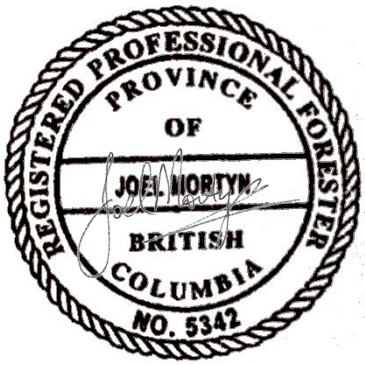
Ćawak ʔqin Forestry

TECHNICAL SUMMARY OF OLD GROWTH FORESTS IN TFL 44

APRIL 2022

Joel Mortyn, RPF



EXECUTIVE SUMMARY

This report summarizes the area and quality of old growth forests that exist today in TFL 44 using the best available information. The analysis was completed at the request of Cʼawak ʔqin Forestry in order to provide objective information on priorities for short-term conservation, while a detailed approach to old growth management is developed through the Hišuk ma cʼawak Integrated Resource Management Plan. The findings are as follows:

Overall Profile

- Close to one third (32% or 38,672 ha) of all forest in TFL 44 is old growth.
- Old growth is projected to increase to 39% (46,710 ha) over the next 250 years in the absence of major natural disturbances.
- 76% of current old growth in TFL 44 is formally protected or outside of the timber harvesting land base.

By BEC Variant

- All biogeoclimatic ecosystem classification (BEC) variants in TFL 44 have >10% old growth, the threshold used by the Old Growth Technical Advisory Panel to define remnant forest.
- The driest BEC variant (CWHxm2) has the lowest proportion of old growth (14%) but is forecast to increase to 37% over the next 250 years in the absence of natural disturbance.
- At a coastal scale, the CWHxm2 BEC variant has 9% old growth.

By Stand Height

- Protected areas in TFL 44 capture proportionally more of the tallest old growth. As stand height increases from <10 m to >45 m tall, protected old growth increases from 4% to 62%.

By Site Productivity

- There is considerably more medium to high productivity old growth than has been claimed:
  - 25% of stands with a site index >25 m in TFL 44 are old growth as opposed to claims of 1% (Holt *et al.*, 2022a).
  - 29% of stands with a site index >20 m in TFL 44 are old growth as opposed to claims of 3% provincially (Price *et al.*, 2021).
  - Past claims used VRI site index data, which is well documented as underestimating the productivity of old growth forests (Nigh and Love, 1997; Nussbaum, 1998; Mah and Nigh, 2003; Mah and Nigh, 2015).
- Despite this, old growth is not as well represented on the highest productivity sites (9% old in stands with site index >30 m) as it is on lower productivity sites (45% old in stands with a site index <15 m). This does suggest that past harvest has had a greater influence on the highest productivity sites.
- Old growth in stands with site index >30 m is forecast to increase from 9% to 30% over the next 250 years as protected sites age over time, given current management assumptions and lack of major disturbances.

It is suggested that the following areas be a focus for old growth conservation in TFL 44 while the IRMP is developed:

- Old forest in the CWHxm2 BEC variant.
- High productivity old forests (>30 m site index) in all BEC variants.

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TABLE OF CONTENTS

Executive Summary i
Acknowledgements ii
Introduction 1
Methods 1
Age Class Profile 2
BEC Variant Profile 5
Stand Height Profile 8
Site Productivity (Site Index) Profile 9
  Site Index Backgrounder 9
  Site Index Profile of Old Growth Forests 12
Conclusions 13
References 14

LIST OF FIGURES

Figure 1 Age class distribution of forests in TFL 44 2
Figure 2 Age class distribution of forests in TFL 44 by status 3
Figure 3 Map of TFL 44 showing current forest status. 3
Figure 4 Age class distribution in TFL 44 now and in 250 years 4
Figure 5 BEC variants in TFL 44 showing percentage of forested area in each 5
Figure 6 Area of forest by BEC variant in TFL 44 including percentage of old forest 6
Figure 7 Percent of old forest by BEC variant today and in 250 years 6
Figure 8 Location of TFL 44 in relation to nearby parks and Landscape Units used in this analysis 7
Figure 9 Percentage of old forest by BEC variant within TFL 44, within TFL 44 and across the BC coast 8
Figure 10 Percent of old forest area in TFL 44 by BEC variant and protection class 8
Figure 11 Height distribution of old growth stands in TFL 44 including percent that is protected 9
Figure 12 Percent of old forest area in TFL 44 by stand height and protection class 9
Figure 13 Suggested site index methods to use at various ages (from Mah and Nigh, 2015) 10
Figure 14 Examples of ground sample validation of VRI site index (Nigh and Love, 1997) and PSPL site index (Nigh and de Jong 2015) 11
Figure 15 Site index distribution of TFL 44 including percentage of old growth forests. 12
Figure 16 Percent of old forest by site index class today and in 250 years 13
Figure 17 Percent of old forest area in TFL 44 by site index and protection class 13

INTRODUCTION

In February 2022, Cʼawak ʔqin Forestry Limited Partnership announced the intention to develop the Hišuk ma cʼawak Integrated Resource Management Plan (IRMP) for Tree Farm Licence (TFL) 44. Using the latest data, science and technology, the objectives for the IRMP are to:

- Create a common vision and direction for government-to-government land and resource management decisions.
- Inform provincially legislated processes such as Forest Landscape Plans and old-growth management.
- Inform on-the-ground operational planning.

A technical summary of the area and quality of existing old growth forest in TFL 44 was requested by Cʼawak ʔqin Forestry in order to help guide decisions around priority conservation areas while the IRMP is developed. This report utilizes the best available forest inventory information to summarize the current and projected future statuses of old growth forests in TFL 44.

METHODS

This report utilized the spatial inventory dataset detailed in the Management Plan #6 Information Package (Huang, 2021) to be used in the Timber Supply Analysis (TSA) for the provincial Chief Forester to determine the allowable annual cut under the Section 8 of the Forest Act.

Old growth was defined as per the Biodiversity Guidebook for coastal forests as stands >250 years old (BC Environment, 1995). In this report, the terms old growth, old growth forests and old forests are used interchangeably with the same meaning. Old growth forests are characterized by much more than age, including having a multi-layered canopy with gaps, species diversity and larger trees including dead trees (both fallen and standing). However, as there is not a consistently available metric to measure old growth characteristics across the land base, the age-based definition was applied, following the approach used in the Great Bear Rainforest Land Use Order (Government of BC, 2016).

Sites deemed to be incapable of growing a merchantable stand of trees were excluded. As per the provincial definition of Forest Management Land Base, stands with a site index[1] <5 m were excluded (Government of BC, 2022), with the exception of stands >250 years of age having a volume of >200 m^3/ha[2].

Stand heights were evaluated using Light Detection and Ranging (LiDAR) rather than inventory estimates[3]. LiDAR is widely considered a more accurate measurement of height than inventory height (Tompalski *et al.*, 2021), as it is directly measured using an aerial laser rather than manually from aerial photographs.

Protected stands were considered those designated as Old Growth Management Areas, Wildlife Habitat Areas, Ungulate Winter Ranges, areas covered under the updated Marbled Murrelet Order (November 2021), archaeological sites and Government Actions Regulation recreation sites.

[1] Estimated stand height (m) at age 50.
[2] This is consistent with Cʼawak ʔqin Forestry's approach in the TFL 44 TSA.
[3] LiDAR data was collected for the entire TFL in 2016.

Data to evaluate the prevalence of old growth in different BEC variants in the vicinity of TFL 44 and across the BC coast utilized the dataset prepared by Forsite for their 2021 report summarizing the status of old growth in the province (Brown, 2021).

Future amounts of old growth were derived from the long-term planning model developed for the TFL 44 TSA reflecting planned harvest levels. Amounts of old growth were projected 250 years into the future, consistent with the approach established under the Great Bear Rainforest Order (Government of BC, 2016).

AGE CLASS PROFILE

There are 38,672 ha of old growth forests in TFL 44, representing 32% of the total area of forest (Figure 1).

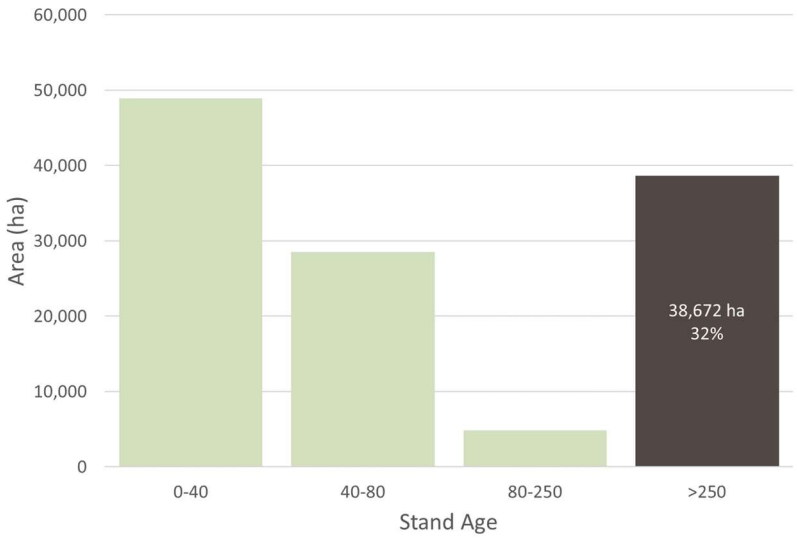

Figure 1 Age class distribution of forests in TFL 44

Over three quarters (76%) of old growth forests in TFL 44 are protected or outside of the timber harvesting land base (THLB) (Figure 2). This is significantly higher than across all age classes, where 36% of forests are protected or outside of the THLB (Figure 3). This demonstrates that protected forests in TFL 44 are predominantly old growth, with 85% of all protected forests in TFL 44 being old growth.

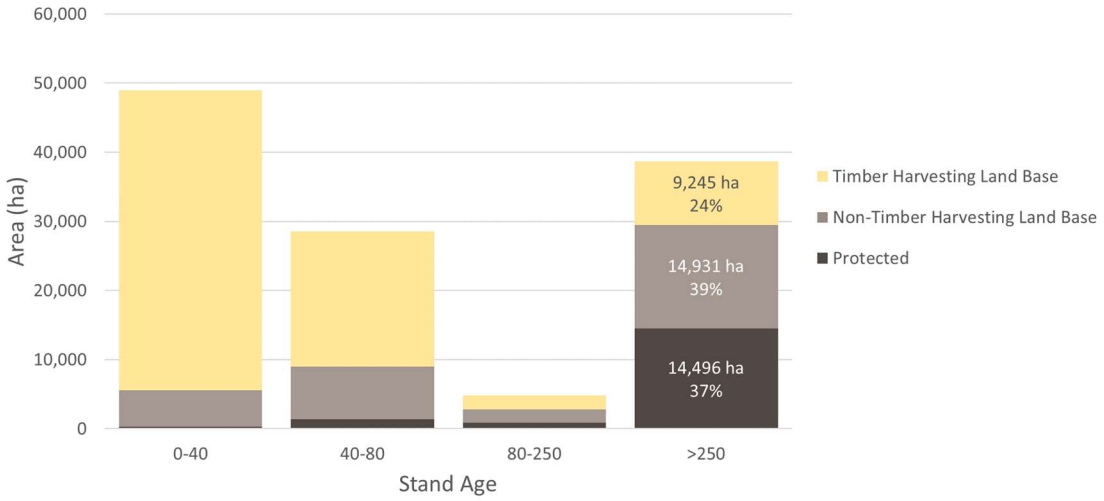

Figure 2 Age class distribution of forests in TFL 44 by status

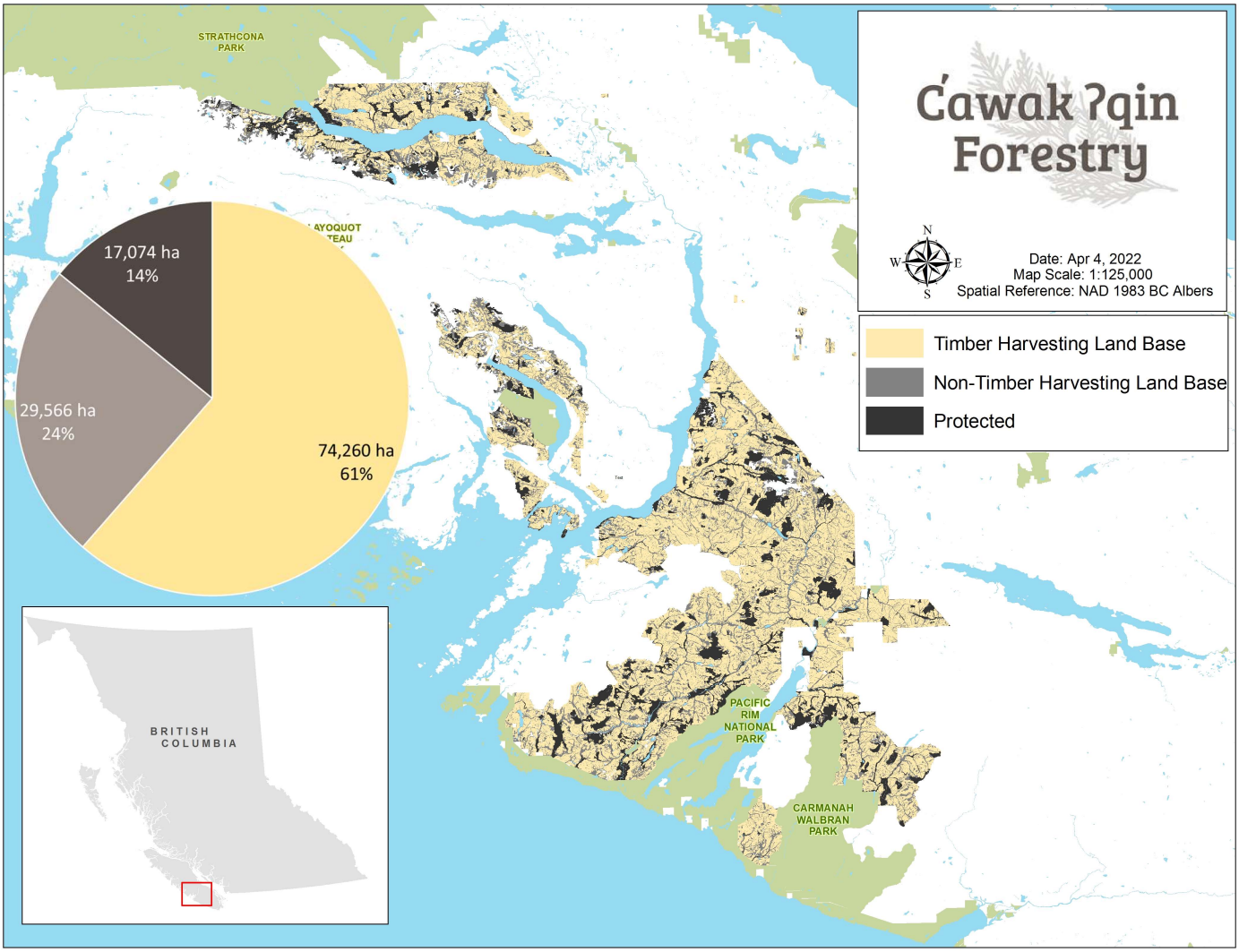

Figure 3 Map of TFL 44 showing current forest status.

Long-term planning models reflecting planned harvest levels and current levels of protection show that the area of old growth forest in TFL 44 will have increased in 250 years' time, assuming no major disturbances (Figure 4). In 250 years, the area of old growth in TFL 44 is forecast to increase to 46,710 ha, or 39% of the total area as younger stands outside of the THLB mature.

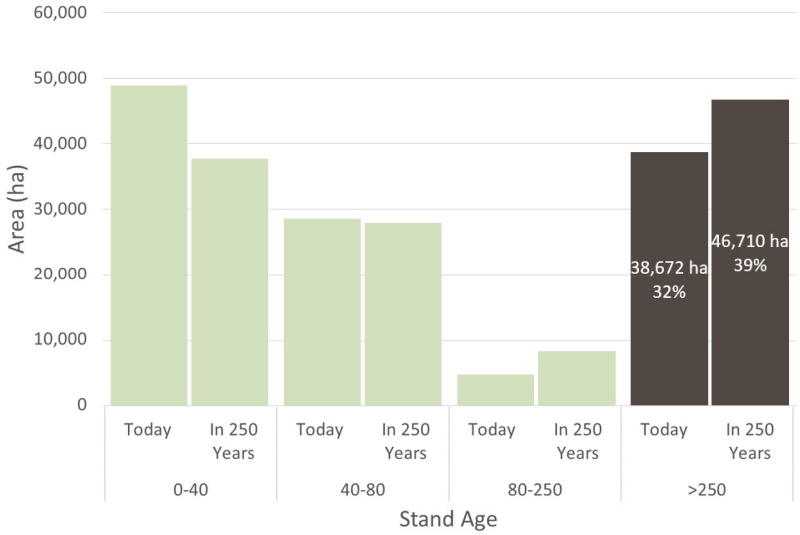

Figure 4 Age class distribution in TFL 44 now and in 250 years

BEC VARIANT PROFILE

TFL 44 is represented by eight different Biogeoclimatic Ecosystem Classification (BEC) variants[4] (Biogeoclimatic Ecosystem Classification Program of British Columbia, 2012), with CWHvm1 representing 57% of the forested area (Figure 5).

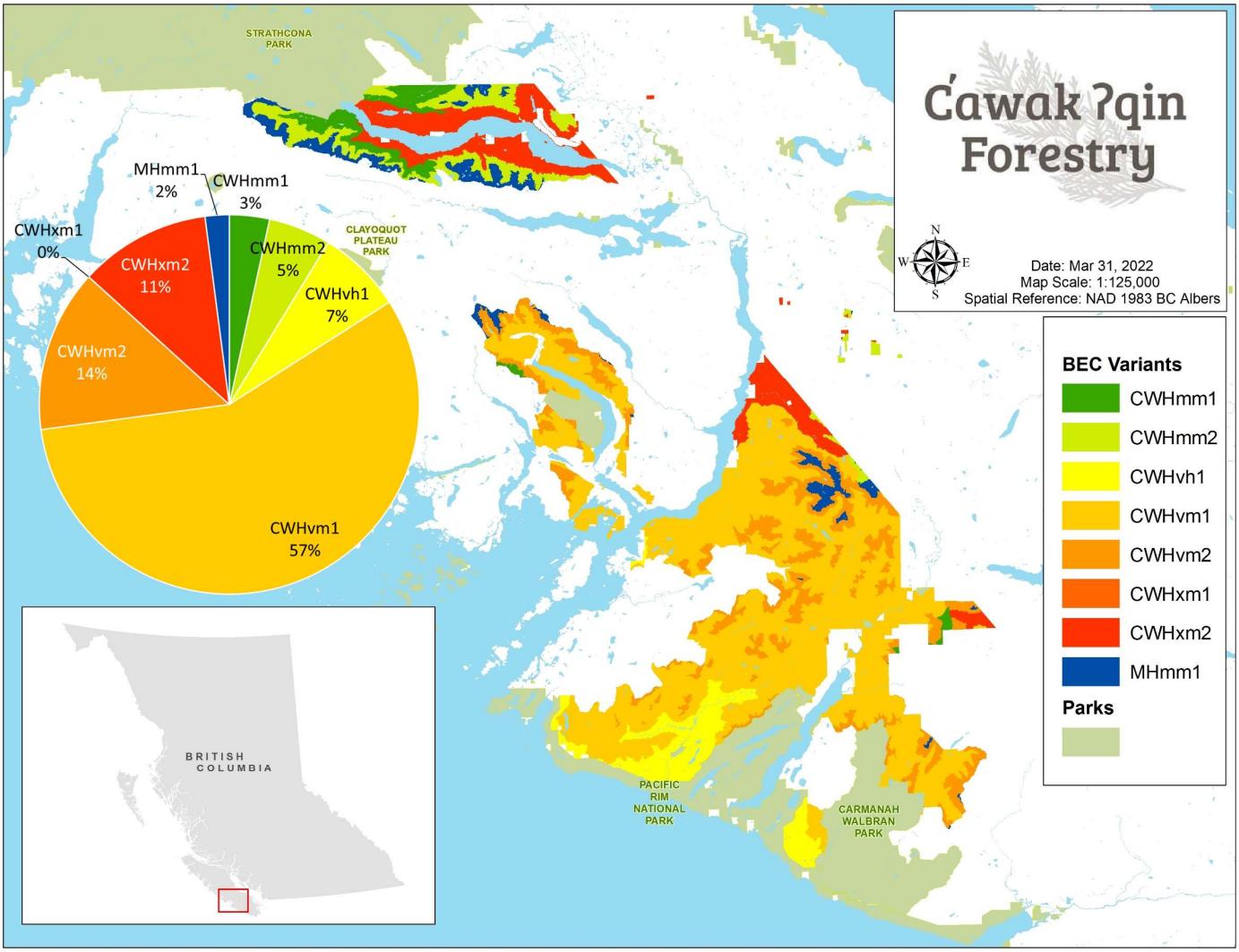

Figure 5 BEC variants in TFL 44 showing percentage of forested area in each

All BEC variants have >10% old forest, which is above the threshold used by the Old Growth Technical Advisory Panel (TAP) to classify as remnant forest (Figure 6) (Merkel *et al.*, 2021). The two most prevalent BEC variants (CWHvm1 and CWHvm2) contain 25% and 51% old forest respectively. The CWHxm2, which is the driest BEC variant in TFL 44, has the lowest percent of old forest (14%).

[4] Based on Terrestrial Ecosystem Mapping for TFL 44.

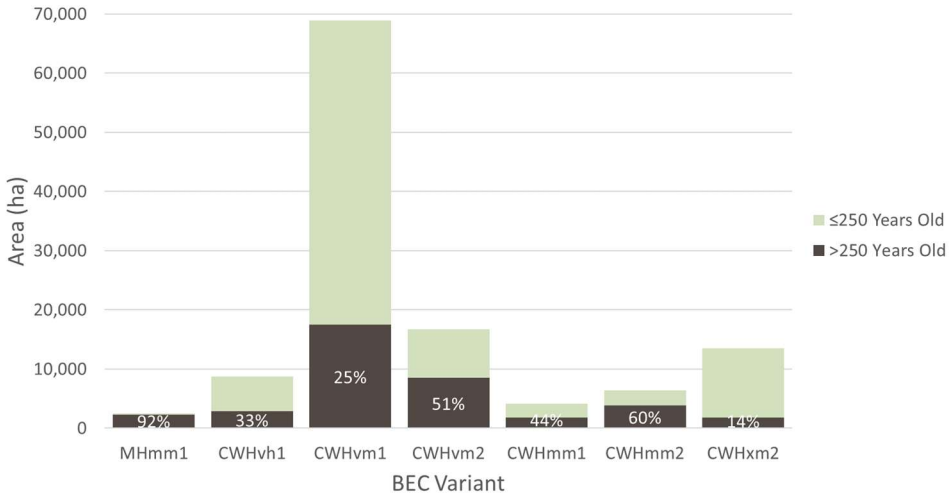

Figure 6 Area of forest by BEC variant in TFL 44 including percentage of old forest[5]

The area of old growth forest is projected to almost triple in the CWHxm2, from 14% today (1,846 ha) to 37% (5,038 ha) in 250 years (Figure 7), assuming current levels of protection and lack of major disturbances. This suggests that there are significant areas for old growth recruitment in the CWHxm2; younger stands that are protected or outside of the timber harvesting land base that will mature into old growth over time.

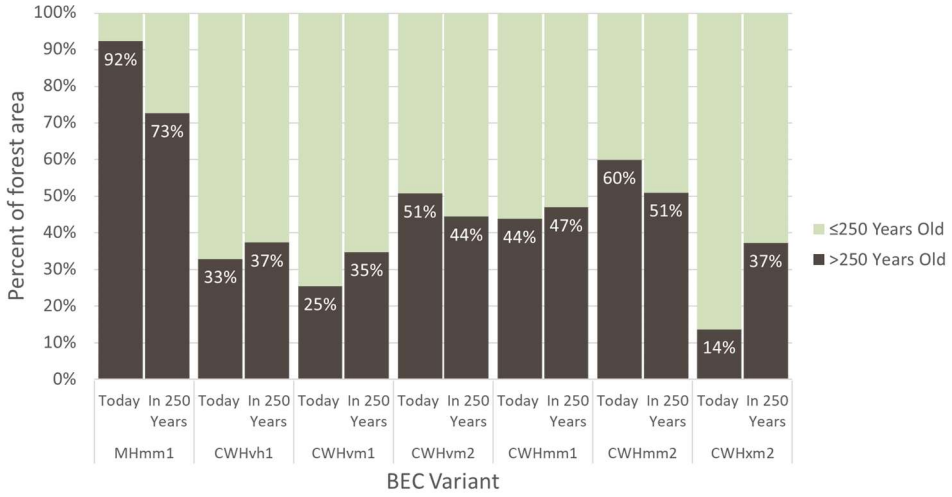

Figure 7 Percent of old forest by BEC variant today and in 250 years

If we limit the scope of this analysis to the TFL boundary, it ignores the fact that there are significant areas close by that are in parks and protected areas, many of which were historically part of the TFL (Figure 8). Nearby parks include Pacific Rim National Park, Carmanah Walbran Provincial Park, Strathcona Provincial Park and the Clayoquot Special Management Zone, which contain many of the same BEC variants and considerable areas of old growth. If we expand the scope to Landscape Units within and in the vicinity of TFL 44, the percentage of old growth forest

[5] CWH xm1 contains <15 ha of productive forest for the entire TFL, so is excluded from charts. Of this area, only 4 ha is within the THLB.

increases for most BEC variants (Figure 9). In the CWHxm2 specifically, 24% of the forested area is old growth within TFL 44 and nearby Landscape Units.

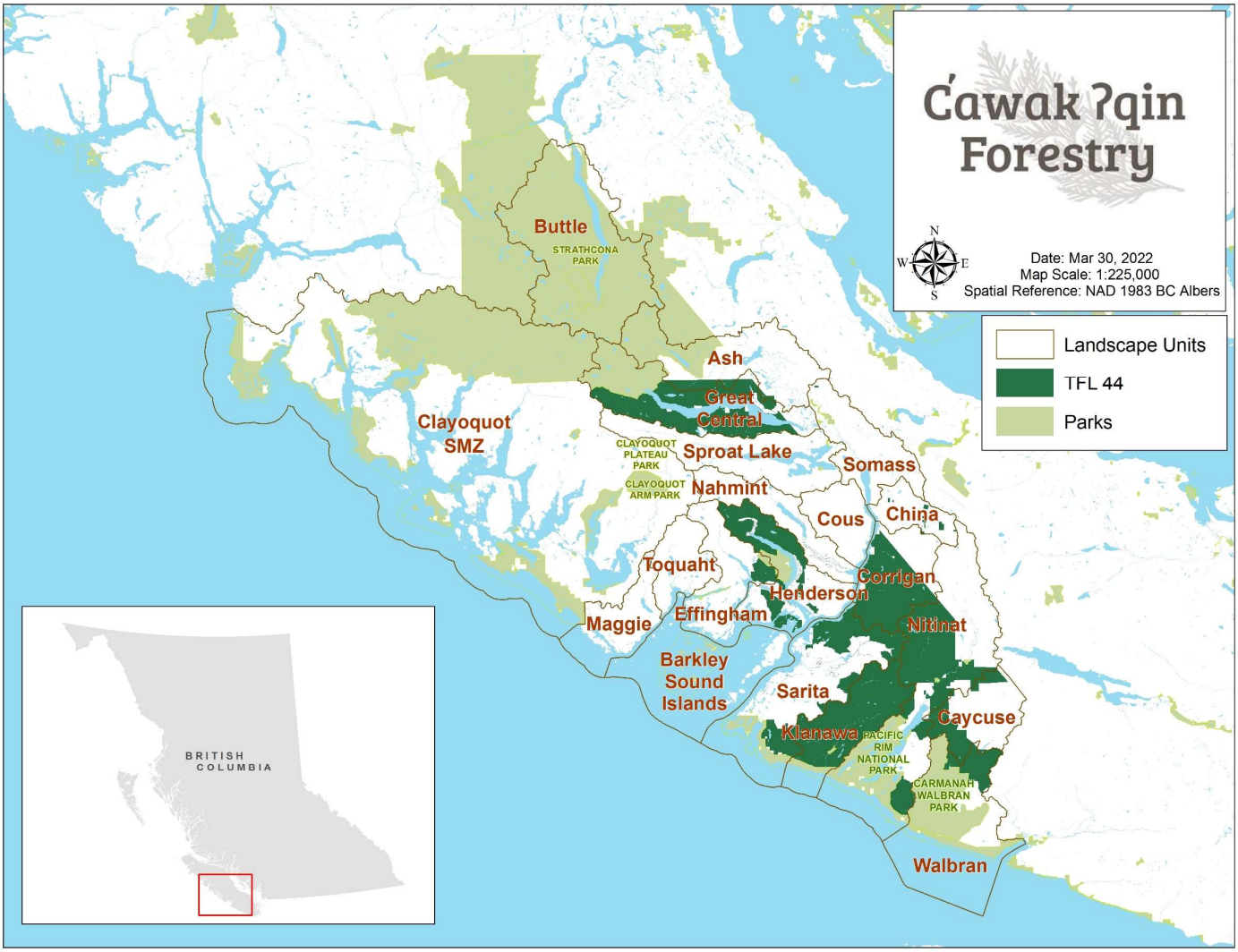

Figure 8 Location of TFL 44 in relation to nearby parks and Landscape Units used in this analysis

If we expand even further to all crown forest across the BC coast, there is a lower percentage (9%) of old growth in the CWHxm2 (Figure 9).

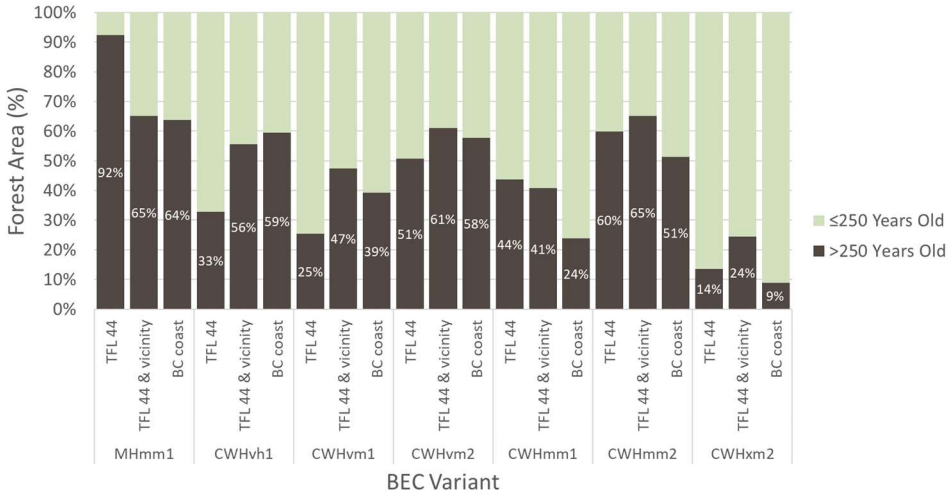

Figure 9 Percentage of old forest by BEC variant within TFL 44, within TFL 44 and across the BC coast

For each BEC variant in TFL 44, the vast majority (72%-84%) of old forest is either protected or outside of the timber harvesting land base (Figure 10). Within the CWHxm2 specifically, 62% of the old growth forest area is protected and a further 21% is outside of the timber harvesting land base.

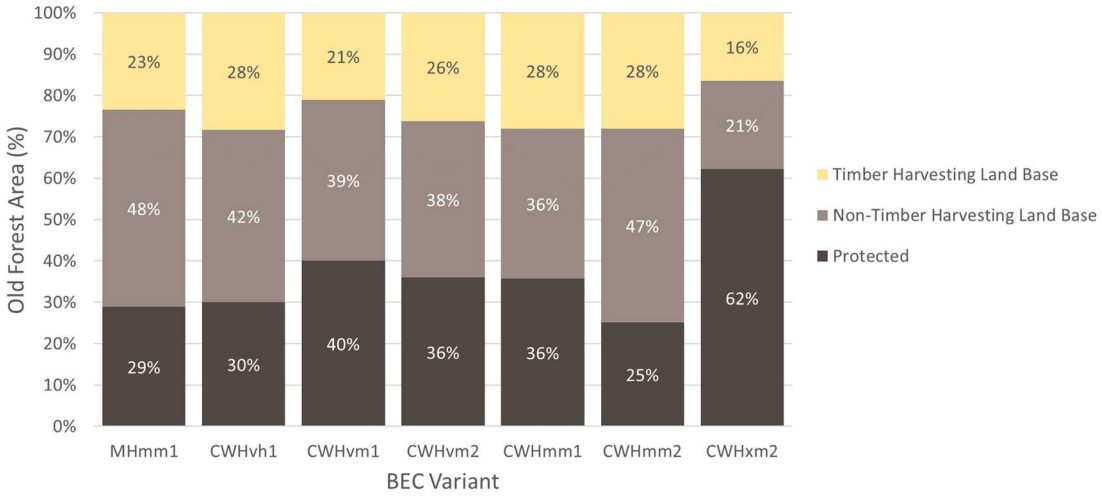

Figure 10 Percent of old forest area in TFL 44 by BEC variant and protection class

STAND HEIGHT PROFILE

For forests of equivalent maturity, stand height is a good measure of the productivity of the growing site. Old growth stands in TFL 44 range from <10 m to >50 m tall (Figure 11). Protected areas capture proportionally more of the best growing sites; as stand height increases, the percent of protected old growth increases from 4% (<10 m tall) to 62% (>45 m tall).

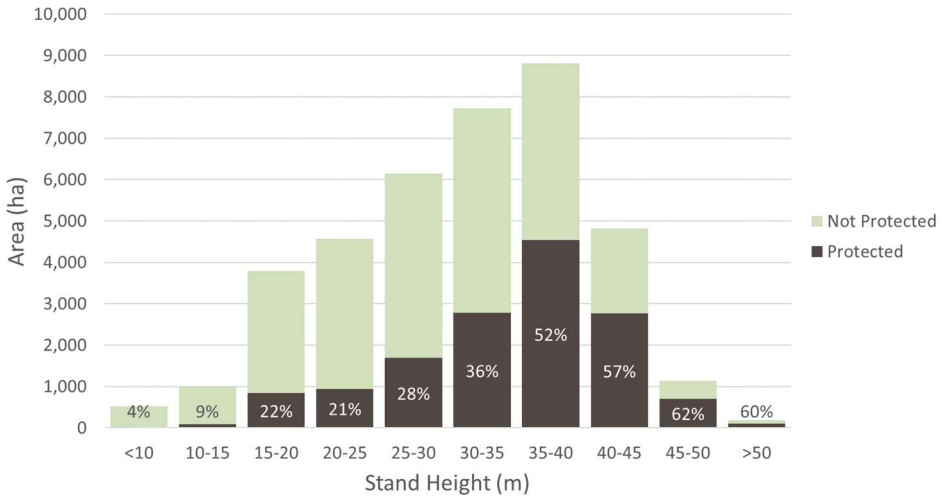

Figure 11 Height distribution of old growth stands in TFL 44 including percent that is protected

Relatively few of the tallest stands are within the THLB. For stands >45 m, just 15% are within the THLB. (Figure 12).

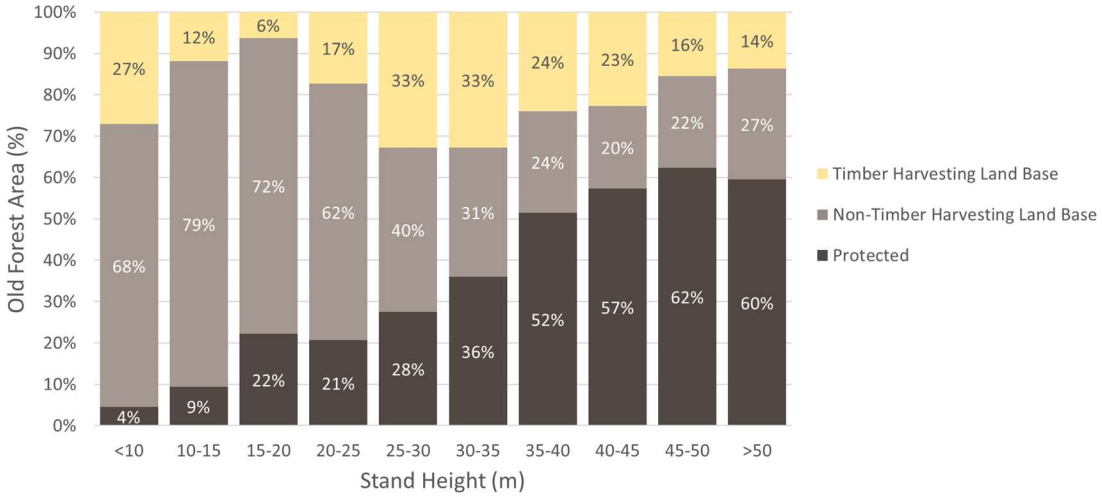

Figure 12 Percent of old forest area in TFL 44 by stand height and protection class

SITE PRODUCTIVITY (SITE INDEX) PROFILE

The height distribution of old growth does not address whether it is representative of the historic stand height/productivity profile. In order to determine if the highest productivity stands have been disproportionately harvested, it is necessary to stratify the entire land base by site productivity and then assess the amount of old growth in each class. However, due to confusion surrounding old growth site productivity in BC, a backgrounder on how it is measured is warranted.

Site Index Backgrounder

The measure of site productivity in BC is referred to as site index and is an estimate of how tall a healthy stand would be at age 50. For example, a stand of trees 20 m in height at age 50 is considered to have a site index of 20. Because site index is measured at exactly age 50, older and

younger stands require curves to estimate site index. These curves are generally built from stands under 150 years of age, so extrapolations for very old stands have high levels of uncertainty.

In BC's Vegetation Resource Inventory (VRI), each stand of trees has its height determined using stereo photography and its age estimated based on cues in the photography (height, site conditions, stand structure, etc.). Ages for old stands are very difficult to estimate from photography and get increasingly inaccurate with actual stand age (Merkel *et al.*, 2022). Inaccurate ages for old growth stands further adds uncertainty to VRI site index values, as does the reality that old growth stand heights may not reflect true growth potential due to impacts from wind, pests and disease over 250+ years (Stearns-Smith, 2001).

In the late 1990s, evidence showed that second growth stands were growing at much faster rates than the site index assigned to the previous old growth stand. This should not occur if the site index is accurate. Site index is, by definition, the inherent growing potential of the site and should be stable irrespective of whether the stand is old growth or second growth.

This led to a flurry of research on the topic. Second growth hemlock stands were found to have an average site index 11.3 m higher than old growth stands on the same sites, an 82% increase (Nigh and Love, 1997). Adjustment factors were developed to correct for the under-estimation in old growth site index (Nussbaum, 1998), and this work ultimately led to the development of a new site index layer based on fine scale ecosystem classifications, known as SIBEC and later the Provincial Site Productivity Layer (PSPL) (Mah and Nigh, 2003; Mah and Nigh, 2015). Follow up validation against ground plots found the PSPL site index estimates to be generally accurate (Nigh and de Jong, 2015). Due to issues identified in VRI site index, the BEC based site index (PSPL) is the provincially recommended method for estimating site index in old growth stands (Figure 13) (Mah and Nigh, 2015).

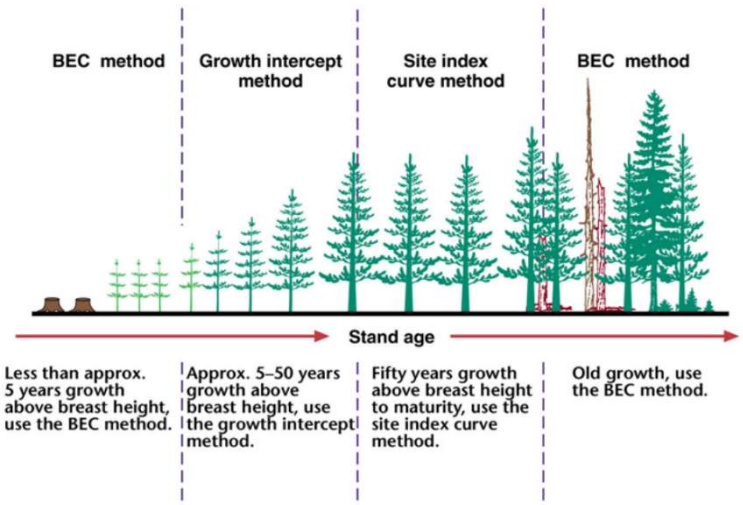

Figure 13 Suggested site index methods to use at various ages (from Mah and Nigh, 2015)

In recent years, site index has been used to raise concern about how much highly productive old forest remains in BC, with often repeated claims that 3% of stands with site index of >20 m are old growth and <1% of stands with a site index >25 m are old growth (Price *et al.*, 2021). More recently, it has been suggested that just 1% of stands with a site index >25 m in TFL 44 are old

growth (Holt *et al.*, 2022a). These claims are based on the VRI site index without applying the adjustments that were developed to account for its known under-estimation in old growth. If proponents wish to compare the site productivity of old versus young stands using VRI site index, then adjustment factors based on the published research to account for the underestimation in old forests must be applied.

Recently, the TAP suggested that VRI site index performed better at predicting tree height in old growth stands than PSPL site index (Merkel *et al.* 2022). They used the coefficient of determination statistic (r^2) and found a higher correlation between the VRI site index and ground samples than the PSPL site index. However, the r^2 statistic is not a measure of accuracy but rather precision (Lin and Torbeck, 1998). The accuracy of VRI site index estimates in old growth stands was the issue identified, not the precision. Indeed, published examples of ground validation of VRI and PSPL site index estimates are textbook examples of the difference between accuracy and precision (Figure 14).

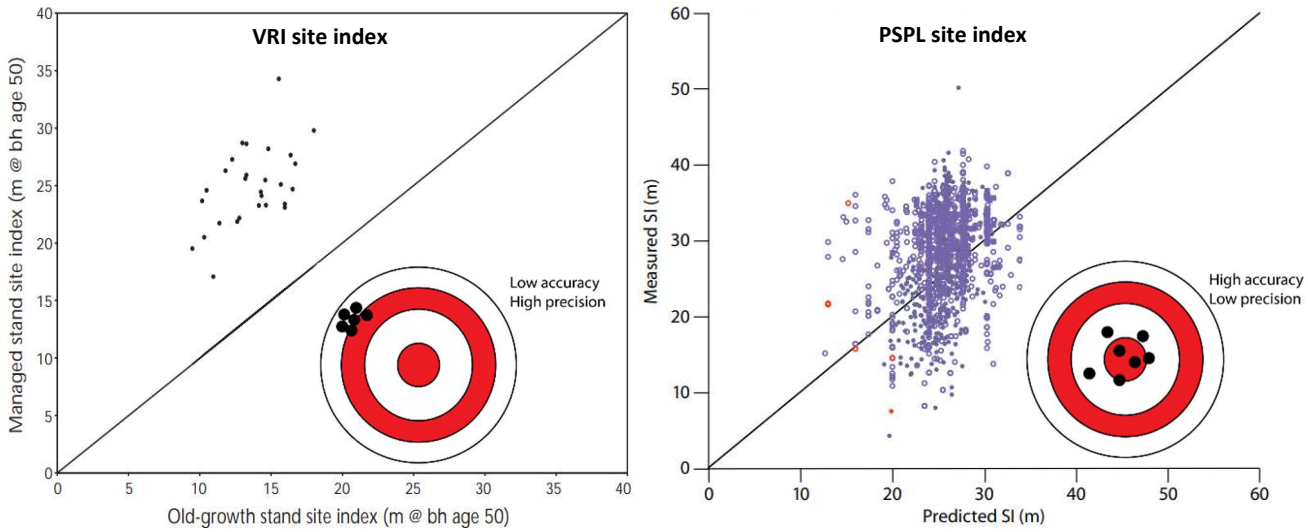

Figure 14 Examples of ground sample validation of VRI site index (Nigh and Love, 1997) and PSPL site index (Nigh and de Jong 2015)

It should come as no surprise that the TAP found VRI site index to be more precise than PSPL in old growth stands. After all, it was developed by photo interpreters reviewing each stand, so predictions will be correlated with the underlying stand attributes. In contrast, PSPL is an indirect estimate based on the BEC classification and therefore will be less correlated to specific sites.

This is not to suggest that VRI site index is more precise than PSPL overall. While we know that VRI estimates are inaccurate for old growth stands, we also know that they are not consistently inaccurate across all ages. Young stands in the VRI tend to have more accurate site index estimates because they are closer to 50 years of age and/or they have been assigned a PSPL site index.

For this analysis, where we are comparing the relative productivity of old versus young stands, then the accuracy of the predictions is critical. The PSPL was used as it has been found to be unbiased and is the provincially recommended approach for old forests. In TFL 44, where

Terrestrial Ecosystem Mapping (TEM) has been completed giving a high quality ecological inventory, PSPL would be expected to be even more accurate compared to other parts of the province where TEM is not available.

Site Index Profile of Old Growth Forests

An evaluation of the distribution of old forests by site index in TFL 44 indicates that old forests are under-represented in higher productivity sites (Figure 15). For the highest site productivity class (>30 m), 9% of stands are old growth. Conversely, 45% of sites with a productivity of <15 m are old growth. However, there is considerably more high productivity old growth than has been claimed:

- 25% of stands with a site index >25 m in TFL 44 are old growth as opposed to claims of 1% (Holt *et al.*, 2022a).
- 29% of stands with a site index >20 m in TFL 44 are old growth, whereas just 3% has been claimed to exist across the province (Price *et al.*, 2021).

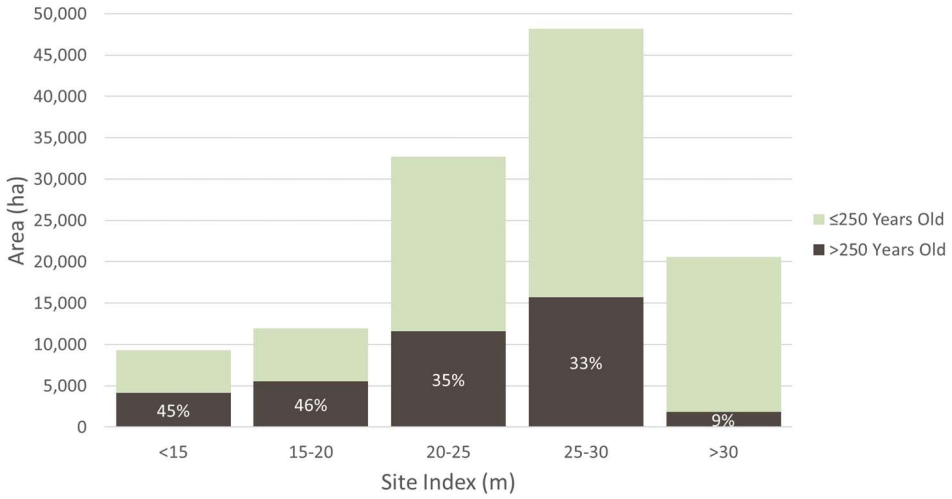

Figure 15 Site index distribution of TFL 44 including percentage of old growth forests.

The area of old growth forest in stands with a site index >30 m is expected to more than triple over the next 250 years, from 9% today to 30% (Figure 16). This is a result of areas set aside from harvesting that are currently <250 years old maturing into old growth over time.

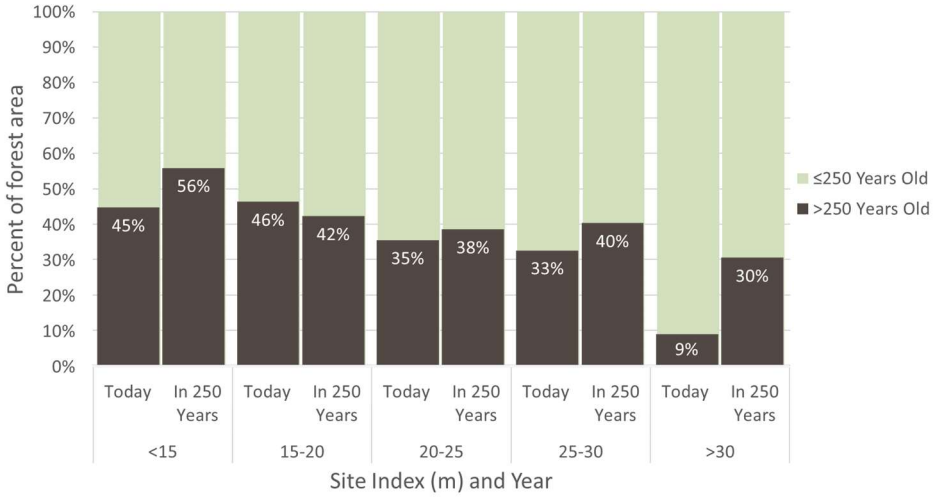

Figure 16 Percent of old forest by site index class today and in 250 years

As site index increases, the percentage of old forest that is protected steadily increases (Figure 17). 62% of old forest with a site index >30 m is in protected areas versus 28% of old forest with a site index of <15 m. When we also consider land that is outside of the THLB, 83% of old forest with a site index of >30 m is either protected or outside of the THLB.

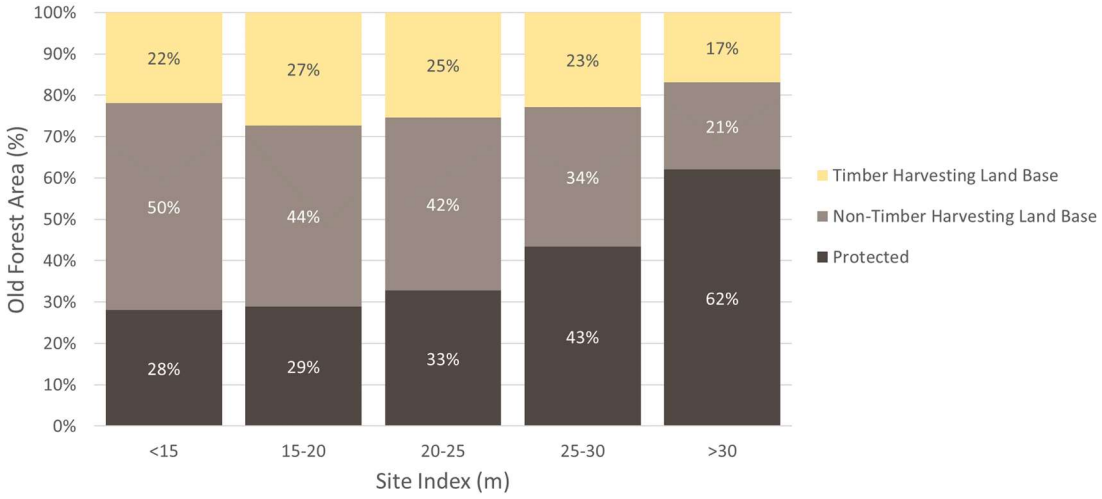

Figure 17 Percent of old forest area in TFL 44 by site index and protection class

CONCLUSIONS

This report summarizes the current status of old growth forests in TFL 44 in order to provide objective information to help guide short-term conservation decisions for old growth forests within TFL 44 while the IRMP is being developed.

Old growth forests are not at risk of disappearing in TFL 44: 32% of forests are old growth (38,672 ha) and they are projected to increase to 39% (46,710 ha) in 250 years' time. Over three-quarters of the old growth is either formally protected or outside of the timber harvesting land base.

All BEC variants in TFL 44 have >10% old growth, the threshold used by the Old Growth Technical Advisory Panel to define remnant forest (Merkel *et al.*, 2021). The driest variant (CWHxm2) has the lowest percentage of old forest (14%), although this is projected to almost triple in the next 250 years. This demonstrates that reserves and areas outside the THLB include young stands that will provide future old growth recruitment.

In TFL 44 and nearby areas, there is a higher percentage of old growth in most BEC variants than within TFL 44 alone, including in the CWHxm2 (24%). This is a result of the high conservation focus in the vicinity of TFL 44 including the Pacific Rim National Park, Carmanah Walbran Provincial Park, Strathcona Provincial Park and the Clayoquot Special Management Zone. At the coastwide scale, there is just 9% old growth remaining in the CWHxm2 BEC variant. It is therefore suggested that old growth within CWHxm2 in TFL 44 should be considered high priority for conservation during development of the IRMP.

Levels of old growth protection increase with stand height in TFL 44. As stand height increases, the percent of protected old growth increases from 4% (<10 m tall) to 62% (>45 m tall). It has been suggested that much of the remaining old growth consists of small trees growing in “bog forests” (Holt *et al.*, 2022b). For TFL 44 this is not a valid assertion, given the majority of old growth stands are >32 m tall when measured using LiDAR.

The proportion of old growth declines as site productivity increases. In stands with a site index of >30 m, there is 9% old growth versus 45% in stands with a site index <15 m. While there is considerably more old growth in high productivity sites than has been recently claimed: 25% has a site index >25 m versus 1% (Holt et al., 2022a), this does indicate that past harvest has had a greater influence on the highest productivity sites. High productivity old growth within TFL 44 should therefore be considered for conservation during development of the IRMP.

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