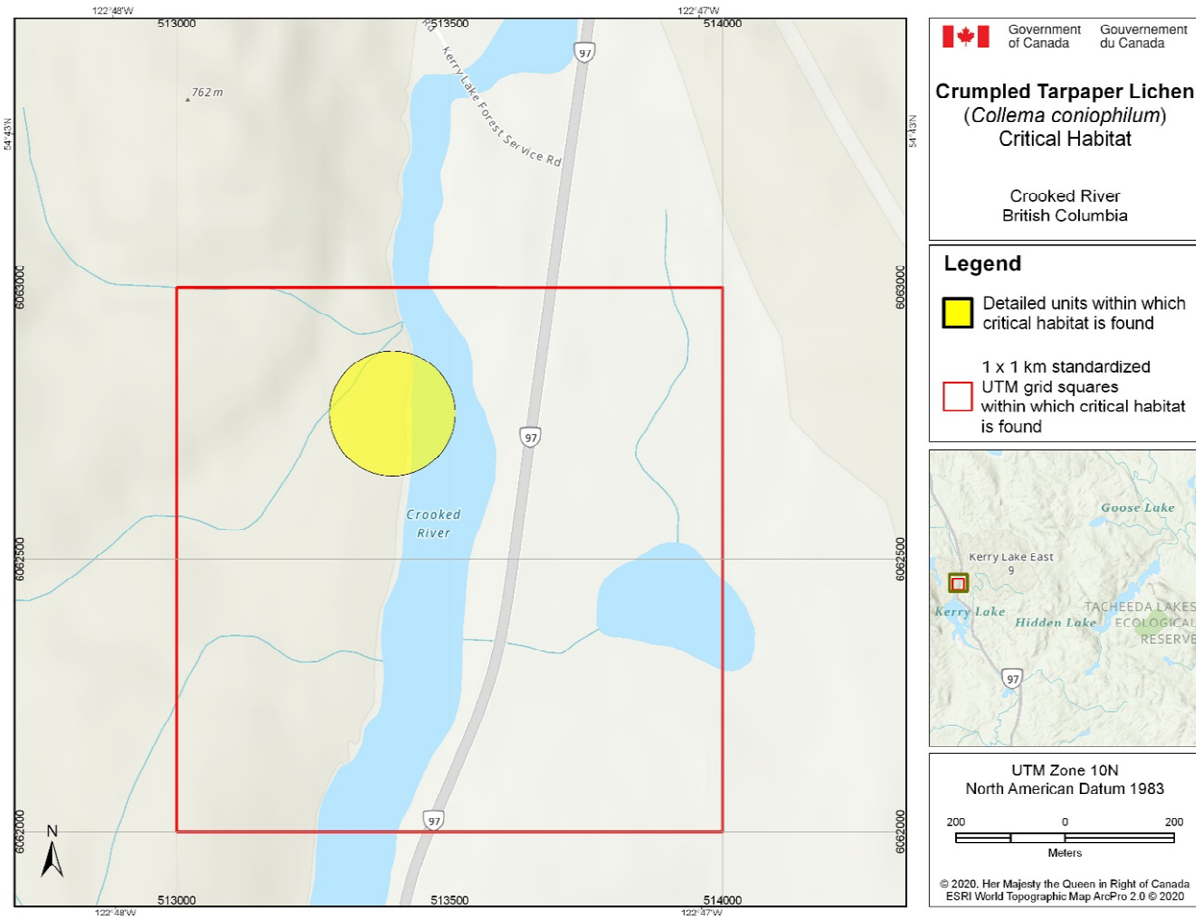




**Figure 11.** Critical habitat for Crumpled Tarpaper Lichen at Hominka River (EO15) northeast of Prince George, B.C., is represented by the shaded yellow polygons, except where excluded areas (as described in section 6.1) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid systems used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.



**Figure 12.** Critical habitat for Crumpled Tarpaper Lichen at Caswell Creek (EO17) southeast of Mackenzie, B.C., is represented by the shaded yellow polygons, except where excluded areas (as described in section 6.1) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid systems used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.



**Figure 13.** Critical habitat for Crumpled Tarpaper Lichen at Crooked River (EO18) north of Prince George, B.C., is represented by the shaded yellow polygons, except where excluded areas (as described in section 6.1) occur. The 1 km x 1 km standardized UTM grid overlay (red outline) shown on this figure is part of a standardized national grid systems used to indicate the general geographical area within which critical habitat is found. Areas outside of the shaded yellow polygons do not contain critical habitat.

## 6.2 Schedule of Studies to Identify Critical Habitat

The following schedule of studies (Table 5) outlines the activities required to complete the identification of critical habitat for the Crumpled Tarpaper Lichen.

**Table 5.** Schedule of studies to identify critical habitat for Crumpled Tarpaper Lichen.

Description of activity	Rationale	Timeline
Verify occurrence information reported for two populations of Crumpled Tarpaper Lichen in Alberta and one in Northwest Territories and obtain information about local habitat requirements and threats.	This activity is required to ensure that sufficient critical habitat is identified to meet the population and distribution objectives.	2022-2032

## 6.3 Examples of Activities Likely to Result in the Destruction of Critical Habitat

Understanding what constitutes destruction of critical habitat is necessary for the protection and management of critical habitat. Destruction is determined on a case-by-case basis. Destruction would result if part of the critical habitat were degraded, either permanently or temporarily, such that it would not serve its function when needed by the species. Destruction may result from a single or multiple activities at one point in time or from the cumulative effects of one or more activities over time. Section 4 provides a description of the potential threats to Crumpled Tarpaper Lichen. Activities described in Table 6 include those likely to cause destruction of critical habitat for the species; destructive activities are not limited to those listed.

**Table 6.** Examples of activities likely to result in destruction of critical habitat for Crumpled Tarpaper Lichen.

Description of activity	Details of Effect on Attributes of Habitat	Additional Information including related IUCN-CMP threat <sup>a</sup>
Activities that result in removal or destruction of natural habitat features within the area containing critical habitat, e.g., logging and wood harvesting or construction of roads	The removal or destruction of natural habitat features (e.g., trees, branches, other substrates) can result in destruction of critical habitat through causing direct and permanent loss of the biophysical features and attributes required to sustain both the site context and specific growing locations that support Crumpled Tarpaper Lichen establishment, growth, reproduction and dispersal.	IUCN-CMP Threats #4.1, 5.3  Destruction of critical habitat by these activities can be caused at any time of year. Most likely to result in destruction when they occur within the boundaries of critical habitat; however, activities that result in significant changes to local light and moisture regimes may result in destruction of critical habitat when they occur in areas outside the bounds but adjacent to critical habitat. All site locations are potentially implicated.
Activities that result in the introduction or significant increase of airborne pollutants in critical habitat areas, e.g., via quarrying or smelting of minerals and other materials	Crumpled Tarpaper Lichen requires habitat that is free of airborne acidifying pollutants (e.g. acidic emissions, industrial outputs) for successful growth and reproduction. Lichens directly absorb solutes in airborne rainwater, cloud, and mist, and are thereby highly sensitive to pollutants, which may interfere with establishment, growth, reproduction and dispersal.	IUCN-CMP Threat #9.5  Destruction of critical habitat by this activity can be caused at any time of year. Most likely to cause destruction where pollution sources are located in close proximity to areas containing critical habitat.  Destruction of critical habitat by airborne pollutants is most likely to occur in site locations within the Robson Valley watershed (e.g. Amanita Creek, Aleza Lake, and Upper Fraser), if the approved Giscome smelter is constructed.

<sup>a</sup> Threat classification is based on the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system (<https://www.iucnredlist.org/resources/threat-classification-scheme>).

## 7. Measuring Progress

The provincial recovery plan (Part 2, section 8) contains a section on measuring progress toward meeting the three recovery objectives that are set out in that plan (Part 2, section 5.3). Environment and Climate Change Canada adopts “Section 8: Measuring Progress” with the addition of the following performance indicators that define and measure progress toward meeting the population and distribution objective as it is set out in this federal recovery strategy, i.e.,:

- The number of mature individuals for Crumpled Tarpaper Lichen is stable or increasing at all known extant sites over the next 10 years.
- Human-caused threats are managed such that the area, extent, and quality of forest habitat that is suitable for Crumpled Tarpaper is maintained in a way that allows for population resilience at all known extant sites.

## 8. Statement on Action Plans

One or more action plans for the Crumpled Tarpaper Lichen will be posted on the Species at Risk Public Registry within 10 years of the posting of the final recovery strategy.

## 9. Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the [Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals](#)<sup>11</sup>. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the [Federal Sustainable Development Strategy](#)'s<sup>12</sup> (FSDS) goals and targets.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the strategy itself, but are also summarized in the statement below.

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<sup>11</sup> [www.canada.ca/en/environmental-assessment-agency/programs/strategic-environmental-assessment/cabinet-directive-environmental-assessment-policy-plan-program-proposals.html](http://www.canada.ca/en/environmental-assessment-agency/programs/strategic-environmental-assessment/cabinet-directive-environmental-assessment-policy-plan-program-proposals.html)

<sup>12</sup> [www.fsds-sfdd.ca/index.html#/en/goals/](http://www.fsds-sfdd.ca/index.html#/en/goals/)

The provincial recovery plan for Crumpled Tarpaper Lichen contains a section describing the effects of recovery activities on other species (i.e., Section 9). Environment and Climate Change Canada adopts this section of the provincial recovery plan as the statement on effects of recovery activities on the environment and other species. Recovery planning activities for Crumpled Tarpaper Lichen will be implemented with consideration for all co-occurring species at risk, in order to avoid negative impacts to these co-occurring species or their habitats. Some management actions for Crumpled Tarpaper Lichen (e.g., inventory and monitoring, threat mitigation, habitat conservation, education, and research) may promote the conservation of other species at risk that overlap in distribution and rely on similar interior old-growth forest habitat attributes.



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**Part 2 – *Recovery Plan for the Crumpled Tarpaper*  
(*Collema coniophilum*) in *British Columbia*, prepared by the  
British Columbia Ministry of Environment and  
Climate Change Strategy**

## Recovery Plan for Crumpled Tarpaper (*Collema coniophilum*) in British Columbia



Prepared by B.C. Ministry of Environment



Ministry of  
Environment

December 2013

## **About the British Columbia Recovery Strategy Series**

This series presents the recovery documents that are prepared as advice to the Province of British Columbia on the general approach required to recover species at risk. The Province prepares recovery documents to ensure coordinated conservation actions and to meet its commitments to recover species at risk under the *Accord for the Protection of Species at Risk in Canada* and the *Canada–British Columbia Agreement on Species at Risk*.

### **What is recovery?**

Species at risk recovery is the process by which the decline of an endangered, threatened, or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of a species' persistence in the wild.

### **What is a provincial recovery document?**

Recovery documents summarize the best available scientific and traditional information of a species or ecosystem to identify goals, objectives, and strategic approaches that provide a coordinated direction for recovery. These documents outline what is and what is not known about a species or ecosystem, identify threats to the species or ecosystem, and explain what should be done to mitigate those threats, as well as provide information on habitat needed for survival and recovery of the species. This information may be summarized in a recovery strategy followed by one or more action plans. The purpose of an action plan is to offer more detailed information to guide implementation of the recovery of a species or ecosystem. When sufficient information to guide implementation can be included from the onset, all of the information is presented together in a recovery plan.

Information provided in provincial recovery documents may be adopted by Environment Canada for inclusion in federal recovery documents that the federal agencies prepare to meet their commitments to recover species at risk under the *Species at Risk Act*.

### **What's next?**

The Province of British Columbia accepts the information in these documents as advice to inform implementation of recovery measures, including decisions regarding measures to protect habitat for the species.

Success in the recovery of a species depends on the commitment and cooperation of many different constituencies that may be involved in implementing the directions set out in this document. All British Columbians are encouraged to participate in these efforts.

### **For more information**

To learn more about species at risk recovery in British Columbia, please visit the B.C. Ministry of Environment Recovery Planning webpage at:

<http://www.env.gov.bc.ca/wld/recoveryplans/rcvry1.htm>

**Recovery Plan for Crumpled Tarpaper (*Collema coniophilum*)  
in British Columbia**

**Prepared by the B.C. Ministry of Environment**

**December 2013**

## **Recommended citation**

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## **Cover illustration/photograph**

Tim Wheeler

## **Additional copies**

Additional copies can be downloaded from the B.C. Ministry of Environment Recovery Planning webpage at:

<<http://www.env.gov.bc.ca/wld/recoveryplans/rcvry1.htm>>

## **Publication information**

**ISBN:** 978-0-7726-6735-9

## Disclaimer

This recovery plan has been prepared by the B.C. Ministry of Environment, as advice to the responsible jurisdictions and organizations that may be involved in recovering the species. The B.C. Ministry of Environment has received this advice as part of fulfilling its commitments under the *Accord for the Protection of Species at Risk in Canada*, and the *Canada–British Columbia Agreement on Species at Risk*.

This document identifies the recovery strategies that are deemed necessary, based on the best available scientific and traditional information, to recover crumpled tarpaper populations in British Columbia. Recovery actions to achieve the goals and objectives identified herein are subject to the priorities and budgetary constraints of participatory agencies and organizations. These goals, objectives, and recovery approaches may be modified in the future to accommodate new objectives and findings.

The responsible jurisdictions and all members of the recovery team have had an opportunity to review this document. However, this document does not necessarily represent the official positions of the agencies or the personal views of all individuals on the recovery team.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that may be involved in implementing the directions set out in this plan. The B.C. Ministry of Environment encourages all British Columbians to participate in the recovery of crumpled tarpaper.

## **ACKNOWLEDGEMENTS**

This document was completed by Brenda Costanzo (B.C. Ministry of Environment). Input on the threat assessment section was received from Stu Crawford (consultant) and Trevor Goward (consultant), with funding support from Environment Canada (Canadian Wildlife Service, Pacific-Yukon Region). Trevor Goward reviewed this document with funding support from the Land Based Investment Fund. Tim Wheeler is provided the cover image of crumpled tarpaper.

## EXECUTIVE SUMMARY

Crumpled tarpaper (*Collema coniophilum*) is a gel lichen with a leafy thallus (1.5–2.5 wide) bearing several broad, mostly rounded lobes that are thickened towards the tips. Thalli have a dark olive green to blackish brown upper surface, and a dark olive green to pale olive beige lower surface. The upper surface is sparsely covered in low blisters that become networks of narrow folds. The lower surface may bear tufts of tiny white hairs.

Crumpled tarpaper was designated as Threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as it is endemic to Canada, is restricted to trees in old-growth forests, and has a narrow distribution. Crumpled tarpaper is declining as a result of ongoing loss of old-growth forest. It is also expected to be listed as Threatened in Canada on Schedule 1 of the *Species at Risk Act* (SARA). In British Columbia, crumpled tarpaper is ranked S1 (critically imperiled) by the Conservation Data Centre and is on the provincial Red list. The B.C. Conservation Framework ranks crumpled tarpaper lichen as a priority 1 under goal 1 (contribute to global efforts for species and ecosystem conservation). Recovery is considered to be biologically and technically feasible.

The recovery (population and distribution) goal is to maintain stable or increasing populations throughout the species' range in British Columbia.

Recovery objectives for this species include:

1. To ensure long-term protection<sup>1</sup> for the known populations and habitat of crumpled tarpaper.
2. To conduct targeted inventory of suitable habitat (e.g., in Interior Cedar–Hemlock and Sub-Boreal Spruce biogeoclimatic zones).
3. To implement appropriate site management at all known locations.
4. To fill knowledge gaps on the environmental requirements and life history of the species (in particular lifespan, nutrient regime, and microclimatic requirements) for successful recolonization and maintenance of the species with respect to land management activities.

## RECOVERY FEASIBILITY SUMMARY

The recovery of crumpled tarpaper in B.C. is considered technically and biologically feasible based on the criteria outlined by the Government of Canada (2009):

1. Individuals of the wildlife species that are capable of reproduction are available now or in the foreseeable future to sustain the population or improve its abundance.

Yes, species reproduces asexually, although dispersal may be limiting.

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<sup>1</sup> Protection can be achieved through various mechanisms including: voluntary stewardship agreements, conservation covenants, sale by willing vendors on private lands, land use designations, and protected areas.



2. Sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration.

Yes, sufficient habitat is available or can be made available in the Interior Cedar–Hemlock (ICH) and Sub-Boreal Spruce (SBS) biogeoclimatic zones, though notably crumpled tarpaper requires highly nutrient-enriched microsites not likely to be widely distributed.

3. The primary threats to the species or its habitat (including threats outside Canada) can be avoided or mitigated.

Yes. Crumpled tarpaper requires environmental conditions associated exclusively with old forests. The primary threat of logging and wood harvesting can be avoided to some extent, as 1 of the 7 known extant populations occur in a provincial park and another possibly occurs in an ecological reserve. These areas are protected from industrial resource extraction through provisions such as the *Parks Act* and the *Ecological Reserve Act*. Future provincial legislation may likewise minimize the threat of logging at other locations on provincial Crown land (e.g., if crumpled tarpaper is listed as a Species at Risk under the *Forest and Range Practices Act*).

4. Recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.

Yes, best management practices can be developed for successful land management for this species. However, research will still be needed on its environmental requirements and life history, especially regarding generation time and the role of nutrients.

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## 1 COSEWIC\* SPECIES ASSESSMENT INFORMATION

**Date of Assessment:** November 2010  
**Common Name (population):** Crumpled Tarpaper Lichen  
**Scientific Name:** *Collema coniophilum*  
**COSEWIC Status:** Threatened  
**Reason for Designation:** This foliose, tree-inhabiting cyanolichen is endemic to Canada where it occupies a narrow range restricted to trees in old-growth forests on calcareous soils in humid, inland British Columbia. The lichen is poorly adapted for dispersal since it has never been found with sexual reproductive structures and its vegetative propagules are not easily dispersed. The lichen has an apparently declining distribution, resulting from ongoing loss of old-growth forest through clear-cut logging. The factors underlying its rarity and narrow endemism are not well understood.  
**Canadian Occurrence:** British Columbia  
**COSEWIC Status History:** Designated as Threatened in November 2010.

\* Committee on the Status of Endangered Wildlife in Canada.

\*\*Common and scientific names reported in this management plan follow the naming conventions of the B.C. Conservation Data Centre, which may be different from names reported by COSEWIC.

## 2 SPECIES STATUS INFORMATION

<b>crumpled tarpaper<sup>a</sup></b>	
<b>Legal Designation:</b>	
<a href="#">FRPA:</a> <sup>b</sup> No	B.C. <i>Wildlife Act</i> : <sup>c</sup> No
<a href="#">OGAA:</a> <sup>b</sup> No	<a href="#">SARA:</a> Not currently listed <sup>d</sup>
<b>Conservation Status<sup>e</sup></b>	
B.C. List: Red B.C. Rank: S1 (2010)	<a href="#">National Rank:</a> N1 (2009) Global Rank: G1 (2009)
Other <a href="#">Subnational Ranks:</a> <sup>f</sup> None	
<b>B.C. Conservation Framework (CF)<sup>g</sup></b>	
Goal 1: Contribute to global efforts for species and ecosystem conservation.	Priority: <sup>h</sup> 1 (2009)
Goal 2: Prevent species and ecosystems from becoming at risk.	Priority: 6 (2009)
Goal 3: Maintain the diversity of native species and ecosystems.	Priority: 1 (2009)
<a href="#">CF Action Groups:</a>	Compile Status Report; Planning; List under <i>Wildlife Act</i> ; Send to COSEWIC; Habitat Protection; Private Land Stewardship

<sup>a</sup> Data source: B.C. Conservation Data Centre (2013) unless otherwise noted.

<sup>b</sup> No = not listed in one of the categories of wildlife that requires special management attention to address the impacts of forest and range activities on Crown land under the *Forest and Range Practices Act* (FRPA; Province of British Columbia 2002) and/or the impacts of oil and gas activities on Crown land under the *Oil and Gas Activities Act* (OGAA; Province of British Columbia 2008).

<sup>c</sup> No = not designated as wildlife under the B.C. *Wildlife Act* (Province of British Columbia 1982).

<sup>d</sup> It expected to be listed as Threatened in Canada on [Schedule 1](#) of the *Species at Risk Act* (SARA). The COSEWIC assessment has been provided to the Minister of Environment and with the Governor in Council (GIC). The Minister, on the recommendation of the GIC, may amend the List and add a wildlife species.

<sup>e</sup> S = subnational; N = national; G = global; X = presumed extirpated; H = possibly extirpated; 1 = critically imperiled; 2 = imperiled; 3 = special concern, vulnerable to extirpation or extinction; 4 = apparently secure; 5 = demonstrably widespread, abundant, and secure; NA = not applicable; NR = unranked; U = unrankable.

<sup>f</sup> Data source: NatureServe (2012).

<sup>g</sup> Data source: B.C. Ministry of Environment (2010).

<sup>h</sup> Six-level scale: Priority 1 (highest priority) through to Priority 6 (lowest priority).

### 3 SPECIES INFORMATION

#### 3.1 Species Description

Crumpled tarpaper is a small- to medium-sized foliose lichen with a leafy thallus 1.5–2.5 (-3) cm, which becomes gel-like when moistened. The thallus has several broad rounded lobes 2–4 (-5) mm wide and thickened towards the tips. The upper surface is dark olive green to black brown and sometimes appears blistered. The isidia (outgrowths, method of asexual reproduction) on upper surface are black and 0.05–0.2 mm across. The lower surface is a dark olive green to pale olive beige. There are no rhizines (fungal threads), though tufts of small white hairs are sometimes present on the undersurface. (See COSEWIC 2010 for full description; refer to cover photograph.)

#### 3.2 Populations and Distribution

Crumpled tarpaper is endemic to Canada where it is only known from 7 extant and 1 extirpated location in B.C. (Table 1; Figure 1). In the province, it is restricted to inland areas in humid old-growth forests mainly east of Prince George in the Rocky Mountain Trench. Only a few targeted searches in appropriate habitat have been conducted, thus there are potentially more localities to be found in the Sub-Boreal Spruce (SBS) and the Interior–Cedar Hemlock (ICH) biogeoclimatic zones within B.C. (COSEWIC 2010).

The largest known population of crumpled tarpaper occurs at Hiyu Creek (EO4), which supports more than 70% of known thalli. Hiyu Creek is an artificially supported site due to the calcium from the logging road dust that resulted from gravel being deposited on the road. A decline in this population over the past decade has been observed, which may be due to a reduction in (calcareous) road dust due to less logging at the Hiyu site.

The Hiyu Creek locality likely represents a major “source population” for the species, creating an on-going supply of diaspores that, when dispersed (e.g., by birds), help sustain it over a much larger area. The loss of crumpled tarpaper at this locality (e.g., to logging or other disturbances) could result in a gradual regional decline in this species over time because of a lack of dispersal to other areas (T. Goward, pers. comm., 2013). Each locality is considered a separate population as they are more than 1 km apart. As logging has been focused on the bottomland forest types that are characteristic for this species, it is likely that in the past 30 years this activity has resulted in a decline in locations and population size (COSEWIC 2010). This species is at the edge of its ecological capacity to exist (T. Goward, pers. comm., 2013) as its limited reproductive and dispersal capabilities may restrict its ability to re-establish, especially within small populations (see section 3.5).

**Table 1.** Status and description of crumpled tarpaper populations in British Columbia.

<b>Population (numbering refers to B.C. Conservation Data Centre “CDC Element Occurrence data”)</b>	<b>Date last observed and number of thalli (if documented)</b>	<b>Land tenure</b>
EO1. Sugarbowl Creek; 5 km west of Hungary Creek	Extirpated in 2000 <sup>a</sup>	Crown land: Sugarbowl Grizzly Den Provincial Park
EO2. Upper Adams River; 7 km north of Tumtum Lake	1998: <sup>b</sup> 4 thalli	Crown land (potential Old Growth Management Area) <sup>c</sup>
EO3. Kenneth Creek; Viking Ridge	1999: <sup>d</sup> 4 thalli	Crown land: Sugarbowl Grizzly Den Provincial Park
EO4. Hiyu Creek; km 20 on Bowron Road	2006: 140 thalli	Crown land
EO5. Robson Valley; km 3.5 on North Fraser Road	2006: 17 thalli	Crown land
EO6. South of Huble Creek; km 1.5 on Herrick Road	2006: 6 thalli	Crown land
EO7. SW of Aleza Lake; km 1.5 on Aleza Lake Forest Road	2006: 6 thalli	Crown land under lease to Aleza Lake Research Society with the University of Northern BC; Crown land: Aleza Lake Ecological Reserve <sup>e</sup>
EO8. Upper Fraser Bridge	2007: 6 thalli	Crown land

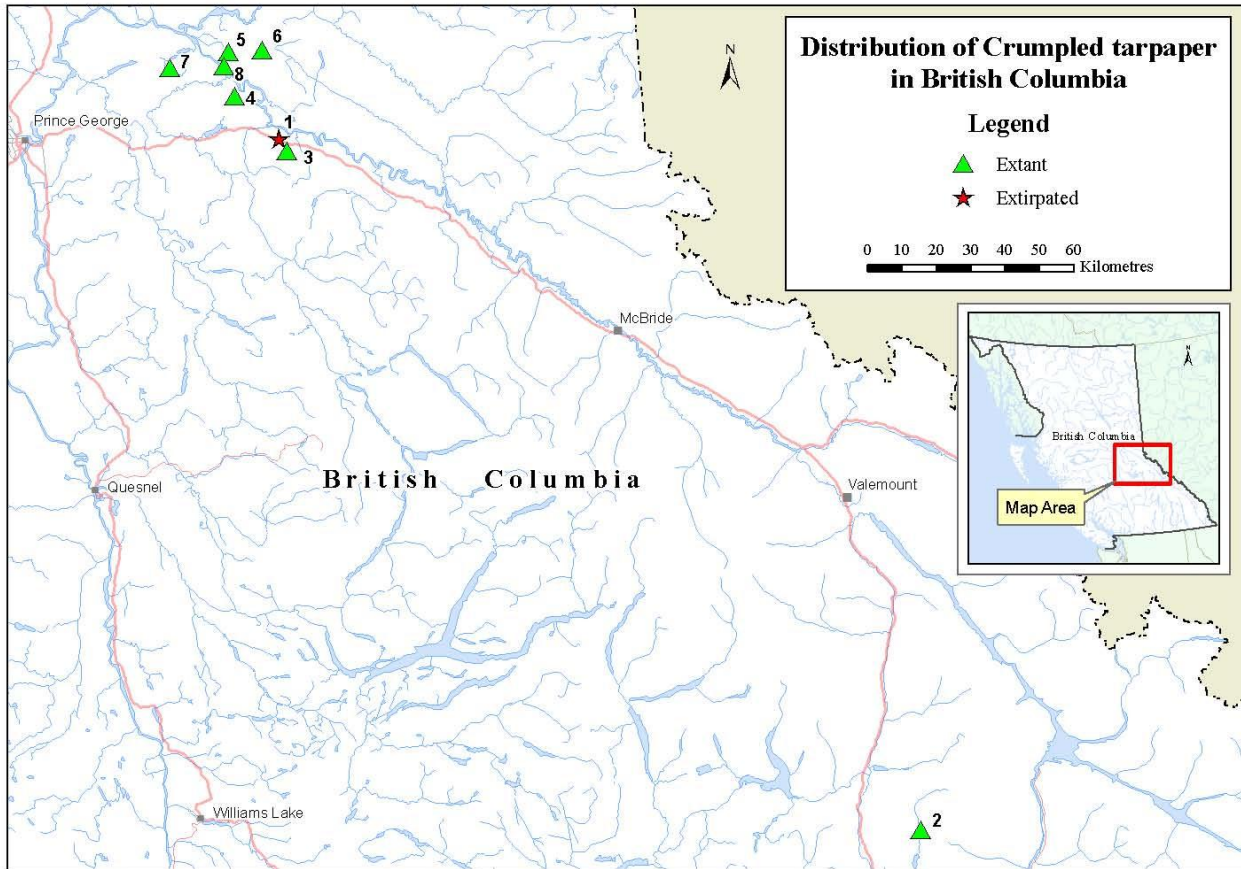
<sup>a</sup> Habitat was removed as a result of shake cutting then by clearcut logging.

<sup>b</sup> Attempts to relocate in 2006 unsuccessful (T. Goward, pers. comm., 2010).

<sup>c</sup> Due to the uncertainty of the location information, it is unknown whether this population occurs within the boundaries of the Old Growth Management Area.

<sup>d</sup> Attempts to relocate in 2004 unsuccessful (T. Goward, pers. comm., 2010).

<sup>e</sup> Due to the uncertainty of the location information, it is unknown whether this population occurs within the ecological reserve.



**Figure 1.** Crumpled tarpaper distribution in British Columbia (B.C. Conservation Data Centre 2013).

### 3.3 Needs of Crumpled Tarpaper

Crumpled tarpaper is a pioneer species that colonizes young twigs and branches through asexual reproduction (via the production of isidia) in humid old-growth forests that are over 100 years old. As this species requires high light levels and is restricted to older forest types (which allow more light than younger forests), stand structure is important to its survival. As well, the nutrients that are leached from higher in the canopy, in particular from trembling aspen (*Populus tremuloides*) and black cottonwood (*Populus trichocarpa*), supply crumpled tarpaper with nutrients for establishment on the lower, partly defoliated branches of adjacent conifer host trees (T. Goward, pers. comm., 2013).

As crumpled tarpaper requires a high level of calcium enrichment for establishment, it is restricted to valley-bottom forests established over calcareous lake sediments deposited during deglaciation; it is not known to occur above about 1000 m elevation. The species is only capable of establishing within the wettest subzones of the Interior Cedar–Hemlock and Sub-Boreal

Spruce biogeoclimatic zones where it inhabits trees that grow on calcareous soils (COSEWIC 2010).

Trees that crumpled tarpaper inhabit include subalpine fir (*Abies lasiocarpa* var. *lasiocarpa*), western hemlock (*Tsuga heterophylla*), Engelmann spruce (*Picea engelmannii*), trembling aspen, and to a lesser western redcedar (*Thuja plicata*) and black cottonwood. In one location (Hiyu Creek), a higher than normal number of thalli grows along gravel logging roads that were formerly subject to considerable calcareous road dust. The species is known to require nutrient-rich or nutrient-enriched substrates (COSEWIC 2010).

### 3.4 Ecological Role

Crumpled tarpaper is not known to serve a critical or keystone ecological function. However, as lichens are known to be indicators of environmental change, it may be one of several lichen species that could be used to monitor environmental health.

### 3.5 Limiting Factors

**Habitat specificity:** Crumpled tarpaper distribution is limited by its specific habitat requirements (see section 3.3).

**Limited reproduction and dispersal capability:** Crumpled tarpaper is not known to produce sexual fruiting bodies (apothecia), but instead reproduces via asexual outgrowths (isidia). Although it is relatively short-lived, probably completing its life cycle within about three decades (T. Goward, pers. comm., 2013), it is thought to take approximately 10 years after establishment of the isidia for the lichen to be reproductively mature. Dispersal occurs exclusively via isidia that are presumably too large for effective wind dispersal; likely this species is transported on the feet of animals, especially birds. This limiting factor is more apparent within small populations as the frequency of individuals producing/dispersing via isidia is less.

## 4 THREATS

Threats are defined as the proximate activities or processes that have caused, are causing, or may cause in the future the destruction, degradation, and/or impairment of the entity being assessed (population, species, community, or ecosystem) in the area of interest (global, national, or subnational) (Salafsky *et al.* 2008). For purposes of threat assessment, only present and future threats are considered.<sup>2</sup> Threats do not include limiting factors, which are presented in section 3.5.<sup>3</sup>

For the most part, threats are related to human activities, but they can be natural. The impact of human activity may be direct (e.g., destruction of habitat) or indirect (e.g., invasive species introduction). Effects of natural phenomena (e.g., fire, hurricane, flooding) may be especially important when the species or ecosystem is concentrated in one location or has few occurrences, which may be due to human activity (Master *et al.* 2009). As such, natural phenomena are included in the definition of a threat, though should be applied cautiously. These stochastic events should only be considered a threat if a species or habitat is damaged from other threats and has lost its resilience, and is thus vulnerable to the disturbance (Salafsky *et al.* 2008) such that these types of events would have a disproportionately large effect on the population/ecosystem compared to the effect it would have had historically.

### 4.1 Threat Assessment

The threat classification below is based on the IUCN-CMP (World Conservation Union–Conservation Measures Partnership) unified threats classification system and is consistent with methods used by the B.C. Conservation Data Centre and the B.C. Conservation Framework. For a detailed description of the threat classification system, see the [CMP website](#) (CMP 2010). Threats may be observed, inferred, or projected to occur in the near term. Threats are characterized here in terms of scope, severity, and timing. Threat “impact” is calculated from scope and severity. For information on how the values are assigned, see [Master \*et al.\* \(2009\)](#) and table footnotes for details. Threats for crumpled tarpaper were assessed for the entire province (Table 2).

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<sup>2</sup> Past threats may be recorded but are not used in the calculation of Threat Impact. Effects of past threats (if not continuing) are taken into consideration when determining long-term and/or short-term trend factors (Master *et al.* 2009).

<sup>3</sup> It is important to distinguish between limiting factors and threats. Limiting factors are generally not human induced and include characteristics that make the species or ecosystem less likely to respond to recovery/conservation efforts (e.g., inbreeding depression, small population size, and genetic isolation; or likelihood of regeneration or recolonization for ecosystems).



**Table 2.** Threat classification table for crumpled tarpaper in British Columbia.

Threat # <sup>a</sup>	Threat description	Impact <sup>b</sup>	Scope <sup>c</sup>	Severity <sup>d</sup>	Timing <sup>e</sup>	Population(s)
5	Biological resource use	Very High	Pervasive	Extreme	High	
5.3	Logging & wood harvesting	Very High	Pervasive	Extreme	High	Hiyu Creek (EO4); Robson Valley (EO5); Huble Creek (EO6); Upper Fraser Bridge (EO8)
7	Natural system modifications	Low	Small	Extreme	Moderate	
7.2	Dams & water management/use	Low	Small	Extreme	Moderate	No known populations; possible within suitable habitat within range
11	Climate change & severe weather	Unknown	Negligible	Unknown	Moderate	
11.2	Droughts	Not Calculated	Large	Unknown	Low	All

<sup>a</sup> Threat numbers are provided for Level 1 threats (i.e., whole numbers) and Level 2 threats (i.e., numbers with decimals).

<sup>b</sup> **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

<sup>c</sup> **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species’ population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

<sup>d</sup> **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or 3-generation timeframe. Usually measured as the degree of reduction of the species’ population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

<sup>e</sup> **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [ $< 10$  years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

## 4.2 Description of Threats

The overall province-wide Threat Impact for this species is Very High.<sup>4</sup> The greatest threat is logging and wood harvesting (Table 2). Details are discussed below under the Threat Level 1 headings.

### IUCN-CMP Threat 5 - Biological resource use

#### 5.3 Logging & wood harvesting

Crumpled tarpaper occurs on trees that grow in nutrient-enriched localities such as old lake bottoms and river mud. If trees growing in these habitats are harvested, there may be a loss of host trees and crumpled tarpaper populations could be eliminated. As well, forest harvesting could increase the isolation of crumpled tarpaper populations and decrease dispersal of the species through removal of host trees and subsequent diaspore reduction. Populations can also decline due to the removal of non-host trees, such as trembling aspen and black cottonwood, that support this species indirectly (i.e., by enriching the twigs and branches of host trees). As a result of logging, smaller and more scattered populations of crumpled tarpaper would likely be more vulnerable to natural stand-replacing events such as windthrow from severe storms, and disease and insect outbreaks. In addition, the microclimate required for establishment of crumpled tarpaper may be disrupted at the edge of clearcuts.

Approximately 97% of the known individuals occur in either a timber supply area (TSA) or in a tree farm licence (TFL). As such, there is potential for the habitat of crumpled tarpaper to be greatly reduced through logging and wood harvesting activities. If, for example, the only currently known source population at Hiyu Creek (EO4) was removed through tree harvesting, the ability of crumpled tarpaper to disperse to other areas would be severely reduced. This in turn could be expected to result in a gradual decline over the next 40–50 years, potentially leading to this species' extirpation in this portion of its range, and the species would be lost (T. Goward, pers. comm., 2013).

The Upper Adams River population (EO2) is not within a provincial park (contrary to assertions in the status report<sup>5</sup>), but rather in the Kamloops TSA. It is uncertain whether this population falls within an Old Growth Management Area (OGMA), which is afforded protection from wood harvesting through the legal provisions of the *Forest and Range Practices Act*. The population at Kenneth Creek (EO3) is protected from wood harvesting in Sugarbowl Grizzly Den Provincial Park through the legal provisions of the *Parks Act*. The population southwest of Aleza Lake (EO7) is potentially situated in the Aleza Lake Ecological Reserve. If so, then it would be

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<sup>4</sup> The overall threat impact was calculated following Master *et al.* (2009) using the number of Level 1 Threats assigned to this species where Timing = High or Moderate, included 1 Very High, 1 Low, and 1 Unknown (Table 2). The overall threat considers the cumulative impacts of multiple threats.

<sup>5</sup> The geospatial data for this location have been corrected in the B.C. Conservation Data Centre database.

protected from all extractive activities including wood harvesting through the legal provisions of the *Ecological Reserves Act*.

## **IUCN-CMP Threat 7 - Natural system modification**

### 7.2 Dams & water management

Due to the species preference for nutrient-rich floodplains and former lake beds, crumpled tarpaper is potentially located within BC Hydro Site C Dam Local Assessment Area (BC Hydro 2013; Environment Canada 2013). Therefore, host trees could be flooded out and/or removed if the project proceeds.

## **IUCN-CMP Threat 11 - Climate change and severe weather**

### 11.2 Droughts

Crumpled tarpaper is restricted to the wettest subzones of the Interior Cedar–Hemlock and Sub-Boreal Spruce biogeoclimatic zones, hence a considerable increase in summer drought would be required to affect it directly. The most likely threat would be indirect (e.g., through an increase in fire frequency as the region dried out). However, this is not predicted within the next 3 generations so impact has not been calculated for this threat.

As crumpled tarpaper occurs in wet areas, fires do not occur frequently. If drought increased over time due to climate change, the fire frequency could also increase. Any natural fires that may occur could potentially damage host trees; however, this is unlikely to be a threat at any of the sites in the next 10 years.

## **5 RECOVERY GOAL AND OBJECTIVES**

### **5.1 Recovery (Population and Distribution) Goal**

The population and distribution goal is to maintain stable or increasing populations throughout its range in British Columbia.

### **5.2 Rationale for the Recovery (Population and Distribution) Goal**

The overall goal is to maintain stable or increasing populations. This includes the known extant populations as well as any populations that are found in the future. It is likely that the species will always be Threatened due to its naturally rare occurrence in specialized habitats in old-growth forests on calcareous soils in humid, inland British Columbia. However, protecting known locations, as well as protecting the species more broadly at the ecosystem level (i.e., preserving the suitable habitats that provide context and connectivity between populations),

could prevent this species from becoming Endangered. This approach may enable continued dispersal of isidia from the Hiyu Creek site to the other extant sites (including any new sites that may be discovered), such that the populations remain stable and/or are increasing throughout its range.

### 5.3 Recovery Objectives

Recovery will be considered significantly advanced if the following short-term (5–10 years) objectives have been met:

1. To ensure long-term protection<sup>6</sup> for the habitat of known populations as well as any potential habitat likely to support the species.
2. To conduct targeted inventory of suitable habitat (e.g., in the wettest subzones of the Interior Cedar–Hemlock and Sub-Boreal Spruce zones).
3. To conduct research into the environmental requirements and life history of the species (in particular lifespan, nutrient regime, and microclimatic requirements) for its successful recolonization and maintenance with respect to land management activities.

## 6 APPROACHES TO MEET OBJECTIVES

### 6.1 Actions Already Completed or Underway

The following actions have been categorized by the action groups of the B.C. Conservation Framework (B.C. Ministry of Environment 2010). Status of the action group for this species is given in parentheses.

#### **Compile Status Report (complete)**

- COSEWIC report completed (COSEWIC 2010). Update due 2020.

#### **Send to COSEWIC (complete)**

- Crumpled tarpaper assessed as Threatened (COSEWIC 2010). Re-assessment due 2020.

#### **Planning (complete)**

- B.C. Recovery Plan completed (this document, 2013).

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<sup>6</sup> Protection can be achieved through various mechanisms including: voluntary stewardship agreements, conservation covenants, sale by willing vendors on private lands, land use designations, and protected areas.

**Habitat Protection and Private Land Stewardship (in progress)****Table 3.** Existing mechanisms that afford habitat protection for crumpled tarpaper populations.

<b>Existing mechanisms that afford habitat protection</b>	<b>Threat<sup>a</sup> or concern addressed</b>	<b>Population</b>
<i>Provincial Parks Act</i>	5.3	Sugarbowl Creek (EO1) in Grizzly Den Provincial Park
<i>Provincial Ecological Reserves Act</i>	5.3	SW of Aleza Lake (EO7), possibly in Aleza Lake Ecological Reserve
<i>Provincial Forest and Range Practices Act (OGMAs)</i>	5.3	Possibly Upper Adams River (EO2)

<sup>a</sup> Threat numbers according to the IUCN-CMP classification (see Table 2 for details).

## 6.2 Recovery Planning Table

**Table 3.** Recovery planning table for crumpled tarpaper.

Objective	Actions to meet objectives	Threat <sup>a</sup> or concern addressed	Priority <sup>b</sup>
1	Obtain more precise location data and land tenure for each population.	5.3	Essential
	Assess impacts of threats at all sites.	5.3	Essential
	Determine appropriate measures to protect habitat using an ecosystem-level approach. When the species is recorded on Crown lands, initiate protection measures under existing legislation and government policy.	5.3	Essential
	Recommend crumpled tarpaper be listed as a Species at Risk under B.C. <i>Forest and Range Practices Act</i> .	5.3	Essential
	Develop Best Management Practices (BMPs) for the species.	5.3	Essential
	Educate landowners (use BMPs) about the importance of the species and its habitat at the ecosystem level.	5.3	Necessary
	Manage known occurrences of the species in a way that minimizes impact (BMPs and uses an ecosystem-level habitat management).	5.3	Necessary
	Monitor locations to assess the status of populations and the effects of any management activities taken to protect habitat at the ecosystem level.	5.3	Necessary
2	Determine suitable habitat localities for targeted inventory.	5.3	Necessary
	Advise appropriate landowners of the potential for the species to be present on their lands.	5.3	Necessary
3	Study the environmental requirements and life history of the species (in particular the role of nutrients, longevity, and requirements for successful recolonization) to determine the links to land management activities that will allow the maintenance and protection of the species.	Knowledge gaps	Beneficial

<sup>a</sup> Threat numbers according to the IUCN-CMP classification (see Table 2 for details).

<sup>b</sup> Essential (urgent and important, needs to start immediately); Necessary (important but not urgent, action can start in 2–5 years); or Beneficial (action is beneficial and could start at any time that was feasible).

### 6.3 Narrative to Support Recovery Planning Table

Protecting the habitat of known locations should be approached from a larger ecosystem-level perspective and should also protect the suitable (connective) habitat between the populations. This approach may enable dispersal of isidia from the Hiyu Creek site, which is considered the only source population and therefore very important to protect.

## 7 INFORMATION ON HABITAT NEEDED TO MEET RECOVERY GOAL

Threats to crumpled tarpaper habitat have been identified. To help meet the recovery (population and distribution) goal for this species, it is recommended that specific habitat attributes be described for crumpled tarpaper. In addition, it is recommended that locations of survival/recovery habitat be geospatially modeled on the landscape to facilitate the actions for meeting the recovery (population and distribution) goal.

### 7.1 Description of Survival/Recovery Habitat

A description of the habitat needs for crumpled tarpaper has been provided in section 3.3.1 based on current knowledge of the habitat occupied by this species. Although some aspects of the species' habitat requirements require further study, the following describes the biophysical attributes of survival/recovery habitat based on our best available information:

- humid inland old-growth forests that are over 100 years old;
- valley-bottom forests occurring below 1000 m;
- within the wettest subzones of the Interior Cedar–Hemlock and Sub-Boreal Spruce zones
- host trees (as described above) that grow on calcium-rich or calcium-enriched soils and are usually within the dripzones of trembling aspen or black cottonwood; and
- host tree species include subalpine fir, western hemlock, Engelmann spruce, and to a lesser extent black cottonwood, trembling aspen, and western redcedar.

### 7.2 Studies Needed to Describe Survival/Recovery Habitat

It is recommended that survival/recovery habitat be geospatially described. A schedule of studies outlining the work necessary to further describe survival/recovery habitat is provided in Table 4.

**Table 4.** Studies needed to describe survival/recovery habitat to meet the recovery (population and distribution) goal for crumpled tarpaper.

Description of activity	Outcome/rationale	Timeline
Conduct surveys:		
• Map occupied (survival) habitat using established mapping techniques.	Known locations are mapped	2014–2015
• Describe and record condition of occupied (survival) habitat as well as surrounding habitat required for survival (including calcium and nutrient availability and supply).	Additional information on biophysical attributes determined	2015–2016
• Add any new habitat information derived from additional inventory for the species.	Additional information on biophysical attributes determined	2015–2016

## 8 MEASURING PROGRESS

The following performance indicators provide a way to define and measure progress toward achieving the recovery (population and distribution) goal and objectives over the next 5 years. Performance measures are listed below for each objective.

### Measurables for Objective 1:

- Mechanisms have been initiated to protect the habitat of locations, including the suitable (connecting) habitat between locations, at a minimum of 5 populations by 2016.
- Best management practices have been developed and will be applied in 5 locations for the species within protected areas by 2015.

### Measurable for Objective 2:

- An inventory program in suitable habitat within B.C. has been prioritized and will be initiated by 2015.

### Measurable for Objective 3:

- Research will be initiated by 2016 to fill knowledge gaps on the environmental requirements and life history of the species (in particular the role of nutrients, longevity, and requirements) for successful recolonization.

## 9 EFFECTS ON OTHER SPECIES

This species occurs in inland old-growth forests. Negative impacts to other species are not anticipated. Actions to conserve and manage crumpled tarpaper (e.g., threat mitigation, habitat conservation, education, monitoring) will promote the conservation of other species using those habitats (e.g., cryptic paw [*Nephroma occultum*], a SARA-listed species), including at least one additional, as yet unnamed gel lichen species potentially worthy of SARA listing (T. Goward, pers. comm., 2013).



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**Personal Communications**

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