

Conservation Values of the Proposed Selkirk Mountain Caribou Park



Jim Lawrence

**Submission to the Governments
of British Columbia and Canada**

**On the urgent need to fully protect the last remnants
of rare Inland Temperate Rainforest in the Central Selkirk Mountains,
including habitat for a herd of 30 endangered Mountain Caribou**

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This park proposal is designed to meet the needs identified by two BC Auditor Generals.

BC Auditor General, 2010

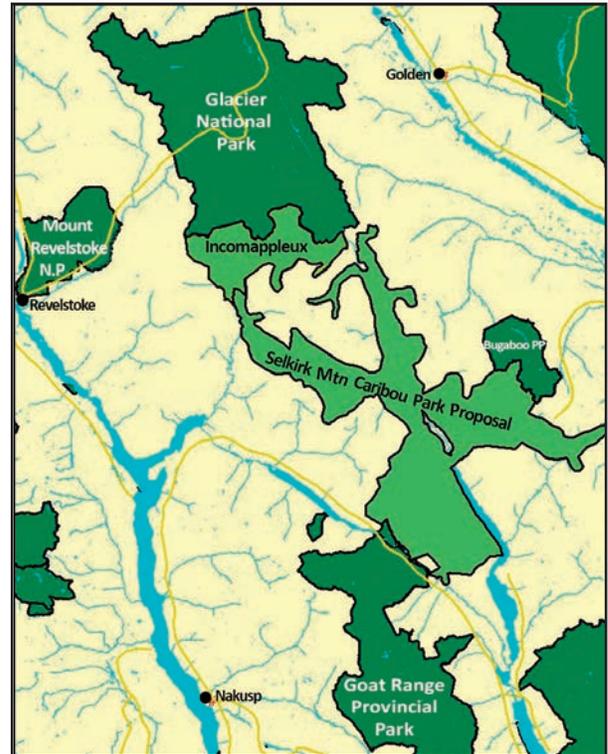
“We expected the system plan to be considering and ensuring viable representation of British Columbia’s biogeoclimatic zones, adequate land sizes and adequate connectivity between protected areas Instead we found otherwise it was apparent that the conservation of biodiversity will become more at risk in the future due to the inadequate connectivity of parks and protected areas.”

BC Auditor General, 2017

“There has been little effort to address the issue of connectivity for grizzly bears or to provide wildlife corridors and safe transition areas for those populations in the south that may have limited migration and may experience genetic inbreeding ... Government’s announcement in Nov. 2016 of its BC Parks Future Strategy does not include connectivity of the parks system.”

It is supported by:

- BC Nature
- Golden Chapter, Council of Canadians
- North Columbia Environmental Society
- Pacific Wild
- Purcell Alliance for Wilderness
- Raincoast Conservation Foundation
- Save-the-Cedar League
- Valhalla Wilderness Society
- West Kootenay Ecosociety
- Wilderness Committee
- Wolf Awareness Inc.



The park proposal is located in the central Selkirk Mountains, in the “Interior Wetbelt.” BC has the world’s only Inland Temperate Rainforest, and most of it is in the Interior Wetbelt, also known as the Inland Rainforest Region. These forests are amongst Canada’s highest biodiversity forests.

The park proposal is in the traditional territory of the Sinixt First Nation, also known as the Arrow Lake Indians. The area is also claimed by the Okanagan and Ktunaxa First Nations, and others.

Selkirk Mountain Caribou Park Proposal

A 156,461-hectare park to increase protection of old-growth Inland Temperate Rainforest and connectivity for large wildlife.

Habitat for the Central Selkirk mountain caribou herd (30 animals)

Grizzly bear habitat and a popular grizzly bear viewing area

An internationally renowned hotspot for rare lichen species

A key travel corridor for mountain caribou and grizzly bears between three existing parks.

Spawning grounds for the bull trout, kokanee salmon and Gerrard rainbow trout fisheries of the Arrow Reservoir and Kootenay Lake.

- Includes very rare low-elevation, very wet, primeval Interior Cedar-Hemlock forest (ICHvk) in the renowned upper Incomappleux Valley, plus several other intact stands of old-growth.
- The old-growth in this proposal has escaped 50 years of logging because steep, unstable terrain, damaged roads and/or remoteness from mills made access prohibitively expensive.
- The only active logging in the vicinity of which we are aware is through BC Timber Sales; the government is unfortunately logging federally-designated Type A critical matrix mountain caribou habitat.
- The connective travel corridors for wildlife follow parts of four rivers with spawning grounds for the fisheries. Low- and mid-elevations along the rivers have been mostly clearcut. Still, they include ICHwk and rare ICHvk ecosystems, wetlands, and critical patches of old-growth forest.
- Almost all of this park proposal is federally designated critical, or Type A critical matrix, mountain caribou habitat, or else provincial Ungulate Winter Range (UWR) for the caribou. The UWR covers 46% of the proposed park, most of which is zoned no-logging.



Karl Gfroerer

Two mountain caribou bulls are about to cross the Lardeau River within or very near the boundary of the park proposal. Some travel from Goat Range Provincial Park in autumn and spend winter in the forest on the other side, climbing into the Badshot Range. This same stretch of river hosts spawning Kokanee salmon and the grizzly bears that feed on them, drawing dozens or hundreds of camera-clicking viewers.

An Ecosystem Gap in BC Parks

The BC Interior's oldest and highest biodiversity forests are largely unrepresented in BC parks

The current percent of fully protected areas in BC is about 15.0% of the land base. How do we know this is not enough? Because the Conservation Data Centre lists over 1,500 species-at-risk in BC, and for 86% of them, the greatest threat is habitat loss.

In BC's Interior Wetbelt, about 17% of the land base is in parks. Several scientific studies have shown that 45-55% should be fully protected to maintain large, wide-ranging mammal species. The Great Bear Rainforest on BC's coast now has about 33% protected.

The Interior Wetbelt has the world's only mountain caribou and some of the best grizzly bear habitat in southern BC, yet only 17% of the land base is protected. How do we know this is not enough? First, because the mountain caribou are imminently threatened with extinction.

The kind of habitat that mountain caribou are lacking is low-elevation cedar-hemlock forest on gentle slopes. This is because most of this habitat type has been logged and has poor representation in BC Parks.

According to BC's Conservation Data Centre there are 40 species at risk in the humid coniferous forests of the forest districts where this park proposal is located. That does not count the many species associated with other habitats, such as wetlands, that would be impacted by logging in these forests districts; nor does it count hundreds of species of lichens, many of which are old-growth dependent, the conservation status of which has never been assessed.

About 80% of Goat Range and Glacier Parks together is ESSF or higher, i.e., 1,400 meters or higher.

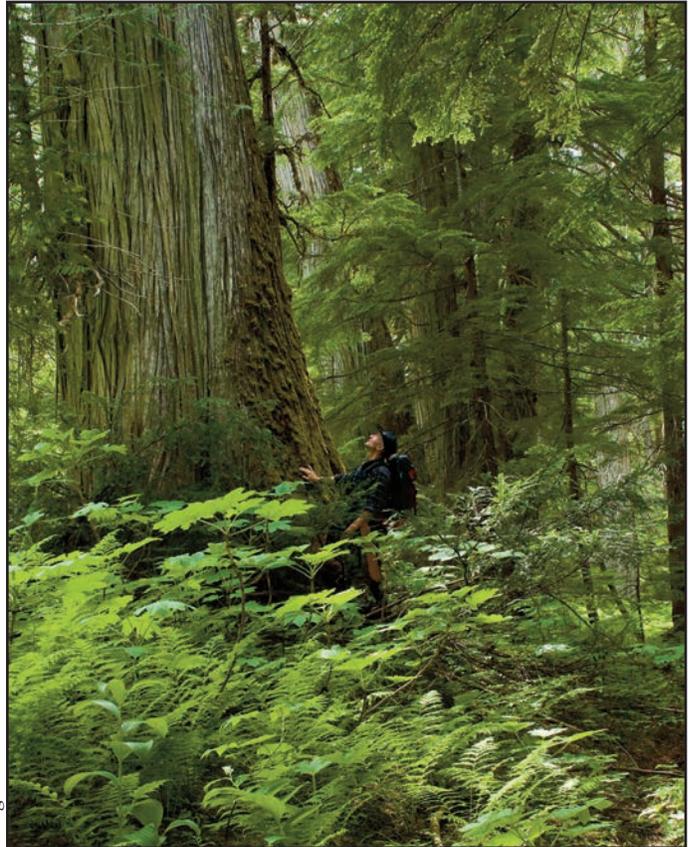
GOAT RANGE PROVINCIAL PARK

- 31.7% subalpine parkland, tundra, rock and ice
- 48.0% spruce-balsam (ESSF)
- 21.3% cedar-hemlock (ICH)
 - 10,675 ha. Inland Rainforest, ICH wk, ("wet")
 - 6,060 ha. ICH mw ("moist")

GLACIER NATIONAL PARK (GNP)

- 35.6% subalpine parkland, tundra, rock and ice
- 45.0% ESSF
- 19.4% ICH
 - 25,263 Inland Rainforest (ICH "wet" and "very wet")
 - 26,494 ha. total ICH, with "moist" included

The highest biodiversity forests in the Interior Wetbelt are the very old, very wet, low-elevation cedar-hemlock. Goat Range and Glacier parks have no habitat lower than 800 metres elevation.



Craig Pettitt

Primeval "very wet" Inland Temperate Rainforest in the upper Incomappleux Valley of the park proposal. NO FOREST LIKE THIS EXISTS IN BC PARKS except for a small fragment recently protected in the Robson Valley.

While these existing parks do have a small amount of old-growth Inland Temperate Rainforest, it lies in the upper elevational range where these forests can grow. The trees are smaller, and the forests give no hint of the spectacular biodiversity to be found at 600 m. in the middle Incomappleux Valley just outside the boundary of Glacier N.P., with trees 1,800 years old.

The existing parks have been too small and too far apart to protect large wildlife. They lack connectivity. Mountain caribou have been eliminated from Glacier National Park and surroundings because of heavy logging outside the boundaries. Goat Range has mountain caribou, but they travel outside the park to cross the Lardeau River to areas in this park proposal.

The proposed Selkirk Mountain Caribou Park would provide connectivity for large wildlife and protect our oldest and highest biodiversity forests.

WHAT IS INLAND TEMPERATE RAINFOREST?



Craig Pettitt

All photos on this and the next page were taken in the upper Incomappleux Valley in this park proposal.



Alan Watson

The Upper Incomappleux is “very wet” Inland Temperate Rainforest (ICHvk).



Craig Pettitt

This park proposal is in the most southern location where ICHvk occurs



Alan Watson

- Inland Temperate Rainforest occurs nowhere else in the world but in BC in the Interior Wetbelt and near the west coast.
- Inland Temperate Rainforest is a type of Interior Cedar-Hemlock (ICH) forest. ICH is the climax forest at low and/or middle elevations over much of the Interior Wetbelt.
- ICH is classified as dry, moist, wet or very wet. Many scientists consider only the “wet” (ICHwk) and “very wet” (ICHvk) to be rainforest. Only these types maintain enough moisture throughout the summer to host many rainforest species otherwise found only in coastal rainforest.
- Due to wetness these forests rarely burn. Therefore Inland Temperate Rainforest has huge trees that may be 500-2,000 years old. The forest itself may be thousands of years older than its oldest trees.
- The ICH extends across the BC-US border as far south as central Idaho. Some scientists refer to all ICH as Inland Temperate Rainforest. But today the huge Western Redcedars found in the northwest US occur only in small, isolated groves. These groves have lost most of their coastal lichens.
- All ICH is dense, humid, high-biomass forest of critical importance to carbon sequestration and storage, and all ICH has a growing constellation of species at risk. But the wet and very wet are the rarest and have by far the highest biodiversity.
- Inland Temperate Rainforest hosts many coastal species that do not otherwise occur inland, but its ecology is unique. A large part of the precipitation falls as snow, and there are both coastal and boreal species.
- These wet ICH forests support hundreds of species of lichens — 283 lichen species have been identified in the Incomappleux Valley alone. Over the last 10 years lichen experts have found species of lichens new to science in these rainforests, and expect to find many more.

FOUR RIVERS, FOUR MAJOR SPECIES AT RISK



Craig Pettitt

Karl Gfroerer



Both photographs above were taken at approximately the same place on the Lardeau River. The mountain caribou bull, photographed last year, has travelled from Goat Range park and is preparing to cross the Lardeau River and enter this park proposal. The grizzly bear was one of

many that come down from Goat Range Provincial Park, and from the proposed new park, to feed on spawning Kokanee salmon in autumn, where they are photographed by many people from all over the region. The same river supports blue-listed bull trout.

There are four rivers in the area. They have very little protection in existing parks.

Glacier N.P. protects 18 kilometres of the uppermost Incomapleux River, but these reaches are swept by continuous massive avalanches, so there is almost no forest on them. Goat Range P.P. protects about 15 kilometres of the Lardeau River.

The park proposal would include 17 kilometres of the Incomapleux River in pristine condition, down to 600 metres, with a totally intact tributary, Battlebrook; all of the Westfall River (partially intact) and much of the Duncan River (heavily logged, with short intact stretches) with some intact tributaries.

The BC government's Mountain Caribou Recovery Plan designated 16,676 hectares of timber harvesting land base in the Central Selkirks as Ungulate Winter Range (UWR). Although this program was grossly deficient for most caribou herds, for the Central Selkirk herd it was a significant step forward. But further steps are urgently needed.

The Ungulate Winter Range (UWR) in the Central Selkirks has a total ban on logging, but it is not protected from mining, hydro, or tourism development. It would not protect wildlife from a mega-tourism development such as the Jumbo Resort, nor from a new or reopened mining exploration road, nor from the devastating impacts of a mine. It would not protect them from huge clearcuts to run hydro lines from independent power projects (IPPs).

The 16,676 hectares of Timber Harvesting Land Base partially and temporarily protected for caribou represents only 8.4% of the total 197,126-hectare UWR in the Central Selkirk region. The rest is high elevation, steep slopes, burns, some heavily clearcut areas, and 3,000 hectares where modified harvesting can still take place. Even in the 16,676 hectares there are extensive clearcuts and burns that are unusable for mountain caribou, while some areas of crucial valley-bottom, old-growth cedar-hemlock forest in Lake Creek, Duncan Lake and the Lardeau River valleys were excluded.

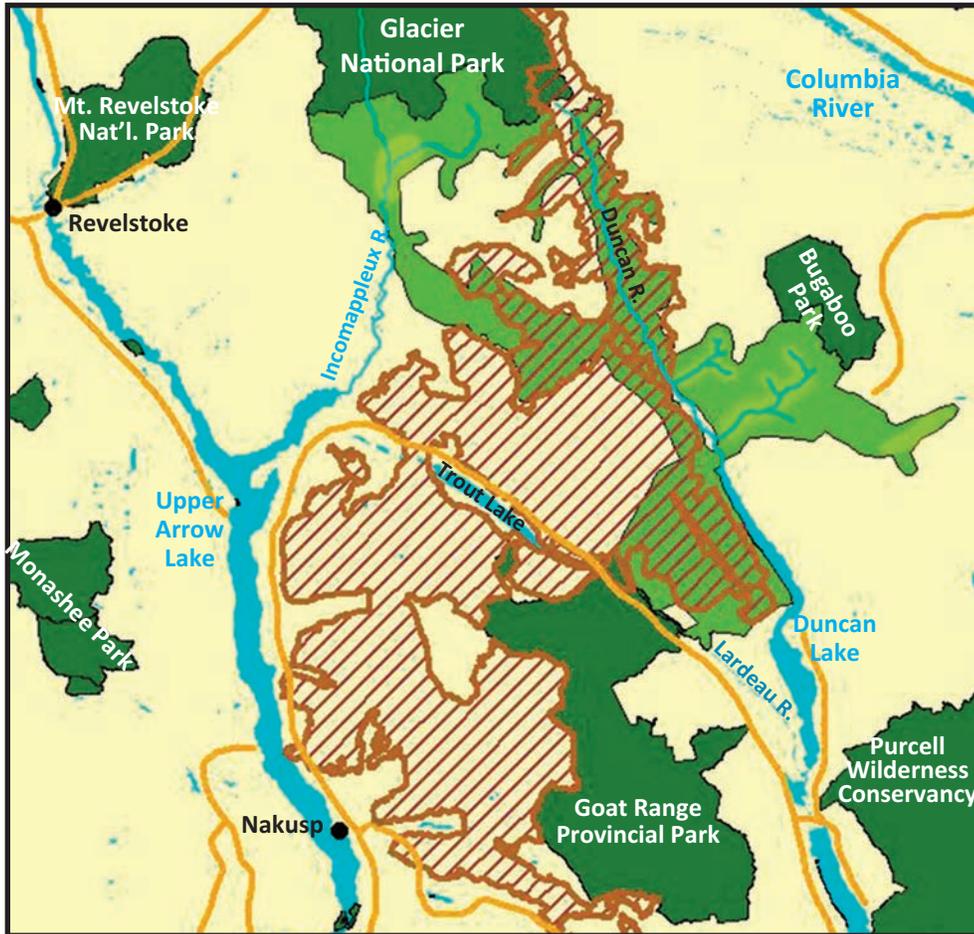
Three large species that use valley-bottom cedar-hemlock — Mountain Caribou, Grizzly Bears and Wolverines — are now red- or blue-listed.

Mountain caribou, grizzly bears and wolverines are famous for their presence in alpine areas of rugged mountains. But to survive, they all make seasonal use of low-elevation forest, especially in spring, when the snow melts earlier and the first greens are available. Autumn is another season when mountain caribou and grizzly bears descend to low-elevation forest. Some wolverines come down to the valley-bottom cedar-hemlock forest in winter. Scientists believe they may be scavenging for dead ungulates.

If the caribou should disappear, the Ungulate Winter Range might also disappear. The other species will still need expanded protection, especially at low elevation.

A CONSERVATION COMPLEX FOR THE CENTRAL SELKIRKS

Ungulate Winter Range and the Selkirk Caribou Park Proposal



The brown slashing is Ungulate Winter Range (UWR) for Mountain Caribou created in 2009.

All of the UWR is now federally designated Critical Mountain Caribou Habitat. Pursuant to the Species at Risk Act, it should have no further logging. A much larger area, including almost all of the proposed new park (except very high elevation) has been federally designated as Type A Critical Matrix Habitat. These areas have already suffered heavy logging, to a point beyond the federal threshold for mountain caribou, and therefore no further logging should occur. Unfortunately, logging of the Type A Critical Matrix is taking place at various locations.

- Existing Protected Areas
- Proposed New Park
- Ungulate Winter Range
- Upgrade UWR to Park

Preserving the Selkirk Mountain Caribou Park and maintaining the additional Ungulate Winter Range would bring together a conservation complex of fully and partially protected lands similar to the Great Bear Rainforest (but much smaller).

The combined size of the parks would be 384,004 ha (944,650 acres). That is almost half the size of the most significant park in the continental United States, Yellowstone. However, areas along the river corridors have been heavily clearcut. Thus it includes its own built-in, partially-logged connectivity corridors linking four major intact areas with old-growth Inland Rainforest.

The park proposal cannot appreciably alter the percentage of lower elevation forest in parks because there is too little left; but it would rescue all that remains between the parks. What would be added would be the oldest, most primeval forest, and the highest biodiversity forest, known to have survived in this area.

Selkirk Mountain Caribou Park Proposal

	Hectares	%
Total Park Proposal	156,461	
Alpine:	11,965	7.6% of park prop.
ESSF Parkland	27,951	18.0% of park prop.
Forestland (ESSF and ICH biogeoclimatic zones)	116,494	74.4% of park prop. 100.0%
ICH biogeoclimatic zone	39,639	34.0% of forestland
ESSF (w/o parkland)	76,855	66.0% of forestland
Burned Areas (1920-):	42,575	27% of park prop.
Logged Areas:	3,160	2.0% of park prop.
Old-Growth*:	37,792	24.0% of park prop.
Timber Harvesting Land Base	17,827	11.4% of park prop.

ESSF = Englemann Spruce-Subalpine Fir
 ICH = Interior Cedar-Hemlock (Inland Temp. Rf.)
 *Burned areas since 1920 removed.

THE PARK PROPOSAL: UPPER INCOMAPPLEUX/BATTLEBROOK

A 27,364-hectare wilderness contiguous to Glacier National Park.

The Incomappleux River originates in a glacier in the park and travels 18 kilometres within park, un-forested due to continuous massive avalanches. This park proposal would protect another 17 kilometres of the river, as well as an intact tributary, Battlebrook, arising from the Battle Range.

The lowland forest along the river and Battlebrook is extremely rare primeval rainforest. Scientists say the forest may have been growing uninterrupted since the last Ice Age. There are many two- to three-metre diameter trees in the 800-1,500 year range. The oldest range up to four metres and an estimated 1,800 years old.

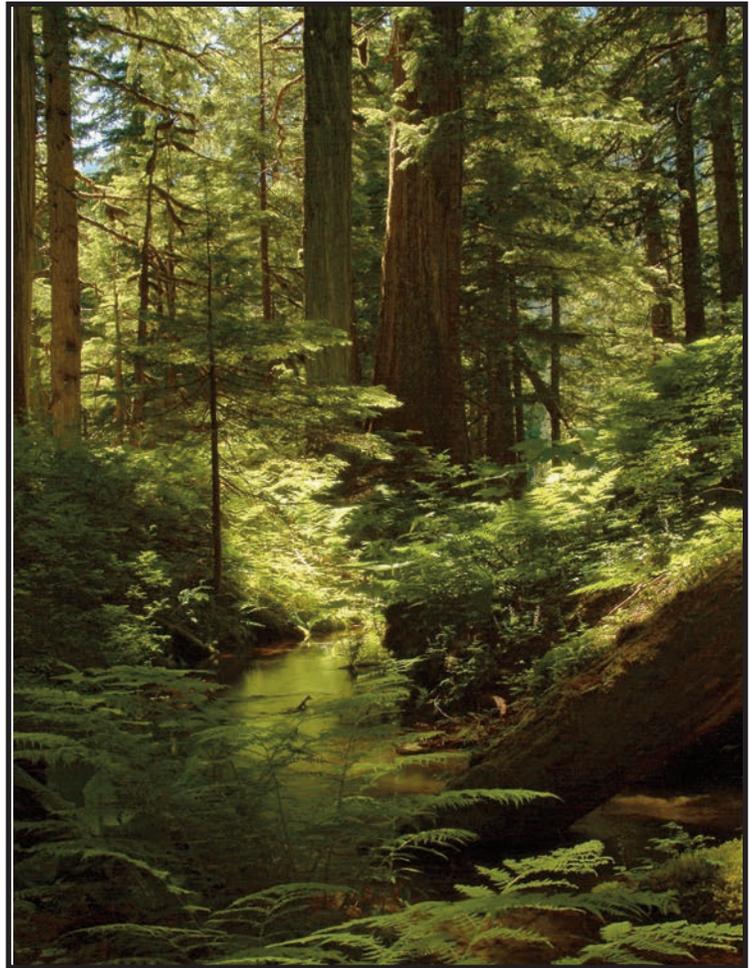
Only about 1,500 hectares of the big trees are within the timber industry “operability line.” This is continued north of the McDougall Creek confluence between the clear-cuts in the river bottom and massive avalanche tracks north of Battle Brook Creek. Yet the visitor can walk amongst these awe-inspiring trees all day long and not come to the end of them.

Upstream of the ancient forest, the Incomappleux River and Battlebrook adjoin Glacier NP to form a remote, wild, intact ecosystem of riparian habitat and avalanche tracts — a haven for Grizzly Bears, offering such amenities as endless cow parsnip and strips of Inland Rainforest for rest in the shade. The bears also use the intact ancient forest downriver, though we’ve seen only their hair on rubbing trees and paw prints.

The logging company that had the licence, Pope & Talbot, went bankrupt, leaving five approved cutblocks within the big trees. The licence has been transferred to Interfor. Some years ago a huge rock-fall on the Incomappleux Canyon road damaged a bridge. The expense of repairing it has protected the trees ever since, but the trees could legally be logged at any time.

Incomappleux recommended as a sanctuary to protect Grizzly Bears from high numbers of Glacier NP visitors.

A 1984 study on the ecology of Glacier and Mt. Revelstoke National Parks cited the Incomappleux Valley as one of two areas within Glacier Park where wildlife inventory staff saw the most grizzly bears. The report recommended special protective status for the Incomappleux to provide sanctuary for grizzly bears from the pressure of recreationists.



Craig Pettit

As early as 1925 the federal government recognized the forests of the Incomappleux - Battle Brooke confluence as an important addition to Glacier National Park and placed a reserve on the area.

“Forests of the calibre of the upper Incomappleux are in a class of their own, owing both to their great age, which has allowed thousands of years of colonization for rainforest-dependent species, and their structural complexity – the interactions of the hundreds of plants and fungal species with thousands of poorly known invertebrate organisms.

“The fragmentation of this forest would represent a direct and immediate threat to many species whose distribution is limited to short distances, and for whom a clearcut represents an immense migration barrier. Fragmentation would create canopy gaps allowing valley winds to penetrate into the heart of forest canopies that have been sheltered and humid for over a thousand years, drying out the habitats of species, such as the COSEWIC-listed Species of Concern *Nephroma occultum*, whose existence depends on very stable humidity and constant, undisturbed conditions.

Lichenologist Toby Spribille

Scientific Research in the Incomappleux



Juscha Granthier

Lichenologists Toby Spribille and Curtis Björk.

Inland temperate rainforest puts BC amongst areas around the world yielding species new to science.

Forests as far north as British Columbia do not have anything like the biodiversity of tropical forests. Many kinds of species become more numerous the further south one travels. But lichen species become more numerous moving north, well into Alaska. Lichens are one of the great pools of diversity in northern forests, but in the past they have been poorly studied. Only recently have scientists discovered totally unexpected explosions of lichen diversity, and this began in the Inland Temperate Rainforest.

To date, up to 300 species of lichens found in the Incomappleux Valley, mostly in this park proposal.

That's more lichen species than all the other plant species found in the Incomappleux put together. The pioneering lichen surveys in the Incomappleux were carried out by Toby Spribille, a researcher from the University of Graz, Austria, and BC lichenologist Curtis Björk, in consultation with Trevor Goward, former curator of the UBC lichen collection. These findings revolutionized the knowledge of biodiversity in northern coniferous forests.

Of the 300 species found in the Incomappleux Valley, about 74% were found in the old-growth rainforest. A large number of them were "oceanic lichens" — usually found only near the coast. The oceanic lichens can live in the interior only where there are very wet conditions. The lichens of the Incomappleux include:

- 3 species not previously known in BC or Canada;
- 3 species not previously known in North America.
- 7 species new to science.

These lichens were found with only a cursory examination of a few areas. According to Spribille, "We are definitely looking at a major center of lichen diversity at a global level that we haven't even begun to fathom or explain."



Craig Pettitt

Lobaria retigera (Smoker's Lung Lichen)

Six-nation team identified species new to science

To determine whether the unidentifiable species were, in fact, new species, a team of eight experts from six countries worked together using DNA analysis. Four of the new species have been named and published (Spribille et al., *The Bryologist*, bryo-112-01-08.3d). A fifth is due for publication soon. One species — *Myochroidea minutula* — has never been found *anywhere* else in the world but in the ancient forest of the Incomappleux.

In 2010 Spribille led a research group to Mt. McKinley National Park in Alaska. A thorough search yielded 766 species of lichens in a small area. Statistical analysis indicates there may be as many as 1,000. It is believed to be likely that a thorough search of the Incomappleux would yield many more species of lichens, some new to science.

Research expanding to other species

Research in the Incomappleux is expanding to other species. Mushroom expert Dr. Oluna Ceska has found rare coastal mushrooms, and Dr. Adolf Ceska, formerly of the BC Conservation Data Centre, has found rare plants. More researchers focused on other species will be arriving soon. The Columbia Basin Fish and Wildlife Compensation Fund has sponsored several fisheries studies in the park proposal.



Toby Spribille

New to science: *Gyalecaria diluta*

Lichens: Major Ecosystem Functions in Temperate Rainforest

The *Peltigera* on the right at top is one of many nitrogen-fixing lichen species. Researchers have reported up to 50% of the nitrogen input to Pacific Northwest forests coming from lichens. They draw nitrogen from the air and convert it to a form that plants and trees can use. Rain leaches the nitrogen into the ground; in addition, lichens fall from trees and decompose into the ground, fertilizing it with nitrogen. This is only one of many functions of lichens in the ecosystem. There are numerous known links with other species, for instance, as part of their food or nesting materials, but there is also much that remains unknown.

The *Alectoria* and *Bryoria* hair lichens (bottom, far right) are almost the sole food of mountain caribou in the winter, and a major food in the summer. Every single species is important to save because we do not know what they do. Amongst hundreds of species of lichens, only these two hair lichen species form the majority of the mountain caribou diet. These lichens were also a favourite food of the interior Salish people. Lichens have associations with a large number of animals as food and nesting material. They also help to break down rock and create soil.

Many small species around the world are now being recognized as holding the biochemical keys to treating diseases and solving many other serious problems. And in many cases they are the *only* species that hold these keys. So the loss of even one species is considered by scientists to be a very great loss to humanity in medical research alone.

The *Lobaria pulmonaria* shown on page 12 was traditionally believed to be effective against tuberculosis. Studies have verified this belief. Scientists have been experimenting with lichens for decades, seeking valuable chemicals. And many of them are being used in commercial products today. Lichens have been found to have anti-tumour or antibiotic properties, as well as effectiveness against HIV.

Lichen species produce myriad chemical compounds and there is very little information on their function in the ecosystem. They hold profound secrets that are for future generations to discover, and some of them will undoubtedly be of immense value.



Anne Sherrod

Genus *Peltigera*

Craig Pettitt

Coral Lichen



Craig Pettitt

Alectoria and *Bryoria* hair lichens.

Toby Spribille

Spilonemella americana

Toby Spribille

Pilophorus acicularis

The Incomappleux Reveals Ancient Forest Legacies



Adolf Ceska

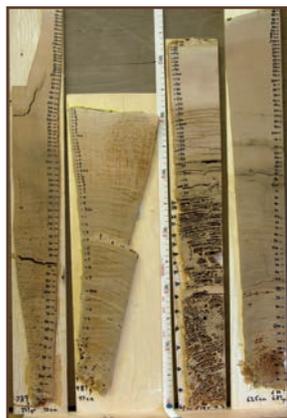
Noted mycologist Dr. Oluna Ceska.



Adolf Ceska

Phaeocollybia piceae

Dr. Oluna Ceska, a prominent BC mycologist, and Dr. Adolf Ceska, a retired biologist at BC's Conservation Data Centre, collected 100 species of mushrooms in one day in the upper Incomappleux. Twenty were found in a clearcut and a spectacular 80 species in the ancient rainforest; 41 of the 80 were coastal species. They included the rare old-growth rainforest mushroom, *Phaeocollybia piceae*. Uncommon even in coastal old-growth, at the time of its discovery in the Incomappleux it was (and likely still is) the first and only inland occurrence in BC. Its only other location in BC was Carmanah.



Mark McLean

HOW OLD IS A 3.25-METRE (10 FEET) THICK TREE?

The oldest cedar documented in the Incomappleux is 3.25 metres diameter. The age of ancient cedars cannot be determined precisely because the natural life cycle of the tree includes rotting in the core, resulting in a hollow centre. Counting tree rings from solid stumps of mature trees, Valhalla Wilderness Society director Craig Pettitt found the following ages from the tree rings in the cross-sections shown in the photo above, centre:

Ages from left to right

- 739 years from a 1.5 m log = 492 years/metre
- 489 years from a 1 m log = 489 years/metre
- 514 years from a 1.3 m stump = 395 years/metre
- 689 years from a 1.3 m stump = 530 years/metre

Assuming similar growth rates throughout the tree's lifetime, a three-metre tree might be 1,300-2,200 years old, average 1,750 years. BC's Ministry of Forests says 800 years old. That means the 3-metre tree would have had to put on approximately two metres more than these trees in about 60-300 years, or a phenomenal 1 centimetre of diameter per year over their entire lifespan. The U.S. Forest Service in Idaho calculated its similarly huge cedar trees at 1,800 years old.

In the Incomappleux, stable growing conditions over thousands of years have allowed time for some of the most fragile small species, including many that need coastal conditions, to establish colonies. Time has enabled the creation of a precious legacy of ancient soil enriched with millions of microscopic organisms, and undisturbed root systems with invisible filaments from organisms, all interconnecting to hasten the process of decay and the transport of nutrients to support continuous rebirth.



Craig Pettitt

In the ancient forest, lichenologist Toby Spribille found the Mountain Moonwort shown on the left. It is a primitive fern that goes back to the melting of the glaciers and is found only in ancient cedar-hemlock forest.

Rivers and streams in the park proposal are critical spawning and rearing habitat for the fisheries of the huge Kootenay Lake and Arrow Lakes Reservoir.

Fishing in these lakes is a major tourist attraction and source of income in the Kootenays. The lakes are not in the park proposal, but the resident Rainbow Trout, Bull Trout and Kokanee salmon need moving, well-aerated water to lay their eggs. This need is provided by creeks and rivers within the park proposal. The government has spent millions of dollars over many years to restore the fisheries of the Arrow Lakes Reservoir.

In the U.S. Bull Trout are endangered (red-listed). In BC they are blue-listed. The Incomappleux, Duncan and Westfall rivers are especially important for them.

They need very cold spawning waters within a narrow temperature range, often near springs that feed very cold water into the creeks and rivers. The glacier-fed Incomappleux and Duncan Rivers are opaque and such waters are favoured by Bull Trout. They may have colder and more stable temperature. (Decker and Hagen 2007)

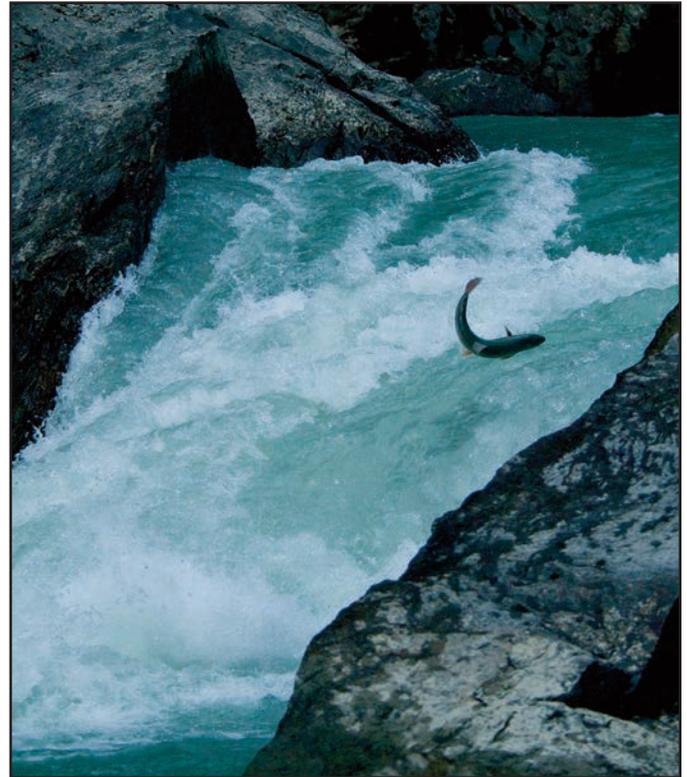
A study conducted in 1996 showed that the primary spawning sites of Bull Trout in Kootenay Lake were the Westfall River, Houston Creek, and upper mainstem Duncan River (O'Brien 2001) — all within this park proposal.

Another study found that there are only five tributaries of the Arrow Lakes that have relatively abundant juvenile Bull Trout (Decker and Hagen 2007). The Incomappleux is the second most important of these streams for Bull Trout spawning and rearing areas. It had 26% of the juvenile Bull Trout counted in tributaries to the ALR.

In 2012 two applications for private power developments in the Incomappleux Valley, one of them 10 kilometres above the confluence of the Incomappleux River and Battlebrook, were withdrawn when the companies were advised of the ecological sensitivities of the areas, and a petition signed by 5,000 people was presented to government. The government advised VWS that no other applications for the Incomappleux would be accepted.

The Lardeau River has the largest kokanee spawning migration in the Columbia Basin.

The Incomappleux, Duncan and Lardeau rivers host runs of Kokanee, a small, landlocked Sockeye Salmon. They are the chief food for large trout. After spawning they die and fertilize the entire river and lake systems, as well as the forests through the droppings of animals such as bears. The taxpayers have paid many millions of



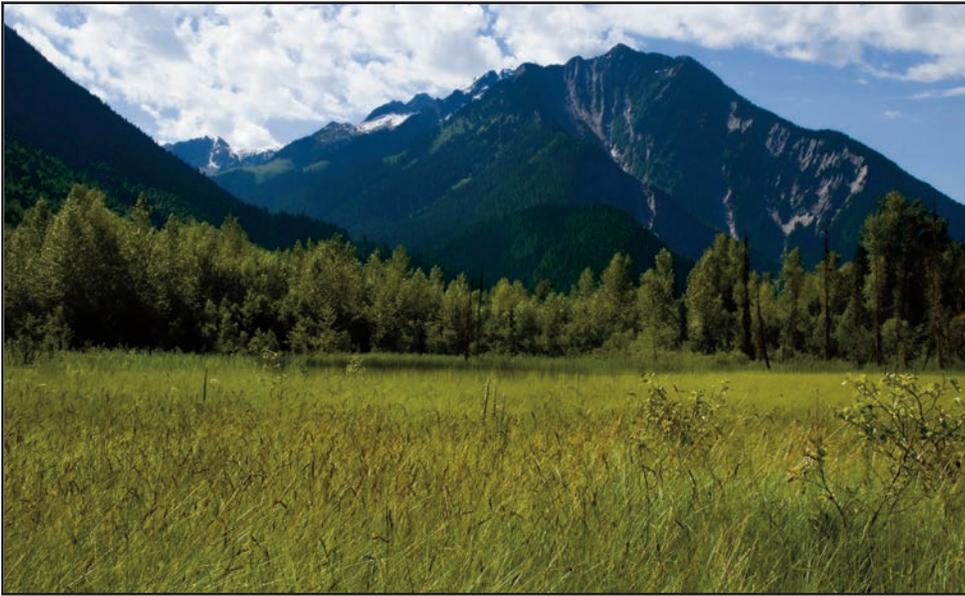
Above: Bull Trout hurl themselves up the Incomappleux River. Their competitors, Rainbow Trout, cannot make it. This makes the Incomappleux especially important to Bull Trout.

Below: Gerrard Rainbow Trout — the largest trout in the world. They are seen here in their only native spawning ground in the world: the Lardeau River in the Goat Range Provincial Park. To get there they pass the mouths of Lake and Healy Creeks in this park proposal.



Craig Pettitt

dollars to restore the Kokanee from collapse caused by dams, yet very little has been done to protect their spawning and rearing habitat in the rivers and streams. At present, the fishery is in serious condition due to the Kokanee collapse.



Anne Sherrod



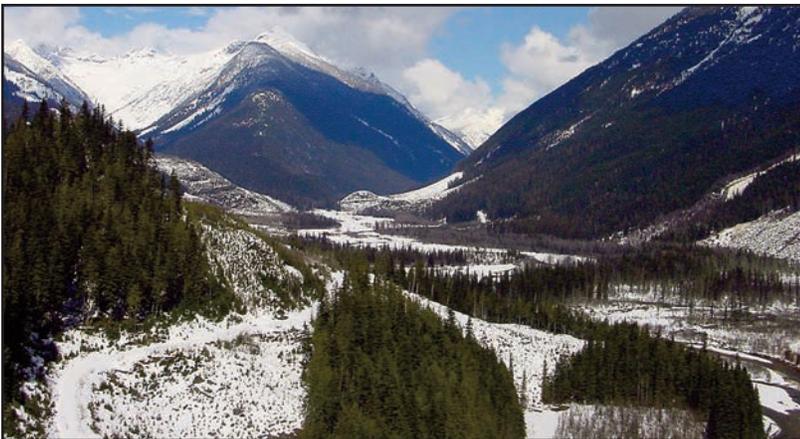
Anne Sherrod

INCOMAPPEUX-BOYD CREEK CONNECTOR: KELLIE CREEK WETLAND

The photo above shows a small part of the extensive wetland at the mouth of Kellie Creek in the heavily logged portion of the Incomappleux River. No survey of species has ever been done to our knowledge. However, at a glance, botanists Toby Spribille and Curtis Bjork quickly spotted Loesel's Twayblade (*Liparis loeselii*), as well as the Ochroleucous Bladderwort (*Utricularia ochroleuca*) — a plant that traps insects. Both plants are red-listed (endangered). The wetland also contains the blue-listed beaked spikerush, *Eleocharis rostellata*. Loesel's Twayblade is known to occur in only three other locations in BC. The Incomappleux population is the largest so far ever found in

BC, but there are reports of another location within the park proposal that has a significant number.

The strips of forest left around the wetland are in the ICHvk biogeoclimatic zone, and thus are likely to be the rare “very wet” Inland Rainforest. Despite the clearcutting on the surrounding slopes, a visit to the marsh with hip waders is a rare experience of grand nature. The wetland is included in the park proposal, in the Incomappleux-Boyd Creek connector. After taking in the marsh, the park proposal departs the Incomappleux River and ascends Boyd Creek where a pass connects to the Westfall River.



Craig Pettit



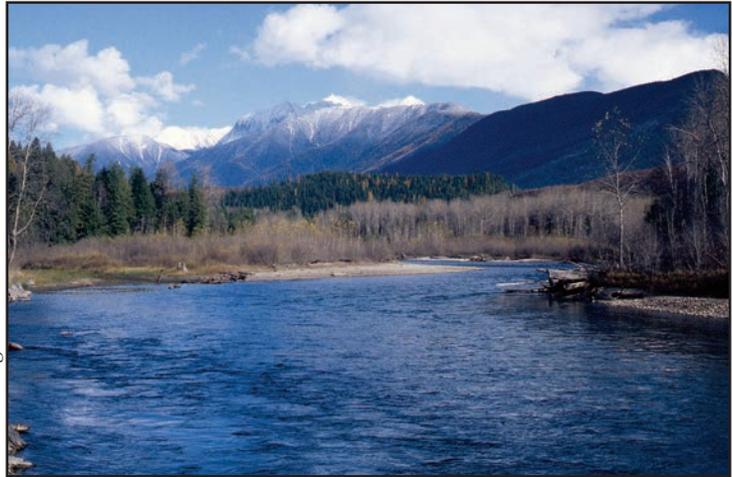
Mark Gronvall

Incomappleux Logging: Two-thirds of the length of the Incomappleux River Valley have been clearcut. Loggers say that some of the trees were so big that only one could be loaded on a truck. The snow reveals roads and clearcuts. The forested slope on the right is too steep to economically log. The upper portion beginning with the mountain in the background is splendidly intact. About 17 kilometres of river valley were left unlogged. Due to rugged terrain only about 1,500 hectares of the upper Incomappleux is loggable, but a great deal more is walkable, and because it is contiguous with Glacier National Park, it is part of a large intact wilderness.

THE PARK PROPOSAL: DUNCAN AND LARDEAU WATERSHEDS

The Badshot Range divides the Lardeau and Duncan Rivers. This is the most important Mountain Caribou habitat in the park proposal. The 2010 government caribou census found up to 27 caribou or caribou tracks within or near the boundary of this part of the park proposal — about one-third of the Central Selkirk herd.

Thirteen of the caribou counted in late winter 2010 were in the Healy Creek tributary of the Lardeau River. The alpine of Healy Creek connects to a system of ridges and passes that give access to Lake Creek, Hall Creek and the Duncan River. Cedar-hemlock at lower elevations in these valleys likely contains critical spring and early winter habitat for these animals.



James Bergdahl

Badshot Range

With their breathtaking scenery, the Badshots have been visited by recreationists since the days of the silver and gold rush that flooded the valley with settlers in the early 1900s. Besides providing vast views of the Selkirk Mountains, the Badshots themselves are composed of spectacular limestone formations called karst. The high content of dissolvable minerals in the soil around karst formations is known to stimulate high diversity of plants and lichens.

Both mountain caribou and grizzly bears are sometimes seen on the ridges of the Badshots. The scenery is spectacular.



Anne Sherrod

Accessible by ATV, the spectacular alpine of Healy Creek offers easy cross-country hiking and sees many visitors every year. Caribou use it in autumn and winter.

Duncan River

The Duncan River originally was a vast valley of ancient Inland Temperate Rainforest, used extensively by Mountain Caribou. The easily accessible old-growth has largely been wiped out by clearcuts, but there are patches and slopes of low-elevation old-growth connected to the high-elevation Mountain Caribou habitat. The river has Bull Trout, Rainbow Trout, Kokanee, Mountain Whitefish, unidentified sculpin and Longnose Dace. It is a major spawning route for Bull Trout and Kokanee Salmon from Kootenay Lake. Intact Houston Creek has ESSF forest and heavily used game trails. Winter surveys have not recorded mountain caribou in the Duncan River drainage for a few years, but the surveys are only in winter and the caribou use of forest in the spring and early winter is little known.



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A cedar bear den along the middle section of the Duncan River.



Jim Lawrence

Gary Diers



LEFT: NOT PROTECTED BY THE MOUNTAIN CARIBOU RECOVERY PLAN — The Ungulate Winter Range does include much of Lake Creek, but an exclusion was made for the old-growth valley-bottom cedar, despite the fact it is classic mountain caribou spring and early winter habitat. Old-growth cedar-hemlock forest in the Lake Creek valley was excluded from the Ungulate Winter Range, even though there have been caribou seen in that drainage for many years.



Gary Diers

East Creek in the park proposal, with Howser Spire in Bugabo Park in the background.

East and Giegerich Creeks

The East Creek and Giegerich Creek tributaries of the Duncan were in the licence areas of Slocan Forest Products and Meadow Creek Cedar for many years. But because of a barrier of steep slopes at the start, they were not economically loggable. *They were classified as non-Timber Harvesting Land Base in the Mountain Caribou Recovery Plan.* Both of these creeks have huge old cedar trees, but it appears that some in Giegerich may have burned recently.



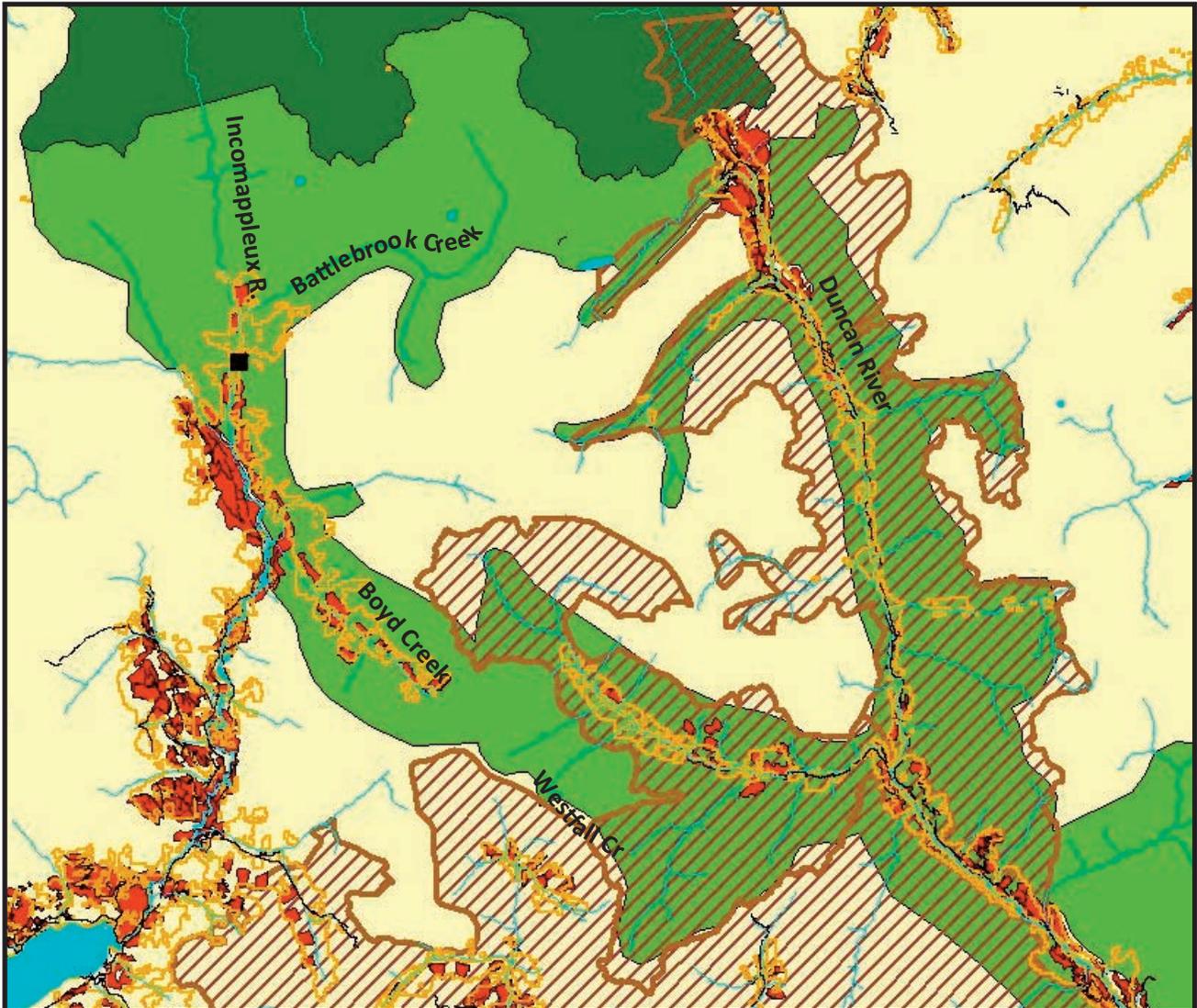
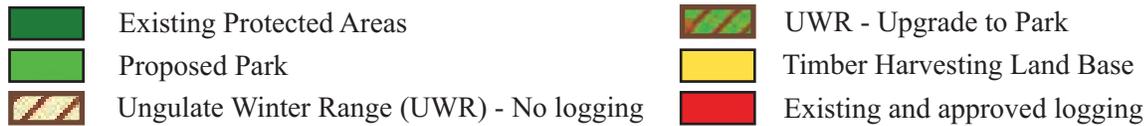
Gary Diers

The Westfall River

Westfall River

Half logged, the Westfall River is a tributary to the Duncan River. Being very remote, it proved uneconomical to log. It has been designated as “no logging” under the Mountain Caribou Recovery Plan. This is a significant piece of wilderness. There are still intact slopes of old-growth cedar-hemlock forest above the river that intermittently go all the way down to the river. This river is one of the primary spawning grounds of the blue-listed bull trout in the Kootenay Lake fishery.

Caribou UWR, Timber Harvesting Land Base, Clearcuts, Approved Clearcuts: Incomappleux, Duncan and Westfall Rivers



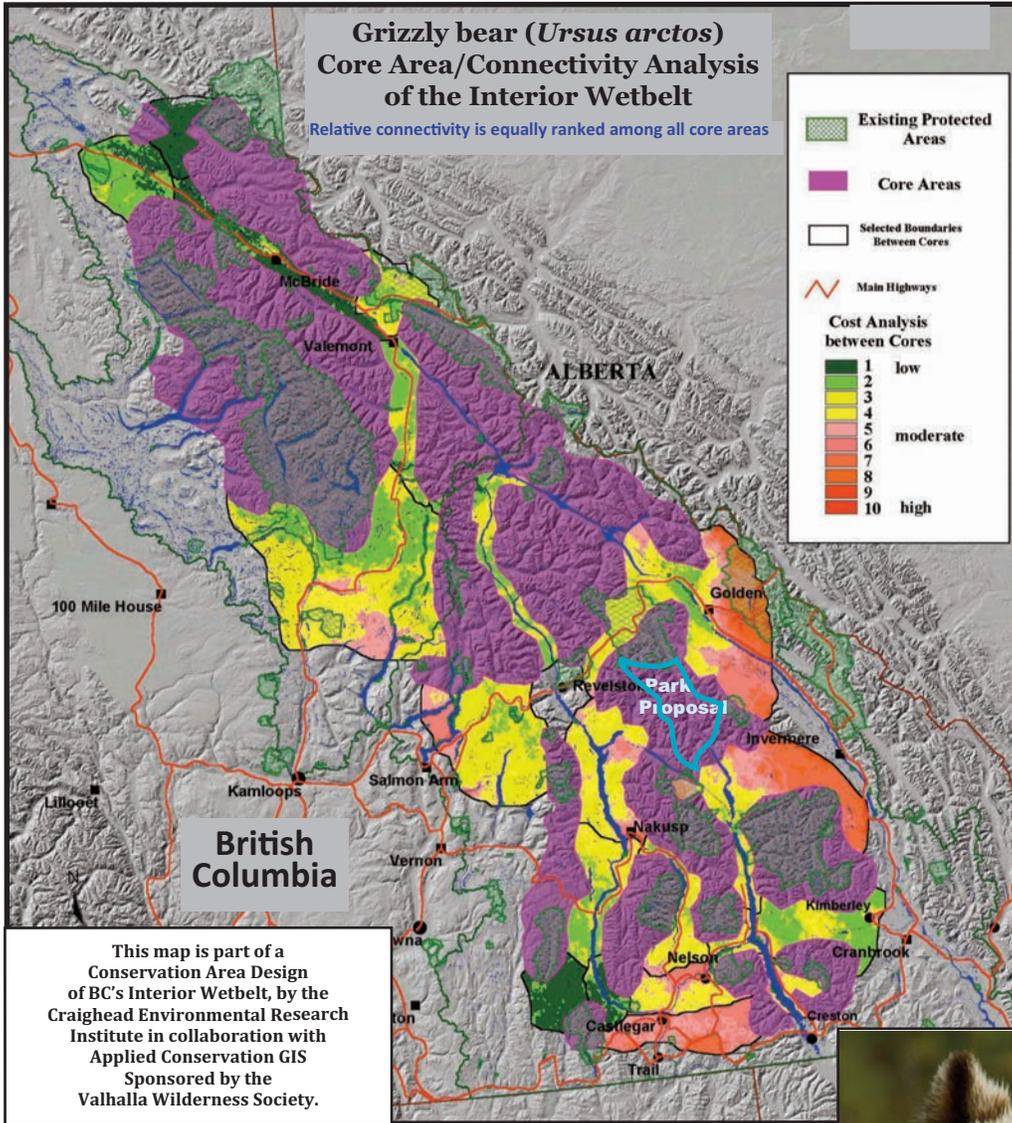
Timber Harvesting Land Base in the park proposal: 17,827 hectares, 11.4% of the park proposal.

Mtn. Caribou Ungulate Winter Range in the park proposal: 72,304, 46% of the park proposal.

The Ungulate Winter Range is more or less closed to logging.

The best and the most economically accessible forest has been logged. Remoteness of the northern part of the proposal requires long trips hauling logs, and the mountainous terrain and wet weather sometimes required expensive road building, things that logging companies cannot afford now that the best and most accessible has been logged. There are extensive clearcuts that do not show up well on the map at this scale, especially along the Duncan River and the Westfall River.

GRIZZLY BEAR AND WOLVERINE CORE HABITAT IS SHRINKING



The purple areas are core Grizzly Bear habitat in BC's Interior Wetbelt. The map shows that the land between four parks — Glacier, Goat Range, Valhalla and Bugaboo — is part of a large area of core habitat. The Selkirk Caribou Park Proposal is roughly outlined in light blue.

Core habitat areas become smaller in the south, fragmenting as they approach the U.S. border. Across the border, the bears are almost wiped out, existing mainly in Montana, with very few in Idaho and Washington. This represents encroaching disappearance of the bears from the intensely developed southern areas.

The maintenance of habitat connectivity down the spine of the Selkirks into the US is believed to be critical to the continued existence of Grizzly Bears across the border.

Claims that BC has the largest and healthiest Grizzly Bear population in Canada omit that the bears' range has shrunk by 54% and is seriously fragmented in southern BC. Shrinking range means less resilience to environmental change, less genetic diversity, and more susceptibility to pressures. Nine species of bear worldwide are threatened.

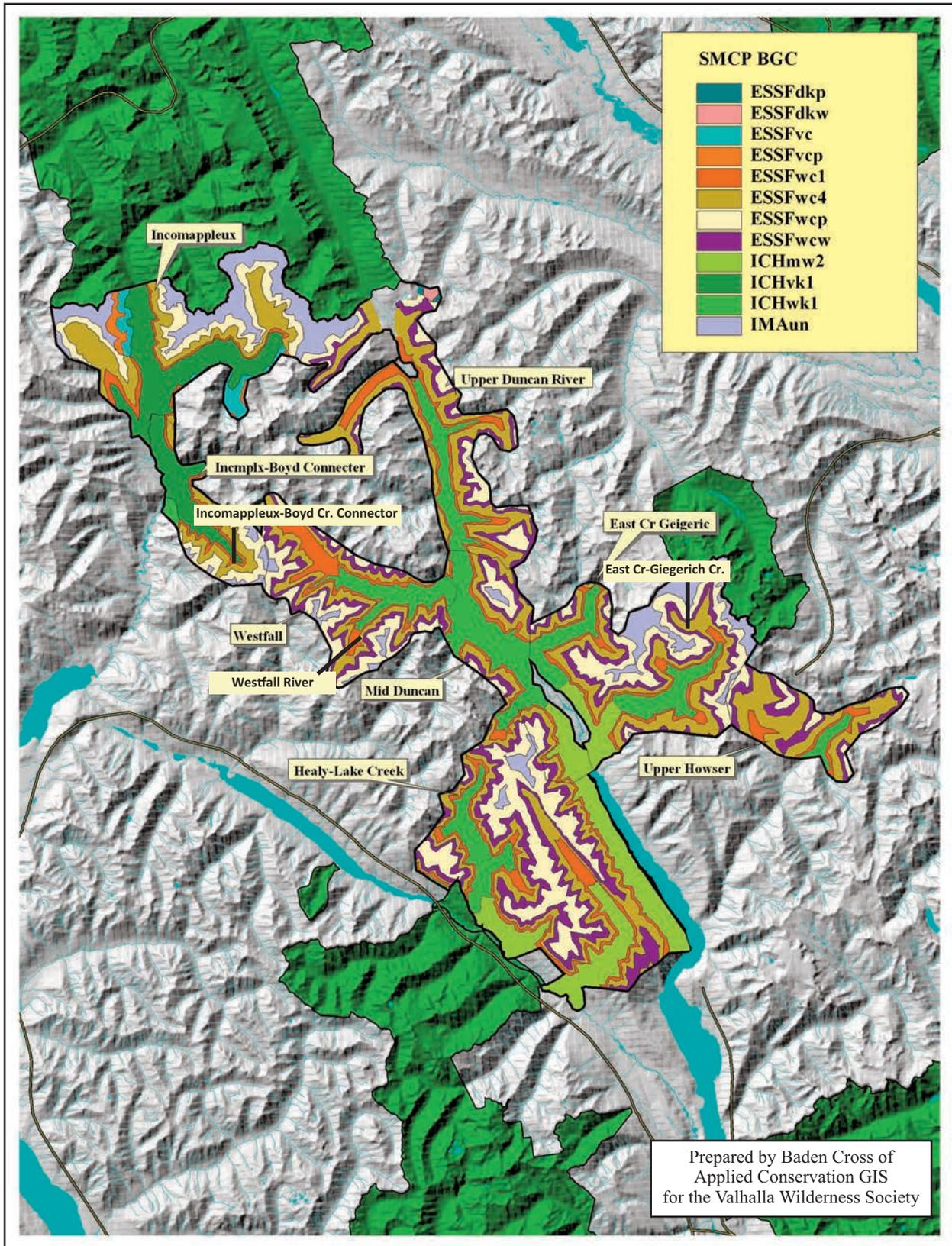
Some scientists believe that the Central Selkirk and Purcell Mountains, in the area of this park proposal, have healthy populations of Grizzly Bears. However, bear-human conflicts in Glacier National Park and along the Trans Canada Highway and CPR mainline are thought to have taken a heavy toll on the Grizzly Bear population north of the park proposal. Bears of the central Selkirks and Purcells are besieged by threats from all directions, including logging roads, private power projects, swarms of off-road vehicles, hunting from ATVs, backcountry lodges, and mega tourism development such as the Jumbo Glacier Resort.



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This blonde grizzly cub of the Goat Range Provincial Park uses the park proposal as well. The bears need expanded protection.

BIOGEOCLIMATIC ZONES OF THE SELKIRK MOUNTAIN CARIBOU PARK PROPOSAL



Park Proposal Planning Units	Forest Cover (hectares)	Conservation Values	Status
Incomappleux 27,364 hectares	6,576 ICHvk 8,964 ESSF 5,403 ESSF Parkland 6,421 tundra (IMAun) 54 clearcut	Mostly intact wilderness contiguous to Glacier National Park. 2,997 ha very rare rainforest, 1,800 yr. old trees. Important spawning and rearing for Arrow Lakes bull trout International biodiversity research	5 approved cutblocks in 1,800 year old trees never logged after P&T sold to Interfor and rockfalls damaged the bridge. Current bridge unsuitable for logging trucks.
Incomappleux-Boyd Connector 8,090 hectares	3,315 ICH vk, w (Inland Temp. Rainforest) 2,689 ESSF 1,583 ESSF Parkland 504 tundra (IMAun) 620 clearcut	1413 very fragmented old-growth rainforest. Connectivity: narrow corridor along massively logged river climbs Boyd Cr over pass into Duncan watershed. Extensive wetland along river with red- and blue-listed species.	Logging at high elevation began some years ago but was abandoned when rock-falls damaged the bridge. Current bridge unsuitable for logging trucks. Boyd Creek substantially intact.
Westfall River 16,415 hectares	2,556 ICHwk1 8,758 ESSF 3,455 ESSF Parkland 646 tundra (IMA un) 450 clearcut	948 ha rare old-growth rainforest 3,752 ha old-growth ESSF Critical mountain caribou habitat Primary bull trout spawning for Kootenay Lake.	5-year logging window allowed by UWR has expired and full cut never logged due to high logging cost.
Mid Duncan River 1,3074 hectares	4,773 ICHwk1 1,569 ICHmw2 5,151 ESSF 1,362 ESSF Parkland 219 tundra (IMAun)	1,782 remnant stands old-growth rainforest. Spawning Bull Trout, Kokanee Mountain Caribou habitat Connectivity for Mountain Caribou Grizzlies feeding on Kokanee	Heavily fragmented by logging. Designated no-logging caribou UWR except for valley bottom exclusion zone with 20-year logging window (but so far no new logging after 8 years).
Upper Duncan 16,719 hectares	2,597 ICHwk1 12,044 ESSF 2,035 ESSF Parkland 43 tundra (IMAun) 279 clearcut	1,043 old-growth ICHwk1 4,188 old-growth ESSF Mountain Caribou habitat Intact tributary - Houston Cr. Primary spawning for Kootenay Lake Bull Trout - Grizzly Bears	Heavily fragmented by logging and forest fires. Designated no-logging caribou Ungulate Winter Range.
East Creek/ Giegerich 26,385 hectares	4,295 ICHwk1 1,737 ICHmw2 11,564 ESSF 5,359 ESSF Parkland 3,430 tundra (IMAun) 156 clearcut	2 almost totally intact tributaries of the Duncan River Connects to Bugaboo Prov Park. 1,283 ha old-growth ICHwk,mw 2,277 ha old-growth ESSF	Classified non-timber-harvesting land base during the mtn caribou process. Partially burned In cutting licences for many years - never logged.
Healy-Lake Cr 39,452 hectares	3,203 ICHwk1 8,376 ICHmw2 19,372 ESSF 7,814 ESSF Parkland 687 tundra (IMAun) 376 clearcut	Connects to Goat Range Prov Park 3,491 old-growth ICH Mountain Caribou, Grizzly Bear and Wolverine core habitat Tributaries to Lardeau R. - only undammed river feeding Kootenay Lake. Largest Kokanee salmon run in Kootenays. Bald Eagles-heron.	Mostly designated caribou Ungulate Winter Range. Lake Creek nearly intact except for large burn. Caribou sightings or tracks every year. 2016 Fire allowed to destroy important Caribou habitat at Healey Pass.
Upper Howser 8,964 hectares	642 ICHwk1 7,313 ESSF 994 ESSF Parkland 15 tundra (IMAun) 521 clearcut	1,907 old-growth ESSF Critical Grizzly Bear corridor from Selkirk Range to Purcell Range Headwaters to Bull Trout stream Reported mountain caribou	Site of proposed Glacier-Howser IPP which appears to have failed due to massive opposition and withdrawal of power contract.

PROVINCEWIDE PROTECTION OF INLAND RAINFOREST



Craig Pettitt



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Many of the conservation figures for this area come from a 10-year GIS mapping project sponsored by the Valhalla Wilderness Society and carried out by Baden Cross of Applied Conservation GIS. The mapping project area is called the Inland Rainforest Region (IRR). It approximates the Interior Wetbelt and the historical range of the mountain caribou. In the analysis, “protected” means permanently, legally and fully protected in designations such as parks, conservancies and ecological reserves. “Old-growth” is defined by the BC Forest Service standard of 140 years or older. “Inland Rainforest” is used exclusively for ICH vk and wk.

- **IRR land base: 14.31 million hectares.**
- **Forest in the IRR: 9.6 million hectares.**
- **Parks in the IRR: 2.44 million ha., or 17% of land base.**
- **Only 15% of forest in the IRR is Inland Rainforest.**
- **Only 18% of the Inland Rainforest is fully protected; includes 263,376 ha. of ICHwk and 51,075 ha. of ICH vk.**
- **Government data show that one-third of all fully protected Inland Rainforest is in *one* park: Wells Gray Provincial Park. The majority of this forest burned in the 1940s.**
- **Not surprisingly, only 20% of the protected Inland Rainforest is old-growth. That’s counting all the forest 140 years and older. Trees 1,000+ years old would be exceedingly more rare in protected areas.**
- **Only 51,457 hectares or 0.54% of the interior rainforest region forest base of ICHwk old-growth exist in fully protected areas.**
- **Only 10,014 hectares 0.1% of the interior rainforest region forest base of ICHvk old-growth exist in fully protected areas.**
- **About two-thirds of the combined ICHvk and wk in parks are over 1,000 m. in elevation, soon to transist to spruce-subalpine fir. This elevation level has far fewer species than the low-elevation rainforest.**
- **47% of Inland Rainforest in parks and ecological reserves is on steep slopes 40% or over — slopes this steep are usually avoided by mountain caribou.**

The “very wet” rainforest, ICHvk, is noted for large quantities of moss and lichen on the trees.



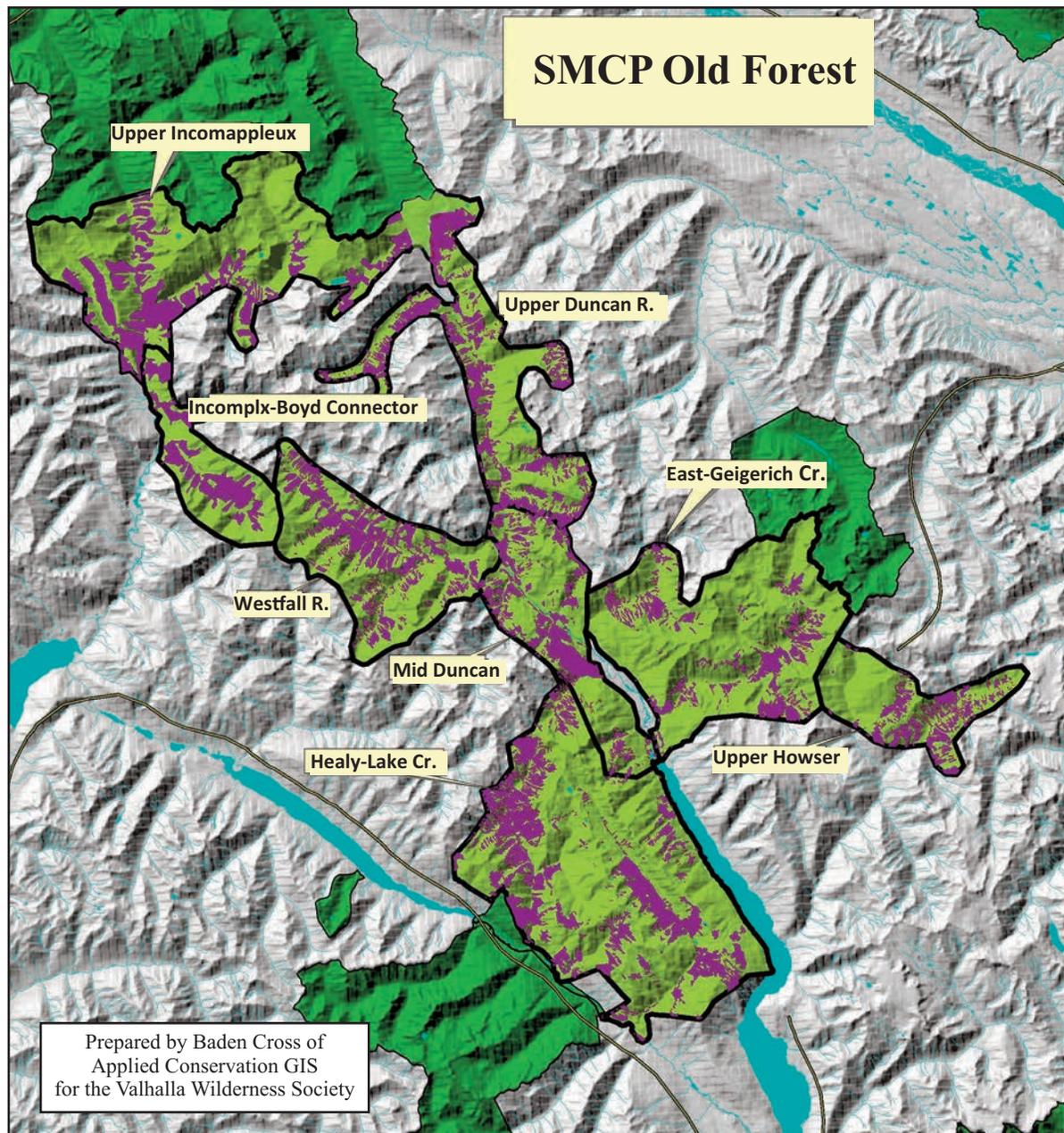
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Ferns, devil’s club and skunk cabbage are predominant in the lush undergrowth of these forests.



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The trees are literally encrusted with lichens, which contribute many ecosystem services to the forest.



Old-growth in the Park Proposal by Biogeoclimatic Zone

Unit	Total ha	ICHvk OG	ICHwk OG	ICHvk+wk OG	ICH OG	ESSF OG	IMA/ESSFp	Clearcuts
Howser	8,964	0	266	0	266	3,830	1,009	521
Upper Dun	16,719	0	1,043	1,043	1,043	4,188	2,078	279
East/Geig	26,385	0	983	983	1,283	2,277	8,789	156
Healy/Lake	39,452	0	1,719	1,719	3,491	5,398	8,501	376
Westfall	16,415	0	948	948	948	3,498	4,101	450
Mid Dun	13,074	0	1,782	1,782	1,908	1,749	1,591	704
Incomplx	27,362	2,997	0	2,997	2,997	2,749	11,824	54
Boyd Conn	8,090	1,301	112	1,413	1,413	971	087	620
Total	156,461	4,298	6,853	10,885	13,349	24,660	39,980	3,160

References

Biodiversity & Species at Risk

Austin, M.A., D.A. Buffett, D.J. Nicolson, G.G.E. Scudder and V. Stevens (eds.). 2008. "Taking Nature's Pulse: The Status of Biodiversity in British Columbia. Biodiversity BC", Victoria, BC. 268 pp. Available at: www.biodiversitybc.org.

B.C. Ministry of Environment. 2007. Environmental Trends in British Columbia: 2007. State of Environment Reporting. Victoria, B.C. Accessed October 2009 at: www.env.gov.bc.ca/soe/et07/EnvironmentalTrendsBC_2007.pdf.

Ceska, O. 2004. "Incomappleux Valley – Macrofungi," Sept. 12, 2004, www.vws.org.

Chivian, E., and Bernstein, A., (Editors), Center for Health and the Global Environment, Harvard Medical School, *Sustaining Life: How Human Health Depends on Biodiversity*, 2008.

Conniff, R., "What Are Species Worth? Putting a Price on Biodiversity," Yale Environment 360, Yale School of Forestry and Environmental Studies, http://e360.yale.edu/feature/what_are_species_worth_putting_a_price_on_biodiversity/2322/

Open letter to the BC government, 27 Sept. 2010, by Scientists for Species, signed by numerous scientists at BC universities, calling for a BC Species at Risk Act, available at: www.scientists-4-species.org/

Conservation Planning and Mapping

Craighead, L., "A Conservation Area Design of the Inland Rainforest of Canada," 2004.

Craighead, L., and Cross, B., "Identifying Core Habitat and Connectivity for Focal Species in the Interior Cedar-Hemlock Forest of North America to Complete a Conservation Area Design," USDA Forest Service Proceedings, RMRS-P-49, 2007.

Glacier National Park

"Ecological Land Classification of Mount Revelstoke and Glacier National Parks, British Columbia, Vol. 1 & 2, Ed. Achuff, P.L. et al.

Mount Revelstoke, Glacier and Rogers Pass Management Plan, www.pc.gc.ca/docs/v-g/bc/glacier/pd-mp/sec4.aspx.

Fish and Fish Habitat

Bergdahl, J.C., "Bull Trout Streams of the Upper Columbia River Basin of Southeast British Columbia, with Notes on the Char's Ecology and Conservation Biology," Mar. 16, 1998.

Columbia Basin Fish & Wildlife Compensation Program, Annual Reports, 2003-04 to 2008-09.

Decker, S., and Hagen, J., "Distribution of Adfluvial Bull Trout Production in Tributaries of The Arrow Lakes Reservoir And The Feasibility Of Monitoring Juvenile And Adult Abundance," Columbia Basin Fish and Wildlife Compensation Program, B.C. Hydro, June 2007.

Decker, S., and Hagen, J., "Adfluvial Bull Trout Spawner Abundance in Tributaries of the Arrow Lake Reservoir (2004-2007)," Columbia Basin Fish and Wildlife Compensation Program, B.C. Hydro, June 2008.

Legebokow, C.S., "Akolkolex River: Addressing Fish and

Wildlife Habitat Values," *Streamline: Watershed Restoration Technical Bulletin*, Vol. 2, No. 4.

O'Brien, D. S., "Bull Trout Spawning Migrations in the Duncan River: Insights from Telemetry and DNA," Columbia Basin Fish & Wildlife Compensation Program, April, 2001.

Seaton, P., "Fish and Fish Habitat Inventory of the Incomappleux (Fish) River Tributaries," Pope & Talbot Ltd., 1998.

Inland Temperate Rainforest and Lichens

Arsenault, A. and Goward, T., "Ecological Characteristics of Inland Rain Forests," *At Risk: proceedings of a conference on the biology and management of species and habitats at risk*, Kamloops, BC 15-29, ed. L.M. Darling, 1999, Vol. 1, pp. 437-439.

Björk, C., "Distribution patterns of disjunct and endemic vascular plants in the interior wetbelt of northwest North America," *Botany* 88:409-428(2010).

Goward, T. and Spribille, T., "The Inland Rainforest Formation of Northwestern North America: A Lichenological Perspective," 2002.

Goward, T. and Spribille, T., "Lichenological evidence for the recognition of inland rain forests in western North America," *J. Biogeogr.*, 2005, 32, 1209-1219.

Lichthardt, J., "Inventory of Giant Western Redcedar Groves on the Clearwater National Forest: 1998 Survey," Idaho Conservation Data Center.

Ministry of Forests, "The Ecology of the Interior Cedar-Hemlock Zone," QP #19043.

Spribille, T., "Oceanic Macrolichens in the Incomappleux River Valley, southeastern British Columbia," Report to the Valhalla Wilderness Society, 2002.

Spribille, T., "Report on botanical surveys in the Incomappleux River," Report to the Valhalla Wilderness Society, 2004.

Spribille, T., Björk, C., Ekman, S., Elix, J., Goward, T., Printzen, C., Tonsberg, T., Wheeler, T., "Contributions to an epiphytic lichen flora of northwest North America: I. Eight new species from British Columbia inland rainforests," *The Bryologist*, bryo-112-01-08.3d 24/7/08 12:44:30.

Mountain Caribou

Apps and McLellan, "Factors influencing the dispersion and fragmentation of endangered mountain caribou populations," *Biological Conservation* 130 (2006), p. 84-97.

Edwards, E.Y., "Fire and the Decline of Mountain Caribou," *Journal of Wildlife Mgmt.*, Vol. 18, No. 4, Oct. 1954.

Hamilton, D., and Herbison, B., "Central Selkirk Caribou Project," Annual Report, September, 1998, for Slocan Forest Products.

Herbison, B., "Central Selkirks Caribou, Historic to Present Times: Apparent Trends and Emerging Priorities," for Pope & Talbot, Ltd., 1996.

Nanuq Consulting, "Central Selkirk Caribou Project," Annual Report, September, 1997, for Pope & Talbot.

Central Selkirk mountain caribou census data and wildlife

sighting information reports, 1996-2008, available on government website <http://a100.gov.bc.ca/pub/siwe/details.do?id=723>.

Sinixt Occupancy

Ray, Verne, "Native Villages and Groupings of the Columbia Basin," *Pacific Northwest Quarterly* Vol. XXVII, 1936.

Elmendorf, W., "Lakes and Spokane Field Notes." Unpublished. Copy on file with B.C. Archives.

Bouchar, R. and Kennedy, D., *First Nations' Ethnography and Ethnohistory in B.C.'s Lower Kootenay/Columbia Hydropower Region*. Columbia Power Corporation, Castlegar, B.C. August, 2000. 2nd printing, April 2005.

Wildlife (Other than caribou)

Krebs, J. A., and Lewis, D., "Wolverine Ecology and Habitat Use in the North Columbia Mountains: Progress Report," *Proc. Biology and Mgmt. of Species and Habitats at Risk*, Kamloops, BC, 15-19 Feb. 1999.

Laliberte, A.S., and Ripple, W.J., *Bioscience* 54:123-138, 2004, Oregon State University and the U.S. Department of Agriculture.

Proctor, M.F., et al., "Genetic analysis reveals demographic fragmentation of grizzly bears yielding vulnerably small populations," *Proc. R. Soc B* (2005) 272, 2409-2416.

Woodroffe, R., and Ginsberg, J.R., "Edge Effects and the Extinction of Populations Inside Protected Areas," *Science*, Vol. 280, 1998.