Endangered Forests of the Inland Temperate Rainforest:

An inventory of old-growth in Trout Lake and the Incomappleux

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Table of Contents

EXECUTIVE SUMMARY

Within the Inland Temperate Rainforest, wetter portions of the Interior Cedar Hemlock zone are naturally dominated by old-growth forests. Old-growth forests can be defined in various different ways, including using age, development stage or structural attributes, but using a variety of criteria to rank the 'old-growthness' of stands has been promoted (Franklin and Spies 1991) as a robust approach to assessing and ranking the values associated with individual stands.

In this pilot project we used an existing index of old-growthness to identify old-growth forests with 'exceptional' conservation values (Holt and MacKillop 2002). This approach uses a number of different variables (including tree ages, tree and snag sizes, etc) to identify those stands that contain unusual or extreme old-growth associated attributes. Potential high value stands were located and sampled for a variety of structural attributes and ages of trees. The old-growthness of these potentially exceptional forests was then compared to that of a larger sample of old-growth forests using data from a previous study (Holt and MacKillop 2002; MacKillop 2003).

This pilot study was limited in geographic scope – study areas were chosen from accessible areas within the Incomappleux drainage and within the Trout Lake and Upper Lardeau Areas. Nine different areas were sampled and data were summarised for individual sample sites within each area. A number of the areas sampled stood out as having exceptional 'old-growthness' based on both age and stand structural values. Outstanding areas include:

a) The upper Incomappleux drainage from the McDougal / Incomappleux confluence (referred to as Battle Brook, North and West Incomappleux in this study) which contained some of the oldest (estimated between 1200 and 1500 year old) trees, and huge stand structures (many trees with 2 and 3m diameters at breast height). This area has additional conservation value because it is currently unfragmented by roads and is adjacent to the boundary of Glacier National Park. This area also has known locations of rare oceanic lichens (Arsenault 2004; Spribille 2002; 2004). This area is within Pope and Talbot's Tree Farm License 23.

b) Small, remnant areas located in the mid section of the Incomappleux drainage (areas referred to as Scott and Ruby Silver) which have very old and very large trees, and so have very high stand-level old-growthness. Their total conservation value is lower than the far end of the Incomappleux because they are located within a heavily harvested local landscape. However, they remain valuable as remnant patches of very old forest in this portion of the drainage. These areas have not been sampled for the presence of old-growth associated rare lichens. These areas are within Pope and Talbot's Tree Farm License 23.

c) Trout Lake Private Land #1. This area is a relatively small area with very old trees (estimates range from ~800 – 1400 years old) and very large trees (up to 2.7m dbh). The location of this area increases its conservation value, as it is adjacent to a large low elevation wetland-lake complex that also has high biodiversity values. This area is private land and there is a conservation opportunity through application of a conservation covenant or similar tool.

d) The Lardeau Alpha area is located on a small, narrow bench area adjacent to the Lardeau River (close to Ferguson). Two areas (~2 km apart) were sampled here: one in 2005 and another in a previous project (Holt and MacKillop 2002). Both sampled areas are located on Crown Land (Arrow Timber Supply Area) and were found to have high old-growth structural value (trees up to 1.9m dbh).

e) Boyd Creek (a tributary of the Incomappleux) contains high value old-growth forests, which are not as large-structured or as old as some of the stands identified in this study. However, we also note that Boyd Creek is at higher elevation, in a different mesoslope position, and of a drier (more mesic) site series than the other stands sampled. Given these differences, it should not be expected to contain the same exceptionally large attributes as the wetter sites. We did find that some sites within the Boyd area contained unusually old hemlock trees (500 years plus) and old and large western redcedar trees (~500 – 800 years old and 1.8m dbh).

This area remains of conservation interest even though it is not 'exceptional' old-growth because of its old-growth trees (600 / 700 years old), its location as potential connectivity to the Westfall, and as value for mountain caribou recovery habitat. This area is within Pope and Talbot's Tree Farm License 23.

When assessed for combined stand and landscape level attributes, the upper Incomappleux areas and the Trout Lake Private Land #1 were given the highest old growth rating. Note however that the conservation values of these stands are based on a) a stand level assessment of their 'old-growthness' and a landscape level assessment of their size and location. Many other factors can also contribute to conservation values (e.g. habitat values of particular areas), but these additional factors are not included in this assessment.

The strongest conservation opportunities exist for the Trout Lake private land area #1, which has the possibility of having some form of conservation covenant applied to it. This approach would allow its attributes to be maintained while providing value to its present owner. Without this, the long-term future for this stand is uncertain.

Conservation opportunities for the areas located within TFL 23 (e.g. the McDougal/ Incomappleux area and Boyd Creek) are currently poor, given current management regulations for crown land. Landscape planning does not differentiate between average 'old-growth' of approximately 250 years in age and the exceptionally old and large structured forest identified in this project. Old Growth Management Areas, which are intended to maintain local biodiversity values within landscape units, are preferentially located outside the timber harvesting landbase (Province of BC 1999). Although not mandated by current policy, Pope and Talbot have suggested they may have an interest in deferring harvest in one of the sites identified in this study (Battle Brook), but have existing cutting permits and road layouts for other identified exceptional stands in the same general area (North and West Incomappleux). This entire zone (from the junction with McDougal Creek and the Incomappleux) makes a logical area for conservation since it contains exceptional old-growth values and is adjacent to the Glacier National Park boundary.

Boyd Creek remains relatively intact (at least in its upper portions) but conservation opportunities within the timber harvesting landbase remain very poor. There are no measures within provincial policy that encourage protection, or low impact harvesting. Harvesting to date in this area has been clear-cut harvesting, which is incompatible with natural disturbance regimes in this forest type. Identifying exceptional areas within Boyd Creek as retention areas (e.g. as wildlife tree patches) and maintaining old-growth structures throughout any cutblocks (i.e. high level retention partial harvesting) would maintain some of the conservation values in this area, and may improve the value of the area for mountain caribou recovery habitat (Milt Hamilton pers. comm.).

Conservation opportunities for the Lardeau Alpha area, which is on crown land, are reasonable because the area lies between the road and the Lardeau river. Some of this stand would be maintained as part of the default riparian management requirements under the Forest and Range Practices Act (FRPA), although the whole stand would not be protected. We suspect that additional similar areas exist along the river on similar bench sites and should be protected under the discretion provided as part of FRPA.

In addition, we recognise that this pilot project did not locate all exceptional old-growth or high conservation value forest stands. A basic theming of potential areas where these forests may exist shows that other areas may remain (Map 2a and 2b). For example, relatively large potentially exceptional forests remain in the Incomappleux drainage along McDougal Creek, in Boyd Creek, above Menhinick and Scott Creeks, and above McRae Creek. These sites should be explored for exceptional old-growth values before additional important conservation opportunities are precluded. Very few potential sites remain in the heavily harvested Trout Lake study area, other than those sampled here.

Acknowledgements

We thank a number of people for their input into this project. John Krebs (CBFWCP) and Stewart Clow (MoAL) helped with initial project design, and reviewed the final report. Amy Waterhouse produced maps. Dale Anderson provided input into available old growth attribute data residing in Kootenay Lake Forest District. Jakob Dulisse helped with field work and provided some of the photos within the report (credit given where used). Laney Benson volunteered in the field.

We also thank the private landowners for their permission to sample forests on their lands.

INTRODUCTION

OLD GROWTH FORESTS IN THE INLAND TEMPERATE RAINFOREST

The Inland Temperate Rainforest (ITR) is the only location on the earth where 'temperate rainforest' occurs away from a coastal region (Arsenault and Goward 2000). This Rainforest is a broad but disjunct region located from west of Prince George to south of the US border, bounded to the east by the Rocky Mountains and to the west by the windward side of the Columbia Mountains. Within the northern section of the ITR (Northern Columbia Mountains ecoregion and Central Columbia Mountains ecosection) forests are characterised by wet and very wet Interior Cedar Hemlock (ICH) forests at lower elevations and Engelmann Spruce-Subalpine Fir (ESSF) zones at higher elevations.

Large-scale natural disturbances in these forest types are relatively infrequent. Fires do occur but are naturally quite rare in the wet and very wet subzones (Meidinger et al. 1988, Lloyd et al. 1990, Braumandl and Curran 1992). Avalanches and landslides are quite common 'medium-sized' disturbances but these tend to occur on specific and repeated areas of the landscape. At a smaller scale, the forest itself is characterised by disturbance events caused by death of trees from old age, insects, disease and windthrow. This combination of disturbance types at multiple scales results in a natural landscape that is dominated by old-growth forests.

The term 'old-growth forest' is often used ubiquitously to describe forests greater than a certain age. However, it is well known that 'old growth' exists along a continuum of development, with a range of biological values present in stands of different ages, disturbance histories and structural attributes (Franklin et al. 2002). In the wet and very wet Interior Cedar Hemlock zones 250 years is used as the cut-off for defining old growth provincially (Province of BC 1995), although individual trees and stands of trees are often considerably older. Where there are very long timeframes without large disturbances, 'antique' forests can develop: – here the stand of trees is much older than the age of individual trees. For example, trees within a stand may be 900 years old but the stand itself may have remained undisturbed for 2,000 years or more.

LANDSCAPE HISTORY

Over the last 100 years or so, the natural habitats in the ITR have been impacted primarily by two types of development: damming and the resulting inundation of major river systems, and forest harvesting. Together these two activities have had a significant impact on lower elevation ecosystems of the region, and previous work (Holt 2001; Holt et al. 2004) has identified these two activities as the primary threats to maintaining biodiversity in this region. In some more localised areas (e.g. Trout Lake) historic impacts of larger settlements related to mining activities have also had significant impacts on low elevation forests and associated wildlife such as mountain caribou populations.

Habitat types lost due to dams in the Columbia Basin were mapped using interpretation of airphotos taken prior to flooding (Ketcheson et al 2004). The full impacts on habitat, ecosystems, and wildlife are not yet available in summary form, but prime habitat types that were impacted include cottonwood ecosystems, wetland / riparian complexes and low elevation coniferous old growth (G. Utzig pers. comm.).

Forestry activities have also tended to focus initially on lower elevation sites, and many major lower elevation valleys have little or no remaining old growth stands of any significant size (e.g. Duncan River drainage, Lardeau River, lower Incomappleux River). Ancient forests with 'exceptional' stand structure tend to be located on low elevation, moisture-receiving sites and so have been particularly impacted by historic harvesting.

RARE OR EXCEPTIONAL OLD GROWTH

In many temperate regions of the world old-growth forests themselves are rare; in the ITR, natural old-growth forests remain relatively common. From a conservation perspective, it is therefore useful to identify the characteristics that would distinguish rare or exceptional old growth in these ecosystems.

Assessments of the conservation value of a particular ecosystem or forest stand should consider multiple scales and different approaches to defining value or rarity. Ecosystems may be rare 'naturally' (i.e. they were never prevalent on the landscape), or they may be rare as a result of development activities that may have reduced the distribution of a formerly abundant ecosystem.

In addition, ecosystems or forests may have high conservation value as a result of having high habitat values (for example, for caribou in this area), for rare and endangered species, for the presence of a high diversity of values, or for landscape values such as connectivity.

Globally and Nationally: the forests of the ITR are 'rare' and are of conservation value because of the unique suite of factors that has allowed the development of this 'oceanic' forest type in a continental (inland) environment (Arsenault and Goward 2000). This general statement is useful for placing watershed and stand scale conservation discussions into an appropriate context.

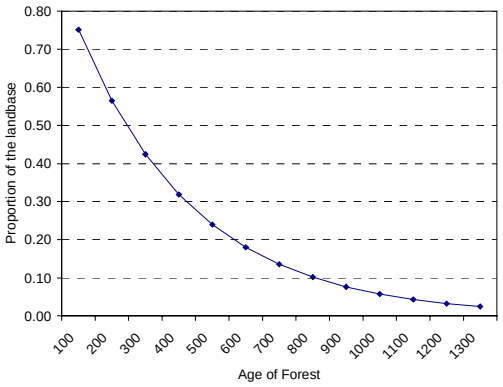
Landscape / Watershed scale: at this scale, intact or primarily intact areas are of conservation interest because they are relatively rare on the landscape. In previous studies we have noted that there are relatively few large tracts of low elevation old forest remaining (Holt 2001, Holt and Mackillop 2002, Holt et al. 2003), and that the landscape context of a particular stand can add or detract from its overall conservation value (Noss 1996).

Stand level: this work is primarily aimed at the stand level. At this scale, useful criteria for identification of high conservation value forests include:

a) Large structured forests. These tend to occur on valley bottoms, benches and moisture-receiving sites on side slopes. These forest types are relatively rare naturally because they tend to be located only on the highest productivity sites, or on lower productivity sites that have been undisturbed for very long periods. They are additionally rare because they have been targeted by forest harvesting over the last century and impacted by inundation due to dams.

b) Exceptional aged (antique/ ancient) forests. These forests are naturally relatively rare, based on natural disturbance patterns. For example, in a forest type where the average stand-replacing disturbance interval is 500 years, it should be expected on average that 14% of the area would exist as stands ≥1000 years old. Alternatively, if the mean disturbance interval is 250 years, that percentage would drop to less than 2% of the landbase as forest ≥1000 years old[1]. Very old forests are therefore rare on the landscape (see adjacent Figure).

Assuming a stand-replacing disturbance interval of 350 years.



c) Large-structured and very old forests. The two options (a and b above) do not always occur together: large forests are not necessarily very old, and very old forests may not necessarily

[1] These estimates are based on the "exponential" equation: % stands greater than age t = exp(-(t/b)), where b is the average stand replacing disturbance interval (Ministry of Forests and Ministry of Environment, Lands and Parks 1995).

be large structured. Where these two values overlap in a geographic area the forests can be considered particularly high conservation value.

d) Riparian Forests. Riparian forests have been significantly reduced in the region as a result of damming of major river systems. Riparian forests may or may not be particularly old as riparian areas often have higher rates of disturbance than adjacent upland areas. However, they tend to be highly productive ecosystems, often harbour rare or endangered species and provide a high diversity of habitat types.

MANAGEMENT CONTEXT

On Crown land in BC, old growth forests are identified on the basis of estimated stand age. Forests in the wet ICH biogeoclimatic subzones that are greater than Age Class 9, or 250 years old, are tagged as being old growth forests. However, it is widely recognised that this definition fails to identify the important structural attributes of old growth forests, and also fails to differentiate between the wide range of forests that are all older than 250 years in age. For example, forest stands that are 251 years old and those that are 500 years or 800 years old are considered equal for the purposes of planning under BC forest policy (e.g. Landscape Unit Planning Guide (LUPG), Province of BC 1999). In addition, protection of old growth through the identification of Old Growth Management Areas must preferentially select old forests located outside the timber harvesting landbase where possible (Province of BC 1999). In many areas, this limits OGMA locations to steep or potentially unstable slopes, riparian areas, or other environmentally sensitive sites. These policies raise concerns that available tools fail to identify those forests of greatest conservation concern.

Some work has occurred locally (Dale Anderson MoFR KLFD; Stewart Clow MoAL; Mike Knapik MoE) to identify forest stands on the basis of their structural attributes, however, because of the limiting rule-set provided by the LUPG (Province of BC 1999) this has tended to result in younger or less structurally diverse stands being identified as "old growth" rather than identifying the oldest / highest structure stands for retention.

On Private Land in BC, there are no provincial regulations regarding protection of rare or unique values, unless the private land is part of a Managed Forest agreement (e.g. part of a Woodlot License) in which case the standard BC forest policy as described above applies. The Federal Fisheries Act also applies to private land, although its protection value for riparian forests may be limited in this case (J. Krebs pers. comm.).

OBJECTIVES

The specific objectives of this project were to:

- Identify old-growth forest areas of particularly high conservation value, focusing on stand level values. The types of stands that may meet 'high conservation value' criteria are those of exceptional age, exceptional stand structural attributes or a combination of both factors (as outlined in the Introduction). Forests were examined on both private[2] and crown lands.
- Summarise attributes in these local forest locations from our data and other existing projects.
- Identify conservation opportunities for old-growth forests of high conservation value, as appropriate.
- Produce a digital map that links data from this study and other available information on old growth to forest cover inventory data.

[2] For reasons of confidentiality the areas of private land in this report are identified by number rather than by owner or location. Details of ownership are summarised in Appendix X which is unavailable to the general public.

STUDY AREA

This pilot project focused on two broad areas: a) accessible areas within the Incomappleux drainage (Map 1a) and b) the areas within Arrow Forest District adjacent to Trout Lake (Map 1b). These two areas were chosen because of good access into potential sites of interest.

INCOMAPPLEUX

The Incomappleux drainage (also known as the Fish River) is located adjacent to the Duncan and Battle Ranges, within the Central Columbia Mountains Ecosection. The drainage is approximately 70km long and flows north-south, rising within Glacier National Park and flowing south into the Northeast (Beaton) Arm of the Upper Arrow Lake (Reservoir). The river rises in the Battle Range and is joined by Battle Brook before it is confined for a short distance within a rock canyon less than 5m across. It is joined by McDougal Creek approximately 10km downstream from its confluence with Battle Brook and then becomes largely a braided river system that criss-crosses the valley floor for the lower half of its length. The valley bottom here is relatively low elevation (approximately 2000ft / 680m), wide and flat. The river moves through another canyon before entering the Upper Arrow Lake (Reservoir) at Beaton. Major tributaries in the lower portion of the drainage include Boyd, Poole, Mohawk, Sable, Scott, Lexington, McRae, and Menhinick Creeks.

The lower elevations of the drainage are located within the wet, cool and very wet, cool Interior Cedar Hemlock (ICHwk1 and ICHvk1) biogeoclimatic subzone variants. Higher elevations are within wet cool subzone variants of the Engelmann Spruce-Subalpine Fir zone (ESSFwk1 and ESSCwk4), with parkland and alpine tundra at highest elevations.

The extensive riparian ecosystems of the Incomappleux consist of a wide range of cottonwood, spruce, wetland-marsh complexes that cover a large portion of the wide valley floor. Much of the accessible conifer-dominated forest in this zone has been previously harvested. We did not sample the extensive riparian habitats remaining – though there are no doubt areas of high conservation value remaining here.

Historically, the area has seen extensive activity. The old mining townsite of Camborne, located just after the lower canyon, impacted much of the low elevation areas in the south end of the drainage, including historic partial cutting (high-grading) at the turn of the 20th century. Harvesting has occurred throughout much of the valley, with recent harvesting up to very high elevations.

A number of tributaries (particularly Poole and Mohawk Creeks) have high value mountain caribou habitat, but were not sampled as part of this study.

The entire area sampled within the Incomappleux is crown land and is tenured as part of TFL23 (Pope and Talbot).

TROUT LAKE

Two different areas were sampled close to Trout Lake: within the Trout Lake valley itself and in the adjacent tributary drainage of upper Lardeau Creek (Map 1b). Lower elevations are located within the wet cool and moist warm interior cedar hemlock subzone variants (ICHwk1 and ICHmw2) and higher elevations are within the Engelmann Spruce-Subalpine Fir wet cool subzone variants (ESSFwk1 and ESSFwk4), with parkland and alpine tundra at higher elevations.

The valley bottom between Trout Lake townsite and the top of the Beaton Hill is an area of extremely high ecosystem diversity and biodiversity value. Two main creeks create the area: Wilkie Creek flows down to the valley floor then turns southeast, eventually flowing into Trout Lake, while Beaton Creek flows northwest through two small lakes (Staubert Lake and Armstrong Lake) and eventually flows into the Beaton Arm of Upper Arrow Lakes Reservoir. Highway 31 (partially paved) runs through the valley.

The drainage of both these systems has created an extensive riparian complex of wetlands, including marshes, swamps, cottonwood ecosystems, and coniferous forest (primarily western

redcedar and western hemlock with apparently a smaller spruce component). Water levels are extremely variable with extensive flooding through much of the area in the spring that dries out in fall and early winter. An area of slightly higher land exists in the divide between Beaton and Wilkie Creek watersheds. Photos 1 and 2 provide views of the wetland areas.

This mix of habitat types provides a high level of biodiversity values. No 'wildlife' sampling was undertaken for this work, but potential species using the area include ungulates (elk are commonly and moose more rarely found – I. Linden pers. comm.); historically the area was used by mountain caribou in early winter (I. Linden and A. Marlow pers. comm.) though it does not appear to be used today likely due to extensive local fragmentation of surrounding old growth forests; carnivores (grizzly, black bear, wolves, occasional cougar) use the area, as likely do smaller carnivores such as marten. A wide diversity of breeding birds are likely (there are suspected bald eagle nests, heronries, osprey nests, and common loon nesting locally) plus an unsampled diversity of neotropical migrants and waterfowl. Possible owl species include western screech owl, great horned owl, barred owl, pygmy owl and northern saw-whet (J. Dulisse pers. comm.). Possible reptiles and amphibians include Columbia spotted frog, Pacific treefrog, western toad, long-toed salamander, western terrestrial garter snake and common garter snake (J. Dulisse pers. comm.). Bats (unknown species) are known to roost in large cedar trees within this area. Similarly, no vegetation sampling was undertaken in the wetlands, but there is an obvious diversity of riparian habitat types and the potential for a large diversity of plant species locally.

The headwaters of the Lardeau drainage were also assessed in the Trout Lake area as part of this study (i.e. prior to it joining Trout Lake – no areas south of Trout Lake along the Lardeau were sampled). This area has historically been settled (townsites of Ferguson and Ten Mile) by relatively large numbers of people and much of the lower elevation areas have been either harvested or impacted by settlement. Adjacent to the river there are relatively narrow strips of forest remaining between two mainline roads, and some of these were sampled in this and previous studies (Lardeau Alpha). More extensive stands remain at higher elevations, although only one stand (Upper Lardeau) was sampled here. The entire upper Lardeau drainage is important habitat for mountain caribou, but stands were not assessed on that basis.

See Appendix 5 for a summary of land ownership in relation to the stands sampled in this study.

METHODS

SITE SELECTION

This pilot project focused on two broad geographic locations – the Incomappleux and Trout Lake, as described above.

Within these broad zones, we targeted several areas, with each area defined as a group of stands that were within a few kilometers of one another and that had similar characteristics. Individual 'stands' or 'sites' were then sampled in each area (e.g., broad geographic location = Incomappleux, area = North Incomappleux, site = plot 1, 2, 3 etc). Specific candidate sites for sampling were located using the following:

a) existing information that suggested an area was high conservation value based on stand level old-growth attributes (this included discussions with local biologists, ministry staff (ILMB / MOF / MoE), ENGOs etc),

b) previous field reconnaissance taken as part of other local projects (e.g. the ICHwk1 old growth sampling project, Holt and MacKillop 2002),

c) use of maps to locate likely candidate areas for 'rare' forest types. This included looking for existing stands greater than 140 years old (from forest cover) located on bench or toe slope areas. These are two topographic locations that tend to promote development of larger and /

or older stands due to moisture availability and lack of disturbance, (see further description below and Maps 2a and 2b),

d) additional sites were also sampled or visually assessed when encountered (e.g., drive-bys and walk-bys).

In some cases, we walked into a stand of potential interest, but if attributes did not appear to be in the higher end of the range of sites seen we did not sample within those stands. This was the case in several stands near the Ferguson townsite (north and east of town) and along the slopes above Trout Lake.

Where smaller stands or polygons within a well-sampled area appeared to have exceptional values, we used "visual" assessments rather than field data collection. Notes on these sites were recorded and are summarised along with results from other studies conducted in the area (see Maps 3a and 3b).

Note that not all potential 'exceptional old-growth sites' within the two study areas were sampled in this pilot. Two 'potential' maps have been created based on the following criteria:

- Age: Forest Cover, Projected Age Class greater than 7 (140 years),
- Any leading species with the exception of deciduous leading,
- BEC Site Series: 01, 05 in the ICHvk1, 05, 06 in the ICHwk1, and '05' & '06' sites in ICHmw2
- Slope: less than or = 25% (data source: 1:20K DEM)
- All 3 criteria had to overlap in order to make a potential site.

These maps show areas remaining that have the potential to be similar forest types to those sampled in this study. For this study we prioritised stands based on background information and accessibility.

SAMPLING METHODS

Nine local areas were sampled in 2005 (e.g. Battle Brook, North Incomappleux, Trout-PL-#1), with multiple sites/ stands sampled within many of these (Map 1a and 1b). Within each site/ stand two primary approaches were used to assess stand characteristics:

1) variable radius plots, and
2) strip transects.

Variable radius plots are a fast and efficient way to estimate tree size distributions in a stand, and were used at all sites. Strip transects require more detailed measures and were conducted in at least one of the sites/ stands of the most significant areas sampled. Where strip transects were used, at least one variable radius plot was also sampled at the start of the transect.

Plot and/or transect locations were determined in the field based on selection of 'representative' portions of a given stand, with a particular focus on portions of stands with exceptional age and/or structure.

At all sites, basic ecology, mensuration, and stand age characteristics were assessed. Ecology data included lists of dominant and indicator plants, determination of biogeoclimatic ecosystem classification (BEC) site series, soil moisture and nutrient regime, and arboreal lichen assessments, as well as collection of slope, aspect, global positioning system (GPS) data, and mesoslope position. Ecological data were collected at the first variable radius plot in each site sampled (at the start of all transects, and in all single plot sampling scenarios). Supplementary data (quick plots) were collected at the ends of transects (where sampled). Notes on disturbance within stands, such as insects, fire, disease, and logging, were also recorded, as were signs of regeneration on fallen logs.

Variable radius plot sampling, using prism sweeps, focused on tree and snag counts by size class, using the following dbh classes: <7.5 cm; 7.5-17.4 cm; 17.5-29.9 cm; 30-49.9 cm; 50-74.9 cm;

75-99.9 cm; 100-149.9 cm; 150-199.9 cm; ≥200 cm. In many cases, actual tree measurements (dbh and pathology) were recorded for several trees as anecdotal information. Variable radius plots were used at all sites.

Strip transects were also conducted at 11 sites. Each transect was 100 m long by 10 m wide and included measures of dbh, pathology, and wildlife tree class for all trees and snags over 75 cm. Coarse woody debris was also sampled on the first 48 m of each transect using standard line intercept sampling techniques (MELP and MoF 1998).

ANALYSIS METHODS

All measures collected were standardised and summarised on a per hectare basis. For variable radius plots, summaries were based on the mid-point of the dbh classes, since individual tree diameters were not collected. For strip transects, per hectare conversions were based on the area of the transect.

Data were summarised for each individual site within the areas sampled. For example, three sites were sampled in the North Incomappleux area and summaries are provided for each of these sites. Individual summaries of sites are provided rather than combining data into an area average because of the potential heterogeneity within these areas.

AGE ASSESSMENTS

Stand age is difficult to determine in old forests in the wet ICH because internal decay is extremely common in older trees. In this study, a total of 87 tree cores were extracted from dominant and codominant (large) trees and analysed (counted using a light microscope with up to 60X magnification). The majority of cores (70%) were from western redcedar trees, followed by western hemlock (30%) and spruce (1%). These cores were taken from trees ranging in size from 51 cm to 305 cm dbh, with only 5 of 87 cores reaching the centre of the tree without encountering decay.

Where cores were incomplete due to internal decay, age estimates were determined for the missing portions of the tree ring record using a series of average growth ring extrapolation techniques (outlined in Appendix 2). Extrapolations are the only practical means of determining stand age, however, they often have low accuracy, particularly when only a small portion of the tree ring record is available (MacKillop 2003). For this reason, we have presented a range of ages for each tree including maximum and minimum 'likely' age estimates as well as the most likely estimate (based on our assessment of each of the estimates).

Given the prevalence of decay, cut tree stumps provide a much better platform for estimating ages than do live trees. Where available, ring counts were conducted on stumps in adjacent stands or portions of stands previously logged. Stump counts were conducted in two previously sampled stands (in 2001) where all or part of the area was logged since sampling. In both of these areas, the age assessments summarised in Holt and MacKillop (2002) were considerable lower than those derived from stump counts (e.g., estimate from tree cores for Beaton (2001) = 437 years; estimate from stumps (2005) ranged from 653 - 859 years). This provides evidence for our assertion in the results that 2001 stand age estimates were conservative.

When discussing stand age, foresters will often refer to the mean age of dominant and co-dominant trees in an attempt to reflect timber attributes such as the stand's MAI (mean annual increment) or merchantable volume. In very old forests or those with multi-storied canopies, the mean age does not reflect the actual time since stand initiation. The maximum age, or the age of the oldest tree that developed following the most recent stand-initiating disturbance, is a more descriptive term. We have provided both age estimates (mean and maximum) in this report in an attempt to reflect ecological processes as well as standard forestry reporting measures. However, in some of the stands sampled, it is likely that the ages of the oldest trees are still less than the time since stand initiation (Goward 1993).

OLD GROWTH INDICES

Old-growth forests can be rated on the basis of several attributes including stand age and structural characteristics. In this study we focused on finding potentially exceptional old-growth forests, and in order to put them in context with the broader array of old growth forests in these ecosystems, we used an index of 'old-growthness' developed by Holt and MacKillop (2002; Appendix 4) to describe and compare study sites. Using an index to evaluate old growth characteristics has two primary benefits:

1) it provides a framework for assessments based on consistent, standardised measures and objective data, and
2) it ensures that assessments are based on multiple values rather than single attributes such as stand age.

The old growth index for the wet ICH is based on 38 samples from stands located between Trout Lake, the Wood Arm (north of Mica Creek), the west side of the Upper Arrow and Revelstoke Reservoirs, and the east side the Kinbasket Reservoir (north of Golden). The youngest stands sampled were between 80 and 100 years old, while the oldest stands included 'antique' forests that were at least 975 years old. The objective in 2001 focused on sampling a range of sites in terms of stand age (between age class 6 and 9) and geography. The old-growth index developed introduces 'High' and 'Very High' thresholds for several structural attributes including the density of trees and snags by size class and stand age (Holt and MacKillop 2002).

We used the index to rank stand-level attributes of all old-growth stands measured in 2001 and in this 2005 study. In applying the index to our new data, some of the parameters from the original index were modified slightly based on improved information. For example, very large trees (>200 cm or >300 cm dbh) were rare in the sites sampled in the 2001 project, but were more common here. As such, the index did not recognize the potential presence of these large trees. To account for the higher prevalence of very large trees in the 2005 data we added this variable to the index. We also removed two variables from the analysis (small trees and snags) because they were not measured consistently across both studies.

Defining 'best' or 'better' old growth is quite difficult because forests differ in terms of many attributes. Recognising that some stands have different combinations of attributes (e.g. some very old stands have lichen, whereas others do not, or some have a multi-storied canopy whereas others are dominated by large cedar trees with little other structure amongst these groves), we used variations of the old-growth index that included or dropped different variables in an attempt to account for some of this variability. In this way we could provide a relative ranking of stands while identifying those areas that consistently appear close to the top of the list (even with variations in criteria). The versions of the index used were: a) "full index" which included all variables b) addition of a large snag measure ("full index + maximum snag"), c) full index minus trees 17.5-30 cm dbh ("no small trees") and d) a combination that excluded all these measures ("minimal index").

OLD GROWTH RATINGS

The index scores for each site were used to determine a stand-level rating for each of the sites sampled in 2001 and 2005. Final stand-level ratings were based on an average score across the four versions of the index used. Overall landscape-level ratings were also developed based on stand-level attributes, intactness, rarity or uniqueness at a landscape scale, and landscape connectivity.

RESULTS

Nine different areas were sampled. Within these, 22 sites were sampled with multiple plots and transects within each site. Throughout the report two complementary maps are used to show the

study sites, (Map 1a and 1b), potential areas of interest (Map 2a and 2b) and overall ranking results (Map 3a and 3b).

Results are compiled in different formats:

a) **As a comparison of attributes.** Stands are ranked based on their sampled attributes with three comparisons:
i) the index of old-growthness is used to evaluate the sites sampled for this study. An effort was made here to find the 'best' stands so this is a comparison largely between 'exceptional' stands,
ii) the index of old-growthness is used to compare attributes in a wider range of stands within the wet ICH that were sampled in 2001 for development of the old-growth index. This wider comparison provides a better overview of the ranking of each plot in relation to the broader definition of 'old growth' in the ICHwk1 and ICHvk1 since it is based on a larger number of plots from a wide geographic area.
iii) a summary of 'very large' trees (>200cm dbh) is provided since these attributes are rare across the landscape and were particularly lacking from many of the stands previously sampled. Densities of very large trees give an indication of the large structural attributes present in a limited number of stands sampled.

b) **As a description and summary of information for each stand sampled in this project**. A summary of values present (attributes, ages, old-growth index, landscape values) is provided.

c) **As a summary of overall rankings**: Map 3a and 3b, and Table 11, show both stand and landscape level rankings given to each area, plus a total overall ranking derived from a combination of these two.

A) A COMPARISON OF ATTRIBUTES

The old-growth index was used to assess the overall suite of structural and age attributes within plots from different old forest stands. The index was initially intended to help identify stands that may meet a definition of 'old growth' based on a combination of structural attributes, rather than simply using the single definition used by MoF as greater than 250 years old. In this work the index has a slightly different use - to compare stands which are all clearly 'old-growth' but to give them a relative ranking based on a combination of attributes.

I) COMPARISON WITHIN PLOTS SAMPLED FOR THIS STUDY

Figure 1 shows how the plots within stands compare with each other (for this project) depending on the different index variables used. The figure is 'sorted' by the 'full index' and the additional points show how stands move in terms of relative ranking based on different indices.

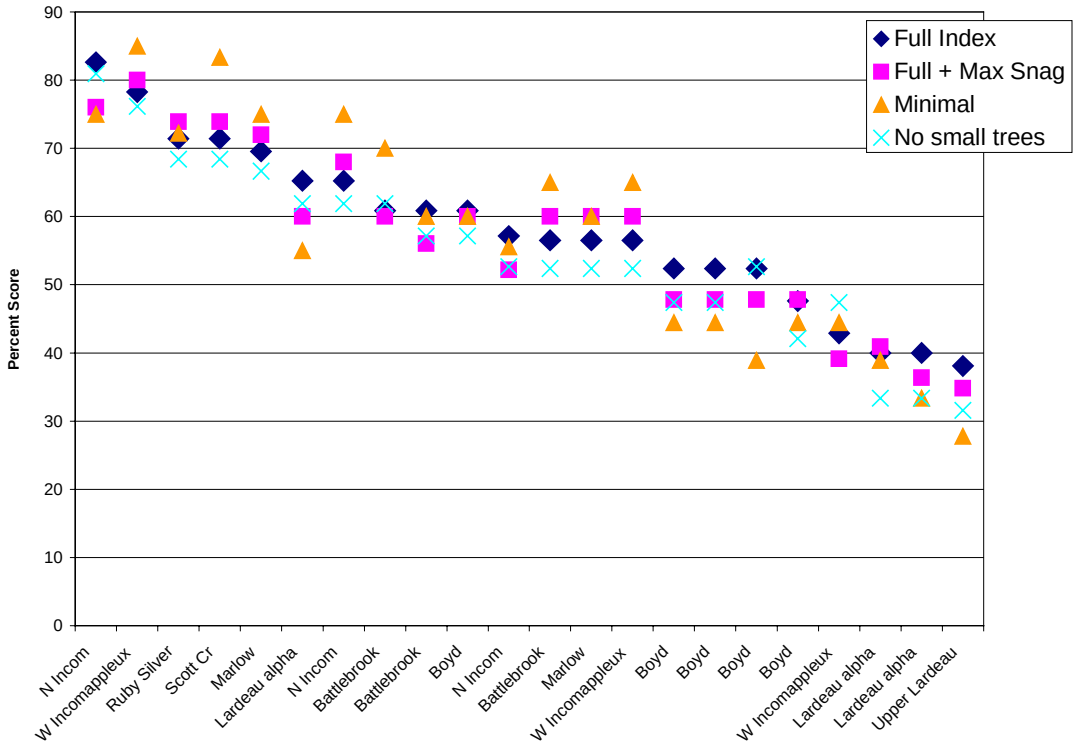


Figure 1. Relative ranking of stands based on different versions of the old-growth index.

In general, the ranking of plots remains very similar irrespective of the index variables used, which is what we would expect if there is any robustness to the approach. However, individual plots also shift positions based on individual attributes, with most changes from the 'full index' occurring when using the 'minimal index'. This latter index had a tendency to increase the rank of certain types of plots (particularly open / single storied stands dominated by large / old trees).

Using all of the variable combinations, one site from each of the North Incomappleux, West Incomappleux, Trout-PL-1, Scott Creek, and Ruby Silver areas stands out most clearly. One of the Lardeau Alpha sites, as well as two Battle Brook and one Boyd Creek site also stand out from the other sites in terms of age and structural attributes. Note that this ranking procedure simply identifies those that stand out further within this group.

Note also that within this group sampled, some sites are not always comparable- e.g. Boyd Creek sites tended to be mesic and at higher elevation, so they would not really be expected to have the attributes of a toe-slope position, lower elevation site such as North or West Incomappleux.

II) COMPARISON OF STANDS SAMPLED IN 2001 AND IN THIS PROJECT

To provide more context to the relative old-growth rankings, we then compare the sites sampled for this project with the larger pool of sites sampled in 2001 as part of the index development. Figure 2 shows this comparison, using the 'full index' of old-growthness.

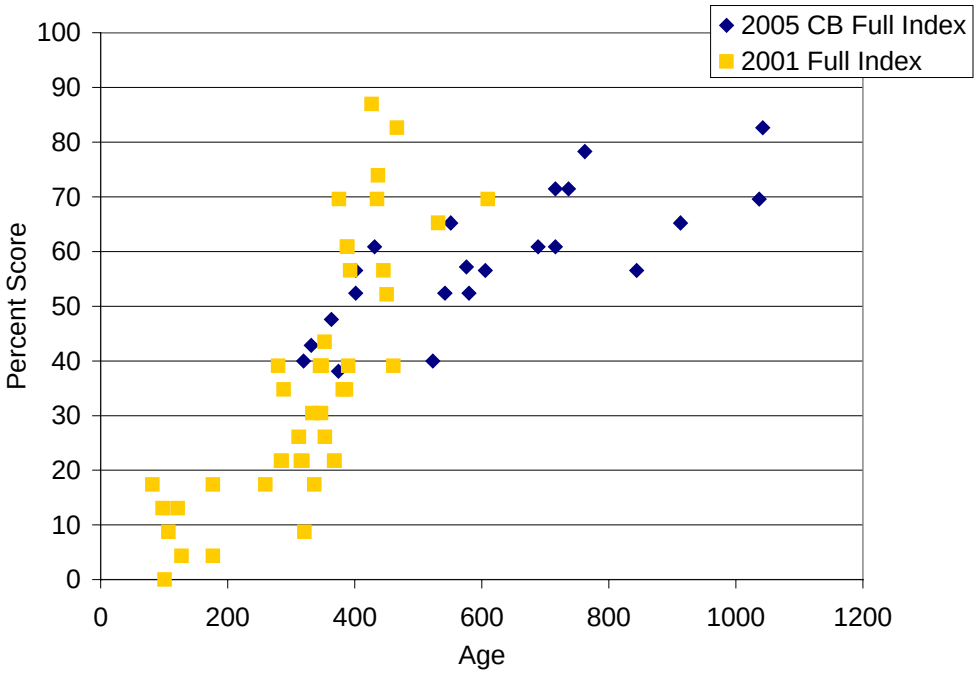


Figure 2. Comparison of 2005 data from this study with that collected in 2001 in the larger ICHwk1 study.

The first thing to note is that the stands sampled in 2005 generally appear to be older than those sampled in 2001. This trend is generally correct, but we note that a more conservative estimate of age was used in the 2001 work; this was confirmed when we sampled stumps in stands or portions of stands logged since sampling in 2001 – stand age estimates from stumps were considerably higher than those from the original tree cores. This did not have an impact on index scores for the older stands since the age threshold in the index was based on the conservative estimates (i.e. age threshold for "very high" structural value was 408 years).

The stands sampled in 2005 also tend to have higher 'old-growthness' scores than those sampled in 2001. This is generally because of the higher occurrence of very large trees in stands within the Battle Brook, North Incomappleux, West Incomappleux, Trout-PL-1, Scott Creek, and Ruby Silver areas. These stands also had very high estimated tree ages (see site summaries below). This suggests that most of the stands sampled in 2005 are in fact exceptional in terms of structural attributes and stand age. Again, this is not surprising since the goal of the project was to find and sample 'exceptional' old-growth stands. We also note that there were some 'exceptional' stands sampled in 2001 (Beaton, Moratorium, Liberty, Park, Alpha, Snow, Thor). Locations and descriptions of these are noted in the summary and shown on Maps 3a and 3b.

III) DENSITY OF LARGE TREES

In addition to the index, we summarised the density of 'large' trees (>200cm DBH) in all 60 sites sampled (38 in 2001; 22 in 2005). Figure 3 shows only those sites where very large trees were sampled[3]. Most of the sites (though not all plots) sampled in 2005 did contain these larger trees, while only a few from 2001 (Park, Beaton, Moratorium, Liberty) did. The results here show that high densities of trees with a dbh >200 cm, as sampled in the West and North Incomappleux,

[3] Note that this does not mean that trees >200cm dbh do not exist in these stands. Rather, that sampling did not detect them. For example, the site called Thor (sampled in 2001 in the Pingston Valley) had the occasional tree over 200 cm dbh, but these did not fall into sample plots. While lack of detection is not surprising for rare attributes, we do not expect trees >200 cm dbh to be found at most sites.

are extremely rare at a regional scale (i.e. across the Columbia and Arrow Forest Districts). This rarity in large structure confers additional conservation value on the stands sampled here.

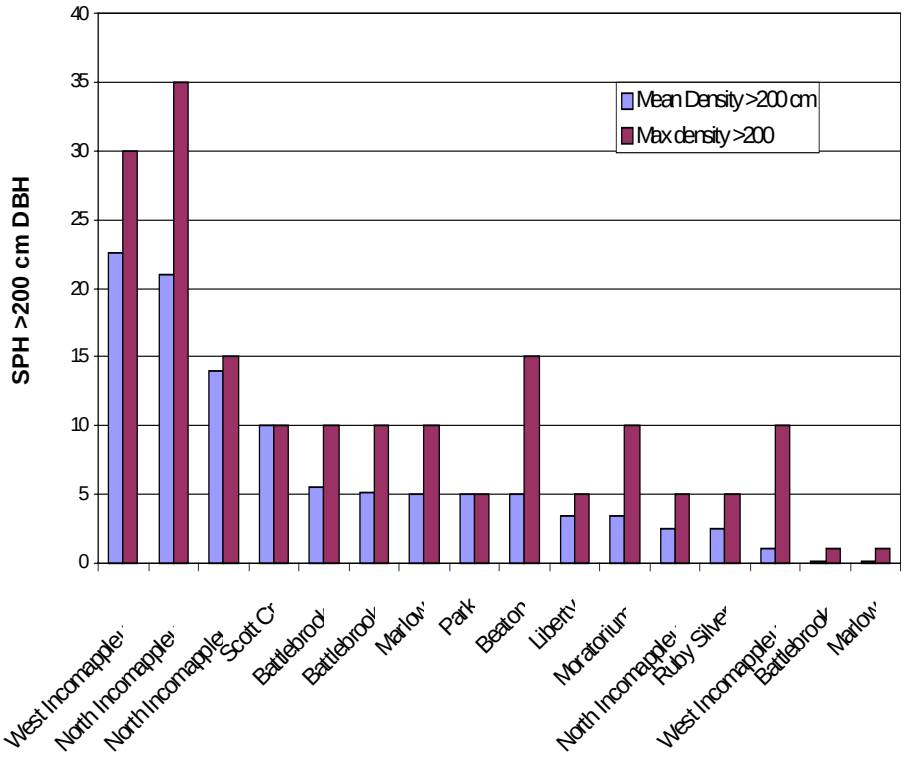


Figure 3. Mean and maximum density of very large (>200cm DBH) trees. Sixteen plots had trees greater than 200cm DBH, including four sites sampled in 2001 (Park, Liberty, Moratorium outside of the study area, and Beaton in the lower Incomappleux); 26 plots did not have trees of this size (not shown).

B) STAND AND AREA DESCRIPTIONS

We visited nine general areas and sampled between one and five sites within each. We named each area based on its general geographic location, although different groupings would also suffice. For example, together the Battle Brook, North Incomappleux and West Incomappleux comprise the back end of the (upper) Incomappleux drainage. Scott Creek and Ruby Silver are in the lower-mid portions of the Incomappleux valley (although on the east and west sides of the river and several kilometers apart), and Boyd Creek is a tributary to the Incomappleux. Upper Lardeau and Lardeau Alpha are in the Trout Lake region and are approximately 20 km apart. Based on these distinctions, the spatial distribution and arrangement of the following stand and area descriptions should be considered when evaluating each individual site. All areas are shown on Map 1a and 1b.

INCOMAPPLEUX – BATTLE BROOK

This stand is located at the northern end of the Incomappleux drainage, at the end of the 'East Fork' forestry road, on the east side of the Incomappleux river between the end of the road and Battle Brook. The 'Battle Brook' stand is at approximately 700m in elevation and is located within the ICHvk1 at the toe of a steep slope and on the relatively flat area adjacent to the Incomappleux River. The area sampled was quite 'benchy' with some steep sections between

benches, so the attributes observed here are located at some distance from the creek up the hillside (Photograph 4).

Three different sites within the Battle Brook area were sampled and are summarised separately in Table 1. One of the described sites was mesic (ICHvk1 04) while the other were generally wet (ICHvk1 01-05 and ICHvk 01). The entire stand is generally open understory on drier/mesic sites with devils club dominating the understory in wetter sites. Throughout the stand large western redcedars dominate the canopy with scattered indication of a full multi-storied canopy. In general, this stand is dominated by groves of very large cedar trees, several with dbh greater than 2 m. A subcanopy layer of western hemlock, ranging in size from 30 to 130 cm dbh, was prominent in the mesic site sampled, and had a varied distribution throughout the remaining sites.

Two of three sample sites had a mean of 5 stems per hectare >200cm DBH, with all plots having between 33 and 44 stems per hectare >100 cm DBH. The high density of large trees and little gappiness suggested that disturbance, even at a small scales within the stand, is rare. This may explain the relatively low level of seedlings noted through much of the stand.

The maximum 'most likely' age was 879 years old, while the oldest estimated age was 1154 years. Dominant and codominant western hemlocks were considerably younger than redcedar (closer to 300 years, rather than between 700 and 1150 years for cedar) (see Table 1).

Table 1. Summary data on tree ages found in Battle Brook. Full data from all trees are found in Appendix 3.

Site No	Area Name	Sp	Max of "Most Likely Age"	Max of "Max Estimated Age"	Max of "Min Estimated Age"
1.1	Battle Brook	Cw	879	1155	686
		Hw	299	354	307
1.2	Battle Brook	Cw	765	1045	630
		Hw	153	156	155
1.3	Battle Brook	Cw	878	836	696
		Hw	271	287	256

Landscape Level Rating: Exceptional

Stand Level Rating: Very High to Exceptional

Summary:

The old growth index shows the Battle Brook plots close to the top of the ranking list (8, 9 and 12th) overall in terms of a combination of structural attributes and age. The specific index used made little difference in these stands, except that the 'minimal index' tended to result in higher ranking for these plots, which may be due to the more dense canopy. In terms of the single attribute of 'very large' trees, all the Battle Brook stands contained large trees >200cm dbh and two of the three plots had very high densities of them (Figure 3).

The Battle Brook stand is exceptional in terms of structural attributes and age when compared to the broader group of old-growth stands sampled during this and previous work (Figure 1). Compared to the 'exceptional' stands sampled in this study the Battle Brook stand ranks high.

In terms of landscape level attributes, the Battle Brook stand has increased conservation value due to its location at the end of a drainage because it is surrounded by other forests that have extremely high conservation values (West and North Incomappleux), and because of its close proximity to Glacier National Park. This landscape context provides a relatively large area of unfragmented exceptional forest. In addition, there are other known high values present here, including lichens and rare plants (see discussion).

INCOMAPPLEUX – NORTH INCOMAPPLEUX

This stand is located at the northern end of the Incomappleux drainage, at the end of the 'East Fork' forestry road and is reached by crossing a log jam over to the west side of the Incomappleux river. More specifically, the site extends from the log jam (~200 m south of the end of the East Fork road) north to the confluence with Battle Brook creek, and may extend further to the north (in areas not sampled). The North and West Incomappleux areas are contiguous, but are described separately primarily for sampling purposes. Polygon 29 (082 K093/29 CwHw 9517-17) separates the two areas, and, although unsampled, has high conservation value and a high density of large trees based on visual assessments (see Photograph 3).

The North Incomappleux stand is within the ICHvk1 and is located at the toe of a steep slope on the relatively flat area adjacent to the Incomappleux. It is on the opposite bank to the Battle Brook stand. The area sampled was primarily located on "benchy" areas with steep sections between the sample sites and the Incomappleux River. Upslope areas are generally steeper with smaller diameter trees, including a higher percentage of western hemlock.

Three different sites within the North Incomappleux area were sampled and are summarised separately in Table 2. All three sites were moist to wet (ICHvk1 01). The entire area is a complex of medium to large sized trees intermixed with very, very large trees. The understory is generally open with devils club dominating the understory in wetter areas, and a more sparse moss/huckleberry/oakfern understory on drier areas. Throughout the stand, large western redcedars dominate the canopy, although western hemlock is present in medium (30 – 100 cm dbh) size classes. An historic component of western white pine was present in the stand, but live trees are rare at this time.

Some of the largest trees found in the study were located in this stand, with several trees over 3 m dbh found at the second site sampled. The maximum 'most likely' age sampled was 1269 years old with an oldest estimated age of 1562 years. Dominant and codominant western hemlocks were considerably younger than western redcedar (between 300 and 500 years old for hemlock, and between 700 and 1300 years for cedar) (see Table 2). All three plots had stems greater than 200cm DBH (ranging from a mean of 3 to 21 SPH >200cm dbh), as well as stems >100cm DBH (between 27 and 42 SPH).

Table 2. Summary data on tree ages found in North Incomappleux. Full data from all trees are found in Appendix 3.

Site No	Area Name	Sp	Max of "Most Likely Age"	Max of "Max Estimated Age"	Max of "Min Estimated Age"
7.1	North Incomappleux	Cw	726	857	585
		Hw	473	596	373
7.2	North Incomappleux	Cw	1269	1269	940
7.3	North Incomappleux	Cw	1018	1562	776
		Hw	328	371	310

Landscape Level Rating: Exceptional

Stand Level Rating: Exceptional to V. High

Summary: The old growth index shows the North Incomappleux plots close to the top of the ranking list (1, 7 and 11th) overall in terms of a combination of structural attributes and age. The specific index used made almost no difference in these stands, except for one plot that came out higher with the "Minimal" index (Fig. 1).

In terms of the single attribute of 'very large' trees, all the North Incomappleux sites contained these large structures and two of the three plots had some of the highest densities observed in any location (14 and 21 sph) (Figure 3).

In terms of both structural attributes and age the North Incomappleux stand is exceptional compared to the broader suite of old-growth stands sampled during this and the previous work. Compared to the 'exceptional' stands sampled in this study the North Incomappleux area ranks very high.

In terms of landscape level attributes, the North Incomappleux stand has increased conservation value due to its location at the end of a drainage because it is surrounded by other areas that have extremely high conservation values (West Incomappleux and Battle Brook), and because of its close proximity to Glacier National Park (i.e. it is part of a rare large unfragmented area). In addition, there are other known high values present here, including lichens and rare plants (see discussion).

Note that two of the forest cover polygons in this area were typed as being 140 – 250 years old, so these areas do not register as old growth forest using the standard forestry inventory layer.

WEST INCOMAPPLEUX

This stand is located at the northern end of the Incomappleux drainage, and is accessed from the end of the 'East Fork' forestry road by crossing a log jam to reach the west side of the Incomappleux river. More specifically, it is found between the log jam (~200 m south of the end of the road) and the confluence with McDougal Creek to the south. The North and West Incomappleux areas are contiguous, but are described separately for sampling purposes only. Polygon 29 (082 K093/29 CwHw 9517-17) separates the two areas, and, although unsampled, has high conservation value and a high density of large trees based on visual assessments.

The West Incomappleux stand is within the ICHvk1, located at the toe of a steep slope on the relatively flat area adjacent to the Incomappleux. The area sampled was primarily along the lower and toe slopes, although occasional steep sections separated stands on benches from the Incomappleux River.

Three different sites within the West Incomappleux area were sampled and are summarised separately in Table 3. All three sample sites described were moist to wet (ICHvk1 01 / 05), although the first site sampled was by far the wettest, most open, and contained the highest density of very large trees (mean of 23 sph >200 cm dbh) (polygon 45 CwHw 9417-15, mapsheet 082 K093). This site is at the toe of the slope and is punctuated by very wet areas dominated by devils club and lady fern, with scattered pockets of red-osier dogwood. The remaining two sites sampled were at the transition between the lower and toe slope positions. The second site sampled was unusual in that it was almost entirely comprised of large (100-150 cm) western redcedar trees with a relatively closed canopy. This density of purely large cedars is very rare, based on sampling in this and previous work.

The maximum 'most likely' age of the first sample site in this area was 935 years old, while the oldest estimated age was 1010 years (see Table 3). In the other two plots, the maximum 'most likely' age was 401. Two of three sample sites had stems ≥200 cm DBH and overall, stem densities >100cm DBH were between 48 and 73 SPH.

Table 3. Summary data on tree ages found in West Incomappleux. Full data from all trees are found in Appendix 3.

Site No	Area Name	Sp	Max of "Most Likely Age"	Max of "Max Estimated Age"	Max of "Min Estimated Age"
6.1	West Incomappleux	Cw	935	1010	734
6.2	West Incomappleux	Cw	385	508	370

6.3	West Incomappleux	Cw	437	467	369

Landscape Level Rating: Exceptional

Stand Level Rating: High to Exceptional

Summary: The old growth index shows the first West Incomappleux site sampled close to the top of the ranking list (2nd) with the others somewhat lower in ranking between stands sampled in this study (14 and 19). These patterns were consistent across a combination of structural attributes and age and the specific index used made almost no difference to the rankings (Figure 1).

In terms of the single attribute of 'very large' trees, two of the West Incomappleux stands came out very high, with the first site having the highest mean and maximum densities seen anywhere (maximum 30 stems per hectare > 200cm DBH); the second site sample did not have these large trees, but was comprised largely of 100-185 cm dbh redcedar trees. While this portion of the stand did not rank as high as the other sites, it still contains above-average structural attributes (Fig. 3).

In terms of both structural attributes and age the West Incomappleux stand is exceptional compared to the broader suite of old-growth stands sampled during this and the previous work. This is particularly true of the first site (polygon 45 CwHw 9417-15, mapsheet 082 K093), which was particularly exceptional, although the entire stand contained high to very high structural attributes. Compared to the 'exceptional' stands sampled in this study the West Incomappleux stand ranks very high.

In terms of landscape level attributes, the West Incomappleux stand has increased conservation value due to its location at the end of a drainage, where it is surrounded by other areas that have extremely high conservation values (North Incomappleux and Battle Brook). The close proximity to Glacier National Park also increases landscape level conservation value.

Note that the forest cover polygon for the almost pure cedar stand in this sampled area was typed as 140 – 250 years old (age class 8), which would not register as old growth forest using the standard forestry inventory layer. From the existing road on the opposite side of the valley, the cedar stands appear to be a closed canopy, mature stand. It is only once inside that the size (150-250 cm dbh) and age (~400+ years) become evident.

INCOMAPPLEUX – BOYD CREEK

Boyd Creek is located on the east side of the mainstem of the Incomappleux Valley, and is accessed from the 'East Fork' forestry road. The drainage has a logging road on the north side of Boyd Creek which climbs to approximately 1200m elevation. From there, a new road is proposed that works its way along a bench above the creek. Sampling began at the start of the new road and extended for ~ 3 km, covering an area ~ 9 ha. The area sampled is primarily located on a "benchy" area above Boyd Creek, and sampling emphasised lower and toe slope positions. A steep section (up to ~50 m in height difference) exists between most of the sampled areas and Boyd creek. See Photograph 5.

Five different sites within Boyd Creek were sampled and are summarised separately in Table 4. All sites are within the ICHvk1 but varied considerably, with areas ranging from mesic, hemlock-leading stands (04 site series) to moist or wet, cedar groves (05 and 01 site series). Western redcedar and hemlock 100-150 cm dbh were common throughout the area, with occasional 150-200 cm cedar trees.

The maximum 'most likely' age of the plots sampled in Boyd ranged from 444 to 725 years old, while the oldest estimated maximum tree age ranged from 483 to 984 years (see Table 4). No

plots had stems greater than 200cm DBH, although stem densities >100cm DBH were between 12 and 24 SPH for all species, and between 2 and 16 SPH for hemlock trees.

In general, these stands are younger with smaller-sized attributes in comparison to some of the others sampled during this study. Although other sites contained larger trees, this area is primarily mesic and hemlock leading, and should be evaluated differently than the cedar-leading wet sites. In addition these stands are located at higher elevation, closer to the ESSF transition zone..

Table 4. Summary data on tree ages found in Boyd Creek. Full data from all trees are found in Appendix 3.

Site No	Area Name	Sp	Max of "Most Likely Age"	Max of "Max Estimated Age"	Max of "Min Estimated Age"
5.1	Boyd	Cw	645	766	508
		Hw	523	535	420
		Sx	224	224	219
5.2	Boyd	Cw	573	855	480
		Hw	531	574	465
5.3	Boyd	Cw	725	984	601
		Hw	430	497	354
5.4	Boyd	Cw	696	773	549
5.5	Boyd	Cw	405	483	409
		Hw	444	473	402

Landscape Level Rating: Very High

Stand Level Rating: High to Very High

Summary: The old growth index shows the Boyd Creek plots in the mid to lower end of the stands sampled in this study (10^{th}, 15,16,17,18^{th}) in terms of a combination of structural attributes and age (Figure 1). However, this is largely because these mesic hemlock and hemlock-cedar stands are being compared to moister, more productive, cedar forests.

In terms of the single attribute of 'very large' trees, the Boyd Creek stands did not have exceptionally large attributes. However, they but did have high densities of the 'smaller' size class of >100cm DBH, with unusually high densities of large hemlock trees (Figure 3).

In terms of both structural attributes and age, the Boyd 'stand' is not exceptional old growth compared to the broader suite of old-growth stands sampled during this and the previous work. However, the Boyd Creek samples differ from most of the other 'stands' sampled because they are in a higher elevation, primarily mesic area, and are generally hemlock-leading. When compared to similar mesic stand types in the Columbia and Arrow Forest Districts, the Boyd Creek stands have unusually high densities of hemlock >100 cm dbh (up to 16 sph). Only 6 out of 27 similar site types sampled here and in 2001 (Holt and MacKillop 2002) have similar densities or large hemlock trees.

In terms of landscape level attributes, the Boyd Creek stand has relatively continuous forest cover, and likely provides connectivity over to the Westfall Creek. This area currently appears to have relatively low values for mountain caribou, but has high capability. With appropriate management, it has the potential to provide important caribou recovery habitat (D. Hamilton pers. comm.).

INCOMAPPLEUX - RUBY SILVER

The Ruby Silver area is located in the mid Incomappleux valley. It is located in a toe slope position, but is very limited in extent. The stand is directly adjacent to the east side of the 'East Fish' forestry road, which bisects this small area of existing old forest.

The area is located in the ICHvk1. Only one site was sampled in this stand, although a complete walk-through of the site was conducted. The site is primarily moist to wet (01 site series) with areas of thick lady fern, spiny wood fern and oak fern interspersed with devil's club and open mossy areas. The portion of the stand sampled is in the transition between the relatively flat valley bottom and the steep mountain slopes on the valley sides.

Historic logging and more recent shakeblock activity are evident in this small remnant patch, particularly at the south end of the stand (sampling occurred in the north end). The Backroads BC book shows an old mining/hiking trail beginning in this stand, but evidence of such a trail is dubious on the ground.

The maximum 'most likely' age sampled was 896 years old with an oldest estimated maximum tree age of 951 years (see Table 5). The plot had a (relatively) low density of stems per hectare greater than 200 cm DBH (3), although trees of this size are considerably rare at landscape and regional scales. Stem densities >100cm DBH were high with 60 SPH ranging from 100 cm to 227 cm dbh.

Table 5. Summary data on tree ages found in Ruby Silver. Full data from all trees are found in Appendix 3.

Site No	Area Name	Sp	Max of "Most Likely Age"	Max of "Max Estimated Age"	Max of "Min Estimated Age"
8.1	Ruby Silver	Cw	896	951	861

Landscape Level Rating: Very High

Stand Level Rating: Exceptional

Summary: The old growth index shows the Ruby Silver plot high on the ranking compared with stands in this study (3rd) in terms of stand-level structural attributes and age. When assessed on the basis of the single attribute of 'very large' trees, the Ruby Silver plot had 3 SPH> 200cm dbh and a high density (60 sph) of trees > 100cm DBH.

Although very limited in extent, this site was sampled since it is one of the few remaining areas with large diameter, very old trees in the heavily logged mid and lower Incomappleux Valley.

In terms of both structural attributes and age the Ruby Silver stand is exceptional old growth compared to the broader suite of old-growth stands sampled during this and previous work.

In terms of landscape level attributes, the Ruby Silver stand has increased value in that it is one of the few remaining patches of large sized and old aged trees in the mid to lower Incomappleux Valley. However, the lower valley is highly fragmented and the Ruby Silver site is considerably isolated from other intact habitat. It is also a very small patch, which confers lower landscape-level value. Despite these concerns, the rarity of stands with this type of 'exceptional' stand level attributes and age characteristics warrant conservation, particularly when considered within an ecological restoration framework.

INCOMAPPLEUX – SCOTT CREEK

The Scott Creek area is located in the mid Incomappleux valley, directly adjacent to the west side of the Fish mainline forestry road. The stand is a thin remnant of the once extensive stands of large cedar found in the mid and lower valley, and may have survived development because it is wedged between the very steep mountainside and a meander of the Incomappleux River.

The sampled area is located in the ICHvk1 in a toe slope position, and is very limited in extent. Only one site was sampled in this stand, although a complete walk-through was conducted. The site is primarily moist to wet (01 site series) with areas of thick lady fern, spiny wood fern and oak fern interspersed with devil's club or open mossy areas. Historic logging (at the turn of the 20th century) created openings in the stand that have since filled with primarily hemlock seedlings, saplings, and smaller trees.

The maximum 'most likely' age sampled was 990 years old with an oldest estimated maximum tree age of 1115 years (see Table 6). The plot had a high density of stems greater than 200 cm DBH (10 sph), including one tree over 300 cm dbh, and an average of 18 sph >100cm.

Table 6. Summary data on tree ages found in North Incomappleux. Full data from all trees are found in Appendix 3.

Site No	Area Name	Sp	Max of "Most Likely Age"	Max of "Max Estimated Age"	Max of "Min Estimated Age"
9.1	Scott Cr	Cw	990	1115	748

Landscape Level Rating: Very High

Stand Level Rating: Exceptional

Summary: The old growth index shows the Scott Creek stand to be high in the relative ranking done for this study (4th) in terms of a combination of structural attributes and age. The ranking increased to 2nd position in the minimal variables version of the index (largely because the higher density of small trees was not included) (see figure 1).

In terms of the single attribute of 'very large' trees, the plot had a high density (10 SPH; Figure 3), including one tree in the plot that was over 3 m dbh. Trees of this size are extremely rare.

In terms of both structural attributes and age the Scott Creek stand is exceptional compared to the broader suite of old-growth stands sampled during this and the previous work. Historic logging (~100 years ago) removed several stems in the 100-150 cm dbh class. However, larger stems were left, and relatively dense regeneration has filled the gaps created by the openings (Photographs 6 and 7). Despite the historic partial logging, this site has exceptional stand-level old growth value.

In terms of landscape level attributes, the Scott Creek stand is very small and isolated. Despite these concerns, the site has increased value in that it is one of the few remaining patches of large sized and old aged trees in the mid to lower Incomappleux Valley. The rarity of stands with this type of 'exceptional' stand level attributes and age characteristics warrant conservation, particularly when considered within an ecological restoration framework.

TROUT LAKE – PRIVATE LAND #1 AND #2

Specific locations and ownership of these areas of private land are summarised in Appendix 5 (not available for public distribution).

Trout-PL-#1 and #2 are located within 10km of Trout Lake townsite.

Trout-Pl-1 is a predominantly forested acreage, with stands of at least two different time period origins. The area at the south end of the property is the area with the highest conservation value and consists primarily of large cedar trees with occasional hemlock and cottonwood.

This portion of the private land has not been harvested though there is some disturbance through the general movements of the owner. A small number of smaller trees have been felled and milled to build the beginnings of a shelter for visitors to the area, and large trees that have fallen naturally have in some cases been milled or shaked. Some large dead or dying trees have

also been removed over time, but this has had little impact on the overall old-growth character of the property.

The other portion of the private land to the north, and visible on orthophotos (hard copy provided to John Krebs), consists of considerably younger and smaller statured forest. This area burnt on at least one occasion and trees here are closer to an average of 50cm DBH and likely range between 80 – 150 years. This section does not detract from the conservation value of the larger stand, but does not provide the outstanding values present in the adjacent forest. In addition, on the north end, the private land contains an extensive area of riparian habitat and includes some cottonwood stands, marsh and other wetlands. This portion of the property adds considerably to the overall conservation value.

The Trout-PL-1 property is located in the valley bottom on relatively flat lands in the transition zone between the ICHwk1 and ICHmw2. Although officially mapped as ICHmw2, the area contains more site-level characteristics of the ICHwk1. Two areas were sampled with both sites located on wet areas (ICHwk1 05-06 site series[4]). The understory is relatively open, with devils club and ferns common in the herbaceous layer. Western redcedar dominates the areas sampled, although hemlock, spruce and cottonwood were also present. The maximum 'most likely' age sampled at the Trout-PL-1 property was 1023 years old, with an oldest estimated (maximum) age of 1399 years (see Table 7). Two plots had stems > 200cm DBH, with one in particular having a high density (maximum of 10 sph and mean of 5 sph). The density of stems over 100 cm was also high, although most large trees were closer to 200 cm dbh.

Table 7. Summary data on tree ages found in Trout-PL-1 Property. Full data from all trees are found in Appendix 3.

Site No	Area Name	Sp	Max of "Most Likely Age"	Max of "Max Estimated Age"	Max of "Min Estimated Age"
2.1	Trout-PL-1	Cw	1050	1399	795
2.2	Trout-PL-1	Cw	1023	1057	770

Landscape Level Rating: Exceptional

Stand Level Rating: Very High to Exceptional

Summary: In terms of both structural attributes and age the Trout-PL-1 stand is exceptional compared to the broader suite of old-growth stands sampled during this and the previous work.

The old growth index shows the Trout-PL-1 stand to be high in the ranking (with plots ranking 5th and 13 from this study), in terms of a combination of structural attributes and age (Figure 1). In terms of the single attribute of 'very large' trees, both plots contained trees of >200cm DBH with one plot having a high density (average 5 SPH and maximum 10 SPH; Figure 3).

In terms of the landscape scale, this site has considerable increased conservation value because it is one of the rare sites where old growth forest is located within a low-elevation, valley-bottom, riparian complex. The adjacent wetlands, including the extensive marsh-swamp areas and cottonwood stands add considerably to this already exceptional old growth stand. In our sampling (in this project and previous work), we have not come across a similar combination of exceptional riparian and old growth forest. This has added value in that we expect that areas such as this would have been more prevalent prior to dam construction and subsequent inundation of valley bottoms within the Columbia Basin. While some "selective" logging has occurred within the Trout-PL-1 property, the family has owned the land for over 40 years and has maintained a "conservation" goal in its stewardship. Logging has only removed a very small portion of the trees (likely <1% of the tree cover over time) and has only minimally altered the site characteristics.

[4] We have used site series classifications for the ICHwk1 here, but if classified under the ICHmw2, the Trout PL-1 sample area would be classified primarily as the ICHmw2/06 site series.

Trout-PL-2 property appears to be located as the middle rectangle between the two areas of the Trout-PL-1 pieces (it is not shown separately on available maps and this information is from the neighbours). This piece was not assessed during this study (the owner was not present), but reconnaissance suggests it consists of a similar large structured old forest type, again primarily a cedar-leading stand. It also borders the wetland complex and has very high conservation value because it extends the area of old-growth forest and also provides continuity to the wetland habitat.

TROUT LAKE – PL-3

This private land is adjacent to Trout-PL-1 described previously. We toured this area and found that it historically was likely very similar to the Trout-PL-1 property, however the older, larger trees on the property have been harvested over the last 20+ years, leaving some very impressive stumps, shake block piles and a single very large cedar tree (270cm in diameter). This area still retains wildlife values because younger trees were retained and there remain a fair number of cottonwoods on the property. This area is at the 'height of land' and both Wilkie and Beaton Creek flow through it. The area also contains high value riparian / cottonwood habitat. In summary, the Trout-PL-3 property is not exceptional old growth, but it does provide added conservation value to the adjacent PL1 and PL2 properties, as well as the adjacent wetland/cottonwood area.

TROUT LAKE – LARDEAU ALPHA

This site is located adjacent to the Lardeau River east of the old townsite of Ferguson (and northeast of the Trout Lake townsite). The area containing the attributes found here is relatively small and is located below the Alpha forestry road above the Lardeau River on crown land. The site was in a lower slope position and "benchy" with a steep slope between the river and the sampled area.

The sites sampled here are within the ICHwk1 biogeoclimatic subzone variant and were classified as moist to wet (01-05 site series). Three separate sites were sampled within the general area, although all sites were relatively close together (within ~ 500 m). The area was mixed in terms of dominant species, with redcedar and hemlock dominating individual sampling sites.

A transect and series of variable radius plots were conducted at the first sample site, which was classified as wet (05 site series) and contained numerous large (150-200 cm dbh) western redcedar trees. Although the other sample sites had high old growth structural attributes, the first sample site contained the highest structural attribute scores on the index.

The remaining sites sampled in the Lardeau Alpha stand were located at lower slope positions and contained a higher percentage of hemlock. One of these sites was on a steeper, gullied area with devil's club in depressions, and drier plant species on elevated ridge sites.

The maximum 'most likely' age was 736 years old, while the oldest estimated maximum age was 1022 years (see Table 8). These oldest trees were all redcedar, with hemlocks being somewhat younger (with most likely estimates at 600 years and maximum likely estimates at 900 years).

A similar site was sampled in 2001 (Alpha) and contained numerous trees >100 cm dbh. This site, which is approximately 2.5 km downstream, was also located at the toe-slope position on a bench above the Lardeau Creek.

Table 8. Summary data on tree ages found in Lardeau Alpha site. Full data from all trees are found in Appendix 3.

Site No	Area Name	Sp	Max of "Most Likely Age"	Max of "Max Estimated Age"	Max of "Min Estimated Age"
3.1	Lardeau Alpha	Cw	736	1022	580

Site No	Area Name	Sp	Max of "Most Likely Age"	Max of "Max Estimated Age"	Max of "Min Estimated Age"
3.2	Lardeau Alpha	Hw	636	840	636
3.3	Lardeau Alpha	Cw	311	350	331
		Hw	438	985	349

Landscape Level Rating: Very High

Stand Level Rating: High to Very High

Summary: The old growth index shows the Lardeau Alpha plots to be somewhat variable – with one plot having a very high ranking (10th in this study) and the others being towards the bottom of the ranking (23rd and 24th; figure 1). No trees greater than 200cm DBH were sampled in this stand and the lower size class densities were relatively low (0 – 8 SPH > 100cm DBH).

The Lardeau Alpha stand has some very old trees, including very old hemlock (which is relatively unusual). This mix of very old cedar and hemlock possibly explains the lower ranking within the old-growth index, although the first plot (cedar-leading) ranked much higher than the others. The variability in rankings reflects a composite of stand structural types in this area.

At a landscape scale, this site has increased conservation value in that it is located near the Lardeau River and has the potential to provide movement habitat. A similar site sampled nearby in 2001 suggests that the area between the Alpha forestry mainline and Lardeau Creek may provide some connectivity and a larger area of high-structural value. This type of stand is also relatively rare in the Trout Lake-Ferguson area due to extensive development (primarily mining and logging) in the area.

TROUT LAKE – UPPER LARDEAU

The Upper Lardeau site was sampled in the transition zone between the ICHvk1 and ESSFwk1, at the back end of the Lardeau River. The site is a hemlock-leading stand, and is located at higher elevations than most of the remaining sites. It is also a mesic site (04 site series), and should not be directly compared to wetter cedar-leading sites

Only one plot was sampled in the Upper Lardeau area. The site was located above the forestry road, which bisects this old growth stand.

The maximum 'most likely' age was 472 years old with an estimated maximum age (based on extrapolations) of 654 years (see Table 9). No trees were sampled greater than 200cm DBH or greater than 100cm DBH, but this is not surprising given the higher elevation and hemlock dominance.

Table 9. Summary data on tree ages found in Upper Lardeau. Full data from all trees are found in Appendix 3.

Site No	Area Name	Sp	Max of "Most Likely Age"	Max of "Max Estimated Age"	Max of "Min Estimated Age"
4.1	Upper Lardeau	Cw	472	654	430
		Hw	466	519	405

Landscape Level Rating: High

Stand Level Rating: High

Summary: The old growth index shows the Upper Lardeau site to be low in the ranking (bottom of the plots sampled for this study). However, compared to many other old growth sites sampled previously, this stand contains conservation values in that it is ~ 472-654 years old, and contains many 75-100 cm dbh trees. It is not an "exceptional" old-growth forest for any of the reasons cited for other sites such as those in the Incomappleux or the Trout-PL-1 property, but for its species composition and elevation, it is a good example of high quality old-growth.

In terms of age and structural attributes the Upper Lardeau stand has trees of moderate age and structure but does not represent exceptional old growth values.

In a landscape context, the Upper Lardeau site has value in that it is located towards the backend of the Lardeau Valley in an area with high logging pressure. Of the stands in this area, this is likely to have high old growth value.

ADDITIONAL SITES "VISUALLY ASSESSED" IN THIS STUDY

Incomappleux Log Jam (bench above Incomappleux River) – this stand is located between the North Incomappleux and West Incomappleux sample areas in the vicinity of a logjam used to cross the river. The stand contains very large cedar trees (>2 m DBH) scattered amongst groves of smaller cedar and hemlock stands. Several small streams and associated riparian areas are also found in this stand. If the area had been sampled, we expect it would have been rated as Very High (with small pockets of exceptional forest).

Although separated for sampling purposed in this study, the Incomappleux log jam area connects the North and West Incomappleux study areas, which form an approximately 5 km band of high conservation value forests along the lower and toes slopes of the western Incomappleux between McDougal Creek and Battle Brook (note that sampling did not occur north of the Battle Brook and it is possible that the stand types sampled here extend to the north).

End of the Road (lower slope bench) – this site is located along the east side of the Incomappleux near the end of the East Fork road. From a quick visual assessment, the stand appears to be a complex of ICHvk1/01 and ICHvk1/05 site series. Very large western redcedar are mixed among openings filled with Devil's Club and ferns. An especially large tree (332 cm DBH) was measured within 15 m of the forest service road. This site, although small, has exceptional stand structural characteristics.

Alpha Junction (lower slope) – this site is located in the valley bottom between the Alpha Road and Lardeau Creek. Although no sampling occurred, large trees are evident from the road. Logging has occurred adjacent to the stand, although other old forests including the Alpha, Lardeau Alpha and Snow sites are nearby.

Low and moderate sites: In addition to the areas listed above, we looked for potential high conservation value forests in other areas, including the forested slopes adjacent to Trout Lake and both north and east of the Ferguson townsite.

ADDITIONAL SITES SAMPLED BY HOLT AND MACKILLOP (2002) IN THE TROUT LAKE AND INCOMAPPLEUX AREAS

The following sites were sampled within the Trout Lake and Incomappleux areas in the 2001 old growth study:

Mehninick Creek (Midslope bench - lower Incomappleux Valley) – this area was called "Beaton" in the 2001 study. It had very high old growth structure when sampled in 2001, with a dbh of 206 cm on the largest tree sampled, and up to 15 sph >200 cm dbh and 90 sph >100 cm dbh in

one plot. When ranked among the sites sampled in both 2001 and 2005, the Beaton site was 5th (6th, depending on the index used) among 64 sample sites. However, the site was logged in the spring of 2005. Some large trees were left on site (estimated 10 sph) in this 5 ha area, but the unique old-growth attributes of the site are no longer present. In 2001, tree core samples were taken from 9 cedar and 9 hemlock trees. Using extremely conservative estimates, the average stand age was 437 years, with an estimated maximum age of 799 years (at breast height). In 2005, ring counts were conducted on stumps (which provide more accurate estimates than tree cores). Ages for stump height (~1.6m) ages for three cedar stumps ranged from 613 to 819 years (177 cm to 233 cm diameter). One western hemlock stump was counted at 580 years (125 cm diameter), a very old age for western hemlock.

Alpha (lower slope). In 2001, the Alpha site was rated as having high structure. When ranked with all stands sampled in 2001 and 2005 (n = 64), the Alpha site was 10th. Distinctive old growth attributes on the site include a density of up to 30 sph >100 cm dbh and a max tree size measured of 158 cm dbh. The oldest tree aged, using conservative tree age estimates, was 647 years old.

The area is within 5 km (downstream) of the Lardeau Alpha site sampled in 2005. Although areas between the two sites were not sampled, it is likely that the entire zone along the Lardeau Creek (in this area) consists of small patches of large cedar trees intermixed with older hemlock stands. As an area adjacent to the riparian zone, the Alpha and Lardeau Alpha sites likely provide higher biodiversity and conservation value as connectivity routes, in addition to their habitat for species requiring old and/or large trees, snags, and CWD.

Snow (mid slope, above the Lardeau Creek, Alpha road area). This ~14 ha polygon is located on gentle terrain adjacent to a spur road above the Alpha forestry road (near the junction with the Ferguson road). In 2001 it was rated as having high old growth structural value, with up to 35 sph greater than 100 cm dbh and a maximum tree diameter of 171 cm. It was ranked 9th among all sites sampled in 2001 and 2005.

A road bisects the polygon, and some logging has taken place since sampling in 2001 on the western side of the road (identified as Snow Logged on maps). In 2001, tree cores taken from this stand suggested mean and maximum ages of 433 and 827 years.

Other Sites Two other stands were sampled in the Incomappleux Valley in 2001, but both Fish (mapsheet: K082; polygon: 368 H(CS)9315-9) and Last (mapsheet K082; polygon: 263 FH(C)7529-25) were rated as not having high old-growth structural values, with mean stand ages of 250 (Fish) and 282 (Last). (Note that Fish was mapped as "old growth" – age >250, but did not have the unique characteristics of the older stands sampled in 2005, while Last was mapped as younger – 120-140 years old, but was actually much older)

ADDITIONAL SITES SAMPLED FOR RARE LICHENS BY ARSENAULT (2004) IN THE UPPER INCOMAPPLEUX

Upper Incomappleux A. Arsenault and T. Goward sampled rare epiphytic cyanolichens and calicoid microlichens at 10 locations within five forest cover polygons in the upper Incomappleux (see Table 10; Arsenault 2004). One of those polygons overlaps with the Battle Brook site sampled in this study. The remaining sample sites include areas to the north of Battle Brook and upslope areas to the southeast of Battle Brook and in the McDougal Creek drainage.

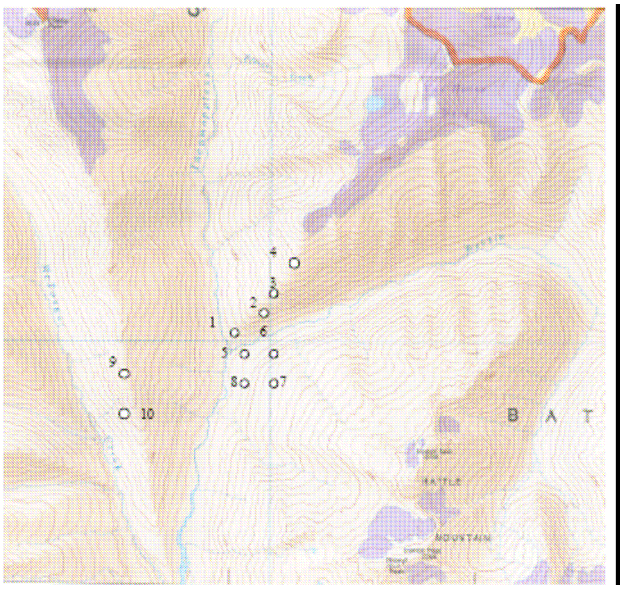


Figure 4. Approximate locations of sampling by Goward and Arsenault for rare lichens (from Arsenault 2004). See associated Table 10.

In addition to lichen sampling, Arsenault and Goward gave coarse age-class ratings to each of the sample sites. These ratings (summarised in Table 10) include "Old", "Very Old", and "Antique". The "Antique" rating, which is based on expert opinion of structural characteristics and anticipated disturbance history, corresponds to our "Exceptional" category. "Very Old" and "Very High" structure, and "Old" and "High" structure are also roughly analogous. Locations, age-class ratings and ecosystem types are summarised in Table 11, while detailed descriptions of findings are provided in the Discussion.

Table 10. Locations, Ecosystem Types, Age-Class and Elevation for sites sampled by Arsenault and Goward (Arsenault 2004) in the upper Incomappleux.

Plot #/Polygon#	FC label	Ecosystem type	Age	Elevation M
1/147	CH9516-19	Lower slope sprayzone	Very Old	700
5/18	CH9515-17	Lower slope sprayzone	Very Old	700
2/147	CH9516-19	Lower slope	Antique	725
8/18	CH9515-17	Lower slope	Antique	700
3/144	HWCW9517-18	Mid-slope	Very Old	800
4/145	HWCW9417-13	Midslope	Old	900
6/19	CH8416-17	Midslope	Old	900
7/19	CH8416-17	Midslope	Old	900
9/199	HC8316-13	Upper slope	Very Old	1200
10/199	HC8316-13	Upper slope	Very Old	1150

DISCUSSION

In this study we identify the conservation value of forest sites based on their age and structural attributes. However, there are numerous ecological values associated with the stands sampled here. For example, Mountain caribou, an at-risk species, are one of the major biological concerns within both the Trout Lake and Incomappleux areas. In addition, the upper Incomappleux valley is known to contain "bull trout populations, grizzly bear populations, rare lichen populations, a generally rare forest type of global significance, and a low elevation natural connectivity corridor linking a managed landscape with a National Park" (Arsenault 2004).

SUMMARY OF STAND AND LANDSCAPE LEVEL OLD-GROWTH RATINGS FOR AREAS SAMPLED WITHIN THE TROUT LAKE AND INCOMAPPLEUX AREAS

The following table (Table 11) summarises the stand-level and overall ratings of the areas sampled in this and other studies conducted in the Incomappleux and Trout Lake areas. Age, attributes, and landscape value are highlighted as being 'exceptional', 'very high', 'high' from this study – many moderate and low stands were sampled in the previous study but are not included here. Stand-level ratings are based entirely on the attributes measured and their scores across an index of old-growthness developed for the wet ICH (Holt and MacKillop 2002). Overall ratings incorporate stand, landscape, and other (e.g. species specific) values (see comments – Table 11).

The summary in Table 11 includes stands sampled in this study, as well as those sampled in 2001 by Holt and MacKillop (2002) and those sampled by Arsenault (2004). We applied our ratings to Arsenault's stands by directly converting his age-class categories to our ratings (summarised above). Note that Arsenault's plots 5/18 and 8/18 overlap with the Battle Brook site sampled in 2005. Several of his other sample sites are in close proximity to the Battle Brook and North Incomappleux areas.

Table 11. Summary of old growth ratings for stands sampled in this and previous studies in the Incomappleux and Trout Lake areas.

Area name	Site No.	Project	Mapsheet and Polygon	Stand-Level Old Growth Rating *	Land Manage-ment Status	Overal Stand and Landscape Level Rating	Comments
Upper Incomappleux							
Battle Brook	1.1	Sampled 2005	K093 18 CH 9515-17	V. High	P & T	Exceptional	Part of large contiguous area adjacent to Glacier NP. Known to contain rare oceanic lichens and plants. Overall rating is based on combined stand and landscape level attributes.
	1.2		K093 18 CH 9515-17	Exceptional	P & T		
	1.3		K093 18 CH 9515-17	V. High	P & T		
West Incomappleux	6.1	Sampled 2005	K093 45 CH 9417-15	Exceptional	P & T	Exceptional	Part of large contiguous area adjacent to Glacier NP. Overall rating is based on combined stand and landscape level attributes.
	6.2		K093 43 CH 94 0-15	High	P & T		
	6.3		K093 28 CH(Pw) 95 0-17	V. High	P & T		
North Incomappleux	7.1	Sampled 2005	K093 31 HC 84 0-17	V. High	P & T	Exceptional	Part of large contiguous area adjacent to Glacier NP. Overall rating is based on combined stand and landscape level attributes. Known to contain at-risk plants and potentially rare lichens.
	7.2		K093 17 CH 8515-21	Exceptional	P & T		
	7.3		K093 5 CH 94 0-15	Exceptional	P & T		
Incomappleux Log Jam	10.1	Visually Assessed 2005	K093 29 CH 9517-14	V. High	P & T	Exceptional	Exceptional overall rating because of part of the combined upper Incomappleux sites.
End of the Road		Visually Assessed 2005	K093 490 CH(Pw) 95 0-17	Exceptional	P & T	Exceptional	Measured Cw with 332 cm DBH. Exceptional overall rating because of proximity to other upper Incomappleux sites.

Area name	Site No.	Project	Mapsheet and Polygon	Stand-Level Old Growth Rating *	Land Manage-ment Status	Overal Stand and Landscape Level Rating	Comments
Arsenault Plot 1/147	17	Arsenault 2004	N003 147 CH9516-19	V. High	P & T	Exceptional	Overall rating is based on landscape position – part of upper Incomappleux stands. Arsenault 5/18 overlaps with Battle Brook plot 1, while Arsenault 8/18 overlaps with Battle Brook plots 2 and 3.
Arsenault Plot 2/147	18		N003 147 CH9516-19	V. High	P & T		
Arsenault Plot 3/144	19		N003 144 HC9517-18	Exceptional	P & T		
Arsenault Plot 4/145	20		N003 145 HC9417-13	Exceptional	P & T		
Arsenault Plot 5/18	21		K093 18 CH9515-17	V. High	P & T		
Arsenault Plot 6/19	22		K093 19 CH8416-17	High	P & T		
Arsenault Plot 7/19	23		K093 19 CH8416-17	High	P & T		
Arsenault Plot 8/18	24		K093 18 CH9515-17	High	P & T		
Arsenault Plot 9/199	25	Arsenault 2004	K092 199 CH8316-13	V. High	P & T	V. High	Overall rating is based on proximity to other upper Incomappleux stands.
Arsenault Plot 10/199	26		K092 199 CH8316-13	V. High	P & T		
Mid Incomappleux							
Boyd	5.1	Sampled 2005	K083 309 SCH 85 0-24	High	P & T	V. High	Higher elevation, drier site. V. High overall rating is based on potential connectivity to the Westfall, potential Mountain Caribou recovery habitat, and relative intactness.
	5.2		K083 309 SCH 85 0-24	V. High	P & T		
	5.3		K083 309 SCH 85 0-24	High	P & T		
	5.4		K083 306 S(C) 85 0-24	High	P & T		

Area name	Site No.	Project	Mapsheet and Polygon	Stand-Level Old Growth Rating *	Land Manage-ment Status	Overal Stand and Landscape Level Rating	Comments
	5.5		K083 261 HCS 84 0-15	High	P & T		
Ruby Silver	8.1		K082 397 C 9518-19	Exceptional	P & T	V. High	Remnant area in mid Incomappleux. Very High rating is due to small area, but rare in the landscape.
Scott Cr	9.1	Sampled 2005	K082 465 CAc 84 0-17	Exceptional	P & T	V. High	Remnant area in mid Incomappleux. Very High rating is due to small area, but rare in the landscape.
Mehninick Creek (Beaton)	11		K082 457 CH 9516-19	Was Exceptional but recently logged	P & T	Low	Was exceptional structure when sampled in 2001 – however, the stand was logged in early 2005 (low overall rating).
Fish	14	Sampled 2001	K082 368 H(CS) 9315-9	Moderate	P & T	Moderate	
Last	15	Sampled 2001	K063 263 FH(C) 7529-25	Moderate	P & T	Moderate	
Trout Lake							
Private Land #1	2.1	Sampled 2005	K063 11 CH 9515-19	Exceptional	Private land	Exceptional	Exceptional overall rating is based on adjacency to high value wetland / riparian area and rarity of stand structure in the landscape.
	2.2		K063 11 CH 9515-19	V. High	Private land		
Ferguson / Upper Lardeau							
Lardeau Alpha	3.1		K063 755 CH 95 0-17	V. High	Arrow TSA	V. High	Adjacent to Lardeau river, within a heavily impacted landscape. Overall rating is based on riparian and connectivity values.
	3.2	Sampled 2005	K063 755 CH 95 0-17	V. High	Arrow TSA		
	3.3		K063 755 CH 95 0-17	High	Arrow TSA		
Upper Lardeau	4.1	Sampled 2005	K064 232 CH 84 0-17	High	Arrow TSA	High	Higher elevation, transitional to ESSF, mesic site – not expected to have the same attributes as wetter sites.
Alpha	13	Sampled 2001	K063 610 CH 8517-20	Exceptional	Arrow TSA	V. High	
Snow	12	Sampled 2001	K063 607 CH8416-15	Exceptional	Arrow TSA	V. High	

Area name	Site No.	Project	Mapsheet and Polygon	Stand-Level Old Growth Rating *	Land Manage-ment Status	Overal Stand and Landscape Level Rating	Comments
Snow Logged		Visually Assessed 2005	K063 607 CH8416-15	Was V.High; but recently logged	Arrow TSA	Low	Part of the Snow polygon that was sampled by Holt and MacKillop (2002). This portion only was logged since sampling (and now has an overall low rating)
Alpha Junction		Visually Assessed 2005	K063 439 HC 850-20	High	Arrow TSA	V. High	Near Alpha and Lardeau Alpha sites.

* Ratings are based on stand structural characteristics. Please see stand descriptions for landscape level characteristics.

MOUNTAIN CARIBOU

Mountain caribou are a broad ranging species that require large tracts of old-growth forests for forage and cover from predators (Province of BC[5]). They are generally considered an old-growth affiliated species and numerous studies have been conducted on their habitat use and population dynamics. However, the focus of this study has been old forest characteristics, separate from caribou habitat needs. Within the current conservation framework, it is hoped that other species will be maintained by preserving areas for caribou, although it is not clear whether the "umbrella species" approach will maintain the full range of biodiversity values. In a study defining old growth forests in the ICHwk1 BEC variant, Holt and MacKillop (2002) found several differences between old growth characteristics on wet and mesic sites. Many of the characteristics associated with caribou habitat were reduced or absent on the wetter sites. They concluded that,

> "*Old Growth Management Area selection and harvesting retention strategies designed to maintain caribou food sources might be compatible with retention of other biodiversity values associated with old-growth forests on Mesic sites. However, Wet sites with Very High old-growth structure are not correlated with [habitat indicators such as] arboreal lichen or falsebox abundance. Conservation of these globally rare and endangered forests must be addressed separate from the mountain caribou context."*

RARE PLANTS AND LICHEN

Several studies and sampling efforts have focused on rare lichens and plants in the upper Incomappleux valley (stands named Battle Brook, North Incomappleux and West Incomappleux in this study).

Local sampling within the area at the back-end of the Incomappleux (referred to as Battle Brook, North and West Incomappleux in the current study) has identified the presence of a number of rare species[6].

Epiphytic cyanolichens and calicoid microlichens are groups of lichens considered to be old-growth dependent and generally considered threatened across their range (Arsenault 2004). Areas within the Incomappleux drainage have been sampled for these species by Trevor Goward (formerly UBC lichenology curator) and Andre Arseneault (Ministry of Forests and Range, Forest Sciences Branch, Southern Interior Forest Region) (Goward and Arsenault 2000, Arsenault 2004).

The upper Incomappleux was identified as being:

> *"one of the Northern Hemispheres 'hotspots' for cyanolichens growing on conifers…" (Goward and Arseneault 2000)…* and *"without a doubt one of Canada's hotspots for epiohytic cyanolichen diversity" (Arsenault 2004).*

Based on field sampling experience, Goward and Arsenault (2000) predict that spray zone areas (adjacent to creeks and waterfalls) and nutrient-rich areas have the highest densities of cyanolichens and calicoid lichens. In a study of select stands within the back-end of the Incomappleux, they found 19 species of cyanolichens with a community diversity somewhat different to that found in otherwise similar ecosystems in the upper Adams and Robson valleys (Arsenault 2004). They note that the very high species diversity appeared to be limited to the spray zone areas (19 species) and lower slope ecosystems (7 species), compared with only 2 and 4 species in the midslope or upper slope areas. Sampling in the Battle Brook stand (name from this study), close to the confluence of Battle Brook and the Incomappleux showed moderate

[5] http://wlapwww.gov.bc.ca/wld/documents/caribou.pdf and http://wlapwww.gov.bc.ca/wld/documents/mtcaribou_rcvrystrat02.pdf

[6] To our knowledge, no systematic sampling has occurred in areas within the Trout Lake / Incomappleux region except in isolated areas within the Incomappleux as described. We therefore do not know whether rare species exists within some of the other stands identfied as structurally exceptional in this study.

densities of cyanolichens. Arsenault (2004) suggests that this density is likely to be considerably lower on the much steeper slopes in the higher drainages (e.g. McDougal and Battle Brook) where draft Old Growth Management Areas have been deployed following Province of BC procedures for locating OGMAs (Province of BC 1999).

Arsenault (2004) also reports finding 30 species of calicoid lichens, most of which are old growth associated. Most important microhabitats were western redcedar bark (23 species), western hemlock bark (18 species), lignin on live trees and snags from cedar and hemlock (9 species). The Battle Brook stand (name from this study) had the richest species diversity, with 23 species. McDougal Creek also had high species richness with between 16 and 20 species (note this is one area not sampled for structural attributes in this study). In general, older "old growth" forests had more calicioid lichens than younger stands. The sampling also showed important variability among otherwise similar stands, showing the important local variability even within ecosystem types.

Arsenault (2004) concludes:

> *"The old growth forests of the lower slopes, near the confluence of the Battlebrook and Incomappleux rivers, and the very old red-cedar stands located south of the confluence to be unique ecosystems deserving special attention during landscape unit planning"…* and
>
> *"A number of species of cyanolichens and other oceanic lichens described in this project were only found in the area of the confluence of the Incomappleux and Battlebrook rivers. It is possible that some of these species could also occur or grow in other limited areas close to the Incommapleux river's edge, especially near small waterfalls, on rich soils, or on toe or lower slope topographic positions. An indicator of good habitat for these lichens is the abundance of hanging moss. Another area to be considered is the old-growth forest that contains cottonwood and that is located on the West side north of McDougal Creek."*

Sampling for lichens and plants was also undertaken by Toby Spribille in the upper Incomappleux (Spribille 2002, 2004). A total of 59 epiphytic macrolichen species were collected in the valley, with most (93%) macrolichen species found on western hemlock (55 species), and a much lower number present on western redcedar (14 species). Spribille writes:

> *"Many species were found only in the upper Incomappleux* (Battle Brook in our study)*. Significant among these are* Fuscopannaria ramulina*,* Hypogymnia oceanica, Lichinodium canadense, Lobaria linita, Microlychnus epicorticis, Nephroma isidiosum, Nephroma occultum, Parmeliella parvula, Platismatia norvegica, Polychidium dendriscum, Sticta limbata *and* Sticta oroborealis. *Except for* L. linita*, which has not been previously recorded as a branch epiphyte, these species have all been identified as species with oceanic distributions characteristic of perhumid inland rainforests by Goward & Spribille (2002). Highly significant is the occurrence of* Spilonemella americana *on* Tsuga *twigs along Battle Brook. This recently described species is otherwise known in inland British Columbia only from waterfall spray zones; this is the first recorded occurrence in a regular riparian area, pointing to the high climatic moisture.*
>
> *Several other species were collected that represent documentations of rare or uncommon species in the area. These include the oceanic species* Pilophorus acicularis *and* P. clavatus. P. clavatus *was only recently reported as occurring in inland regions by Spribille (2002), this being its third locality in inland North America. Another uncommon species found in the Incomappleux River canyon was* Solorina saccata*."*

In summary he writes:

> *"The discovery of so many oceanic species in the Incomappleux River area is compelling evidence in support of a southward extension to 51°N of the perhumid inland rainforest, a discontinuous band of moist forests in eastern and southeastern British Columbia otherwise extending from about 54° to 51°N (Goward & Spribille 2002). In fact, the presence of so*

many key indicator species suggests that the extent of the rainforest phenomenon in southern valley areas requires further study. It also points out the significance of the Incomappleux River Valley as a major centre of oceanic species diversity in southern interior British Columbia, and possibly as a source for colonisation of other areas."

On a subsequent sampling trip in 2004, Spribille (2004) found additional species including several 'oceanic' lichens found in the old growth forest just south of Battle Brook. New species include 'smoker's lung lichen' (*Lobaria retigera*), *Cavernularia hultenii* and other crustose species.

In addition, T. Spribille and A. Ceska, formerly of the BC Conservation Data Centre, discovered two red-listed plant species in the upper Incomappleux. Loess's twayblade orchid (*Liparis loeselii*) was found in a wetland near the mouth of Kellie Creek and represents only the third record of this species in Canada west of Saskatchewan and only the fifth site in the mountains of western North America. Additionally, ochroleucous bladderwort (*Urticularia ochroleuca*) is a "carnivorous" plant . The species is considered to be extremely rare in the province and for a long time was known only from Liard Hot Springs near the Yukon border; the Incomappleux site becomes one of few areas in British Columbia with known records of this bladderwort. A third rare species the red listed mountain moonwort (*Botrychium montanum*) was also located within the upper Incomappleux (Patrick Williston pers. comm. 2005).

From the above summaries, it is clear that the "exceptional" forests identified in this study contain multiple elements of high conservation value. Although most studies have taken place in the upper Incomappleux, rare and at-risk species may be present in other "exceptional" areas such as the forest sampled at the Trout Lake Private Land #1 site, the small remnant patches in the mid Incomappleux (Scott Creek and Ruby Silver) and potentially the stands above Lardeau Creek (Alpha, Lardeau Alpha, Snow).

CONSERVATION OPPORTUNITIES

Conservation opportunities differ on private lands and Crown lands. On Crown lands, conservation opportunities are primarily found through the delineation of Old Growth Management Areas (OGMAs; Province of BC 1999). However, as summarised in the Introduction the process for OGMA delineation does not guarantee that stands of exceptional age or structure will be preserved. Government policy does not apply to private lands and so long as they do not damage other lands or fish bearing streams landowners are free to manage their lands as they please. Thus, conservation covenants, land purchase, and other similar measures are the primary conservation opportunities on private lands.

INCOMAPPLEUX

The Incomappleux has some areas of private land primarily at low elevation close to Camborne at the south end of the drainage. No outstanding areas of forests were found in relation to this private land. The vast majority of the drainage is crown land and is part of Pope and Talbot's Tree Farm License #23. North of the Battle Brook stand is the boundary with Glacier National Park, which includes the headwaters of the Incomappleux.

The TFL area is subject to Landscape Unit Planning (as outlined in the Forest and Range Practices Act) and which is being undertaken as outlined by the Landscape Unit Planning Guide (Province of BC 1999). This requires targets for old growth protection to be met primarily in the non-contributing landbase. It also identifies old-growth as forests greater than 250 years old only. Work has been undertaken locally to identify areas that have higher structural and age values (S. Clow pers. comm.) but there is no legal approach to ensure that these areas are retained. Current Candidate Old Growth Management Area maps for this area identify small patches of 'typed' age class 9) forests that exist outside the Timber Harvesting Landbase. There

is one exception to this – the Battle Brook stand has been deferred from harvest temporarily – currently its legal status is unknown (S. Clow pers. comm.).

The West and North Incomappleux stands, plus an area close to the areas identified as having high lichen diversity (Arsenault 2004) in McDougal Creek are identified on or close to Pope and Talbot's current Forest Development Plan (an exact match is difficult to determine). The threat towards these stands, which clearly have exceptional values, is therefore very real and imminent.

An obvious unit for conservation is the area north of the McDougal Creek/ Incomappleux confluence, which encompasses North, West Incomappleux and Battle Brook stand sampled here. Their combined size – which results in a relatively large area with extremely high attributes, ages and rare species, plus combined with the fact that they are intact results in very high landscape level values in addition. The boundary with the Glacier National Park is quite close, and currently no roads (or bridge) exist into these sites. Existing operability maps show relatively little operable above this confluence. Conservation efforts should be considered to maintain these extremely high value stands and this extremely high value landscape.

The additional stands that were identified as having exceptional values within the Incomappleux are Ruby Silver and Scott Creek – these sites are basically remnant stands located within a landscape that has been extensively harvested. Similar stands have already been harvested adjacent to these, including the Mehninick Creek site sampled in 2001 with exceptional structural attributes. Planning should be undertaken to avoid harvest of the Ruby Silver and Scott Creek stands, which should be feasible as their size is quite small and their stand level values extremely high.

Boyd Creek also had some areas that have very high stand and age values, particularly in relation to the fact that these stands are at higher elevation than most of the others sampled. These stands come out relatively high in the ranking of old growth overall – showing that they have high conservation values. This area is all within TFL23 and we would recommend that additional fine-scale planning be undertaken to ensure that areas of exceptional values are maintained through time. In addition, harvest methods used should be are appropriate to maintain a significant portion of the very old structural attributes that are found throughout these stands. Pope and Talbot have demonstrated an ability to undertake this type of harvesting (e.g. in Lardeau Creek) and should apply it whenever they harvest in any old-growth stands.

Map 3a suggests there may also remain other locations within the Incomappleux where forests with exceptional conservation values may remain. These areas include areas up the McDougal drainage, above McRae Creek, in Boyd Creek, and on the east side of the river above Scott and Menhinick Creek. Similar conservation objectives should be applied as itemised above - exceptionally old or large stands should be maintained and somewhat younger, though still very old stands, should be carefully planned with structural attributes retained throughout any areas of harvesting.

TROUT LAKE- LARDEAU

The Lardeau areas differ in their conservation status – the Alpha and Lardeau Alpha sites had high values and are located at the bottom of a steep hill between the road and the Lardeau River. The river here is likely an S3 stream (between 1.5 – 5m wide, with the presence of fish). Under the FPC riparian guidelines this would have a reserve zone of 20m and a management zone of 20m. This combined width would likely not maintain the values of this benchy site (estimated 150m wide at its widest). We suspect that other similar high value stands exist in adjacent areas along the creek (where benches and toe slopes are relatively wide) and suggest that appropriate management to maintain these values would include a wider reserve zone, as allowed under FRPA to meet biodiversity and riparian objectives.

The site named Snow that was sampled in 2001 also has very high structural attributes. It is located in a midslope position, on gentle terrain within a heavily harvested area. A small portion

of the stand has already been harvested since old growth sampling occurred in 2001. Appropriate management for this site would be designation as an OGMA since it represents one of the last remaining forests with large trees in the local vicinity.

The Upper Lardeau stand is of 'average/ good' old growth values and should be managed to maintain some structural attributes if / when it is harvested.

TROUT- PL-1 AND PL-2

The sites in Trout Lake – PL-1 and PL-2 provide some of the most obvious conservation opportunities found in all of the areas sampled. The stand structural and age values of the Trout-PL-1 property are very high as shown in the results. The adjacency to an extensive wetland/ riparian ecosystem combines with the stand-level attributes to increase its value. In addition, the areas are privately owned and have the potential to have conservation covenants (or similar tools) applied to them.

Note that overall this stand does not have the same value as the combined areas of the Battle Brook, North and West Incomappleux plots. The upper Incomappleux stands have higher conservation value because of their larger size, lack of disturbance, and landscape position. However, this privately owned area has high value and provides an excellent conservation opportunity.

Map 2b shows that very few areas remain within this landscape that may contain such exceptional values. There are a number of extremely small potential locations close to Ferguson, and potentially other sites on the extremely heavily harvested Trout Lake face. Such areas warrant conservation status, if in fact they do contain these high values stands.

MEETING CBFWCP MITIGATION NEEDS

The Trout Lake wetland / forest complex under discussion (Trout Lake PL1 and PL2) has extremely high ecosystem diversity and biodiversity values.

This habitat type has been lost throughout the Columbia basin as a result of damming and inundation of several surrounding major drainages. Cottonwood and riparian ecosystems are now considerably under-represented compared to their expected natural distribution (Holt 2001, G. Utzig pers. comm.). Similarly, large structured, low elevation old growth forests are also locally rare, particularly on valley bottom sites where they have been impacted by harvesting, settlement, and flooding. Conservation of the Trout Lake PL1 and PL2 lands would help to mitigate some of these losses.

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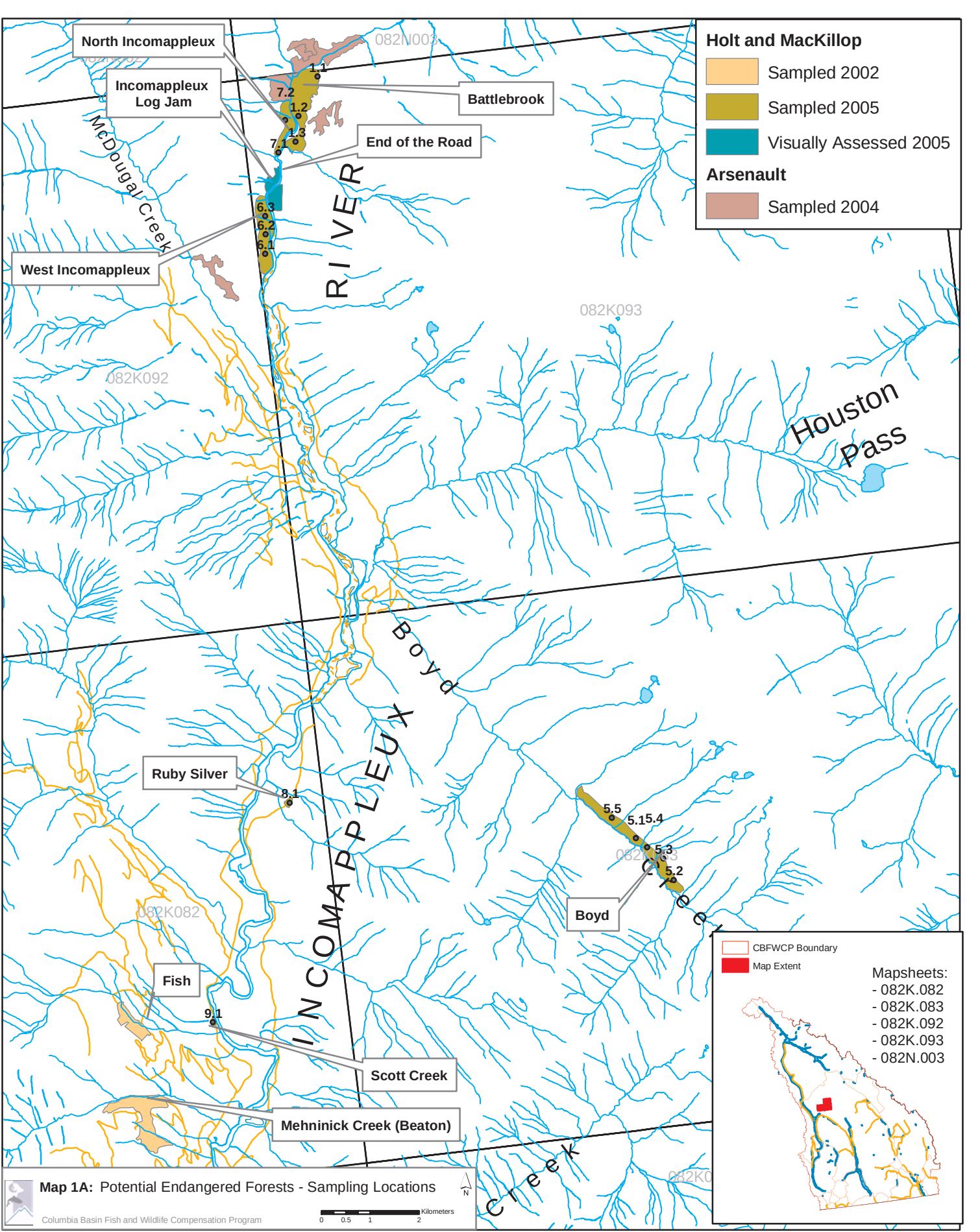
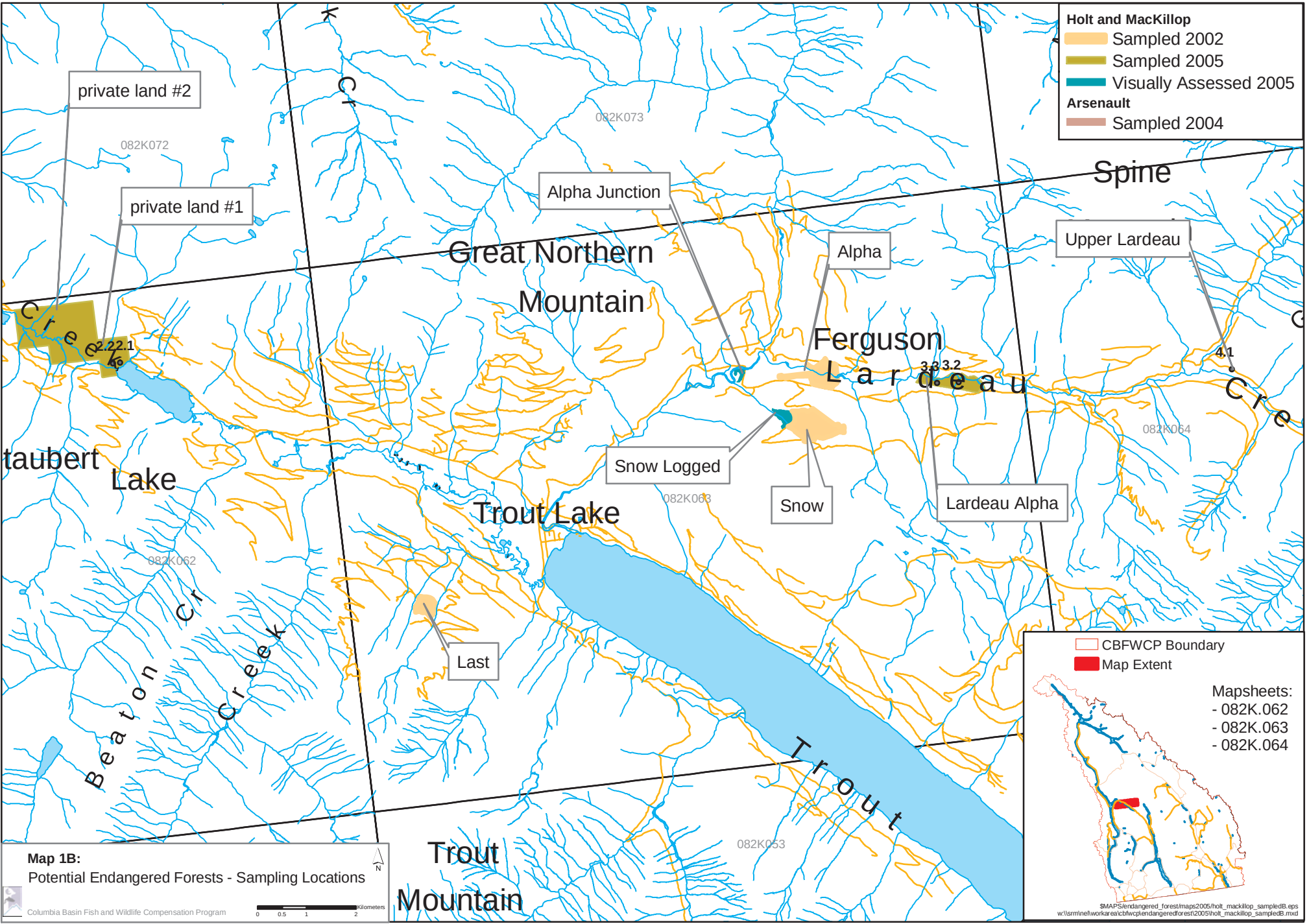
APPENDIX 1. MAPS AND PHOTOGRAPHS.



Map 1A: Potential Endangered Forests - Sampling Locations

Columbia Basin Fish and Wildlife Compensation Program


Holt and MacKillop
Sampled 2002
Sampled 2005
Visually Assessed 2005
Arsenault
Sampled 2004
private land #2
private land #1
Alpha Junction
Alpha
Upper Lardeau
Snow Logged
Snow
Lardeau Alpha
Last
Spine
Great Northern
Mountain
Ferguson
Lardeau
Trout Lake
Trout
Mountain
Beaton Creek
Beaton Cr
taubert
Lake
082K072
082K073
082K062
082K063
082K064
082K053
2.2.2.1
3.3.3.2
4.1
CBFWCP Boundary
Map Extent
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- 082K.064
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Map 1B:
Potential Endangered Forests - Sampling Locations
Columbia Basin Fish and Wildlife Compensation Program
Kilometers
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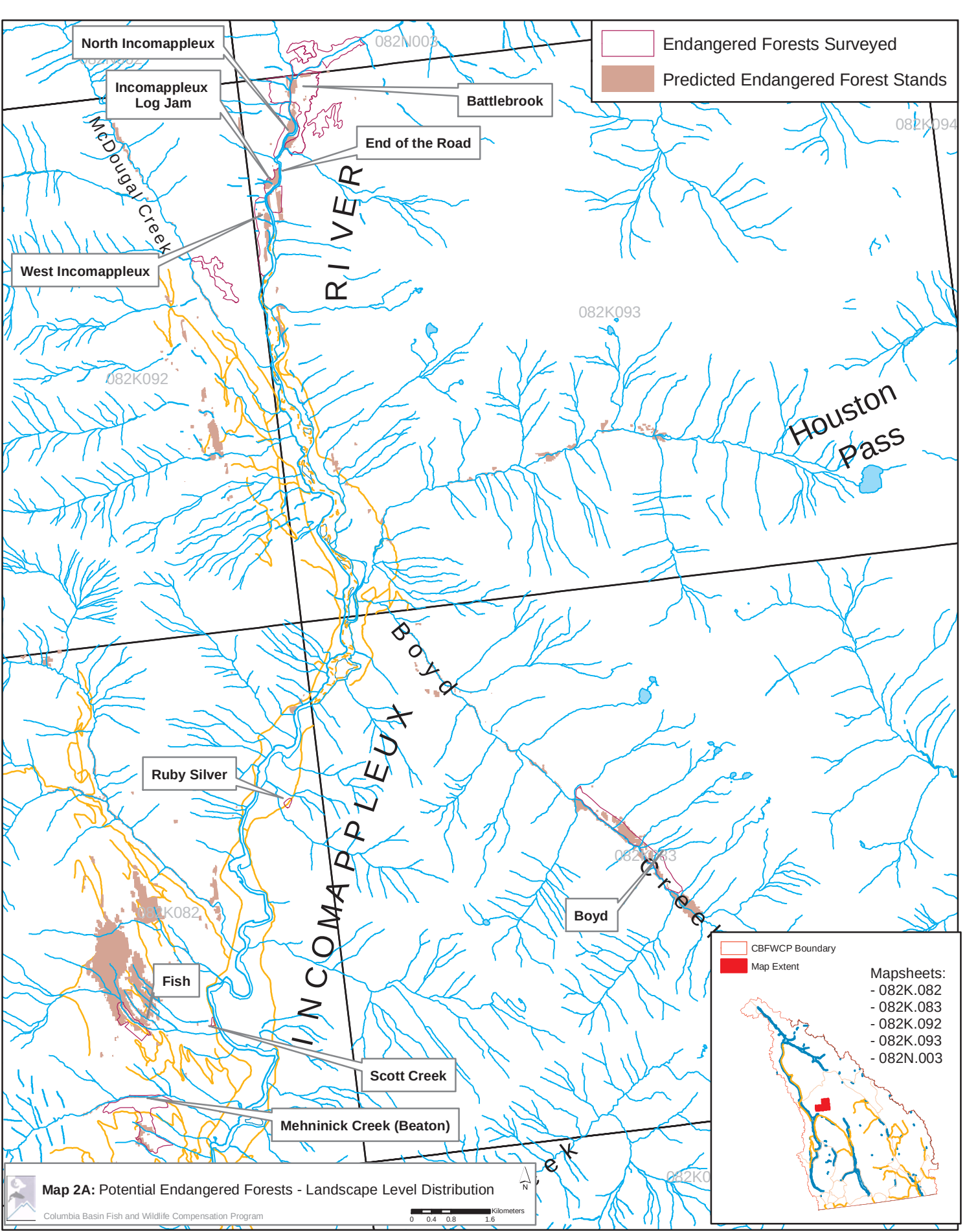
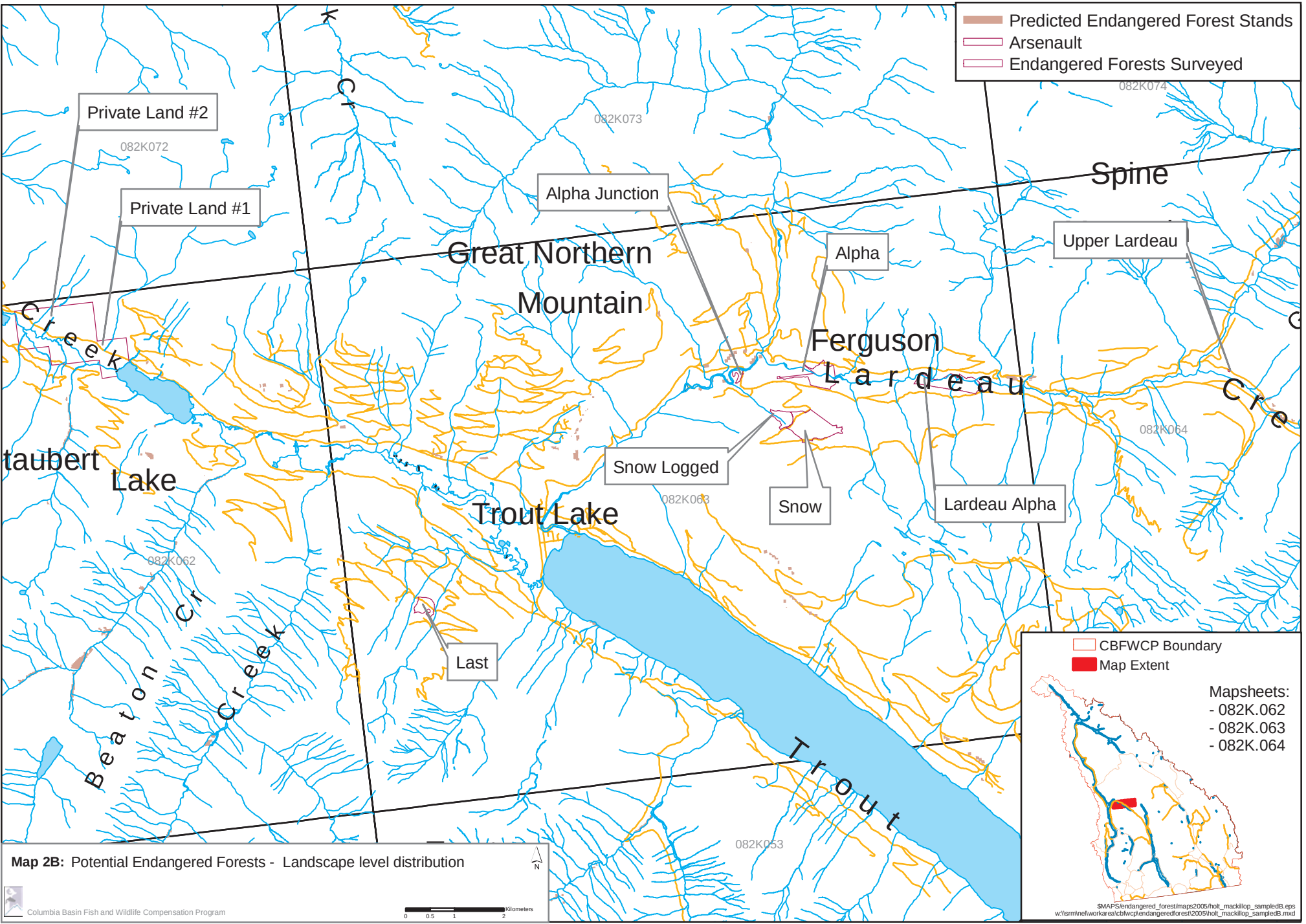
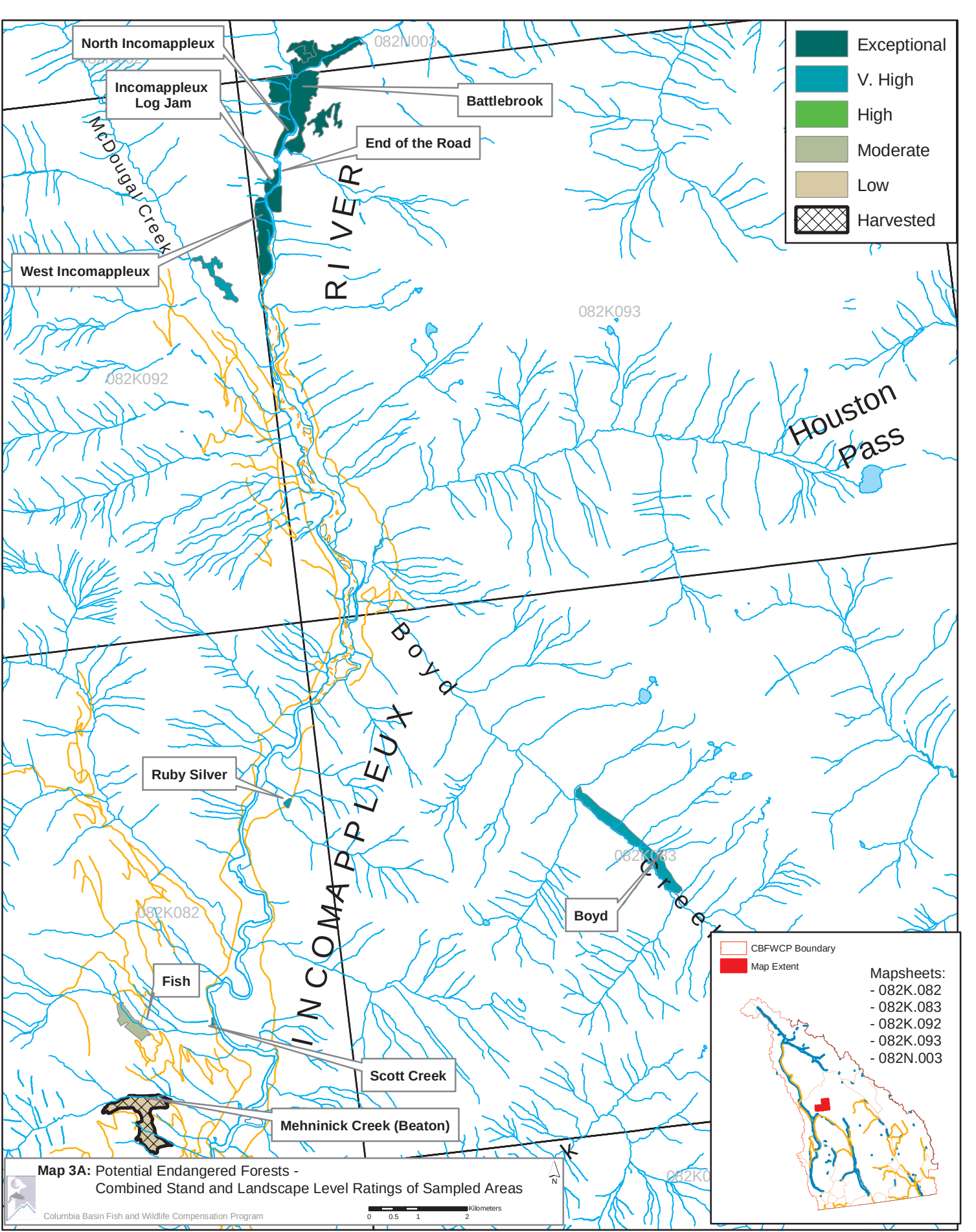

Endangered Forests Surveyed
Predicted Endangered Forest Stands
North Incomappleux
Incomappleux Log Jam
Battlebrook
End of the Road
McDougal Creek
West Incomappleux
RIVER
082N003
082K094
082K093
082K092
Houston Pass
Boyd
INCOMAPPLEUX
Ruby Silver
Boyd Creek
082K083
082K082
Fish
Scott Creek
Mehninick Creek (Beaton)
CBFWCP Boundary
Map Extent
Mapsheets:
- 082K.082
- 082K.083
- 082K.092
- 082K.093
- 082N.003
Map 2A: Potential Endangered Forests - Landscape Level Distribution
Columbia Basin Fish and Wildlife Compensation Program
Kilometers
0 0.4 0.8 1.6



Map 2B: Potential Endangered Forests - Landscape level distribution


North Incomappleux
Incomappleux Log Jam
Battlebrook
End of the Road
McDougal Creek
West Incomappleux
RIVER
082N003
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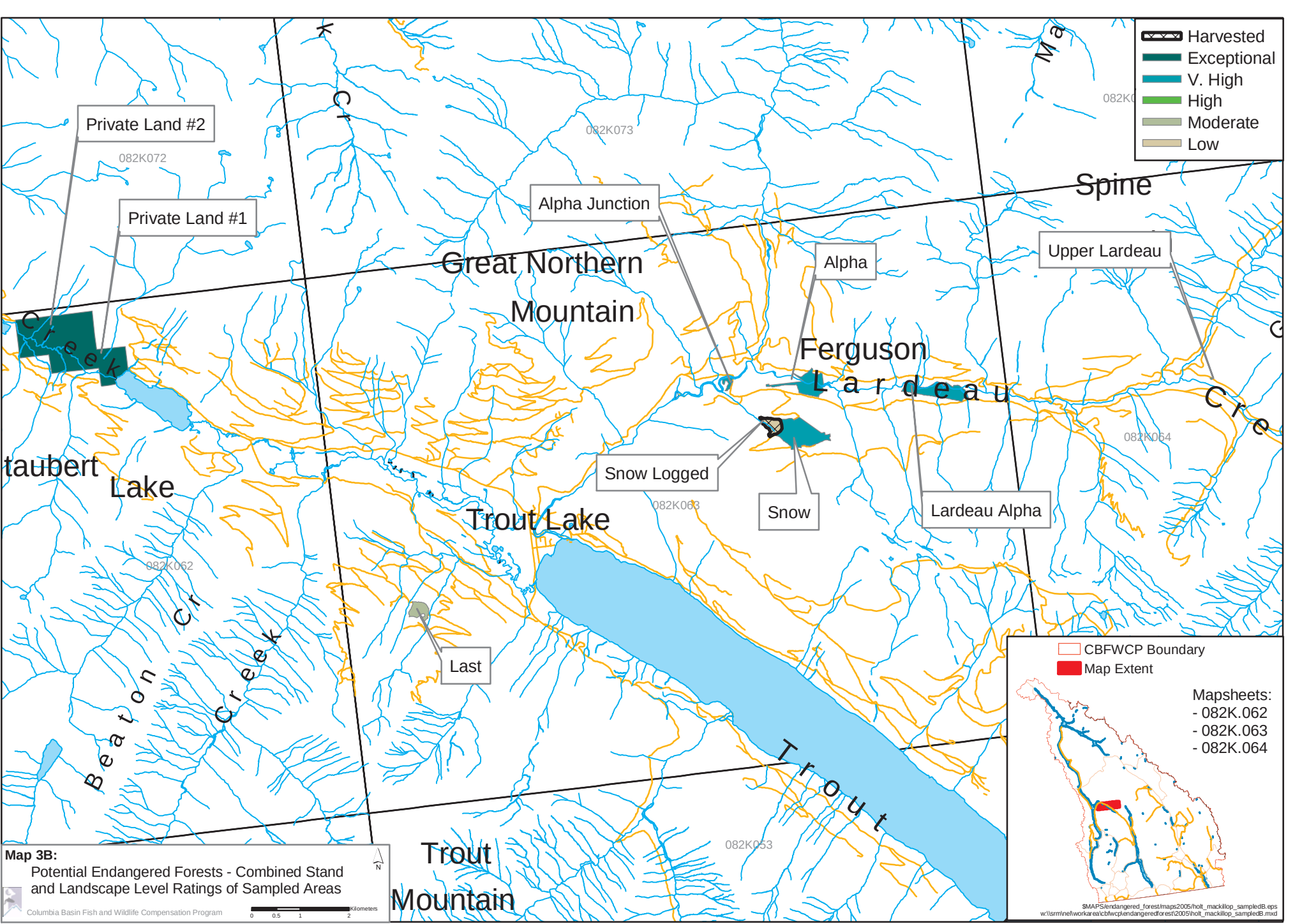
Houston Pass
Boyd
INCOMAPPLEUX
Ruby Silver
082K083
Boyd
Creek
082K082
Fish
Scott Creek
Mehninick Creek (Beaton)
Exceptional
V. High
High
Moderate
Low
Harvested
CBFWCP Boundary
Map Extent
Mapsheets:
- 082K.082
- 082K.083
- 082K.092
- 082K.093
- 082N.003
Map 3A: Potential Endangered Forests -
Combined Stand and Landscape Level Ratings of Sampled Areas
Columbia Basin Fish and Wildlife Compensation Program
Kilometers
0 0.5 1 2


Harvested
Exceptional
V. High
High
Moderate
Low
Private Land #2
Private Land #1
Alpha Junction
Alpha
Upper Lardeau
Spine
Great Northern
Mountain
Ferguson
Lardeau
Snow Logged
Snow
Lardeau Alpha
Trout Lake
Last
Trout
Trout
Mountain
082K072
082K073
082K062
082K063
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082K053
CBFWCP Boundary
Map Extent
Mapsheets:
- 082K.062
- 082K.063
- 082K.064
Map 3B:
Potential Endangered Forests - Combined Stand and Landscape Level Ratings of Sampled Areas
Columbia Basin Fish and Wildlife Compensation Program
Kilometers
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Photograph 1. Overview of the Trout Lake Private Land #1 (and #2), with adjacent wetlands, riparian areas and Highway (R. F. Holt).

Photograph 2. Wetlands adjacent to the Trout Lake Private Land # 1 and 2 Areas (R.F. Holt).

Photograph 3. North Incomappleux Area. Cedar trees greater than 3m dbh (J. Dulisse).

Photograph 4. Battlebrook Area (J. Dulisse).

Photograph 5. Boyd Creek (J. Dulisse).

Photograph 6. Counting rings at Beaton (previously sampled in 2001 and described as exceptional old-growth at that time). J. Dulisse

Photograph 7. Evidence of high-grading from earlier this century, at Ruby Silver Creek. J. Dulisse.

APPENDIX 2. DETAILED METHODS USED TO DETERMINE BREAST HEIGHT AGE ESTIMATES FOR SAMPLED TREES

Tree cores were sampled at breast height (1.3m), stored in plastic straws, then counted under a 60x microscope. Most cores (93%) did not reach the centre of the tree due to heartwood decay. For these cores, breast height ages were estimated using four extrapolation techniques. For each technique, the length of missing radius was calculated by subtracting the estimated bark thickness (using double bark thickness ratios from PrognosisBC; Zumwari pers comm. 2001[7]) and the length of sampled core from the total radius. This approach assumes concentric rings with a pith in the geometric centre of the tree. Although there are still inherent errors, this assumption is an unbiased approach to addressing an unknown and undeterminable variable.

The approaches used to extrapolate the number of rings in the "missing" portions of the radius were:

1) the average growth rate over the total length of core sampled
2) the average growth rate of the innermost 20 growth rings
3) the average growth rate of intact cores (to the pith) from a study of 209 tree cores in the wet ICH – 7.4 rings/cm (Holt and MacKillop 2002)
4) a conservative estimate of average "fast" growth rates – 5 rings/cm for the study are

Maximum, minimum, and most likely ages were then derived for each sampled tree based on the above estimates of breast height ages. In most cases, using a growth rate of 5 rings/cm provided the lowest age estimate, and using the mean growth rate of the total core sampled resulted in the highest estimates. The innermost 20 rings and the mean growth rate of 7.4 rings/cm led to the most likely age estimates in most cases.

These patterns are consistent with typical tree growth patterns. Many trees, particularly old growth, display an age trend whereby the width of growth rings decline over time (Daniels pers comm. 2003[8]). In this case, using the inner 20 rings will best reflect actual growth patterns. However, western red cedar and western hemlock are highly shade tolerant and have the capacity to remain beneath the canopy in a suppressed state for many years (Wright et al. 2000). Should the inner 20 rings fall within a highly suppressed portion of the core, the estimate could be extremely large. Using a regional average growth rate is intended to smooth out the temporal variations in individual tree growth and to provide a more plausible estimate of tree age.

Tree radius to core length ratios, magnitude of estimates, and comparisons between estimation techniques were used to determine minimum, maximum, and most likely tree age estimates. Extra caution was used where less than 40% of the tree's radius was sampled in a tree core, since less complete cores tend to produce less accurate estimates. MacKillop (2003) found that tree cores with less than 40% of the radius intact consistently overestimated tree ages in the moist warm ICH in the Nelson area.

The above methods refer to breast height age estimates and do not reflect total tree ages (since germination). However, given the long time intervals since tree inception, growth to breast height estimates will also have a large degree of error. For example, stand conditions during early growth are unknown. If trees were relatively open grown, rates should be higher. If trees established beneath a tree canopy or under heavy herbaceous and shrub cover, growth rates will be lower. Both patterns are likely in the trees sampled in this study. Ring counts from the tops of

[7] Growth and Yield Biometrician, British Columbia Ministry of Forests, Research Branch.

[8] Dendrochronologist, Univeristy of British Columbia.

stumps adjacent to sample locations suggest that many trees had slow early growth rates[9]. In a study of old-growth forests in the moist warm ICH, cedar generally took approximately 40 years to grow to breast height, while hemlock trees took 25 years (MacKillop 2003). However, growth to breast height for saplings was as high as 102 years for cedar and 160 years for hemlock. Without any definitive means of measuring early growth rates, we suggest adding a uniform growth to breast height estimate for total tree ages based on the average values for hemlock and cedar found in MacKillop (2003). These mean values likely underestimate ages where regeneration occurred in shaded conditions, but are the best available estimates for the species in question.

It should be remembered that even with the multiple approaches to estimating tree ages, these are still estimates. Accuracy could be within as much as a few hundred years. Regardless, estimates are the only reasonable means of determining ages for very old stands in the wet ICH where internal decay is prevalent.

[9] Ring counts on stumps can provide a clearer picture of growth rate histories and often indicate growth patterns near the pith (where rings are often visible, but too decayed to capture in an increment bore sample).

APPENDIX 3. TREE AGE DATA

Site No	Area Name	Sp	Max of Tot Most Likely Age	Max of Tot Max Est Age	Max of Tot Min Est Age
1.1	Battle Brook	Cw	879	1155	686
		Hw	299	354	307
1.2	Battle Brook	Cw	765	1045	630
		Hw	153	156	155
1.3	Battle Brook	Cw	878	836	696
		Hw	271	287	256
2.1	Marlow	Cw	1050	1399	795
2.2	Marlow	Cw	1023	1057	770
3.1	Lardeau Alpha	Cw	736	1022	580
3.2	Lardeau Alpha	Hw	636	840	636
3.3	Lardeau Alpha	Cw	311	350	331
		Hw	438	985	349
4.1	Upper Lardeau	Cw	472	654	430
		Hw	466	519	405
5.1	Boyd	Cw	645	766	508
		Hw	523	535	420
		Sx	224	224	219
5.2	Boyd	Cw	573	855	480
		Hw	531	574	465
5.3	Boyd	Cw	725	984	601
		Hw	430	497	354
5.4	Boyd	Cw	696	773	549
5.5	Boyd	Cw	405	483	409
		Hw	444	473	402
6.1	West Incomappleux	Cw	935	1010	734
6.2	West Incomappleux	Cw	385	508	370
6.3	West Incomappleux	Cw	437	467	369
7.1	North Incomappleux	Cw	726	857	585
		Hw	473	596	373
7.2	North Incomappleux	Cw	1269	1269	940
7.3	North Incomappleux	Cw	1018	1562	776
		Hw	328	371	310
8.1	Ruby Silver	Cw	896	951	861
9.1	Scott Cr	Cw	990	1115	748
Grand Total			1269	1562	940

APPENDIX 4. INDEX OF OLD-GROWTHNESS (HOLT AND MACKILLOP 2002).

ICHwk1 – Wet Stands (Site Series 05-06)*

Site Series_____ Slope_____Aspect _____ Elevation _____ Size (ha) _____

Stand Name _____ Polygon _____ Map Sheet _____ FC Age _____

Structural Attribute**	Measured Value	Threshold for High Structure	Threshold for Very High Structure	Score = 0 for Low; 1 for High; 2 for Very High
Mean Stand Age		>243	>408	
Trees17.5-30 (sph)		<109	<40	
Trees30-50 (sph)		<123	N/A	
Trees50-75 (sph)		<72	<47	
Trees>100 (sph)		>13	>35	
Number of Trees>75cm with Dead or Broken Tops (sph)		>9	>31	
Largest Tree (cm)		>111	>150	
Largest Snag (cm)		>81	>103	
Snags_17.5-30 (sph)		<36	<6	
Snags_30-50 (sph)		<21	<9	
Snags_75-100 (sph)		>6	N/A	
Snags_100 (sph)		N/A	>5	
Average Canopy Lichen Loading**		>1.9	N/A	
%cover layer A: trees >10m tall		<30	<19	
				Sum:
Landscape Considerations/ notes				

- Index is considered applicable to ICHvk1 01/05 sites as well.
- Note that additional variables were added to the index to account for trees >200 cm dbh and >300 cm dbh.