Old Growth Deferrals:

a meaningful approach.

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SUMMARY

The 2020 Old Growth Strategic Review (OGSR) Panel identified the need for **immediate deferrals of the highest value**, **most at risk old forest** in the province. **Deferrals are intended to retain options** during ongoing land-use planning discussions with First Nations and to allow time for the recommended paradigm shift in forest management that puts First Nations rights and interests, ecological integrity and long-term community stability as priorities over timber volume.

OGSR Recommendation 6 says: **Until a new strategy is implemented, defer development in old forest where ecosystems are at very high and near-term risk of irreversible loss.** The OGSR lists a series of criteria to identify the most important old forest for deferral.

In a continuation of our work on this issue (Price, Holt and Daust 2021[1]), we created a map that identifies areas, distributed across BC's forested ecosystems, that best meet the criteria outlined in the OGSR report. Our map shows the location of these forests inside and outside protected zones[2], and we identify the ~1.3 million hectares that falls outside protected zones as **candidate options** for deferral.

Meaningful deferrals <u>prevent harvest of areas that would otherwise be harvested</u>. Candidate areas should be a) overlaid with existing proposed cut blocks and roads to identify the actual area for deferral, and b) be provided to decision-makers to ensure no new overlapping cutting or road permits are granted. No effort should be wasted on areas that are not at risk of harvest for this deferral process.

INTENT

A year after the OGSR panel delivered their report, our intent is to kickstart the urgent conversation about old forest deferrals by mapping candidates for deferral as identified in Recommendation 6.

Recommendation 6 criteria are conceptually straightforward, although known data issues require careful interpretation. The OGSR did not prioritise these deferral criteria. The criteria span a range of ecological concepts; each identifies a different, though somewhat overlapping, suite of old forest. Rare old forests are relatively straightforward to map, but may be the 'guts and feathers' of what was once present. Ancient forest is of very high value—irreplaceable in the true sense of the word—but poorly represented in provincial datasets, though often easy to spot on the ground. The 'most productive' forests are conceptually simple (most people know when they are in one), but are more complex to map

[1] Price, K., R.F.Holt and D.Daust. https://veridianecological.files.wordpress.com/2020/05/bcs-old-growth-forest-report-web.pdf and in a peer reviewed journal: https://cdnsciencepub.com/doi/full/10.1139/cjfr-2020-0453

[2] Protected zones include all areas designated as no-harvest, though in reality they span a wide range of actual protection and condition – from Protected Areas / Parks to no harvest Wildlife Habitat Areas. Note that legal OGMAs are not shown on the map product.

because they are not easily represented by a single variable, and because in different ecosystems the forests are visibly different from one another. We mapped the top 1%, 3%, 5% and 10% of **tallest, largest old forests** remaining in each ecosystem, inside and outside of protected zones. The area mapped outside protected zones provides the basis for a prioritised and robust set of candidate areas that meet the productive forest criterion. Resilient forests are also one of the OGSR criteria, and must be a long-term goal, but we have not included them in this version of our mapping. A candidate 'resilient forest' map will be made available shortly. Where insufficient old forest exists to meet any of the percent targets, we do not recruit younger forest in this process[3].

How much area? The area identified by the OGSR for deferral priorities, **not including resilience areas**, totals approximately 1.1 million ha[4]. Our prioritised Candidate Options map therefore shows the top 3% tallest and largest trees in each ecosystem (including areas in already designated no harvest areas), plus mapped ancient forest, and covers 1.3 million ha[5] (~2.6% of the forested landbase). In addition, the map shows the top 10% of tallest and largest old forests in each ecosystem for context[6].

Where? Ecosystems inherently vary in their ability to grow large-treed forests. However, the largest remaining old forests within each ecosystem are important regionally. Our model used the ecological principle of **evenly representing** the top 1,3,5, and 10% of large old forests **within each biogeoclimatic variant** to look for potential candidate deferral areas spread across the province. The final Candidate Options map of 3% similarly shows the areas distributed across the range of ecosystems. In ecosystems with better protection levels, less area is identified as a candidate for deferral.

At-Risk? In this context, forest is at immediate risk if it has been identified to be harvested i.e., in a harvest plan and has a cutting permit. However, because this is a rolling window (more areas are identified every day for harvest), a two-pronged deferral approach is needed. A) defer harvest for existing permits that overlap with the top 1.3 million hectares identified, and B) avoid approving new permits in the top 1.3 million hectares until land-use planning is completed. The final distribution of **deferrals** may be uneven across different ecosystems, because the pattern of harvest pressure is also uneven.

HOW TO USE THIS PRODUCT

Step 1: Use the map provided – the best 3%, plus ancient forest and some of the rare - as the Candidate deferral options. Augment our map with locally known important old growth areas that are not represented adequately in VRI, or have local value (e.g., culturally important old growth).

[3] Our maps do not show recruitment. This is a potential flaw as recruitment of non-old is at least as pressing as protecting the last scraps of old in some ecosystems. For example, old stands in coastal ecosystems dominated by Douglas-fir are largely extirpated in relation to their former extent and majesty.

[4] 307,000 ha of productive forest, plus 508,000 of forest in units with <10% old remaining, plus 278,000 ha of ancient forest. All classes incremental and outside no-harvest zone.

[5] Areas such as wildlife tree patches are identified in some areas because there is no old forest remaining, and we expect some 'false positives', areas without actual values on the ground. These should be removed and replaced with real known on the ground old forest that the strategic mapping has not identified.

[6] Most rare is included in the 10% map, and some proportion of rare is included in the 3% map.

Step 2: Overlay Options Map with any permitted and planned cut blocks and roads to identify areas which should be deferred from logging immediately. Apply the two-pronged approach above to identify actual areas that require deferral now, and ongoing during land-use planning.

Step 3: Revise the candidate deferral map as needed, and re-iterate deferral process:

- The OGSR outlines the need for immediate action. An imperfect map should not slow that process. After Steps 1 and 2 are finalised, revise the map as needed. Fill data gaps for areas that are currently missing forest cover/VRI data (e.g., much of Vancouver Island and other TFLs).
- Further augment the deferral options with locally known areas that are not represented adequately in VRI, or have local value (e.g., culturally important old growth). Remove areas that are already harvested or clearly lack attributes.

Step 4: Move towards resilience mapping. Additional variables as outlined could be examined to determine whether the model's approach can be improved. This process will be useful to feed this work into longer term land use planning processes. This work, combined with Resilience and Carbon maps (in preparation) should be used to guide longer term planning, in concert with First Nations and others.

NEXT STEPS: SHORT-TERM

This is not a resilience map. Forest resilience requires 30-50% of the landscape to be identified, considering intactness, patch size, representation, climate refugia, old forest and old-forest recruitment and other values. We are currently developing an approach to resilience mapping for the province.

This is not a recruitment map. Because most low elevation areas of the province do not have 3% or even 10% old forest remaining, our old forest candidate deferral map identifies significantly less than the stated percent in many areas. We did not 'fill' the target with non-old because this work is focused on informing the old forest deferral process. However, in some areas the remaining areas of old may be extremely small, or have poor values on the ground. In these ecosystems, recruitment of productive younger forest in important places is likely the most important strategy.

It cannot be over-stated – deferrals are a means to an end. But they are not the end goal!

Immediate appropriate deferrals are critical to create space for conversation; moving rapidly towards identifying adequate forest for protection, recruitment and long-term resilience is of utmost urgency. Many of the steps required are outlined in the OGSR report.

We hope the information we provide may be useful to First Nations who want an improved understanding of the condition of ecosystems in their territories. We are willing to provide support and explanation to anyone who would like additional information.

Resilience and carbon storage maps (in preparation) in combination with this candidate deferral map could be used to guide longer term planning, in collaboration with First Nations and others.

CANDIDATE DEFERRAL MAP AND GUIDANCE DOCUMENTS

Available at: www.veridianecological.ca/old-growth-resilience

OLD GROWTH DEFERRALS - TECHNICAL BACKGROUND DOCUMENT

The OGSR review identified the need for immediate deferrals of the highest value, most at-risk old forest in the province. These deferrals are intended to retain options during ongoing land-use planning discussions with First Nations and to allow time for the recommended paradigm shift in forest management that puts First Nations rights and interests, ecological integrity and long-term community stability as priorities over timber volume.

In continuation of our work on this issue (Price, Holt and Daust 2021[7]), we have created an approach for identifying areas of the province that best meet the criteria outlined in the OGSR report.

The OGSR Recommendation 6[8] says: **Until a new strategy is implemented, defer development in old forest where ecosystems are at very high and near-term risk of irreversible biodiversity loss.**

The OGSR implementation advice includes a list of suggestions for how to move forward with this recommendation, including a list of criteria for identifying relevant forest:

3. Consider the following old forest areas (and possibly others) for short-term deferrals:
    a. Any BEC variant with less than 10% old forest remaining today;
    b. Old forest in any BEC – Landscape Unit combination that has less than 10% old forest today;
    c. Ancient forests (e.g., forests >500 years on the coast and wet ICH) and forests > 300 years in ecosystems with higher disturbance intervals);
    d. Areas with a high potential to contribute towards larger ecosystem resilience; and
    e. Areas with a Site Index of >20m.
4. Determine which of those areas are subject to harvesting or other significant disturbances within the next two years. We would expect the FLNRORD staff to have this information or be able to collect it from licensees.

INTENT

The intention outlined in the deferral portion of OGSR Recommendation 6 is clear: identify the 'best' or the 'most at risk' or the most 'irreplaceable' old forest that is at risk from harvest in the province, and do not harvest it while broader planning is undertaken. The criteria are conceptually straightforward, although known data issues require careful interpretation to identify appropriate deferral areas. The OGSR did not prioritise these criteria for implementation. The criteria span a range of ecological concepts and each identifies a different suite of old forest that may or may not overlap one another to varying degrees:

- Rare (items 3a and 3b): identifies areas with little old forest remaining. This old forest tends to be fragmented, in small patches, and may be relatively low value compared to historically available old (as much of the larger structured forest has been harvested). It may be locally and regionally important. May not be at highest risk locally as often relatively high levels of mature forest with larger trees.

[7] Price, K., R.F.Holt and D.Daust. https://cdnsciencepub.com/doi/full/10.1139/cjfr-2020-0453
[8] https://engage.gov.bc.ca/app/uploads/sites/563/2020/09/STRATEGIC-REVIEW-20200430.pdf, page 55.

- Ancient (item c): All old forest by its definition is valuable from a temporal perspective, but ancient forest – forest that has been on the landscape for many multiple centuries is truly irreplaceable. Often with very high biodiversity values (e.g., rare species and huge carbon stores), and with trees older than 300 or 500 years. Likely part of a larger old forest ecosystem as tend to exist in wetter ecosystems in the province. High value. Likely not more at risk than surrounding areas as being ancient may not result in larger trees on the site.
- Resiliency (item d): a resilient landscape is critical to maintaining future the values of BC's forests. In this work, we have not mapped resilience ecosystems, though we did use criteria that tends to map larger patches in order to avoid a 'scatter' map as much as possible. We are in the process of mapping an approach to resilience which will be available very soon.
- Productive old (item e): the OGSR suggested using SI>20 as a measure of productive ecosystems. Based on feedback, we have developed a more robust approach to identifying this category. Our provincial (Price et al.) and GBR-specific (Holt et al. in prep.) analyses show a significant bias of harvest towards sites with the largest standing biomass. **Remaining productive old forest areas represent very high values and very high risk**.

We have created a map delineating forest types which we suggest meet four of the five OGSR criteria, and therefore should not be harvested until broader planning is undertaken. An unknown portion of the areas identified in our map would meet the criteria #4 identified as areas at risk of immediate harvest.

MAPPING APPROACH

We used provincial VRI[9], updated with harvest history, and focused on the forested landbase as defined in Price et al. 2021. Total forested landbase ~ 50 million ha. Appendix 1 provides an overview of potential data and variables and comments on their utility for mapping old forest. Our approach replicates the criteria for identifying relevant forest for deferral (shown above, from the OGSR report) and is summarised below:

Forested Land Base: stands with site index > 5 metres within the provincial Forest Management Land Base and within forested BEC zones, excluding private and federal land and areas (typically TFLs) with missing data[10].

Age of Old: we generally use standard provincial age classifications of stands >250 and >140 and >120 as per the Biodiversity Guidebook, except that we used >140 for old for all ESSF variants (when defining the most productive forest) to deal with issues of known mis-classified age in the ESSF [11].

Rare [A/B]: mapped old stands where old forest is less than 10% in the BEC variant, or less than 10% in the BEC variant – landscape unit combination.

[9] See Appendix 3 for further discussion of different measures of site index (VRI and PSPL)
[10] There are some areas with significant 'missing data', e.g., northern and eastern Vancouver Island. This provides a significant risk for these ecosystems, as even basic understanding of forest condition is not available.
[11] We use the standard BGB age-class definitions for all units for calculating the other old forest variables.

Ancient [C]: mapped old stands where the age in the VRI is identified as >500 years in the coastal and inland temperate rainforests, and >300 years elsewhere in the province.[12]

Most Productive Old[13] [E]: the OGSR identified stands with site index >20 as most productive, however, concerns around limitations of VRI site index encouraged us to define a broader approach. We explored using a variety of combinations of attributes from the provincial VRI dataset (Table 1) and used our pooled knowledge of actual old forest areas on the ground to preliminarily verify our approach[14].

Table 1. Scenarios examining variables to contribute to productivity scores. A '1' indicates the attribute was included in the scenario.

Scenario	Age	Stand Volume	Site Index	Tree Volume	Height	Crown
1	1	0	0	0	0	0
2	0	1	0	0	0	0
3	0	0	1	0	0	0
4	0	0	0	1	0	0
5	0	0	0	0	1	0
6	1	1	0	0	0	0
7	1	0	0	1	0	0
8	1	0	0	0	1	0
9	0	1	0	0	1	0
10	1	0	0	1	1	0
11	0	1	0	0	0	1
12	0	1	0	1	0	0
13	0	0	0	1	1	0

Based on our data examination (see below) we recommend the following approach: to avoid concerns over site index and strict forestry productivity measures, we allowed the SELES model to choose forest from any site class (using only a SI>5 threshold). From that pool SELES chose old forest based on a variety of combinations of attributes (see Table 1) proportionally from each biogeoclimatic variant to provide a generally even distribution of identified forest through BC's forested ecosystems. We explored the use of choosing stands based on age, site index, stand volume, tree volume, height and canopy closure, and combinations of each. **The final model provided here is based on selecting old forest within each biogeoclimatic variant based on a combination of stand height and tree volume (stand volume/ stems per hectare).**

[12] ITR is defined as all ICH variants with a moisture class of moist or wetter, CTR is defined as all CWH and MH units.
[13] The productivity of interest is realised productivity (what is on the site today), not future productivity (which is a site level characteristic that does not reflect the condition of the forest on that site today. As a result, we widened the site index category allowed to contribute, and used measures of current biomass on the site to identify 'best' forest (see Table 1). See Appendices 1 and 3 for further discussion of productivity.
[14] Consider this as the poor man's LIDAR from publicly available data – using actual LIDAR would produce a better result, and could be used to verify the forest attributes identified.

How much? The model chose the best (i.e., largest, most productive) 1%, 3%, 5% and 10% by biogeoclimatic variant of old forested area irrespective of existing protection designations, in each biogeoclimatic variant.[15] This allowed the most productive forest in parks and other designated non-harvest areas to be chosen by the model. Productive areas within designated non-harvest areas (see Appendix 2 for list) are then removed from the final totals, but are shown for reference in the attached map.[16] In this way, biogeoclimatic variants with good capture of high value forest in protected zones have a smaller additional area identified for deferral, and conversely, where little to no high value forest is captured in designated no-harvest areas, the total amount captured approaches 1,3, 5 and 10%. Note that we focused only on identifying the very best areas within the existing old forest for deferral, and do not include recruitment in this version of the model.

Resilience and Recruitment [D]: including an analysis of potential areas required for resilience and recruitment (where little old exists), requires additional work. A resilience map would identify in the order of 30 – 50% of the landscape, focusing on intact areas, larger functional patches, climate resilience, distance from road, and other landscape scale factors. It would also include recruitment or recovery forests – those needed to reduce the risk associated with the very low levels of old growth remaining in many areas. A draft map for resilience is under development.

DEFERRAL OPTIONS MAP

The map product available from this analysis is available and can be provided to interested parties.

Based on the criteria applied (tree height and volume / tree), this strategic level map aims to identify the biggest and tallest forest within each BEC variant, up to a potential total of 10% for each BEC variant. It then identifies any additional rare and mapped ancient forest within each BEC variant. These different criteria often overlap in area.

The area identified by the OGSR for deferral priorities, **not including resilience areas**, totals approximately 1.1 million ha[17]. Our prioritised Candidate Options map therefore shows the top 3% tallest and largest trees in each ecosystem (including areas in already designated no harvest areas), plus mapped ancient forest, and covers 1.3 million ha[18] (~2.6% of the forested landbase). In addition, the map shows the top 10% of tallest and largest forests in each ecosystem for context[19].

The 'deferral' portion of the map is any identified area with existing cutting permits today, and any areas slated to be harvested in the upcoming months, as needed for adequate planning to be undertaken. The

[15] The SELES model uses a 1ha raster grid. Volume is averaged into larger polygons, and the model tends to choose larger areas (~25ha) where the overall average is higher. This tends to identify larger patches of higher volume forest, rather than very small fragments of forest.
[16] Legal OGMAs are not shown on the map for clarity, but were considered to be 'protected' from harvest for this product.
[17] 307,000 ha of productive forest, plus 508,000 of forest in units with <10% old remaining, plus 278,000 ha of ancient forest. All classes incremental and outside no-harvest zone.
[18] Areas such as wildlife tree patches are identified in some areas because there is no old forest remaining, and we expect some 'false positives', areas without actual values on the ground.
[19] All rare is included in the 10% map, and some proportion of rare is included in the 3% map.

total amount of 'at risk' areas is unknown to us, but can be identified by overlaying with existing/planned cutting and road permits and will be a much smaller portion of the total map.

APPLYING AND IMPROVING THE DEFERRAL OPTIONS MAP

Strategic level mapping to identify conservation options is a good place to start, but is not sufficient for effective long-term planning. Areas on the ground that are known to meet the intent of the criteria should also be deferred.

Rare Old: it is simple to identify BEC and BEC/ LU combinations that have less than 10% old forest remaining. Although a reasonable starting point for identifying rare old forest, we note that this BEC variant level criteria fails to identify the most productive rare ecosystems within each variant, many of which have very much less than 10% remaining in the province (Price et al. 2021). Although defining rare at the level of BEC variant is a useful starting point to identifying the broad ecosystems most at risk, it is inadequate to provide good guidance for the portion of most ecosystems that have been targeted by harvesting and are at very high risk, even when large areas of low productivity old forest remain. Focusing deferrals on the most productive rare is important.

Ancient Forest: the map identifies ancient forest based on VRI age, but these data are known to be poor. Areas identified as ancient likely are very very old, but other areas not identified in the dataset may be ancient. Areas that are potentially very very old should be identified on the ground and not harvested in this deferral period. Efforts to improve data on stand age should be a priority.

Most Productive Old: We explored several options to map these very important forests using provincially available data, and we used the combination of values that tended to have more differentiation power at the scale of the BEC zone (i.e. showed variability that appeared to reflect known ecological variability). We found that some variables were relatively poor at differentiating between different stands (i.e., landscapes with a variety of visibly different forests were not showing much variation) and some that showed more explanatory power in some ecosystems over others (e.g. volume versus volume / tree). For example, in mixed severity multi-species ecosystems, stands with high volume may be large spaced trees, or may be high density over-stocked stands. Age criteria ought to help differentiate between these, but age is relatively poor so may fail to do so. As a result, we developed the volume / tree metric to try and prioritise larger trees overall, rather than more dense stands. Overall, we felt that stand height was the most useful criterion, and that, augmented with volume/ tree provided most discrimination. In future, including additional variables such as leading / secondary species (focus on old forest associated species such as cedar/ hemlock and fire-resistant species such as Douglas-fir, ponderosa pine and western larch over early seral species such as lodgepole pine may provide improved identification of areas for long-term old-forest protection).

Landscape Context: Deferral Options Map does not consider the condition of the candidate area in terms of its size or landscape context, though it does tend to identify larger patches of forest as a result of how the model looks for larger areas of higher volume and taller trees. However, due to the fragmented nature of the forest remaining productive forest, many small areas are identified, particularly using the rare and ancient criteria. Additional factors of landscape context (e.g., avoiding wildlife tree patches that were identified when no other old forest was available, or prioritising areas where old is vey rare such as valley bottoms) could be considered when actually determining whether

an area should be deferred from harvest in the short-term - prior to the update of more detailed landscape planning undertaken under a paradigm shift umbrella. It may be useful as an additional step to identify candidate patches of forest over a particular size threshold as highest priority.

Non-mapped areas: Additional areas that fit the intent of the criteria outlined in the OGSR include **field verified areas** that meet any of the following criteria:

- **Near-extirpated forest types:** original late successional / old growth coastal Douglas-fir and Ponderosa Pine parkland ecosystems are largely extirpated in BC. Key example areas include east Vancouver Island, Sunshine Coast, southern GBR and associated Islands, lower Mainland and Howe Sound areas for Douglas-fir and Okanagan and Rocky Mountain Trench and dry valleys of the southern interior for Ponderosa Pine. The historic extent of both these forest old forest types is largely lost from settler history. **No large primary forest Douglas-fir or Ponderosa Pine forests, or stands with primary trees, should be harvested[20].** These are not synonymous with any specific BEC variants, and so can be missed when looking at strategic level data.
- **Any exceptionally old or exceptionally large** forest stands identified in the field. Strategic level inventory data do not provide certainty for stands found on the ground. Regionally rare old forests should be deferred where they are found on the ground. Diameter limits could be employed to ensure largest stands are not lost in this period of transition.

Data Gaps

The provincial VRI dataset is currently missing data for some areas (see Deferral Options map, and including large areas of Vancouver Island and other Tree Farm Licenses around the province). Most of this information exists within TFL datasets and **must be a priority to incorporate** into the Deferral Options methodology and decisions.

Prioritizing Deferrals to fill Deferral Budget.

OGSR Recommendation 6 is clear that deferrals are necessary because of the very high level of risk for many old growth ecosystems, and because current policy fails to protect it. This assumption holds for the province in general (Price et al. 2021) for the GBR (Holt et al. in prep.), and is further elevated in places such as the Kootenays where Orwellian loopholes are in use to avoid meeting even existing targets. **The deferral process must therefore prioritise the ecologically highest value old forests, and, following Recommendation 2 of the OGSR, must put timber supply considerations as a lower priority.**

We recommend the following approach:

- Use the best 3% largest and tallest forest map, and add in mapped ancient forests outside protected zones. This results in ~1.3 million hectares of candidate area, similar to the magnitude of area proposed by the OGSR criteria.
- Remove very small fragment areas (<2ha minimum, but consider <9ha minimum especially with no interior habitat).

[20] VRI and TEM mapping does not adequately identify stands with large primary forest Douglas-fir trees, or veteran ponderosa pine trees. Where these trees are located they should not be harvested, irrespective of the typed age of the stand around them.

- Remove 'false positive' areas – areas identified but that may have already been logged, or may not have the mapped values.
- Add in locally known important old forests if they are missed by the strategic level provincial data.
- Replace removed areas with the next highest identified areas (from the 1,3,5, 10% mapping).

This recommended approach sets a path for approximately 2.6 - 3% of the forested landbase to be candidate deferral areas, distributed evenly across BC's forested ecosystems, with relatively more area in ecosystems with less protected forest. The outlined approach is flexible to accommodate known high value forests on the ground, and targets the highest value most at-risk old forest as outlined by the OGSR. Further analysis is needed to understand the short-term economic implications.

SHIFTING BASELINE AND EXTIRPATED ECOSYSTEMS

It remains a strong concern that the largest, most productive old forests are already gone in many areas of the Province (e.g., on Vancouver Island, the south coast, southern GBR, Kootenays, any major valley bottom in most of the rest of BC) meaning that the distribution of remaining old forest is skewed towards the lower productivity sites and smaller treed forests. This provides a shifting baseline problem, as the historic extent of those massive historic forests must be factored into any risk and recovery analysis.

THIS IS NOT A RESILIENCE MAP

We are working to produce a draft resilience map for the province.

NEXT STEPS:

Step 1: Use the map provided – the best 3%, plus ancient forest - as the Candidate deferral options. Augment our map with locally known areas that are not represented adequately in VRI, or have local value (e.g., culturally important old growth).

Step 2: Overlay Options Map with any permitted and planned cut blocks and roads to identify areas which should be deferred from logging immediately. Apply the two-pronged approach above to identify actual areas that require deferral now, and ongoing during land-use planning.

Step 3: Revise the candidate deferral map as needed, and re-iterate deferral process:

- The OGSR outlines the need for immediate action. An imperfect map should not slow that process. After Steps 1 and 2 are finalised, revise the map as needed. Fill data gaps for areas that are currently missing forest cover/VRI data (e.g., much of Vancouver Island and other TFLs).
- Further augment the deferral options with locally known areas that are not represented adequately in VRI, or have local value (e.g., culturally important old growth). Remove areas that are already harvested or clearly lack attributes.

Step 4: Move towards resilience mapping. Additional variables as outlined could be examined to determine whether the model's approach can be improved. This process will be useful to feed this work into longer term land use planning processes. This work, combined with Resilience and Carbon maps (in preparation) should be used to guide longer term planning, in concert with First Nations and others**.**

CANDIDATE DEFERRAL MAP AND GUIDANCE DOCUMENTS

Available at: www.veridianecological.ca/old-growth-resilience

APPENDIX 1. DISCUSSION OF AVAILABLE DATA RELATING TO OLDER FOREST VALUES*.

Description	Attribute Status	Data / Comments (*explored in this analysis)
Old forest (generic)	Highly variable conservation status. Not useful as a term because condition, status and value are highly variable.	13.2 million ha. Undisputed area Not useful to inform any old forest question.
Large old forest – conservation of existing natural stands **Mapped using available data in our Deferral Options map.**	Variable conservation status, but always rare compared to historic condition. Note: VRI Site Index provides a strategic overview of trends in forest condition (Price et al. 2021). Comments are raised about absolute accuracy but relative accuracy within old growth continues to be useful to understand broad patterns. However, growth rate of the site is not the same as the current condition (large trees can occur in both fast and slow growing sites), we therefore moved away from site index in this work to focus on actual attributes of the site to avoid further confusion on productivity. VRI Site Index remains useful to understand broad patterns, and to give a best available estimate of the total extent of original forest variability.	<u>Current Condition Modeling:</u> Site index* Stand Volume* Height* Volume / tree (calculated as volume / stems per ha)* Diameter Canopy closure* <u>Current Condition on the ground:</u> LiDAR Local field knowledge
Ancient forest **Mapped using available data in our Deferral Options map.**	In wet inland temperate rainforests, and coastal forests expect 42 – 65 % of the forest to be older than 300 years if disturbance intervals are between 350 – 700 years. And between 36 – 78% older than 500 years in age (500 – 2,000-year return intervals). Nothing near this remains due to harvesting in higher site index areas. Much ancient forest likely exists on low productivity sites.	Poor quality age data in VRI.* Mapped ancient probably is ancient. Forest mapped as younger than ancient may be ancient, especially in wetter variants. Likely requires stand level protection criteria. Strategic data/inventory will likely never shed light on this issue.

Description	Attribute Status	Data / Comments (*explored in this analysis)
	Individual trees older than 1000 years can exist on a wide range of sites. These are not forests, though individual trees have inherent value.	
Absolute 'rare' old forest **Mapped using available data in our Deferral Options map.**	Rare, but tends to be small patches in a sea of cutblocks or naturally younger forest e.g. older forest in BEC variants with less than 10% remaining.	Mapped using age-class, BEC variant and some combination of site index, volume etc. to reflect 'large' forests obscured by broad ecosystem classification. Measuring rarity at level of BEC variant is insufficient to reflect risk, as historic harvest patterns are masked.
Large old forest – recovery areas. **Not Mapped.**	On south coast already harvesting 2/ 3rd growth areas. And many old forest ecosystems are red/ blue-listed. Requires appropriate areas for recovery. Oldest second growth is likely most suited for recovery, as it will get to old soonest, and also because best forest tended to be harvested first. In some areas this second growth has already been harvested. As above, 'productivity' or growth rate *per se* is not the focus of this work.	<u>Potential Recovery</u> Either VRI SI (which is accurate in the 30 – 120-year range; FAIB pers comm.) or possibly PSPL site index (see below concerns about averaging and homogenizing data). We recommend to not mix these site index measures in data, nor analyses, as PSPL significantly increases lower productivity site measures and tends to decrease the range of high productivity site measures relative to VRI SI. If used, combine with at least some real current data on the status of the stand on the ground, e.g. Age / Volume or volume / tree combination Age / Height combination.
Resilience **Not Mapped.**	Combinations of factors can be mapped to identify areas likely needed for resilience. See second briefing note (in prep)	
Primary forest (generic) May or may not be old due to natural disturbance. **Not Mapped.**	Lots of primary forest (generic), but very little primary forest that overlaps with forest containing large trees. At significant risk in some areas due to harvesting and additionally pellet production.	No specific data layer Assume forest >120 on coast, and >100 years in interior is natural primary forest. Also forest in recovering large burns. Easy to calculate area total in these age-classes.

APPENDIX 2: AREAS ASSUMED 'PROTECTED' FROM FOREST ACTIVITY IN THIS MAPPING WORK.

We identified areas that substantially limit timber harvesting from a provincial land designations dataset (Table 1) and then added Special Forest Management Areas in the Great Bear Rainforest, Community Watersheds near Vancouver and local and regional parks.

Table 1. Land Designation Codes that we treated as substantially protected from timber harvesting. Dataset name: Land Designations that Contribute to Conservation in BC - Spatial Data; retrieved (2020) from https://catalogue.data.gov.bc.ca.

Park_national	uwr_no_harvest
park_er	wha_no_harvest
park_provincial	biodiv_mining_tourism_areas
park_conservancy	wildland_zone
park_protectedarea	muskwa_kechika_special_wildland
park_recreationarea	ogma_legal
private_conservation_lands_admin	designated_area
national_wildlife_area	great_bear_grizzly_class1
ngo_fee_simple	s_chilcotin_mta
migratory_bird_sanctuary	

Where the identified old forest falls within these areas, it is shown on the candidate map for reference. Legal OGMAs are not shown on the map due to their small size. The final total area identified as candidate for deferral are the top 3% of biggest / tallest forests. plus ancient forest that fall OUTSIDE of the designated areas identified above in Table 1.

Note that many of these examples are not protected from other resource development (e.g. oil and gas activity, mining etc). We are not considering the implications of those activities to forest condition in our analysis.

APPENDIX 3: SIDEBAR ON MEASURES OF PRODUCTIVITY[21]

Our understanding is that the province is promoting the use of PSPL[22] SIBEC site index data as the most appropriate for determining productivity (though they have not talked directly to us in the provincial context). **This may be the case for potential productivity of new / young stands** - though we have concerns about the way in which PSPL cuts off the tails in the productivity distribution with fewer low and fewer high site stands), the extent to which it increases mean productivity and, in combination with large TEM polygons, homogenizes natural ecosystem variability within productivity data (see Holt and Holmes 2021 response to EBM WG). These issues have wide-ranging implications for sustainability (and timber supply) and should be a central concern to all parties. **However, our preliminary analysis suggests that PSPL data are not appropriate to evaluate the status of current older stands, and we are unsure why the provincial analyses are (apparently) not separating out current condition from potential (future) condition more clearly.**

The province notes that VRI site index systematically downgrades productivity of the site for remaining old forest stands. We agree that this may indeed be a trend (albeit of unclear total effect and which does not take the wider distribution of higher site index sites into account); however, we suggest that this does not detract from the utility of **relative** Inventory SI in prioritizing old forest stands for conservation.

Standing biomass in older stands >140 years is quite tightly related to Inventory Site Index (Figure 1). Stands with low Inventory Site Index have low volume / ha, and stands with very high inventory Site Index have high volume / ha. The narrow tail in the distribution (e.g. for the SI 15-20) shows the very small proportion of stands where the relative relationship does not hold – i.e. there are a very small number of stands that are typed as 15-20 which have a low volume/ ha. In general, the bulk of the SI 15 – 20 stands have higher volume / ha than stands with SI <15. For the highest SI classes (>30SI and >25-30 SI), there is a relatively small range of volume – and for both categories, more than 90% of stands are in the very highest end of the volume / ha range.

[21] Note that we have avoided considering site index in our current work, as we believe 'productivity' *per se* is not the primary issue of concern. Instead, we moved to using the attributes of the actual forest stand directly to determine conservation value. However, we include this Appendix to identify, if site index is used, why we are using VRI site index over PSPL SIBEC site index.

[22] Provincial Site Productivity Layer

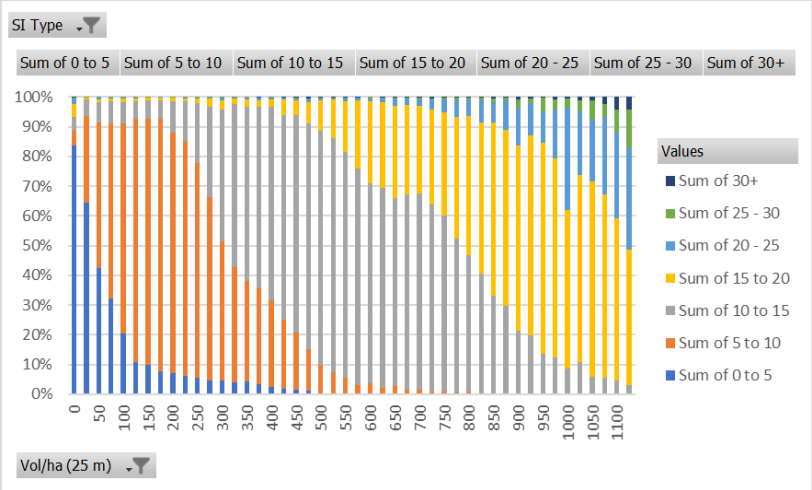

Figure 1. Inventory Site Index classes and Standing Biomass (Volume/ ha), for forests >140 years only on the coast (Vancouver Island and GBR).

The PSPL dataset gives a very different picture. Here there is little or no correlation between PSPL Site Index and standing biomass (vol/ ha) for stands >140 years in age (Figure 2). This lack of relationship may or may not be surprising, but irrespective, it clearly notes that the PSPL does not reflect current condition of standing biomass of the stand that is present today. We also suggest this raises important questions about the use of PSPL to determine future harvest levels, but that is a different conversation.

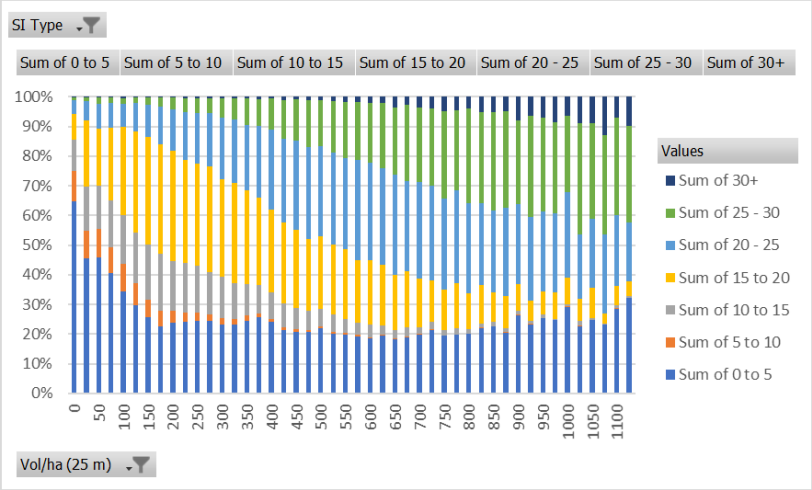

Figure 2. PSPL Site Index classes and Standing Biomass (Volume/ ha), for forests >140 years only (Vancouver Island and GBR)

Conclusion: If the goal is to identify the best of the remaining large old(er) forests for protection:

- Inventory Site Index is an appropriate data source for stands >140 years in age, as site index classes are strongly related to standing biomass estimates measured as vol/ ha.
- It is irrelevant that inventory site index tends to under-estimate productivity for older stands, because there is no evidence that the **relative** site index is incorrect, nor is the site index measure being used to suggest potential future growth if the old forest is harvested.

- Inventory site index is considered to be accurate in the 30-140 age class (Sunde et al. 2020[23]), and the relationship to standing biomass via growth and yield curves generally holds for this age range. Inventory Site Index is, therefore, an appropriate data layer to use to assess recruitment stands for representativeness of both productivity and standing biomass within this age range.
- PSPL data are not an appropriate data layer to assess current relative conservation value of a stand, particularly older forest stands today. This is not a criticism of the PSPL data set, but PSPL data appear completely inappropriate to differentiate between old or mature forest stands with regard to their potential utility for conservation today as there appears to be little to no relationship with current condition.
- PSPL MAY[24] be a useful data layer for assigning recruitment stands in very young (<30 yrs.) stands but there are additional concerns about the data that should be evaluated.

However, in the bigger picture, the question is not about the growth potential of sites, it is about the values and attributes of the stand on the site today. That is likely better reflected using stand attributes available in VRI. We appreciate that none of the strategic data layers are particularly accurate and reflect that this is simply one of the outcomes of having a forest management program that has not focused on biodiversity or ecological health. However, we suggest that these attributes, combined with obvious information in the field, can be used to appropriately defer and manage for old and recruitment forests in BC, should we collectively choose to do so.

[23] Sunde et al. 2020. Assessing Site Productivity and Tree Species in Great Bear Rainforest Landscape Reserves J. Sunde, R. De Jong, S.C. Saunders, P. Dykstra, R. Cotton. Draft Report Dec 9, 2020.

[24] However, because SIBEC/PSPL shifts the mean and shape of the SI curve, attempting to hybridize these datasets may be akin to mixing apples to oranges and making grapefruits.