Assessment of the Live Tree Retention Targets of the Williamson's Sapsucker Best Management Practices

Research Report

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Abstract

Best Management Practices (BMPs) for timber harvesting in Endangered Williamson's Sapsucker Critical Habitat were published in 2014. These established several live tree (>17.5-cm dbh) retention targets in cutblocks (with a minimum of 85 live tree stems per ha (sph) and a maximum of over 225 sph) to maintain suitable habitat of Williamson's Sapsucker. We first reviewed the rationale for the targets and found them well supported by analyses of independent datasets. These datasets included locations of nests in cutblocks relative to sph, direct observations of adults foraging from nests, foraging stand preferences based on radio-telemetry, tree densities at nests versus unoccupied sites, and breeding occupancy of cutblocks. Williamson's Sapsucker avoided stands with <100 sph and >400 sph. Examination of 113 cutblocks approved after 2014 that contained Critical Habitat for Williamson's Sapsucker found that 62% did not retain even the minimum 85 sph targets of the BMPs, largely because application had been voluntary. The live tree retention targets will need to be met by selection harvesting and silvicultural systems at the hectare scale, i.e., not averaged over whole cutblocks, because any portions of cutblocks with <100 sph would be lost habitat that could not be replaced by averaging over portions of the block that may be more densely treed.

Keywords: Williamson's Sapsucker, critical habitat, best management practices, partial harvesting

Introduction

Williamson's Sapsucker is a migratory woodpecker assessed as Endangered in Canada (COSEWIC 2005, 2017) that breeds only in British Columbia. It is listed in Schedule 1 of the Species at Risk Act, with a recovery goal to maintain populations at current abundance and distribution (Ministry of Environment 2012, Environment Canada 2014, Environment and Climate Change Canada 2016). This goal was "entirely predicated on the maintenance of the current amount and quality of suitable habitat" (Environment and Climate Change

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Canada 2016). As such, provincial Best Management Practices (BMPs) were published in 2014 (Ministry of Forests, Lands and Natural Resource Operations 2014a, 2014b, 2014c) that could be voluntarily applied to timber harvesting and silvicultural practices in B.C.

The overarching goal of the BMPs was to provide guidance on forest management practices within the contiguous Williamson's Sapsucker Areas of Occupancy (AO) to support the recovery goal. The focus of this assessment was on two regional AOs: the Okanagan-Boundary AO and the West AO (west of Okanagan Lake), which together contained 90% of the population (Gyug et al. 2014a, COSEWIC 2017).

Here, we reassess the live-tree retention targets of the 2014 BMPs. We first review the data from 2006 to 2008, upon which those live tree retention targets were based. Then we re-examine the appropriateness of the targets through analysis of new data, and assess cutblocks that contained Critical Habitat and were approved and cut since 2014 to determine: 1) if the BMPs were applied, and 2) whether the BMP application was effective.

There are several aspects critical to understanding Williamson's Sapsucker occurrence in a landscape managed for timber harvest. Firstly, live trees play a significant role in their feeding ecology. Large-bodied ants are the majority of the biomass fed to nestlings (Gyug et al. 2014b). These ants are gleaned from tree trunks or large branches, as they access aphid colonies at branch tips. Live conifers are also required for sap well feeding (Gyug et al. 2009a). While aphids will colonize conifers of any size from 1-m tall up to mature overstorey trees, Williamson's Sapsucker preferred to forage on larger trees over smaller trees (St-Amand et al. 2018). Secondly, Williamson's Sapsuckers breeding territories in B.C. average 42 ha (Gyug et al. 2023) and may include some cutblocks within those territories. They will sometimes nest in remnant trees within cutblocks, but preliminary observations from as early as 2003 indicated that the adults nesting in cutblocks foraged almost entirely in nearby forest. It is therefore important to understand and quantify how a cutblock is used before final assessment.

Table 1. Live tree retention targets (≥17.5 cm dbh) and the percent area of new blocks (blocks established after April 1, 2014) to be retained in the target classes for each licensee within moderate and low suitability habitat. Neither Old-Growth Management Areas nor Wildlife Habitat Areas for any species could be included in the live tree retention target averaging.

Average live tree retention target (trees/ha)	% area of new blocks for each licensee
85–125	5–15
126–175	25–35
176–225	40–50
>225	10–20

Note: This table was identical in each of the regional 2014 BMPs.

Current (2014) BMP live tree retention targets

The BMPs set live tree retention targets for trees ≥17.5 cm dbh as stems per hectare (sph) across different nesting habitat suitability classes. In high suitability habitat (0.7% of the AOs), >225 sph were to be retained. In moderate and low-suitability nesting habitat (44% of the AOs), Table 1 of each BMP sets the average live tree retention targets in cutblocks at various levels. The BMPs were meant to be applied to Critical Habitat for Williamson's Sapsucker, but application by forest licensees was voluntary. Critical Habitat was spatially identified as habitat modelled as low or better suitability but also included all habitat within 500 m of known nests in very low or nil suitability habitat (Environment Canada 2014; Environment and Climate Change Canada 2016). Only in the East Kootenay was Critical Habitat spatially identified as just the 500-m radius around known pair or nest locations.

These retention levels were based largely on two data sources. The first was Gyug et al. (2010), who found that Williamson's Sapsucker nest productivity was significantly lower where live tree density in the 60–225 m radius belt around nests was below 85 sph. The second was the distribution of sph classes around known nest sites (Figure 1). The radius of 225 m was chosen because this was half the average inter-nest distance in benchmark habitat (Gyug et al. 2007). Plot methods used to estimate tree densities have been previously described (Gyug et al. 2010, Drever et al. 2015). The live tree retention targets of Table 1 were purposely skewed slightly to the lower side of the mean (206 sph). This was to make allowances for timber harvesting and to recognize that some of the higher-density classes would be met by reserved areas such as Wildlife Habitat Areas (WHAs), Old-growth Management Areas, or other protected areas, which together accounted for 9% of the AOs (COSEWIC 2017).

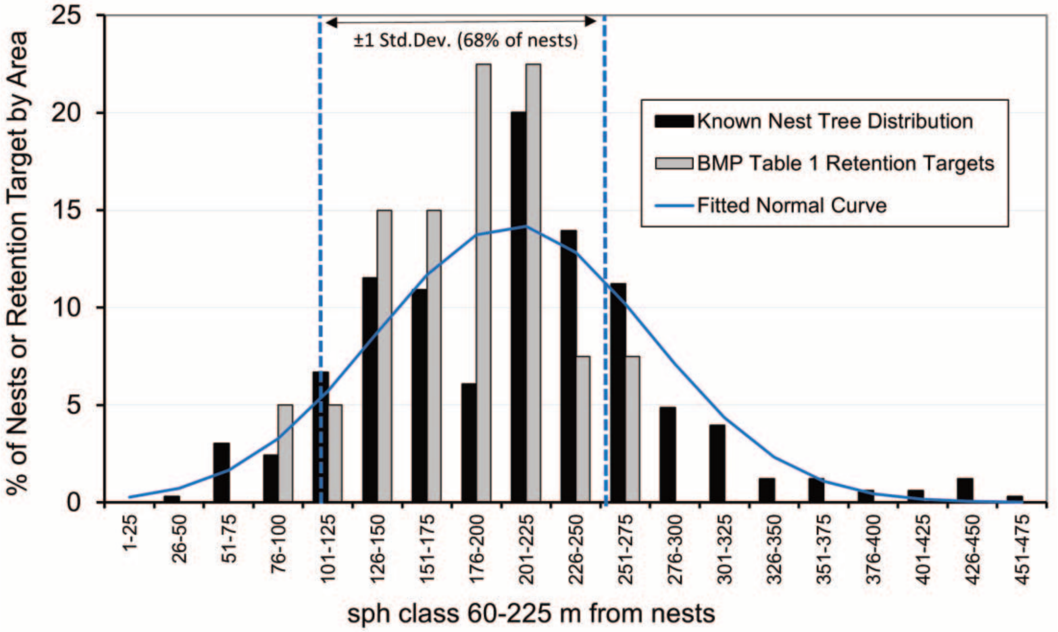

Figure 1. Frequencies of mean live tree ≥17.5 cm dbh densities (sph) in a 60-225 m radius belt around known Williamson's Sapsucker nest trees in the Okanagan-Boundary and West Areas of Occupancy, not including non-treed habitat (e.g. lakes, hayfields, power lines, treeless open range) in the mean. Based on 198 known nest trees with habitat plots around them that were used for nesting a total of 329 times. The fitted normal curve has $\mu = 206$ and $\sigma = 69$.

Live tree retention target assessment

We re-assessed the live tree retention targets of the BMPs by first examining the number of nests in cutblocks of varying live-tree densities and the distance of those nests from adjacent forests using data from as early as 2003. Second, we analysed data that was collected beginning in 2004, which allowed us to quantify adult foraging use of different habitats by direct observation of adults foraging from nests in or near cutblocks. Third, we used data from the 2014–2015 radio-telemetry study of St-Amand (2017) that provided unbiased quantification of adult foraging use in stands where the adults could not otherwise be directly observed by sight alone. Finally, in light of the analyses, we revisited the habitat selection analyses of Drever et al. (2015).

Nest locations in cutblocks

We assessed the locations of 443 Williamson's Sapsucker nest trees found between 1996 and 2019 with respect to cutblock-forest edges. Most nest trees (73%) were found in forests with >200 sph, with only 27% found in cutblocks. Within cutblocks, more nests were found further from the forest as retained live tree density increased (Figure 2). Where <50 sph were retained in a cutblock, the mean distance from the forest edge was 55 m, and no nests were >150 m from the forest edge. Similarly, St-Amand et al. (2021) found using radiotelemetry that Williamson's Sapsucker avoided foraging in large openings, and the longest observed opening crossing was 160 m across open grassland.

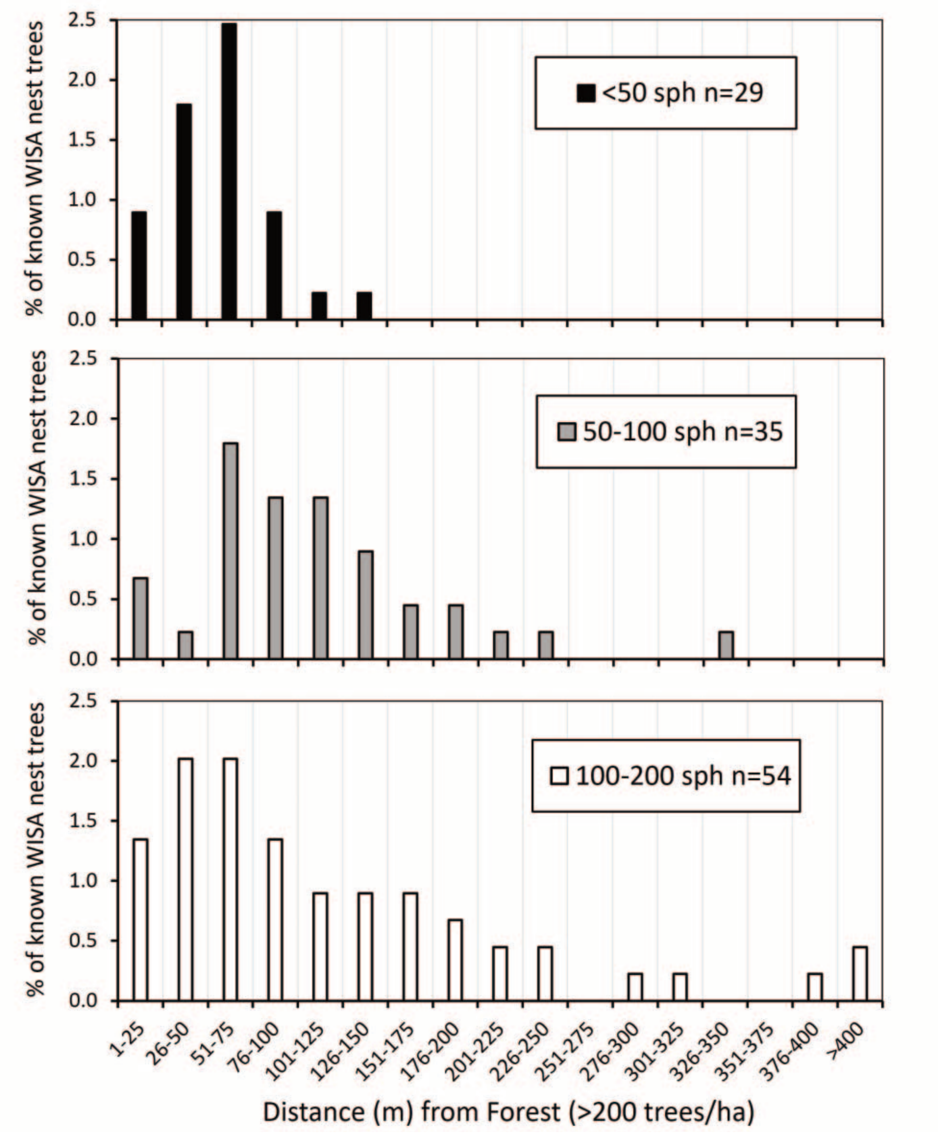

Figure 2. Distances of Williamson's Sapsucker (WISA) nest trees from the forest in cutblocks with different levels of live tree retention. The data from 118 nest trees in these histograms represent only 27% of the 443 known nest trees. The remainder were in stands with >200 sph.

However, even in cutblocks with higher live tree retention, the mode of each nest location distribution was <75 m from the forest, and most of the nests were <100 m from the forest. The nest trees in cutblocks usually had cavities from many years, including prior to timber harvest. As such, nesting in the cutblock may have been incidental, i.e., not a choice made because the cutblock was suitable foraging habitat, but simply because suitable nest trees are very scarce (Gyug et al. 2009), and the nest tree was close enough to better foraging habitat to ensure successful nesting. This was supported by the number of young fledged per nest being correlated with tree density in the larger foraging territory up to 225 m from the nest, but not in the 60-m radius around a nest (Gyug et al. 2010).

Direct observations of Williamson's Sapsucker foraging

At active nest trees in cutblocks or very open stands, Williamson's Sapsucker could frequently be seen travelling from the nest into nearby forested habitat (>200 trees/ha) to gather food for nestlings. We visually quantified foraging habitat use by observing which habitat the adults entered as they left and returned to the nest. To determine foraging habitat preferences, we used Kimmerer and Slaughter's (2021) electivity index (X) based on log odds ratios that limit X to between 0 and 1, and where $X > 0.5$ indicates preference and $X < 0.5$ indicates avoidance. Use of habitat for each nest was based on time spent foraging in each habitat for both the male and female; availability was based on the area of each habitat within the radius we could either see or assume the birds were using.

In 38.7 total hours of bird observations at 19 nests from 2004 to 2025, stands with less than 100 sph were avoided (Figure 3). Stands with >200 sph were preferred, while stands with 100–200 sph were used in proportion to availability. Stands with <100 sph included cutblocks, burns, and naturally open sites. Stands with 100–200 sph included both partial cuts and burns. These results confirmed that nest locations in cutblocks with <100 sph were not preferred foraging habitats, but that adults would need to commute to nearby denser stands to forage.

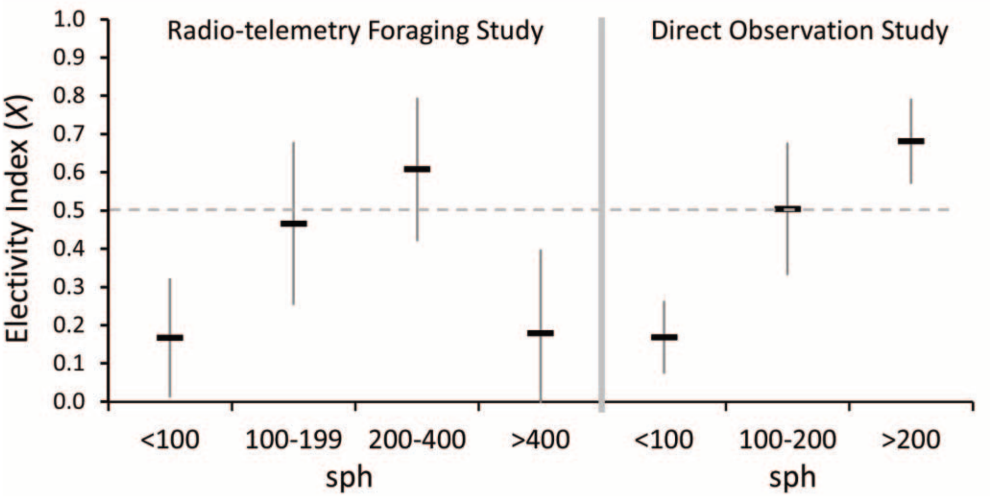

Figure 3. Williamson's Sapsucker foraging site selection relative to live tree densities based on radiotelemetry observations ($n = 14$ nests) and by direct observation ($n = 19$ nests) using Kimmerer and Slaughter's (2021) Electivity Index (X). Means and 95% confidence intervals shown. $X > 0.5$ indicates preference; $X < 0.5$ indicates avoidance.

Radiotelemetry locations of foraging sites compared to available sites

We conducted a foraging habitat preference analysis using radio-telemetry foraging locations (St-Amand 2017) during the period when adults were feeding nestlings. We calculated sph from the Vegetation Resources Inventory (VRI, B.C. Forest Service 2024) polygon attributes except where we had tree count plots to estimate sph (72 of 236 polygons). Use for each polygon was defined as the total observed foraging minutes in the polygon relative to the total observed foraging minutes for that same nest. Availability for each nest was the area of each polygon divided by the total area within the radius from the nest that contained 95% of the adult telemetry locations during the nestling period. St-Amand et al. (2021) found that 95% of foraging trips were within 340 m of the nest in the Okanagan and within 410 m of the nest in the West. These were compared using Kimmerer and Slaughter's (2021) electivity index (X).

Stands with live tree densities <100 sph and >400 sph were avoided (Figure 3) while stands with densities between 100 and 400 sph were used in proportion to their availability, i.e., with X near 0.5 and the confidence intervals overlapping 0.5. These radiotelemetry findings confirmed the direct observations of foraging avoidance of stands with <100 sph. However, it also included avoiding very dense stands (>400 sph), where direct observations could not be made once birds entered forested stands.

Habitat models based on nest sites contrasted with random unoccupied sites

In light of the findings of avoidance of stands with <100 sph and >400 sph of the radiotelemetry study, the habitat selection analyses of Drever et al. (2015) were revisited. Firstly, we found that the best-fit GIS-attribute model for the West AO was not supported when additional data (44 nests, 346 random sites) were added to the analysis, with the Area under the Curve (AUC) reduced from a good model (AUC = 0.88) to a fair model (AUC = 0.68). We found the field habitat models of Drever et al. (2015) for both the West and the Okanagan-Boundary-East Kootenay could be simplified to more parsimonious subset models using an information-theoretic approach (Burnham & Anderson 2002). Simpler models, in which each variable could be seen as causative, would be preferred to more complex models, in which some variables would have unknown causative effects or biological correlations.

The best-fit subset nesting habitat models included only sph (Figure 4) and the primary nesting trees (Table 2). In the Okanagan-Boundary and East Kootenay AOs, the primary nest tree was western larch >57-cm dbh (Gyug et al. 2009b). However, in the West AO, we found it necessary to split the Biogeoclimatic Ecosystem Classification (BEC) subzones due to differences in the tree species used as nest trees. In the higher elevation Interior Douglas-fir dry cool (IDFdk) subzone, 97% of the known nest trees (n = 68) were trembling aspen. In the lower elevation Interior Douglas-fir xeric hot (IDFxh) and

Table 2. Nest habitat modelling of Drever et al. (2015) was re-analyzed to find parsimonious best-fit models using an information-theoretic approach. $QAIC_c$ is the version of Akaike's Information Criterion (AIC) applied to overdispersed (quasi-likelihood) datasets with low sample size (Burnham & Anderson 2002). Density (D.) refers to live trees ≥17.5-cm dbh unless otherwise stated. Likelihood is the likelihood that the top-listed model would be better than the 2015 model. For Okanagan-Boundary and East Kootenay AOs, the original dataset was re-analyzed, but for the West AO, 16 random sites were added to the 2015 dataset to better balance the number of random sites with the number of nests.

Model Terms*	df	$QAIC_c$	$\Delta QAIC_c$	Likelihood	R^2	AUC
Okanagan-Boundary and East Kootenay AOs						
D. Lw >57-cm dbh + 2nd order D. Live Tree	3	34.59	0.00	1	0.16	0.75
2015 Model (3 2nd order terms + 3 other terms)	8	61.75	9.08	343	0.29	0.83
West AO IDFdk subzone						
D. At + 2nd-order D. Conifers other than Py	3	12.68	0.00	1	0.61	0.96
2015 Model (D. At + 2nd-order D. Py >57-cm dbh)	3	15.23	2.55	3.58	0.36	0.87
West AO IDFxh/PPxh subzone						
D. At + D. Py	2	37.66	0.00	1	0.20	0.79
2015 Model (D. At + 2nd-order D. Py >57-cm dbh)	3	43.21	5.55	16.05	0.11	0.71

Notes: *At = trembling aspen; IDFxh = Interior Douglas-fir dry cool; Lw = western larch; PPxh = Ponderosa Pine xeric hot; Py = ponderosa pine

Ponderosa Pine xeric hot (PPxh) subzones, both trembling aspen (55%) and ponderosa pine (33%) were important nest trees (*n* = 109).

Probability of nesting for all regions was highest when the average sph within 225 m of a nest was in middle densities between approximately 50 and 250 sph (Figure 4). This analysis did not align perfectly with radiotelemetry or direct observational analyses (i.e., stands with <100 sph and >400 sph were avoided) because it considered overall averages within the radius, rather than foraging stands alone. In the lower-elevation West AO IDFxh/PPxh subzone, the simplest model contained only the densities of trembling aspen and ponderosa pine. There was only one site of the 53 sites in the IDFxh/PPxh subzones with >300 sph, so that the high tree densities at these lower elevation nests did not appear to play as significant a role in distinguishing nest sites from random sites.

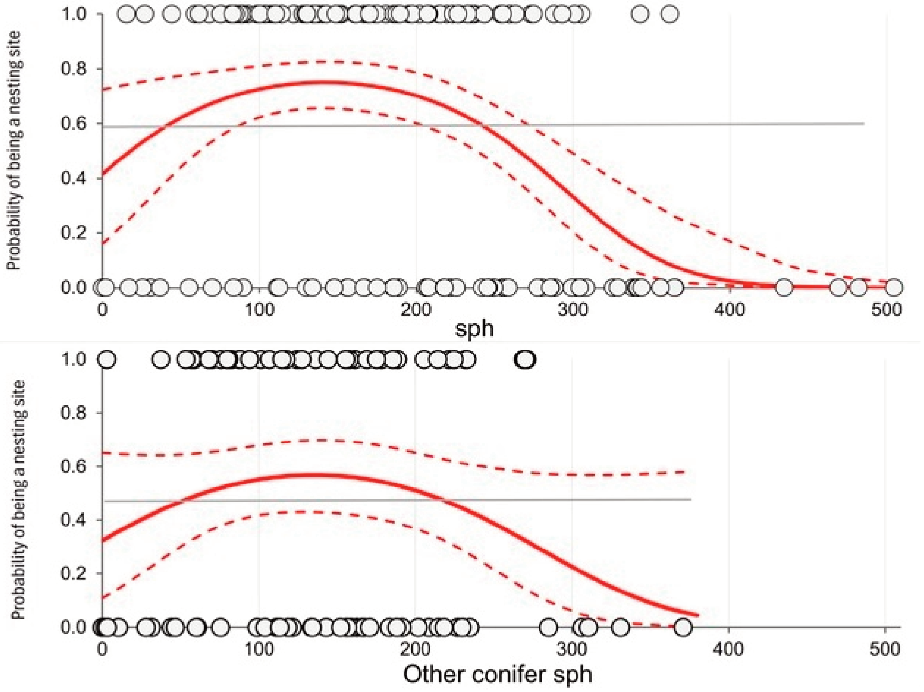

Figure 4. 2nd-order polynomial logistic regressions of Williamson's Sapsucker nest sites compared to unoccupied random sites from 2006-2008 against live tree ≥17.5-cm dbh (sph) within 225-m radius (16-ha) of the nest or random unoccupied points for the Okanagan-Boundary and East Kootenay AOs and for the West AO. Data points shown as open circles (nests = 1, random unoccupied = 0). Grey line across graph indicates proportion of nests in sample, i.e., the expected probability of being a nest in these datasets. 95% confidence bands shown as dashed lines.

2018–2021 assessment of BMP cutblocks

BMP application to cutblocks

We compared the hypothetical distribution of live tree densities if the BMP live tree retention targets of Table 1 had been applied to the live tree densities retained in the 113 assessed cutblocks that were harvested between 2014 and 2021 and assessed between 2018 and 2021 (Figure 1). These cutblocks were chosen for assessment because they had been approved since the adoption of the BMPs in 2014 and contained Critical Habitat to which the BMPs should have been applied. In total, 62% of the cutblocks retained <85 sph and did not meet the targets of Table 1, i.e., the BMPs had not been applied (Figure 5).

Based on the silvicultural system stated in site plans, mean retained sph in blocks that were either clearcut or clearcut with reserves was 29.6 (SD 24.6, range 1-90, *n* = 67), in small-scale salvage blocks between 14 and 132 ha in size was 107.2 (SD 57.5, range 70-208, *n* = 5) and in select harvested blocks was 129.0 (SD 40.9, range 43-216, *n* = 42). Total sample size was 114 above because one cutblock had two treatment units that were very different in retained sph. No cutblocks retained >225 sph despite that being the live tree retention target for 10-20% of blocks. The only place we found >225 sph retained were in two situations, neither of which were included in our cutblock sampling. First, some small-scale salvage licences encompassed very large areas with relatively few dead or live trees removed from large areas. Second, in some woodlots cutblocks were not necessarily laid out and cut as they would be for major licensees. Often relatively low volumes were removed from widespread parts of the woodlot leading to high levels of average retention that were difficult to characterize as individual cutblocks.

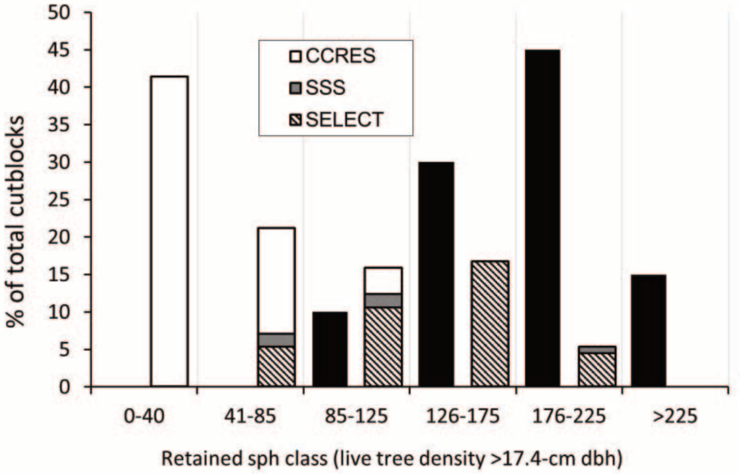

Figure 5. Actual distribution of live tree density classes in the portions of 113 cutblocks containing Critical Habitat prior to logging in the Okanagan-Boundary and West regions, compared with the hypothetical areas (black columns) that would have been retained if the targets of Table 1 of the BMPs had been met. CCRES = Clearcut with reserves, SSS = Small-scale salvage, SELECT = selection harvesting.

Breeding occupancy of cutblocks

For the 113 cutblocks examined between 2018 and 2021, a cutblock was considered occupied in June (value of 1) if there was a nest in the cutblock or if adults were observed in the cutblock; otherwise, they were considered unoccupied (value of 0). The data were examined using logistic regression to assess occupancy as a function of retained live tree density. Live tree densities were determined using at least 10 plots for cutblocks >10 ha in size, or 1 plot/ha for cutblocks smaller than 10 ha, except where very few live trees had been retained, and densities were estimated by quick visual counts of the few remaining trees.

Of 113 cutblocks, there were active nests in only 5, but some June foraging use in another 15. Occupancy of cutblocks decreased as sph decreased below 100 sph (Figure 6). Mean occupancy of cutblocks with <100 sph (0.12, SD 0.33, *n* = 82) was significantly lower ($t = 2.55, p = 0.01$) than for cutblocks with >100 sph (0.32, SD 0.48, *n* = 31). Similar to our previous findings (see **Live tree retention target …**), very open stands with <100 sph were used less often than more dense treed stands.

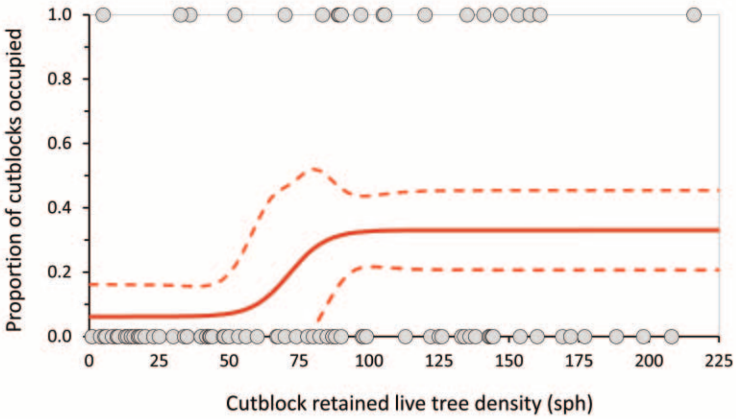

Figure 6. Logistic (sigmoid curve) regression of the proportion of 113 cutblocks occupied by breeding Williamson's Sapsucker in June, 2018-2021, vs density of retained live tree ≥17.5-cm DBH (sph) in the harvested portions of the cutblocks. 95% confidence band shown (dashed lines).

Preferred stand structure

The BMPs were silent on the preferred stand structure to be retained in cutblocks because, as of 2014, we had only average stand data without radio-telemetry information confirming actual preferred foraging tree sizes (St-Amand 2017). Williamson's Sapsucker used a wide range of tree sizes for gleaning ants, with larger trees preferred over those <20 cm dbh

(Figure 7). This wide range of larger trees used was consistent across all 12 breeding territories in the radio-telemetry study. At no breeding territory was only a narrow range of tree sizes used for gleaning, and no breeding territory contained only a single cohort of trees, i.e., a very wide range of tree diameter classes was available. These multi-aged stands that have been selectively harvested or high-graded in the past have been estimated to make up 85% of the Williamson's Sapsucker AOs (L. Gyug, unpublished data). Although we are presenting foraging stand structure for all tree species in this article, live Douglas-fir were generally selected for gleaning by Williamson's Sapsuckers and their retention during timber harvesting should be prioritized (St-Amand et al. 2018, 2021) along with retention of the primary nest trees and nest tree recruits (i.e., western larch, trembling aspen and/or ponderosa pine) that are not directly addressed here.

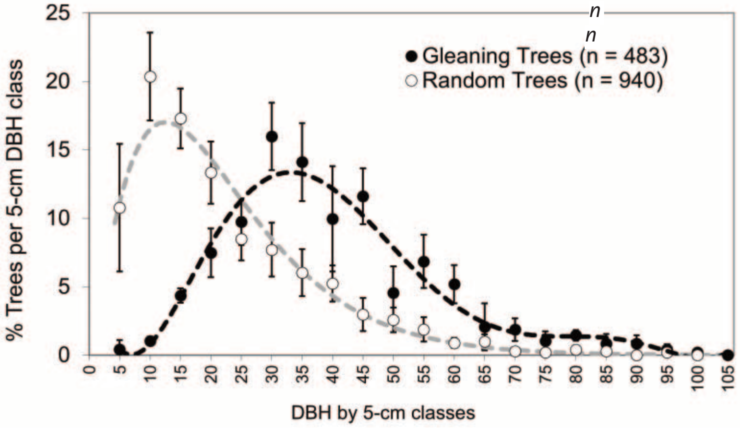

Figure 7. Ant gleaning tree frequency by 5-cm dbh classes compared to random tree frequency. Curves fitted to show trends in stand structure for illustrative purposes only (Hoerl curve for random trees; sixth-order polynomial for gleaning trees). Error bars shown are standard errors. A single gleaning tree of 141-cm dbh is not included on the graph.

Detailed stand structure was presented here for 12 cutblocks in the Boundary AO that had been single-tree selection harvested and retained >144 sph. Stand structure was estimated from post-harvest plots that included both tree and stump counts. Williamson's Sapsucker nests or pairs were found in 5 of these 12 blocks after harvest.

Mean retained live tree density in these 12 blocks was 270 sph prior to harvest (95% CI 244-296 sph) and 170 sph (95% CI 157-183 sph) post-harvest. Retained trees (Figure 8) were from the full range of size classes on site, excepting the largest size classes >55-cm dbh, where more trees were retained as per the BMP recommendations to retain potential nest trees and nest tree recruits. Removal levels (by density) averaged 50% for trees in the 30-40-cm dbh classes, but 20-40% for other dbh classes. Basal area prior to harvest averaged 26.0 m^2/ha, and after harvest 20.6 m^2/ha for an average 21% removal of basal area.

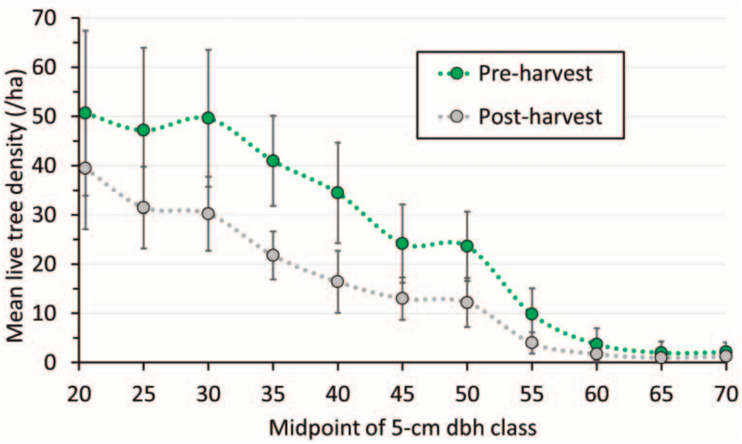

Figure 8. Average stand structure before and after selection harvest of BMP cutblocks in the Boundary where ≥140 sph been retained. 95% confidence intervals shown for each 5-cm dbh class (*n* = 16 cutblocks). Trees with dbh > 70 cm have been included in the 70-cm dbh class.

Most of the sites had been partially harvested or selectively harvested sometime in the mid-twentieth century, so this was not first-pass logging. The mean basal area of all 36 cutblocks in the Boundary sample was also 26.0 m^2/ha, i.e., similar to our sample of 12, indicating that most of those other cutblocks could probably have retained higher tree densities after harvest. The general stand profile both before and after logging (Figure 8) matched the relative stand structure of Figure 7 found in Williamson's Sapsucker breeding territories, i.e., smaller trees were more numerous than larger trees, and the stands were not even-aged. This seemed to be true of most stands in the regions occupied by Williamson's Sapsucker, where the typical stand is a multi-aged Douglas-fir stand regenerating after past high-grading or selective logging.

Assessment

Live tree retention targets

The live tree retention targets established in Table 1 of the 2014 BMPs were reasonable based on the data available at the time, and have been shown to be supported by five other lines of data collected and/or analyzed later including nest locations in cutblocks, direct observations of foraging in and near cutblocks, radio-telemetry foraging location stand preferences, nest sites contrasted with unoccupied sites, and breeding occupancy of cutblocks. Cutblocks or sites with <100 sph were never preferred; cutblocks or sites >100 sph were more often used for both nesting and foraging; and very densely treed sites with >400 sph were not preferred or used as often for either foraging or nesting.

The concept of how minimum standards are derived and then applied to species-at-risk management was examined here in the light of Conner's (1979) recommendations. Minimum standards should not be the goal of timber management for any species, much less for an endangered one. The target should be the optimum, i.e., the observed mean, rather than a minimum. Based on the studies presented here, the optimum is 206 sph. While allowances have been made in the live tree retention targets of the BMPs for much lower targets in the range of 85-125 sph, these should not exceed 5-15% of the cutblocks, as per Table 1. However, our assessment found that 62% of the cutblocks retained live tree densities below even the minimum live tree retention class of Table 1 (Figure 5). To meet the BMP targets and, more importantly, to meet the Williamson's Sapsucker recovery goal, more cutblocks will need to be harvested by single-tree selection systems that, on average, will meet the Table 1 live tree retention targets.

Spatial configuration and retained stand structure

The 2014 BMPs were silent about both the spatial configuration of live tree retention and the size classes of live trees to be retained. For spatial configuration, the 2014 BMPs assumed that a live tree retention target could be met as an average on the "cutblock" spatial scale, and that a wider range of live tree retention in separate cutblocks would meet the targets of Table 1. However, our assessment of 113 cutblocks showed that the Table 1 targets were not being met because BMP application was voluntary, and the targets were not being applied to all cutblocks where they should have been applied. Our data on foraging use did not support the cutblock scale of averaging. Portions of blocks with less than 100 sph were effectively unsuitable foraging habitat for Williamson's Sapsucker. Targets need to be met and/or averaged at the hectare level, not the entire cutblock level. Any portions of a cutblock that have <100 sph, and especially those with far less than 100 sph, will have little to no foraging suitability, will result in habitat loss rather than maintenance, and the recovery goal will not be met. We found that only when harvesting maintained relatively even target live tree densities over the entire cutblocks was there high success in maintaining occupancy and habitat suitability within the cutblock (Figure 6).

The preferred foraging stand profile (Figure 7) is very similar to that of a balanced uneven-aged silvicultural system (e.g., Forest Practices Branch 2003, Jull et al. 2025). Shelterwood systems, which may sometimes retain high densities of overstorey trees, may be inappropriate because they usually result in even-aged stands over time with the eventual intent to remove the overstorey once regeneration has established (Day et al. 2011). Here, we found that partial harvesting systems, the majority of which were single-tree selection harvests (Figure 8), appeared to successfully retain the stand structure preferred by Williamson's Sapsucker (Figure 7). It is these Douglas-fir-dominated uneven-aged stands that Williamson's Sapsucker prefer for foraging, and that characterize most of the forest stands the species occupies in B.C., whether those stands resulted from past selective logging or past mixed-severity fires. Any harvesting or silvicultural system that retains too few trees to remain preferred foraging habitat (i.e., <100 sph) will be inappropriate.

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