

Williamson's Sapsucker West Region: WHA and BMP Monitoring 2021

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ABSTRACT

Wildlife Habitat Areas (WHAs) have been established for the Endangered Williamson's Sapsucker with 150 approved between 2008 and 2016, and 31 others formally proposed between 2002 and 2019. The voluntary Best Management Practices (BMPs) published in 2014 provided guidelines for timber harvesting that would maintain habitat suitability for WISA. This 2021 project for the southern portion of the WISA West Area of Occupancy (AO) near Aspen Grove and Princeton completes the first round of assessment of WHA and BMP effectiveness that has, since 2017, now covered each of the WISA regional AOs.

In 2021, WISA breeding occupancy of 16 approved WHAs and 9 proposed WHAs was assessed in April-May and in June. Including the 2019 data for the northern portion of the West AO, WISA breeding was confirmed or probable at 28% of the 67 approved and proposed WHAs in the West AO, and possible at an additional 24% for total breeding occupancy of 52%. In the 2021 surveys, none of the original nest trees (n = 25) around which the WHAs were established or proposed were re-used for nesting. Re-nesting took place in 17 trees that were on average 223 m from the original nest tree, 29% of which were outside the WHAs. Recommendations were made for WHA changes based on field observations and on minimum spatial habitat requirements determined from previous analysis of radio-telemetry results.

WISA breeding occupancy of 32 harvested cutblocks in the West AO was assessed in April-May and again in June 2021 for any blocks where WISA had been found within or near the blocks. All 24 blocks for which Site Plans were obtained stated that the BMPs had been applied. By way of comparison, the BMPs had been applied to none of the 18 blocks assessed in 2019 in the northern part of the West AO. In early May WISA were found in 7, and near another 12, of the 32 blocks assessed in April-May 2021. By June, there was confirmed or probable breeding in, or on the edge of, three cutblocks, and WISA foraged within parts of another four cutblocks from nests near the harvested areas.

Of 151 cutblocks in the West AO submitted since 2014 and that intersected WISA Critical Habitat (Low or better suitability) only 50, which includes the 18 assessed in 2019, have been monitored for WISA occupancy and for whether, and how, the BMPs were applied. These were not a random sample, instead representing, for the most part, the blocks where the BMPs were applied, or where some form of partial cutting had been applied but not necessarily for retention of WISA habitat suitability. Of the 50 cutblocks, 11 met the minimum BMP live tree

retention target of 85 trees/ha on the harvested portion of the block alone, and an additional 10 met the target when averaging over the gross block area including reserves. Only 4 blocks met the next higher level of live tree retention (>125/ha) on the harvested portions of the blocks, while an additional 3 blocks met that target when averaged over the gross block area. While the lowest BMP target level of 85-125 retained trees/ha was supposed to be only 5-15% of new blocks, it has become the norm on blocks where the BMPs have been applied, rather than the exception.

Unless retained tree densities were >80 trees/ha in the harvested portions of the block (n = 50), the blocks were not effective at maintaining WISA occupancy. Based on similar results in the Boundary in 2018-2020 (n = 58 cutblocks) the minimum BMP live tree retention targets should be 100 trees/ha and need to be met on just the harvested area, not averaged over the gross block area.

Re-census of the Dodds Lake area (6.3 km²) found a drop in breeding territory density from 1.40/km² in 2012 to 0.64/km² in 2021, coinciding with a reduction in Critical Habitat from 60% to 46% of the area from timber harvesting between 2012 and 2021. Re-census of the August Lake area (4.8 km²) found an increase in breeding territory density from 1.73/km² in 2005 to 2.71 km² in 2021. Less than 10% of the August Lake area has ever been clearcut (with reserves), with that clearcutting happening in 2014-2015. That level of creating openings did not appear to have affected the local breeding density. Based on these results, and the results from other census areas, there may be a threshold effect on breeding density when Critical Habitat is reduced below 50% in a given area.

Nest tree survivorship for all regions from 2018-2021 was examined including the 2021 data gathered here. Only about 50% of trembling aspen, ponderosa pine and Douglas-fir nest trees were still suitable for nesting 10 years after initial discovery, and most of them would be expected to be no longer suitable after 20 years. Western larch nest trees in the Okanagan-Boundary and East Kootenay AOs had a much higher survival rate of 90% up to 15 years, and 80% after 20-25 years.

Erratum: October 26 version of this report had incorrect calculations of Basal Area and Figure 5 (stand structure) due to an incorrect entry in a lookup function within Excel. This has been corrected in Appendix 4, Figure 5 and within the text of this November 9 version.

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INTRODUCTION

Williamson's Sapsucker (WISA) has been designated as Endangered in Canada (COSEWIC 2005, 2017), and is listed under Schedule 1 of the Species at Risk Act. Effectiveness monitoring protocols (Gyug 2016) were prepared to estimate the conservation effectiveness of Wildlife Habitat Areas (WHAs) and the Best Management Practices (BMPs) (BC FLNRORD 2014) for timber harvesting in the Williamson's Sapsucker Area of Occupancy (AO). Application of the BMPs to cutblocks is voluntary for licensees, i.e., there is no Government Action Regulation (GAR) stipulating they must be applied. However, the provincial WISA Recovery Plan (BC MOE 2012) and the federal Recovery Plan (Environment Canada 2014, Environment and Climate Change Canada 2016) both rely on the application of the BMPs to provincial crown forest to attain its objective of maintaining current abundance through maintenance of current habitat suitability.

Since WHAs are only established around known breeding sites, they can be considered effective if WISA breeding continues at normal rates, i.e., not every breeding territory is necessarily occupied every year, so an average occupancy rate of 0.3 to 0.4 can be considered successful, and if the habitat within the WHA remains suitable based on established criteria (see Gyug 2016 and Gyug 2021). The BMPs can be considered to be effective if firstly, they are applied to cutblocks, and secondly, if WISA either breed within the cutblocks or forage within cutblocks from adjacent breeding sites. In addition, the tree densities remaining within cutblocks were examined for correlation with WISA breeding occupancy to assess whether the recommended tree retention targets of the BMPs had been appropriately set to maintain habitat suitability.

Surveys began in 2017 to assess effectiveness of WHAs and BMPs. Detailed surveys of WHAs and cutblocks were done in June 2019 in the Merritt area of the West AO (Gyug 2019a), in April and June 2019 in the East Kootenay (Gyug 2019b), in the Boundary from 2018-2020 (Gyug 2020a), and in the Okanagan in 2020 (Gyug 2020b). This project completes the first round of WHA and BMP effectiveness surveys of all the WISA regional AOs from 2017-2021.

The objectives of this 2021 project in the southern portion of the West AO were to:

1. Report April/early May (Level 1) and June (Level 2) WISA breeding occupancy in WHAs and in any cutblocks approved and harvested after April 2014 that overlapped with WISA Critical Habitat not including blocks already surveyed in 2019;
2. Summarize and interpret WHA and cutblock occupancy results from 2019-2021 in the West AO;

3. Assess WHAs occupancy and habitat suitability and make recommendations as to whether to proceed with proposals or make any other changes or modifications to WHAs;
4. Estimate survivorship of nest trees through status checks of old nests;
5. Assess the effectiveness of the BMPs in harvested cutblocks in the West AO based on whether and how they have been applied to cutblocks and on observed WISA breeding occupancy in the blocks, and compare to other regional AOs; and
6. As one of several other long-term monitoring methods, re-census two areas where there were clusters of both cutblocks and WHAs that were already going to be part of the 2021 surveys.

METHODS

Study Sites

The 2019 WISA WHA and BMP effectiveness surveys had been conducted in the northern part of the West AO (Gyug 2019a). The 2021 surveys detailed in this report were in the southern part of the West AO near Aspen Grove and Princeton. A set of cutblocks for which the WISA BMPs had been applied at Promontory Hills in the northern portion and had been cut since 2019 were also included.

There are 67 approved and proposed WHAs in the West region. In 2017 16 WHAs were monitored for WISA presence only in April or early May (Level 1) including 12 WHAs in the north part of the West AO, and 4 WHAs in the south part. In 2019, all 42 WHAs in the north part of the West AO were surveyed for WISA occupancy, but only in June (Level 2), when surveys are not particularly efficient. In 2021, 16 approved and 9 proposed WHAs in the south part of the West AO were surveyed for WISA occupancy first in April or early May (Figure 1). These were conducted from May 4-8, 2021, but other surveys for different projects from April 5-13 and April 21-22, 2021, also contributed to determining if WHAs were occupied. Any WHAs occupied in April or early May were re-surveyed for WISA breeding activity on one or more days between June 8 and June 26.

All cutblocks were examined for possible field assessment if they had been submitted or approved after April 2014, i.e., when the BMPs were published. From April 2014 until March 2021, there were 219 cutblocks intersecting the WISA West AO totaling 3855 ha gross area, and 3382 ha net area. This gross cutblock area was about 5% of the West AO. 151 of

these blocks intersected WISA Critical Habitat, i.e., Low or better suitability habitat (Environment Canada and Climate Change Canada 2016). The highest habitat suitability ratings in the West AO are Moderate (0.8 to 2.3 nests/km²) relative to the highest (benchmark) densities of 3.1 nests/km² in the Okanagan-Boundary (Gyug 2010). All habitats from Very Low and upwards support WISA breeding, albeit at lower densities (Low supports 0.2 to 0.8 nests/km², and Very Low supports 0 to 0.2 nests/km²). To date, only 50 of those 151 cutblocks have been assessed for WISA breeding occupancy. The 50 were not a random sample, instead representing the blocks where the BMPs were applied, were most likely to have been applied, or where some form of partial cutting was seen to have been applied based on satellite imagery or the author's personal knowledge of the site.

Cutblocks were selected for further examination of WISA occupancy if they had been already cut, and overlapped with at least 1 ha of WISA Critical Habitat (Low or better suitability habitat). Site Plans were obtained to assess if the prescriptions included reference to WISA and the BMPs, and if so, how they had been applied. Very few of the Site Plans showed specifically how the cutting specifications were to meet the WISA BMP live tree retention targets, either by density or by area. Most just stated that that the BMPs were being applied.

In 2019, the WISA BMPs had been applied to none of the blocks in the north part of the West AO, so all 18 were surveyed (Gyug 2019a). In 2021, WISA BMPs or partial cutting methods had been applied to 26 cutblocks found throughout the West AO, which were surveyed in early May (May 4-8) for WISA occupancy, and then again on one or more days from June 8 to June 26 if occupied in early May (Figures 1 and 2). One additional cutblock (611-06) was added to the 26 cutblocks to make a total of 27. It was <1 ha in size, so was not initially included in the sample, however, it was effectively sampled because it was only 35 m from block 611-05, and it did contain a nesting WISA pair, so was included in the final sample. An additional five cutblocks were surveyed for occupancy even though the WISA BMPs had not been applied to get more complete geographical coverage in the Pike Mt area, where there were no cutblocks to which the BMPs had been applied.

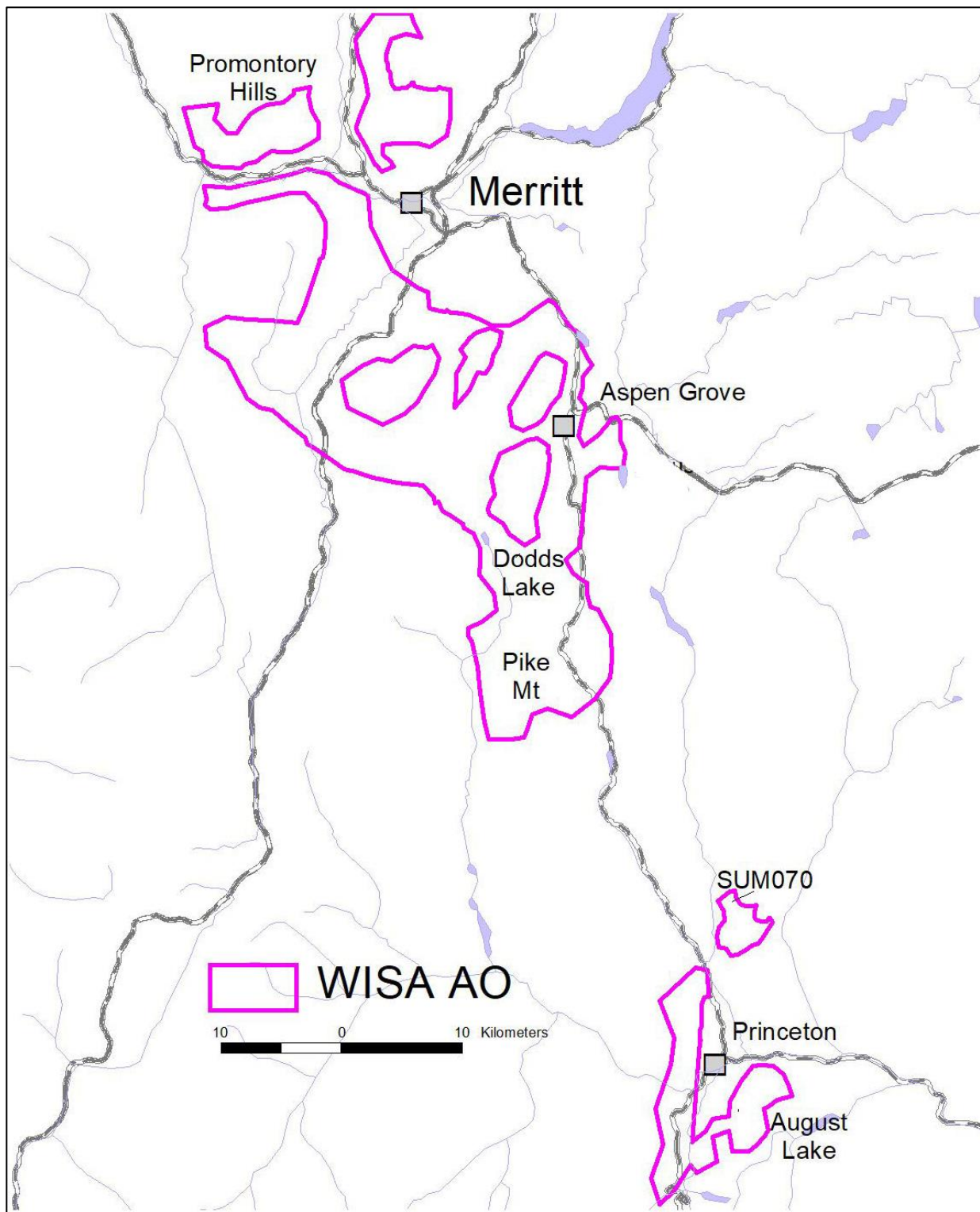


Figure 1. Overview of WISA occupancy sampling areas in the West AO, 2021.

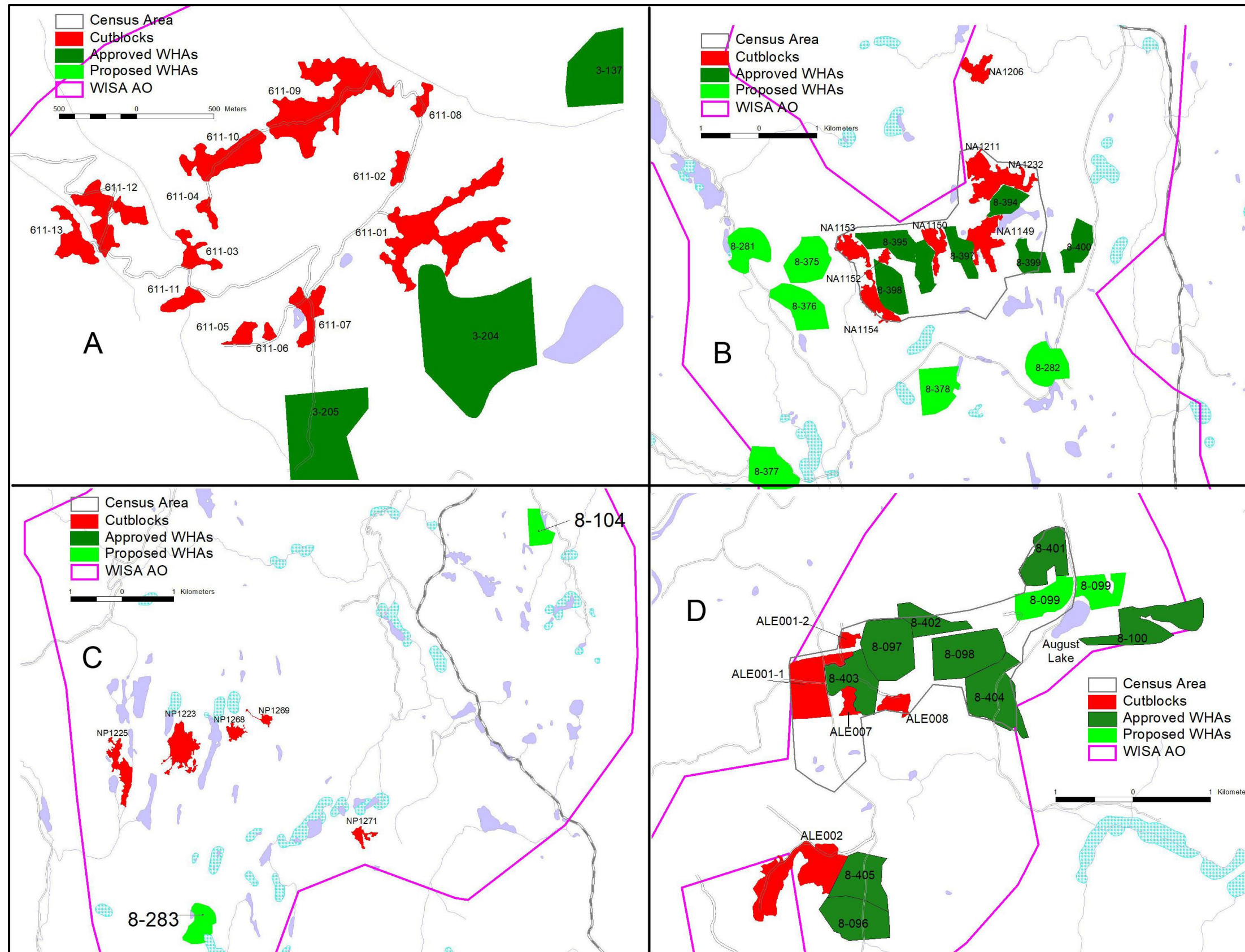


Figure 2. Maps of WISA WHA and cutblock occupancy sampling sites in the West AO, 2021.

A) Promontory Hills

B) Dodds Lake (note that cutblock NA1151 between 8-395 and 8-398 is not shown on Figure)

C) Pike Mt.

D) August Lake.

Occupancy Field Methods

The WHAs and cutblocks were sampled for Level 1 occupancy in April or early May, 2021. Methods have been described in Gyug (2016) but have been slightly modified as reported by Gyug (2020a) and summarized below. Breeding was determined to be Possible, Probable or Confirmed based on Breeding Bird Atlas criteria (see Appendix 6).

Occupancy Level 1: WISA Presence during territory establishment phase (April-early May).

1. Visit the site any time from approximately April 1 to May 7.
2. At any given site, begin assessment at any previously known nests (if any).
3. If no WISA are detected at known nest sites, use at least 5 Call Playbacks (CPB) over 30 minutes moving around entire site and listening for responses. If sites are larger than 16 ha, this may take longer than 30 minutes.
4. The assessment can be terminated when any WISA are found, although additional observations of possible territory centers or possible nest sites can be helpful for later (Level 2) surveys.

Occupancy Level 2: Breeding Confirmation during nesting phase (mid-May to late-June).

1. If no WISA were present on a prior Level 1 visit, then WISA will almost certainly not be present later in the breeding season, and Level 2 surveys need not be conducted as WISA will be assumed absent.
2. Breeding confirmation requires:
 - a. firstly, visits to any old nests to check for occupancy, with the current status of any previously known nest trees recorded,
 - b. secondly, up to 30 minutes spent on sites of 16 ha or smaller including a series of CPB throughout the site, approaching any potential breeding areas of the site to within at least 200 m, or until a response is detected, and
 - c. should a site be larger than 16 ha, surveys will take proportionately longer.
3. Wherever WISA are present within a site, the breeding activity will be assessed using the Breeding Bird Atlas breeding evidence codes (see Appendix 6). This may take considerably longer than 30 minutes even for a 16-ha site, and may require re-visits to confirm the exact state of breeding occupancy on the site.

Call playback equipment used included FoxPro electronic game caller units through large external FoxPro speakers with front bell dimensions of 25-cm x 17-cm or 21-cm diameter. When walking through the site with the intention of covering every area of the site to within at least 200 m, sometimes only a pocket call playback unit (FoxPro NX4 or equivalent) with a 14-cm diameter speaker was used.

Each formal CPB point sample consisted of three broadcasts of a 10-15 second Williamson's Sapsucker drum and call combination repeated three times in three directions, and then a silent listening period of 3 minutes, for a total listening time of 4 minutes and 20 seconds. At least one formal CPB point was done during the initial survey at a site. We recorded location of each such point. For each WISA detection we recorded the time (seconds) of the initial response from the beginning of the CPB. We recorded the sex (male, female, unknown or pair), the number of birds, and the type of responses (visual, drum and/or call), the estimated distance (m) and direction (degrees from a compass reading) to each WISA. Both male and female WISA drum, so the type of response cannot be used to identify sex. While walking within a site where we were doing CPBs, we did not necessarily do the full CPB protocol because WISA would be heard while walking away from a site, or even at the next CPB point. In those cases, we recorded the GPS track showing the route taken, and for each WISA detection we recorded WISA location by estimating distance and bearing from observer location, or by extrapolating WISA location directly on GPS unit using the cursor.

Where WISA were detected in the Level 1 occupancy checks, we returned to the WHA or cutblock in June for a Level 2 occupancy check. Wherever WISA were detected on the Level 2 check, a nest search was undertaken. If no WISA were detected, then we searched the site until we had confidence WISA were absent during the survey period. Location, type of observation and sex (if observed) were recorded for any WISA detections. The breeding evidence observed was recorded using the Breeding Bird Atlas breeding activity code (Appendix 6) along with any other observations, such as the location and nesting tree data for any newly-discovered nests. When an active nest was confirmed, other nearby WISA detections of the same pair were not usually entered into the final observation file.

Where there were WISA nests within or adjacent to cutblocks ($n = 5$), we observed the foraging bouts from the nest using two observers in radio contact for at least 1 hour to determine if they were foraging within the block or in adjacent forest or other stands, and the proportion of foraging time in the cutblock (or portion of) vs the adjacent stands. For each site examined, preference or avoidance was considered to be shown if there was a 10% or greater difference in time spent in a given habitat compared to the amount available within 225 m of the nest. For habitats that were available at all five sites, i.e., forest or portions of cutblocks with <50 trees/ha cut, we used t-tests to determine if percentage of foraging time in a habitat differed from the percent available.

Re-census of census areas of at least 1.0 km² had been an additional recommended monitoring method (Gyug 2016). There were 24 such census areas in the West AO, any of which could be used as long-term monitoring sites. Two of these areas (Dodds Lake: 6.3 km² and August Lake: 4.8 km²) were re-censused in 2021 because most of the area of these two sites were now within either WHAs or cutblocks that were already part of the 2021 surveys. Dodds Lake had been originally censused for breeding density in 2012, and August Lake in 2005. Census survey effort in April-May was 1.5 person-days for August Lake and 1 person-day for Dodds Lake. Census survey effort in June was 3.5 person-days for August Lake and 2 person-days for Dodds Lake.

Field data was entered into a single WISA Excel file template designed in 2007 in consultation with the Wildlife Species Inventory (WSI) for submission to the WSI Species Inventory (SPI) system of the BC Ministry of Environment and Climate Change Strategy. This file was quality checked for formatting and for data entry errors, and submitted to SPI at the end of the field season along with WISA data from other projects.

WHA Assessment

All WISA approved and proposed WHAs were spatially assessed in March 2021 to determine if they met proposed minimum area and habitat standards (see Gyug 2021). Those standards were based on average and minimum breeding territory sizes within the average radius from nests that contained 95% of observations from the radio-telemetry study (see Gyug and St-Amand 2020). Foraging territories around nests are usually not circular but do tend to occur within a certain radius of the nest. Based on those analyses, minimum recommendations were for at least 19 ha suitable (Moderate or better) foraging habitat within 340 m of a nest, and failing that, at least 19 ha within 460 m of a nest. These were based on the average requirements within 95% kernel breeding territories determined from radio-telemetry minus 1 standard deviation, i.e., were the minimum, not the expected goal. Based on 95% kernel breeding territory sizes, most WHA should be at least 34 ha in size, and better still, the average plus 1 standard deviation, i.e., 52 ha. The desktop analysis of all approved and proposed WHAs to see if they met these standards was done by Gyug (2021). Those results are not repeated here.

Field effectiveness assessment of the 25 WHAs in the south part of the West was done at a reconnaissance level according to the recommendations of Gyug (2021) in the spring of 2021 when visited during WISA surveys.

Cutblock Habitat Plots

The intent of the habitat plots was to document the retained tree densities after timber harvest in the cutblocks that were assessed in 2021. First, Site Plans were obtained from licensees. A sampling plan for habitat plots was developed in GIS that placed plots randomly within the harvested portion of the blocks treating any Wildlife Tree Patches or other reserves as a separate stratum if those boundaries were indicated on the Site Plan maps. Plots were at least 17 m from cutblock or strata boundaries, and at least 50 m from each other. Additional plots were placed randomly within the portion of cutblock NA1149 where WISA had been observed foraging within the block.

Circular tree, snag and stump tally plots were placed at each of the pre-planned random points. Target plot densities were 1 plot/ha for cutblocks <11 ha (minimum 3 plots per block), 10 plots for cutblocks >10 ha, and more plots were included where WISA were using a block and/or tree densities differed greatly in the part(s) of a block that WISA used.

Habitat plot data collection methods have been previously described in Gyug (2020a) and were only slightly modified for 2021. Habitat plot field methods and field data forms used in 2021 are included in Appendix 6. Plots were nested so that smaller trees were counted in smaller radius plots than larger trees around the same plot centre. Trees, snags and stumps were tallied by 5-cm DBH classes from 7.5-cm DBH and up. The actual radii used at any given plot depended on tree density and sight lines but we attempted to be consistent within any single strata within a cutblock. In harvested blocks, plots were sometimes quite large (>17 m) if there were few trees. Distance from plot centre to trees were measured using a laser distance measurer (accuracy 0.1 m) for trees near plot boundaries. Snags were tallied within 17.84-m radius from the same plot centres, but only for snags with DBH >17.4 cm.

Tree tallies in plots were used to estimate the merchantable tree density and snag density remaining after timber harvest; stump tallies were used to estimate trees taken during the most recent harvest. Stumps were tallied within a 9.77-m radius plot and were classified as from old logging, or from the most recent harvest. Stump diameter by 5-cm class was measured at stump height (DSH), including bark, if that was still intact. Where stumps had been pulled such as on a roadway, landing or root rot centre, no estimate of stump density was made, and the value for that plot treated as missing data.

Basal area was estimated for the live trees using the sum of the density by 5-cm classes and multiplying by the basal area for that class. To estimate the basal area prior to

logging, the same was done for stumps. However, stump diameter will typically be larger than the DBH, so a conversion factor was used. Conversion factors for stump DSH to DBH require the diameters of stumps inside bark (DSIB) and the height of each stump (Omule and Kozak 1989). These parameters were not measured throughout this project, so a subsample of 127 stumps (i.e., every stump within the 22 plots done on October 1) were measured for the DSH, DSIB and height to create a conversion factor particular to this project. DSH as measured was converted to DBH for each 5-cm class of stumps using the factors estimated in the stumps subsample to estimate stump density by DBH class, and estimate basal area, which is estimated from DBH.

Coarse Woody Debris (CWD) was not measured because it was not expected to be an issue in assessing the BMPs. Almost all blocks previously surveyed in 2019 and 2020 had been found to meet or exceed BMP CWD recommendations (see Gyug 2019a, Gyug 2020a).

Suitable WISA Nest Trees (see Appendix 7) were tallied within a radius of 25.23 m around plot centres. Large thatch ant nests (usually *Formica rufa* species group) were tallied within the same radius plots as stumps.

Habitat plot data was entered into an Excel template file developed specifically for this WISA plot data. The summarized results of those plots were added to the WISA habitat plot master shapefile that includes all plots from 2006 onwards.

RESULTS and DISCUSSION

WISA Surveys

WISA were found in or very near 64% of the 25 approved and proposed WHAs surveyed in April or early May 2021 (Table 1). By June, there was confirmed or probable breeding at 40% of the WHAs. Including possible breeding, 60% of these WHAs were occupied in 2021. These rates in the south part of the West AO were higher than in the north part of the West AO surveyed in 2019, i.e., 60% vs 48%. The overall West AO WHA June occupancy rate for confirmed or probable breeding of 28% (n = 67 approved and proposed WHAs) was similar to that found in the other regional AOs in B.C. (Table 1). However, when including possible breeding, the 52% level was higher than in the other regional AOs.

24 of the 32 harvested blocks surveyed in the West AO in 2021 had previously had at least some surveys for WISA, with WISA found in or near 13 of the 24 (summary in Table 2, details in Appendix 2). In early May 2021, WISA were found in or near 19 of the 32 blocks but

Table 1. Williamson's Sapsucker WHA occupancy summary, West AO, 2017, 2019 and 2021, compared to other regions. See Appendices for detailed information on each site and Appendix 6 for the definitions of Possible, Probable and Confirmed nesting.

Type of Site	Occupancy Level 1 (April to early May)			Occupancy Level 2 (June)				
	Sites (N)	Occu- pied Sites (n)*	Occu- pancy Rate (%)	Sites (N)	Prob. and Conf. Nesting		Poss., Prob. and Conf. Nesting	
					Sites (n)	Rate (%)	Sites (n)	Rate (%)
West North								
2017 (Level 1), 2019 (Level 2)	12	5	42	12	3	25	5	42
2019 30 other WHAs	na			30	6	20	15	50
Subtotal 2019	na			42	9	21	20	48
West South								
2017 (Level 1; re-checked in 2021)	(4)	(3)	(75)	na				
Approved WHAs (2021)	16	11	69	16	7	44	11	69
Proposed WHAs (2021)	9	5	56	9	3	33	4	44
Subtotal 2021	25	16	64	25	10	40	15	60
West Region Totals	37	21	57	67	19	28	35	52
Other Regional Totals								
East Kootenay (2018-2019)	35	11.5	33	35	4	11	10.5	30
Boundary (2018-2020)	38	25	65	38	10.5	28	11.5	30
Okanagan Approved (2020)	na			19	4	21	6	32
Okanagan Proposed (2020)	na			22	6	27	9	41
WHA Total	110	57.5	52	181	43.5	24	72	40

*Fractionally occupied WHAs possible when checked in >1 year from 2017-2021, i.e., for those with different occupancy in different years.

only within 7 of the blocks. In June 2021, WISA were found nesting within the harvested portions of two of the cutblocks (ALE001-01, 19 m from a Wildlife Tree Patch on the block boundary, and 611-06, 11 m from the block boundary) and in a snag right on the block boundary of 611-01. Block 611-06 was not in the originally planned set of blocks to survey because it was smaller than 1 ha. It was added because WISA were found nesting within it during surveys of an adjacent block 611-06 (35 m away). WISA were found foraging within portions of four other cutblocks from nests near to the blocks (611-02, 611-04, 611-05 and NA1149). WISA were found nesting within 60 m of the harvested portions of three cutblocks: one nest in a Wildlife Tree Patch of ALE001-1 55 m from any opening, one 57 m from NA1149, and one 60 m from 611-04.

Table 2. WISA cutblock breeding occupancy in the West AO in cutblocks assessed in 2019 and 2021.

Type of Site	Sites (n)	Occupancy Level 1 (April to early May)		Occupancy Level 2 (late-May to June)			
		Occ. Sites (n)	Occ. Rate (%)	Prob. and Conf. Nesting		Poss., Prob. and Conf. Nesting	
				Occ. Sites (n)	Occ. Rate (%)	Occ. Sites (n)	Occ. Rate (%)
Harvested Cutblocks 2019							
Previously Surveyed for WISA*							
WISA presence known in or near block	4	na		0	0	1	25
Previously surveyed but no WISA detected	9	na		0	0	0	0
Not previously Surveyed	<u>5</u>	<u>na</u>		<u>0</u>	0	<u>0</u>	0
Total	18	na		0	0	1	5
Harvested Cutblocks 2021							
Previously Surveyed for WISA*							
WISA presence known in or near block	13	3	23	2	15	3	23
Previously surveyed but no WISA detected	11	1	9	0	0	2	18
Not previously Surveyed	<u>8</u>	<u>3</u>	38	<u>1</u>	13	<u>3</u>	38
Total	32	7	22	3	9	8	25

*Previous WISA CPB were conducted for other purposes between 2004 and 2014.

One nest found active on June 14 had been depredated by a black bear between June 14 and when we returned to attempt to quantify foraging times on June 20. This nest had been 19 m above ground right at the top of a dead Py and was on the boundary of block 611-01. On June 20, fresh bear claw marks could be seen on the tree trunk, and the section of wood that had contained the nest was on the ground at the bottom of the tree. Where the wood had been torn off by the bear the nest cavity had been exposed, and no WISA were seen or heard in the immediate area. The nestlings heard on June 14 were no longer present, and were presumed to have been eaten by the bear as they would not have been old enough to have fledged by June 20.

Forest was the preferred foraging habitat at four of the five nests where foraging was observed (Table 3) based on differences of >10% in foraging time vs available habitat. The mean percentage of foraging time in forest (75.2%, SD 26.3, n = 5) was significantly higher (p = 0.01) than the percentage of available habitat (52.2%, SD 19.4, n = 5). In none of the five

Table 3. Foraging observations of nesting adult WISA (sum of male and females) in different habitats compared to habitat availability, West AO, 2021. Non-habitat (paved roads, powerlines and wetlands) was not included in % habitat available. **Green cells** indicate preference, i.e., at least 10% difference in foraging time compared to available, while **Greyed cells** indicate non-preference/avoidance.

Adjacent Cutblock	Nest Tree ID	Observed Foraging Period (min.)	% Foraging Time Spent In:				
			Forest	Open Forest	Partial Cut	Cut with <40 trees/ha retained	Non-merch Reserve
611-04/10	WNM122	120	96*	-	4	0	-
611-06	WNM123	135	83	-	17*	0	-
NA1149	WNM118	118	31*	0	36	33	-
ALE001	WNP029	30	73	-	0	27*	-
ALE001	WNP026	120	93*	-	-	0	7
			% Habitat available within 225 m				
611-04/10	WNM122		76	0	15	9	
611-06	WNM123		62	0	15	23	
NA1149	WNM118		24	31	16	29	
ALE001	WNP029		45	0	17	38	
ALE001	WNP026		54	0	0	35	11
			Tree (>17.4-cm DBH) Density (/ha)				
611-04/10	WNM122		NA†	-	135	25	
611-06	WNM123		NA	-	105	NA	
NA1149	WNM118		585	NA	62	32	
ALE001	WNP029		364	-	180	33	
ALE001	WNP026		364	-	-	33	

*habitat in which nest was located.

†indicates tree density Not Available from plot data

cases were the open areas averaging <40 trees/ha retained preferred WISA foraging sites. The mean foraging time in cuts with <40 trees/ha (12.0%, SD 16.6, n = 5) was lower ($p = 0.09$) than the percentage of available habitat (26.8%, SD 11.6, n = 5). However, there was considerable variance in this use of open habitat (Table 3), so the avoidance was not as clear as the foraging preference shown for forest. Partial cuts were preferred at only one nest (NA1149, WNM118, Table 4), where the retained tree density in the partially cut harvested area used by WISA was 62/ha and the more-heavily harvested area used by WISA was 32/ha. These areas were not separate treatment units, but retained tree densities were noticeably different, so were separated for this analysis.

The high variance shown in use of cuts with <40 trees/ha retained came because two sites had some use, but three sites had no use. At ALE001, nest WNP029 was in the cutblock 19 m from the boundary, and the male seemed to spend time on trees in the nest vicinity within the cutblock. At nest WNM118, which was in an aspen grove 57 m outside the block boundary, the pair frequently foraged within the adjacent cutblock NA1149. However, they were foraging atypically, doing more flycatching and foraging on stumps and logs than I have ever before seen for WISA. This was not just the chance result of observations made during a single session, as we returned the next day, and saw the pair foraging in the same fashion. Therefore, the preferred tree density in that particular situation of only 62 trees/ha should not be viewed as a standard for such cuts. The behavioural plasticity shown by this particular pair, i.e., to be able to use a cutblock with only 32 to 62 trees/ha and still raise a clutch of 4 fledglings (nest was viewed with a nest camera on June 27, 2021, when nestlings were very near fledging age) should not be viewed as typical WISA behaviour, and should not set the standard for WISA BMP cutblocks, which should be based on the average (or better) and not on unusual exceptions.

Census Areas

In the Dodds Lake census area (6.26 km²), WISA breeding density decreased between 2012 and 2021. In 2021, there were 3 active nests, and one other male present for which no nest could be found. In 2021, nest density was 0.48 nests/km² and total possible breeding territory density was 0.64/km². In the 2012 census 6 active nests were found, one other pair, and one other WISA present, for a density of 1.05 active nests/km², and total possible breeding territory density of 1.40/km². In 2012, WISA fairly even spaced themselves out within the census area with mean nearest neighbour distance between nests/pairs in 2012 of 725 m (SE 70 m, n = 6). In 2021, mean nearest neighbour distance between nests/pairs was 1271 m (SE 597 m, n = 3), with the increased between-pair distance reflecting the decreased density.

Many portions of the Dodds Lake census area had been high-graded or partially cut in the distant past with old logging roads and skid trails found throughout. In or about 2004-2007, 8.5% of the area had been logged (or rather re-logged). In or about 2018-2019, an additional 22.8% of the area had been logged. When the original WISA suitability modeling was done in 2010 using the 2008 VRI, 60% of the census area was in Low or better suitability habitat. By 2021, this had been reduced to 46% of the census area because of the timber

harvesting in 2018-2019 and WISA breeding density had decreased to half of what it was in 2012. In the Okanagan Falls benchmark census area (see Gyug et al. 2007, and Gyug 2016), initial logging of about 33% of the area in the 1980's probably did not have much effect on WISA nesting densities, but the additional logging in 2005 that left only 39% old forest caused a significant population decline. The Dodds Lake retention of only 46% of Low or better habitat is of a similar magnitude, and seems also to have caused a population decline. WISA breeding densities may be responding to habitat threshold effects that operate on a scale of multiple breeding territories, i.e., areas of 200 – 600 ha, where a single breeding territory is in the range of 30-50 ha depending on habitat quality.

In the August Lake census area (4.8 km²), WISA breeding density increased from 2005 to 2021. In 2021, there were 9 active nests, 2 other pairs present, and 1 other WISA present for which no nest could be found. In 2021, nest density was 1.88 nests/km² in 2021 and total possible breeding territory density was 2.71/km². This compares to the 2005 census (4.05 km²), which had slightly different boundaries, where only 4 active nests were found, two other pairs, and one other WISA present, for a density of 0.99 active nests/km², and total possible breeding territory density of 1.73/km². In 2021, WISA fairly even spaced themselves out within the census area with mean nearest-neighbour distance between nests/pairs of 612 m (SE 131 m, n = 7). In 2005, mean nearest-neighbour distance between nests/pairs was similar at 715 m (SE 103 m, n = 3).

The August Lake area has a long history of logging, but until 2005 it had almost all been partial cutting or high grading based on a review of 1985 aerial photos for the area (the earliest date for which aerial photos are available online at <https://www2.gov.bc.ca/gov/content/data/geographic-data-services/digital-imagery/air-photos/air-photo-viewer>). A large 147-ha cutblock approved in 2003 covered about one-third of the census area but was partial harvest or select cut, and much of the area within that block was not harvested at all. In 2015, the ALE001, ALE007 and ALE008 blocks with net harvested area of 41.2 ha (8.5% of census area) appeared to be the first timber harvest openings in the census area that were not some type of partial cutting. That harvest that created openings of <10% of the census area did not appear to have affected WISA breeding density because the density increased from 2005 to 2021.

The increase in WISA breeding density at August Lake may have been for two reasons. Firstly, there had been extensive pine beetle kill of mature and old Py in and around 2007-2010, which meant there seemed to be an overabundance of potential nest trees. Secondly,

there was an extremely high density of *Formica rufa* spp. group ants (probably primarily *Formica obscuripes*, the western thatching ant), which is one of the preferred ant species with which WISA feed their nestlings (Gyug et al. 2014). This density was higher than I have noted anywhere else, either within or outside the WISA AO, and much higher than in 2005 in the August Lake area. For example, there were 3 such large thatch nests within 20 m of one of the WISA nests discovered in 2021. Average thatch ant nest density in the West AO from other surveys was 1.6/ha in 2006-2015 (n = 10 census areas, total of 28.5 ha searched within plots, or on transects between plots), and 2.6/ha in 2019 (n = 10 cutblocks, total of 4.5 ha searched at 113 plots). Average thatch ant nest density in the Promontory Hills area in 2021 within partially cut blocks was 1.7/ha, i.e., similar to previous estimates. These densities were all very much higher than in the Okanagan, where a density of 0.11/ha was detected using the same survey methods in 2015, 2020 and 2021 (total of 55.0 ha searched). The habitat plots done in the August Lake and Dodds Lake areas in 2021 did not encounter any active large thatch ant nests, but were primarily done within cutblocks that were more heavily cut (Clearcut with Reserves) than the partially cut sites at Promontory Hills. We found what may have been some old nests, but after timber harvesting and site preparation disturbance, the status and even the identification of these possible nests were difficult to determine. Clearcutting is known to have a severe impact on *F. rufa* spp. group ants, both through mound disturbance by machinery and a reduction in abundance of honeydew-producing aphids when trees are cut and removed (Sorvari 2016).

Nest tree survival

We examined 36 WISA nest trees in the Merritt area in 2021 for current status (see Appendix 5). The nest tree was considered to have survived if it remained suitable for nesting, i.e., usually standing, and with the portion of the tree where nesting occurred, or could occur, still intact. The results from the West in 2021 were included with other nest trees examined in the north portion of the West, the Okanagan, Boundary and East Kootenay from 2018-2021. In total, 291 known WISA nest trees were examined from 2018-2021 for current status. These included 164 western larch (Lw), 94 trembling aspen (At), 24 ponderosa pine (Py), 15 Douglas-fir (Fd), 9 water birch and 2 spruce sp. The discussion below is for all WISA nest tree species, not just those of the West AO.

For trembling aspen (At), survivorship was only about 60% after 10 years, and could be expected to drop to zero between 20 and 25 years (Figure 3). We have only been following

three aspen nest trees for longer than 18 years, all of which have fallen. Based on these results, relatively continuous recruitment of new aspen nest trees will be required for the aspen stands to retain value for WISA nesting. Managing for suitable WISA nest trees in the West AO area will require relatively constant recruitment of aspen into suitable age classes for WISA nesting (generally 60-120 years old) because aspen is not as long lived, and senesce at a younger age, than western larch or other conifers.

For western larch (Lw) (which is not found in the West AO), nest tree survival was relatively high at 90% up to 15 years after discovery, dropping to about 80% after 20-25 years (Figure 2). Managing for suitable WISA Lw nest trees will require retention and protection of

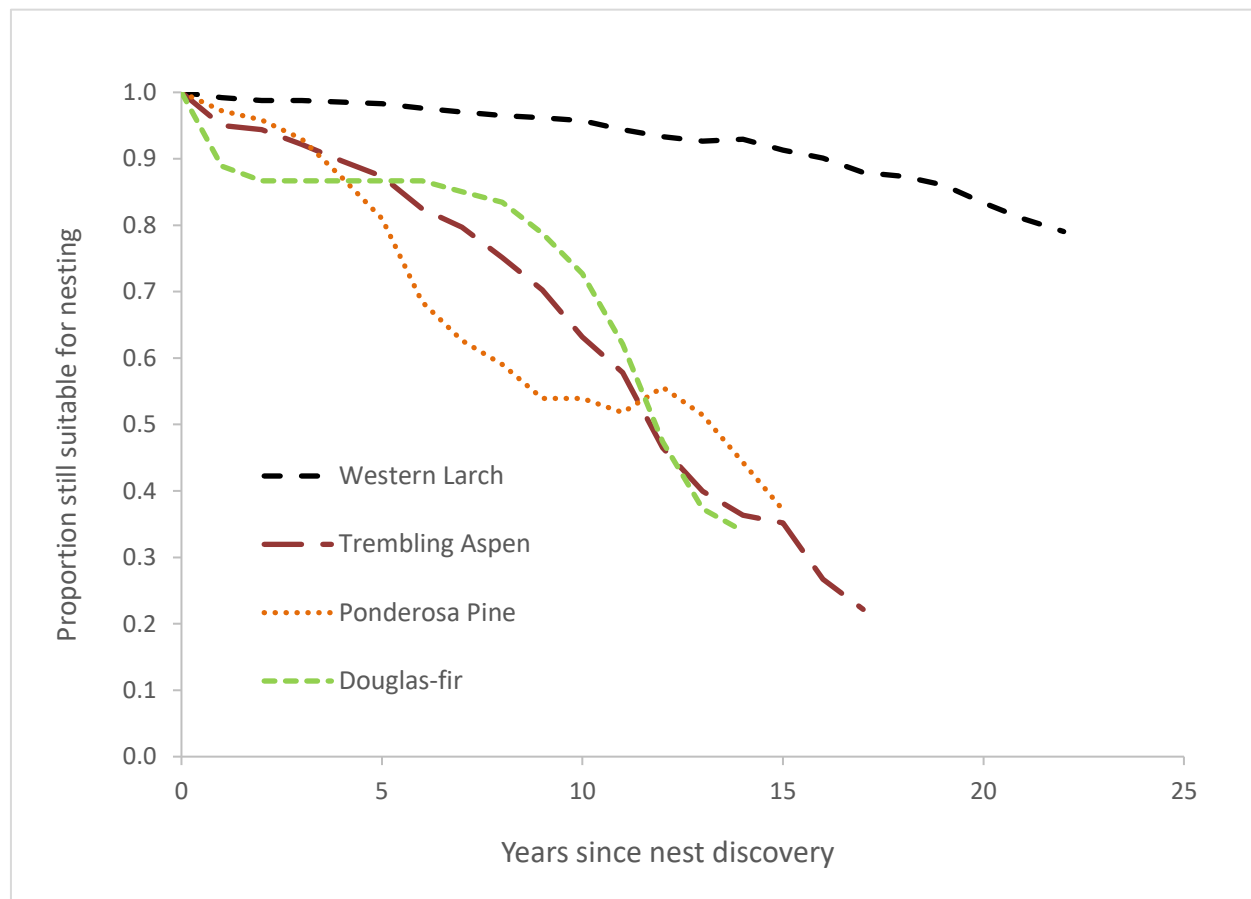


Figure 3. WISA nest tree survivorship until 2018-2021 from year of first discovery as a WISA nest tree. Graphs were extended in time until the minimum sample size of the oldest cohort was five nest trees. Curves were smoothed using moving averages.

existing nest trees, and recruitment of future nest trees on a very long time-scale. Lw generally become suitable WISA nest trees (mean 77 cm dbh, $n = 117$, Gyug et al. 2009) only when they get older than 300 years and the tops start dying back. We have counted the rings on some stumps of 80-cm DBH and larger Lw, and found them to be 500-600 years old. However, these were usually cull-trees that were not logged during the initial logging phases sometime between 1900 and about 1970 because they exhibited significant decay, so may not have been typical of all veteran Lw in the area. Based on Lw growth curves (Table 27 of Schmidt et al. 1976), for a typical site index of 20 (height in m at age of 50 years), a DBH of 64 would be expected at 200 years, and a DBH of 85 at 300 years, assuming that increment of DBH continued after 140 years at the same rate as before 140 years (the limit of the currently available DBH growth tables). However annual increment in DBH after 140 years almost certainly slows down, rather than continuing at the same pace as has been shown for height growth after 140 years (Brisco et al. 2002). It therefore probably takes even longer than 300 years for Lw to reach DBH of greater than 80 cm in mesic sites and to become highly suitable WISA nest trees.

WISA tended to use ponderosa pine (Py) and Douglas-fir (Fd) for nesting when the trees were already dead (Gyug et al. 2009). Survival of nest trees of these two conifer species to 10 years was about 50% (Figure 3). Almost no Py nest trees would be expected to be still standing after 20 years, while ~25-30% of Fd might still be standing, but only one Douglas-fir has been followed for that length of time. Most of the Py nest trees we examined had been killed by pine beetles during the epidemic of 2005-2010. Their survival as nest trees appears to be relatively limited in time to a few decades at best. Survival of the very large veteran Fd that WISA tend to use for nesting appeared to survive longer than smaller trees, but still not as long as for western larch.

Water birch ($n = 9$) was not included in Figure 3 because of limited sample size. However, the data indicated 100% survival to 13 years ($n = 3$), then no survival after 14-24 years ($n = 6$). We know this is not representative of true birch survivorship because a number of these nest trees were observed to fall before 13 years when checked incidentally prior to 2018. Water birch nest tree survivorship is probably similar to that of aspen.

WHA ASSESSMENT and RECOMMENDATIONS

In 2021, none of the previously known nest trees around which the WHAs had been established were re-used for nesting. We found that 80% of them had fallen over since the nests were discovered and were no longer suitable for nesting. However, we did still find WISA nesting in or near 17 of these nest trees, and we assumed that these pairs used the same or at least a similar foraging territory to the original nest trees. The mean distance shift in nest trees was 223 m (SD 156 m, SE 38 m, range 22-637 m, $n = 17$). Based on this observed shift of nesting sites, management and/or establishment of WHAs should not be centred just around current nest trees, but around the current nest tree plus the any stands of potential future nest trees given that nest tree survival was, on average, around 10 years in the West AO. This also highlights the importance of effectively managing for suitable habitat retention outside of the WHAs because the WHAs do not operate in isolation of the habitat around them.

When many of the WHAs were originally proposed, the area around them was forested, and there often seemed to be little difference between the forests within the WHAs, and the forests surrounding the WHAs. That, however, has changed. This was particularly notable in the Dodds Lake census area, where most of the stands between the WHAs have been recently logged as clearcuts with reserves. Similarly, in the Princeton area, clearcuts with reserves are now the western boundaries of WHA 8-098 and 8-403. WISA will be increasingly relying upon the WHAs as breeding habitat as the areas around them are clearcut.

Specific recommendations for changes, additions or deletions of WHAs are listed in Appendix 1 but some are also highlighted here. Quantification of the areas of suitable habitat within WHAs was done by Gyug (2021) and has not been repeated here.

For approved WHAs, I recommend:

- No approved WHAs be deleted,
- The boundaries of two approved WHAs be expanded to meet at least minimum size of suitable nesting and foraging habitat within the WHA, and the revised boundaries be submitted for approval decisions:
 - Expand the boundaries of approved WHA 8-397 to the southwest and to the northeast by 200 to 400 m to bring the amount of suitable nesting and foraging habitat within the WHA up from ~10 ha to minimum size standards of >20 ha.

This would increase the size of the WHA from 25.6 ha to about 50 ha and include a new nest found in 2021 (WNM118).

- Expand the boundaries of approved WHA 8-402 to the north and east by 200-300 m to encompass the foraging territory around nests WNP017 and WNP034. Radio-telemetry results (St-Amand 2017) from that nest site can be used to guide the area to be encompassed around the nests to bring their habitat suitability up to minimum size standards of at least 20 ha. Currently there is only 7.5 Low or better suitability nesting habitat and 16 ha foraging habitat. WHA size would be increased from 20.6 ha to 40 ha.

For currently proposed WHAs, I recommend:

- Move forward for an approval decision for the portion of proposed WHA 8-099 which is on crown lands, but drop the portion overlapping private land. The crown portion has been occupied annually by WISA every year from 2012 onwards by at least one if not two pairs. The boundaries of the proposal should be expanded about 500 m to the west on the north side of the hydro transmission line to encompass the area around nest tree WN302. That nest was not active in 2021, but the breeding territory was still occupied, although we could not locate an active nest there.
- Move the application forward for approval decision for WHA 8-283 – this site still has suitable nesting trees in an aspen patch, along with 24 ha of adjacent suitable foraging mature Fd forest habitat.
- Move forward for approval decisions for proposed WHAs 8-281, 8-375 and 8-376. These three WHAs are nearly adjacent to each other, and all were occupied by WISA in 2021. In addition, an active WISA nest was discovered in 2021 in the area of about 20 ha in between the three proposed WHAs, which should be proposed as a new WHA. Alternatively, it may be simpler to amalgamate all three current proposals into one WHA proposal that would include the area between them as part of the proposal, and then resubmit to move forward for an approval decision. The forested area between these three WHAs is currently a non-legal Old-Growth Management Area, so there should be no competing timber harvesting interests for those stands.
- Move forward with approval decisions for proposed WHAs 8-282, 8-377 and 8-378. Each of those contains sufficient (or very nearly so) habitat to meet minimum standards, and contains some potential nesting trees.

- Drop WHA 8-104 proposal – the habitat was marginal to begin with, and there are few or no currently suitable nest trees within the proposed area. There was only 11.8 ha of suitable habitat within the WHA by the 2008 modeling, and only 6.9 ha by the time of the 2018 model update. There are no adjacent opportunities to expand the WHA proposal to include more suitable habitat.

BMP ASSESSMENT and RECOMMENDATIONS

Application of the BMPs

As of March 2021, 219 cutblocks in the West AO had been submitted since the publication of the BMPs in April 2014. 151 of these blocks intersect WISA Critical Habitat, i.e., the Low or better suitability habitat where the BMPs should be applied. The Site Plans of most of these blocks have not been examined since we only obtained or requested Site Plans for 42 of these blocks in either of the 2019 or 2021 monitoring projects in the West AO, and have assessed the remaining stands and the WISA occupancy of 50 of the blocks. The other 101 blocks have yet to be selected for assessment, either because they had not yet been harvested by 2019 in the northern portion of the West AO, or by 2021 in the southern portion of the West AO, because they contained <1 ha of Low or better suitability habitat, or because sufficient field resources were not available to field assess them. No comprehensive assessment of all those blocks has been done yet, and approximately 30 or more new blocks are being submitted annually.

There is, as yet, no simple, efficient and ongoing system to track which blocks are incorporating the BMPs into their site planning, and whether the leave tree specifications are such that the plan will meet the live tree retention targets of the BMPs. Such a system should be developed, otherwise quantifying whether recovery goals for habitat are being met will not be possible.

In 2019 in the northern portion of the West AO, the BMPs, application of which is voluntary, had not been applied to any of the 18 cutblocks (Gyug 2019a). By 2021, the BMPs had been applied to 24 of 24 blocks for which Site Plans were obtained (see Appendix 3). However, application of the BMPs to these cutblocks did not seem to be consistent, with some of the guidelines applied on some blocks, but other portions not applied. Only one licensee had included reference to applying the WISA BMPs in their most recent (2018) Forest Stewardship Plan.

The following table, excerpted from the West BMPs (Table 1 of BC FLNRORD 2014), summarizes the BMP live tree density expectations on timber harvest blocks in the West AO. These were to be averaged over the entire block area, including any Wildlife Tree Patches or other reserves. The minimum goal of 85-125 trees/ha was to only apply to a small fraction of the blocks for any licensee; higher retention targets were to be set for the majority of blocks. The BMPs also state that “minimum live tree retention for any given hectare within the harvested area [is] to be ≥ 20 live trees >17.5 cm dbh”.

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.

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

Neither OGMA's nor WHAs for any species are to be included in the live tree retention target averaging.

Cutblocks assessed in detail in 2021 fell into three sets, CP 611 at Promontory Hills, cutblocks “ALE”-prefix near Princeton, and cutblocks “NA”-prefix near Dodds Lake. Only the 13 cutblocks of CP611 were all select cut. Block SUM070 near Princeton had been burned before the cutblock was developed in late 2017, which would limit how the BMPs might be applied. All other blocks were clearcut with reserves.

In CP 611, the Site Plan goal was to retain 50 trees/ha in the harvested portions of the blocks (see Appendix 3). This goal by itself would not have met the minimum WISA BMP target of at least 85 trees (>17.4 -cm DBH)/ha, and would not have met the target when all blocks were considered, i.e., only $<15\%$ of new blocks should meet that minimum target. In addition, the Site Plan did not indicate that there were any Wildlife Tree Patches over which the retained tree density might be averaged. However, our habitat plot results indicated that the target of 50 trees/ha was exceeded by almost double, with an average of 99 trees/ha retained in the harvested portions of the blocks (weighted by block areas, see Appendix 4). Basal Area retention of trees >17.4 -cm DBH was a weighted average of $11.0 \text{ m}^2/\text{ha}$. Based on the sum of our counts of stumps and retained trees, density of trees prior to harvest was 291

trees/ha and Basal Area was 33.4 m²/ha. The timber harvest was therefore approximately 66% of the standing trees, and 67% of the estimated Basal Area.

In the set of clearcuts-with-reserve cutblocks, i.e., all blocks except those of CP611, the density of retained trees in the harvested area was far below the target levels of BMP Table 1. These blocks needed to rely upon averaging with reserves if they were going to achieve the recommended BMP live tree retention. These reserves were either Wildlife Tree Patches, specific WISA reserve areas, or other non-harvested reserves such as riparian areas within the blocks. This was examined in more detail for 13 blocks for which there was habitat plot data. This excluded only SUM070 near Princeton which had no WTPs in the WISA AO area of the block, and was a block harvested after being burned in a wildfire in 2017.

In those 13 blocks, average tree (>17.4-cm dbh) density in the harvested portions was 19.7/ha (range 8 to 40), and average tree density in the reserved portions (whether Wildlife Tree Patches or other reserves) was 289/ha (range 40 to 453). Basal Area retention in the blocks averaged 24.8 m²/ha prior to harvest and 3.1 m²/ha after harvest, i.e., 87% removal of basal area (or equivalently, 13% retention). The average retained tree density over the gross block areas was 91/ha (range 15 to 203). Only one block had average retained tree density <40, where the Wildlife Tree Patches had very few trees, i.e., were openings from very old timber harvesting or were riparian areas. Averaged over the reserve areas, 7 of the 13 blocks met the minimum standard of 85 trees retained per ha as per Table 1 of the BMPs, and three of those had >125 trees/ha on average. Within the harvested portions of the blocks, where at least 20 trees were to be retained on every hectare, 9 of the 13 blocks did not reach 20 trees on average, much less 20 trees on every hectare.

Of the 50 cutblocks assessed in the West AO in either of 2019 or 2021, 11 met the minimum BMP live tree retention target of 85 trees/ha on the harvested portion of the block alone, and an additional 10 met the minimum target only when averaging over the gross block area including any reserves. However, as discussed in the next section, only by meeting the minimum target in the harvested area are the cutblocks successful at retaining WISA habitat suitability. Only 4 blocks met the next level of live tree retention (>125/ha) on the harvested portions of the blocks, with an additional 3 blocks meeting that target when averaged over the gross block area. While the lowest BMP target level of 85-125 trees/ha retained was supposed to be only 5-15% of new blocks, it has become the standard, rather than the exception.

Do the BMP live tree targets maintain WISA occupancy?

WISA breeding occupancy of cutblocks was very low where there were <80 trees/ha retained within the harvested area of the blocks in the West (upper left graph of Figure 4). This result was very similar to the result from the Boundary in 2020 (lower left graph of Figure 4 – see Gyug 2020a) although >100 trees/ha were required to reach the upper occupancy level in the Boundary, compared to >80 trees/ha in the West. When the data from the two regions was combined (right graph of Figure 4), the logistic regression reached the upper limit at about 100 trees/ha. The proportional occupancy rate of 0.3 to 0.4 sites occupied reaches the expected level of occupancy in any given year based on long-term occupancy data from known WISA breeding territories (Gyug 2016).

For CP 611, the average retention of 98 trees/ha in the cutblocks was relatively successful at retaining WISA breeding occupancy. However, even within those blocks, there were areas where additional trees could have been retained to meet the BMP targets within the harvested portions of the blocks. We observed WISA avoiding the open areas of blocks 611-10 and 611-04, but using the portions of block 611-04 where >100 trees/ha had been retained (see Table 3).

In the other 20 blocks, all had much lower retained tree densities in the harvested portions of the blocks than CP611 and averaged only about 20 trees retained per hectare (see previous discussion of 12 of those blocks). WISA were only observed in two of the 20 blocks (see WISA Surveys section). While seven of 12 of those blocks that were assessed in detail met the minimum BMP target tree retention density when averaged over the gross block area, the critical element for habitat suitability appears to be the tree retention within the harvested portion based on the regressions shown in Figure 4.

The live tree retention targets of the BMPs need to be rewritten to reflect the results of these assessments, i.e., that tree retention targets refer only to the harvested area, not an average over gross block area including reserved areas.

There is an untested possibility that the live tree density targets higher than the minimum 85-125 trees/ha could be met by averaging over reserve areas but the spatial distribution of those reserves would have to be specified. For example, at least 100 trees/ha could be required on the harvested area, and the higher density targets could be met by

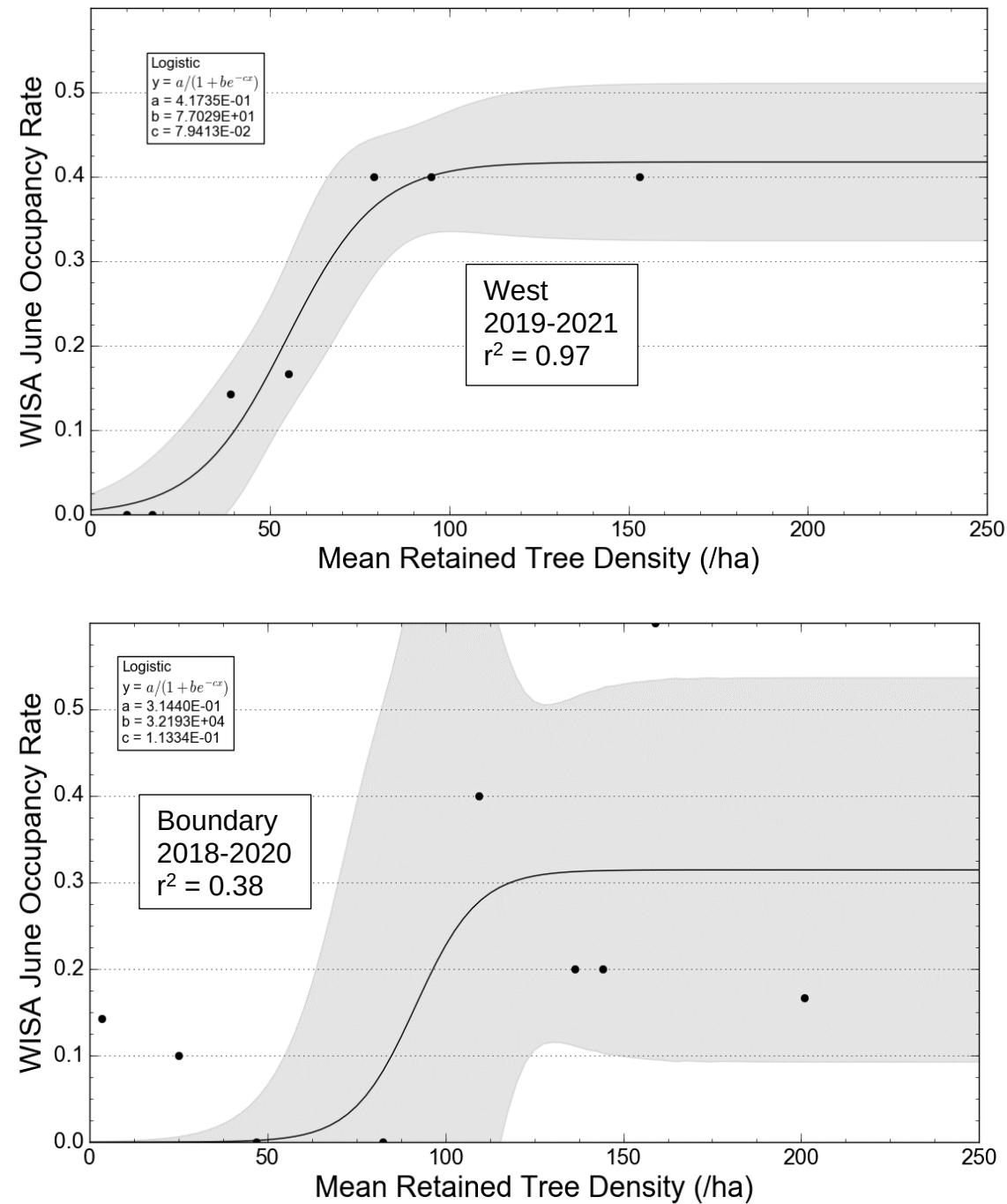
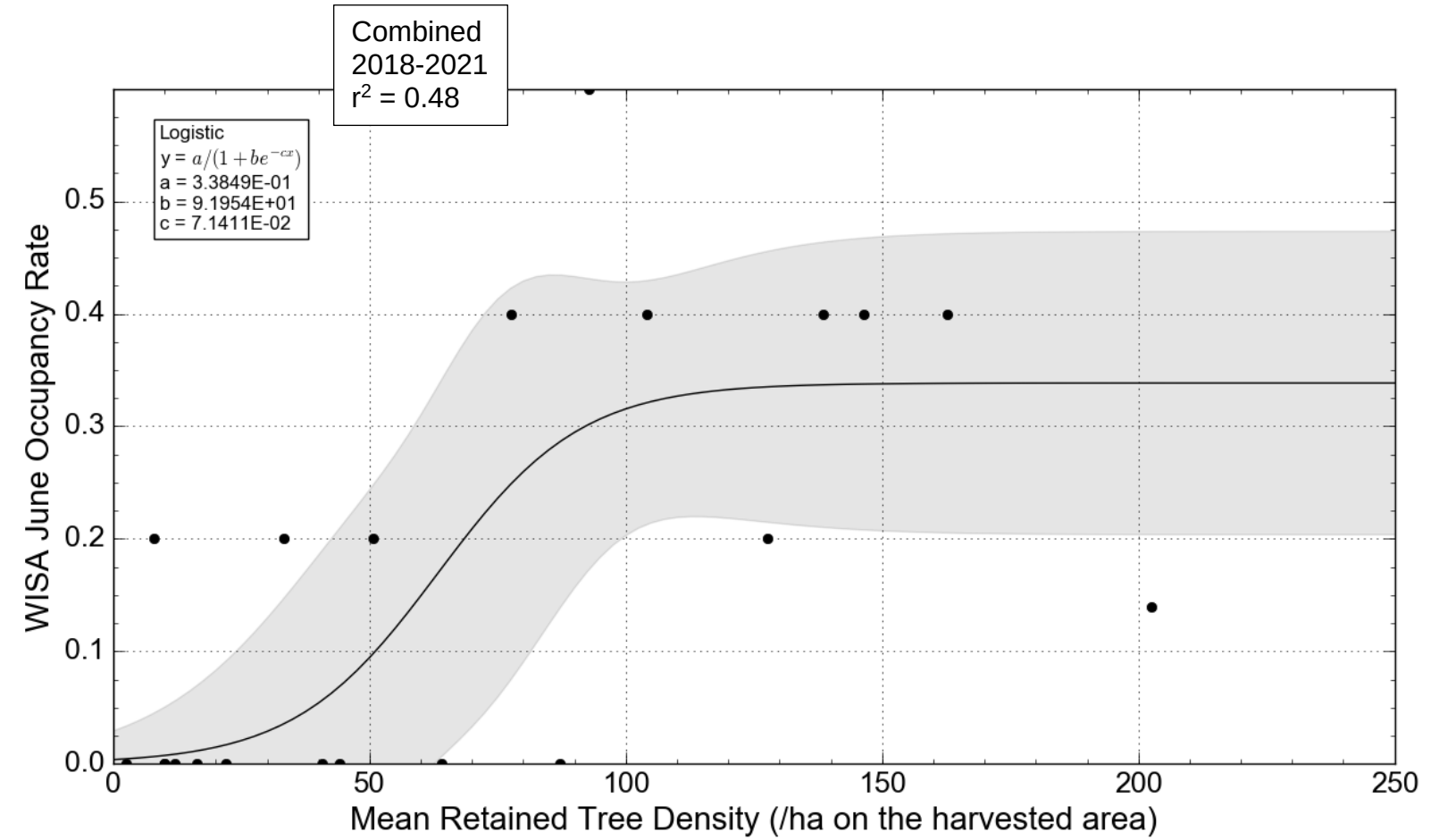


Figure 4. WISA Possible, Probable and Confirmed June breeding occupancy of cutblocks, 2018-2021, in relation to tree density (≥ 17.5 -cm DBH) in the harvested portions of cutblocks. Blocks were grouped to retain at least 5 blocks in each tree density group. 95% Confidence Interval of the regression shown as shaded grey.

Upper Left Graph: West AO, $n = 50$ cutblocks including foraging observations within blocks.

Lower Left Graph: Boundary region $n = 58$ cutblocks (See Gyug 2020a).

Right Graph: Combined West AO and Boundary region ($n = 58$)

averaging over reserve areas contained on every hectare, i.e., multiple small reserve patches that touch every hectare of the block. Minimum such patch size would be about 0.1 ha which would be in addition to the 100 live trees retained/ha in the harvested portion of the block.

The BMP minimum of 20 live trees retained on every hectare should be raised to at least 50 live trees on every hectare (e.g., see Figure 4 of COSEWIC 2017), if not higher, while still meeting the target of at least 100 trees/ha on average within the harvested area. The minimum of 20 trees/ha in the BMPs was based on the absolute minimum found in a single successful breeding territory in a Wildlife Tree Patch surrounded by a clearcut with reserves in the Boundary. That breeding territory was the exception, not the rule. Additional habitat plots completed at the Wildlife Tree Patch site in the Boundary in 2017 and 2021, found that there was an average of 38 trees/ha in the clearcut portion of that single site, and the original assessment of tree density there was either incorrect or based on too few plots to be representative.

In addition, minimum habitat tolerances for species at risk have been recommended to be based on the average minus one standard deviation (Conner 1979), rather than on the bottom of the range. We do not have an estimate of the mean or standard deviation of tree densities in openings that WISA will use, because 1) our plots were usually 0.04 ha plots, rather than 1-ha plots, so represent variation at a different scale, and 2) the mean would depend on how openings were defined, and could therefore be artificially low if there was an upper limit on tree density built into the definition of opening. If, however, the mean and standard deviation were calculated from the same data used in the COSEWIC (2017) report ($n = 47$ nest sites where >50% of the 225-m radius around a WISA nest had been recently harvested), the mean live tree density on the harvested area was 122 trees >17.4-cm dbh/ha and the standard deviation was 71 trees/ha. The mean minus one standard deviation was 51 trees/ha. However, this does not tell us if these sites were used, just that they existed near occupied nests. The analyses of Gyug and St-Amand (2020) found that openings with fewer than 80-100 trees/ha were not preferred foraging sites, so any minimum density of live trees to be retained in a harvested area within the BMPs should be set conservatively, rather than to the minimum.

Stand Structure

The stand structure, averaged over all cutblocks within a set of blocks (Figure 5) showed the differences in harvesting approaches that resulted in mostly suitable WISA habitat retention within CP 611, and mostly unsuitable habitat after timber harvest within “ALE” and the “NA” prefixed cutting permits. The blocks that resulted in unsuitable habitat (ALE and NA) retained very few trees overall (20/ha on average within the harvested area). Very few mid-range DBH trees (35-50 cm DBH classes) were retained in the “ALE” and “NE” blocks, compared to what could have been retained based on what was available prior to harvest. Even CP 611 could have retained additional trees in the 35-50 cm DBH range to better meet the WISA BMP retention targets over the higher range of tree densities, rather than just the minimum target. In the largest tree diameter classes (>57.4-cm DBH), CP 611 retained 68% of the trees, “ALE” cutblocks retained all trees (although the density was very low at only 2.9 such trees/ha), and “NA” cutblocks retained only 31% of such trees. These trees are those most likely to become suitable nest trees in the future, and therefore should be retained.

While not directly analyzed here, overlaying the cutblocks from this project on the WISA habitat suitability modeling and mapping of 2008 and 2018, showed that the mapping is not very reliable at the cutblock level. The habitat modeling, which was largely based on VRI polygons, accurately predicts WISA densities at a regional or perhaps subregional level, but should not be relied upon for precise stand level tree retention or for harvesting decisions. Similarly, VRI would never be solely relied upon to make timber harvesting decisions. In particular, Very Low suitability nesting habitat (i.e., the model result to which the current BMPs do not apply) may be suitable and even preferred foraging habitat (see Gyug 2021 and Gyug and St-Amand 2020). Clearcutting of such Very Low habitat can result in habitat loss. The BMPs should be rewritten or clarified to reflect this.

Gyug (2021) recommended a rule-of-thumb for determining which habitats the BMPs should be applied to. In essence, if a stand in the West WISA AO has a significant mature Douglas-fir component, the BMPs should be applied. This would apply to both previously unharvested stands, but especially to stands that have been previously logged sometime in the past 100 to 120 years, most often by select cutting or high grading. The only stands to which the BMPs would not apply would be stands dominated by lodgepole pine, spruce or true fir (i.e., >70% of one or more of those species). However, even then, retention of the aspen, Douglas-fir and/or the ponderosa pine components would still assist in retaining future nesting and foraging suitability for Williamson's Sapsucker.

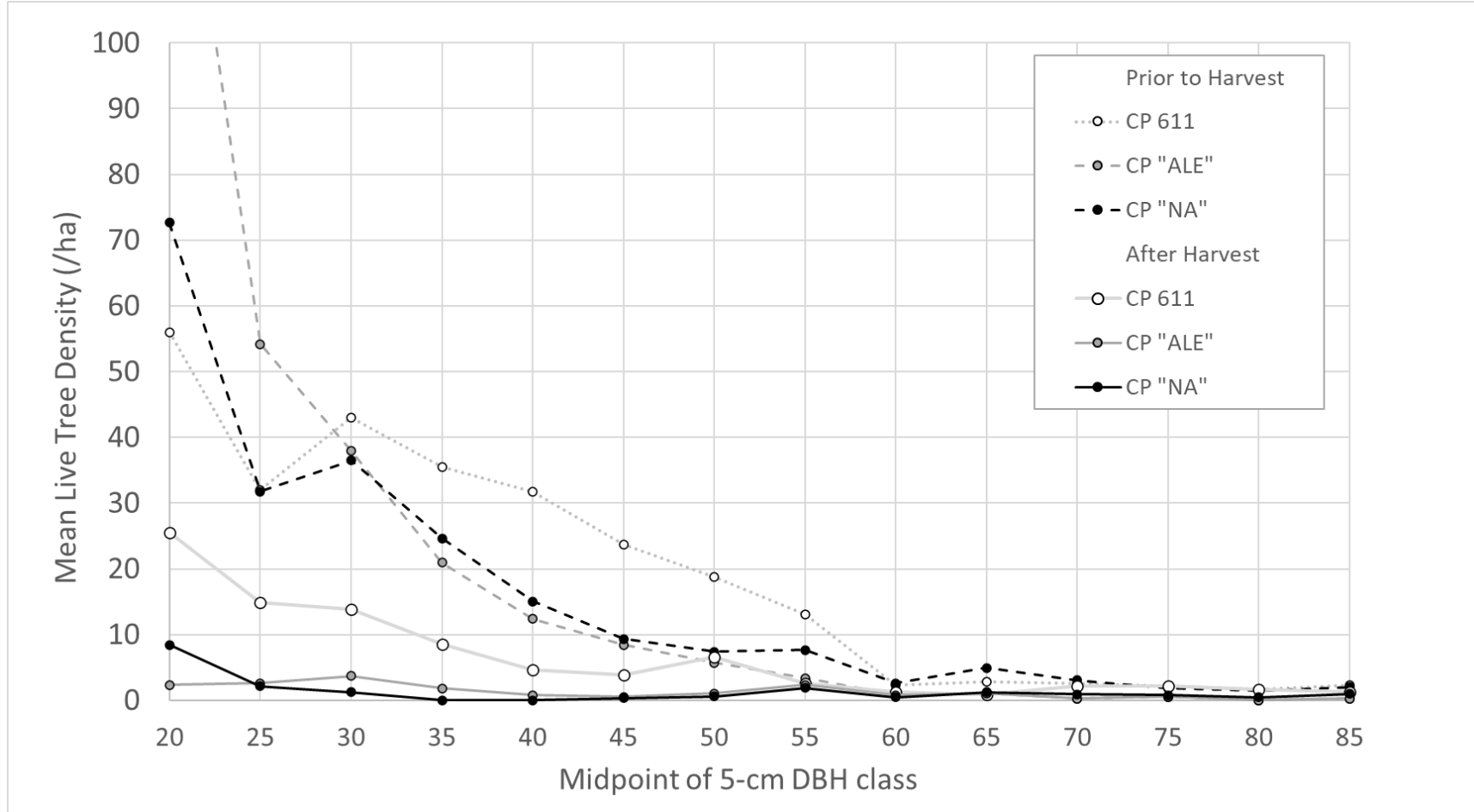


Figure 5. Average stand structure prior to and after timber harvest by cutting permit for 28 cutblocks in the WISA West AO assessed in 2021. “ALE” (Allenby) refers to five blocks at Princeton, CP 611 to the 13 blocks at Promontory Hills, and “NA” to 10 blocks in the Dodds Lake area.

The 85-cm DBH class included any trees/stumps >85-cm dbh (the largest tree in the sample was 115-cm DBH, and the largest stump was estimated as 100-cm DBH). The y-axis was truncated at 100 trees/ha for clarity of the less dense size classes. Only CP “ALE” had an estimated 148 live trees/ha in the 20-cm DBH class prior to harvest. Pre-harvest estimates of tree density were based on stump tallies, adjusted for size from DSH to DBH (see Methods text).

SUMMARY of RECOMMENDATIONS

Wildlife Habitat Areas

For WHAs, the following is a summary of the recommendations that have been discussed more fully within the text of the report.

1. Expand the boundaries of two approved WHAs to meet at least minimum size of suitable nesting and foraging habitat within the WHA, and submit the revised boundaries for approval decisions:
 - a. Expand the boundaries of approved WHA 8-397 to the southwest and northeast,
 - b. Expand the boundaries of approved WHA 8-402 to the north and east.
2. Revise the boundaries of approved WHAs 8-397 and 8-402 to bring their habitat suitability up to minimum size standards and submit revised proposals for approval decisions.
3. Move forward for an approval decision with the portion of proposed WHA 8-099 which is on crown lands, but drop the portion overlapping private land. The boundaries of the proposal should be expanded to the west.
4. Move the application forward for approval decision for proposed WHA 8-283 – this site still has suitable nesting trees in an aspen patch, along with 24 ha of adjacent suitable foraging mature Fd forest habitat.
5. Move forward for approval decisions for proposed WHAs 8-281, 8-375 and 8-376. These three WHAs are nearly adjacent to each other, and all were occupied by WISA in 2021. In addition, there was an active WISA nest in an OGMA between the three proposed WHAs, which should be proposed as a new WHA or amalgamated into one of the current proposals.
6. Move forward with approval decisions for proposed WHAs 8-282, 8-377 and 8-378. Each of those contains sufficient (or nearly sufficient) habitat to meet minimum standards, and contains some potential nesting trees.
7. Drop WHA 8-104 proposal. The amount of suitable habitat was marginal and there are no adjacent opportunities to expand the WHA proposal to include more suitable habitat.

Best Management Practices

For the BMPs, the following is a summary of the recommendations that have been discussed more fully within the text of the report.

1. The WISA BMPs should be rewritten to reflect findings from this study and others including:
 - a. Revise the live tree targets of the BMPs need to be revised to reflect that the target should be calculated just on the harvested portion of the block, and not be calculated by averaging over the gross block area including reserve areas. The effectiveness monitoring has shown that the BMPs are only effective when at least 80 trees and more typically 100 trees/ha are retained on the harvested portions of the cutblocks.
 - b. Very Low nesting habitat is often the suitable foraging habitat that is required to support nesting in adjacent habitat so the BMP live tree retention targets of >100 trees/ha should apply to a wider range of habitats, i.e., not just Low or better nesting habitat.
 - c. The minimum of 20 live trees retained on every hectare should be raised to at least 50 live trees on every hectare, while still meeting the target of at least 100 trees/ha on the harvested area in total (see discussion). That minimum of 20 trees/ha was based on the absolute minimum found in a single successful breeding territory, which has been found to be the exception, and not the rule.
2. Direct communication to licensees of the intents of the BMPs and the most effective methods by which the targets of the BMPs can be met is recommended to assist in providing consistent and effective application of the BMPs. That would include viewing example sites where the BMP targets have been applied successfully.
3. To quantify whether recovery habitat goals are being met, develop a simple, efficient and ongoing system which tracks all blocks in the West AO, including whether the BMPs have been incorporated into the Site Plans, and whether those blocks meet the BMP live tree retention targets as laid out within the leave tree specifications of the Site Plan.

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APPENDICES

Appendix 1. Wildlife Habitat Area (WHA) WISA occupancy survey results, West AO, 2017-2021. (P) indicates proposed WHA. In 2019, only June surveys were done, while in 2021, both early May and June surveys were done.

Sort No.	WHA Name	WHA Area (ha)	N WISA nests known in WHA prior to 2017	N WISA found April-early May (2017)	Results of June Occupancy (2019)
1	3-090	43	1	0	0
2	3-092	34	2	0	0
3	3-131	38	3	3	2 pairs + Male at nest hole
4	3-132	49	3	2	0
5	3-133	59	3	2	0
6	3-134	49	1	1	Female
7	3-135	50	1	1	0
8	3-168	50	1	0	0
9	3-204	49	1	0	Male
10	3-205	33	1	0	Pair
11	3-213	49	1	0	0
12	3-219	46	1	0	NY
13	3-220	49	1	0	0
14	3-091	41	1	na	NY
15	3-093	39	2	na	0
16	3-094	32	1	na	0
17	3-095	22	1	na	0
18	3-096	23	3	na	0
19	3-127	23	1	na	0
20	3-129	26	2	na	Male
21	3-130	15	3	na	0
22	3-137	20	1	na	Male
23	3-139	49	1	na	Female
24	3-142	48	1	na	Nest - Female CF
25	3-143	32	1	na	0
26	3-167	42	1	na	0
27	3-169	52	1	na	0
28	3-170	52	1	na	0
29	3-202	49	1	na	Male
30	3-203	35	1	na	NY outside WHA
31	3-206	25	1	na	Pair + Male
32	3-207	50	1	na	0
33	3-208	40	3	na	NY
34	3-209	32	2	na	NY
35	3-210	26	3	na	2 Males
36	3-211	47	1	na	1 Unk Sex
37	3-212	41	1	na	0
38	3-214	46	2	na	Male
39	3-215	43	1	na	0
40	3-216	46	1	na	0
41	3-217	41	1	na	Male-same as 3-218
42	3-218	44	1	na	Male-same as 3-217

Appendix 1. continued

Sort No.	WHA Name	WHA Area (ha)	N WISA nests known prior to 2021	N WISA found April-May (2021)	Results of June Occupancy (2021)	WHA Comments (based on spatial assessment in Gyug 2021 WHA report and on field observations May-June 2021)
43	8-096	39	2	2	2 males, no nest could be found	
44	8-097	46	2	3	new WISA nest	
45	8-098	47	1	2	new WISA nest	
46	8-100	49	1	0	NA	
47	8-394	24	2	2	male only on June 20; no WISA found on June 25	
48	8-395	35	1	2	new WISA nest	
49	8-396	25	2	0	NA	<20 ha Low or better in 2008 but 25 ha in 2018 modeling, no changes needed, WHA now surrounded by recent cutblocks
50	8-397	26	1	0	NA	<20 ha Low or better in 2008 and 2018; could be expanded to SW
51	8-398	37	1	2	new WISA nest	
52	8-399	23	1	0	NA	<20 ha Low or better in 2008 but 22 ha in 2018 modeling; no changes needed, WHA very heavily impacted by pine beetle
53	8-400	30	1	0	NA	<19 ha within 460 m of known nest; habitat very sparsely treed around previously known nest so expanding will not assist
54	8-401	31	1	1	2 males and 1 female; no nest could be found	
55	8-402	21	1	2	new WISA nest	<20 ha Low or better in 2008 and 2018; could expand 200 m or more at NE corner in vicinity of known nests. Alternatively, could expand 8-099 proposal to include up to moderate habitat between it and 8-402 east boundary
56	8-403	33	1	4	new WISA nest	
57	8-404	48	1	2	new WISA nest	
58	8-405	35	1	2	WISA detected on June 8, but not on June 19, no nest in WHA, male present on June 8 appeared to move south into 8-096 where it was found on June 19	<20 ha Low or better in 2008 and 2018; already adjacent to 8-096, so no changes needed
59	8-099(P)	28	1	2	new WISA nest plus separate fledging male and other adult male, i.e., possibly 2 nests; only west half on crown land included	WHA boundary needs to be redrawn to exclude private land; WISA consistently present on Crown portion every year (site is on annual monitoring route) so that part of the proposal is appropriate
60	8-104(P)	25	1	0	NA	<20 ha suitable and foraging habitat in 2008 and 2018, Batstone Lake area Habitat no longer suitable for WISA, proposal should be dropped

Sort No.	WHA Name	WHA Area (ha)	N WISA nests known prior to 2021	N WISA found April-May (2021)	Results of June Occupancy (2021)	WHA Comments (based on spatial assessment in Gyug 2021 WHA report and on field observations May-June 2021)
61	8-281(P)	41	1	2	new WISA nest	<20 ha foraging habitat in 2008, 33 ha in 2018 modeling. Proposed WHAs 8-281, 8-375 and 8-376 should be expanded to include area between WHAs, where WISA was found nesting in 2021.
62	8-282(P)	43	2	2	NA	WISA present at site 7 of 10 years based on annual roadside monitoring, so proposal is suitable
63	8-283(P)	32	1	0	v	If proposed block within WHA is cut, WHA may no longer be suitable
64	8-375(P)	48	1	3	new WISA nest	See WHA 8-281
65	8-376(P)	49	1	1	Male seen on sapwell tree and within WHA; no nest in 2021; forest to East where male flew is boundary flagged for timber harvest (NA1155, which appears on nearby block maps, but was not (yet) in DataBC cutblock coverages)	See WHA 8-281
66	8-377(P)	49	1	0	NA	
67	8-378(P)	46	2	1	NA	<20 ha (18 ha) suitable habitat; WISA probably relies upon adjacent forest on private ranch lands while nesting in the proposed WHA

Retained Tree density refers only to the harvested portion of the block.

Block	Area (ha)	Retained Tree Density (trees ≥17.5 cm DBH/ha)	Previous in or near block		2021	
			CPB* (n)	WISA detected	April-early May	June Results
A18695 Promontory Hills						
611-01	19.0	89	6	2	WISA inside and outside	WISA Nest on block boundary + WISA nest 235 m West of block
611-02	1.7	83	1	0	only outside, same WISA as 611-01	WISA from 611-01 occasionally foraging in this block
611-03	2.9	43	0		WISA outside - same WISA as near 611-04	Not within block
611-04	1.2	135	0		WISA outside - same as near 611-03	WISA nest between 611-04 and 611-10; male occasionally foraged in denser part of 611-04
611-05	1.8	120	0		WISA inside but left block, plus WISA outside	Not directly observed in June, but seen flying towards this block
611-06	0.7	90	0		WISA very near block	WISA nest 11m inside Block 611-06 which was smaller than 1 ha, and therefore not included initially in list
611-07	4.3	98	5	0	WISA outside	NULL
611-08	1.5	60	0		WISA inside	WISA nest 135 m from block
611-09	20.2	98	1	0	WISA inside	WISA present in area but no nest found
611-10	8.5	68	0		WISA outside	WISA nest between 611-04 and 611-10 was 26 m outside block; WISA did not forage in this block
611-11	2.4	53	1	0	NULL	n/a
611-12	8.4	125	10	1	NULL	n/a
611-13	4.7	83	1	0	NULL	n/a
A18696/7 Dodds Lake						
NA1149	30.4	26	6	6	WISA male in block	WISA nest 58 m outside block; pair foraged inside block sometimes
NA1150	15.5	40	3	2	NULL	n/a
NA1151	6.3	16				
NA1152	3.6	40	3	2	NULL	n/a
NA1153	16.7	19	2	2	WISA only outside block	NULL
NA1154	20.3	14	4	4	WISA only outside block	NULL
NA1206	14.6	18	2	1	NULL	n/a

Block	Area (ha)	Retained Tree Density (trees ≥ 17.5 cm DBH/ha)	Previous in or near block		2021	
			CPB* (n)	WISA detected	April-early May	June Results
NA1211	14.2	8	3	1	2 WISA to West and Southwest, not in block	NULL
NA1232	32.6	10	4	0	WISA only outside block; same WISA as NA1211	NULL
A18698 Princeton						
ALE001-1	32.1	26	11	10	WISA came into block to CPB	WISA nest in WTP + WISA nest in block 19 m from WTP, almost all foraging outside block
ALE001-2	4.5	10	0		3 WISA but only outside	Only rarely foraged in block from nest in ALE001-1
ALE002	53.0	13	1	0	NULL	n/a
ALE007	6.0	16	5	1	NULL	n/a
ALE008	8.1	18	6	2	2 WISA but only outside block	NULL in block; WISA nest found 535 m from block for pair that responded to CPB from within block
SUM070	67.1	50	13	1	WISA to south, did not come inside block	WISA nest found 158 m from block, did not forage within block
A88928 Pike Mt.						
NP1223	35.0	<20	8	0	NULL	n/a
NP1225	24.1	<20	16	0	NULL	n/a
NP1268	7.4	<20	2	0	NULL	n/a
NP1269	3.9	<20	2	0	NULL	n/a
NP1271	7.4	est 20-40	0		NULL	n/a

*Previous WISA CPB were conducted for other purposes between 2004 and 2014.

Appendix 3. Cutblock specifics from Site Plans, WISA West AO, 2021. CCRES = Clearcut with reserves.

Block	Type of Cut	Gross Area (ha)	Issue Date (YYYY-MM)	WISA BMPs in Site Plan	Leave Tree Specs
611-01	SELECT	19.0	2019-02	Yes – goal 50 sph	Retain 30-70 sph Fd 17.5-67.5, retain 95% Fd >67.5 and Py At, retain FdSx <17.5 50-500 sph Note that the Forest Stewardship Plan for this licensee refers to applying the WISA BMPs.
611-02	SELECT	1.7	2019-02	Yes – goal 50 sph	Retain 30-70 sph Fd 17.5-67.5, retain 95% Fd >67.5 and Py At, retain FdSx <17.5 50-500 sph
611-03	SELECT	2.9	2019-02	Yes – goal 50 sph	Retain 30-70 sph Fd 17.5-67.5, retain 95% Fd >67.5 and Py At, retain FdSx <17.5 50-500 sph
611-04	SELECT	1.2	2019-02	Yes – goal 50 sph	Retain 30-70 sph Fd 17.5-67.5, retain 95% Fd >67.5 and Py At, retain FdSx <17.5 50-500 sph
611-05	SELECT	1.8	2019-02	Yes – goal 50 sph	Retain 30-70 sph Fd 17.5-67.5, retain 95% Fd >67.5 and Py At, retain FdSx <17.5 50-500 sph
611-06	SELECT	0.7	2019-02	Assumed Yes	SP not seen yet (block < 1ha so not initially selected)
611-07	SELECT	4.3	2019-02	Yes – goal 50 sph	Retain 30-70 sph Fd 17.5-67.5, retain 95% Fd >67.5 and Py At, retain FdSx <17.5 30-300 sph
611-08	SELECT	1.5	2019-02	Yes – goal 50 sph	Retain 30-70 sph Fd 17.5-67.5, retain 95% Fd >67.5 and Py At, retain FdSx <17.5 40-400 sph
611-09	SELECT	20.2	2019-02	Yes – goal 50 sph	Retain 30-70 sph Fd 17.5-67.5, retain 95% Fd >67.5 and Py At, retain FdSx <17.5 40-400 sph
611-10	SELECT	8.5	2019-02	Yes – goal 50 sph	Retain 30-70 sph Fd 17.5-67.5, retain 95% Fd >67.5 and Py At, retain FdSx <17.5 40-400 sph
611-11	SELECT	2.4	2019-02	Yes – goal 50 sph	Retain 30-70 sph Fd 17.5-67.5, retain 95% Fd >67.5 and Py At, retain FdSx <17.5 50-500 sph
611-12	SELECT	8.4	2019-02	Yes – goal 50 sph	Retain 30-70 sph Fd 17.5-67.5, retain 95% Fd >67.5 and Py At, retain FdSx <17.5 30-300 sph
611-13	SELECT	4.7	2019-02	Yes – goal 50 sph	Retain 30-70 sph Fd 17.5-67.5, retain 95% Fd >67.5 and Py At, retain FdSx <17.5 50-500 sph
ALE001	CCRES	45.0	2015-04	Yes	Marked trees to be left, retain 95-100% At
ALE002	CCRES	53.0	2015-04	Yes	Marked trees to be left, retain 95-100% Py and At (only East Block of 29 ha was in WISA AO)
ALE007	CCRES	6.0	2015-04	Yes	Marked trees to be left, retain 95-100% At
ALE008	CCRES	8.1	2015-04	Yes	Marked trees to be left, retain 95-100% At
SUM070	Clearcut	67.1	2017-11	Yes	Leave marked trees (i.e., not specified – was burn salvage block) (24.8 ha in WISA AO)
NA1149	Not stated	15.5	2018-05	Yes	TU E: retain 95% Fd >55 cm DBH (14-22/ha); TU G: reserve 5% Fd 65-70 cm DBH (0.5/ha), and 95% >70 (0-8/ha); retain 95% Py; retain 95% deciduous
NA1150	Not stated	3.6	2018-05	Yes	TU A: retain 95% Fd >70 cm DBH (0-7/ha), 95% Py, 95% deciduous
NA1151	-	6.3	-	Assumed Yes	SP not yet obtained – entirely in Very Low habitat as mapped in 2008 so not initially selected but re-mapped as Low in 2018 (prior to timber harvest)
NA1152	Not stated	16.7	2018-05	Yes	SU A not logged for WISA habitat (i.e., 100% retention)
NA1153	Not stated	20.3	2018-05	Yes	TU H: retain 50% Fd 55-60 (8-22/ha) and 95% >65; TU F: retain 95% Fd >50 cm DBH (15-25/ha); retain 95% Py and deciduous
NA1154	Not stated	14.6	2020	Yes	TU F: retain 95% Fd >50- cm DBH (4-12/ha), 95% Py (8-16/ha), 95% deciduous; TU C [very small]: retain all for WISA
NA1206	-	30.4	2018-05	SP not seen	SP not yet obtained
NA1211	Not stated	14.2	2018-05	Yes	TU C (Low WISA): "in compliance with" BMPs, but not specified; TU D (VL WISA): reserve 95% Fd >65-cm DBH (0.5/ha) , 95% Py (0-3/ha) and 95% deciduous
NA1232	Not stated	32.6	2018-05	Yes	TU C – retain all stems for WISA; TU A - reserve 95% Fd >69 cm, 95% Py, 95% deciduous
NP1223	CCRES	35.0	2015-11	SP Not seen	SP assumed to be CCRES, or perhaps ST Cut based on field observations
NP1225	CCRES	24.1	2015-11	"	"
NP1268	CCRES	7.4	2015-11	"	"
NP1269	CCRES	3.9	2015-11	"	"
NP1271	CCRES	7.4	2015-11	"	SP assumed to be CCRES, but more trees retained than other cutblocks in this area

Appendix 4. Cutblock retained tree and other habitat elements, WISA West AO, 2021.

Block	Stratum	Area (ha)	N Plots	Basal Area (m ² /ha) of trees >17.4 cm DBH	Densities (/ha)							
					Tree 7.5-17.4 cm DBH	Tree >17.4 cm DBH	Tree >22.4 cm DBH	Tree >52.4 cm DBH	Snag >22.4 cm DBH	Recent Stump >17.4 cm DSH*	Suitable WISA nest trees	Large Thatch Ant Nests
611-01	SELECT	19.0	15	10.1	102	89	71	10.7	4.0	149	0.3	2.2
611-02	SELECT	1.7	3	8.1	83	83	70	3.3	0.0	211	0.0	0.0
611-03	SELECT	2.9	3	8.1	111	43	43	10.0	3.3	144	0.0	0.0
611-04	SELECT	1.2	3	22.7	22	135	93	26.7	13.3	111	1.7	0.0
611-05	SELECT	1.8	3	9.0	167	120	53	13.3	0.0	422	0.0	0.0
611-06	SELECT	0.7	3	9.7	222	90	70	10.0	3.3	256	0.0	11.1
611-07	SELECT	4.3	4	8.9	113	98	53	7.5	2.5	225	0.0	0.0
611-08	SELECT	1.5	3	5.7	50	60	40	6.7	3.3	244	0.0	0.0
611-09	SELECT	20.2	10	11.2	94	98	66	14.0	3.0	217	0.0	0.0
611-10	SELECT	8.5	8	11.9	78	68	55	15.0	5.0	200	0.6	0.0
611-11	SELECT	2.4	3	7.5	22	53	40	6.7	0.0	217	0.0	20.0
611-12	SELECT	8.4	8	15.4	104	125	85	20.0	3.8	179	0.0	4.2
611-13	SELECT	4.7	4	10.6	150	83	68	12.5	5.0	158	0.0	0.0
ALE001-1	CCRES	25.5	14	4.7	4	26	21	10.0	3.6	249	0.4	0.0
ALE001-1	Leave Area (prior cut)	6.4	6	5.6	302	47	25	6.7	5.0	0	0.8	0.0
ALE001-1	Reserve	6.7	5	23.0	127	317	205	6.0	2.0	0	1.0	0.0
ALE001-2	CCRES	4.5	5	0.7	0	10	10	0.0	6.0	560	0.0	0.0
ALE001-2	Reserve (is in WHA)	2.3	3	12.0	333	243	93	3.3	3.3	0	0.0	0.0
ALE002	CCRES (East Block)	17.6	10	1.2	61	13	10	2.0	5.0	237	0.0	0.0
ALE002	Reserve (East Block)	11.7	5	23.8	282	279	216	18.0	4.0	0	0.0	0.0
ALE007	CCRES	4.7	5	2.3	2	16	16	4.0	0.0	520	0.0	0.0
ALE007	Reserve	1.3	2	28.7	350	130	68	5.0	10.0	0	0.0	0.0
ALE008	CCRES	6.0	4	2.9	3	18	18	5.0	0.0	NA	0.0	0.0
ALE008	Reserve	2.2	3	28.7	458	448	290	6.7	6.7	0	0.0	0.0
SUM070	Clearcut (after wildfire)	24.8	5	8.5	0	50	44	14.0	8.0	120	1.0	0.0
NA1149	Cutblock	19.1	9	3.9	40	26	14	7.8	1.1	237	0.0	0.0
NA1149	Reserve	5.2	3	41.6	417	453	265	46.7	30.0	0	0.0	0.0
NA1149	WISA Area "partial cut"	2.0	5	10.0	116	62	42	18.0	0.0	220	0.0	0.0

Block	Stratum	Area (ha)	N Plots	Basal Area (m ² /ha) of trees >17.4 cm DBH	Densities (/ha)							
					Tree 7.5-17.4 cm DBH	Tree >17.4 cm DBH	Tree >22.4 cm DBH	Tree >52.4 cm DBH	Snag >22.4 cm DBH	Recent Stump >17.4 cm DSH*	Suitable WISA nest trees	Large Thatch Ant Nests
NA1149	WISA Area "ST Cut"	3.5	5	4.6	20	32	20	12.0	2.0	325	0.0	0.0
NA1149	WISA Area Reserve	0.5	2	64	517	585	482	35.0	15.0	0	0.0	0.0
NA1150	Cutblock	12.5	9	2.8	66	40	13	4.4	3.3	270	0.0	0.0
NA1150	Reserve	3.0	2	33.4	175	353	303	15.0	0.0	0	0.0	0.0
NA1151	Cutblock	4.5	5	2.6	7	16	12	8.0	6.0	208	0.0	0.0
NA1151	Reserve	1.8	2	21.6	8	160	150	30.0	0.0	0	0.0	0.0
NA1152	Cutblock	2.0	4	4.6	25	40	15	5.0	0.0	308	0.0	0.0
NA1152	Reserve	1.6	3	43.0	33	407	357	23.3	13.3	0	0.0	0.0
NA1153	Cutblock	13.4	7	4.6	28	19	13	12.9	7.1	148	0.0	0.0
NA1153	Reserve	3.3	4	19.1	94	170	145	20.0	20.0	0	0.0	0.0
NA1154	Cutblock	15.4	8	2.2	66	14	13	5.0	5.0	237	0.0	0.0
NA1154	Reserve†	4.2	2	28.0	71	178	153	20.0	15.0	0	0.0	0.0
NA1206	Cutblock	29.4	9	3.3	69	14	7	4.4	1.1	285	0.0	0.0
NA1206	Reserve	1.0	2	3.0	77	40	40	0.0	10.0	0	0.0	0.0
NA1211	Cutblock	8.9	6	3.6	11	8	8	8.3	3.3	261	0.0	0.0
NA1211	Reserve	5.3	4	36.2	425	379	279	35.0	15.0	0	0.0	0.0
NA1232	Cutblock	27.4	7	4.5	11	10	9	9.0	4.3	195	0.0	0.0
NA1232	Reserve	5.2	3	22.7	935	400	270	0.0	16.7	0	0.0	0.0

*DSH = diameter at stump height

† the gross block area overlapped an OGMA, which was not included in this reserve calculation

Appendix 5. WISA Nest Tree status for trees checked in 2018-2021. 9 for Wildlife Tree Code means tree has fallen.

Nest Tree GPS Mark	Most recent Year Checked, or year known down if no longer suitable	WHA	Year nesting first observed	Tree Sp.	Wildlife Tree Code (1-9) Status in Year first observed	Current Wildlife Tree Code Status	Tree Still suitable for Nesting ?	Comments
Boundary (2018-2020; 88 nests checked including 82 of 118 known prior to 2018)								
WN006	2020	8-216	1995	Lw	2	2	1	
WN007	2020	8-217	1995	Lw	4	4	1	
WN008	2020	8-218	1995	Lw	2	2	1	
WN011	2021	8-382	1996	Lw	2	7	1	Broke in half in 2015, but cavity observed below break in 2021
WN013	2020	8-219	1996	Lw	6	6	1	
WN016	2019	8-387	1997	Lw	2	9	0	
WN017	2020		1997	Lw	2	2	1	
WN018	2021		1997	Lw	2	4	1	
WN019	2003	8-389	1997	Lw	2	9	0	Cut down ~2003 for firewood
WN020	2008		1997	Ew	4	9	0	Fallen by 2008
WN025	2006	8-205	1998	Lw	5	9	0	Tree decayed beyond suitability by 2006
WN026	2008		1998	Ew	6	9	0	Fallen by 2008
WN028	2020		1998	Lw	2	2	1	
WN029	2020		1998	Lw	2	2	1	
WN033	2005		1999	Sx	4	9	0	fell by 2005
WN045	2020		2003	Lw	2	2	1	
WN046	2021	8-215	2003	Lw	2	5	1	
WN047	2020	8-389	2003	Lw	2	4	0	Counted 78 cavity nest holes in tree. Tree broke off in 2021.
WN205	2020		2004	Lw	2	2	1	
WN211	2021	8-310	2004	Fd	2	6	1	
WN212	2021	8-383	2004	Lw	6	6	1	
WN213	2021	8-383	2004	At	6	7	1	
WN214	2020	8-354	2004	Ew	6	9	0	
WN215	2021	8-209	2004	Lw	2	7	0	broken in half
WN216	2021	8-206	2004	Lw	3	5	1	
WN217	2020	8-207	2004	Lw	2	5	1	
WN218	2020	8-209	2004	Lw	5	9	0	
WN221	2020	8-223	2004	Lw	3	3	1	Pair interested in different tree
WN222	2021	8-220	2004	At	2	6	1	
WN223	2021	8-208	2004	Lw	2	7	0	broke off between 2018 and 2021
WN237	2020	8-225	2004	Lw	2	2	1	
WN238	2020	8-224	2004	Lw	6	9	0	
WN310	2021	8-203	2005	Lw	2	2	1	
WN311	2021	8-213	2005	Lw	2	2	1	
WN312	2021	8-213	2005	Lw	2	2	1	
WN316	2021	8-204	2005	Lw	2	2	1	
WN317	2021	8-210	2005	Lw	2	2	1	
WN318	2020	8-354	2005	Ew	6	9	0	
WN320	2021	8-222	2005	Lw	2	2	1	

Nest Tree GPS Mark	Most recent Year Checked, or year known down if no longer suitable	WHA	Year nesting first observed	Tree Sp.	Wildlife Tree Code (1-9) Status in Year first observed	Current Wildlife Tree Code Status	Tree Still suitable for Nesting ?	Comments
WNB001	2021		2006	Lw	2	4	1	
WNB002	2021	8-316	2006	Lw	2	2	1	
WNB003	2020	8-392	2006	Lw	2	2	1	
WNB004	2020	8-313	2006	Fd	6	9	0	
WNB005	2021	8-312	2006	Lw	6	6	1	
WNB006	2021	8-220	2006	At	3	6	1	
WNB008	2021		2006	Lw	2	6	1	
WNB009	2020		2006	Ew	2	9	0	
WNB010	2012	8-312	2006	At	2	9	0	
WNB011	2021		2006	Lw	2	2	1	
WNB012	2021	8-204	2006	Lw	2	6	1	broken off
WNB013	2021		2006	Lw	2	2	1	
WNB014	2021		2006	Lw	2	2	1	
WNB015	2021		2006	Lw	2	4	1	
WNB016	2021		2007	Lw	2	2	1	
WNB017	2021		2007	Lw	2	2	1	
WNB018	2020	8-313	2007	Lw	2	6	1	
WNB020	2021		2007	Lw	2	2	1	
WNB021	2018	8-383	2007	At	3	7	0	
WNB022	2020	8-354	2007	Lw	4	4	1	
WNB023	2018	8-312	2007	At	6	9	0	
WNB024	2020	8-367	2007	At	5	6	1	
WNB025	2021	8-310	2007	Lw	2	2	1	
WNB028	2020	8-225	2007	At	2	7	1	
WNB029	2021		2007	At	2	9	0	
WNB030	2018		2007	Lw	2	2	1	
WNB031	2021		2007	Lw	2	2	1	
WNB032	2021	8-316	2007	Lw	4	4	1	
WNB033	2021		2008	Lw	2	2	1	
WNB034	2020	8-367	2008	At	2	5	1	
WNB035	2021	8-366	2008	Lw	2	2	1	
WNB036	2021	8-364	2008	Lw	2	2	1	Trunk broken half-way at old nest cavity, still nesting below that point
WNB037	2021	8-202	2008	Lw	2	9	0	
WNB038	2021	8-379	2008	Lw	2	2	1	
WNB040	2020	8-386	2010	Lw	2	6	1	
WNB041	2018		2012	Lw	2	2	1	
WNB042	2018		2012	Lw	2	2	1	
WNB048	2017		2012	Py	3	9	0	
WNB053	2021		2012	Lw	3	3	1	
WNB058	2021	8-202	2012	At	2	2	1	
WNB059	2021	8-389	2012	Lw	2	2	1	
WNB061	2018		2012	Lw	2	2	1	
WNB065	2018		2012	Lw	2	2	1	
WNB070	2020		2018	At	3	7	0	
WNB071	2021		2018	Lw	2	2	1	

Nest Tree GPS Mark	Most recent Year Checked, or year known down if no longer suitable	WHA	Year nesting first observed	Tree Sp.	Wildlife Tree Code (1-9) Status in Year first observed	Current Wildlife Tree Code Status	Tree Still suitable for Nesting ?	Comments
WNB083	2021		2020	Lw	2	2	1	
WNB084	2021		2018	Lw	2	2	1	
WNB085	2021		2018	Lw	2	2	1	
East Kootenay (all known nests listed here, n = 61)								
WNE501	2018/19	4-108	2004	Lw	5	6	1	
WNE502	2018/19	4-108	2005	Lw	2	2	1	
WNE001	2018/19	4-141	2006	Lw	2	2	1	
WNE002	2018/19	4-144	2006	Lw	2	2	1	
WNE003	2018/19	4-142	2006	Lw	2	2	1	
WNE004	2018/19	4-143	2006	Lw	2	2	1	
WNE005	2018/19		2006	Lw	2	2	1	
WNE006		(4-110)	2006	Lw	3			Nest in U.S. – not checked
WNE007	2018/19	4-127	2006	Lw	2	2	1	
WNE008	2021		2006	Py	3	7	1	Checked 2021
WNE009			2007	Lw	2			Not checked in 2018/19
WNE010	2018/19	4-138	2007	Fd	3	4	1	
WNE011	2018/19	4-129	2007	Fd	2	7	0	
WNE012	2018/19	4-136	2007	Fd	2	2	1	
WNE013	2018/19	4-137	2007	Lw	2	2	1	
WNE014	2018/19	4-128	2007	Lw	2	2	1	
WNE015		4-143	2007	Lw	2			Not checked in 2018/19
WNE016	2018/19	4-139	2008	Lw	2	4	1	
WNE017	2018/19	4-188	2008	Lw	3	3	1	
WNE018	2018/19	4-187	2008	Lw	2	2	1	
WNE019	2018/19	4-190	2008	Lw	3	3	0	Cut stub- nest hole filled with grass
WNE020		4-183	2008	Lw	2			Not checked in 2018/19
WNE021		4-183	2008	Lw	2			Not checked in 2018/19
WNE022	2018/19	4-202	2008	Lw	2	2	1	
WNE023	2018/19	4-193	2008	Fd	5	7	0	
WNE024	2018/19	4-191	2008	At	2	2?	1?	Could not determine which At the tree was; -presumed Okay
WNE025	2018/19	4-190	2008	Lw	2	2	1	
WNE026	2018/19		2008	Lw	2	2	1	
WNE027	2018/19	4-128	2008	Lw	2	2	1	
WNE028	2018/19	4-137	2008	Lw	2	8	0	
WNE029	2018/19	4-127	2008	Lw	2	2	1	
WNE030	2018/19	4-196	2008	Lw	2	2	1	
WNE031	2018/19	4-201	2009	Lw	2	2	1	
WNE032	2018/19	4-186	2009	Lw	2	2	1	
WNE033	2018/19	4-200	2009	At	2	2	1	
WNE034	2018/19	4-198	2009	At	3	2	1	
WNE035	2018/19	4-189	2009	At	2	2	1	
WNE036	2018/19	4-195	2009	At	2	6	0	
WNE037	2018/19	4-194	2009	At	2	2	1	
WNE038	2020		2009	At	2	2	1	Checked February 2020
WNE039	2018/19	4-192	2009	At	2	5	1	NOFL in tree
WNE040	2018/19	4-182	2009	Lw	2	2	1	
WNE041	2018/19	4-184	2009	Lw	3	3	1	

Nest Tree GPS Mark	Most recent Year Checked, or year known down if no longer suitable	WHA	Year nesting first observed	Tree Sp.	Wildlife Tree Code (1-9) Status in Year first observed	Current Wildlife Tree Code Status	Tree Still suitable for Nesting ?	Comments
WNE042	2018/19	4-185	2009	Lw	2	2	1	
WNE043	2021		2009	Lw	2	2	1	Checked 2021
WNE044	2018/19	4-193	2011	Lw	2	7	0	
WNE045	2018/19	4-181	2011	Lw	2	2	1	
WNE046	2018/19	4-197	2011	Lw	2	2	1	
WNE047		4-199	2011	At	2	?	?	No notes made on tree status
WNE048	2018/19		2012	At	2	2	1	
WNE049	2018/19	4-139	2012	Lw	2	2	1	
WNE050	2018/19		2012	Lw	2	2	1	
WNE051	2018/19		2012	Lw	2	2	1	
WNE052	2018/19		2013	Lw	2	2	1	
WNE053	2018/19		2013	Lw	2	2	1	
WNE054	2018/19		2018	Lw	2	2	1	
WNE055	2018/19		2015	Lw	2	2	1	Location corrected in 2019.
WNE056	2018/19	4-200	2019	At	2		1	New nest 2019
WNE057	2018/19		2019	Lw	2		1	New nest 2019
WNE058	2018/19	4-202	2019	Py	2		1	New nest 2019
WNE059	2018/19	4-196	2019	Lw	2		1	New nest 2019
WNE060	2018/19		2019	Py	5		1	New nest 2019

Merritt area WHA Nests (n = 59 nest trees checked in 42 WHAs in 2019)

WN204	2019	3-094	2004	At	3	3	1	
WN304	2019	3-095	2005	At	3	7	0	
WNA002	2019	3-096	1994	Ac[?]		?	?	Nest tree location not exact
WNA004	2019	3-096	1996	At		?	?	"
WNA005	2019	3-096	2003	At		?	?	"
WNL001	2019	3-127	2007	At		9	0	
WNM003	2019	3-090	2006	At	4	9	0	
WNM004	2019	3-092	2006	At	2	9	0	
WNM005	2019	3-093	2006	At	3	9	0	
WNM007	2019	3-091	2006	At	2	7	0	
WNM014	2019	3-130	2006	At	2	9	0	
WNM016	2019	3-168	2007	At	2	9	0	
WNM020	2019	3-093	2007	At	2	2	1	
WNM023	2019	3-129	2007	At	6	9	0	
WNM028	2019	3-143	2007	At	2	2	1	
WNM029	2019	3-133	2008	At	3	9	0	
WNM030	2019	3-131	2008	Py	3	9	0	
WNM031	2019	3-135	2008	At	2	8	0	
WNM032	2019	3-137	2008	At	2	8	0	
WNM035	2019	3-130	2008	At	2	9	0	
WNM040	2019	3-129	2008	At	2	2	1	
WNM043	2019	3-142	2008	At	2	2	1	
WNM044	2019	3-134	2008	At	2	2	1	
WNM045	2019	3-139	2008	Fd	2	2	1	
WNM046	2019	3-133	2008	Py	2	9	0	
WNM047	2019	3-132	2008	At	2	9	0	
WNM049	2019	3-130	2009	At	4	9	0	
WNM050	2019	3-167	2009	At	2	9	0	
WNM054	2019	3-169	2010	At	6	6	1	

Nest Tree GPS Mark	Most recent Year Checked, or year known down if no longer suitable	WHA	Year nesting first observed	Tree Sp.	Wildlife Tree Code (1-9) Status in Year first observed	Current Wildlife Tree Code Status	Tree Still suitable for Nesting ?	Comments
WNM057	2019	3-170	2011	At	2	2	1	
WNM058	2019	3-209	2012	Py	5	9	0	
WNM059	2019	3-210	2012	Fd	2	2	1	
WNM060	2019	3-208	2012	At	4	4	1	
WNM062	2019	3-211	2012	Py	4	9	0	
WNM063	2019	3-213	2012	At	2	2	1	
WNM064	2019	3-214	2012	At	4	6	1	
WNM065	2019	3-215	2012	At	2	2	1	
WNM066	2019	3-216	2012	At	2	2	1	
WNM075	2019	3-202	2012	At	2	2	1	
WNM078	2019	3-203	2012	At	3	9	0	
WNM079	2019	3-206	2012	At	2	2	1	
WNM080	2019	3-205	2012	Py	3	8	0	
WNM081	2019	3-204	2012	Py	3	3	1	
WNM082	2019	3-207	2012	Fd	3	3	1	
WNM083	2019	3-220	2012	At	2	3	1	
WNM084	2019	3-219	2012	At	3	7	0	
WNM085a	2019	3-217	2012	At	4	9	0	
WNM086	2019	3-210	2012	Py	3	3	1	
WNM087	2019	3-209	2012	Py	2	2	1	
WNM088	2019	3-208	2012	Fd	3	3	1	
WNM089	2019	3-132	2012	At	2	2	1	
WNM090	2019	3-212	2012	At	3	9?	0	
WNM092	2019	3-218	2012	At	2	7	0	
WNM096	2019	3-132	2015	At	?	9?	0	
WNM097	2019	3-092	2015	At	?	9	0	
WNM098	2019	3-131	2015	Py	?	4	1	
WNM099	2019	3-131	2015	Py	?	5	1	
WNM100	2019	3-210	2015	Py	?	5	1	
WNM101	2019	3-214	2015	At	?	2	1	
West AO South WHA Nests (n = 33 nest trees checked in 25 WHAs in 2021, plus 2 other trees)								
WN024	2021	8-096	1997	At	2	9	0	
WN031	2021	8-100	1999	Fd	2	2	1	Unsure which of 3 very large Fd vets is the actual tree
WN034	2021	8-096	1999	At	2	9	0	
WN206	2021	8-097	2004	Fd	2	9	0	
WN207	2021	8-098	2004	Fd	3	9	0	
WN302	2021	-	2005	Py	6	6	1	
WNM001	2021	8-282	2006	At	2	9	0	
WNM011	2021	8-283	2006	At	2	9	0	
WNM015	2021	8-281	2006	At	2	7	0	
WNM018	2021	8-104	2007	At	2	9	0	
WNM024	2021	8-282	2007	At	2	9	0	
WNM036	2021	8-377	2008	At	2	9	0	
WNM037	2021	8-378	2008	At	3	9	0	
WNM041	2021	8-376	2008	At	2	7	0	
WNM042	2021	8-375	2008	At	6	9	0	
WNM067	2021	8-282	2012	At	2	9	0	
WNM068	2021	8-394	2012	At	2	2	1	

Nest Tree GPS Mark	Most recent Year Checked, or year known down if no longer suitable	WHA	Year nesting first observed	Tree Sp.	Wildlife Tree Code (1-9) Status in Year first observed	Current Wildlife Tree Code Status	Tree Still suitable for Nesting ?	Comments
WNM069	2021	8-396	2012	At	2	9	0	
WNM070	2021	8-395	2012	At	2	9	0	dead and fallen but propped up by adjacent tree
WNM071	2021	8-398	2012	At	3	9	0	
WNM072	2021	8-397	2012	At	2	9	0	
WNM073	2021	8-399	2012	At	2	9	0	
WNM076	2021	8-400	2012	At	2	8	0	
WNM095	2021	8-396	2013	At	2	8	0	
WNM104	2021	8-394	2016	At	6	6	1	
WNM105	2021	8-378	2018	At	3	7	0	
WNP010	2021	8-401	2012	Py	4	9	0	
WNP012	2021	8-404	2012	At	6	6	1	
WNP013	2021	8-097	2014	At	6	9	0	
WNP014	2021	8-403	2012	Py	3	9	0	
WNP015	2021	8-405	2012	At	3	9	0	
WNP017	2021	8-402	2012	Py	3	9	0	
WNP019	2021	8-402	2014					Tree deleted from database -same tree as WNP017
WNP020	2021	8-099	2014	Py	3	5	1	
WNP021	2021	8-097	2014	Py	3	9	0	
WNP022	2021	-	2014	Fd	2	2	1	
Okanagan Nests (n = 80 nest trees checked of 100 total known)								
WN001	2020	8-106	1994	At	NR	NR	NR	2nd hand- location uncertain
WN002	2020	8-108	1994	Lw	2	2	1	(14 km signboard)
WN003	2020	8-106	1994	Lw	NR	NR	NR	2nd hand- location uncertain
WN010	2020	8-211	1996	Ew	6	9	0	Tree fallen by 2006
WN027	2020	P8-111	1998	Lw	2	2	1	
WN038	2020	8-101	2003	Sx	6	8	0	
WN039	2006		2003	Fd	5	9	0	
WN040	2020	P8-117	2003	Py	2	4	0	
WN041	2020	8-102	2003	Lw	2	2	1	
WN042	2020	P8-119	2003	Lw	2	2	1	
WN043	2020	P8-120	2003	Lw	2	2	1	
WN044	2020	8-192	2003	Lw	2	2	1	
WN048	2020	8-108	2003	Lw	2	2	1	
WN049	2020	8-108	2003	Lw	2	2	1	
WN050	2020	8-108	2003	Lw	2	2	1	
WN051	2020	8-107	2003	Lw	2	2	1	
WN052	2020	P8-114	2003	Lw	2	2	1	
WN053	2020	8-106	2003	Lw	2	6	1	
WN203	2020	P8-114	2004	At	2	2	1	
WN209	2020	8-201	2004	Lw	2	2	1	
WN225	2020	8-103	2004	Lw	2	2	1	
WN226	2020	P8-307	2004	Lw	2	2	1	
WN227	2020	8-110	2004	Lw	2	2	1	
WN228	2020		2004	Lw	2	2	1	
WN229	2020	8-197	2004	Lw	2	4	1	
WN230	2020	P8-195	2004	Lw	2	2	1	
WN231	2020	8-194	2004	Lw	2	2	1	
WN232	2020	8-191	2004	Lw	2	2	1	

Nest Tree GPS Mark	Most recent Year Checked, or year known down if no longer suitable	WHA	Year nesting first observe d	Tree Sp.	Wildlife Tree Code (1-9) Status in Year first observed	Current Wildlife Tree Code Status	Tree Still suitabl e for Nesting ?	Comments
WN233	2020	8-190	2004	Lw	2	2	1	
WN234	2020	8-197	2004	Lw	2	2	1	
WN235	2020	P8-193	2004	Lw	2	2	1	
WN236	2020	P8-120	2004	Lw	2	3	1	
WN239	2020	8-106	2004	At	2	9	0	Tree fallen by 2016
WN305	2020	P8-198	2005	Lw	2	4	0	
WN306	2020	8-190	2005	Lw	6	6	1	
WN307	2020	8-199	2005	Lw	2	2	1	
WN308	2020	P8-200	2005	Lw	2	2	1	
WN309	2020	P8-196	2005	Lw	2	2	1	
WN314	2020	8-113	2005	At	2	6	0	
WN322	2020	8-110	2005	Lw	3	5	1	
WN325	2020	P8-212	2005	Py	4	9	0	
WN326	2020	8-197	2005	Lw	2	2	1	
WN327	2020	P8-114	2005	At	6	9	0	
WKN001	2020		2006	Lw	5	8	0	
WKN002	2020		2006	Lw	2	2	1	
WKN003	2020	8-103	2006	Lw	7	7	0	
WKN004	2020		2006	Lw	2	2	1	
WKN005	2020	P8-112	2006	Lw	2	4	1	
WKN006	2020	P8-115	2006	Lw	2	9	0	could not find tree; probably cut during timber harvest
WKN007	2020	8-308	2006	At	2	2	1	
WKN008	2020	8-108	2006	Lw	2	2	1	
WKN009	2020	P8-306	2006	Lw	2	2	1	
WKN010	2020	P8-114	2007	Lw	2	2	1	
WKN011	2020	8-308	2007	At	2	2	1	
WKN012	2020	P8-123	2007	Ew	2	2	1	Large dead central stem, suckers still alive
WKN013	2020	P8-393	2007	Lw	2	4	0	
WKN014	2020	P8-119	2007	Lw	2	2	1	
WKN015	2020	8-108	2007	Lw	2	9	0	Tree cut down 2009
WKN016	2020	P8-120	2007	Lw	2	9	0	Tree removed, surrounding area cleared
WKN017	2020	P8-363	2008	Ew	2	2	1	
WKN018	2020	P8-112	2008	Lw	2	2	1	
WKN022	2020	8-355	2008	Lw	2	2	1	
WKN023	2020	P8-362	2008	Lw	2	2	1	
WKN024	2020	8-308	2008	At	2	2	1	
WKN025	2020	P8-200	2008	Lw	2	2	1	
WKN026	2020	8-356	2008	Lw	2	2	1	
WKN028	2020	8-101	2010	Lw	2	2	1	
WKN029	2020	P8-307	2010	Lw	2	2	1	
WKN031	2020	8-110	2010	Lw	2	2	1	
WKN033	2020	P8-124	2012	Lw	2	2	1	
WKN035	2020	P8-212	2013	Py	2	2	1	
WKN038	2020	8-108	2013	Lw	2	2	1	
WKN039	2020	8-108	2013	Lw	2	2	1	
WKN040	2020	8-108	2013	Lw	2	2	1	
WKN043	2020	P8-123	2014	Ew	2	2	1	dead central stem

Nest Tree GPS Mark	Most recent Year Checked, or year known down if no longer suitable	WHA	Year nesting first observe d	Tree Sp.	Wildlife Tree Code (1-9) Status in Year first observed	Current Wildlife Tree Code Status	Tree Still suitabl e for Nesting ?	Comments
WNK044	2020	P8-116	2015	Lw	2	2	1	
WNK045	2020	P8-122	2015	Lw	2	2	1	
WNK046	2020	P8-115	2015	Lw	2	2	1	
WNK047	2020	P8-115	2015	Lw	2	2	1	
WNK048	2020	P8-115	2019	Lw	2	2	1	
WNK050	2020		2019	Lw	2	2	1	
New Nests discovered 2020						-		
WNK052	-		2020	Lw	2	-		
WNK053	-		2020	Lw	2	-		
WNK054	-		2020	Lw	2	-		
WNK055	-		2020	Lw	2	-		

Appendix 6. Breeding Bird Atlas codes used for WISA breeding evidence.

OBSERVED

X Species observed in its breeding season (no breeding evidence)

POSSIBLE

H Species observed in its breeding season in suitable nesting habitat

S Singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season

PROBABLE

M Multiple singing males (7 or more) found during one visit within the same square, during the breeding period in suitable nesting habitat. Most species listed as (M) can be upgraded during other visits. Use with caution to avoid counting migrants.

P Pair observed in suitable nesting habitat in nesting season

T Permanent territory presumed through registration of territorial song, or the occurrence of an adult bird, at the same place, in breeding habitat, on at least two days a week or more apart, during its breeding season. Use discretion when using this code. "T" is not to be used for colonial birds, or species that might forage or loaf a long distance from their nesting site e.g. Kingfisher, Turkey Vulture, and male waterfowl

D Courtship or display, including interaction between a male and a female or two males, including courtship feeding or copulation

V Visiting probable nest site

A Agitated behaviour or anxiety calls of an adult

B Brood Patch on adult female or cloacal protuberance on adult male

N Nest-building or excavation of nest hole by wrens and woodpeckers

CONFIRMED

NB Nest building or carrying nest materials, for all species except wrens and woodpeckers

DD Distraction display or injury feigning

NU Used nest or egg shells found (occupied or laid within the period of the survey)

FY Recently fledged young (nidicolous species) or downy young (nidifugous species), including incapable of sustained flight

AE Adult leaving, occupying or entering nest sites in circumstances indicating occupied nest (e.g. sitting on nest)

FS Adult carrying fecal sac

CF Adult carrying food for young

NE Nest containing eggs

NY Nest with young seen or heard

Appendix 7. Habitat Plot instructions and field forms WISA West 2021

WISA Habitat Plots 2021

Reference Pg. 1

Field: DO NOT move a plot from the planned point. If unsafe to do a plot, e.g. on a cliff or in a river, then drop plot. Roads or landings are okay if that is how the stratum has been laid out. Even if there are no trees, that is a valid result. Record any notes about plot site history (e.g. recently harvested, old high-grading, mature forest, road in plot, skid trail through plot).

Plot sheets are designed to be printed on 8.5x11" paper, fold on centerline to use on a half-size clipboard (which fits in a vest pocket), or in a 6-ring notebook binder.

Suggested nested fixed-plot radii:

In typical IDF forest: 7.98 m or smaller for 10 or 15 cm dbh trees
11.28 m for 17.5 – 52.4 DBH trees/stumps,
17.84 m for ≥ 52.5 DBH trees and for snags ≥ 22.5 DBH.

In Cuts: 9.77 m for stumps, 12.62 for trees if density 100-200,
17.84 for trees if $< 100/\text{ha}$, and larger plots for ST Cuts

Use smaller radii in dense young PI stands or SxBI stands.

Use the SAME plot size by DBH size class for all plots in a given stratum/stand for each survey area/block/WHA.

Other Potential Plot Sizes

Inter tree spacing = $\sqrt{11547/\text{density}}$

Circular Plot Radius (m)	50-m Trans. Total Width (m)	Plot Area (ha)	Plot Factor Tally x Factor = Density (/ha)
3.99	1	0.005	200
5.64	2	0.01	100
7.98	4	0.02	50
9.77	6	0.03	33.33
11.28	8	0.04	25
12.62	10	0.05	20
15.45	15	0.075	15
17.84	20	0.1	10
20.60	-	0.133	7.5
21.85	30	0.15	6.666
25.23	40	0.2	5
28.21	50	0.25	4
32.57	-	0.33	3
35.68	-	0.4	2.5
39.89	-	0.5	2
56.42	-	1.0	1

WISA Habitat Plots 2021

Reference Pg. 2

Trees and Snags

Tally trees by 5-cm dbh classes as mid points. E.g., 25 = 22.5-27.4 cm dbh

Tally Dead ≥ 17.5 cm dbh in largest plot size (usually 17.84 m).

Wildlife Tree Class (WTC) = Live (L or 1 or 2) or Dead (WTC 3 to 8)
Record DBH for > 52 .

Stumps are WTC 9: Old rotten Cut Stumps (9O), recent cut stumps (9R) or Natural Stumps still in ground (9N). For stumps use Dia at Stump Ht (dsh). Use separate line for old ~ 1 -m high stumps (9Oh). Turned up stumps are CWD, not recorded on tree list.

Species = Py, PI, Sx, BI, Fd, At, Ac, Lw, Ew

Record C for Cavity seen in a tree or snag: the letter is a tally mark.

Suitable Nest Tree (SNT) Plots usually overlap the Other Tree plots, therefore a SNT would be recorded in both plot types if it falls in both plots.

Radius used will depend on visibility. At a minimum use 17.84 m radius, but often much larger (e.g., 25.23 or 35.68 m but be consistent). Depending on project, may also use 20-m width on each side of line between plot centres as belt transect between plot (e.g., 200-m x (20+20) = 0.8 ha)

SNTs will almost always have both old and new nest cavities of the size made and used by sapsuckers (3-4 cm diameter), as trees are used for many years.

Do NOT count trees with:

- only old nest cavities, (e.g., punky old Fd or At WTC 8)
- only small (< 3 -cm diameter) typical of chickadees and nuthatches,
- only with very old large cavities (> 5 -cm diameter) (NOFL or PIWO)

Be sure to distinguish nest cavities (round entrances) from large woodpecker feeding holes.

Also record Potential Nest Trees (PNT), i.e., trees with the above characteristics that could be nest trees, but do not have cavities, or do not have sapsucker-sized cavities

Not done for West Cutblocks 2021

CWD transects only measure the diameter of the piece/log at the intercept with the transect line.

Tree calipers work best for CWD intercept-diameters.

Use 25-m North and 25-m East for total of 50 m.

To calculate CWD volume in m^3/ha : $0.024674 \times \text{sum of (diameters}^2)$

WISA Habitat Plot Data Date:_____ Time:_____

OBS: _____ WHA or CP _____ Plot ID _____

Plot History/Age: _____ Photo _____

Sp	WTC	10	15	20	25	30	35	40	45	50	Enter DBH >52.4
Plot Radius (m):											
	Live										
	Live										
	Live										
	Live										
	Live										
		Radius:									

WISA SNTs and F. rufa nests

Plot Radius or POT/POC L x W	Sp-dbh-WTC-Cavities and Comments / F. rufa nest tally

Other Comments:

WISA Habitat Plot Data Date:_____ Time:_____

OBS: _____ WHA or CP _____ Plot ID _____

Plot History/Age: _____ Photo _____

Sp	WTC	10	15	20	25	30	35	40	45	50	Enter DBH >52.4
Plot Radius (m):											
	Live										
	Live										
	Live										
	Live										
	Live										
	Live										
		Radius:									

WISA SNTs and F. rufa nests

Plot Radius or POT/POC L x W	Sp-dbh-WTC-Cavities and Comments / F. rufa nest tally

Other Comments: