

Botrychium Basin Sensitive Area Plan

**Kispiox Forest District
March 2002**

Prepared by:



Patrick Williston, M.Sc., R.P. Bio.

MNIUM ECOLOGICAL RESEARCH

P.O. Box 4979, Smithers, BC, V0J 2N0

Pwilliston@bulkley.net

Ph. (250)-877-7702

Order to Establish a Sensitive Area and Objectives

Pursuant to section 5 of the *Forest Practices Code of British Columbia Act*, 256.6 hectares of Crown land in the McCully Creek watershed are established as a sensitive area effective _____, 2002.

Effective _____, 2002, the following objectives are established for this sensitive area:

Core reserve zone (as shown on Map 2):

1. Maintain antique forest attributes in the core reserve zone by precluding commercial timber harvesting and road construction, except where required to maintain forest health and control fires.
2. Retain a representative example of an antique forest with its full complement of associated lichens.
3. Protect a globally significant population of a red-listed fern, *Botrychium montanum*.

Buffer zone (as shown on Map 2):

4. Retain the interior forest condition of the core reserve area.
5. Maintain additional representation of antique forests while allowing commercial timber harvesting and road construction such that antique attributes are retained.
6. Protect additional populations of *Botrychium montanum*.

The boundaries of the Botrychium Basin sensitive area are shown on the attached 1: _____ scale map dated _____, 2002 (described as Map 2 in the Botrychium Basin Sensitive Area Plan).

(original signed by)

Shane Berg, District Manager
Kispiox Forest District

Date

File number:

Table of Contents

District Manager’s Policy	i
Table of Contents	ii
1.0 Introduction	1
1.1 Map 1. Location of the Botrychium Basin Sensitive Area within the Kispiox Forest District.....	2
1.2 Map 2. Zone Boundaries of the Botrychium Basin Sensitive Area.....	3
2.0 Site Description	4
2.1 Ecological Characteristics.....	4
2.2 Landforms and Geology.....	5
2.3 Other Identified Values and Uses.....	6
3.0 Zoning Within the Sensitive Area	7
3.1 Core Reserve Zone.....	7
3.2 Buffer Zone.....	7
4.0 Objectives and Strategies	9
5.0 Implementation Strategy	10
Appendix 1 Botrychium Basin Sensitive Area: Background Information.....	11
1.0 Rationale for Establishing the Sensitive Area.....	11
2.0 Information Assembly.....	12
3.0 Description of Antique Forest Attributes.....	12
Appendix 2 <i>Botrychium montanum</i> : a rare fern of Interior Cedar-Hemlock Forests.....	16
Appendix 3 Glossary of Terms.....	20
References	22

1.0 Introduction

The Kispiox Land and Resource Management Plan (LRMP) states that within resource management zones the objectives for biodiversity are to:

- maintain rare or threatened plant and animal species and communities; and
- maintain rare ecosystems and environmentally sensitive areas such as wetlands, floodplains, and riparian areas.

These objectives constitute a higher level plan and are legally mandated under the Forest Practices Code of British Columbia. The designation of a sensitive area is recognized as an appropriate management approach to meeting the objectives as stated in the Kispiox LRMP. This approach has been previously used to establish a sensitive area maintaining a rare ecosystem at Mill Creek in the Kispiox District.

The western redcedar and western hemlock stands of Botrychium Basin support ecological characteristics that are rare in inland forests. Foremost among these characteristics is prolonged ecological continuity, or the maintenance of stable biological and environmental conditions for very longed time periods. This continuity may even outdate the oldest trees in the stand, which can be 800 years old or older, and is reflected by the presence of an association of lichens that are adapted to these conditions.

The name ‘Botrychium Basin’ refers to the discovery of a rare fern within the proposed area, *Botrychium montanum*, which is known from only three locations within Canada, all within antique forests. This fern is considered globally vulnerable by the Nature Conservancy.

The retention of representatives of this rare ecosystem is in accordance with the resource management zone objectives of the Kispiox LRMP and is consistent with the Forest Practices Code of British Columbia and the landscape unit planning process. Further rationale for this proposal is provided in Appendix 1.

**Map 1. Location of the Botrychium Basin Sensitive Area within the
Kispiox Forest District**



Bot. Basin Map
1.pdf.pdf

Map 2. Zone Boundaries of the Botrychium Basin Sensitive Area



Bot. Basin Map
2.pdf.pdf

2.0 Site Description

2.1 Ecological characteristics

Botrychium Basin Sensitive Area is located in a small drainage on the south side of McCully Creek, a tributary of the Kispiox River. It is the first major drainage west of kilometer 23 on the Date Creek FSR and can be accessed from a number of places on branch 2300. The area is included within the moist cold subzone of the interior cedar – hemlock biogeoclimatic zone (ICHmc; Banner et al. 1993). Though transitional between two variants of the subzone –the Nass variant (ICHmc1) and the Hazelton variant (ICHmc2)– the site series in the sensitive area are primarily ICHmc2 01a, 03, 04, and 05 (Banner et al. 1993).

Forests are dominated by large diameter western redcedar and western hemlock with the occasional amabilis fir. Varying amounts of devil’s club (*Oplopanax horridus*), oak fern (*Gymnocarpium dryopteris*), bunchberry (*Cornus canadensis*), false azalea (*Menziesia ferruginea*), Alaska blueberry (*Vaccinium alaskense*), thimbleberry (*Rubus parviflorus*), enchanter’s nightshade (*Circaea alpina*), foam flower (*Tiarella trifoliata*), five-leaved bramble (*Rubus pedatus*), and lady fern (*Athyrium filix-femina*) comprise the herb and shrub layers. The forest floor is generally covered by a carpet of feathermosses (*Hylocomium splendens*, *Ptilium crista-castrensis*, *Pleurozium schreberi*, *Rhytidiadelphus triquetris*), with leafy mosses (*Rhizomnium* spp.) where seepage is present.

Forest soils within the antique stands of the sensitive are predominantly luvic-gleysols with mottled peds indicating prolonged saturation. The soils of oldgrowth and mature stands in the area are more commonly humo-ferric podzols and have more rapid drainage, often due to slope position.

Botrychium Basin contains extensive stands of antique forests. Trevor Goward (1994) used the term ‘antique’ to describe forests that have escaped fire for very long time periods and that support ecological continuity predating the age of the oldest trees in the stand. The antique forests of the Kispiox Valley have been shown to support an assemblage of epiphytic macrolichens that are dependent on moist, stable ecological conditions (Appendix 1). These species are rare or infrequent within BC. The proposed sensitive area harbours an exceptional representation of antique forests.

In addition to the fourteen species of macrolichens considered to be indicators of antique forests, other antique indicators such as the presence of hanging moss, micromounding, and well-decayed large logs are also present in the proposed sensitive area (see Appendix 1). Furthermore, a red-listed fern species (*Botrychium montanum*) dependent on oldgrowth interior forests of redcedar and hemlock was found in the proposed area. The discovery of this fern represents the northernmost occurrence of this species in the world and the largest of three populations known in Canada (Appendix 2).

This mild and humid environment is reflected by the presence of species more typical of oceanic climates and very rarely found inland including deer fern (*Blechnum spicant*), salmon berry (*Rubus spectabilis*), hanging moss (also called shoulder moss; *Antitrichia curtipendula*), Braun's holly fern (*Polystichum braunii*), and Anderson's holly fern (*Polystichum andersonii*).

2.2 Landforms and Geology

The Botrychium Basin Sensitive Area is situated on the moderate to steep lower slopes and the toe slopes of the Kispiox Range, and encompasses the drainage of a small tributary of McCully Creek, which flows into the Kispiox River. The southern boundary of the proposed reserve is bordered by a steep-walled basin created by the gradual erosive processes of two forks of this tributary. The tributary is hereby called Oregana Creek after *Lobaria oregana*, the largest and one of the most abundant antique indicator lichens in the area. The east and west boundaries loosely follow natural slope breaks while the northern boundary is amid a gently sloping bench above McCully Creek. The most important antique stands of the sensitive area are found on the toe slopes of the tributaries and are situated within the core reserve zone, but there are also significant antique stands within the buffer zone on the bench which functions as a perched toe slope above McCully Creek. Toe slopes are collecting areas for moisture and nutrients that are transported through soil water. Toe slope sites are therefore usually moist and very rich.

The proposed area supports physical features that have deterred stand-replacing fires and thus have helped maintain ecological continuity. For instance, with its northern aspect, the toe slope position collects water and when combined with summer precipitation, promotes very humid and mild conditions. The steep basin that forms the southern boundary of the sensitive area also provides protection from wind and is a natural firebreak.

The parent materials in the Botrychium Basin Sensitive Area are largely comprised of glacial till but also include fluvial veneers and blankets, colluvium, and bedrock. Fluvial deposits border the two forks of the creek. The east fork, which is smaller, features a meandering creekbed that supports a large antique stand and the rare *Botrychium* population. The west fork is mostly contained within a steep-walled gully that is bordered in places by seeping bedrock cliffs and colluvial slopes. The wet, rocky habitats along the east fork are uncommon within the Kispiox Valley and contain assemblages of plants that are significant in terms of the biodiversity of the valley (see Appendix 1).

The bedrock in the core area is mainly volcanic basalt; however, the Geological Survey of Canada soil map 1712A suggests that the surrounding region is largely sedimentary. The bedrock is most easily examined at the waterfalls (called here Slipknot Falls) on the west fork of the creek where the

creek has cut a semi-circular headwall through the layered basalt. The bedrock is a part of the back arc and foredeep wedge of the Stikinia terrane and dates to the Middle and Upper Jurassic (146-178 million years b.p.).

2.3 Other Identified Values and Uses

First Nations

The Botrychium Basin Sensitive Area lies within the traditional territories of the Gitxan First Nation and under the House territory of Chief Kliiyem Laxltaa. First Nations and others use neighbouring areas for mushroom harvesting; however, in general the sites found within the Botrychium Basin Sensitive Area are wetter than suitable for the most desirable mushroom species.

Wildlife

A number of vertebrate species found in the ICH may be associated with the habitat features found in Botrychium Basin (Appendix 1, Table 3). Well-decayed large logs provide valuable habitat for salamanders and small mammals (voles, mice, and shrews). Least and short-tailed weasels, marten, and Barred Owls depend on these species as primary prey items.

Standing dying or dead trees provide nesting, roosting, and feeding habitat for cavity nesting birds. These species exist within ‘nest webs’ where interactions among species are centered around nest site availability (Martin and Eadie 1999). Primary cavity nesters (eg. woodpeckers) excavate cavities used by many species of birds and mammals. Weak cavity nesters (eg. chickadees and nuthatches) use cavities created by primary cavity nesters, but also create cavities of their own, while secondary cavity nesters (eg. swallows, owls, bats, squirrels) use cavities created by the first two guilds or a limited number of natural cavities. Maintaining cavity nesting species in forest stands could have a strong influence on the richness and abundance of other species that require nest cavities.

In northern Fennoscandia, resident species of the Family Paridae (chickadees and tits) use boreal epiphytic lichens as a main site for their food caches and may depend on the invertebrates associated with lichens during the late winter (Pettersson et al. 1995). In the ICH, Chestnut-backed chickadees (*Poecile rufescens*) forage under lichen mats during the breeding season, although the importance of this foraging substrate during periods of low food abundance is unknown (Mahon, unpublished data).

Alder-devil’s club thickets provide high quality foraging habitat for both black and grizzly bears in the ICH. The high diversity of forbs and berry-producing shrubs found in these subhygric sites provide forage opportunities during spring, summer, and fall months.

Traplines and Guiding Permits

The Botrychium Basin Sensitive Area is a part of the trapping licence 630T007 and the guiding licence 630G001.

Timber Harvesting

This proposed area was selectively logged in the 1950's and 1960's for cedar poles. Harvesting was light, and openings were very small. Old skid roads and cedar stumps can be found throughout the buffer zone and into the lower reaches of the core reserve zone of the sensitive area. The remainder of the core reserve area has no previous harvesting. These past activities have not significantly altered the ecological continuity of antique stands within the buffer zone as they still support a full array of antique associated lichens. This suggests that partially cutting with light removal, for instance less than 30%, may be permitted in the buffer zone if it can be demonstrated that such activity will not cause a dramatic change in the ecological conditions of the forests.

3.0 Zoning within the Sensitive Area

The sensitive area is 256.6 hectares in size and includes two levels of zoning: a core reserve zone and a buffer zone. These zones are shown on Map 2.

3.1 Core Reserve Zone

The core reserve zone is 133.5 ha and includes Botrychium Basin proper and an area surrounding two forks of Oregana Creek that flows north into McCully Creek. The south and east boundaries of the core reserve zone follow a dramatic slope break that descends into the basin. The north and west boundaries are adjacent to the buffer zone (Map 2).

Botrychium Basin encompasses an extensive stand of large diameter western redcedar and western hemlock located along the east fork of the creek. This stand is characterized by lichens associated with antique forests and the presence of *Botrychium montanum*, a globally rare fern.

The west fork of Oregana Creek has an impressive waterfall and steep-walled canyons. This drainage also contains moist cliffs and talus slopes that are dominated by alder and devil's club thickets. These talus slopes support at least uncommon two fern species normally associated with coastal forests and rare inland: Braun's holly fern and Anderson's holly fern.

Timber harvesting and road construction will not be permitted the core reserve zone; however, management activities will include the prevention of fire and the management of pests that might threaten adjacent forests.

3.2 Buffer Zone

The buffer zone extends from the northern and western sides of the core reserve zone and is 123.1 ha, encompassing the junction of the two forks of the creek and extensive oldgrowth forests. The east and west boundaries loosely follow the fall line and natural slope breaks, and the northern boundary traverses a gently sloping bench above McCully Creek (Map 2).

The buffer zone supports toe slope antique forests, oldgrowth forests, and alder-devil's club thickets, as well as mature mid-slope stands. Young and immature stands are uncommon in the buffer zone. Stands with antique forest lichen indicators are widespread within this zone and additional populations of *Botrychium montanum* were also found here.

Timber harvesting is permitted in the buffer zone; however, the management of this area must focus upon ensuring that openings do not threaten the ecological integrity (the structure and the biological processes) of the core reserve zone. For instance, the buffer zone is a corridor from McCully Creek to the core reserve area and forms a natural travel route for mammals. Maintaining antique and oldgrowth forest characteristics is important in the buffer zone to provide spatial continuity from the valley floor to the basin.

Earlier partial cutting for cedar poles in the area show that some removal is possible without adverse affects on all antique forest characteristics. These stands tend to support most of the associated lichens 50 years after harvesting. A partial cutting management approach is recommended for the buffer zone with a maximum of 30% basal area removed.

Because it encompasses a bench that contours the lower slopes of the Kispiox Mountain, the buffer zone is situated in an access corridor for stands further west in the McCully Creek drainage. Old skid roads from earlier cedar pole logging can be found traversing the buffer zone; however, most of these roads have become overgrown with trees and shrubs in the ensuing 50 years and in many places they are difficult to follow. Their impact on the antique forests of the buffer zone appears to be minimal. If a road is built through the buffer zone, the engineering must recognize the sensitivity of the area and the width of the right of way should be minimized.

4.0 Objectives and Strategies

The objectives of the sensitive area are statements of desired future conditions of the forest resources. As a higher level plan, they provide legally-binding direction for forest management and must be reflected in operational plans. The associated strategies describe recommended approaches to achieving the objectives.

Objectives	Strategies
<p>Core Reserve Zone (Map 2)</p> <ol style="list-style-type: none">1. Maintain antique forest attributes and the full complement of antique forest lichens.2. Retain interior forest conditions.3. Retain representative examples of rare ecosystems including antique forests, and cliffs and colluvial slopes with seepage.4. Protect the habitat of a rare species.5. Maintain the hydrological stability of the creek systems	<ul style="list-style-type: none">• Respond to fires to ensure maximum possible protection of the core reserve zone• Allow natural processes to occur including pests and disease so long as they do not threaten adjacent commercial stands. If intervention is required, it should be conducted so as to retain the structural diversity of the stand as well as the stand's interior forest conditions.
<p>Buffer Zone (Map 2)</p> <ol style="list-style-type: none">6. Maintain additional antique forest reserves while allowing limited harvesting restricted to non-clearcut silvicultural systems.7. Protect additional habitat of a rare species.8. Provide a buffer to maintain interior forest conditions in the core reserve zone.9. Provide a wildlife corridor and connectivity between McCully Creek and the core reserve zone.10. Protect the core reserve zone from windthrow.11. Maintain the hydrological stability of the creek systems	<ul style="list-style-type: none">• Respond to fires to ensure maximum possible protection of the core reserve zone• Allow natural processes to occur including pests and disease so long as they do not threaten adjacent commercial stands. If intervention is required, it should be conducted so as to retain the structural diversity of the stand as well as the stand's interior forest conditions.• Commercial harvesting is permitted using non-clearcut silvicultural systems that retain the antique structural and biological attributes of the stand.• A maximum of 30% basal area can be removed with the exception of harvesting for road construction.• Road construction is permitted within the buffer zone with an emphasis on minimizing impact and the width of the right of way.

5.0 Implementation Strategy

All provisions of the higher level plan take effect as of the date specified in the attached order. A statement of higher level plan transition is therefore not required.

The sensitive area and objectives will be reviewed during the planning process for the McCully Creek Landscape Unit. The sensitive area and its objectives will be reviewed in 10 years as outlined in the *Higher Level Plans: Policy and Procedures*.

If changes are made to the resource management zone objectives for the Kispiox LRMP, the objectives for the Botrychium Basin Sensitive Area will be reviewed to ensure that they remain consistent with the revised resource management zone objectives.

The Botrychium Basin Sensitive Area has been integrated into the current Forest Development Plan proposed by the Small Business Forest Enterprise Program as of March 2002.

Appendix 1

Botrychium Basin Sensitive Area:

Background Information

1.0 Rationale for Establishing the Sensitive Area

The unique and diverse assemblages of epiphytic macrolichens found in interior cedar-hemlock (ICH) forests of the Kispiox Valley were first brought to the attention of the Kispiox Forest District and the Prince Rupert Forest Region through the work of lichenologist, Trevor Goward (Goward 1994, Goward and Pojar 1998, Goward and Burgess, Goward and Miège 1996). Goward's work demonstrated that stands which had escaped fire disturbance for long time periods supported a distinctive lichen flora. These forests exhibited remarkable ecological continuity, supporting more or less the same ecological conditions since antiquity, and so Goward referred to them as "antique forests" (Goward 1994). Many of the epiphytic lichen species associated with these antique forests are rare or infrequent in BC (Table 2), and several are endemic to Western North America. Further investigations throughout the valley revealed that the antique forests themselves were also very rare, restricted to the toe slopes of a small number of drainages.

Norm Bilodeau, the Kispiox Small Business Officer, initiated a recent study to identify potential antique forests in McCully Creek drainage in the year 2000. The contract was issued to Mniun Ecological Research (Patrick Williston) and during the inventory, 13 stands were identified as antique forests. Of the 13 stands, 3 were found within a side drainage of McCully Creek, named Botrychium Basin. Within the three stands, 14 species of lichens indicative of antique forest conditions were found; 9 of these species are considered provincially significant (Table 2, Goward and Miège 1996, Williston 2001).

In addition to the lichen communities that characterize these old forests, a rare fern species was found to be associated with the antique forests of Botrychium Basin. *Botrychium montanum*, western goblin fern, is a red-listed species in B.C., and was previously known from only two localities in Canada. The presence of this species in Botrychium Basin represents a significant range extension, the most northernmost occurrence in the world, and with over 100 individuals, it is the largest population in Canada (Williston 2001). Two other *Botrychium* species were found in the vicinity thus earning the name Botrychium Basin.

Further exploration of the basin led to additional discoveries with significance to the biodiversity of the Kispiox Valley. Along the west fork of Oregana Creek is Slipknot Falls, an approximately 10m waterfall that has carved a dramatic amphitheatre from the basalt bedrock. The talus that lines the floor of the amphitheatre is rich with flowering plants, ferns, bryophytes, and lichens, several of which are rare within the Kispiox Valley. Below the falls are cliffs and talus slope that are wet with seepage and support at

least two ferns, Braun' holly fern and Anderson's holly fern, which are rare throughout inland B.C. and have not been found elsewhere in the Kispiox Valley.

2.0 Information Assembly

The proposed sensitive area was reviewed by the Small Business Forest Enterprise Program of the Kispiox District (Norm Bilodeau, Ken Smith, and Leanne Kaupp) during a site visit in the fall of 2000. It was suggested that the area be protected in an oldgrowth reserve due the abundance of antique indicator lichens and the extensive stands of large, old cedars. Stands such as this were once more common in the valley but have become rare as a result of past management activities.

A contract was issued to Mniun Ecological Research in May 2001 to identify and mark the boundary of the sensitive area in the field. The objective was to target areas of high-value antique forests and to provide recommendations to maintain the integrity of these forests. This was completed in September of 2001 (Williston 2001).

In October 2001, Terry Robert of the Kispiox Forest District collected GPS data to demarcate the boundary on the appropriate GIS databases.

Matt Sakals (Assistant Hydrologist, Prince Rupert Region) and Jim Schwab (Geomorphologist, Prince Rupert Region) provided landform and geological information for the proposed sensitive area and wildlife values were determined by wildlife biologist Lisa Mahon.

According to the Chief Forester's policy, a proposed sensitive area must meet the following criteria in order to be established:

1. the area must be less than 1000 ha in size
2. the circumstances associated with the management or conservation of the area must be special and not broadly present in the district
3. the resource must be unique or locally significant.

The Botrychium Basin Sensitive Area fully complies with these requirements.

3.0 Description of Antique Forest Attributes

Antique forests are very important to the biodiversity of the Kispiox Valley at the landscape level. This is because these forests act as centers of diversity and dispersion for the surrounding forest matrix. Antique forests have several attributes that render them biologically unique. Foremost is ecological continuity. Environmental and physical conditions, structural features, and biological components that are associated with ecological continuity in these forests include constant high humidity, the moist toe slope topographical position with gleyed soils, large snags and large well-decayed coarse

woody debris, micromounding, large root tip-ups, the presence of species normally associated with oceanic climates such as hanging moss (*Antitrichia curtipendula*), and the presence of black cottonwood (*Populus balsamifera* subsp. *trichocarpa*) and large diameter western redcedar (Goward and Pojar 1998). Additional attributes of antique forests within the McCully Creek drainage are summarized in Table 1.

Among the organisms that rely upon antique forests for suitable habitat is a unique assemblage of epiphytic macrolichens. These lichens are adapted to the moist, stable conditions found in these forests and as a consequence, are very rare elsewhere within the province. Lichens indicative of antique forests, including those found in Botrychium Basin, are listed in Table 2.

Birds and mammals also make use of the structural attributes of antique forests. Many sensitive species utilize large diameter snags and coarse woody debris for cavity nesting and denning, but also forage upon the berries and the invertebrates (harboured within the well-developed lichen communities) found in these forests (Table 3).

Table 1. Attributes of antique forests in the Kispiox Valley.

Attribute	Range ^a
Subzones	ICHmc1 and ICHmc2
Site series	03, 04 (ICHmc1); 03, 04, 05 (ICHmc2)
Soil moisture	5-6
Soil nutrient	C-D
Topographical position	toe and lowerslope
Canopy closure	10-55%
Coarse woody debris	5-25%
Devil's club	1-40%
Oak fern	1-35%

^a Data obtained from Williston (2001)

Table 2. Epiphytic macrolichens associated with antique forests reported in Botrychium Basin^a and their frequency in British Columbia.

Epiphytic macrolichens ^b	Present in Botrychium Basin	Rare or infrequent in BC ^c
<i>Cavernularia hultenii</i>	+	
<i>Dendroscopula intricatulum</i>	+	+
<i>Hypogymnia rugosa</i>		+
<i>Hypogymnia vittata</i>	+	+
<i>Lobaria oregana</i>	+	
<i>Lobaria retigera</i>	+	+
<i>Nephroma arcticum</i>	+	+
<i>Nephroma isidiosum</i>	+	+
<i>Nephroma occultum</i>	+	+
<i>Nephroma silvae-veteris</i>		+
<i>Pannaria ahlneri</i>	+	+
<i>Pannaria leucosticoides</i>		+
<i>Pannaria mediterranea</i>		
<i>Parmelia pseudosulcata</i>	+	+
<i>Peltigera aphthosa</i>	+	+
<i>Peltigera britannica</i>	+	
<i>Peltigera membranacea</i>	+	
<i>Peltigera neopolydactyla</i>		
<i>Polychidium dendriscum</i>		
<i>Sphaerophorus globosus</i>	+	

^a Data obtained from Williston (2001)

^b Considered indicators of antique old-growth forests (Goward and Miege 1996, Goward and Pojar 1998, Goward 1994)

^c Frequency status assigned by Goward and Miege (1996)

Table 3. Bird and mammal species of the Interior Cedar-Hemlock zone and their associated habitat attributes.

Habitat	Functional Use of Habitat	Habitat Attributes
BIRDS		
Barred Owl	nesting/foraging	<ul style="list-style-type: none"> large diameter trees with broken tops
Boreal Owl	nesting/foraging	<ul style="list-style-type: none"> secondary cavity nester; woodpecker cavity
Northern Pygmy-Owl	nesting/foraging	<ul style="list-style-type: none"> secondary cavity nester; woodpecker cavity
Pileated Woodpecker	nesting/foraging/roosting	<ul style="list-style-type: none"> primary cavity nester; large diameter trees for nesting and roosting
Three-toed Woodpecker and Black-backed Woodpecker	nesting/foraging/roosting	<ul style="list-style-type: none"> primary cavity nester; dying or dead trees for nesting and roosting beetle-infested trees for foraging
Chestnut-backed Chickadee	nesting/foraging	<ul style="list-style-type: none"> weak cavity nester; dying or dead trees for nesting live trees for foliage gleaning
Red-breasted Nuthatch	nesting/foraging	<ul style="list-style-type: none"> weak cavity nester; dying or dead trees for nesting live and dead trees for bark probing
Brown Creeper	nesting/foraging	<ul style="list-style-type: none"> dying trees with loose bark for nesting trees with heavily fissured bark for probing
MAMMALS		
Northern Flying Squirrel	denning/foraging	<ul style="list-style-type: none"> dying or dead trees with natural cavities
Black Bear	denning/foraging	<ul style="list-style-type: none"> large hollow trees for denning alder-devil's club thickets provide forbs and berries
Grizzly Bear	foraging	<ul style="list-style-type: none"> alder-devil's club thickets provide forbs and berries

Appendix 2

***Botrychium montanum*: a rare fern of Interior Cedar-Hemlock Forests**

***Botrychium montanum* W.H. Wagner Western goblin fern**

Description

Botrychium montanum is a fern in the Botrychiaceae, a family recognized by some as being distinct from the related Ophioglossaceae. Species within the genus *Botrychium* are known as the moonworts, and many are considered to be rare. Several new moonworts have been described in the past 25 years including *B. montanum*, first published in 1981 (Wagner and Wagner 1981). *B. montanum* is small, usually less than 8 cm tall, and is distinguished by bearing reduced, rhombic pinnae with irregular or minutely toothed margins on a thick succulent rachis. Plants are a dull grey-green and in BC they tend to appear in mid-August. Spores do not mature until the late fall.



Habitat

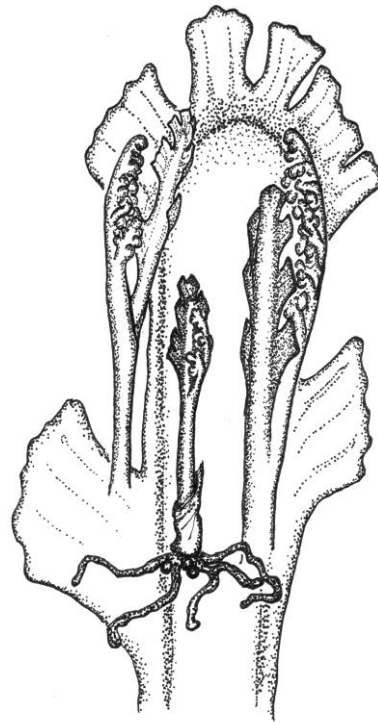
Throughout most of its range, *B. montanum* grows in dark cedar forests near seepage where *Mnium* mosses are common (Wagner and Wagner 1993). In B.C., *B. montanum* has only been found in very old, oldgrowth stands, also known as antique forests. Such forests have supported the same, stable ecological conditions for hundreds of years, often

outdating the oldest trees in the stand, which may be 800 years old or older. In the southern end of its range, this fern appears to have greater ecological amplitude; for instance, in Montana there are a small number of collections from a high mountain passes (Wagner and Wagner 1981).

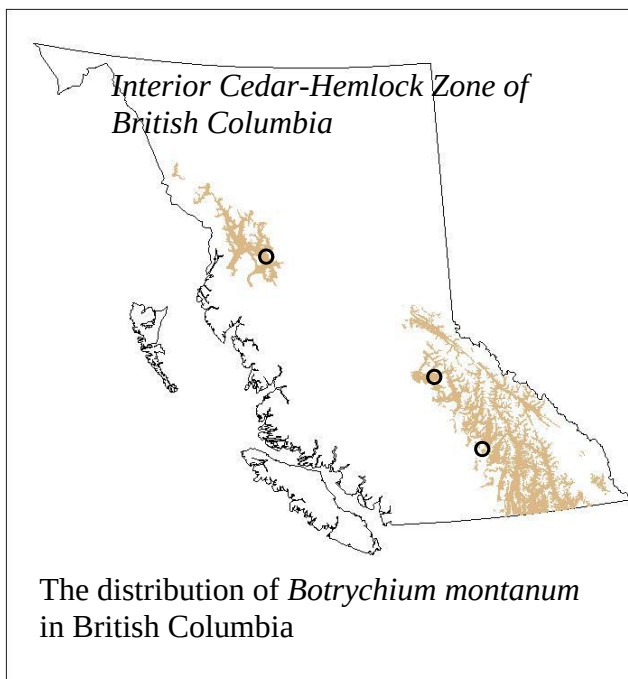
Biology

Moonworts spores germinate underground to produce subterranean gametophytes that are small (2-5 mm) and achlorophyllous (they do not photosynthesize). They rely upon an

association with endophytic fungi to provide nutrients for their survival. The gametophytes produce eggs and sperm on the same plant and often in close proximity to one another. These ferns are selfers, which means they most frequently fertilize themselves to produce a sporophyte, the life history stage that we commonly recognize as a mature fern. Because they are self-fertilized, all of the spores produced by the mature fern are clones of the parent (Farrar 2001). This means that a single spore can initiate an entire population but that they will all be genetically identical. Of course, most spores are unsuccessful, perhaps because they do not land close to their required fungal partners. A small number of moonworts including *B. montanum* also reproduce asexually. By mechanisms not yet fully understood, individual plants appear to be able to produce multiple gametophytes underground (Johnson-Groh pers. comm.). Whether from locally dispersed spores or from asexually derived gametophytes, it is not uncommon to see *B. montanum* stems arising together in tight clusters. Moonworts gametophytes may take up to 3 years to produce an aboveground sporophyte. Individual sporophytes live for approximately 5 years aboveground, but do not always appear every summer and can remain dormant for 1- 3 years before re-emerging (Johnson-Groh pers. comm.).



P. Williston



Range

Western goblin fern has been collected from only three localities within Canada, all of which are from B.C. All three localities are within the Interior Cedar-Hemlock zone (Meidinger and Pojar 1991): one north of Hazelton, one north of Clearwater, and one near Salmon Arm. This fern is also suspected to occur in the antique forests of coastal B.C.; however, specimens from this region are lacking. *B. montanum* is known from Washington, Oregon, California, Idaho, and Montana. Populations in Idaho and Montana are all within close proximity of the B.C. border adjacent

to the East Kootenays where they have yet to be discovered.

Status

With 3 localities, *B. montanum* is ranked S1 in B.C and N1N3 in Canada. It is globally ranked G3 and in the U.S. is N3. It is known from 6 localities in California (S2), 13 from Idaho (S2), 54 from Montana (S3), and 121 from Washington (S3). In Oregon it is ranked S2 (the number of localities in Oregon was not available). Rankings follow the system developed by Nature Conservancy where 1 is endangered and 5 is secured. This system is described in numerous online and printed publications (see srnwww.gov.bc.ca/cdc/).

Threats

The principal threat to this fern is loss of habitat. Antique cedar stands in inland British Columbia are rare and few are protected within parks. Because cedar is among the most valuable of B.C.'s wood products, these stands have been preferentially selected for harvesting. These stands also tend occur close to valley bottoms where access roads are built and stands are most accessible to harvesting. To date, *B. montanum* has not been found in second growth stands within B.C. While undiscovered populations certainly exist, such as in the East Kootenays, the destruction of suitable habitat is rapid, at least throughout its range within Canada. The threat of extirpation for this fern is considerable.

Notes

The name 'western goblin fern' refers to its somewhat 'Tolkien-esque' appearance. This plant often barely emerges from the litter of the forest floor and prefers the cool, dark, and damp seclusion of its seepy habitat, just like most other goblins.

This species is closely related to *Botrychium mormo* (little goblin fern), another rare moonwort with a distribution centred in the Great Lakes region. The two are very similar in appearance and are distinguished by their colour which is dull grey-green (glaucous) for *B. montanum* and shiny yellow-green for *B. mormo* (Wagner and Wagner 1993). All other features appear to more or less intergrade between the two species and isozyme analysis has failed to detect differences in alleles (Farrar 2001). This supports the notion that these plants are in fact varieties of the same species.



P. Williston

In 2001 I encountered this plant a number of times in the antique forests of the Kispiox Valley, north of Hazelton, B.C. These populations represented a northern range extension of nearly 400 km, and with up to 100 individuals, they are the largest populations known within the province (large populations are also known from Montana; Wagner and Wagner 1981).

B. montanum is one of a small number of moonworts that grow in antique forests. Most other moonworts occur in meadows, willow thickets, alpine gravels, sandy areas, or in disturbed sites like eroded slopes and old roadsides.

Appendix 3

Glossary of Terms

Antique forests – stands that have escaped fire and have supported the same ecological conditions for a prolonged time period, longer than the age of oldest trees in the stand. These stands are said to have ecological continuity.

Colluvium – parent material that is derived from fallen rock. Rocks and stones in colluvium deposits are usually angular whereas glacio-fluvial deposits are usually somewhat rounded.

Ecological continuity – supporting the same biological components and environmental conditions for a prolonged time period, longer than the age of oldest cohort of organisms in the ecosystem.

Ecological integrity – the full complement of structure and biological processes that a natural ecosystem supports.

Endemic – exhibiting a distribution that is restricted to a defined geographical region.

Epiphytic lichens – lichens that grow on living plants such as the stems and branches of trees.

Extinct – without living representatives.

Extirpated – no longer present (eradicated) in a defined geographical region, but present elsewhere.

Fluvial veneers and blankets – water borne parent material that overlays other types of parent material in either a thin (<1m veneer) or a thick (>1m blanket) layer.

Glacio-fluvial – parent material deposited by floods during the recession of glaciers.

Interior forest condition – achieved when edge effects no longer influence environmental conditions within a stand. Environmental conditions susceptible to changes caused by edge effects include light intensity, temperature, wind, relative humidity, snow accumulation, and snow melt.

Macrolichens – large lichens that have a leaf-like (foliose), shrub-like (fruticose), or hair-like (fruticose) appearance, but not including the crust-forming (crustose) lichens or the smaller scale-lichens (squamulose) that require the examination of spores for accurate identification.

Perched toe slope – the concave portion of a valley profile that bridges a mountainside with a bench.

Rare ecosystem – an ecosystem that accounts for less than 2% of the landscape unit and is not common in adjacent units.

Red-listed species – any indigenous species or subspecies (taxa) considered to be threatened or endangered of extirpation in British Columbia. Threatened and endangered taxa are of special concern because of characteristics that make them particularly sensitive to human or natural disturbances.

Sensitive area – a small (less than 1000 ha) area of land or water established under the *Forest Practices Code of British Columbia Act* by the district manager to manage or conserve unique or locally significant forest resources.

Stikinia – one of a series of landmasses that collided with the North American continental plate to form the Coast Range Mountains of western British Columbia.

Terrane – an area characterized by distinctive rock types indicating a geological history different from other areas.

Threatened or endangered species – organisms at risk of becoming extirpated from a defined geographical area.

Till – parent material that has been deposited, and often overridden by a glacier. Frequently compacted and bearing somewhat rounded rocks and stones.

Toe slope – the concave portion of a valley profile that bridges the mountainside to the valley floor.

References

- Banner, A., MacKenzie, W., Haeussler, S., Thompson, S., Pojar, J., and R. Trowbridge.** 1993. A Field Guide to Site Identification and Interpretation for the Prince Rupert Forest Region. Land Management Handbook No. 26. B.C. Ministry of Forests, Victoria, B.C.
- Farrar, D.** 2001. Isozyme Characterization of Moonwort Ferns (*Botrychium* subgenus *Botrychium*) and their Interspecific Relationships in Northwestern North America. Final Report Submitted to the Colville National Forest, Washington. 24p. plus appendices.
- Goward, T.** 1994. Notes on oldgrowth-dependent epiphytic macrolichens in inland British Columbia, Canada. *Acta Botannica Fennica* 150: 31-38.
- Goward, T., and D. Burgess.** 1996. Epiphytic lichens as indicators of forest antiquity in the Kispiox Valley (ICHmc subzone), with recommendations for the designation of special management areas. Report to the B.C. Ministry of Forests, Prince Rupert Region, Smithers, B.C. 52p (+ appendices).
- Goward, T., and D. Miège.** 1996. Notes on the distributional ecology of epiphytic macrolichens in the Kispiox and Nass Valleys, with special reference to species of oldgrowth forests. Part 1: The Interior Cedar-Hemlock Zone (moist cold subzone). Report to the B.C. Ministry of Forests, Prince Rupert Region, Smithers, B.C. 30p (+ appendices).
- Goward, T. and J. Pojar.** 1998. Antique forests and epiphytic macrolichens in the Kispiox Valley. Extension Note #33, British Columbia Ministry of Forests, Prince Rupert Region, Smithers. 11p.
- Johnson-Groh, C.** 2002. Personal communications.
- Martin, K. and J.M. Eadie.** 1999. Nest webs: A community-wide approach to the management and conservation of cavity-nesting forest birds. *Forest Ecol. and Manage.* 115: 243-257.
- Meidinger, D. and J. Pojar.** 1991. Ecosystems of British Columbia. British Columbia Ministry of Forests, Research Branch Special Report 6, Victoria. 330p.
- Pettersson, R.B., J.P. Ball, K-E. Renhorn, P-A. Esseen, and K. Sjoberg.** 1995. Invertebrate communities in boreal forest canopies as influenced by forestry and lichens with implications for passerine birds. *Biol. Cons.* 74: 57-63.

- Wagner, W.H. and F.S. Wagner.** 1981. New species of moonworts, *Botrychium* subg. *Botrychium* (Ophioglossaceae), from North America. American Fern Journal. 71: 20-30.
- Wagner, W.H., and F.S. Wagner.** 1993. Ophioglossaceae C. Agardh: Adder's-tongue family. In: (Flora of North America Editorial Committee eds.) Flora of North America, North of Mexico. Vol. 2: Pteridophytes and Gymnosperms. Oxford University Press, New York. Pp. 85-106.
- Whittier, D.P.** 1981. Spore germination and young gametophyte development of *Botrychium* and *Ophioglossum* in axenic culture. American Fern Journal 71: 13-19.
- Williston, P.** 2001. Epiphytic lichens of forests with ecological continuity in the McCully Creek drainage. A report to the Kispiox Forest District, B.C. Ministry of Forests, Prince Rupert Region, Smithers, B.C. 8p (+ appendices).