# OG TAP Old Growth Deferral: Background and Technical Appendices

This report includes material supplemental to our main report **Priority Deferrals: An Ecological Approach** and to the Old Growth Deferral Maps.

# Contents

# Introduction

The Old Growth Technical Advisory Panel (OG TAP) was asked to identify the forests most at risk of irreversible biodiversity loss as per the criteria set out in Recommendation #6 of the **Old Growth Strategic Review** (OGSR). This document provides non-technical background on key concepts and methodology, plus technical appendices to support our report, **Priority Deferrals: An Ecological Approach**.

**Deferral is not protection.**
**Deferral pauses activities to create space and maintain options.**

Deferrals are intended to temporarily (2-4 years) pause harvest of at-risk forests to allow time to develop the new forest management approaches that shift the emphasis from managing for timber, subject to constraints, to managing for ecosystem health, as per the recommendations of the OGSR. The priority deferral map provided by the OG TAP (Map 1) identifies the most at-risk old growth forests as candidates for deferral.

# Old Growth Forests

**Old-growth forests are structurally complex natural ecosystems that develop over long time periods and vary with a landscape's topography, climate, soil and natural disturbance regime.**

Old-growth forests are communities of trees, other plants, fungi, animals and microbes that have lived together long enough to develop complex, interconnected relationships. Old-growth structure can include very large and small, old live trees, large dead standing trees and large, long-fallen trees. British Columbia (BC) has a wide range of types of old growth forest. In ecosystems where large natural disturbances are rare, old-growth trees grow in ancient stands that have been undisturbed for up to 10,000 years, since the last glaciation. In ecosystems with more frequent stand-replacing disturbances, stands can still be many hundreds of years old, though tree age is typically more uniform and veteran large trees provide legacies from past disturbances such as wildfire.

Forest inventories in British Columbia do not always reflect the ecological variability, age, or biodiversity values that are often distinct in old forest. We therefore have relatively limited ability to reflect the natural variation in old forest at the strategic scale in BC. As the best available data at a provincial scale, the OG TAP used the age thresholds typically used in forest management in BC to define old growth:

- Forests older than 250 years in ecosystems with infrequent stand-replacing disturbance;
- Forests older than 140 years in ecosystems with higher stand-replacing disturbance rates.

See Technical Appendices 2 and 8 for information about forest age and disturbance intervals.

**Old-growth forests are primary forests.**

Primary forests are naturally regenerating forests whose structure, composition and dynamics are dominated by ecological and evolutionary processes. Primary forests include naturally disturbed areas (e.g., developing after wildfire, insect disturbance or storms), and forests managed by indigenous peoples, but excludes forest that has been disturbed by industrial activities. Not all primary forest is old, but all old growth is primary forest.

**From an ecological perspective, old growth supports biodiversity, provides a variety of ecosystem services, mitigates the climate crisis and helps us adapt to the changing climate.**

As outlined in the Old Growth Strategic Review report[1]:

"Forests with old and ancient trees contain unique combinations of attributes that grow from ecosystems that have formed over centuries or millennia. These attributes can rarely, if ever, be replicated in younger or compromised ecosystems, even if they contain old trees. Some of the many values found in forests with old and ancient trees are:

- Unique conditions and processes that are important to conservation of biodiversity;
- Unique species, many of which are still undiscovered;
- Banks of genetic material for future use or adaptation strategies;
- High value timber with qualities not found in younger forests;
- Resistance to fire;
- Interception and storage of water;
- High carbon storage and sequestration capacity;
- Botanical forest products, including medicinal, edible, decorative and ceremonial plants;
- Fish and wildlife habitats, including essential attributes for nesting or denning, thermal protection and hiding from predators;
- Spiritual and cultural uses, including carvings, canoes, and ceremonial poles;
- Aesthetics such as resident viewing and tourism;
- Commercial and non-commercial recreation; and
- Knowing they are there for their own sake – intrinsic value".

**Crossing an arbitrary age threshold does not create old growth, because minimum ages do not capture complexity, particularly in industrially managed stands.**

Under stable historic conditions, over long timeframes, the amount of old forest is relatively constant because regrowth matches disturbance. Logging adds to natural disturbance and reduces the abundance of old growth considerably, especially when the oldest forests are targeted for harvest first. Forest management also aims to re-harvest forests on shorter rotations – 60 to 80 years for lower elevation forests. Rotation forestry will not facilitate recovery of old forest because the time frames for old forest development are much longer. In addition, harvesting of old forests has occurred at a rate that is intended to be consistent with meeting future harvest rotation schedules rather than rates that would recover old forest. This is termed "sustained yield" forestry.

[1] Gorley, A. and G. Merkel. 2020. A New Future for Old Forests. https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/old-growth-forests/strategic-review-of-old-growth-forest-management

While the province uses age thresholds (250 and 140 years) to define "old growth", an age-based definition does not capture the variability in structure, form and function of older primary forests (i.e., those that haven't been subject to industrial logging).

Old forests disturbed by wildfire, insect outbreaks or storms regenerate as they have for millennia. Harvesting, and particularly clearcut harvesting, does not mimic natural disturbance. Natural disturbances leave legacies in the form of large veteran trees, snags and logs that provide complexity throughout development; soil disturbance is often minimal. Conversely, clearcutting and other major industrial disturbances, remove most large tree structures, leaving small pieces that decay rapidly; often there is substantial soil disturbance. Even if a logged stand becomes "old", i.e., it crosses an age threshold, it may not have all the attributes of natural old growth developed over a longer timeframe. Industrial harvest of old, primary forest set the ecosystem back hundreds—or even thousands—of years in terms of biodiversity development and ecological function. In some cases, old growth attributes may never recover, particularly given the changing climate.

As the forested landbase changes from primary to managed forest and as that forest ages, it will be increasingly important to differentiate between old primary and harvested forest. This is already an issue in parts of the province with long harvest histories, such as the south coast, where logged 120-year-old forest is now indistinguishable—in the data—from natural 120-year-old forests that have much higher structural complexity and biodiversity and may therefore be higher priority for recruitment.

Forests that are labeled a little less than 250 years in age in the provincial inventory dataset may in fact be considerably older (Technical Appendix 2). In lower productivity forests, smaller trees are often misclassified as younger when in some cases these forests have been developing complexity for thousands of years.

## BC's Remaining Old Growth

**Based on current inventory, 11.1 million hectares of old growth remains in BC, of an expected 25 million hectares that existed prior to industrial forestry harvesting.**

Unfortunately, no direct data exist to show how much old forest was present in BC before industrial harvesting began. However, provincial data can be used to estimate natural levels of old, based on average natural disturbance rates in different ecosystems (Technical Appendices 3 and 8). Using these data, we estimate approximately 25 million ha of old forest would be expected in BC, on average, under pre-industrial harvesting (historic) conditions.

The area of old growth remaining today (11.1 million) is lower than previously reported on government websites (13.2 million) because the OG TAP worked with government staff to update the provincial data layers to include new ecological inventory, wildfire, insect disturbance, and recent harvesting.

Government inventory policy currently retains the "old" designation for burned and insect-disturbed forest, meaning that previous estimates included highly disturbed forest as old growth.

We know from provincial data that at least 10 million hectares of primary forest have been logged in the province; most of that logging would have targeted the most accessible forests in the valley bottoms, and those with the highest economic value, resulting in a historic harvest pattern that has tended to log the oldest and biggest-treed forests first. We therefore expect that the remaining 11.1 million hectares of old growth does not represent the original old growth forests—and that smaller-treed, less-economically valuable forests are over-represented in today's remaining old growth.

## Types of Old Growth

**The remaining old-growth forests have different structure and functions and are at varying levels of risk in different ecosystems across BC. Combining all old forests into one pool is highly misleading because not all old growth is the same.**

BC's old-growth forests differ widely in terms of structure and functions. They also vary in level of risk. In some ecosystems such as at high elevations and in bogs, ancient trees, 400 years old or more, only reach 3 meters tall. These forests have important biodiversity and other values; however, they have not historically been targeted for logging and so are generally still abundant and occur at levels close to expected historic amounts.[22]

In contrast, timber harvesting has historically targeted the largest trees available to log in each region. Big-treed forests support different values than small-treed forests—they are biodiversity hubs, carbon banks and climate change refugia—and are typically at much higher risk. Conservation areas are often biased towards lower-productivity forests, an outcome driven by existing policy to limit the timber impacts of conservation measures. As a result, old forest retention policies often fail to represent all ecosystem types. Big-treed old growth meets the imminent and irreversible biodiversity loss criteria in OGSR recommendation #6 because it has been the focus of logging pressure in BC for the past century.

**As per OGSR recommendations[1], it is critical to differentiate between different types of old forest, in particular between big-treed and small-treed old growth, when assessing current status, trends, or the likely effectiveness of management approaches. While representation of all ecosystems is important, big-treed old growth provides very different values, and these forests face higher risk.**

# OG TAP Deferral Recommendations

As stated in the OG TAP's **Priority Deferrals: An Ecological Approach**: "All old forest is irreplaceable in a human timeframe, and perhaps in any timeframe given climate change". However, some types of old growth forest currently face higher near-term risk. These types are most important to defer. We identified three categories of old growth meeting the at-risk criteria listed in the OGSR: remnant old growth, ancient forests, and big-treed old growth. Some forests fall into two, or rarely all three, of these categories. Focusing harvest deferrals on unprotected areas that face highest risk and are threatened by harvest is the most efficient approach to ensuring deferrals are meaningful.

[2] Historic amount or distribution is based on the historic condition of the forest before large-scale human impacts such as urbanization, industrial forestry, agriculture, oil & gas exploration, mining and transportation.

**Together, big-treed old growth, remnant old growth and ancient forest result in 2.6 million ha of unprotected priority at-risk old growth recommended for immediate deferral (Map 1).**

The big-treed old forest category captures the intent of the "high productivity" category identified in the OGSR Recommendation #6 criteria. We mapped the biggest-treed remaining old growth (tallest and widest trees; see Technical Appendix 1 for rationale) in each ecosystem[3] up to the minimum amount required to avoid high risk within an ecosystem. We first used a *default target*[4] (a minimum of 10% of the forested area, or 30% of natural old forest levels,[5] whichever is greater) to identify a *minimum* level of old forest to consider in landscape level planning (Map 2). This map is based on the ecological principle of identifying a minimum level of old forest in each ecosystem to avoid high risk—one of the core tenets of maintaining healthy ecosystems at a landscape level. This approach identifies approximately 4.1 million ha of unprotected big-treed old forest. The area selected is determined by the targets (i.e., choosing the biggest 10% of each ecosystem will, by simple math, result in a selection that is 10% of BC'sforested area).[6] Much of this area will overlap with forest that is important for single species habitat and other values, but some of it contains relatively small trees—because these are the biggest remaining forests in each ecosystem (i.e., the largest trees have already been logged in many ecosystems).

**The area of big-treed forest in Map 2 is determined by the 'target' amount. Not all forests in this category will be large—because these are the *largest remaining* forests, to a default total, in each ecosystem. These forests are an important foundation for landscape planning for resiliency.**

We then prioritized forests within this area by examining risk levels by ecosystem (see Technical Appendix 4). Based on the results of this risk assessment, we reduced the proposed deferral area in forest ecosystems considered to be at lower risk. Shown on Map 3, this highlights the highest priority 2.2 million ha of unprotected big-treed old forest, some of which overlaps with Remnant and Ancient forest, in the province (again, the area is determined by the targets). We added areas of Remnant and Ancient forest not captured in the big-treed map to create the composite map of priority deferral areas (Map 1).

Not all forest types were considered for deferral. Historically, the very low productivity, smaller-treed forests that make up the Spruce Willow Birch and the woodland ecosystems of the high elevation Engelmann Spruce – Subalpine Fir have not been the focus of timber harvest and thus have not been

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[3] Biogeoclimatic variant.

[4] "Targets" in this context refer to the minimum amounts of old forest conservation required to avoid a high risk of old forest biodiversity loss within an ecosystem. Targets do not reflect amounts specified in existing land use orders or provincial guidance documents.

[5] Research shows that where 30% or less of the historic amount of old growth in an ecosystem remains, risk to biodiversity and ecosystem functions is high. (Environment Canada 2013. How much habitat is enough? Third edition. Environment Canada, Toronto, Ontario). Many big-treed ecosystems have less than 10%, and some have lessthan 1% of the historic amount of old growth.

[6] The area is less than 10% of BC's forested area because not all ecosystems have sufficient old forest to meet targets

included in deferrals. This pattern may change if harvesting for biomass or other purposes targets smaller-treed forests, including those in these ecosystems.

We also recommend deferral of appropriate recruitment forest (forest older than 80 years in areas with very little old forest remaining; see Map 7), and of relatively intact watersheds (Map 6), to maintain options for recovery and resilience. Intact watersheds and recruitment forest are not part of the 2.6 million ha of unprotected area that are identified as priority for deferral, but are critical, particularly in certain areas of the province.

## Remaining Big-treed Old Growth

**Very little big-treed old growth remains compared with historic levels, although the amount varies by ecosystem and depends on the definition of "big trees". Breaking tree size into five categories, about 80% of BC's old growth has very small to medium-sized trees; about 300,000 ha has very large trees.**

The OG TAP used forest inventory variables (tree height and diameter; see Technical Appendix 1) to calculate the relative tree size of old forest remaining in each ecosystem, and divided the range of sizes within each ecosystem into five equal tree-size classes. We found that most of BC's old growth has relatively small or medium sized trees (Figure 1), and that very little has "Very Large" trees, with approximately 300,000 ha in this size class across the whole province. Although this method gives us ecosystem-specific and ecologically relevant definitions of size based on *current* characteristics of the forest, it suffers from a "shifting baseline error". In some ecosystems, entire cohorts of large trees are gone and do not exist in the dataset—or in the forest—anymore. If we had measured the 'big' trees existing in ecosystems 100 years ago, the average big tree size would be much larger than today, particularly in low elevation ecosystems. The grey trees in Figure 1 represent these large, lost, ghost trees.

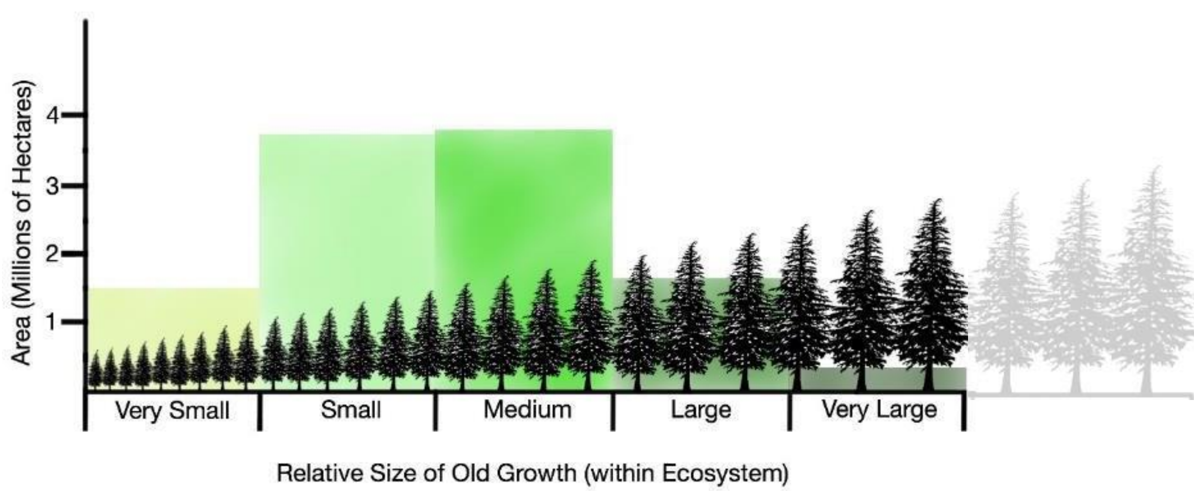



*Figure 1. Area distribution of old forest shown by relative tree size categories. The grey trees represent lost historic large trees that would have made up the "very large" class, showing the shifting baseline.*

Map 8 shows all the forest identified as old in the provincial forest inventory today highlighted by size class, as well as areas that are mapped as having been harvested, for context.

Understanding patterns of ecological risk requires using a metric that applies to all forest ages in order to compare the current area of old growth with the area expected to be old historically. There are no ideal data with which to assess risk for big-treed ecosystems, so studies must choose a method with the leasterror. In our analysis of ground plot data from old-growth forests, VRI site index correlated well with the"realized" growth of the stand (i.e., what has actually grown and is present on the site today; see Technical Appendix 5) and was thus used to evaluate differences in ecological risk across ecosystems.

The OG TAP did not use site index to locate areas of old growth for deferral for several reasons:

a) There are two site index datasets in BC (VRI and PSPL) that reflect superficially similar but actually quite different information.

b) OG TAP decided that although site index is useful from a risk analysis perspective, moving to size attributes of the actual trees on the site would work as well or better to identify deferral areas. This approach is more intuitive and relates better to how First Nations and the public 'see' the forest. We therefore used a combination of tree height and diameter to identify old growth forests and to locate priority big-treed forest deferral areas.

## Old growth missing from deferral recommendations

**Important old forests may be missing from the deferral maps because: they do not meet OGSR criteria for at-risk old growth, because they do not meet OG TAP's definition of priority at-risk old growth, because there are errors or slow updates in the provincial database or because they are within wildlife tree patches.**

OG TAP did not consider values beyond those listed in OGSR Recommendation #6. OG TAP maps focus on the criteria designed to capture at-risk old growth laid out in the 2020 Old Growth Strategic Review—ecosystems that are at very high risk of irreversible biodiversity loss—and do not explicitly identify other high-value old forest.

An area of old growth is on the Priority Deferral Map (Map 1) if it is mapped as old (or older mature in some ecosystems) and has not been subsequently disturbed by wildfire, insects or harvest, if it is not a wildlife tree patch and if it has any of the following attributes in the provincial vegetation resources inventory database:

- it is within the target for largest remaining trees in that ecosystem (Technical Appendix 4);
- it is mapped as ancient (older than 250 or 400 years; Technical Appendix 3); or
- it is mapped in an ecosystem with less than 10% old remaining (Technical Appendix 6).

OG TAP expects that some old forest stands are missing from the map because:

- they are not mapped in the provincial inventory as being old;
- inventory shows these areas have relatively small trees;

- there is sufficient area with larger trees in the inventory, so those stands had lower priority.

**OG TAP recommends that areas that meet the criteria for at-risk old forest on the ground and were missed on maps be added to the deferral recommendations.** See Appendix 9 for some resultant criteria that could be used to identify areas appropriate to add or delete from the big-tree deferral maps.

Some areas will be included in the deferral maps that do not meet criteria due to data errors (see Data Challenges section) and due to the large pixel size (1 hectare) needed for a province-wide analysis.

OG TAP's analyses used updated inventory layers developed with the Province, and therefore cannot be easily verified using older versions of VRI data.

## Recruitment

**Some ecosystems have so little old growth remaining that old-growth deferrals do little to reduce risk. In these cases, recruitment of younger stands is needed urgently.**

The OG TAP was tasked with identifying old growth that should not be logged in the short-term. Remnant old forest is identified for priority deferral where less than 10% old remains. As part of that analysis, we also noted whole ecosystems with little to no remaining old forest. These ecosystems are some of the highest risk ecosystems in the province, and include much of the drier, low elevation coastal forest, plus many of the interior low elevation valleys and ecosystems throughout the province. These ecosystems have had the longest settlement and development histories and are significantly changed from their historic distribution.

For these highest risk ecosystems, where little to no old growth or older mature forest remains, we identified remnant old areas, and then additional forest sufficient to meet the default target with what we term 'recruitment' forest; the largest forest in those ecosystems older than 80 years in age. These younger recruitment stands are not included on the priority deferral map and are mapped separately (Map 7) for government's consideration as it develops further ecosystem health plans.

Since this forest is not old growth, it is not directly under consideration by the province to be part of deferrals. However, these forested ecosystems are some of the most highly impacted, at highest risk, in the province. For context, a MacLean's article[7] written in 1958 said:

> *"That British Columbia has even one public preserve of prime Douglas Firs is due to H. R. MacMillan, the tough old man who probably cut the biggest swath through the fir forest ofthem all. He has given to the people of B.C. a three-hundred-and-fifty-acre stand of superb fir giants, which borders the Alberni Highway of Vancouver Island. Its name is Cathedral Grove. The firs are neither the island's biggest, nor the oldest, although there is one tree whose twenty-seven hundred cubic feet of lumber would build two five-room homes, and others that were sawlogs when Wolf stormed Quebec."*

[7] https://archive.macleans.ca/article/1958/5/10/the-vanishing-giant-that-built-a-province

Today, the notion that Cathedral Grove was not the biggest nor oldest stand of Douglas-fir trees is difficult to fathom, and that this text was written in 1958 makes it more so.

Recovering the health of these most heavily impacted ecosystems and watersheds, including identifying the most ecologically appropriate areas to allow to become the old forests of the future, will be a key task to maintain options as BC moves through its forest management paradigm shift. As a result, the OG TAP recommends that deferrals extend to recruitment forest (Map 7), allowing the most biologically and structurally diverse forest to remain and age towards old growth over time.

## Protected old growth

**BC has 3.5 million hectares of old growth in designated no-harvest zones, leaving 7.6 million hectares unprotected.**

BC has 25 million hectares of protected areas, half of which are forested. Of the 12.5 million hectares of protected forest, 3.5 million hectares are old growth. Of this area, just over 2 million hectares is in parks and protected areas (Tier 1 protection), and the remaining 1.5 million is in areas where harvesting is generally prohibited but not completely excluded, including Old Growth Management Areas (OGMAs), no-harvest Wildlife Habitat Areas and no-harvest Ungulate Winter Ranges (Tier 2 protection).

| Classification | Area (million hectares) |
|---|---|
| **Original estimated old growth** | 25 |
| **Remaining old growth** | 11.1 |
| **Protected old growth** | 2.0 |
| **OGMAs and similar zones** | 1.5 |
| **Unprotected old growth** | 7.6 |

Protected areas do not evenly represent the range of ecosystems, with an over-representation of protection for higher elevation ecosystems and a much lower proportion of protection for low elevation ecosystems that typically can grow larger trees.

**Most forests in Old Growth Management Areas are NOT old.**

OG TAP analysis only counted forest within OGMAs if it was mapped as old forest. Old Growth Management Areas—intended to maintain old forest—are mostly not old. Indeed, only 32% of BC's OGMAs are mapped as old in the provincial inventory. Additionally, of the areas identified as "protected" in provincial data, 250,000 ha is shown as logged.

## Protected Forest and Deferrals

**Protected forest that meets at-risk criteria is mapped and counted towards the targets, but is not included as part of the 2.6 million priority deferral recommendations**

Where protected areas (Tier 1 and Tier 2) contain big-treed, ancient or remnant forest, these forests are 'counted' in the TAP analysis. These areas are not priorities for immediate deferral as they are not supposed to be logged in the short-term; hence they are removed from the OG TAP's priority deferral package, although shown for reference on Map 1. OG TAP notes that these forests should be included in a tracking system to ensure that they are not harvested in the short-term.

Some ecosystems have more forest protected than others. This variability is reflected in the deferral package, as ecosystems with more at-risk old growth forest already protected have less area recommended for deferral.

Very low protection levels in low elevation ecosystems have led to high risk in many of these ecosystems. Because these ecosystems also have little remaining old forest, deferring old forest from harvest in this area will not reduce this risk substantially. In these cases, recruitment of younger forest is necessary to reduce risk.

## Data and mapping challenges

**The OG TAP maps identify old forest for deferral based on updated provincial level inventory. Uncertainty and gaps remain.**

Tree height and diameter are the most reliable strategic indicators for reflecting what is found on the ground. Technical Appendices 1 – 3 summarise analyses of inventory information undertaken by the OG TAP to inform our deliberation of how best to map at-risk old growth. We assessed the reliability of different forest attributes by comparing inventory data to what has been measured on the ground. That analysis showed good support for using measurements of tree height and diameter to map the remaining largest old forest in the province. Conversely, we found that inventoried forest age can be unreliable, particularly for ancient forests. We therefore modified the mapping of recommendations of the 2020 Old Growth Strategic Review slightly to improve reliability in identifying ancient forests and have used the Province's definition for "very old" forests. We expect more ancient forests to be identified on the ground than are shown on the maps.

**We did not map forest based on patch size or shape, although we excluded wildlife tree patches. Planning will require consideration of many elements beyond deferred old growth.**

As outlined in Priority Deferrals: An Ecological Approach, Map 1 shows the prioritized areas for deferral. Each of the criteria for identification (big-treed, ancient and remnant) allow areas as small as one hectare to be identified. We looked at ways to prioritize larger, less fragmented areas in our provincial modeling, but determined that this was not feasible at the provincial scale. We developed a map of relatively intact watersheds as a planning tool.

The deferrals are intended to preserve options to allow for meaningful landscape level planning. We recommend that regional planning builds on Map 1, using Map 2 (default targets for big-treed old), Map 7 (big-treed recruitment) and Map 6 (intact watersheds) as well as local knowledge and field checking as required to identify ecologically meaningful landscape reserves that meet the intent of the broader recommendations of the OGSR. In future resilience planning, best management practices for harvest layout and design could be applied in areas with small deferral areas to ensure deferrals are buffered, or not fragmented and supported to provide effective biodiversity values.

**Despite challenges, we recommend that available data are adequate to guide meaningful deferrals immediately. We recommend precautionary implementation.**

Although these maps are developed at the provincial scale and are limited by data quality, they are adequate to guide meaningful deferrals immediately. We recognize that inventory gaps and errors mean that some forests that should be included in deferrals will be mis-identified and not mapped for deferral. The one-hectare resolution means that sometimes forest polygon boundaries cross through a unit, potentially resulting in confusion at the local scale as whole polygons may not appear to have been chosen. OG TAP recommendations reflect these issues. We recommend precautionary implementation so that decision-making errs towards keeping critical forests standing in the interim, rather than inventory errors or polygon splitting being used to allow forests at high risk to be harvested.

Because OG TAP updated provincial databases prior to analysis, many polygons will not match existing data sources and may look patchy. Differences include the newest version of ecosystem definitions (BECv.12), updating of age to include recent disturbance and exclusion of mapped wildlife tree patches.

**How the inventory may differ from on-the-ground forest, and how to address:**

| Mapping challenge[1] | Cause | How to address |
|---|---|---|
| **Forest is old but not mapped as such.** | Inventory error. | Defer if it meets criteria for at-risk old growth (i.e., big-treed, ancient or remnant) |
| **Old forest has large trees, but not mapped as such.** | Inventory error. | Defer if it meets criteria for big-treed |
| **Forest is ancient but not mapped as such.** | Inventory error. | Defer if tree coring shows trees to be ancient. |
| **Forest is mapped as old but clearly isn't old.** | Disturbance (wildfire, insect attack, harvesting) since inventory; or inventory error. | No need to defer (note that naturally disturbed stands may be important to maintain for other values) |
| **Forest is mapped as old, but questions are raised as to it meeting deferral criteria.** | Potential inventory error. | Defer for now. Flag for review in tracking process. |
| **Portion of deferral polygon crosses boundaries (e.g., non-forest, road, younger forest)** | Large pixel size; or inventory error. | Only defer old forest that exists on the ground. |
| **Deferral polygon covers a portion of inventory polygons** | Deferral excludes wildlife tree patches | Ensure that wildlife tree patches are not logged. |

| | | |
|---|---|---|
| **Deferral polygon covers a portion of inventory polygons** | Polygons have updated for age and BECv12 | Assess need to consider previous versions of polygons for deferral; use complete stand type boundaries, based on finer-scale data (e.g., field, LiDAR, aerial images). |
| **Deferral implementation is intended to be precautionary – ensure modification of deferral polygons does not impact priority old forest retention options.** | | |

[1] Where "old" is referenced in this table, guidance also applies to older mature forests where applicable (seeTechnical Appendix 7).

## Data gaps

**There are four blank areas on maps because data for four Tree Farm Licenses cannot shared with the public or Nations as part of this process.**

Forest inventory information is available to share publicly under the province's open data license for most of the province. Gaps in this coverage were filled with Baseline Thematic Mapping where the province does not have forest inventory information, and with information the province has but does not have a license to share with the public, specifically Tree Farm Licenses #33, 38, 41, 45. The OG TAP was allowed access to these TFL forest inventory data, to include in our analyses (i.e., areas for deferral are identified in these TFLs), but in the final mapping products these areas cannot be shown.

**The OG TAP recommends that all TFL data on public land are made available to all.**

# OG TAP Technical Appendices

The Old Growth Technical Advisory Panel followed the recommendations of the 2020 Old Growth Strategic Review (Recommendation 6) to summarize and map at-risk old growth. Government analysts and ecologists collaborated with the Panel to provide data and discuss analysis methodology and other details. This document compiles several short methodological and analytical descriptions for those wishing to dive into the analyses more deeply.

The OG TAP produced our substantive products between late June and early August, and then produced a prioritized map in September 2021. OG TAP worked in concert with provincial analysts to ensure alignment with base data and general methodologies.

The tight timeline for completing the OG TAP work constrained the level of analysis and reporting. We have aimed to achieve a "good enough" strategic analysis, consistent with the principles of the Old Growth Technical Advisory Panel. This means that we have explored the data at a high level looking for patterns rather than completing formal statistical analyses. The following appendices provide additional detail on aspects of the methodology as well as lists of information that may be useful for planning purposes.

## Appendices

# Appendix 1: Using Ground Plots to Assess Indicators of Big-Treed Forests

## Introduction

Determining priority areas for old growth deferral at the provincial scale, by necessity, relies on existing databases. Available inventory data are uncertain because they rely on remote assessment and because it is difficult to capture the immense variability amongst forested ecosystems without walking through them. To map deferral areas, we need to know which inventory variables are most reliably linked to measured old forest attributes. This report describes the accuracy of inventory variables in predicting stand attributes measured on the ground.

We asked "how well do inventoried attributes (e.g., inventory height) correlate with measured attributes (e.g., measured height)", and "do patterns vary by tree species and BEC zone"? We were particularly interested in learning which variables would be most reliable to use to select at-risk large-treed forests.

## Methods

Government analysts collated and provided available ground plots (n = 6,978) and spatially linked inventory data. Because this project focusses on old growth, we limited our exploration to relationships between inventory data and ground measurements in older forests. We extracted all records for forests measured in the field as > 140 years old. We used 140 years as the age threshold across all BEC zones and did not investigate differences between age class 8 and 9 stands. From the set of old forest plots, we removed ecosystems classed as alpine (n =10) as well as stands that had been harvested since the ground survey (n = 65).[8] We retained naturally disturbed stands, assuming that in these stands, necromass replaced biomass. Our final dataset included 1,945 plots.

We summed live and dead stems to create total standing stems per ha, and live and dead volume to create total volume. Other variables focused on live trees. Utilisation standards were set at ≥ 12.5 cm dbh (i.e., only trees equal to or larger than this limit were included).

We investigated the following attributes:

- Stems per ha (live + dead)
- Basal area per ha
- Total volume per ha (live + dead)
- Volume per tree (total volume per ha/stems per ha)
- Diameter (QMD[9])
- Height of the leading species (healthy co-dominant trees)

[8] Inventory data for these harvested stands represents the young growing stands rather than old growth as measured in the ground plots.
[9] Quadratic Mean Diameter emphasises larger trees

All attributes were both estimated in inventory and measured in ground plots, allowing us to compare the two independent samples for each stand.

Because ecosystems vary and because tree species vary in their growth patterns, we examined the data stratified by leading tree species within BEC zone. This stratification reduces sample size within groups considerably. To avoid misleading results from small samples, we only used leading species/BEC zone combinations with at least 30 ground plots (Table 1.1).[10]

We ran correlations of all pairs of attributes and examined the data for patterns. We looked for the strength of the relationship as described by Pearson's r-value, considering correlations with $r < 0.3$ unrelated in any meaningful way, $r > 0.3$ to 0.5 demonstrating weak to moderate relationships and $r > 0.5$ moderate to strong relationships. The smallest group included 43 plots, meaning that any r-values of $> 0.3$ were statistically significant at $P = 0.05$.[11] Given the noise in ecological data, we looked for consistent patterns in trends across different leading species/BEC zone combinations, rather than focusing on individual correlations.

## Results

Based on our analysis tree height is the most reliable inventory attribute; that is, inventory estimates of tree height correlate well with measured height. For all leading species/BEC zone combinations, estimated and measured height were correlated at $r > 0.3$ (weak to moderate significant relationship), and for nearly half, correlations surpassed $r > 0.5$ (moderate to strong relationship; Table 1.2).

Patterns varied by leading species/BEC zone. In some species/BEC zones, height was the only correlation reaching the $r > 0.3$ threshold while in others, measured and estimated volume, basal area per ha, volume per tree and diameter also correlated at this level (Table 1.2). If one attribute beyond height showed a relationship, others did too, reflecting correlations amongst stand attributes. Investigating patterns within groups was not feasible within the timelines available.

Because trees grow differently (e.g., Cw can be extremely wide and fairly short), height does not capture all elements of a big-treed forest. Our previous deferral maps (Daust, Holt, Price 2021) considered volume per tree. Government analysts suggested using QMD as a measure of diameter. The ground measurements show that diameter and volume per tree are very strongly correlated (range among species/zone groups $r = 0.79$ to 0.96; stronger correlations than any other pairs of attributes), suggesting that either would work equally well.

[10] Arbitrary selection of sample size as time precluded power analyses.

[11] In groups with larger samples, smaller r values would also be considered statistically significant; however, we considered the strength of the relationship to be too weak to provide useful information.

*Table 1. 1**. Number of ground plots for each leading species (from ground plots) and BEC zone. Bolded numbers show groups with more than 30 plots used for analysis.***

| BEC | ACT | AT | BA | BL | CW | EP | FD | HM | HW | LA | LT | LW | PA | PL | PLC | PY | S | SB | SE | SS | SW | SX | YC | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BG** | | | | | | | 1 | | | | | | | | | | | | | | | | | 1 |
| **BWBS** | | | | 4 | | | | | | | 1 | | | 2 | | | 5 | 7 | | | 13 | 8 | | 40 |
| **CWH** | | | **49** | 4 | **134** | | 23 | 29 | **152** | | | | | | 5 | | | | | 1 | | | **78** | 475 |
| **ESSF** | | | 6 | **419** | 6 | | 8 | 18 | 16 | 1 | | | 4 | 20 | | | 25 | | **71** | | 4 | **44** | | 642 |
| **ICH** | 2 | | | 17 | **88** | | 26 | 3 | **78** | | | 1 | | | | | 3 | | 10 | | | 19 | | 247 |
| **IDF** | | | | 1 | 1 | | **94** | | | | | 2 | | 2 | | | 1 | | | | | 2 | | 103 |
| **MH** | | | 28 | 6 | 1 | | | **43** | 10 | | | | | | | | | | | | | | 12 | 100 |
| **MS** | | | | 3 | | | 15 | | | | | 1 | | 13 | | | 2 | | 1 | | | 9 | | 44 |
| **PP** | | | | | | | | | | | | | | | | 3 | | | | | | | | 3 |
| **SBPS** | | | | | | | | | | | | | | 4 | | | | | | | | 2 | | 6 |
| **SBS** | 1 | 2 | 1 | **73** | | 1 | 14 | | 2 | | 1 | | | 16 | | | 21 | 8 | | | 2 | **110** | | 252 |
| **SWB** | | 1 | | 17 | | | | | | | | | | 1 | | | 7 | 2 | 3 | | 1 | | | 32 |
| **Total** | 3 | 3 | 84 | 545 | 230 | 1 | 181 | 93 | 258 | 1 | 2 | 4 | 4 | 58 | 5 | 3 | 64 | 17 | 85 | 1 | 20 | 194 | 90 | 1945 |

*Table 1. 2****. Correlations between estimated inventory data and attributes measure in ground plots. The number of "X"s represents the strength of the correlation (X: r > 0.3; XX: r > 0.4; XXX: r > 0.5).***

| BEC zone | Leading sp. | Height | Diameter | Total volume | Volume per tree | Basal area per ha | Stems per ha |
|---|---|---|---|---|---|---|---|
| **CWH** | BA | XXX | | | | | |
| | CW | XXX | XX | | XX | X | |
| | HW | XXX | | | | | |
| | YC | X | | | | | |
| **ESSF** | BL | XX | X | X | X | | X |
| | SE | X | | | | | |
| | SX | XXX | X | XX | | XX | |
| **ICH** | CW | XX | XX | | X | X | |
| | HW | XX | | | | | |
| **IDF** | FD | XXX | | XX | | XX | X |
| **MH** | HM | X | XXX | | XX | XX | |
| **SBS** | BL | XXX | XX | XXX | XXX | XXX | |
| | SX | XX | X | X | | X | |
| **Total # corr'n** | | **13** | **7** | **5** | **5** | **7** | **2** |

## Implications

- Inventory estimates of height are reliable indicators, confirming the use of height in selecting deferral options.
- Height could be augmented by either diameter or volume per tree. Given that diameter is conceptually simple and does not confound height, our analyses suggest that height and diameter are the best available indicators of forest size that don't involve visiting the forest.
- Because correlations are not strong for all ecosystems (i.e., the size of some forests may be mis-characterised by VRI attributes), we recommend precautionary interpretation and validation locally from ground plots before potentially high priority forests are harvested.

# Appendix 2: Using Ground Plots to Determine Age Thresholds

## Introduction

Mapping old growth at the provincial scale relies on existing data describing forest age. Available inventory data are uncertain because they rely on remote assessment, and it is difficult to assess without coring trees and counting rings. It is particularly difficult to assess age remotely in low productivity stands because these stands look short, but can be very old, with associated complex attributes that may be invisible from the air.

We asked "how well does inventoried age match actual age as measured in ground plots"? We focused on determining whether we need to drop the definition of "old" forest below the ages recommended in the biodiversity guidebook in order to capture old forest that is mis-classified in inventory.

## Methods

Government analysts collated and provided available ground plots (n = 6,978) and spatially linked inventory data. We excluded plots without inventory data, without ground data, and with recorded conversion due to harvest or natural disturbance. Within the filtered dataset, we focused on plots measured as older than 140 years (n = 1,624).

We analysed age over the entire dataset and by groups of BEC variants defined as old at > 140 years (drier ecosystems) and groups defined as old at > 250 years (wetter ecosystems).

## Results

Inventory age slightly overestimates actual age for forest up to age 200, but underestimates the actual age of forest older than 200 years. The difference between measured age and inventory age increases with age (Figure 2.1), so that ancient forests are severely under-represented in the inventory data (Figure 2.2). Inventory data is related closely to measured age for the first 200 years (although overestimated). Variability increases above 200 years, and the curve flattens (Figure 2.3).

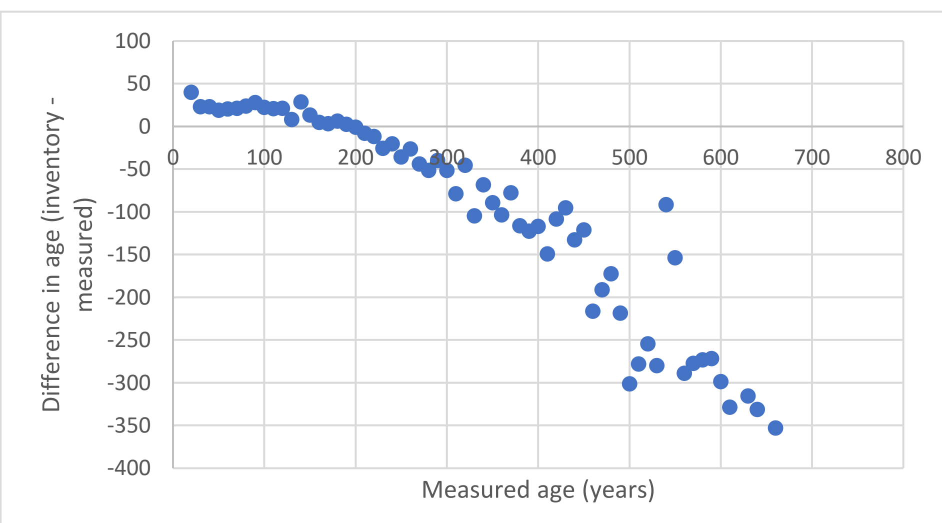



Figure 2. 1. **Difference between inventoried age and measured age as measured age increases over the entire dataset (all ages). Each point shows the average difference for 10-year age increments.**

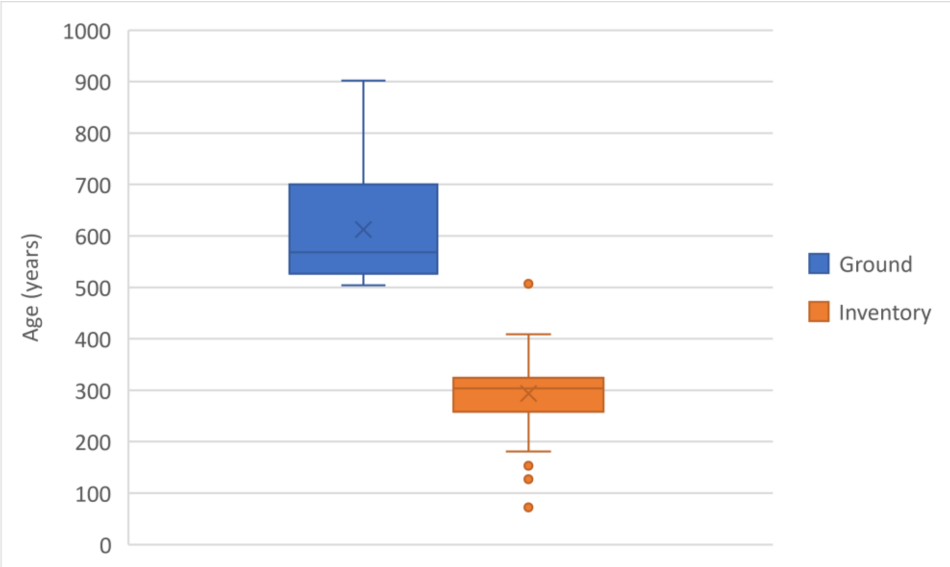



Figure 2. 2. **Box plot showing mean and median age of forest measured as older than 500 years old.**

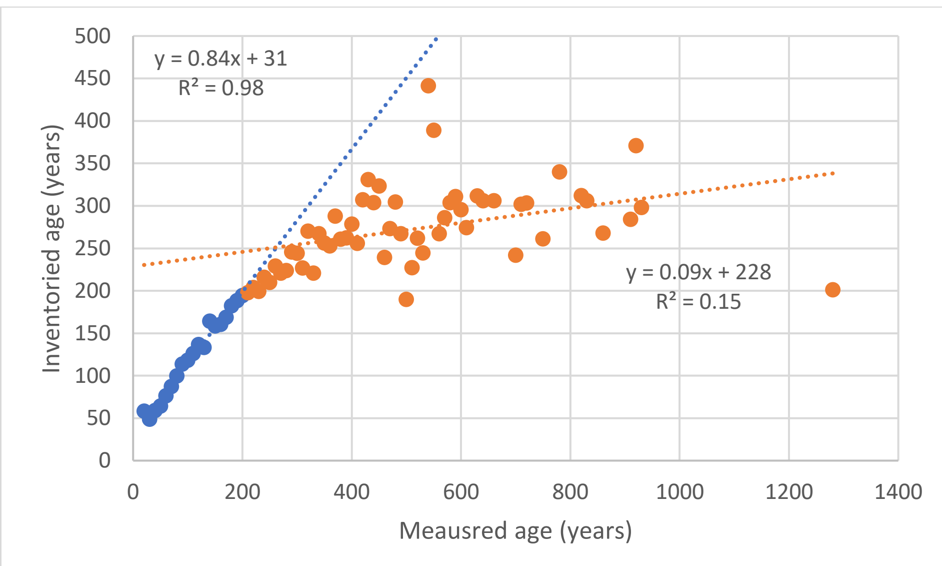



Figure 2. 3. **Inventory age versus actual age for the entire dataset. Each point shows the average inventory age for 10-year measured age increments. Points are divided in a split plot regression (represented by different colours), showing a strong relationship up to 200 years and a weak relationship beyond.**

To account for the underestimation of age, we looked for inventory age thresholds that would capture 70%, 80% and 90% of plots measured as old forest. We divided BEC units into those with a defined old age of > 250 years and those with a defined old age of > 140 years (Table 2.1). Capturing 80% of CWH over 250 years means using an inventory age of 230, not far from 250 years; however, capturing 80% of the over 250-year-old forest in wet ESSF variants requires dropping the age threshold much further to 160 years.

*Table 2. 1**. Inventory age thresholds that capture high proportions of forest measured on the ground as old. Samples of fewer than 10 plots were considered unreliable.***

| Inventory age that captures 70, 80 and 90% of plots with old forest | | | |
|---|---|---|---|
| **Capture of forest > 250 years** | | | |
| **BEC zone (n)** | **>90%** | **>80%** | **>70%** |
| **CWH (244)** | 190 | 230 | 250 |
| **ESSF_wet (84)** | 130 | 160 | 170 |
| **ICH_wet (78)** | 120 | 170 | 190 |
| **IDF (8)** | 20 | 90 | 100 |
| **MH (57)** | 180 | 240 | 250 |
| **SBS_wet (6)** | 90 | 120 | 120 |
| **SWB (3)** | 150 | 190 | 210 |
| | | | |
| **Capture of forest > 140 years** | | | |
| | **>90%** | **>80%** | **>70%** |
| **BWBS (30)** | 50 | 80 | 100 |
| **ESSF_dry (29)** | 120 | 130 | 140 |
| **ICH_dry (12)** | 80 | 90 | 90 |
| **MS (31)** | 80 | 100 | 120 |
| **SBPS (1)** | 50 | 50 | 50 |
| **SBS_dry (101)** | 70 | 100 | 120 |

Reducing the inventory age to capture missed old forest also increases the chance of including younger forest in the sample, these are “false positives”. For example, using 200 years to define old in the CWH means that only 57% of the selected stands are actually over 250 years. The proportion of false positives varies across BEC units.

## Implications

**Because inventory underestimates forest age, we suggest reducing the age threshold when using provincial inventory data to capture a higher portion of old forest**. However, finding a balance between reducing false negatives and increasing false positives is challenging, particularly if the total candidate area remains unchanged (e.g., if the goal is to identify 10% of the best old). In this case, reducing the age threshold could result in forests younger than 250 years being chosen in preference to real older stands, and potentially decreasing the representation of ancient stands in the forests selected.

Assuming that we decide to reduce the age threshold used from which to choose forest, we considered three options:

1. Based on Table 2.1, we could select ages that capture about 80% of old forest that vary by BEC unit. For example, we could use 230 years in CWH and MH, 170 years in wet ESSF and wet ICH, 140 in dry ESSF and 100 in BWBS, dry ICH, MS and dry SBS.

2. We could use the 15% buffer calculated by government analysts for the original deferrals of nine areas in September, 2020, so that age thresholds are 212 years for forests considered old at 250 years and 119 years for those defined as old at 140 years.
3. We could use the “old mature” category defined in the Biodiversity Guidebook: 200 years for forests that are old at 250 years and 120 years for those considered old at 140 years.

Option 1 is most complex. It matches the data best but adds complexity in that cut-offs would vary by BEC unit. Options 2 and 3 are much simpler. Given that options 2 and 3 have similar thresholds, we would prefer to choose based on an ecological rationale. Hence, we proposed that OG TAP use 200 years to select the biggest old forest in BEC units with a 250-year-old definition and 120 years in BEC units with a 140-year-old definition.

As a result, our first model iteration picked the biggest trees from a pool that combined the older-mature forest with the old forest (i.e., from any forest above 200 years in less frequently disturbed BEC units and above 120 years in more frequently disturbed ecosystems). In this selection, “old mature” forest that was larger than forest that was “old” based on inventory age, could be chosen first for deferral. The OG TAP felt this was ecologically justified given that inventory underestimates age, but FAIB raised concerns that we had re-classified the age of “old” forest and that this would lead to confusion.

In our final approach, we thus modified our selection criteria to choose the biggest forest from the “old” pool first, and the “older mature” pool second if needed to fill the target (see Appendix 7). This decision means that some larger forest that is the same age on the ground, but mis-classified in the inventory, will not be identified in deferral maps.

Field validation of age will be important where doubts exist about an area of old forest being harvested or not, in relation to deferrals of priority old forest.

# Appendix 3: Assessment of Expected and Mapped Ancient Forest

## Introduction

Ancient forests are one class of at-risk old growth. Ancient forests are known to be under-represented in inventory data because a) they are difficult to measure remotely (and even on the ground) and b) for timber supply purposes, there is no value in discriminating between old and very old stands (Appendix 2). This report investigates how much ancient forest would be expected in BEC units and compares the expected amount to the amount mapped.

Because the inventory is known to be poor, we examine two sets of ancient age criteria (Table 3.1).

*Table 3. 1**. Ancient age criteria as described in the OGSR and in Land Management Handbook 25.***

| BEC Unit | Age of old | Age of ancient (OGSR) | Age of ancient (LMH 25) |
|---|---|---|---|
| **BG** | 250 | 500 | 400 |
| **BWBS** | 140 | 300 | 250 |
| **CDF** | 250 | 500 | 400 |
| **CWH** | 250 | 500 | 400 |
| **ESSF140*** | 140 | 300 | 250 |
| **ESSF250** | 250 | 500 | 400 |
| **ICH140** | 140 | 300 | 250 |
| **ICH250** | 250 | 500 | 400 |
| **IDF** | 250 | 500 | 400 |
| **MH** | 250 | 500 | 400 |
| **MS** | 140 | 300 | 250 |
| **PP** | 250 | 500 | 400 |
| **SBPS** | 140 | 300 | 250 |
| **SBS140** | 140 | 300 | 250 |
| **SBS250** | 250 | 500 | 400 |
| **SWB** | 250 | 500 | 400 |

*Some BEC zones have variants classified as old at 140 years and other variants classified as old at 250 years. In general, the variants with a higher old age threshold are wetter and experience less frequent natural disturbance. See Table 8.1 for the age thresholds by BEC subzone/variant.

## Methods

We used the natural disturbance estimates provided by provincial government ecologists to estimate the proportion of each BEC variant expected to be ancient by the appropriate age value (Table 3.1) using the negative exponential equation in the biodiversity guidebook. We mapped forest described in inventory as ancient for both sets of criteria (OGSR and LMH 25) and summed the ancient forest by BEC variant across the province in each map. We calculated the percent of the expected ancient forest that was mapped as ancient by BEC variant and averaged these percentages within BEC units (zones divided by the defined age of old forest). We did not have time to explore patterns within finer units.

## Results

The proportion of old forest and ancient forest expected under historic natural disturbance conditions varies by BEC unit (Figure 3.1). BEC units with rare disturbances are predicted to be almost all ancient (CWH, MH; Figure 3.1). The wetter units in the ESSF and ICH are also expected to have a high proportion of ancient forest under historic disturbance conditions.

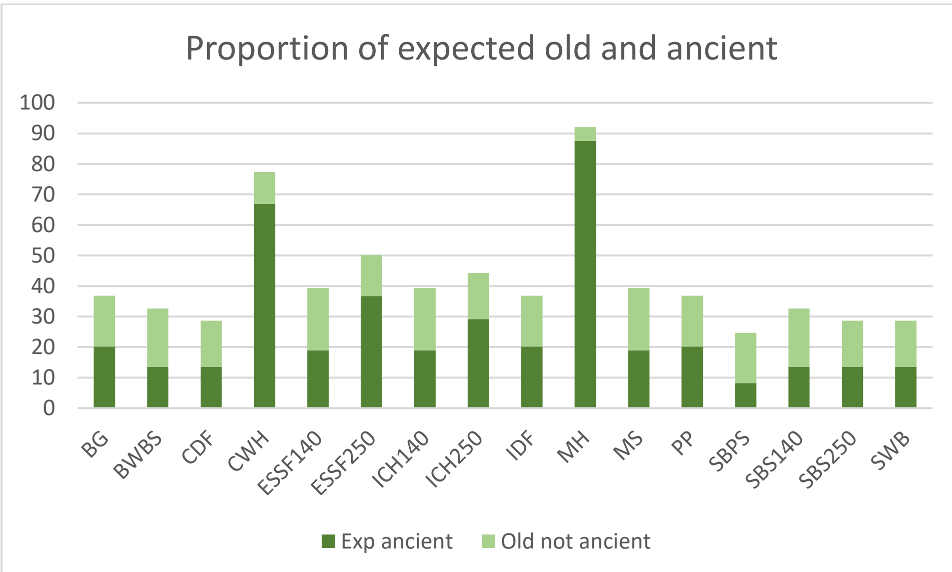
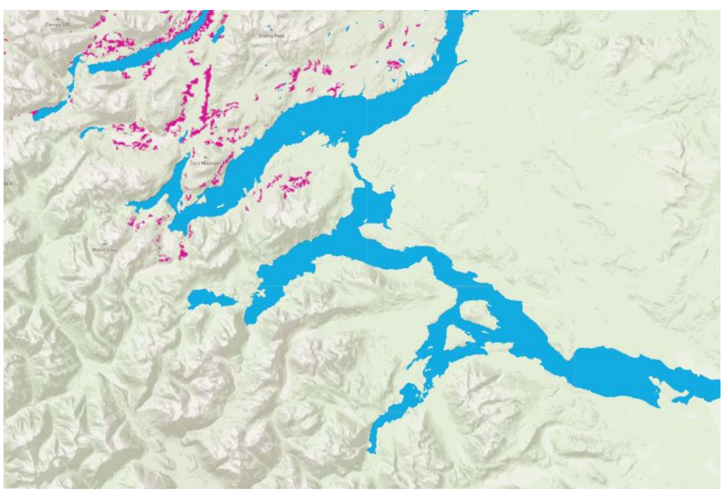



Figure 3. 1**. Proportion of expected old forest (140 years or 250 years; see Table 3.1) and expected ancient forest (250 years or 400 years; LMH 25).**



Accuracy of ancient forest mapping varies across the province because inventory interpretation analysts spent varying amounts of effort in identifying ancient forest. On maps, it is possible to see areas where ancient was and was not mapped, based on the inventory project or specific inventory interpreter (see map – left - where ancient was identified in some areas and an adjacent mountain where ancient was not identified).

The amount of forest mapped as ancient in the inventory is considerably lower than the expected amount, and in most BEC units, less than 5% of the area expected is mapped (Figure 3.2). In many BEC variants, there is no ancient forest mapped. The discrepancy is highest where disturbance is rarest: no BEC unit with old defined as 250 years has more than 3% of expected ancient mapped (Figure 3.2). The lack of ancient forests is partially due to harvest (for example, in BEC zones where there is little old forest of any age remaining) and partially due to low priority in mapping ancient forests for timber management purposes.

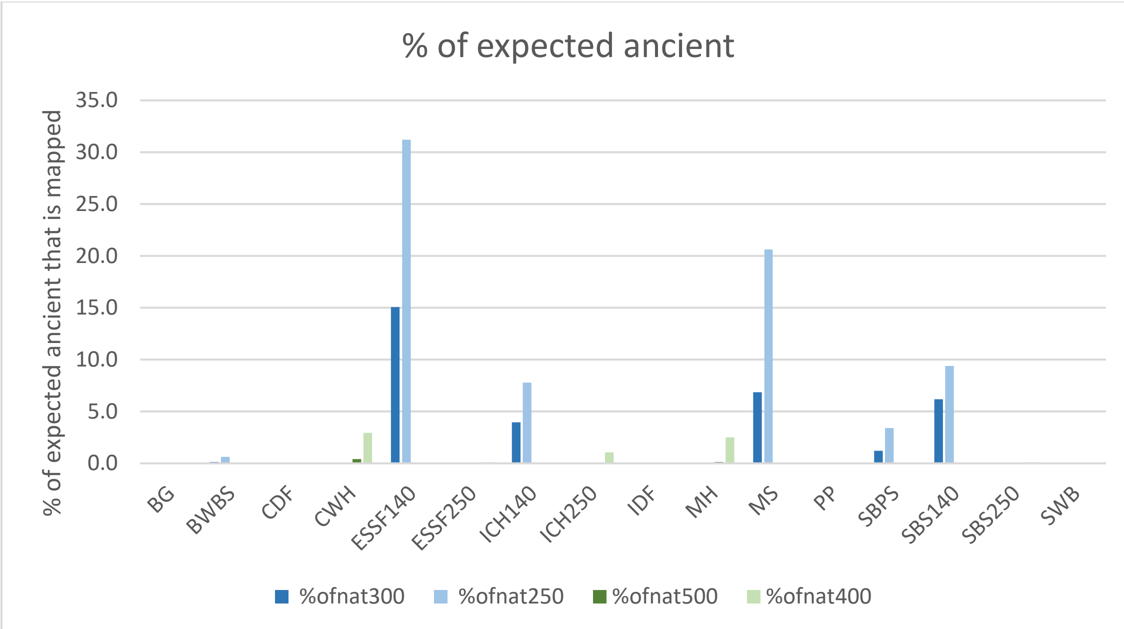



Figure 3. 2. **Percentage of expected ancient forest that is mapped as ancient using two sets of age criteria (see Table 3.1).**

Using the Land Management Handbook 25[12] criteria for ancient (> 250 and > 400 years) captures a higher proportion of the expected amount than using the OGSR criteria (300 and 500 years). Note that the expected amount varies with each definition, so that as well as having more forest over 250 years than over 300 years for example, the expected amount is higher over 250 years than over 300 years; the pattern is not due to simple arithmetic. Using the LMH 25 criteria doubles the amount of forest defined as ancient in the drier ESSF variants and multiples the amount of forest defined as ancient in the CWH by 7 times. The OG TAP concurred with provincial staff that it was more accurate to use the LMH 25 criteria to increase the pool of ancient forest given the unreliable inventory.

## Implications

- Using LMH 25 criteria (250 and 400 years) captures more ancient forest than the OGSR criteria (300 and 500 years). We used the LMH criteria to identify ancient forest.
- Even using the LMH 25 criteria severely underestimates the amount of ancient forest, particularly in ecosystems with rare natural disturbance.
- We recommend augmenting mapped ancient forest by other means. Government analysts had previously suggested deferring a proportion of the area expected to be ancient naturally. We suggested using 30% of expected historic amounts of old growth to define candidate areas for deferral, because many of these stands are likely to be ancient even if mapped as younger. This approach was not implemented in the OG TAP recommendations, but we anticipate that the big-treed old forest category will capture some of the ancient forests that are mis-mapped in the provincial inventory.

[12] Province of BC. 2010. Describing Terrestrial Ecosystems in the Field. Land Management Handbook 25.

# Appendix 4: Prioritising Deferrals within Big-treed Old Forest

## Goal and Rationale

Context: in the mapping of at-risk big-treed forests we used default targets of 10% of forested area, or 30% of the expected amount of natural old (Appendix 8, Table 8.1), whichever was greater. These "targets" reflect the minimum amount of old forest required to avoid a high risk to old growth. We provided this recommendation to the province in August 2021. The provincial government then asked the OG TAP to further prioritise areas for deferral within the at-risk old growth we had mapped. We agreed to do so because we were motivated to identify the most at-risk, and therefore the most effective areas to prioritise for deferral.[13]

We therefore needed an approach to determine which forest types were least at risk, and to identify the degree to which the default target amounts could be reduced. Our goal was to prioritise deferrals in an ecologically defensible way based on the data available and resulted in Map 3, priority at-risk old forests.

## Methods

This analysis applies only to the big-treed forest selection. In order to prioritise within big-treed forest, we developed a methodology to reduce the default targets[14] for deferral based on ecosystem risk for each forest type, to result in a 'prioritised' area for deferral.

Steps included:

1. Define forest types for assessing risk. Determining risk requires knowing how much of a forest type exists currently in comparison to the amount expected historically. Stratifying ecosystems within BEC units is critical to capture ecosystem difference and risk.[15] Because site series classification is unavailable for much of the province, we are limited to using existing data on site productivity as a surrogate for tree size to stratify different forest types within BEC variants. Two options exist: inventory site index and PSPL site index. We investigated the accuracy of each option against ground plot data for old growth (see Appendix 5). Inventory site index performed best in predicting big-treed forest measured on the ground; hence we used inventory site index as the best available method for stratifying BEC units.
    a. Define forest type by BEC group[16] x productivity class: site index 10 – 15, 15 – 20, 20+
2. Determine forest types with < 30% of natural remaining old (use actual "old", excluding older mature category; hence 140 and 250 years as appropriate by BEC variant) out of the total FALB. These are the forest types considered at most risk (Table 4.1).
3. Determine how much forest has been selected in the old versus older mature category (i.e., 120 – 140 years or 200 – 250 years as appropriate by BEC variant). Table 4.1 shows the percent of

[13] Note that both sets of data are made available (default and prioritized layers – Map 2 and Map 3).
[14] "Targets" in this context refer to the minimum amounts of old forest conservation required to avoid a high risk of old forest biodiversity loss within an ecosystem. Targets do not reflect amounts specified in existing land use orders or provincial guidance documents.
[15] https://cdnsciencepub.com/doi/full/10.1139/cjfr-2020-0453
[16] As provided by FLNR ecologists

captured forest that is in the "older mature", as opposed to "old", age class based on the biggest 10% of remaining forest. Evaluating the amount of older mature in this step integrates the current condition of ecosystems in the analysis and ensures that forests with big trees are still identified in ecosystems that already have low amounts of old forest.

4. For each forest type at most risk, determine what amount of big-treed old growth (the biggest 3%, 5%, 7%, 10% of the FALB, or 30% of natural old) captures at least 90% of the old forest (or older mature, as described above) in that forest type. Table 4.1 shows the scenario that captures the given amount.
    a. If <15% of big-treed forest captured is "older mature", then base selection on old forest; if >15% of big-treed forest capture is "older mature", then base selection on older mature plus old forest. This cut-off was logical based on observation of the boundary cases.
5. Determine area of forest included in deferral options (total, unprotected, unprotected excluding scrub–for SWB) and compare to original deferral areas.

*Table 4. 1. Input data to scenario modelling.*

| BEC Group | BEC Variants Included in Group[1] | SI with <30% of natural | % in older mature[2] | Category capturing 90% of old forest in each group |
|---|---|---|---|---|
| **BWBS_Dry** | BWBSdk, mk, mw | None[3] | 0 | 3 |
| **BWBS_Wet** | BWBSvk, wk1, wk2, wk3 | >20 | 3 | 5 |
| **Coast_Dry** | CDFmm, CWHdm, ds1, ds2, xm1, xm2 | >20 | **17** | 10 |
| **Coast_Moist** | CWHmm1,mm2, ms1, ms2, wh1, ws1 | >20 | 0 | 10 |
| **Coast_Wet** | CWHvh1, vh2, vh2, vm1, vm2, wh2, wm, ws2 | >20 | 0 | 7 |
| **ESSF_Dry** | ESSFdc2, dc3, dh1, dh2, dk1, dk2, dv1, dv2, xc1, sc2, sc3, xv1, xv2 | >20 | 0 | 10 |
| **ESSF_Moist** | ESSFdc1, mc, mh, mk, mm1, mm2, mm3, mv1, mv2, mv3, mv4, m2, mw1, mw2, un, wh2, wh3, wm1, wm3, wm4 | >20 | 0 | 5 |
| **ESSF_Wet** | ESSFvc, wc2, wc3, wc4, wh1, wk1, wk2, wm2, wv | >15 | 11 | 7 |
| **ICH_Dry** | ICHdk, dm, dw1, dw3, dw4, mk1, mk2, mk4, mk5 | >20 | 1 | 7 |
| **ICH_Moist** | ICHmk3, mm, mw1, mw2, mw3, mw4, mw5 | >15 | **37** | 10 |
| **ICH_North** | ICHmc1, mc2, vc, wc | >20 | 0 | 5 |
| **ICH_Wet** | ICHvk1, vk2, wk1, wk2, wk3, wk4 | >15 | 0 | 20[4] |
| **IDF_Dry** | IDFdc,dh, dk1, dk2, dk3, dk4, dk5, dm1, dm2, dw | >10 | **67** | 10 |
| **IDF_ICH** | ICHxm1, xw, IDFmw2, ww, ww1 | >10 | **26** | 10 |

| | | | | |
|---|---|---|---|---|
| **IDF_Vdry** | IDFxc, xh1, xh2, xk, xm, xw, xx1 | >10 | **69** | 10 |
| **MH** | MHmm1, mm2, un, wh, wh1 | >20 | 0 | 5 |
| **MS_Dry** | MSxk1, xk2, xk3, xv | >15 | 0 | 12[5] |
| **MS_Moist** | MSdc1, dc2, dc3, dk, dm1, dm2, dm3, dv, dw | >20 | 0 | 12 |
| **OpenFor_Grass[6]** | BGxh1, xh2, xh3, xw1, xw2, IDFxx2, PPxh1, xh2 | >10 | **74** | 10 |
| **SBS_Dry_SBPS** | SBPSdc, mc, mk, xc, SBSdh1, dh2, dk, dw1, dw2, dw3 | >15 | 12 | 10 |
| **SBS_Moist** | SBSmc1, mc2, mc3, mh, mk1, mk2, mm, mw, un | >20 | 0 | 10 |
| **SBS_Wet** | SBSvk, wk1, wk2, wk3 | >15 | 0 | 10 |

1. BEC subzone/variant groupings are draft, provided by provincial ecologists.
2. Bold numbers show BEC groups with >15% of older mature forest captured.
3. One variant within this group reached the criteria for high risk, hence we selected a minimum amount of 3% to capture big-treed forest within this group. Due to a mapping error, only BWBSdk is shown with a 3% deferral on Map 1. For areas involving the broader BWBS landscape, we recommend using Map 2 and/or Map 8 to inform deferral decisions to ensure sufficient area is included as the basis for landscape planning.
4. 20% of the FALB represents 30% of naturally expected old; ICH wet goes from 60% capture to 90% capture moving from Best10 to 30% of natural old
5. 12% represents 30% of naturally expected old; no selection amount reaches 90% capture in MS Dry. MS-Moist previously had a target of 10%.
6. Open forest/grassland covers very little area.

Because some groups have very little big-treed old forest (e.g., IDF), the selection chooses all old and then starts from the biggest of the older mature stands. In these groups, a large portion of the selection comes from the older mature stands—hence we used the data with older mature to choose cut-offs. Where there are < 15% of older mature trees selected, we used the data with just old (because using the older mature increases the denominator but not the numerator and hence it doesn't reach 90%).

## Results

The prioritised deferral area covers about half of the at-risk forest area we had mapped and previously described (Table 4.2; compare Map 1 and Map 3). We prioritised further by removing additional low risk forest types in ecosystems with assumed low risk, including high elevation woodland zones in the ESSF, and shrub-dominated ecosystems in the SWB.

Priority unprotected deferral area covers 2.6 million hectares out of the 5 million hectares of at-risk old forest. The priority unprotected forest (priority deferral areas) covers about 1.2 million hectares within the mapped THLB within Timber Supply Areas.[17]

[17] THLB estimate does not include THLB within Tree Farm Licenses in our data.

*Table 4. 2. Area of old forest selected for total and priority deferral options for big-treed, ancient and remnant categories of at-risk old growth.*

| | Area (M ha) | Unprotected Area (M ha) |
|---|---|---|
| **At-risk old growth** | | |
| **Ancient forest** | 0.6 | 0.4 |
| **Remnant ecosystems** | 0.8 | 0.5 |
| **Big-treed old growth** | 6.2 | 4.1 |
| **Total** | **7.6** | **5.0** |
| **Priority at-risk old growth** | | |
| **Ancient forest** | 0.6 | 0.4 |
| **Remnant ecosystems** | 0.8 | 0.5 |
| **Big-treed old growth[1]** | 2.6 | 1.7 |
| **Total** | **4.0** | **2.6** |

[1] This value does not include areas that overlap with ancient or remnant old forest. Some areas of ancient and remnant ecosystems also meet the criteria for big-treed.

## Implications

By prioritising deferral recommendations to focus on the forest types at higher risk, we reduced the area recommended for immediate harvest deferral considerably. While this approach identifies big-treed areas with the highest priority for deferral (Map 3), the entire area of at-risk forest identified (Map 2) should be considered in landscape planning and forest harvesting decisions.

# Appendix 5: Using Ground Plots to Compare PSPL and VRI Estimates of Site Index

## Introduction

Identifying the most at-risk old growth requires comparing the current area of old growth to the area expected to be old under natural disturbance regimes. If the current amount of old forest is similar to the naturally expected amount, risk to biodiversity and ecological function is low; if current amount is low relative to expected, risk is high. At the provincial scale, this analysis, by necessity, relies on existing databases. Available inventory data are uncertain because they rely on remote assessment or extrapolated models and because it is difficult to capture the immense variability amongst forested ecosystems without walking through them.

While we can use height and diameter to select big-treed old growth for deferral candidates, we cannot use height and diameter to compare current amounts of big-treed old growth to expected amounts, because size varies with age. Hence, we need to describe ecosystem type using indicators that are in defined categories.

BEC subzone/variant remains constant and provides an excellent filter but is too coarse a unit to capture the variation amongst forest types. For example, within coastal BEC variants, forest ecosystems can vary from highly productive valley-bottom forests with massive Sitka spruce to bog forests dominated by bonsai shore pine. Ideally, we would use site series mapping, but this is not available at the provincial scale. Instead, we suggest that site index—a measure of productive capacity—within BEC subzone/variant provides the best *available* surrogate to capture this finer-scale, and highly important, variability.

Two estimates of site index are available within the provincial forest database: inventory estimates of site index and PSPL[18] models of site index. Our previous analyses of risk to old growth forest types used inventory estimates.[19] Others suggest that PSPL might provide a better estimate for old forest. We used available ground plot data to test the relationship between each measure of site index and old forest height and diameter—the factors selected to indicate large-treed old growth.

**Because we are interested in knowing which sites have the largest trees, and not in determining the actual potential growth in a site, we asked "how well do measured tree height and diameter relate to estimates of site index from inventory and from PSPL?"**

## Methods

Government analysts collated and provided available ground plots (n = 6,978) and spatially linked inventory data. Because this project focusses on old growth, we limited our exploration to relationships between site index and ground measurements in old forests. We used the dataset previously created to examine the relationship between ground plot attributes and older forests, including 1,945 plots of

[18] PSPL = Provincial Site Productivity Layer

[19] Price et al. 2021: https://cdnsciencepub.com/doi/abs/10.1139/cjfr-2020-0453

forest > 140 years old (See Appendix 1 for exclusions and inclusions). We focused analyses on tree height and diameter as tree size attributes.

Because ecosystems vary and because tree species vary in their growth patterns, we examined the data stratified by tree species within BEC zone. This stratification reduces sample size within groups considerably. To avoid misleading results from small samples, we only used leading species/BEC zone combinations with at least 30 ground plots.[20] For each leading species/BEC zone group, we ran general linear models of site index against height and diameter.[21]

## Results

Across the full sample of old growth plots, inventory site index and PSPL site index are significantly positively correlated with each other (Figure 5.1; r = 0.52; n = 1,652 plots with PSPL data). PSPL site index is generally higher than inventory site index (difference = 6.2 ± 0.1; mean ± SE; n = 1,652)

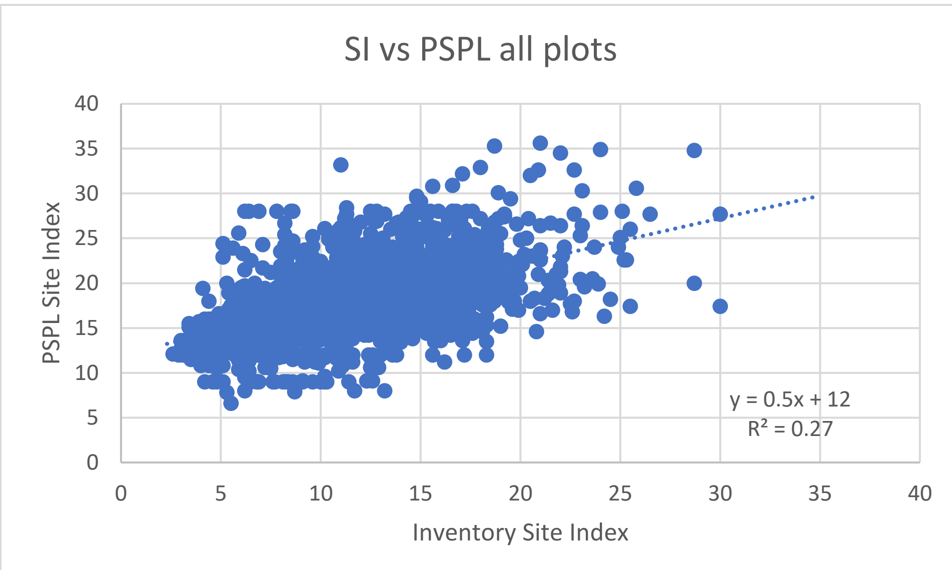



*Figure 5. 1. VRI inventory site index and PSPL site index on sites measured in old growth plots.*

Across tree species/BEC zone groups with sufficient data (i.e., > 30 plots[22]), inventory site index was related to measured old growth tree attributes equally or more strongly than PSPL site index in every case (Table 5.1). PSPL did not perform better at reflecting attributes on the ground, within any group. Relationship strength varied across groups. Both inventory and PSPL site index were related to tree height and diameter in western hemlock within the CWH, subalpine fir and interior spruce in the ESSF and interior spruce in the SBS. Neither were related to tree size in subalpine fir in the SBS.

Site index (both VRI inventory and PSPL) in the ICH performs strangely. For both western redcedar and western hemlock in the ICH, the relationship between measured attributes and site index were negatively related (i.e., stands classed as more productive had smaller trees). There are no obvious

[20] Arbitrary selection of sample size as time precluded power analyses.

[21] R Core Team 2021. R: a language and environment for statistical computing. R Foundation for Statistical Computing. Vienna Austria. https://www.R-project.org/.

[22] Note that not all plots have PSPL estimates; MH plots do not achieve n=30 for PSPL.

causes on quick inspection (e.g., the breadth of the variables is as wide as other groups); this pattern requires further investigation.

*Table 5. 1. Linear relationships between site index and attributes measured on the ground, stratified by leading species/BEC zone. Green cells have significantly positive relationships (dark green P<0.01, light green P< 0.05). Pink cells have significantly negative relationships (i.e., plots with higher site index have smaller trees).*

| BEC | Species | Variable | VRI Inventory SI | | | PSPL SI | | |
|---|---|---|---|---|---|---|---|---|
| | | | F | df | P | F | df | P |
| **CWH** | BA | Diameter | 10 | 47 | <0.01 | 3 | 35 | 0.1 |
| | | Height | 10 | 44 | <0.01 | 2 | 32 | 0.14 |
| **CWH** | CW | Diameter | 32 | 132 | <0.01 | 0 | 119 | 0.6 |
| | | Height | 39 | 116 | <0.01 | 21 | 106 | <0.01 |
| **CWH** | HW | Diameter | 20 | 147 | <0.01 | 11 | 123 | <0.01 |
| | | Height | 36 | 138 | <0.01 | 15 | 115 | <0.01 |
| **CWH** | YC | Diameter | 44 | 76 | <0.01 | 0 | 48 | 0.6 |
| | | Height | 4 | 70 | 0.04 | 2 | 44 | 0.14 |
| **ESSF** | BL | Diameter | 127 | 410 | <0.01 | 10 | 390 | <0.01 |
| | | Height | 42 | 404 | <0.01 | 24 | 385 | <0.01 |
| **ESSF** | SE | Diameter | 8 | 69 | <0.01 | 3 | 66 | 0.09 |
| | | Height | 5 | 67 | 0.02 | 1 | 64 | 0.3 |
| **ESSF** | SX | Diameter | 13 | 42 | <0.01 | 8 | 40 | <0.01 |
| | | Height | 12 | 41 | <0.01 | 12 | 39 | <0.01 |
| **ICH** | CW | Diameter | 4 | 86 | 0.05 | 19 | 82 | <0.01 |
| | | Height | 1 | 76 | 0.4 | 1 | 73 | 0.3 |
| **ICH** | HW | Diameter | 7 | 75 | <0.01 | 2 | 74 | 0.2 |
| | | Height | 2 | 71 | 0.16 | 2 | 71 | 0.2 |
| **IDF** | FD | Diameter | 11 | 91 | <0.01 | 0 | 88 | 0.5 |
| | | Height | 25 | 88 | <0.01 | 8 | 85 | <0.01 |
| **MH** | HM | Diameter | 26 | 40 | <0.01 | 0 | 8 | 0.8 |
| | | Height | 1 | 40 | 0.2 | 0 | 8 | 0.6 |
| **SBS** | BL | Diameter | 2 | 71 | 0.16 | 1 | 62 | 0.2 |
| | | Height | 1 | 69 | 0.3 | 0 | 60 | 0.8 |
| **SBS** | SX | Diameter | 52 | 108 | <0.01 | 18 | 91 | <0.01 |
| | | Height | 24 | 106 | <0.01 | 9 | 89 | <0.01 |

## Implications

This analysis did not ask which site index measure best reflects potential productivity of a site because we are interested in what is present on the site today, not in what might be present tomorrow. Although neither site index measure is perfectly suited to this analysis, our analysis confirms that, at the provincial scale, VRI site index performs better than PSPL at estimating actual tree height and diameter in old growth stands. Thus, we used inventory site in our analyses[23] and recommend that others do the same.

## Appendix 6: List of Remnant Ecosystems

We identified ecosystems with less than 10% old forest remaining at the BEC subzone/variant scale (Table 6.1) and, for BEC units with more than 10% old forest remaining, we identified Landscape Units within BEC subzone/variant with less than 10% remaining (Table 6.2).

*Table 6. 1. List of BEC subzone/variants with < 10% old forest remaining in total, and those BEC subzone/variants with some landscape units with < 10% old forest remaining.[1]*

| BEC Zone | BEC units with < 10% old forest remaining in total | BEC units with < 10% old forest remaining in some landscape units |
|---|---|---|
| **Bunchgrass (BG)** | BGxw2 | |
| **Boreal White and Black Spruce (BWBS)** | BWBSvk | BWBSdk, mk, mw, wk1, wk2, wk3 |
| **Coastal Douglas-fir (CDF)** | CDFmm | |
| **Coastal Western Hemlock (CWH)** | CWHdm, xm1, xm2 | CWHds1, ds2, mm1, mm2, ms1, vh1, vh3, vm1, vm2, wm, ws1 |
| **Engelmann Spruce—Subalpine Fir (ESSF)** | ESSFdc1, mc, mh, mm3, mv1, mv2, mv3, mv4, wc3, wc4, wh2, wh3, wk1, wk2, wm1, wm2, wm3, wm4, xv1, xv2 | ESSFdc2, dc3, dh1, dk1, dk2, mk, mm1, mm2, mw1, mw2, un, vc, wc2, wh1, wv, xc3 |
| **Interior Cedar—Hemlock (ICH)** | ICHmc2, mk3, mk4, mw1, mw2, mw3, mw4, mw5, xm1, xw | ICHdm, dw1, dw3, mc1, mk1, mk2, mk5, mm, vc, vk2, wc, wk1, wk2, wk3, wk4 |
| **Interior Douglas-fir (IDF)** | IDFdc, dh, dk1, dk2, dk3, dk4, dk5, dm1, dm2, mw2, xc, xh1, xh2, xk, xm, xw, xx2 | IDFdw, ww |
| **Mountain Hemlock (MH)** | | MHmm2, un |
| **Montane Spruce (MS)** | | MSdc2, dk, dm1, dm2, dm3, dv, dw, xk1, xk2, xk3, xv |
| **Ponderosa Pine (PP)** | PPxh1, xh2 | |
| **Sub-Boreal Pine—Spruce (SBPS)** | SBPSdc, mk, xc | SBPSmc |
| **Sub-Boreal Spruce (SBS)** | SBSdw3, mc3, vk, wk1, wk2 | SBSdk, dw1, dw2, mc1, mc2, mk1, mk2, mm, mw, un |

[1]BEC variants with < 5,000 hectares and variants within Landscape Units with < 500 hectares of total forest (FALB) were not analysed due to uncertainty associated with small area. This included the BGxh1, xh2, xh3, and xw1 and the IDFxx1; old forests in these BEC variants were identified in the big-treed old forest analysis.

[23] Reminder that OG TAP did not use site index to identify forests for deferral. We only used site index to reduce the target percentages for the lowest risk forests when identifying big-treed forest for deferral.

*Table 6. 2. List of Landscape Units within BEC subzone/variants with < 10% old forest. Where there is less than 10% old forest remaining in the entire BEC subzone/variants, all Landscape Units are defined as at high risk.[1]*

| Variant | Landscape Unit |
|---|---|
| **Boreal White and Black Spruce** | |
| **BWBSdk** | Atlin Lake, Barrington River, Braid, Chukachida River, Gladys River, Inklin River, Jennings River, Kakiddi Creek, Klappan River, Kusawa River, Kwadacha Addition, Mess Creek, Middle Stikine River, Nahline River, Nakina River, Pitman River, Sheslay River, Spatsizi River, Stikine River, Swift River, Tahltan River, Tatshenshini River, Teslin River, Tutshi River, Tuya River, Upper Iskut River, Upper Stikine River |
| **BWBSmk** | Blueberry, Churchill, Dease-Liard, Gathto, Kahntah, Kotcho, Major Hart, Muncho, Petitot, Prophet, Shekilie, Sikanni |
| **BWBSmw** | Dawson Creek, Kiskatinaw, Lower Beatton, Lower Moberly, Milligan, One Island, Redwillow, Schooler, Selwyn, Septimus, Tommy Lakes |
| **BWBSwk1** | Gwillim, Kinuseo, Kiskatinaw, Narraway, Puggins, Redwillow, Upper Moberly, Wapiti |
| **BWBSwk2** | Hudson's Hope |
| **BWBSwk3** | Hyland, Klua, Smith, Trutch |
| **Coastal Western Hemlock (CWH)** | |
| **CWHds1** | Ainslie, Anderson, Chilliwack, Coquihalla, East Harrison, Fraser Valley, South, Gates, Nahatlatch, Silverhope, Whistler, Yale |
| **CWHds2** | Crag |
| **CWHmm1** | Caycuse, Cous, Gordon, Quadra |
| **CWHmm2** | Caycuse, Chemainus, Corrigan, Cous, Rosewall |
| **CWHms1** | Lower Squamish, Tulameen |
| **CWHvh1** | Tlupana |
| **CWHvh3** | Kunghit Island |
| **CWHvm1** | Brittain, Chapman, East Harrison, Hatzic, Holberg, Howe, Powell Lake, Salmon Inlet, Thurlow, Tlupana, West Harrison |
| **CWHvm2** | Haslam, Holberg, Lois |
| **CWHwm** | Anyox, Barrington River, Inklin River, Kusawa River, Lower Stikine River, Unuk River |
| **CWHws1** | Nass River Kalum |
| **Engelmann Spruce—Subalpine Fir (ESSF)** | |
| **ESSFdc2** | Kelly |
| **ESSFdc3** | Campbell, Tranquille |
| **ESSFdh1** | Ainslie |
| **ESSFdk1** | Alexander – Line, Bloom – Caven, Corbin Creek, Cranbrook, Doctor/Fir, Fording River, Hellroaring – Meachen, Mayook – Wardner, Perry – Moyie, Skookumchuck/Torrent, West Flathead |
| **ESSFdk2** | Fording River, Jumbo, Lower Spillimacheen, Upper Bull, Upper Elk |
| **ESSFmk** | Clore, Nadina, Tweedsmuir North |
| **ESSFmm1** | Bastille, Castle, Forgetmenot, Holmes, McBride-Dunster, Mount Robson |
| **ESSFmm2** | Mount Robson |
| **ESSFmw1** | Siska, Spius, Tulameen |
| **ESSFmw2** | Connel Creek, Gates, Kwoiek |
| **ESSFun** | Atlin Lake, Kakiddi Creek, Kusawa River, Nakina River, Sheslay River, Tutshi River, Upper Iskut River |

| Variant | Landscape Unit |
|---|---|
| **ESSFvc** | Fish, French, Tum Tum |
| **ESSFwc2** | Adams Lake, Anstey, Avola, Barriere, Blackwater, Cayenne, Clearwater, Crowfoot, Mad, Mica, Pukeashun, Raft, Redrock, Seymour, Tum Tum, Vavenby, Ventigo |
| **ESSFwh1** | Barnes – Whatshan, Caribou, Cherryville, Cranberry, Fish, Fosthall, Gladstone, Hills, Hoder, Idaho, Kaslo River, Kingfisher, Koch, Lemon, Mabel, Pedro, Perry, Upper Kettle, Upper Shuswap, Vipond, Woden |
| **ESSFwv** | Squingula |
| **ESSFxc3** | Big Bar |
| **Interior Cedar—Hemlock (ICH)** | |
| **ICHdm** | Galbraith – Dibble, Hawkins Creek, Lamb Creek, Moyie Lake, Moyie River, Redding Creek |
| **ICHdw1** | Duck Lake, Fry Creek, Goat River, Hamill Creek, Hawkins Creek, Johnston, Kid Creek, Lasca Creek, Moyie Lake, Moyie River, Riondel, Rossland, Stagleap, Summit Creek |
| **ICHdw3** | Avola, Clearwater, Mad, Mica, Raft |
| **ICHmc1** | Bulkley, Reiseter |
| **ICHmk1** | Salmon Arm, Upper Salmon |
| **ICHmk2** | Campbell, Clearwater, Darfield, Heffley, Skull |
| **ICHmk5** | Kootenay, Kootenay National Park, Steamboat, Twelve Mile, West Bench |
| **ICHmm** | Albreda, EastTwin-McKale, Holmes, Hugh Allan, McBride-Dunster, Mount Robson, SouthTrench |
| **ICHvc** | Middle Iskut River |
| **ICHvk2** | Fraser, Gleason, Humbug, Jarvis, Kenneth, Kitchi, Woodall |
| **ICHwc** | Lower Stikine River, Stikine River, Upper Iskut River |
| **ICHwk1** | Adams Lake, Barriere, Cayenne, Cranberry, Crowfoot, Eagle River, French, Hills, Kingfisher, Mad, McKian – Schroeder, Mica, Mount Revelstoke National Park, Mulvehill, Pukeashun, Raft, Tum Tum |
| **ICHwk2** | Black Creek, Horsefly, Likely, Lower Cariboo, Polley, Wasko/Lynx |
| **ICHwk3** | Dome, Humbug, McBride-Dunster |
| **ICHwk4** | Bowron, Cariboo Lake, Grizzly, Indianpoint, Kenneth, Lower Cariboo, Matthew, Purden, Sandy |
| **Interior Douglas-fir (IDF)** | |
| **IDFdw** | Atnarko, Big Stick, Chilko, Franklyn, Nemiah, Nostetuko, Nude Creek, Telegraph, Westbranch |
| **IDFww** | Anderson, Big Stick, Billygoat, Birkenhead, Gates, Kwoiek, Lizzie, Mehatl, Nahatlatch, Spuzzum, Tuwasus |
| **Mountain Hemlock (MH)** | |
| **MHmm2** | Barrington River, Cranberry, Inklin River, Ishkheenickh, Lower Iskut River, Lower Stikine River, Sheslay River, Unuk River |
| **MHun** | Kusawa River |
| **Montane Spruce (MS)** | |
| **MSdc2** | Nemiah |
| **MSdk** | Albert, Bugaboo, Cross, Findlay, Galbraith – Dibble, Jumbo, North White, Palliser, Toby, Upper Bull, Upper Elk, West Elk |
| **MSdm1** | Harris, Rendell |
| **MSdm2** | Campbell, Smith-Willis, Upper Salmon |
| **MSdm3** | Barriere, Campbell, Darfield |

| Variant | Landscape Unit |
|---|---|
| **MSdv** | Beece Creek |
| **MSdw** | Alexander – Line, Corbin Creek, Cranbrook, East Flathead, Lamb Creek, Lost Dog – Mather, Lower Elk, Moyie Lake, Perry – Moyie, Skookumchuck/Torrent, West Elk, West Flathead, Wigwam River, Yahk River |
| **MSxk1** | Summers |
| **MSxk2** | Bonaparte Lake, Campbell, Deadman, Loon, Lower Bonaparte, Stump Lake,Tranquille, Upper Nicola, Upper Salmon |
| **MSxk3** | Big Bar |
| **MSxv** | Atnarko, Baezaeko, Baker, Bambrick, Big Creek, Clisbako, Clusko, Dash, Gaspard, Haines, Holtry, Marmot, Nazko, Nimpo, Palmer/Jorgenson, Punky Moore, Puntzi, Ramsey, Tibbles, Toil, Wentworth |
| **Sub-Boreal Pine—Spruce (SBPS)** | |
| **SBPSmc** | Baezaeko, Chine, Christenson Creek, Coglistiko, Entiako, Pan, Toil |
| **Sub-Boreal Spruce (SBS)** | |
| **SBSdk** | Burns Lake East, Burns Lake West, Chelaslie, Cheslatta, Endako, Entiako, Halett, Intata, Kluskus, Lucas, Nadina, Nechako, Pinchi, Tachick, Tahtsa, Tatelkuz, TFL42, Tweedsmuir North, Valley |
| **SBSdw1** | Abhau, Dunkley, Hixon |
| **SBSdw2** | Baezaeko, Baker, Bradley Creek, Bridge Creek, Chilako, Euchiniko, Green Lake, Marmot, Narcosli, Pelican, Ramsey, Twan, Williams Lake |
| **SBSmc1** | 108 Mile Lake, Dragon, Murphy Lake |
| **SBSmc2** | Baezaeko, Baker, Bulkley, Burns Lake East, Cheslatta, Coglistiko, Crag, Endako, Francois West, Halett, Intata, Lucas, Marmot, Mud, Nadina, Narcosli, Nechako, Nithi, Pantage, Pelican, Ramsey, Snaking, Stuart, Tachick, Tibbles, Topley, Upper Dean, Wentworth |
| **SBSmk1** | Dunkley, Mollie, Muskeg, Pinchi, Prince, Stuart, Tudyah A |
| **SBSmk2** | Morfee, Muscovite, Nabesche, Selwyn |
| **SBSmm** | Darfield, Vavenby |
| **SBSmw** | Abhau, Dunkley, Hixon, Nechako, Prince, Punchaw |
| **SBSun** | Barrington River, Kakiddi Creek, Sheslay River, Stikine River, Tutshi River |

[1]BEC variants within Landscape Units with < 500 hectares of total forest (FALB) were not analysed due to uncertainty associated with small area.

# Appendix 7: List of BEC Variants With Older Mature Selected

Because some BEC variants have insufficient old forest to meet targets, and because of uncertainty in inventory age (see Appendix 2), we added forest from "older mature" stands to those stands classified as old where needed to address targets aimed at avoiding high risk. In these BEC variants (Table 7.1), areas mapped for deferral may be inventoried as younger than the old growth threshold (i.e., 200 vs. 250 years in less frequently disturbed ecosystems and 120 vs. 140 in more frequently disturbed ecosystems; see Appendix 2 for rationale).

*Table 7. 1. List of BEC subzone/variants where older mature forest has been selected to meet targets.*

| BEC Zone | BEC Subzone/Variant with Older Mature Forest Selected |
|---|---|
| **Bunchgrass (BG)** | BGxh1, xh2, xh3, xw1, xw2 |
| **Boreal White and Black Spruce (BWBS)** | BWBSvk |
| **Coastal Douglas-fir (CDF)** | CDFmm |
| **Coastal Western Hemlock (CWH)** | CWHdm, xm1, xm2 |
| **Engelmann Spruce—Subalpine Fir (ESSF)** | ESSFmh, mv1, mv2, mv4, wh3, wk1, wm3, wm4, xv2 |
| **Interior Cedar—Hemlock (ICH)** | ICHmk3, mw1, mw2, mw3, mw4, mw5, vk2, wk4, xm1, xw |
| **Interior Douglas-fir (IDF)** | IDFdc, dh, dk1, dk2, dk3, dk4, dk5, dm1, dm2, mw2, xc, xh1, xh2, xk, xm, xw, xx1, xx2 |
| **Ponderosa Pine (PP)** | PPxh1, xh2 |
| **Sub-Boreal Pine—Spruce (SBPS)** | SBPSdc, mk, xc |
| **Sub-Boreal Spruce (SBS)** | SBSdw3, vk, wk1, wk2 |

# Appendix 8: Age Definitions and Disturbance Intervals Updated for BEC Version 12

OGTAP's analyses were based on BECv12, which was released in September 2021.[24] We used information on age definitions and disturbance intervals as compiled and reviewed by provincial ecologists (Table 8.1).[25]

In interpreting OGTAP's deferral maps, it is important to note that land use order implementation for old forest management across BC is generally based on older versions of BEC mapping.

*Table 8. 1. Age definitions and stand-initiating disturbance intervals by BEC subzone/variant.*

| BEC subzone/variant | Age of old (>)[1] | Age of ancient (>)[2] | Age of older mature (>)[3] | Stand-initiating return interval[4] | Source[4] | % of area expected old[5] |
|---|---|---|---|---|---|---|
| **BWBSdk** | 140 | 250 | 120 | 125 | BGB | 33 |
| **BWBSmk** | 140 | 250 | 120 | 125 | BGB | 33 |
| **BWBSmw** | 140 | 250 | 120 | 125 | BGB | 33 |
| **BWBSvk** | 140 | 250 | 120 | 125 | BGB | 33 |
| **BWBSwk1** | 140 | 250 | 120 | 125 | BGB | 33 |
| **BWBSwk2** | 140 | 250 | 120 | 125 | BGB | 33 |
| **BWBSwk3** | 140 | 250 | 120 | 125 | BGB | 33 |
| **CDFmm** | 250 | 400 | 200 | 200 | BGB | 29 |
| **CWHdm** | 250 | 400 | 200 | 700 | EBM | 70 |
| **CWHds1** | 250 | 400 | 200 | 500 | EBM | 61 |
| **CWHds2** | 250 | 400 | 200 | 500 | EBM | 61 |
| **CWHxm1** | 250 | 400 | 200 | 700 | EBM | 70 |
| **CWHxm2** | 250 | 400 | 200 | 700 | EBM | 70 |
| **CWHmm1** | 250 | 400 | 200 | 1100 | EBM | 80 |
| **CWHmm2** | 250 | 400 | 200 | 1100 | EBM | 80 |
| **CWHms1** | 250 | 400 | 200 | 700 | EBM | 70 |
| **CWHms2** | 250 | 400 | 200 | 700 | EBM | 70 |
| **CWHwh1** | 250 | 400 | 200 | 3000 | EBM | 92 |
| **CWHws1** | 250 | 400 | 200 | 1100 | EBM | 80 |
| **CWHvh1** | 250 | 400 | 200 | 10000 | EBM | 98 |
| **CWHvh2** | 250 | 400 | 200 | 10000 | EBM | 98 |
| **CWHvh3** | 250 | 400 | 200 | 10000 | EBM | 98 |

[24] Major changes from BECv11 (2018) are in the southern Thompson-Okanagan Region, Skeena and Omineca Regions in the ESSF woodland; minor changes are in Boundary RMZ in Kootenay-Boundary Region.
[25] Compiled by Deb MacKillop (Research Ecologist) with input and peer review by Doug Lewis (Biodiversity Cumulative Effects Lead), Bruce Rogers (Research Ecologist), Craig DeLong (retired Research Ecologist), Sari Saunders (Research Ecologist).

| BEC subzone/variant | Age of old (>)[1] | Age of ancient (>)[2] | Age of older mature (>)[3] | Stand-initiating return interval[4] | Source[4] | % of area expected old[5] |
|---|---|---|---|---|---|---|
| **CWHvm1** | 250 | 400 | 200 | 2000 | EBM | 88 |
| **CWHvm2** | 250 | 400 | 200 | 2000 | EBM | 88 |
| **CWHwh2** | 250 | 400 | 200 | 3000 | EBM | 92 |
| **CWHwm** | 250 | 400 | 200 | 2000 | EBM | 88 |
| **CWHws2** | 250 | 400 | 200 | 1100 | EBM | 80 |
| **ESSFdc2** | 140 | 250 | 120 | 150 | BGB | 39 |
| **ESSFdc3** | 140 | 250 | 120 | 150 | BGB | 39 |
| **ESSFdh1** | 140 | 250 | 120 | 150 | BEC | 39 |
| **ESSFdh2** | 140 | 250 | 120 | 150 | BEC | 39 |
| **ESSFdk1** | 140 | 250 | 120 | 150 | BEC | 39 |
| **ESSFdk2** | 140 | 250 | 120 | 150 | BEC | 39 |
| **ESSFdv1** | 140 | 250 | 120 | 150 | BEC | 39 |
| **ESSFdv2** | 140 | 250 | 120 | 150 | BEC | 39 |
| **ESSFxc1** | 140 | 250 | 120 | 150 | BEC | 39 |
| **ESSFxc2** | 140 | 250 | 120 | 150 | BEC | 39 |
| **ESSFxc3** | 140 | 250 | 120 | 150 | BEC | 39 |
| **ESSFxv1** | 250 | 400 | 200 | 200 | BEC | 29 |
| **ESSFxv2** | 250 | 400 | 200 | 200 | BEC | 29 |
| **ESSFdc1** | 250 | 400 | 200 | 200 | BEC | 29 |
| **ESSFmc** | 250 | 400 | 200 | 200 | BGB | 29 |
| **ESSFmh** | 250 | 400 | 200 | 200 | BEC | 29 |
| **ESSFmk** | 250 | 400 | 200 | 200 | BGB | 29 |
| **ESSFmm1** | 250 | 400 | 200 | 200 | BGB | 29 |
| **ESSFmm2** | 250 | 400 | 200 | 200 | BGB | 29 |
| **ESSFmm3** | 250 | 400 | 200 | 200 | BEC | 29 |
| **ESSFmv1** | 250 | 400 | 200 | 200 | BGB | 29 |
| **ESSFmv2** | 250 | 400 | 200 | 200 | BGB | 29 |
| **ESSFmv3** | 250 | 400 | 200 | 200 | BGB | 29 |
| **ESSFmv4** | 250 | 400 | 200 | 200 | BGB | 29 |
| **ESSFmw** | 250 | 400 | 200 | 1500 | EBM | 85 |
| **ESSFmw1** | 250 | 400 | 200 | 1500 | EBM | 85 |
| **ESSFmw2** | 250 | 400 | 200 | 1500 | EBM | 85 |
| **ESSFun** | 140 | 250 | 120 | 150 | BEC | 39 |
| **ESSFwh2** | 250 | 400 | 200 | 200 | BEC | 29 |
| **ESSFwh3** | 250 | 400 | 200 | 200 | BEC | 29 |
| **ESSFwm1** | 250 | 400 | 200 | 200 | BEC | 29 |
| **ESSFwm3** | 250 | 400 | 200 | 200 | BEC | 29 |
| **ESSFwm4** | 250 | 400 | 200 | 200 | BEC | 29 |

| BEC subzone/variant | Age of old (>)[1] | Age of ancient (>)[2] | Age of older mature (>)[3] | Stand-initiating return interval[4] | Source[4] | % of area expected old[5] |
|---|---|---|---|---|---|---|
| **ESSFvc** | 250 | 400 | 200 | 800 | NEW | 73 |
| **ESSFvcw** | 250 | 400 | 200 | 800 | NEW | 73 |
| **ESSFwc2** | 250 | 400 | 200 | 800 | NEW | 73 |
| **ESSFwc3** | 250 | 400 | 200 | 800 | PG | 73 |
| **ESSFwc4** | 250 | 400 | 200 | 800 | NEW | 73 |
| **ESSFwh1** | 250 | 400 | 200 | 800 | NEW | 73 |
| **ESSFwk1** | 250 | 400 | 200 | 800 | PG | 73 |
| **ESSFwk2** | 250 | 400 | 200 | 800 | PG | 73 |
| **ESSFwm2** | 250 | 400 | 200 | 800 | NEW | 73 |
| **ESSFwv** | 250 | 400 | 200 | 800 | NEW | 73 |
| **ICHdk** | 140 | 250 | 120 | 150 | BGB | 39 |
| **ICHdm** | 140 | 250 | 120 | 150 | BEC | 39 |
| **ICHdw1** | 140 | 250 | 120 | 150 | BEC | 39 |
| **ICHdw3** | 140 | 250 | 120 | 150 | BEC | 39 |
| **ICHdw4** | 140 | 250 | 120 | 150 | BEC | 39 |
| **ICHmk1** | 140 | 250 | 120 | 150 | BGB | 39 |
| **ICHmk2** | 140 | 250 | 120 | 150 | BGB | 39 |
| **ICHmk4** | 140 | 250 | 120 | 150 | BEC | 39 |
| **ICHmk5** | 140 | 250 | 120 | 150 | BEC | 39 |
| **ICHmk3** | 250 | 400 | 200 | 200 | BGB | 29 |
| **ICHmm** | 250 | 400 | 200 | 200 | BGB | 29 |
| **ICHmw1** | 250 | 400 | 200 | 200 | BGB | 29 |
| **ICHmw2** | 250 | 400 | 200 | 200 | BGB | 29 |
| **ICHmw3** | 250 | 400 | 200 | 200 | BEC | 29 |
| **ICHmw4** | 250 | 400 | 200 | 200 | BEC | 29 |
| **ICHmw5** | 250 | 400 | 200 | 200 | BEC | 29 |
| **ICHmc1** | 250 | 400 | 200 | 200 | BGB | 29 |
| **ICHmc2** | 250 | 400 | 200 | 200 | BGB | 29 |
| **ICHvc** | 250 | 400 | 200 | 600 | NEW | 66 |
| **ICHwc** | 250 | 400 | 200 | 200 | BGB | 29 |
| **ICHvk1** | 250 | 400 | 200 | 600 | NEW | 66 |
| **ICHvk2** | 250 | 400 | 200 | 600 | PG | 66 |
| **ICHwk1** | 250 | 400 | 200 | 600 | NEW | 66 |
| **ICHwk2** | 250 | 400 | 200 | 600 | NEW | 66 |
| **ICHwk3** | 250 | 400 | 200 | 600 | PG | 66 |
| **ICHwk4** | 250 | 400 | 200 | 600 | NEW | 66 |
| **ICHxm1** | 250 | 400 | 200 | 250 | BGB | 37 |
| **ICHxw** | 250 | 400 | 200 | 250 | BGB | 37 |

| BEC subzone/variant | Age of old (>)[1] | Age of ancient (>)[2] | Age of older mature (>)[3] | Stand-initiating return interval[4] | Source[4] | % of area expected old[5] |
|---|---|---|---|---|---|---|
| **IDFmw2** | 250 | 400 | 200 | 250 | BGB | 37 |
| **IDFww** | 250 | 400 | 200 | 250 | BGB | 37 |
| **IDFww1** | 250 | 400 | 200 | 250 | BGB | 37 |
| **IDFdc** | 250 | 400 | 200 | 250 | BGB | 37 |
| **IDFdh** | 250 | 400 | 200 | 250 | BGB | 37 |
| **IDFdk1** | 250 | 400 | 200 | 250 | BGB | 37 |
| **IDFdk2** | 250 | 400 | 200 | 250 | BGB | 37 |
| **IDFdk3** | 250 | 400 | 200 | 250 | BGB | 37 |
| **IDFdk4** | 250 | 400 | 200 | 250 | BGB | 37 |
| **IDFdk5** | 250 | 400 | 200 | 250 | BGB | 37 |
| **IDFdm1** | 250 | 400 | 200 | 250 | BGB | 37 |
| **IDFdm2** | 250 | 400 | 200 | 250 | BGB | 37 |
| **IDFdw** | 250 | 400 | 200 | 250 | BGB | 37 |
| **IDFxc** | 250 | 400 | 200 | 250 | BGB | 37 |
| **IDFxh1** | 250 | 400 | 200 | 250 | BGB | 37 |
| **IDFxh2** | 250 | 400 | 200 | 250 | BGB | 37 |
| **IDFxk** | 250 | 400 | 200 | 250 | BGB | 37 |
| **IDFxm** | 250 | 400 | 200 | 250 | BGB | 37 |
| **IDFxw** | 250 | 400 | 200 | 250 | BGB | 37 |
| **IDFxx1** | 250 | 400 | 200 | 250 | BGB | 37 |
| **MHmm1** | 250 | 400 | 200 | 3000 | EBM | 92 |
| **MHmm2** | 250 | 400 | 200 | 3000 | EBM | 92 |
| **MHun** | 250 | 400 | 200 | 3000 | EBM | 92 |
| **MHwh** | 250 | 400 | 200 | 3000 | EBM | 92 |
| **MHwh1** | 250 | 400 | 200 | 3000 | EBM | 92 |
| **MSxk1** | 140 | 250 | 120 | 150 | BEC | 39 |
| **MSxk2** | 140 | 250 | 120 | 150 | BEC | 39 |
| **MSxk3** | 140 | 250 | 120 | 150 | BEC | 39 |
| **MSxv** | 140 | 250 | 120 | 150 | BGB | 39 |
| **MSdc1** | 140 | 250 | 120 | 150 | BEC | 39 |
| **MSdc2** | 140 | 250 | 120 | 150 | BGB | 39 |
| **MSdc3** | 140 | 250 | 120 | 150 | BEC | 39 |
| **MSdk** | 140 | 250 | 120 | 150 | BEC | 39 |
| **MSdm1** | 140 | 250 | 120 | 150 | BGB | 39 |
| **MSdm2** | 140 | 250 | 120 | 150 | BGB | 39 |
| **MSdm3** | 140 | 250 | 120 | 150 | BEC | 39 |
| **MSdv** | 140 | 250 | 120 | 150 | BEC | 39 |
| **MSdw** | 140 | 250 | 120 | 150 | BEC | 39 |

| BEC subzone/variant | Age of old (>)[1] | Age of ancient (>)[2] | Age of older mature (>)[3] | Stand-initiating return interval[4] | Source[4] | % of area expected old[5] |
|---|---|---|---|---|---|---|
| **BGxh1** | 250 | 400 | 200 | 250 | BGB | 37 |
| **BGxh2** | 250 | 400 | 200 | 250 | BGB | 37 |
| **BGxh3** | 250 | 400 | 200 | 250 | BGB | 37 |
| **BGxw1** | 250 | 400 | 200 | 250 | BGB | 37 |
| **BGxw2** | 250 | 400 | 200 | 250 | BGB | 37 |
| **IDFxx2** | 250 | 400 | 200 | 250 | BGB | 37 |
| **PPxh1** | 250 | 400 | 200 | 250 | BGB | 37 |
| **PPxh2** | 250 | 400 | 200 | 250 | BGB | 37 |
| **SBPSdc** | 140 | 250 | 120 | 100 | BGB | 25 |
| **SBPSmc** | 140 | 250 | 120 | 100 | BGB | 25 |
| **SBPSmk** | 140 | 250 | 120 | 100 | BGB | 25 |
| **SBPSxc** | 140 | 250 | 120 | 100 | BGB | 25 |
| **SBSdh1** | 140 | 250 | 120 | 125 | BGB | 33 |
| **SBSdh2** | 140 | 250 | 120 | 125 | BEC | 33 |
| **SBSdk** | 140 | 250 | 120 | 125 | BGB | 33 |
| **SBSdw1** | 140 | 250 | 120 | 125 | BGB | 33 |
| **SBSdw2** | 140 | 250 | 120 | 125 | BGB | 33 |
| **SBSdw3** | 140 | 250 | 120 | 125 | BGB | 33 |
| **SBSmc1** | 140 | 250 | 120 | 125 | BGB | 33 |
| **SBSmc2** | 140 | 250 | 120 | 125 | BGB | 33 |
| **SBSmc3** | 140 | 250 | 120 | 125 | BGB | 33 |
| **SBSmh** | 140 | 250 | 120 | 125 | BGB | 33 |
| **SBSmk1** | 140 | 250 | 120 | 125 | BGB | 33 |
| **SBSmk2** | 140 | 250 | 120 | 125 | BGB | 33 |
| **SBSmm** | 140 | 250 | 120 | 125 | BGB | 33 |
| **SBSmw** | 140 | 250 | 120 | 125 | BGB | 33 |
| **SBSun** | 140 | 250 | 120 | 125 | BEC | 33 |
| **SBSvk** | 250 | 400 | 200 | 200 | BGB | 29 |
| **SBSwk1** | 250 | 400 | 200 | 200 | BGB | 29 |
| **SBSwk2** | 250 | 400 | 200 | 200 | BGB | 29 |
| **SBSwk3** | 140 | 250 | 120 | 125 | BGB | 33 |
| **SWBmk** | 250 | 400 | 200 | 200 | BGB | 29 |
| **SWBmks** | -- | -- | -- | -- | BGB | -- |
| **SWBun** | 250 | 400 | 200 | 200 | BEC | 29 |
| **SWBuns** | -- | -- | -- | -- | BEC | -- |
| **SWBvk** | 250 | 400 | 200 | 200 | BGB | 29 |
| **SWBvks** | -- | -- | -- | -- | BEC | -- |
| **ESSFdcw** | 250 | 400 | 200 | 200 | BEC | 29 |

| BEC subzone/variant | Age of old (>)[1] | Age of ancient (>)[2] | Age of older mature (>)[3] | Stand-initiating return interval[4] | Source[4] | % of area expected old[5] |
|---|---|---|---|---|---|---|
| **ESSFdkw** | 140 | 250 | 120 | 150 | BEC | 39 |
| **ESSFdvw** | 140 | 250 | 120 | 150 | BEC | 39 |
| **ESSFmcw** | 250 | 400 | 200 | 200 | BEC | 29 |
| **ESSFmkw** | 250 | 400 | 200 | 200 | BEC | 29 |
| **ESSFmmw** | 250 | 400 | 200 | 200 | BEC | 29 |
| **ESSFmww** | 250 | 400 | 200 | 1500 | EBM | 85 |
| **ESSFwcw** | 250 | 400 | 200 | 800 | NEW | 73 |
| **ESSFwmw** | 250 | 400 | 200 | 800 | NEW | 73 |
| **ESSFwvw** | 250 | 400 | 200 | 800 | NEW | 73 |
| **ESSFxcw** | 140 | 250 | 120 | 150 | BEC | 39 |
| **ESSFxvw** | 250 | 400 | 200 | 200 | BEC | 29 |

1. Age of old is based on Biodiversity Guidebook approach, defined by natural disturbance type (NDT) and BEC zone.
2. Age of ancient follows Structural Stage 7b (very old) in Land Management Handbook #25 (Province of BC 2010)
3. Age of older mature is based on Biodiversity Guidebook approach, defined by natural disturbance type and BEC zone.
4. Stand-initiating return interval is estimated from best available information from sources listed (BGB = Biodiversity Guidebook 1995; EBM = Ecosystem Based Management work on the coast (as per Cumulative Effects Framework for Biodiversity, Sept 2020; BEC = BGB approach, applied to BEC subzones/variants that are newer than 1995; PG = Delong 2011 estimates for NDT1, ICH and ESSF; NEW = Delong 2011 estimates applied across all NDT1, ICH and ESSF.
5. % of area expected old = estimates of expected percent of old forest under historic disturbance regimes using the listed return intervals in a negative exponential equation.

# Appendix 9: Big-tree Size Selected by BEC Subzone/Variant

The province intends to update old growth deferral areas and track changes. As outlined in OG TAP reports, the deferral maps will both miss areas of high value old forest and show areas that do not contain at-risk old growth forest, due to inventory error, analysis scale, or recent disturbance. A balanced, transparent method for adding and subtracting areas from the deferral pool is therefore needed.

The OG TAP, in conjunction with the province, provides the information in Table 9.1 to help determine whether a stand as measured on the ground meets criteria for big-treed deferral status. **These data will be supported by a framework for implementation to be released by the province shortly.**

## Using Table 9.1 to Update Priority Deferral Pool

To identify deferral areas, the selection algorithm chooses the largest old stands (based on height and diameter; quadratic mean diameter) first, and continues to select polygons until it reaches the target amount for each BEC subzone/variant (as described in Appendix 4). Because targets vary by ecosystem (Appendix 4), the proportion of the old forest characterised also differs by ecosystem. Table 9.1 shows the size of trees found in the last percentile for a given ecosystem (e.g., if the target amount is 7%, and if sufficient old forest remains to reach the target, these data reflect the size of trees found in the 7$^{th}$ percentile). For the trees in that percentile, Table 9.1 shows the lower quartile height and diameter (i.e., within the 7$^{th}$ percentile, one quarter of trees are shorter or narrower than the number shown).

Where insufficient old growth remains to reach a target, all old growth is selected first, and the algorithm then chooses the largest older mature forest (see Appendix 8 for age definition) to reach the target. In some BEC variants, there is insufficient older mature forest to reach the target; in these cases, deferrals do not include the full target amount. Where insufficient old growth (or older mature forest) remains to reach the target, height and diameter are irrelevant—all stands are identified for deferral.

The OG TAP recommends that Table 9.1 can be used to determine whether stands can be dropped or added to the deferral pool for big-treed old forest as follows:

1. If Table 9.1 shows “All” for old forest, or older mature forest, within an ecosystem, then ALL old forest (and older mature forest as appropriate) meet deferral criteria regardless of tree size.
2. If a stand is mapped for deferral, both height and diameter measured on the ground must be below the criteria in Table 9.1 to remove the stand from the priority deferral pool.
3. If a stand is not mapped for deferral, both height and diameter measured on the ground must be above the criteria in Table 9.1 to add the stand to the priority deferral pool.
4. If the stand meets one criterion (i.e., either height or diameter), the stand retains its current status as either deferred or not deferred.

**These data are NOT thresholds for determining forest size, they simply characterize the resultant attributes of forest at the bottom end of polygons included in the priority deferral map by ecosystem.**

*Table 9. 1. Size quartile for height and diameter of old growth (OG) and older mature (OMat) of selected deferral. Where insufficient old forest remains to reach a target, all of it is selected; hence there are no appropriate size criteria. Where sufficient old forest exists, no older mature is selected. Where criteria are listed as "All", all identified old forest within a BEC subzone/variant, and older mature forest as appropriate, are recommended as priority deferral.*

| BEC Variant | Target % | OG %[1] | OG + OMat % | OG Height[2] | OG Diameter | OMat Height | OMat Diameter |
|---|---|---|---|---|---|---|---|
| **BGxh1** | 10 | 0.7 | 5.6 | All | All | All | All |
| **BGxh2** | 10 | 0 | 8.2 | All | All | All | All |
| **BGxh3** | 10 | 1.3 | 6.7 | All | All | All | All |
| **BGxw1** | 10 | 0 | 4.6 | All | All | All | All |
| **BGxw2** | 10 | 2.4 | 10.0 | All | All | 17 | 20 |
| **BWBSdk** | 3 | 3.0 | 3.0 | 28 | 27 | - | - |
| **BWBSvk** | 5 | 0.1 | 5.0 | All | All | 11 | 20 |
| **BWBSwk1** | 5 | 5.0 | 5.0 | 25 | 26 | - | - |
| **BWBSwk2** | 5 | 5.0 | 5.0 | 27 | 27 | - | - |
| **BWBSwk3** | 5 | 5.0 | 5.0 | 20 | 21 | - | - |
| **CDFmm** | 10 | 2.3 | 4.1 | All | All | All | All |
| **CWHdm** | 10 | 4.8 | 6.7 | All | All | All | All |
| **CWHds1** | 10 | 10.0 | 10.0 | 34 | 42 | - | - |
| **CWHds2** | 10 | 10.0 | 10.0 | 35 | 45 | - | - |
| **CWHmm1** | 10 | 10.0 | 10.0 | 37 | 48 | - | - |
| **CWHmm2** | 10 | 10.0 | 10.0 | 46 | 47 | - | - |
| **CWHms1** | 10 | 10.0 | 10.0 | 38 | 43 | - | - |
| **CWHms2** | 10 | 10.0 | 10.0 | 38 | 56 | - | - |
| **CWHvh1** | 7 | 7.0 | 7.0 | 34 | 54 | - | - |
| **CWHvh2** | 7 | 7.0 | 7.0 | 30 | 48 | - | - |
| **CWHvh3** | 7 | 7.0 | 7.0 | 35 | 46 | - | - |
| **CWHvm1** | 7 | 7.0 | 7.0 | 37 | 53 | - | - |
| **CWHvm2** | 7 | 7.0 | 7.0 | 38 | 47 | - | - |
| **CWHwh1** | 10 | 10.0 | 10.0 | 33 | 43 | - | - |
| **CWHwh2** | 7 | 7.0 | 7.0 | 35 | 46 | - | - |
| **CWHwm** | 7 | 7.0 | 7.0 | 36 | 40 | - | - |
| **CWHws1** | 10 | 10.0 | 10.0 | 39 | 42 | - | - |
| **CWHws2** | 7 | 7.0 | 7.0 | 37 | 44 | - | - |
| **CWHxm1** | 10 | 1.2 | 2.5 | All | All | All | All |
| **CWHxm2** | 10 | 7.8 | 9.3 | All | All | All | All |
| **ESSFdc1** | 5 | 5.0 | 5.0 | 27 | 25 | - | - |
| **ESSFdc2** | 10 | 10.0 | 10.0 | 27 | 30 | - | - |
| **ESSFdc3** | 10 | 10.0 | 10.0 | 29 | 32 | - | - |
| **ESSFdh1** | 10 | 10.0 | 10.0 | 33 | 37 | - | - |

| BEC Variant | Target % | OG %[1] | OG + OMat % | OG Height[2] | OG Diameter | OMat Height | OMat Diameter |
|---|---|---|---|---|---|---|---|
| **ESSFdh2** | 10 | 10.0 | 10.0 | 31 | 35 | - | - |
| **ESSFdk1** | 10 | 10.0 | 10.0 | 24 | 26 | - | - |
| **ESSFdk2** | 10 | 10.0 | 10.0 | 28 | 29 | - | - |
| **ESSFdv1** | 10 | 10.0 | 10.0 | 28 | 31 | - | - |
| **ESSFdv2** | 10 | 10.0 | 10.0 | 23 | 33 | - | - |
| **ESSFmc** | 5 | 5.0 | 5.0 | 26 | 29 | - | - |
| **ESSFmh** | 7 | 2.3 | 7.0 | All | All | 28 | 28 |
| **ESSFmk** | 5 | 5.0 | 5.0 | 28 | 42 | - | - |
| **ESSFmm1** | 5 | 5.0 | 5.0 | 32 | 34 | - | - |
| **ESSFmm2** | 5 | 5.0 | 5.0 | 40 | 39 | - | - |
| **ESSFmm3** | 5 | 5.0 | 5.0 | 34 | 42 | - | - |
| **ESSFmv1** | 5 | 0.3 | 4.2 | All | All | All | All |
| **ESSFmv2** | 5 | 3.7 | 5.0 | All | All | 25 | 29 |
| **ESSFmv3** | 5 | 5.0 | 5.0 | 21 | 23 | - | - |
| **ESSFmv4** | 5 | 1.8 | 5.0 | All | All | 23 | 25 |
| **ESSFmw** | 5 | 5.0 | 5.0 | 23 | 30 | - | - |
| **ESSFmw1** | 5 | 5.0 | 5.0 | 35 | 43 | - | - |
| **ESSFmw2** | 5 | 5.0 | 5.0 | 32 | 39 | - | - |
| **ESSFun** | 5 | 5.0 | 5.0 | 27 | 31 | - | - |
| **ESSFvc** | 7 | 7.0 | 7.0 | 32 | 41 | - | - |
| **ESSFwc2** | 7 | 7.0 | 7.0 | 32 | 42 | - | - |
| **ESSFwc3** | 7 | 7.0 | 7.0 | 22 | 25 | - | - |
| **ESSFwc4** | 7 | 7.0 | 7.0 | 28 | 31 | - | - |
| **ESSFwh1** | 10 | 10.0 | 10.0 | 31 | 35 | - | - |
| **ESSFwh2** | 7 | 7.0 | 7.0 | 31 | 35 | - | - |
| **ESSFwh3** | 7 | 3.1 | 7.0 | All | All | 29 | 34 |
| **ESSFwk1** | 10 | 9.0 | 10.0 | All | All | 35 | 56 |
| **ESSFwk2** | 7 | 7.0 | 7.0 | 26 | 29 | - | - |
| **ESSFwm1** | 5 | 5.0 | 5.0 | 22 | 25 | - | - |
| **ESSFwm2** | 7 | 7.0 | 7.0 | 16 | 21 | - | - |
| **ESSFwm3** | 5 | 1.9 | 5.0 | All | All | 27 | 32 |
| **ESSFwm4** | 5 | 0.8 | 5.0 | All | All | 23 | 28 |
| **ESSFwv** | 7 | 7.0 | 7.0 | 31 | 34 | - | - |
| **ESSFxc1** | 10 | 10.0 | 10.0 | 24 | 27 | - | - |
| **ESSFxc2** | 10 | 10.0 | 10.0 | 28 | 30 | - | - |
| **ESSFxc3** | 10 | 10.0 | 10.0 | 23 | 27 | - | - |
| **ESSFxv1** | 10 | 10.0 | 10.0 | 14 | 17 | - | - |
| **ESSFxv2** | 10 | 1.0 | 7.4 | All | All | All | All |

| BEC Variant | Target % | OG %[1] | OG + OMat % | OG Height[2] | OG Diameter | OMat Height | OMat Diameter |
|---|---|---|---|---|---|---|---|
| ICHdk | 7 | 7.0 | 7.0 | 35 | 37 | - | - |
| ICHdm | 7 | 7.0 | 7.0 | 28 | 33 | - | - |
| ICHdw1 | 7 | 7.0 | 7.0 | 30 | 35 | - | - |
| ICHdw3 | 7 | 7.0 | 7.0 | 32 | 36 | - | - |
| ICHdw4 | 7 | 7.0 | 7.0 | 31 | 36 | - | - |
| ICHmc1 | 5 | 5.0 | 5.0 | 34 | 38 | - | - |
| ICHmc2 | 5 | 5.0 | 5.0 | 34 | 37 | - | - |
| ICHmk1 | 7 | 7.0 | 7.0 | 32 | 31 | - | - |
| ICHmk2 | 7 | 7.0 | 7.0 | 30 | 34 | - | - |
| ICHmk3 | 10 | 3.9 | 9.3 | All | All | All | All |
| ICHmk4 | 7 | 7.0 | 7.0 | 25 | 26 | - | - |
| ICHmk5 | 7 | 7.0 | 7.0 | 30 | 31 | - | - |
| ICHmm | 10 | 10.0 | 10.0 | 32 | 35 | - | - |
| ICHmw1 | 10 | 8.0 | 10.0 | All | All | 31 | 42 |
| ICHmw2 | 10 | 4.8 | 9.7 | All | All | All | All |
| ICHmw3 | 10 | 8.0 | 10.0 | All | All | 35 | 52 |
| ICHmw4 | 10 | 2.8 | 6.8 | All | All | All | All |
| ICHmw5 | 10 | 1.7 | 4.9 | All | All | All | All |
| ICHvc | 19.8 | 19.8 | 19.8 | 32 | 35 | - | - |
| ICHvk1 | 19.8 | 19.8 | 19.8 | 33 | 41 | - | - |
| ICHvk2 | 19.8 | 14.9 | 19.8 | All | All | 34 | 55 |
| ICHwc | 5 | 5.0 | 5.0 | 32 | 47 | - | - |
| ICHwk1 | 19.8 | 19.8 | 19.8 | 31 | 37 | - | - |
| ICHwk2 | 19.8 | 19.8 | 19.8 | 32 | 38 | - | - |
| ICHwk3 | 19.8 | 19.8 | 19.8 | 30 | 33 | - | - |
| ICHwk4 | 19.8 | 17.5 | 19.8 | All | All | 37 | 57 |
| ICHxm1 | 10 | 0.3 | 2.4 | All | All | All | All |
| ICHxw | 10 | 0.1 | 0.7 | All | All | All | All |
| IDFdc | 10 | 3.7 | 10.0 | All | All | 28 | 33 |
| IDFdh | 10 | 0.1 | 3.0 | All | All | All | All |
| IDFdk1 | 10 | 2.4 | 8.7 | All | All | All | All |
| IDFdk2 | 10 | 1.2 | 7.5 | All | All | All | All |
| IDFdk3 | 10 | 1.7 | 5.1 | All | All | All | All |
| IDFdk4 | 10 | 1.9 | 4.1 | All | All | All | All |
| IDFdk5 | 10 | 0.4 | 1.9 | All | All | All | All |
| IDFdm1 | 10 | 2.1 | 9.5 | All | All | 20 | 22 |
| IDFdm2 | 10 | 0.1 | 1.4 | All | All | All | All |
| IDFdw | 10 | 10.0 | 10.0 | 23 | 28 | - | - |

| BEC Variant | Target % | OG %[1] | OG + OMat % | OG Height[2] | OG Diameter | OMat Height | OMat Diameter |
|---|---|---|---|---|---|---|---|
| **IDFmw2** | 10 | 0.4 | 1.8 | All | All | All | All |
| **IDFww** | 10 | 10.0 | 10.0 | 25 | 29 | - | - |
| **IDFww1** | 10 | 10.0 | 10.0 | 25 | 32 | - | - |
| **IDFxc** | 10 | 6.7 | 10.0 | All | All | 26 | 34 |
| **IDFxh1** | 10 | 3.5 | 10.0 | All | All | 22 | 28 |
| **IDFxh2** | 10 | 1.6 | 10.0 | All | All | 17 | 26 |
| **IDFxk** | 10 | 0.0 | 1.0 | All | All | All | All |
| **IDFxm** | 10 | 2.9 | 7.7 | All | All | All | All |
| **IDFxw** | 10 | 5.1 | 10.0 | All | All | 18 | 24 |
| **IDFxx1** | 10 | 0 | 5.3 | All | All | All | All |
| **IDFxx2** | 10 | 0 | 0.4 | All | All | All | All |
| **MHmm1** | 5 | 5.0 | 5.0 | 36 | 44 | - | - |
| **MHmm2** | 5 | 5.0 | 5.0 | 33 | 42 | - | - |
| **MHwh** | 5 | 5.0 | 5.0 | 33 | 43 | - | - |
| **MHwh1** | 5 | 5.0 | 5.0 | 29 | 39 | - | - |
| **MSdc1** | 11.8 | 11.8 | 11.8 | 29 | 34 | - | - |
| **MSdc2** | 11.8 | 11.8 | 11.8 | 23 | 26 | - | - |
| **MSdc3** | 11.8 | 11.8 | 11.8 | 25 | 35 | - | - |
| **MSdk** | 11.8 | 11.8 | 11.8 | 29 | 28 | - | - |
| **MSdm1** | 11.8 | 11.8 | 11.8 | 24 | 24 | - | - |
| **MSdm2** | 11.8 | 11.8 | 11.8 | 24 | 28 | - | - |
| **MSdm3** | 11.8 | 11.8 | 11.8 | 27 | 28 | - | - |
| **MSdv** | 11.8 | 11.8 | 11.8 | 24 | 21 | - | - |
| **MSdw** | 11.8 | 11.8 | 11.8 | 21 | 22 | - | - |
| **MSxk1** | 11.8 | 11.8 | 11.8 | 23 | 26 | - | - |
| **MSxk2** | 11.8 | 11.8 | 11.8 | 24 | 27 | - | - |
| **MSxk3** | 11.8 | 11.8 | 11.8 | 24 | 27 | - | - |
| **MSxv** | 11.8 | 11.8 | 11.8 | 15 | 17 | - | - |
| **PPxh1** | 10 | 3.3 | 10.0 | All | All | 24 | 27 |
| **PPxh2** | 10 | 2.5 | 10.0 | All | All | 18 | 30 |
| **SBPSdc** | 10 | 2.7 | 6.8 | All | All | All | All |
| **SBPSmc** | 10 | 10.0 | 10.0 | 26 | 23 | - | - |
| **SBPSmk** | 10 | 4.3 | 9.7 | All | All | All | All |
| **SBPSxc** | 10 | 9.2 | 10.0 | All | All | 18 | 20 |
| **SBSdh1** | 10 | 10.0 | 10.0 | 29 | 28 | - | - |
| **SBSdh2** | 10 | 10.0 | 10.0 | 29 | 32 | - | - |
| **SBSdk** | 10 | 10.0 | 10.0 | 20 | 21 | - | - |
| **SBSdw1** | 10 | 10.0 | 10.0 | 30 | 32 | - | - |

| BEC Variant | Target % | OG %[1] | OG + OMat % | OG Height[2] | OG Diameter | OMat Height | OMat Diameter |
|---|---|---|---|---|---|---|---|
| **SBSdw2** | 10 | 10.0 | 10.0 | 21 | 23 | - | - |
| **SBSdw3** | 10 | 9.5 | 10.0 | All | All | 34 | 45 |
| **SBSmc1** | 10 | 10.0 | 10.0 | 26 | 26 | - | - |
| **SBSmc2** | 10 | 10.0 | 10.0 | 27 | 31 | - | - |
| **SBSmc3** | 10 | 10.0 | 10.0 | 15 | 18 | - | - |
| **SBSmh** | 10 | 10.0 | 10.0 | 35 | 36 | - | - |
| **SBSmk1** | 10 | 10.0 | 10.0 | 26 | 27 | - | - |
| **SBSmk2** | 10 | 10.0 | 10.0 | 27 | 27 | - | - |
| **SBSmm** | 10 | 10.0 | 10.0 | 29 | 32 | - | - |
| **SBSmw** | 10 | 10.0 | 10.0 | 27 | 23 | - | - |
| **SBSun** | 10 | 10.0 | 10.0 | 26 | 29 | - | - |
| **SBSvk** | 10 | 6.6 | 10.0 | All | All | 32 | 39 |
| **SBSwk1** | 10 | 0.9 | 7.0 | All | All | All | All |
| **SBSwk2** | 10 | 3.6 | 9.7 | All | All | All | All |
| **SBSwk3** | 10 | 10.0 | 10.0 | 28 | 34 | - | - |

1. The amount of old growth available. Where this number is less than the target, the algorithm adds forest from the older mature stands. For example, in the BGxh1, the target is 10%, there is 0.7% old growth currently and an additional 4.9% of older mature forest.
2. If insufficient forest remains to reach the target, the algorithm selects “All” of it.