

An Introduction to Stand-Level Retention Evaluation under FREP

FREP 101 – February 16th , 2023

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Overview

- What is Stand-Level Retention?
- Why is it Important?
- How do we Manage for Stand-Level Retention in BC?
- How do we Evaluate Stand-Level Retention Practices?
 - The Revised FREP Stand-Level Retention Protocol
 - Preliminary Results

What is Stand-Level Retention?

Standing live and dead trees or downed wood left behind or retained on site at the time of forest harvesting.

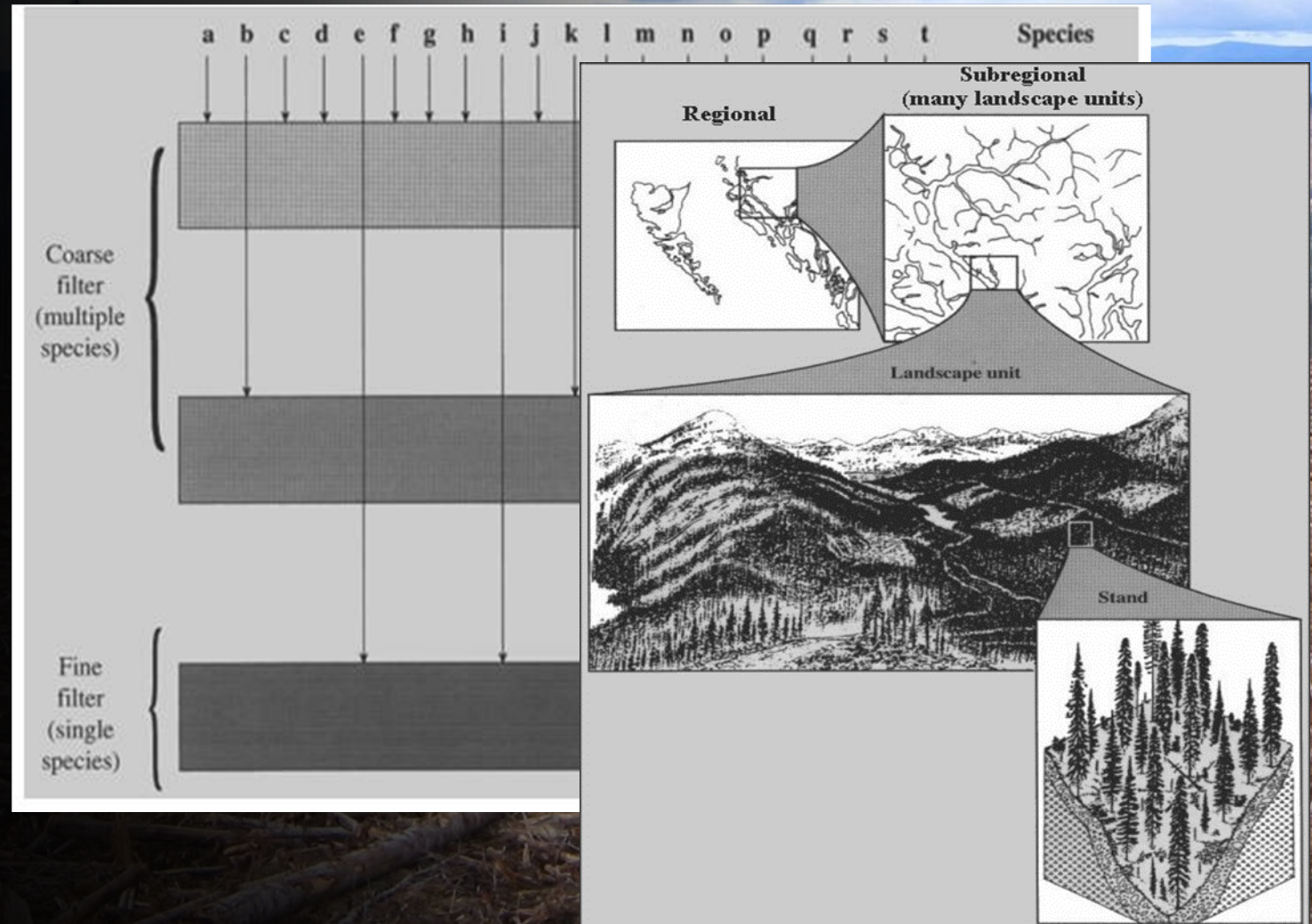
- **Wildlife trees** - a tree or a group of trees that are identified in an operational plan to provide present or future wildlife habitat. (Operational Planning Regulation, Section 1)*
- **Wildlife Tree Retention Area (WTRA) or Wildlife Tree Patch (WTP):** an area/patch of trees with special characteristics that provide valuable habitat for the conservation and enhancement of wildlife.*
- **Coarse Woody Debris** – dead woody material >10cm diameter in all stages of decay including above-ground logs, bucking waste, exposed roots and large fallen branches.**

* Provincial Wildlife Tree Policy, 2000 <https://www.for.gov.bc.ca/hfp/publications/00034/wltpolicyfinalmay15-00.pdf>

**Provincial Coarse Woody Debris short-term strategy, 2000.

What is Stand-Level Retention?

- Stand-level wildlife tree and CWD retention are coarse-filter biodiversity conservation tools.*
- Natural Disturbance-based approach
- More that forest practices resemble patterns of natural disturbances, more likely that biodiversity will be maintained.



*BC Ministry of Forests and BC Ministry of Environment. 1995. Biodiversity Guidebook

Why is Stand-Level Retention Important?

Residual trees provide **Ecosystem memory**- the adaptations, individuals, and materials that persist after a disturbance and shape responses to future disturbances. *

Disturbance legacies* – biologically derived legacies that persist in an ecosystem or landscape following a disturbance**

- **Information legacies** – responses (adaptations) to historical disturbance cycles, described by the presence, frequency, and distribution of species traits in a community or population **
- **Material legacies** – individual or matter (e.g. survivors, seeds, dead trees, nitrogen pools) present in an ecosystem after a disturbance event**

*Biological legacies- defined as organisms, organic materials, and patterns that persist through a disturbance (Franklin et al. 2000)

** Johnstone et al. 2016. Changing disturbance regimes, ecological memory and forest resilience. *Frontiers in Ecology and Environment* 14(7)

Residual snags, CWD and natural regeneration 20 years following a wildfire near Kamloops, BC

Why is Stand-level Retention Important?

- Forest resilience is shaped by ecosystem memory*
- Disturbance legacies may persist for decades to centuries:
 - Shape future disturbances,
 - and shape how ecosystems respond to future disturbance events.



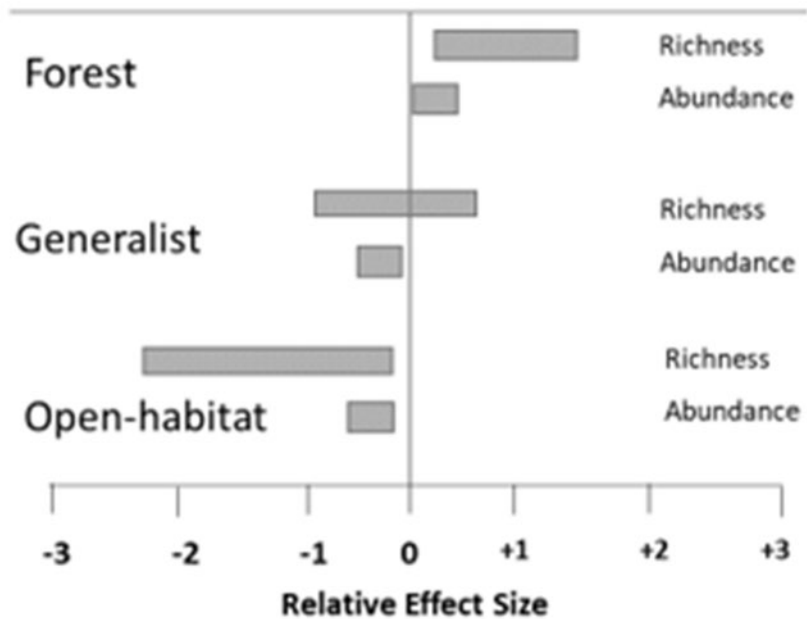
Natural Douglas fir regeneration in a burned area adjacent to an unburned patch 20 years following a wildfire near Kamloops BC

* Johnstone et al. 2016. Changing disturbance regimes, ecological memory and forest resilience. *Frontiers in Ecology and Environment* 14(7)

Mountain caribou tracks moving between residual trees in a 30 yr. old high elevation ESSF block near Blue River, BC. Caribou utilized the abundant arboreal lichens that accumulated on residual trees after harvest.

Why is Stand-Level Retention Important?

Effect of Retention Cuts on Species Richness and Abundance Compared to Clearcut Controls
(adapted from Fedrowitz et al. 2014)



How do we Manage for Stand-level Retention? The Broader Landscape Context

- Landscape context refers to the condition of the forested land-base surrounding and immediately adjacent to a cutblock being evaluated.
- 'Landscape' defined by the Landscape Unit (LU) and Biogeoclimatic subzone (BEC Unit) combination in which the cutblock being evaluated falls
- Landscape context is important and determines what is necessary and appropriate for stand-level retention (Beese et al. 2019).
- Retention requires planning!



Landscape and stand-level retention following Mountain Pine Beetle salvage harvesting , Chase Creek BC

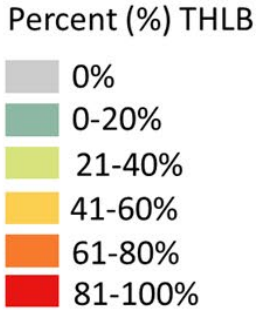
Why is Landscape Context Important?

- Our level of management concern over loss of mature and old forest habitats changes with landscape context
 - Increased Timber Harvest Land-Base (THLB) means more chance our management activities will affect outcomes.
 - Increased disturbance means less and mature and old forest habitats.

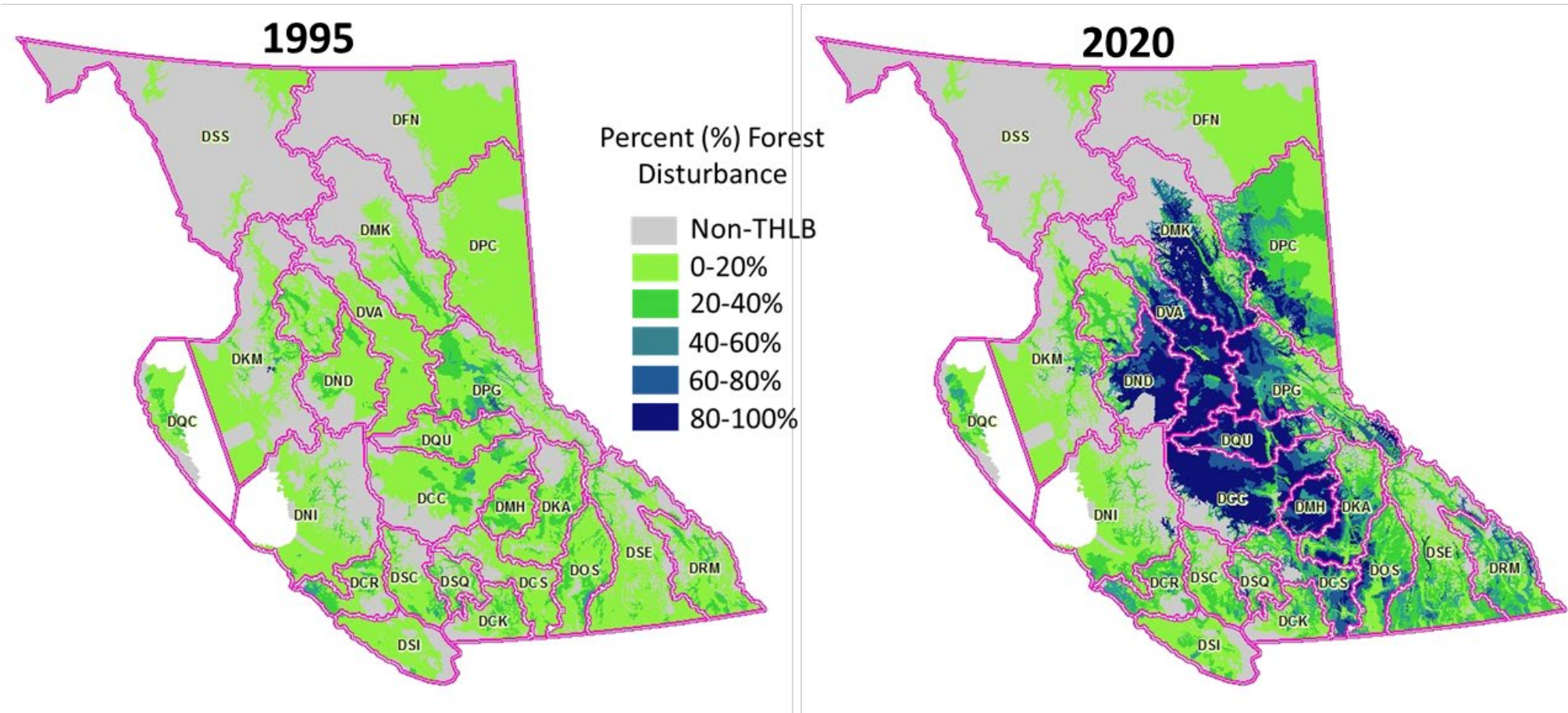
Level of Management Concern Related to Loss of Mature and Old Forest Habitats

	% Forest Disturbance (<40 years old) in the THLB					
		<20	20-40	40-60	60-80	>80
% THLB in LU/BGC Subzone	<20	Very Low	Very Low	Very Low	Low	Low-Mod
	20-40	Very Low	Very Low	Low	Low-Mod	Moderate
	40-60	Low	Low	Low-Mod	Moderate	High
	60-80	Low-Mod	Low-Mod	Moderate	High	Very High
	>80	Low-Mod	Moderate	High	Very High	Very High

Timber Harvesting Land Base

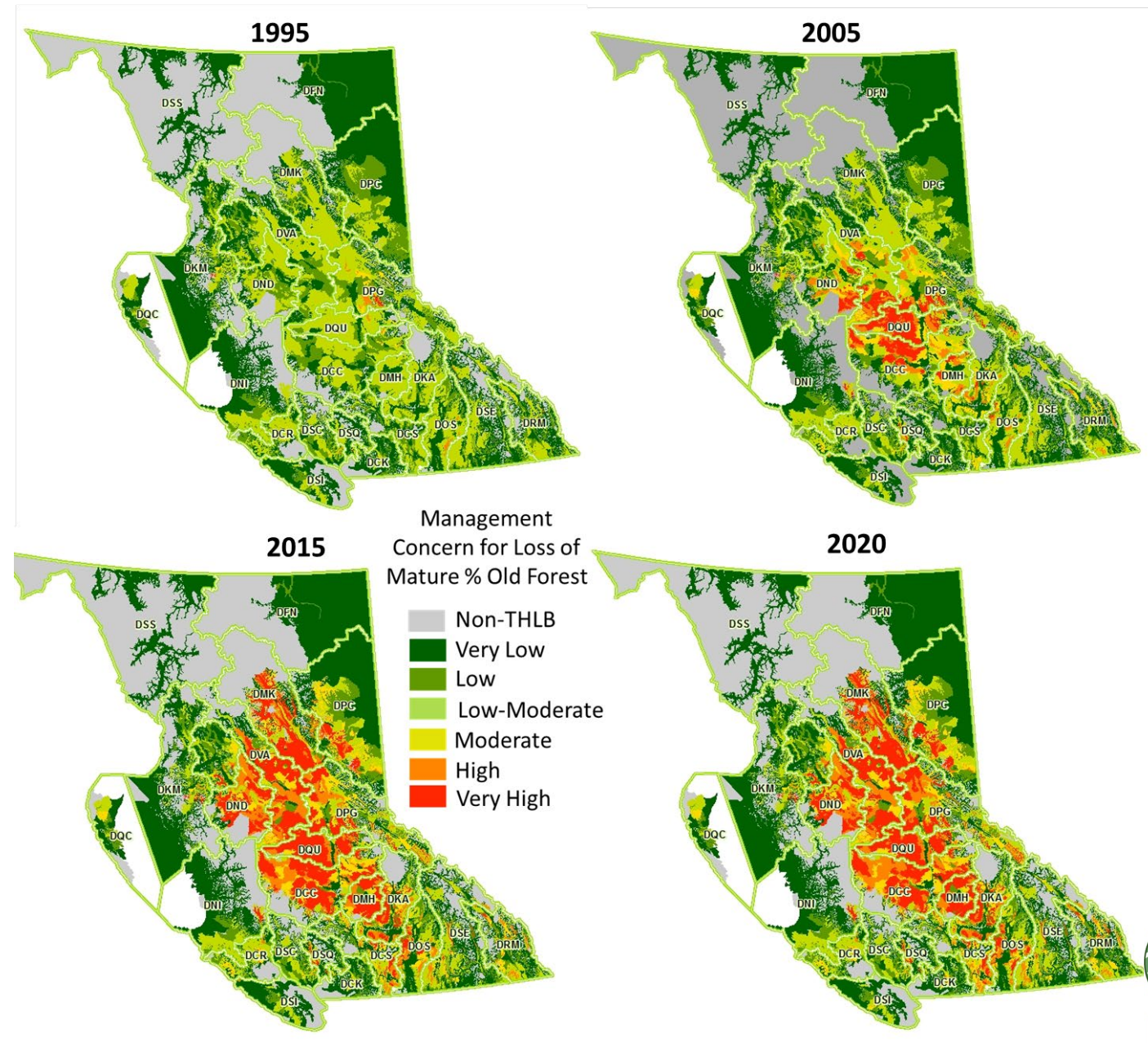


Landscape Context Changes Over Time With Disturbance (Harvesting, Insects, Wildfire)



Landscape Context Rating Changes Over Time

- Increased level of management concern in the interior
 - MPB, wildfire and associated salvage.
- Increased concern on parts of the Coast
 - History of forest management



How do we Manage for Stand-level Retention? The Broader Landscape Context

Management guidance recommends increased retention where:

- More of the landscape available for harvest and affected by disturbance.
- Amalgamation of cutblocks into larger openings – and larger areas disturbed.

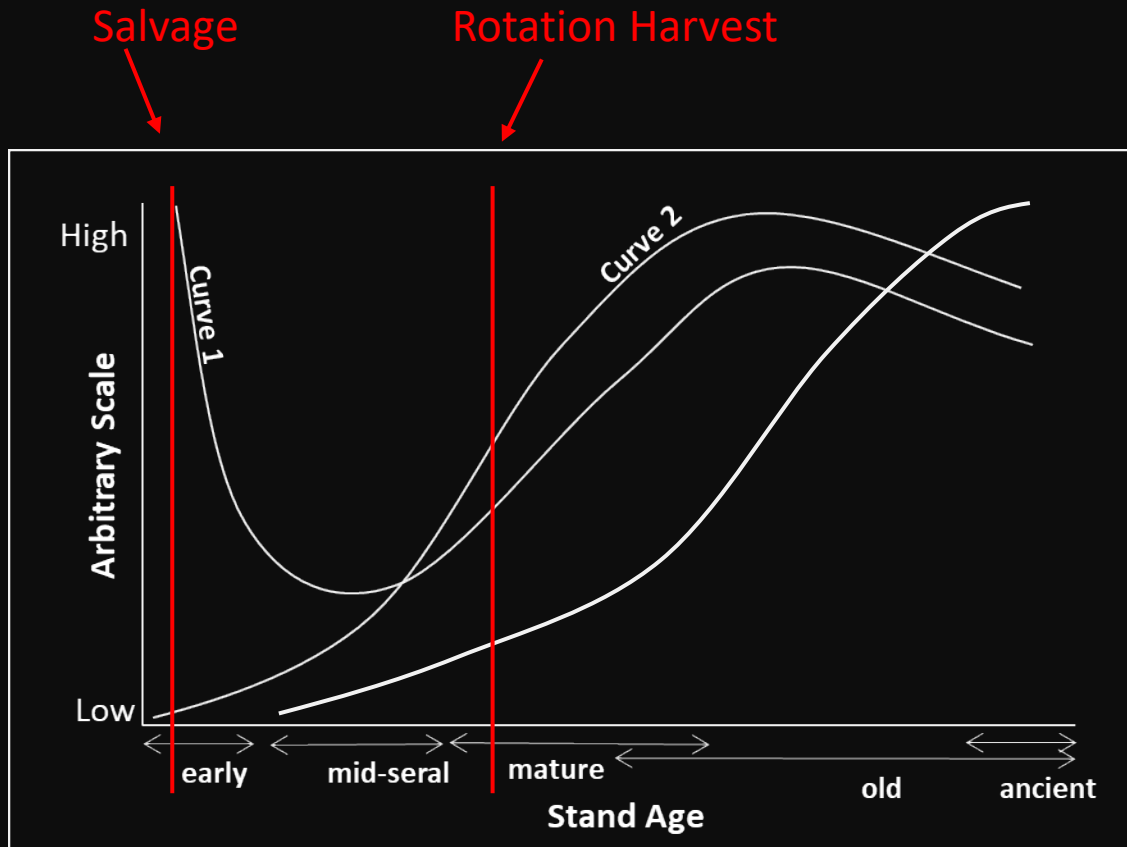
Table 2. Adapted from Table 20(a) page 65 of the Biodiversity Guidebook. Percentage of a cutblock required as wildlife tree patches when landscape units have been designated and landscape level biodiversity objectives established

% of the area ^a available for harvesting that has already been harvested without recommended wildlife tree retention	% of the biogeoclimatic subzone within the landscape unit available for harvest				
	90	70	50	30	10
10	10	8	6	4	3
30	12	10	8	6	4
50	14	12	10	8	6
70	16	14	12	10	8
90	18	16	14	12	10

Table 1. Recommended proportion of stand-level retention based on opening size.

Opening Size	Percent of Opening Un-harvested/retained
<50 ha	10%
50 – 250 ha	10 – 15 %
250 – 1000 ha	15 – 25 %
> 1000 ha	> 25 %

How do we Manage for Stand-Level Retention? Recruiting Structure over Time



- In managed landscapes:
 - forest harvesting largely replaces natural disturbances,
 - or occurs immediately after to recover damaged timber
 - Shortened rotation cycles
 - Difficult to recruit key structures over time
 - Retention Requires Planning!

Curve 1 - (e.g. standing dead, CWD, forage shrubs)

Curve 2 - (e.g. large live trees, large snags, function such as shading or snow interception)

Curve 3 - (vertical and horizontal complexity, canopy gaps, variable microclimate,)

A photograph of a forest scene. In the foreground, a large, broken-topped snag tree stands prominently. The background is filled with tall, slender evergreen trees. The sky is overcast and grey. The image is used as a background for the slide.

Managing Stand-Level Retention: Recruiting Structure over Time

Guidance emphasizes maintaining and recruiting structures

- Wildlife Tree Retention areas
- Large live standing trees
- Large dead trees – advanced stages of decay
- Coarse Woody Debris- various stages of decay
- Ecological anchors

A small Wildlife Tree Retention Area (WTRA) established to protect a broken –topped snag with wildlife (cavity nester) use. Recent cutblock southwest of Kamloops, BC

How Do We Evaluate Stand-Level Retention in FREP?

The Forest and range Practices Act (FRPA) objective for wildlife tree retention is found in Section 9.1 of the Forest Planning and Practices Regulation (FPPR). It reads,

“the objective set by government for wildlife and biodiversity at the stand level is, without unduly reducing the supply of timber from British Columbia's forests, to retain wildlife trees.”



How Do We Evaluate Stand-Level Retention in FREP?

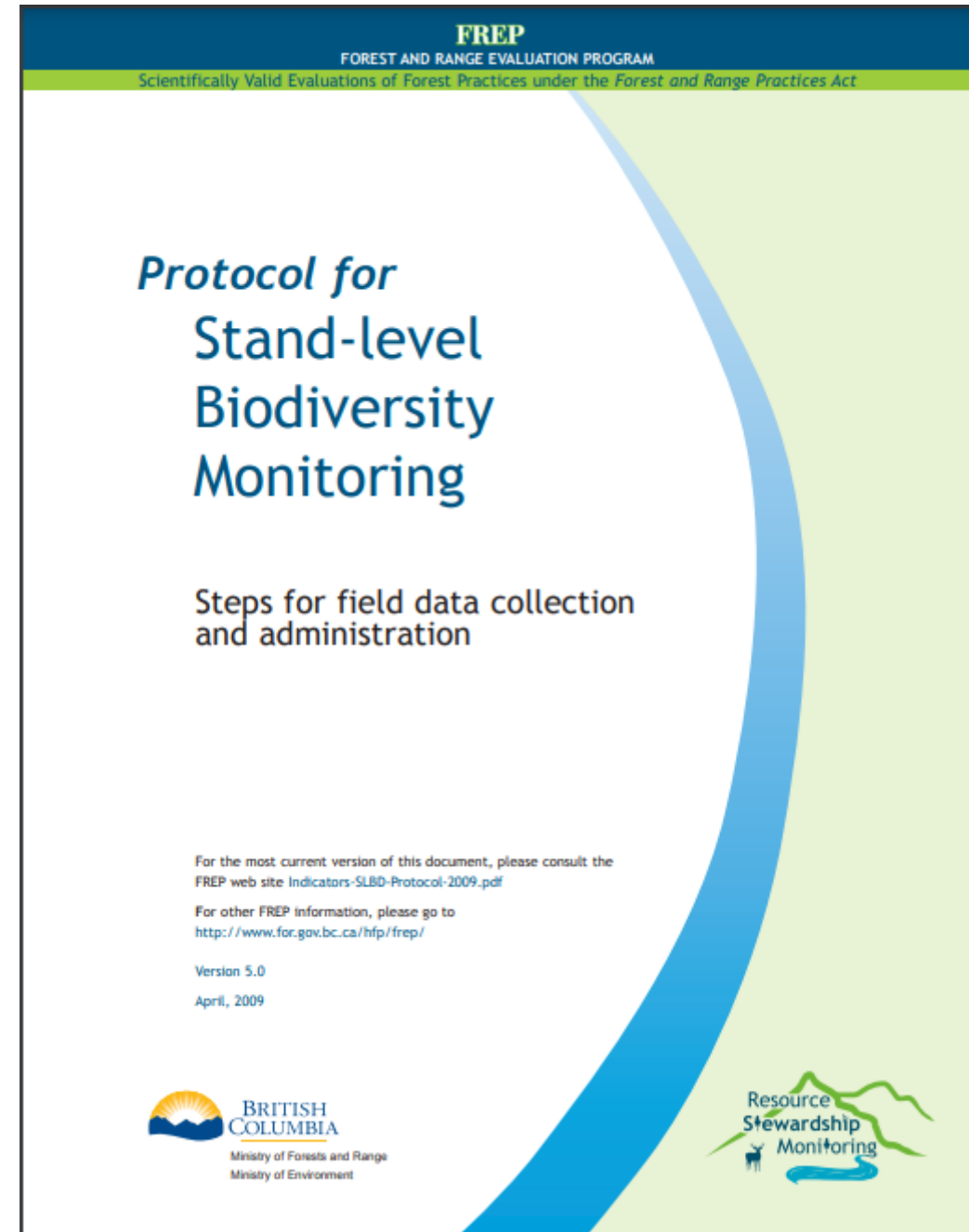
The FREP Question:

“Is stand-level retention providing the range of habitat with the structural attributes understood as necessary for maintaining the species dependent on wildlife trees and CWD?”



How do we Evaluate Stand- Level Retention Practices?

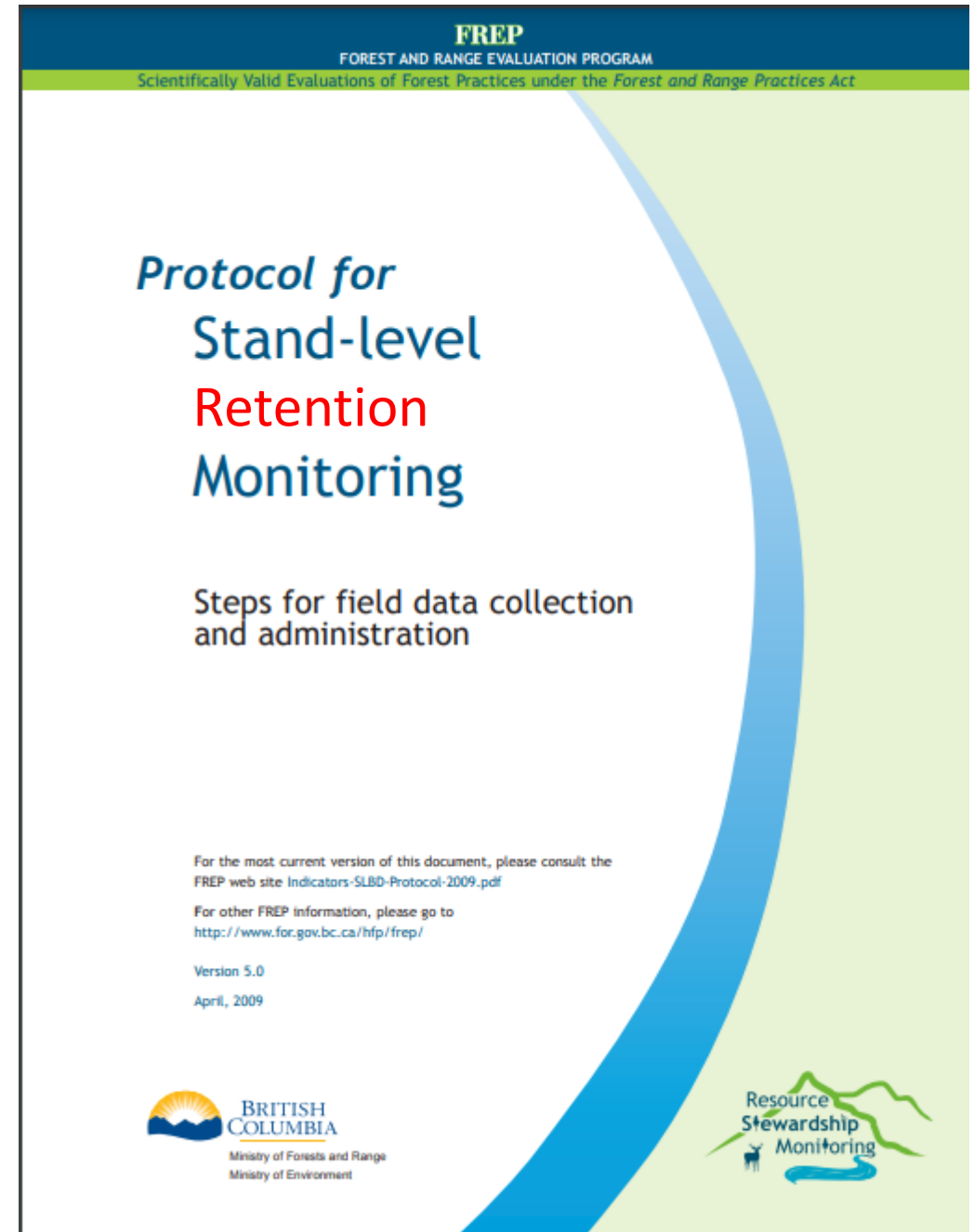
- Original Stand-Level Biodiversity protocol developed in 2006
- Used from 2006 – 2019/2020
- A Revised FREP Stand-Level Retention(SLR) Protocol (2021) replaces the original Stand-Level Biodiversity Protocol.



How do we Evaluate Stand-Level Retention Practices?

Overview of Changes:

- Name change to reflect what is actually being evaluated – retention amounts and practices – not biodiversity and wildlife habitat.
- Field sampling protocol measurements remain the same.
 - Allows continuity with previous samples
- Includes GIS-based measures of landscape context.
- Evaluates observed retention practices relative to guidance targets.
- Provides a rating on how 'likely' practices achieve the FREP question



Goal of the Protocol Revisions

To utilize the existing Stand-level data collected since 2006 to provide an evaluation of stand-level retention practices. Benefits of this approach include:

- Immediate feedback - final score or rating as an outcome.
- Useful feedback on forest practices - where improvement can occur.
- An effective learning and teaching tool for new (or old) practitioners and others interested in understanding the role of retention in conserving biodiversity and wildlife habitat.



Post- harvest retention in a cutblock near McBride, BC – ICH wk1

Stand-Level Retention Monitoring Results to Date

Revised SLR protocol applied to samples collected between 2006-2021 on blocks harvested from 1997-2019

- 2960 Blocks sampled
- 9784 different strata (Net Area to be Reforested (NAR) in the cutblock WTRAs)
- 21,186 Plots/Transects
- 98,736 Trees sampled
- 197,451 Logs sampled



Post- harvest retention in a cutblock near McBride, BC – ICH wk1

How do we Evaluate Stand- Level Retention: Principles and Assumptions

1. Assessing retention practices – not biodiversity and wildlife habitat. Measuring response of organisms to retention is beyond the scope of a 'routine' evaluation.
2. Following guidance more likely to meet biodiversity and wildlife habitat needs.
3. No 'correct' level of retention - emphasis on maintaining habitats for 'a subset of species, assuming forest harvest and other disturbance provides habitats for 'generalist' and 'open-forest' species.
4. Landscape context is important and determines what is necessary and appropriate for stand-level retention.



Large CWD piles and windrows in a regenerating IDF forest in the Okanagan. Part of a trial to examine small mammal use of CWD (Photo courtesy of Tom Sullivan)

Stand –Level Retention Protocol Questions

- Practices Evaluated based on 8 Questions
- 7 sub-Questions used to answer 3 of the questions
- 4 landscape Context – using GIS Indicators
- 4 Questions using collected field data

Category: Landscape Context

Question #1 – Tree Retention Amount - is the amount of stand-level retention adequate considering the landscape context?

Question #2 - Patch Size – Is the amount of stand-level retention in the cutblock adequate considering the size of the associated patch?

Question #3 – Landscape Connectivity – Is the amount and spatial location of stand-level retention adequate to help maintain landscape-level connectivity?

Question #4 - Micro-Environment - Does Wildlife Tree Retention and block shape contribute to a range of microenvironments and structural complexity within the block?

Category: Wildlife Tree Retention Practices

Question #5 - Standing Live and Dead Tree Size and Condition – Will the amount, size and condition of retained wildlife trees provide habitat refugia and structural complexity in the regenerating stand now and into the future?

5a) Large Live Trees >30cm DBH

5b) Snags >30cm DBH

5c) Soft Snags >30cm DBH

Question #6 –Wildlife Tree Retention Practices - Do stand-level retention practices retain wildlife trees to conserve important habitat features, and minimize blowdown effects?

6a) average amount of blowdown

6b) Maximum amount of blowdown in one patch

Category: Coarse Woody Debris Retention Practices

Question #7 – Amount and Spatial Dispersion of Downed Wood – Does the amount and dispersion of CWD provide habitat refugia and structural complexity in the regenerating stand now and in the future?

7a) CWD Volume

7b) Area contributing future CWD inputs

Question #8 - Downed Wood Size and Condition – Does the size and condition of CWD provide habitat refugia and structural complexity in the regenerating stand now and in the future?

FREP Stand-Level Retention protocol: GIS Landscape Indicators

GIS analysis of random cutblocks provides information on:

Question #1- Landscape context – Retention Amount

- Area of operable land-base and % disturbance within the Landscape Unit associated with cutblock.

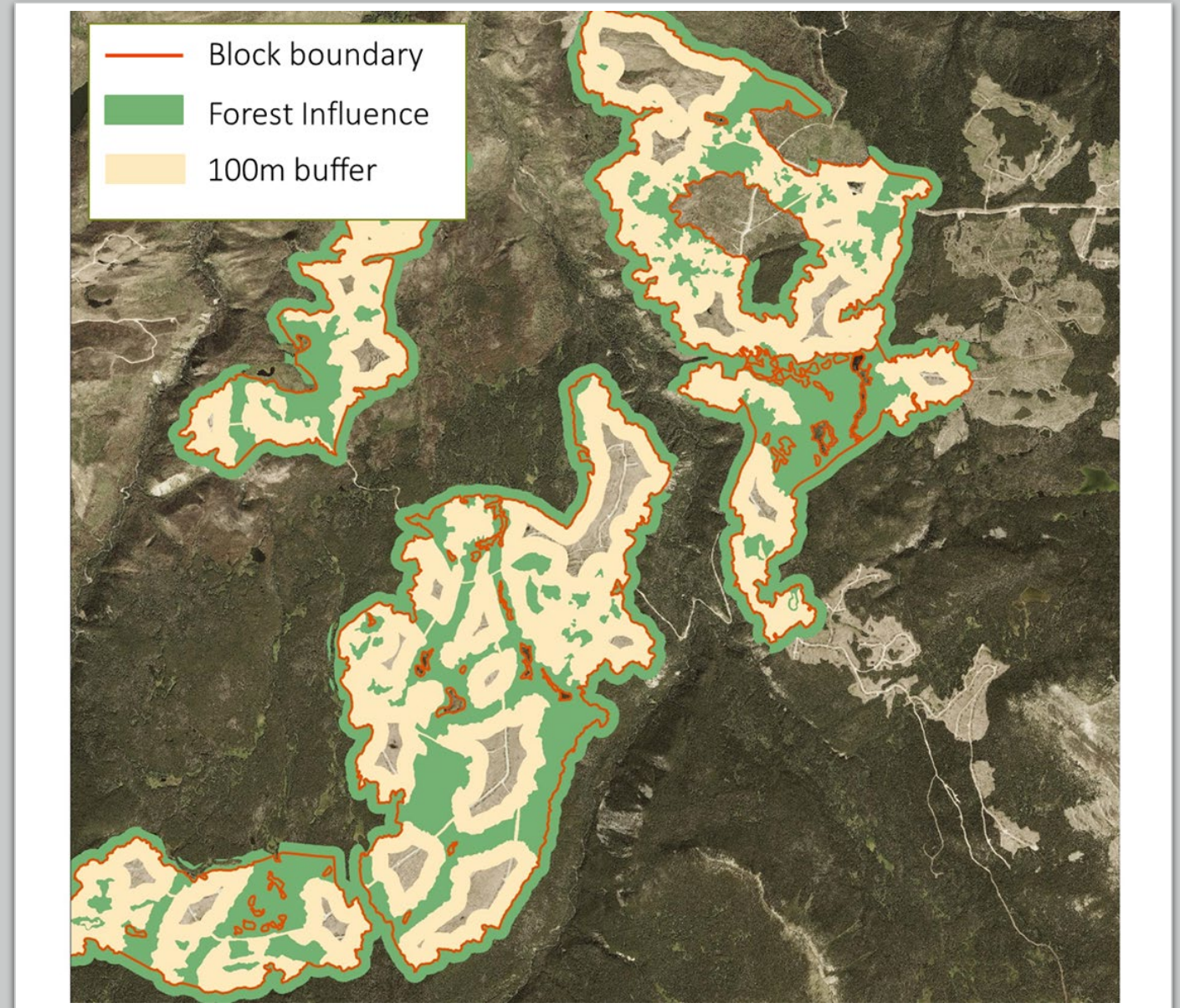
Question #2- Patch Size – Retention Amount

- Size of 'patch' or 'functional opening' to which the cutblock is associated.

Question #3- Maximum distance across cutblock between retention and adjacent forest.

Question #4- Area of Forest Influence

- Area of cutblock within 1 tree length of retention or adjacent forest



Target Categories: Evaluating Retention Practices Against Guidance Targets- Landscape Context

Depending on how closely the measured data aligns to the specified target, the outcome for each question is assigned to one of four target categories:

- **Exceeding** – retention levels exceed minimum guidance targets
- **Meeting** – retention levels meet minimum guidance targets
- **Below** - retention levels are below minimum guidance targets
- **Well Below** – retention levels are well below minimum guidance targets

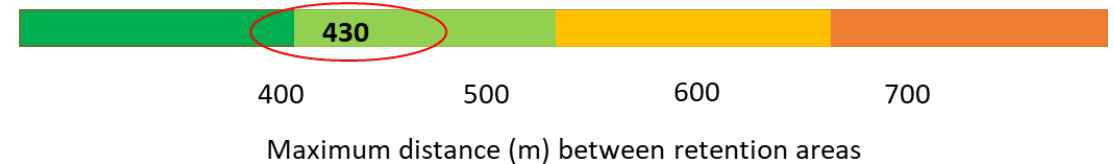
Flexibility incorporated to accounts for

- Measurement error
- Operational reality

Table 3-1. Recommended distances between retention areas >0.25ha within harvested openings relative to surrounding landscape condition. Table adapted from Klenner (2006).

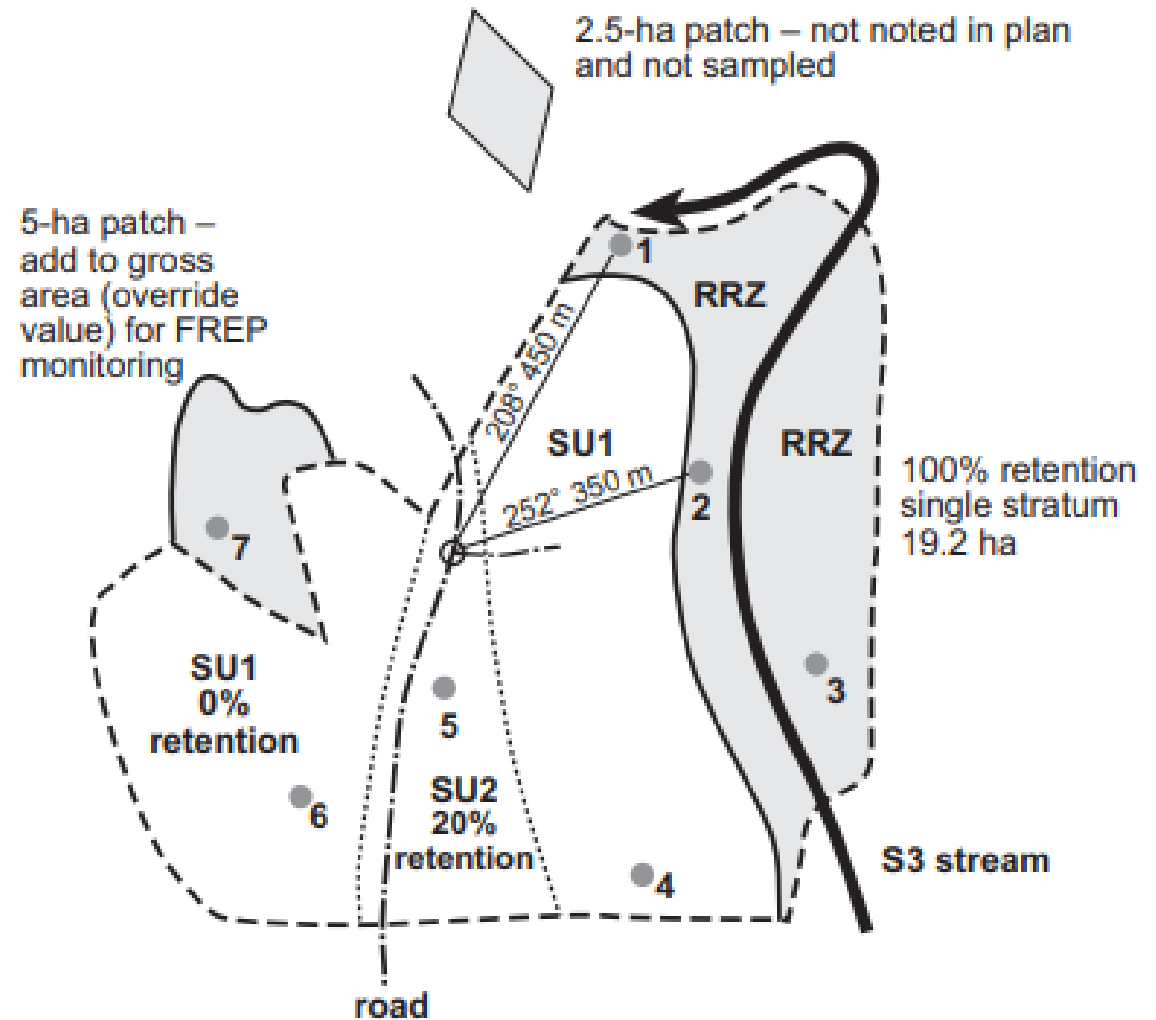
		Percent (%) Forest Disturbance Percent of LU/BGC subzone harvested pre-1995, early seral forest and/o medium-high severity disturbance		
Percent of THLB in LU/BGC subzone	<33%	<33%	33-66%	>66%
	<33%	<500m ^a	<400m	<300m
	33-66%	<400m	<300m	<200m
	>66%	<300m	<200m	<150m

^a 500m is the maximum recommended distance between wildlife tree patches in the Biodiversity Guidebook. The remaining distances are from Klenner (2006). Omineca Region Guidance also recommends <250m between retention consistent with ecosystems that experience fewer stand-replacing disturbances and more gap-phase (Delong 2011) and is consistent with recommended levels in the lower right of this table



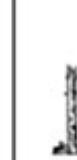
FREP Stand-Level Retention Protocol: Field Measurements

- Randomly selects cutblocks from a broader population of all harvested blocks at least 2 years since harvest.
- Cutblock is stratified into reserves (wildlife tree retention areas; WTRAs) and Net Area to Be Reforested (NAR) which can include dispersed tree strata.
- Randomly locate:
 - - 1 Plot/ha in reserve patches up to a maximum of 5/patch.
 - - Minimum 3 plots in NAR.



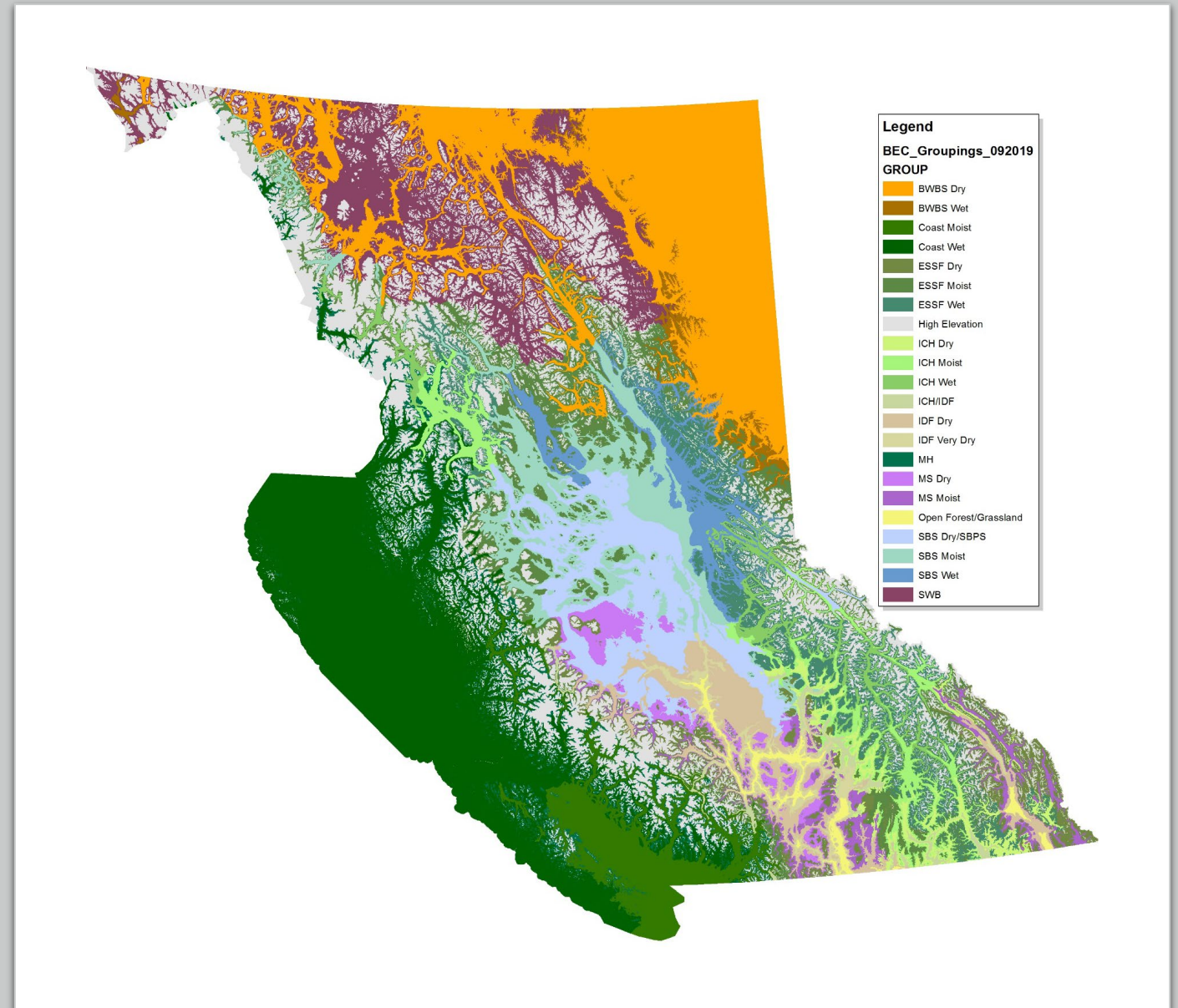
FREP Stand-Level Retention Protocol: Field Measurements

- Measures at each plot include:
 - Stand Structure – fixed or variable radius plot (prism)
 - Tree species, diameter breast height (cm), Height (m), WT Class.
 - Coarse Woody Debris (CWD) – 30 m transects (2 -15m ‘legs’ @ 90 degree angle)
 - Log species, diameter (cm), length(m) and decay class.

								
Live			Dead					Dead Fa
		Hard →		Spongy	→ Soft		Not Samp	
1	2	3	4	5	6			
								
CWD Decay Class								
								
Log class 1	Log class 2	Log class 3	Log class 4	Log-class 5				
Hard	Sap rot (but still hard)	Advanced decay (spongy)	Extensive decay (crumbles/mushy)	Many small pieces, soft				
Bark firm	Loose bark	Bark trace/absent	Bark absent	Bark absent				
Elevated	Sagging	Sagging to settled on ground	Fully settled on ground	Partly sunken in ground				
Hard branches with twigs	Soft branches	Branches stubs/ absent	No branches	No branches				

FREP Stand-Level Retention Protocol: Benchmarks for stand attributes

- Baseline levels for forest structure (Standing Live, Dead and Downed Wood) derived from plot\transect data including;
 - Cruise Plot data (2005-2010/2015-2020)
 - FREP data
 - Permanent Sample Plots
 - National Forest Inventory(NFI)
- Compiled by Biogeoclimatic Groups – groups of BGC subzone variants with similar climatic and disturbance characteristics.
- Used for Questions #5-#8 of the protocol



Target Categories: Evaluating Retention Practices Against Guidance Targets- Field Data

- Biogeoclimatic subzones broadly grouped into Forest Types
- Expected amounts of different stand attributes for each forest type summarized from plot data (e.g cruise plots, inventory plots)
- Target categories are based on average levels of different stand attributes found in forest types:
 - Trees >30cm DBH
 - Snags >30cm DBH
 - Soft snags (WT class 6-8) >30cm DBH
 - CWD Volume (m³/ha)
 - Large CWD Pieces (>20cm Diameter and >10m length)

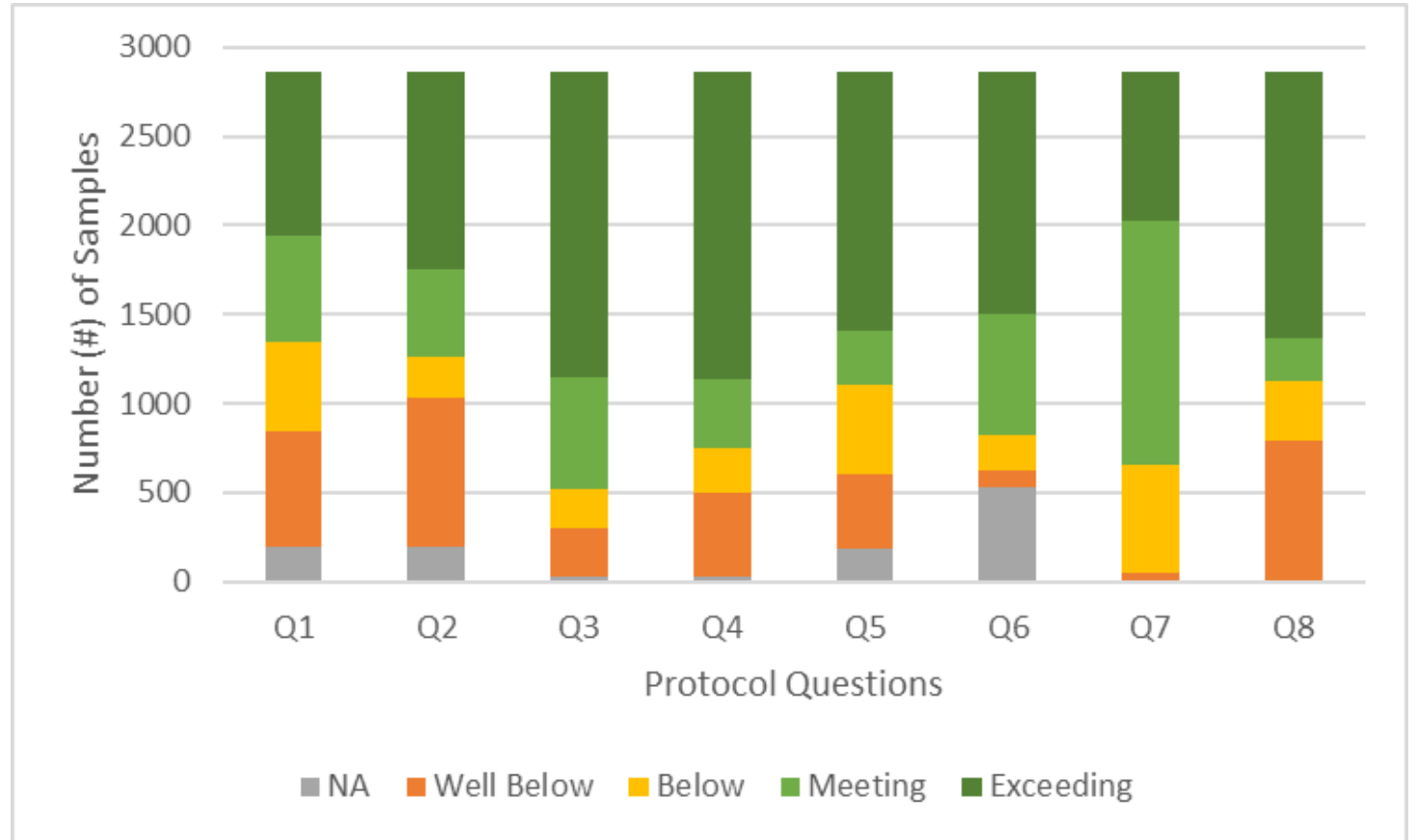
		all trees			
		Trees>30cm DBH		Trees>50cm DBH	
		% of all trees	stems/ hectare	% of all trees	stems/ hectare
NDT4	Dry Forest	15-25%	90-125	1-4	10-20
	Cool Dry Montane 1	5-15%	70-85	<1%	2-7
NDT3	Cool Dry Montane 2	25-30%	175-200	3-6	25-35
	Cool Montane 1	15-20%	125-175	1-3	5-20
NDT2	Cool Montane 2	25-35%	175-225	2-6%	20-35
	Cool Wet Montane	35-40%	250-350	10-15	75-125
NDT1					

	Trees>30cm			
	Well Below	Below	Meeting	Exceeding
Dry Forest	<50	50-70	70-150	>150
Cool Dry Montane 1	<25	25-50	50-110	>110
Cool Dry Montane 2	<75	75-125	125-250	>250
Cool Montane 1	<50	50-75	75-225	>225
Cool Montane 2	<75	75-125	125-275	>275
Cool Wet Montane	<150	150-200	200-400	>400

Preliminary Results – All samples - Questions

Poorest outcomes:

- Q1- retention amount and landscape context.
- Q2 – retention amount and patch size.
- Q4 – micro-environment/forest influence.
- Q5 – quality of stand tree retention.
- Q8 – CWD piece size.



Concluding on Stand-Level Retention

- Each question is scored from 1 to 4 where:
 - *Exceeding* = 4,
 - *Meeting* = 3,
 - *Below* = 2,
 - *Well Below* = 1.
- To be rated as *Likely* or *Very Likely*, the cutblock must be *Meeting* or *Exceeding* targets (a “Yes” answer to that question) in at least half of questions, achieving a minimum combined score of >20.

Final Rating for the cutblock that speaks to FREP question:

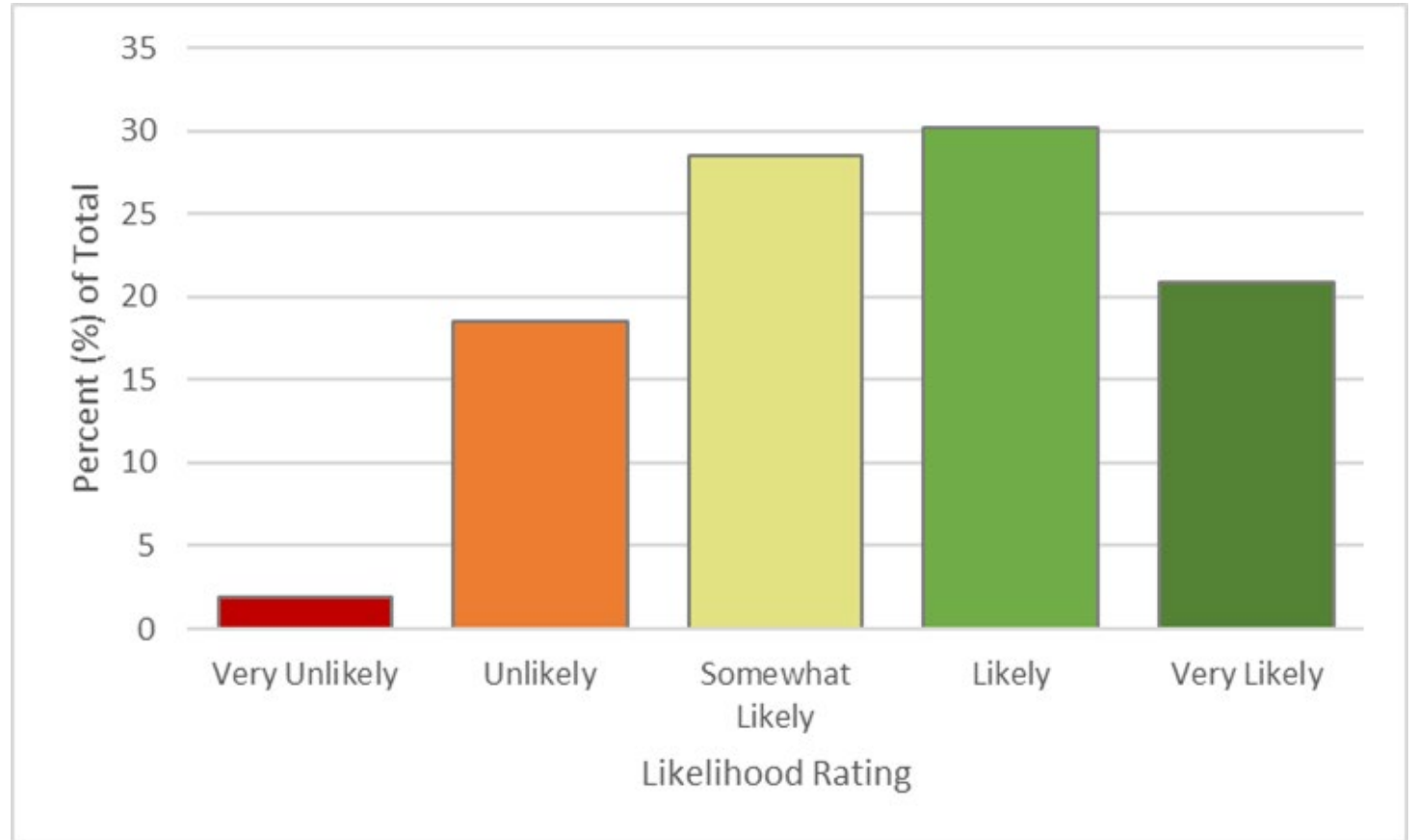
“ Is stand-level retention providing the range of habitat with the structural attributes understood as necessary for maintaining the species dependent on wildlife trees and CWD”

Rating	Score (Out of 32)	Relationship to Evaluation Questions
Very Likely	>25	Meeting or Exceeding retention guidance benchmarks for most or all questions
Likely	21-25	Meeting or Exceeding retention guidance benchmarks for most questions
Somewhat Likely	16-20	Meeting retention guidance on less than half of questions
Unlikely	12-15	Below or Well Below retention guidance benchmarks for most questions
Very Unlikely	<12	Below or Well Below retention guidance on most to all questions.

Intended to identify good retention practices and opportunities for improvement

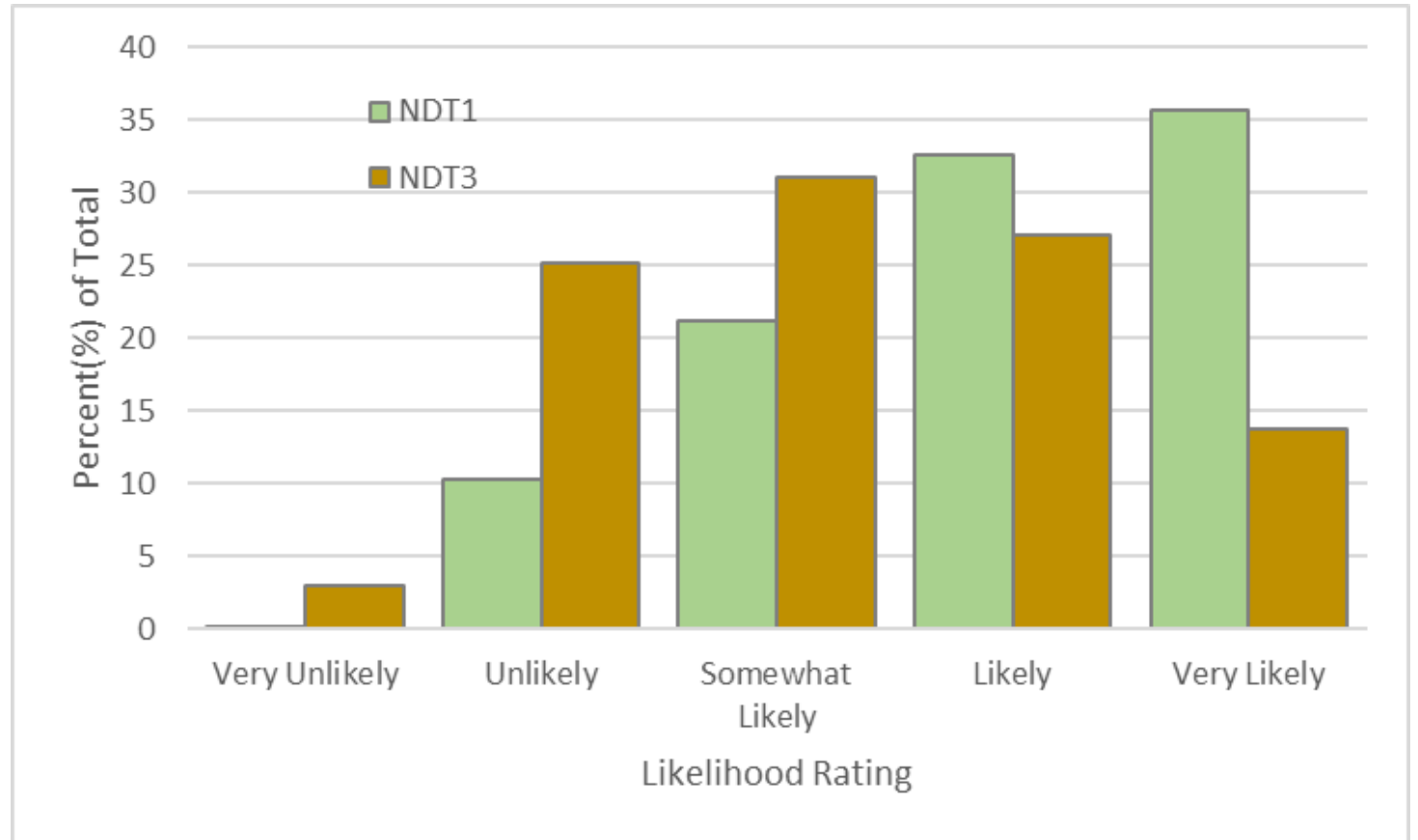
Preliminary Results – All samples- Final Ratings

- Just over 50% of all samples rated *Likely* to *Very Likely* that the range of habitat with the structural attributes understood as necessary for maintaining the species dependent on wildlife trees and CWD
- 20% *Unlikely* to *Very Unlikely* to maintain the range of habitat attributes....



Preliminary Results: Comparing Different Ecosystems

- Differences reflect retention practices and landscape context.
- NDT3 greater proportion of total samples:
 - 1257 in NDT3 vs. 611 in NDT1
 - NDT3 larger average cutblock size (28 Ha in NDT1 vs. 50 Ha in NDT3)
- NDT3 samples represent greater proportion of broader population of cutblocks and area harvested in BC.



Questions?

