

Williamson's Sapsucker Occupancy Monitoring, 2017-2018

Les Gyug, R.P.Bio.

Okanagan Wildlife Consulting
3130 Ensign Way,
West Kelowna, BC V4T 1T9

Prepared for:
Ministry of Forests, Land, Natural Resource Operations
and Rural Development
#401-333 Victoria St.
Nelson, BC V1L 4K3

2 August 2018

ABSTRACT

Field data collection for effectiveness monitoring for the Endangered Williamson's Sapsucker began in 2017. This report deals only with the occupancy portion of effectiveness monitoring. Occupancy was determined in 2017 or 2018 at Level 1 (April-early May) when territories are being established, and for some sites at Level 2 occupancy (June) when nesting is occurring. Occupancy rates were determined for 27 Wildlife Habitat Areas (WHAs), 18 cutblocks where timber was harvested according to Best Management Practice (BMP) guidelines, and 10 unharvested control forests. Occupancy in WHAs was 63% (n = 27) for Level 1 and 55% (n = 11) for Level 2. Occupancy for harvested areas where nesting was not previously known was 47% (n = 15) for Level 1, and 10% (n = 10) for Level 2. There were fewer than 10 samples in any other groups. It is anticipated that future sampling will augment sample size in all groups to allow statistical comparisons. It is intended to compare harvested areas to unharvested controls in two groups: where nesting was previously known, and where nesting was previously not known. Habitat plots were done at some sites. Residual tree (≥ 17.5 cm dbh) densities in harvested areas ranged from 33 to 200 trees/ha with tree densities in forests ranging from 192 to 763 trees/ha. Field methods for Williamson's Sapsucker occupancy surveys and for habitat plots are revised and updated in this report. Recommendations have also been made for future study design and data collection.

TABLE OF CONTENTS

INTRODUCTION	3
METHODS.....	4
Study Sites	4
Occupancy Field Methods.....	4
Habitat Plots	6
RESULTS	7
Occupancy	7
<i>Merritt and Princeton</i>	7
<i>Boundary</i>	7
<i>East Kootenay</i>	8
Habitat Plots	8
DISCUSSION.....	9
RECOMMENDATIONS	11
LITERATURE CITED	12
TABLES	13
FIGURES.....	18
Appendix A. Recommended instructions and field tally sheets for WISA habitat plots.....	22

Acknowledgments

This monitoring was funded by the Ministry of Forests, Land, Natural Resource Operations and Rural Development, Nelson, B.C., through contract GS19NLE033.1070-20 to Okanagan Wildlife Consulting. Lisa Tedesco was the contract monitor. Many thanks to Ted Antifeau for assistance to the author collecting Williamson's Sapsucker field data in 2018 in the East Kootenay. Habitat plot information in the East Kootenay and Boundary were collected by FLNRORD staff including Emily Chow and Becky Phillips. Field data was collected in the Merritt-Princeton areas by FLNRORD staff and others including Bevan Ernst, Emily Ernst, Kindra Maricle, Colin Brewer and Sean Dawson.

INTRODUCTION

Williamson's Sapsucker (WISA) has been designated as Endangered in Canada (COSEWIC 2005, and re-confirmed in 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 for timber harvesting in the Williamson's Sapsucker Area of Occupancy (AO). After choice of study sites, Level 1 monitoring determines if Williamson's Sapsucker are present at sites early in the breeding season, and if Level 2 monitoring is done, whether they are successfully breeding at these sites. Plots describing the habitat at these sites may or may not be done later in the season.

Study sites, both WHAs and harvested areas, were chosen in early 2017 by Ministry of Forests, Land, Natural Resource Operations and Rural Development (FLNRORD) in the Thompson Region (Merritt and Princeton AOs), and in the Kootenay Region (Boundary and East Kootenay AOs). In 2017, Level 1 monitoring was completed by FLNRORD in the Merritt and Princeton AOs, but only habitat plots were completed by FLNRORD in the Boundary and East Kootenay AOs. In 2018, Level 1 and Level 2 monitoring was completed in the Boundary and East Kootenay AO sites, as well as at extra sites added as forested controls on harvested sites. This is an ongoing multi-year project, with only interim results summarized here.

The purpose of this report was to:

1. Summarize:
 - a. 2017 Level 1 monitoring in the Merritt and Princeton AOs of 2017,
 - b. 2018 Level 1 and Level 2 monitoring in the Boundary and East Kootenay AOs,
 - c. Habitat plot results from the Boundary and East Kootenay AOs,
2. Recommend further study priorities, and to
3. Provide further recommendations where the Effectiveness Monitoring Protocols did not provide sufficient detail for
 - a. Future study site selection and study design, and
 - b. Standardized habitat data collection methods.

METHODS

Study Sites

Study sites were chosen in 2017 by FLNRORD in the Merritt-Princeton, Boundary and East Kootenay portions within the AO of Williamson's Sapsucker (Tables 1-3, Figures 1-4). No sites were chosen in the Okanagan portion of the AO. In the Boundary region, additional study sites were added in early 2018 to provide unharvested controls for harvested sites. These control forests were nearby the harvested sites and were of similar habitat suitability for WISA. Lehman Springs conservation area owned by the Nature Conservancy of Canada was included by FLNRORD in the comparison even though it was not a WHA.

Occupancy Field Methods

Methods have been described in Gyug (2016) and are repeated here with some revisions and clarifications. The methods as written below should be used as the field methods for this project going forward, replacing the field methods outlined in Gyug (2016).

Occupancy Level 1: WISA Presence during territory establishment phase.

1. Sites to be visited early in year (approximately April 1 to May 7) when breeding territories are being set up to confirm WISA presence.
2. This requires one extended site visit, i.e., with >1 CPB done on site.
3. If visiting a site where previous occupancy is known, begin by revisiting the old nest site(s) in ideal weather conditions (wind < Beaufort 3, and not raining).
4. Then, if no WISA have been detected, use at least 5 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.
5. If visiting a site where previous breeding occupancy is unknown, start CPB upon arrival, and continue for at least 30 minutes moving around the entire area or until one or more WISA are detected.
6. If one or more WISA are detected, attempt to determine if only males are detected or if a breeding pair may be present.

Occupancy Level 2: Breeding Confirmation during nesting phase.

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. In that case, Level 2 surveys need not be conducted as WISA will be assumed absent.
2. Visit site during egg incubation or nestling period (approximately May 15 to June 20).
 - a. Exact timing will depend on breeding conditions in any given year although mid-June is the most reliable time for nesting surveys.
 - b. Timing must allow for general furtive behaviour in May or early June if the pair are still incubating eggs, and general unresponsiveness of WISA in (at a minimum) the first week after eggs hatch while they are brooding young.
 - c. Young may fledge as early as mid-June (depending on the year), but more typically fledge in the last week of June or sometimes the first week of July. Nesting may be difficult to confirm if young have fledged and both young and adults have left the nest area, but sometimes the young remain in the nesting territory for a week or more after fledging.

3. Breeding confirmation will require:
 - a. Visits of any old nests, and
 - b. Up to 45 minutes on site of 16 ha in ideal weather conditions (winds <Beaufort 3 and not raining) including a series of CPB in the site, not just at any old nests, or until a response is detected.
 - c. Only after 45 minutes of searching of a 16-ha site can it reasonably be concluded that WISA are absent if no responses are detected.
 - d. The entire site must be searched, approaching all areas to within at least 100 m as previously unknown nest trees may be used.
 - e. Sites larger than 16 ha may take considerably longer to survey properly for nesting activity. In 2018, surveying the Lehman Springs conservation area of 28 ha took 2-3 hours, and was done twice to ensure accurate results.

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 100 m, sometimes only a pocket call playback unit (FoxPro NX4 or equivalent) with a 3-4" 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 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 CPB were done but the full formal CPB protocol was not necessarily followed after the first CPB, we recorded the GPS track that was followed, 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. We also recorded the same WISA information as at a formal CPB point.

When returning to a site for the Level 2 occupancy check the methods were slightly different. The previous WISA detection label or previous nest label was used as the Design Component (i.e., the site), with a search undertaken to determine if WISA could be re-found at that site. CPB are assumed to be used, but not recorded as individual CPBs. The nest or site is searched until nesting is confirmed, or until the site has been covered well enough to confirm that there is no nesting. If no WISA are found on this revisit, the result is recorded as NULL. Location, sex, and type of observation are recorded for any WISA detections. Where an active nest is confirmed, other nearby WISA detections of the same pair need not be recorded.

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. Formal CPB from the Level 1 (April-early May) surveys were entered into the “CPB-DataEntry” sheet. Follow-up visits to WISA detections and old nests to check for continued occupancy or re-occupancy were entered into the “NestSearch_Visits-DigiDataEntry” sheet. There was a separate sheet for incidental detections of WISA or other species. This file has been quality checked for formatting and for data entry errors, and submitted to SPI.

Habitat Plots

Data collection generally followed the field methods outlined in Gyug (2016) and as described in more detail in previous WISA studies from 2006 to 2015. In 2017, tree and snag densities were estimated using nested radius plots in forested or partially forested sites, and by Closest Individual and T-Square (a type of nearest neighbour) methods in low tree density sites (usually <100 trees/ha). Plot radii used were: 7.98 m for 7.5-17.4-cm trees and snags, 11.28 m for trees, snags and stumps 17.5-52.4 cm dbh (or at ground level for stumps), 17.84 m for trees, snags and stumps 52.5-57.4 cm dbh, and 25.23 m for trees, snags and stumps ≥57.4 cm dbh. Trees and snags were identified to species, but stumps were not. Where there were no closest individuals within a size class and within 56 m, no distance was recorded for that size class. Where there was only one closest individual within 56 m, its distance from plot centre was recorded for each size class. Where there was a nearest neighbour to that closest individual within 56 m, its distance from the closest individual was recorded, otherwise no distance was recorded for the nearest neighbour.

Tree, snag and stump densities per ha for each species and size class were estimated for each plot by dividing the tally by the area sampled. Using the closest individual, the density estimate (after Byth 1982 and Engeman et al. 1994) for each size class was based on: $\text{Area}/((2 \times \text{distance}_1)^2)$, where A = 10,000 to convert to density per ha, and distance was in m. Where there was a nearest neighbour, the density estimate for each size class was: $1/((2 \times \text{distance}_1) \times \text{Sqrt}(\text{distance}_2))$. This method is biased if individuals are clustered, so where second distances were <3 m, these were raised to 3 m to avoid severe overestimation of density. Where there were no closest individuals within 56 m, the density for that plot was estimated to be zero.

Habitat data from the 265 plots were entered into a spreadsheet designed specifically to handle the data as it was collected in 2017. A different spreadsheet has been designed for future data entry. A summary of the data from each plot was added to the WISA habitat plot shapefile that previously contained 4584 habitat plots completed from 2006 to 2015, but not including those from the WISA radio-telemetry study (St. Amand 2017).

RESULTS

Occupancy

Overall territorial Level 1 occupancy of WHAs in 2017 or 2018 was 63% in April or early May, and nesting Level 2 occupancy was 55% in June (Table 4). Occupancy in April at harvested sites was relatively high (47%) but then very low in June when nesting occurs (10%).

Merritt and Princeton

The 25 study sites including 16 in WHAs and 9 elsewhere in the Merritt and Princeton areas were sampled for Level 1 occupancy from April 18 through May 9, taking nine field days. A total of 166 non-overlapping CPB were completed detecting 38 WISA at 13 of the sites (Table 1). Level 1 occupancy rate was 50% in the 16 WHAs, with too few of any other type of site sampled in 2017 to form a reliable estimate of occupancy (Table 4).

Boundary

The 26 study sites in the Boundary were sampled for Level 1 occupancy from April 9-13, 2018. Most of the forestry roads in the area were still snowbound, so access to most sites was by snow machine. The 16 sites where WISA were found in April were resampled from June 11-18, 2018, to check for nesting.

WISA occupancy in April at unharvested WHAs was high at 84% (Tables 2 and 4). WISA occupancy in June was also high at the unharvested WHAs at 57%. There were no nests actually in WHA8-221 where the old nest tree had fallen. A male was on territory and probably nesting in forest 100-200 m west of the WHA, and another WISA was found about 100 m southwest of the WHA in a lightly partially harvested area. One new nest tree was found in the Lehman Springs conservation area. There was a second male in the area, but he did not appear to be nesting, and was continually moving around the south end of the conservation area, vocalizing and drumming throughout the search times. This one active nest was considerably lower than the maximum of five active nests found in June 2007.

For sites where prior nesting was known, all sites were occupied in April, whether harvested or not (Table 1). WISA bred successfully in two of the tree harvested sites, and one of the three unharvested sites. WISA were found in both of the WHAs that had been harvested, one that was harvested prior to WHA designation, and one that was partially harvested for ecosystem restoration. There was successful breeding at only one of the two harvested WHAs. In the harvested WHA 8-389, the male was found dead on the ground a few m from the known nest tree where he had been very active in April. It appeared to have been killed by an avian predator as both wings had been removed and left near each other on the ground as well as some of the belly feathers had been plucked and left. One new nest tree was found in WHA 8-312 where there had been ecosystem restoration treatment. The two previously known aspen nest trees in this area, and the one ponderosa pine, had all naturally fallen over. The new nest was in a dead aspen in a portion of the area where no ecosystem restoration had been done. In general, the only suitable nesting trees in the WHA were aspen as all suitable western larch had been logged out of this area long ago. With relatively little new aspen regeneration, the long-term prognosis for WISA nesting habitat in this WHA is not

very good as most aspen are overmature or dead, and will not provide nest habitat for more than probably 20-30 years.

For sites where prior nesting was not known, either because the area had never been sampled or had been sampled but no WISA nest had been found, WISA were found in April at about half the harvested and half of the control sites (Tables 1 and 2). However, no WISA breeding was found at any of the harvested sites, while one WISA nest was found at an unharvested control site.

East Kootenay

The six study sites in the East Kootenay were sampled for Level 1 occupancy from April 24-25, 2018. The two sites where WISA were found in April were resampled from June 17-18, 2018, to check for nesting. Six study sites where habitat plots were done in 2017 were not sampled for WISA occupancy in 2018, so remain to be sampled in 2019 or later.

Only one of the two WHAs was occupied (Table 3). In the WHA that was unoccupied (WHA 4-136), the nest tree was in an Ecosystem Restoration partially harvested site, and the nest tree had decayed to the point where it was no longer suitable for nesting use. In the site that was occupied (WHA 4-110), the WHA had been established as foraging territory for a nest discovered in 2006 that was just across the border in the U.S.A. In 2018, there was still no nest on the B.C. side, although WISA were present and foraging within the WHA. Any nesting appeared to be on the U.S. side where territorial activity was concentrated, and there appeared to be many more suitable nesting trees than on the B.C. side. We did not cross the border to determine if there may be an active nest there, but the behaviour of the pair indicated they were probably nesting.

In the three harvested sites, we only found WISA in April in one site (Kiahko Cut 2; Table 3). Returning in June, the active nest was found within the harvested area approximately 40 m from the forest edge. This was a previously unknown nest site and has been assigned the GPS mark WNE054.

The last site was at the edge of the 2017 Linklater Creek Burn. The area chosen to sample had been partially burned, while the majority of the burn had killed 100% of trees within the burn perimeter. No WISA were found in this area, even though it was adjacent to (400 m away from) WHA 4-110 where WISA were active. The site was cut in 1994 and by 2018 consisted primarily of dead small-diameter regenerating Pl.

Habitat Plots

Sites were initially classified (Table 4 and Tables 1-3) from ground visits or from aerial photo inspection as Seed Tree (ST) cuts or Partial Cuts based on a dividing line of about 50 mature trees (≥ 22.5 cm dbh) per ha remaining after harvest. While merchantable trees for any thin-barked species (which excludes Py) includes trees ≥ 17.5 -cm dbh, the small trees from 17.5-22.4 cm dbh are often difficult to tell from residual smaller trees on aerial photos while larger trees can usually be well distinguished. St. Amand (2017) used the 22.5-cm dbh division to define mature Douglas-fir trees as preferred for foraging by WISA.

The only portions of the habitat plot data summarized for this report were the merchantable tree (defined as any tree ≥ 17.5 -cm dbh) and large snag (≥ 22.5 cm dbh) densities (Table 5). Merchantable tree densities ranged from 192 to 763 trees/ha in forested sites (most of which have undergone some timber harvest over the past century, but most often light partial cuts or high-grading). Merchantable tree densities ranged from 100-200 trees/ha in partially cut sites (as defined above) and were 33-68 trees/ha in seed tree cuts. There were not yet enough sites for which we have complete data, i.e. both tree densities and WISA occupancy (Table 5), to attempt to conduct an analysis of occupancy by tree density classes.

DISCUSSION

Occupancy in April at harvested sites was relatively high (47%) but then very low in June when nesting occurs (10%). This would indicate a very high failure rate of breeding in harvested sites between territory establishment and nesting. However, not enough harvested sites and controls have been sampled yet to reliably compare occupancy rates, either in sites where WISA nesting was previously known, or in sites where WISA nesting was previously unknown. A full analysis of this data will have to wait for future sampling to increase sample size of this study, which would assume that occupancy rates do not differ by year. Gyug (2016) found no evidence that occupancy rates differed significantly from year to year. However, this does indicate that Level 2 occupancy will probably be required for these analyses since many sites may be occupied early in the breeding season, but if the majority of them fail in harvested sites, i.e., the same trend was not noted in WHAs, then this is significant to species recovery.

Estimating occupancy rate is only one method, albeit the most direct and meaningful, to determine effectiveness of WHAs. Comparison of WHAs to other unharvested sites where WISA nesting was previously known is not likely to be fruitful because the two groups would not differ in any meaningful habitat variable. After occupancy rate, I think the next most efficient variable for determining effectiveness would be to estimate density of suitable WISA nest trees. Some WHAs have only one suitable nest tree, and if it falls down or is cut down, then the WHA will lose effectiveness. Gyug et al. (2009, pg. 2320) defined suitable nest trees as “any trees that were either known to be used for nesting by Williamson's Sapsucker in a previous year or had both older and recently excavated nest cavities with entrances in the size range made and used by sapsuckers (3-5 cm diameter).” Expected density of these suitable nest trees is on the order of 0.1 to 0.5/ha by region (Gyug et al. 2009), although may be higher in old-growth Lw stands and in mature aspen stands. Reliable sampling at these low densities will require large plots, many small plots, or long transects. For example, Gyug (2009) used the 400-m traveled between CPB plot centres as straight-line suitable nest tree transects.

Habitat plots should not use the Closest Individual or any other nearest neighbour method. Gyug (2015) used these in sampling habitat of 256 ha sites where only one or two plots may have been completed in a given cutblock, and those few plots did not adequately describe the residual tree density. Where many plots are done in a cutblock, then Closest Individual methods are not necessary, especially given their bias towards overestimation of

density for clustered distributions. Recommended in harvested areas with sparse residual trees are either larger plot radii, or more plots of the same size as the adjacent forest.

Occupancy rates with only a few sites in any group will not provide for meaningful analyses of harvested sites compared to unharvested controls until more sites of each type can be added to the sample. If sites are resampled, these are not independent samples, but any extra years of sampling would serve to refine the occupancy entered into the analysis for any given site. In other words, a site may have occupancy of 50% if occupied in only one of two years, where if only one year is sampled, occupancy is either all or nothing, i.e. 0% or 100%. Gyug (2016) estimated sample sizes on the order of 25-35 per group for sites with previously confirmed breeding, and 50-70 per group with no prior information would be required for a comparison with reasonable power of 80%. It remains to be seen if that many sites are actually needed, especially if some sites are sampled in more than one year, until variance of the actual sample and the power of the test can be estimated.

Total minimum sample size would therefore be 75 harvested sites including 25 harvested where breeding was previously confirmed (4 already done), and 50 other harvested sites (15 already done). Sampling could be completed in two field seasons if another 25-30 harvested sites, and just as many controls, were sampled in each field season. WHAs or other unharvested sites can be used as controls, as long as they are selected to be approximately comparable in initial suitability or stand type. To assist in budgeting, an experienced WISA surveyor (e.g., this report) sampled 26 sites in the Boundary for Level 1 occupancy in 4 field days (40 hours) with resampling for Level 2 Occupancy in June requiring 6 field days (52 hours). Sampling the 25 sites in the Merritt-Princeton area required 9 field days by a crew relatively inexperienced at WISA sampling.

Some of the harvested areas selected for sampling in the Boundary had not been harvested, and some of the habitat plots sampled both harvested and reserved portions of the cutblocks. I suggest that no cutblock be included in the sampling until the actual harvested area determined from FLNRORD GIS files, the CP is examined, and that harvesting be confirmed with either the licensee or from up-to-date satellite imagery. Sampling both for WISA and for habitat plots must then be stratified by harvesting type or reserve within a given cutblock perimeter.

In the 2017 samples, cutblocks from both before 2014 and after the publication of the Williamson's Sapsucker Best Management Practices were included. To make efficient use of resources, recommended is that only cutblocks approved since the publication of the BMPs be selected for sampling so that habitat plots can be used to determine whether the guidelines of the BMPs have been met. In that case, plots must be done in both the harvested area and the reserve areas that will be treated as separate sampling strata.

Many of the WHAs already have habitat plots in them from 2006-2008. In WHAs, habitat plots will generally show that little to no change has taken place with a few exceptions where there have been entries, or Mountain Pine Beetle has changed the forest composition, or where the WHA was established on a previously harvested area. Where there has been no obvious habitat change since WHA approval, then only occupancy checks and Suitable Nest Tree plots are recommended. Habitat plots for tree and snag density are lower priority.

RECOMMENDATIONS

1. Finish data collection and entry for previously sampled sites:
 - a. Determine WISA occupancy at 6 East Kootenay sites where there have been habitat plots done in 2017 but WISA have yet to be sampled for occupancy.
 - b. Enter the data for habitat plots in the Merritt-Princeton areas from 2017; summarize as per this report (Table 5) and include data in WISA habitat plot summary shapefile.
2. Continue effectiveness monitoring for harvested sites by:
 - a. Selecting potential sample sites from cutblocks approved after the publication of the WISA BMPs:
 - i. Within the AO, determine the location, CP/block boundaries, size and harvested strata within CP boundaries, and whether the CP indicates the cutblock was intended to be harvested to the BMP guidelines.
 - ii. Confirm that these cutblocks have been harvested from the licensee, site visit, or recent imagery.
 - iii. Identify control unharvested sites near each harvested site with similar stand type, WISA habitat suitability and/or WISA breeding history.
 - iv. Determine WISA-sampling portion of block, (e.g., the entire area of a BMP block, or just the harvested area of an older cutblock).
 - b. Select as many sites per year for sampling as regional budgets will allow.
Recommended is a goal of at least 25 sites per year (approximately 5 field days for Level 1, and additional 6 field days for Level 2). Level 2 occupancy checks are high priority in harvested sites if breeding fails at many sites fail between April and June.
3. WHAs are lower priority for effectiveness monitoring than harvested sites because in general no, or very minimal, habitat changes are expected. However, these may be used as control sites for harvested sites.
4. Revisions and standardization of methods:
 - a. WISA occupancy surveys be conducted using the field protocol as revised and updated in the Methods of this report, and be conducted to at least Level 1 at all sites, with Level 2 high priority only in harvested sites.
 - b. Suitable Nest Tree transects or plots are the second most valuable method after occupancy to estimate WISA nesting suitability in both harvested sites and WHAs. These are large radius plots or long and wide transects using the definition of nest tree suitability outlined in Appendix A.
 - c. Habitat plots be conducted as outlined in Appendix A to this report for recently harvested cutblocks. Data collected can be simplified to trees ≥ 17.5 cm dbh and snags ≥ 22.5 cm dbh (with separation by size classes as per Appendix A), with stumps only tallied in forested sites to help determine site history. Stumps will be assumed to be abundant in recently harvested sites and therefore not tallied. In harvested areas where mature trees may be very scarce, complete counts of trees can sometimes be substituted for plots to estimate density.
 - d. CWD intercept transects are lower priority, but a visual estimate of CWD in broad classes should be made. If there is almost no CWD (< 20 m³/ha), or surveyors are not confident in their visual estimates, then conduct CWD intercept transects.

LITERATURE CITED

- Byth, K. 1982. On robust distance-based intensity estimators. *Biometrics* **38**:127-135.
- COSEWIC. 2005. COSEWIC assessment and status report on the Williamson's Sapsucker, *Sphyrapicus thyroideus*, in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Ontario, Canada. 45 p.
- Engeman, R.M., R.T. Sugihara, L.F. Pank, and W.E. Dusenberry. 1994. A comparison of plotless density estimators using Monte Carlo simulation. *Ecology* **75**(6): 1769-1779.
- Gyug, L.W. 2009. Williamson's Sapsucker habitat analysis for the East Kootenay: field data collection. Environment Canada, Canadian Wildlife Service, Delta, BC
- Gyug, L. W., C. Steeger, and I. Ohanjanian. 2009. Williamson's Sapsucker (*Sphyrapicus thyroideus*) nest tree characteristics and densities in British Columbia. *Canadian Journal of Forest Research* **39**:2319-2331.
- Gyug, L.W. 2016. Draft Williamson's Sapsucker WHA and BMP effectiveness protocols. Report prepared for Thompson-Okanagan Region, Ministry of Forest, Lands and Natural Resource Operations, Kamloops, B.C.
- St. Amand, J. 2017. Foraging ecology of Endangered Williamson's Sapsuckers in Canada: multi-scale habitat selection in two biogeoclimatic zones. Master's of Science thesis, University of British Columbia, Vancouver, BC.

TABLES

Table 1. Merritt-Princeton site descriptions and WISA occupancy, 2017.

Site No.	Name	Generalized Habitat	WHA Area or Area Searched* (ha)	Comments	WISA known prior to 2017	N CPB done Level 1	N WISA found during Level 1
WHAs							
1	WHA 3-090	Open Stands and Old Cut	43		1 nest	14	0
2	WHA 3-092	Forest	34		2 nests	12	0
3	WHA 3-131	Forest	38		3 nests	4	3
4	WHA 3-132	Open Stands and Old Cut	49		3 nests	2	2
5	WHA 3-133	Forest and MPB	59		3 nests	5	2
6	WHA 3-134	Forest/Old Cut	49		1 nest	1	1
7	WHA 3-135	Open Stands and MPB	50		1 nest	2	1
8	WHA 3-204	Forest	49		1 nest	4	0
9	WHA 3-205	Forest	33		1 nest	3	0
10	WHA 3-213	Forest and Open Stands	49		1 nest	12	0
11	WHA 3-219	Forest and Cut 2009	46		1 nest	2	0
12	WHA 3-220	Old Cut	49		1 nest	13	0
13	WHA 8-097	Partial Cut 1990s	46		2 nests	12	6
14	WHA 8-098	Forest (Old Cut)	47		1 nest	6	3
15	WHA 8-402	Forest and Partial Cut MPB	21		1 nest	2	2
16	WHA 8-404	Forest and Partial Cut MPB	48		1 nest	1	0
Other Sites							
17	WL1446	Forest and Partial Cuts	175	Woodlot	5 nests	25	6
18	Merritt-1	MPB Cut 2000	32	A18695 CP403-2	Present, no nests known	6	0
19	Coutlee-1	Cut – Private ~2008	80	Shulus Cattle Co.	2 nests	8	0
20	Coutlee-2	MPB, Burn and Salvage 2009	35		Adjacent, no nests known	3	2
21	Coutlee-3	Forest (Old Cut?)	100		1 nest	6	4
22	Kane-1	Seed tree/Partial Cut 2008	50		Not Known	8	0
23	Kane-2	Forest (Old Cuts?)	25		Present, no nests known	6	0
24	Allenby-1	ST Cut 2015	40	A18698 ALE001	Present, known nest adjacent	2	1
25	Allenby-2	ST Cut 2015 + Partial Cut1990s	15	A18698 ALE008	Present, no nests known	6	4

Nominal area searched based on approximately 250-m radius around CPB points.

Table 2. Boundary site descriptions and WISA occupancy, 2018.

Site No.	Name	Habitat	Comments	WISA nest Prior	N WISA found during Level 1	WISA Level 2 Occupancy (June)
WHAs						
2	WHA 8-221	Forest		1 nest	2	Old nest tree in WHA has fallen; Male found on new territory 100-200 m West of WHA; another WISA found in lightly partially harvested area about 100 m SE of WHA
3	WHA 8-379	Forest		1 nest	1	No WISA found
4	WHA 8-213	Forest		2 nests	1	No WISA found
5	WHA 8-202	Forest		1 nest	2	Old nest re-occupied (WNB058)
6	WHA 8-204	Forest		1 nest	0	-
7	WHA 8-210	Forest		2 nests	1	Old nest re-occupied (WN317)
9	Lehman Springs	Forest	NCC Conservation Area	5 nests	3	New nest found (WNB071) and non-nesting Male
Harvested Sites						
8	WHA 8-389	ST Cut 2000	Cut before WHA designation; nests in WTPs	2 nests	3	WNB059 F present, M found dead, WN047 not occupied
11	Copper Mt.	Partial Cut 2010		2 nests	4	Old nests re-occupied (WNB041 and WNB042)
15	WHA 8-312	Partial ER Cut	Ecosystem Restoration cut after WHA designation	2 nests	2	New nest found (WNB070) in old WTY (old nest trees WNB010 WNB023 WNB048 all have fallen)
10	Davis Lake S	Partial Cut 2001	Moderate after cut	Not known	2	WISA present but no WTY centre or nest
12	Ed James 3	ST Cut 2016	VL after cut	Not known	0	-
13	Ed James 2	ST Cut 2000	Low after cut	Not known	0	-
14	Ed James 1	ST Cut 2014	Low after cut	Not known	1	No WISA found
16*	"WL0474"	ST Cut 2017	Low before, VL after cut	Not known	0	-
28*		Partial Cut	Partial Cut to replace No. 17	Not known	1	No WISA found
17	Lower Fish Lake	Forest	Not cut, so excluded from comparison	Not known	0	N/A
Control Sites						
26	Control for 8	Forest/Edge		1 nest	2	Old nest re-occupied (WNB061)
20	Control for 11	Partial Cut 2012?	Very light cut	1 nest	2	WISA present but no WTY centre, nest not found
25	Control for 15	Forest	Unharvested portion of 8-312, Control to 15	1 nest	2	No WISA found
19	Control for 10	Forest		Not known	3	New nest found (WNB069)
21	Control for 12	Forest		Not known	0	-
22	Control for 13	Forest		Not known	1	No WISA found
23	Control for 14	Forest		Not known	0	-
27	Control for 16	Forest		Not known	0	-
18	Davis Lake N (near 8-316)	Forest	found not to be true Class 1 suitability because old high-grading removed Lw vets	Not known	0	-

* "WL0474" site is not really within Woodlot 474, is actually BCTS A92598-3. There was no control site for harvested site 28.

Table 3. East Kootenay site descriptions and occupancy, 2018.

Site No.	Name	Habitat	Area (ha)	Comments	WISA nests Known Prior	N WISA found during Level 1	WISA Level 2 Occupancy (June)
WHAs							
1	WHA 4-110	Forest (Partial Cut 1998)	35		(1)	2	WISA pair present, but nest not in B.C.; nest probably in U.S.A. as in 2006
2	WHA 4-136	Forest	40		1	0	
3	WHA 4-141	Forest and Old Cut	30		1	NA	
4	WHA 4-142	Forest and Old Cut	53		1	NA	
5	WHA 4-189	Forest and Cut 2006	43		1	NA	
6	WHA 4-191	Forest and Old Cuts 1989-2002	50		1	NA	
Harvested Sites							
7	Baker North (BN1)	Seed Tree Cut 2013	16		Unknown	NA	
8	W of WHA 4-110 (BC1)	Burned (2017) Regen	NA	Regenerating PI from 1994 cut was burned in 2017	Unknown	0	
9	Kiahko Cut 1 (KC1)	Partial Cut 2015	10		Unknown	1 Male	Active nest found in harvested area, 36 m from forest
10	Kiahko Cut 2 (KC2A)	Partial Cut 2015	10	Unknown	0		
	Kiahko Cut 2 (KC2B)	Partial Cut 2015	7	Unknown	NA		
11	Linklater Cut 1 (LC1)	Seed Tree Cut 2010	39	Only part of area sampled, including WT Patch	Unknown	0	
12	Linklater East Cut 1 (LE1)	Seed Tree Cut 2014	42	Only part of area sampled	Unknown	NA	

Table 4. Williamson's Sapsucker Occupancy summary, 2017-2018. WISA occupancy rates were only totaled where more than one region was sampled.

Type of Site	Occupancy Level 1 (April-early May)			Occupancy Level 2 (June)			
	N Sites	N Sites Occupied	Occupancy Rate	N Sites	N Sites with confirmed or probable nesting	Breeding Occupancy Rate	N Sites Occupied but nesting not found
WHAs							
Boundary	9	8	0.89	9	5	0.56	0
Merritt-Princeton	16	8	0.50		NA	NA	NA
East Kootenay	<u>2</u>	<u>1</u>	0.50	<u>2</u>	<u>1</u>	0.50	0
Total WHAs	27	17	0.63	11	6	0.55	
Non-WHA Sites							
Prior Nests Known							
Harvested							
Boundary	1	1	1.00	1	1	1.00	0
Merritt-Princeton	<u>2</u>	<u>1</u>	0.50	-	-	-	-
Total	3	2	0.67				
Unharvested							
Boundary	3	3	1.00	3	1	0.33	1
Merritt-Princeton	<u>1</u>	<u>1</u>	1.00	-	-	-	-
Total	4	4	1.00				
Prior Nesting Not Known							
Harvested							
Boundary	6	3	0.50	6	0	0.00	1
Merritt-Princeton	5	3	0.60	-	-	-	-
East Kootenay	<u>4</u>	<u>1</u>	0.25	<u>4</u>	<u>1</u>	0.25	0
Total	15	7	0.47	10	1	0.10	
Unharvested							
Boundary	5	2	0.40	5	1	0.20	0
Merritt-Princeton	<u>1</u>	<u>0</u>	0.00	-	-	-	-
Total	6	2	0.33				

Table 5. Habitat plot summaries at sites in the Boundary and East Kootenay, 2017. For WISA Occupancy, 1 = Occupied, 0 = Unoccupied in 2018.

Site No.	Name	Habitat*	WISA Occu-pancy	Density (/ha) by DBH class (cm)					
				Trees 17.5-22.4	Trees 22.5-52.4	Trees ≥52.5	Sum Trees ≥17.5	Sum Trees ≥22.5	Snags ≥22.5
Boundary									
Forested Sites									
2	WHA 8-221	Forest	1	95	200	25	320	225	18
3	WHA 8-379	Forest	1	133	106	6	245	112	23
4	WHA 8-213	Forest	1	95	97	1	192	98	0
6	WHA 8-204	Forest	0	145	242	4	391	246	3
7	WHA 8-210	Forest	1	103	111	54	268	165	7
9	Lehman Springs	Forest	1	-	-	46	279	-†	2
11	Copper Mt.	Forest	1	63	171	28	262	199	0
17	Lower Fish Lake	Forest	0	236	250	11	497	261	0
18	Davis Lake N	Forest	0	58	156	59	273	215	20
Harvested Sites									
5	WHA 8-202	Partial Cut	1	40	89	7	136	96	0
10	Davis Lake S	Partial Cut	1	44	100	33	178	133	0
11	Copper Mt.	Partial Cut	1	31	81	26	139	107	25
15	WHA 8-312	Partial Cut	1	34	69	10	113	79	7
8	WHA 8-389	ST Cut	1	-	-	11	68	-†	3
12	Ed James 3	ST Cut	0	25	14	28	67	42	3
13	Ed James 2	ST Cut	0	34	34	9	78	43	22
14	Ed James 1	ST Cut	1	21	12	2	35	14	3
16	“WL0474”	ST Cut	0	17	12	6	35	18	0
East Kootenay									
Forested Sites									
	WHA4-136	Forest	0	97	242	22	361	264	15
	WHA4-141	Forest	-	169	303	24	496	327	19
	WHA4-142	Forest	-	60	270	26	356	296	17
	WHA4-189	Forest	-	375	388	0	763	388	19
	WHA4-191	Forest	-	38	488	15	540	503	38
	KC1	Forest	1	113	413	0	525	413	0
	Linklater	Forest	0	56	344	20	420	364	22
Harvested Sites									
	WHA4-110	Partial Cut	1	36	136	18	191	154	15
	WHA4-191	Partial Cut	-	43	154	6	203	160	7
	KC1	Partial Cut	1	30	125	1	157	126	<1
	KC2A	Partial Cut	0	20	75	13	108	88	1
	KC2B	Partial Cut	0	0	150	3	153	153	1
	WHA4-189	ST Cut	-	25	43	7	76	50	11
	BakerN	ST Cut	-	21	14	<1	36	15	<1
	Linklater	ST Cut	0	13	24	4	41	28	5
	LinklaterE	ST Cut	-	8	16	9	33	25	9
	Border	Burned Regen	0	22	8	2	33	10	0

* The difference between Partial and Seed tree (ST) cuts were arbitrarily defined based on dividing point of 50 mature trees (dbh ≥22.5-cm) /ha remaining in the harvested area. See text for fuller description.

† Plots in these sites grouped several tree dbh classes together.

Sites may appear on more than one line if a site included both mature forest and harvested areas. At least two plots were required in each habitat before they were reported in this table. Habitat plot information for Merritt-Princeton has not yet been summarized or analyzed.

FIGURES

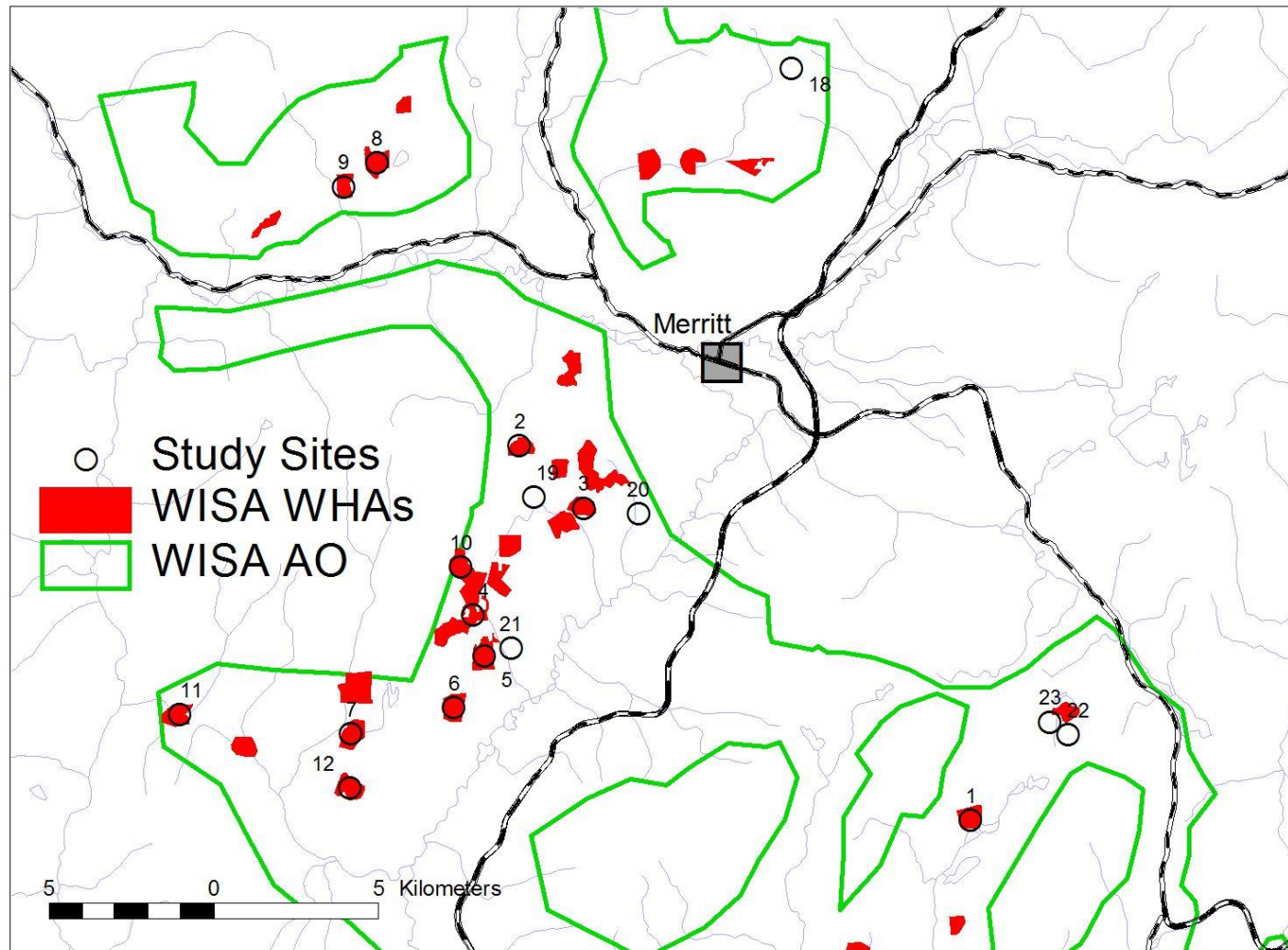


Figure 1. Study sites for occupancy monitoring in the WISA AO in the Merritt area, 2017.

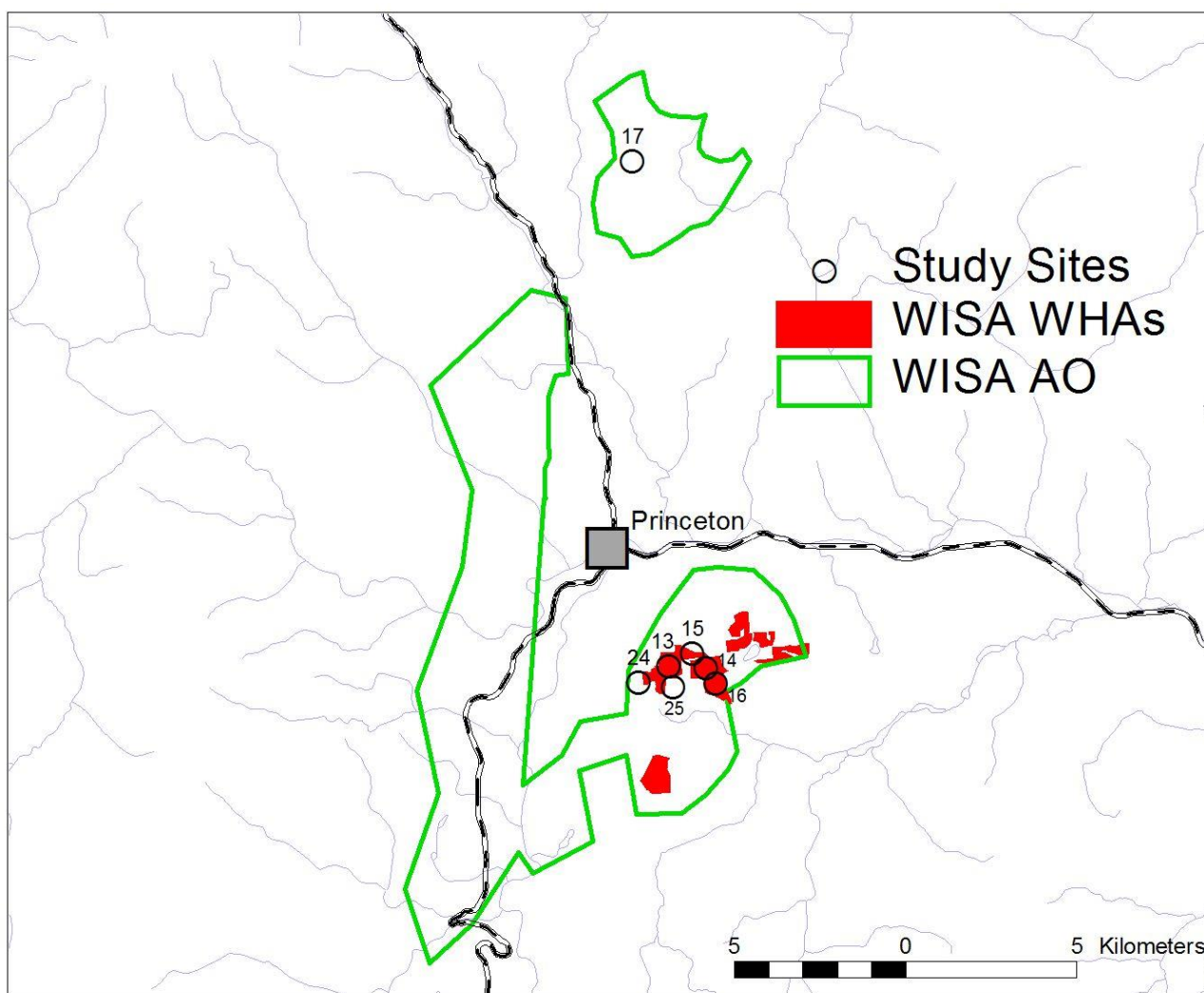


Figure 2. Study sites for occupancy monitoring in the WISA AO in the Princeton area, 2017.

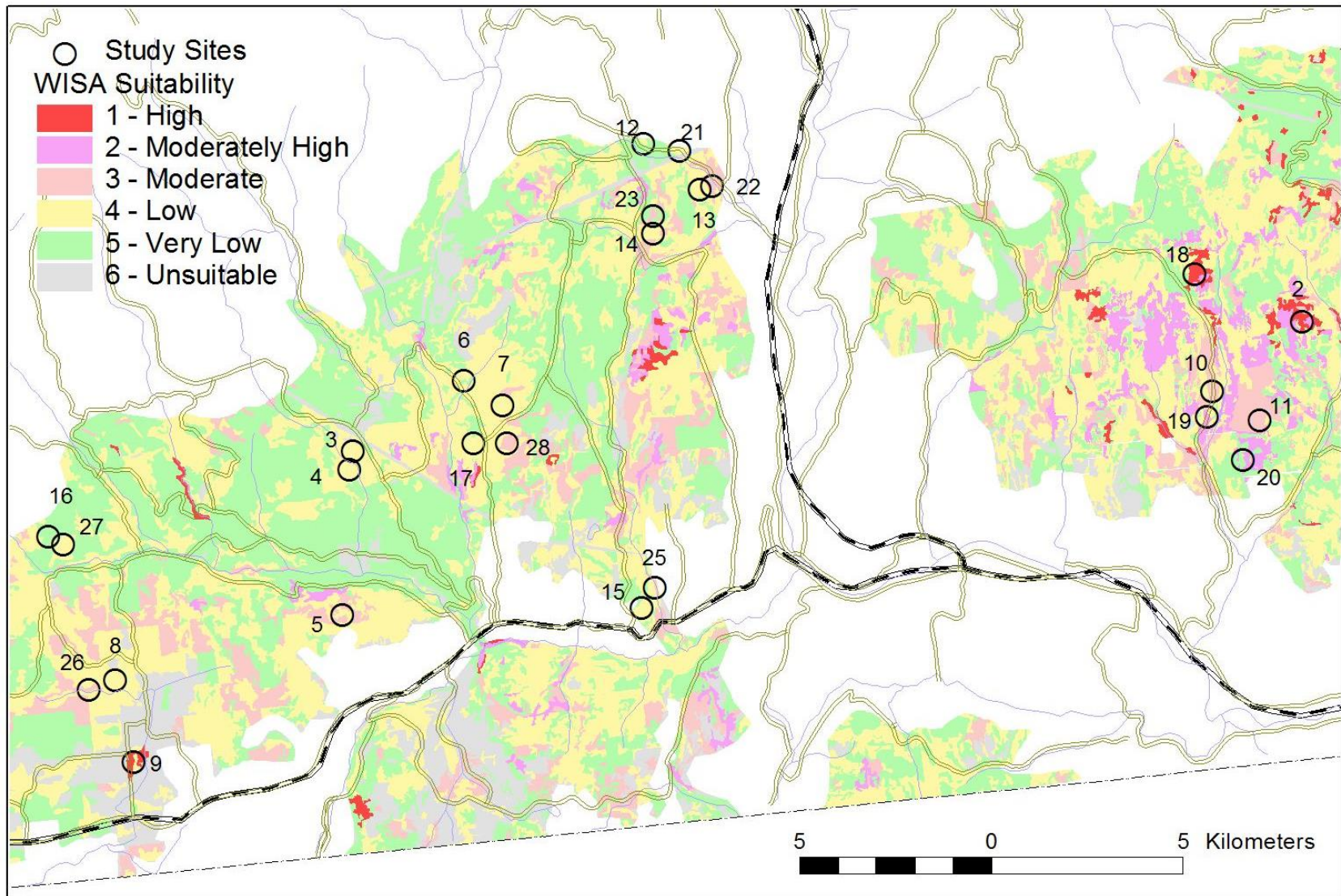


Figure 3. Study sites for occupancy monitoring in the WISA AO in the Boundary region. 2018 WISA nest habitat suitability used for west of Highway 33 and south of Highway 3, and suitability from 2008 east of Highway 33.

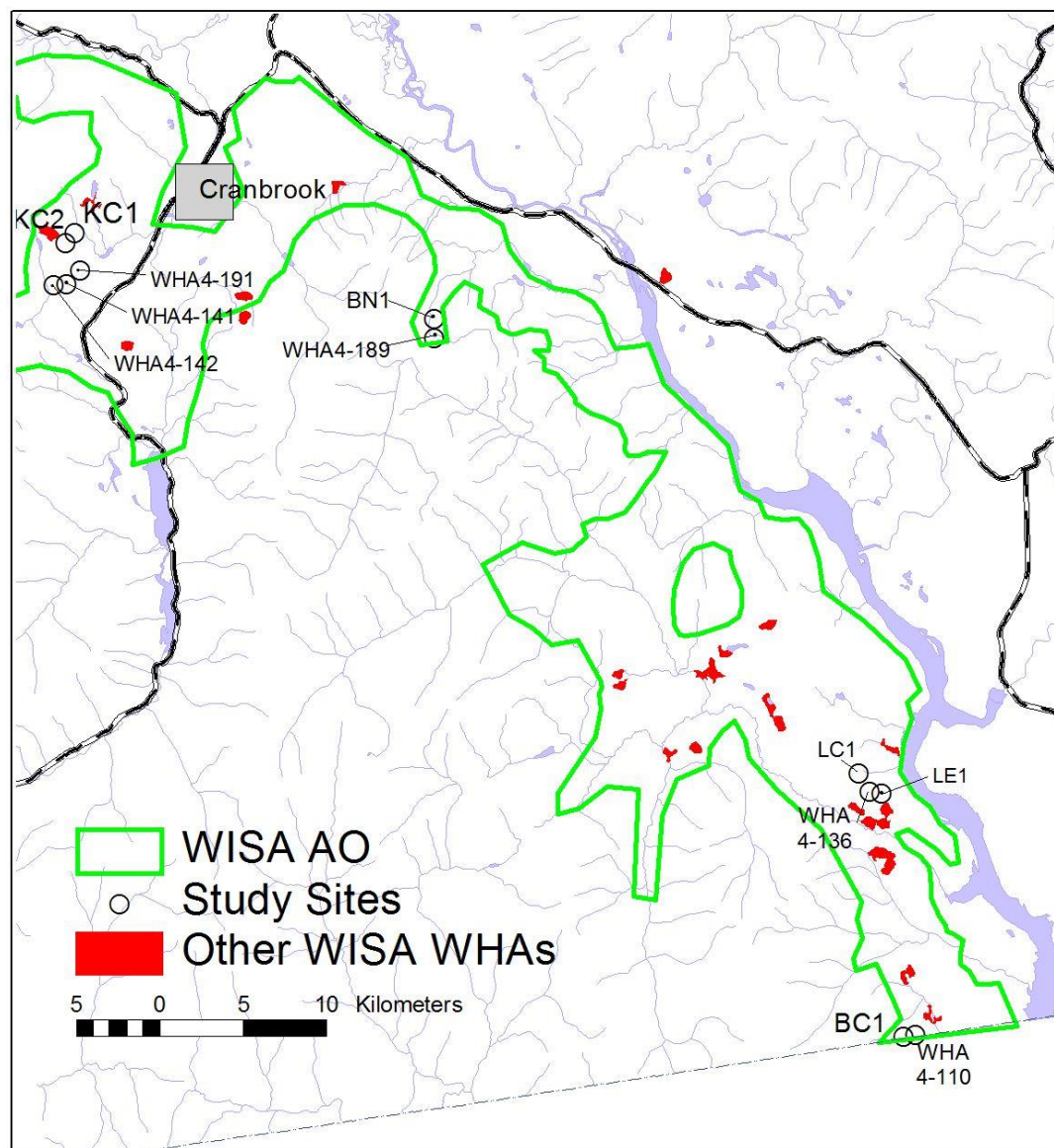


Figure 4. Study sites for WISA occupancy monitoring in the East Kootenay AO, 2017-2018.

Appendix A. Recommended instructions and field tally sheets for WISA habitat plots.

You can either use the single sheet per plot field sheet that records everything on one sheet,

OR use the multiple plots per sheet, with separate sheets for:

1. Trees/Snags/Stumps
2. CWD
3. Suitable Nest Trees

Reminders:

Plan in the office where habitat plots will go and which data are to be collected. Plots do not overlap strata boundaries (e.g. forest and harvested area boundaries).

Navigate to the plot centre with GPS, and NEVER move a plot from the intended point.

Use the same methods/plot sizes at all plots within a single stratum.

Enter habitat plot data in provided Excel template.

WISA Habitat Data 2018

Reference Pg. 1

Desktop: Find the CP-Block number. Make the harvested area and reserves different strata. WHAs can be >1 stratum if required. Confirm from satellite/orthophotos/etc. that block has been harvested. Place plots by stratum in GIS - either randomly without overlap or at intersection of 100-m grid. 100-m grid is only for fairly small areas. If >16 ha, either use random plots, or 150-m, or 200-m, etc. grid to reduce total number of plots. Check plot placement does not overlap strata boundaries, i.e., each plot at least 25 m from boundary.

Field: NEVER 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).

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. You can use the multiple sheets (Trees/Snags, CWD, SNT) or use the single sheet format.

Minimum plot radii in typical IDF forest:

9.77 m for 17.5-22.4 cm DBH trees;

11.28 m for 22.5 – 52.4 DBH trees/stumps,

17.84 m for ≥52.5 DBH trees/stumps and for all snags ≥22.5 DBH.

Use larger radii where trees are scarce, e.g. Seed tree cuts, or smaller radii in dense young PI stands or SxBI stands.

Stumps are optional in recently harvested stands (assumed abundant); but note whether you recorded them or not.

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

Use either straight line route between points as **SNT** transects (e.g., 40-m x 100 m), or very large radius at the plot centre. These are optional as low densities are expected. But if you are going to do them, do them at ALL plots.

Other Potential Plot Sizes

Circular Plot Radius (m)	50-m Trans. Total Width (m)	Plot Area (ha)	Plot Factor Tally x Factor = Density (l/ha)
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
17.84	20	0.1	10
25.23	40	0.2	5
35.68	80	0.4	2.5
39.89	100	0.5	2
56.42	200	1.0	1

WISA Habitat Data 2018

Reference Pg. 2

Suitable Nest Tree 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.

Suitable WISA nest trees will almost always have both old and new nest cavities of the size made and used by sapsuckers (3-5 cm diameter), as trees are used for many years.

Do NOT count trees with:

- only old nest cavities, (e.g. punky old Fd WTC 8)
- only small (<3-cm diameter) typical of chickadees and nuthatches,
- only with old large cavities (>5-cm diameter) typical of Northern Flickers, or
- only large and oblong cavity entrances typical of Pileated Woodpeckers.
- only one recent hole in a relatively hard tree (e.g. relatively small sized lodgepole pine) as these will normally be from Black-backed or American Three-toed Woodpeckers.

Nest cavities will sometimes be high up on the tree, and not visible from the ground on very tall large trees or snags-check carefully on large Lw

Suitable nest trees will most often be large to very large live Lw with obvious defects (broken top, dead top) or large dead Lw with that had obvious heart rot (when it was alive). **Do not** count fire-killed Lw that remain solid, i.e. did not have any decay before they were fire-killed.

Large aspen and birch are the next most used suitable nest trees. Only count if there are multiple cavities of the correct size, with some new and some old.

Other large conifers are rarely used, so be cautious before including these. Make sure the cavities are of the right size, and there are some new cavities and some old. Be sure to distinguish nest cavities (round entrances) from large woodpecker feeding holes. Tree decay class 8 snags of any species (very decayed and soft, usually <6-m tall), are not suitable nest trees.

DBH 5-cm classes are mid points. E.g., 25 = 22.5-27.4 cm DBH.

CWD transects are optional if you can visually estimate CWD to 20-50 m³/ha, 50-100 m³/ha or >100 m³/ha. If <20 m³/ha estimated, do transects. If you are unsure of estimates, do transects.

CWD transects only measure the diameter of the piece/log at the intercept with the transect line. No need to measure anything else – just visually estimate the LED to decide which class (LWD, SWD) it is in, or measure it if in doubt. Tree calipers work best for CWD intercept-diameters

Split CWD into LWD (LED ≥22.5 cm) and SWD (LED 7.5-22.4 cm) to allow comparisons with past data. The LED is what distinguishes LWD from SWD. E.g., the intercept can be as little as 8 cm for a log with LED ≥22.5 cm.

Sometimes SWD can have an intercept >22 cm if the log is intercepted lower on the bole than the DBH/LED.

Where the CWD is a branch or root piece, this is considered SWD, do not use the LED of the tree bole.

WISA Habitat Plot Data SINGLE PLOT SHEET
OBS: _____ **Date:** _____

Site: _____ **WHA-** _____ **or CP**
Tree/Snag/Stump Tally

Stratum/ Plot ID	Sp	WTC	Live 17.5- 22.4	Live 22.5- 37.4	Live 37.5- 52.4	Live 52.5- 57.4	Live >57.4 Dead >22.4
Plot Radius (m):							

CWD Intercept Transects

Stratum/ Plot ID	Tran/ Length	Record Intercept Diameters (d) (to closest cm) e.g. 20,35,8,15,11. . .
	North-SWD	
	North-LWD	
	East-SWD	
	East-LWD	

WISA Suitable Nest Trees Can use large radius plot, or transect.

Stratum/ Plot ID	Plot Area (LxW) or Radius	Sp	WTC	DBH 5-cm Class	Number/Type/Size of Cavities and Comments

Trees and Snags

WTC = Live (1/2) or Dead (WTC 3-8) or Cut Stumps (9C) or Natural Stumps still in ground (9N). For stumps use DSH (Diam at Stump Ht). Only Tally Dead ≥ 22.5 cm dbh in largest plot size.
 Species = Py, Pl, Sx, Bl, Fd, At, Ac, Lw See LMH25 for other codes
 Record C for Cavity: the letter is considered a tally mark.
 Stumps are optional in recently harvested areas; just note whether they were recorded or not (e.g. "Stumps not tallied". They are assumed to be abundant.

CWD
Optional as per Reference Page instructions.

Trans = **N**(orth) or **E**(ast), Length should be 25 m for each transect
 CWD = **SWD** (Small CWD LED <22.5 cm) OR **LWD** (Large CWD LED ≥ 22.5 cm)
 LED (Large End Diameter) measured where DBH would be measured on log,
 or at the large end if you cannot tell where DBH was
 Only record Decay Classes 1 to 4 (i.e. not if majority of log is in duff layer)

When L = 25 m; $m^3/ha = 0.049348 \times \text{Sum } (d_1^2, d_2^2, d_3^2, \dots)$
 When L = 50 m $m^3/ha = 0.024674 \times \text{Sum } (d_1^2, d_2^2, d_3^2, \dots)$

Suitable Nest Trees (SNT)

This sheet is optional in a project. But if you do it for one plot, do it for all plots.
 Can use large radius plot, or transect.
 Expected densities are very low (<0.2/ha), so Zeros are often expected.
 See definition of SNT on reference page.
 Note: to be a SNT, the tree/snag MUST have nest cavity holes of suitable WISA-size.
 DBH 5-cm classes are mid points. E.g., 25 = 22.5-27.4 cm DBH.
 SNTs can overlap with other plots; in that case record it twice.
See the two Reference Pages for more information.

WISA Habitat Plot Data Tree/Snag/Stump Tally Sheet

OBS: _____ Date: _____

Site: _____ WHA- _____ or CP _____

Stratum/ Plot ID	Sp	WTC	Live 17.5- 22.4	Live 22.5- 37.4	Live 37.5- 52.4	Live 52.5- 57.4	Live ≥57.5 Dead ≥22.5
Plot Radius (m):							
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							

WTC = Live (1/2) or Dead (WTC 3-8) or Cut Stumps (9C) or Natural Stumps still in ground (9N). For stumps use DSH (Diam at Stump Ht).

Only Tally Dead ≥22.5 cm dbh in largest plot size.

Species = Py, Pl, Sx, Bl, Fd, At, Ac, Lw See LMH25 for other codes

Record C for Cavity: the letter is considered a tally mark.

WISA Habitat Plot Data Tree/Snag/Stump Tally Sheet

OBS: _____ Date: _____

Site: _____ WHA- _____ or CP _____

Stratum/ Plot ID	Sp	WTC	Live 17.5- 22.4	Live 22.5- 37.4	Live 37.5- 52.4	Live 52.5- 57.4	Live ≥57.5 Dead ≥22.5
Plot Radius (m):							
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							

WTC = Live (1/2) or Dead (WTC 3-8) or Cut Stumps (9C) or Natural Stumps still in ground (9N). For stumps use DSH (Diam at Stump Ht).

Only Tally Dead ≥22.5 cm dbh in largest plot size.

Species = Py, Pl, Sx, Bl, Fd, At, Ac, Lw See LMH25 for other codes

Record C for Cavity: the letter is considered a tally mark.

WISA Habitat Plot Data CWD

OBS: _____ Date: _____

Site: _____ WHA- _____ or CP _____

Stratum/Plot ID	Tran/ Length	SWD/ LWD	Record Intercept Diameters (d) (to closest cm) e.g. 20,35,8,15,11. . .

Trans = **N**(orth) or **E**(ast), Length should be 25 m for each transect
CWD = **SWD** (Small CWD LED <22.5 cm) OR **LWD** (Large CWD LED ≥22.5 cm)
LED (Large End Diameter) measured where DBH would be measured on log,
or at the large end if you cannot tell where DBH was
Only record Decay Classes 1 to 4 (i.e. not if majority of log is in duff layer)

When L = 25 m; $\text{m}^3/\text{ha} = 0.049348 \times \text{Sum } (d_1^2, d_2^2, d_3^2, \dots)$

When L = 50 m $\text{m}^3/\text{ha} = 0.024674 \times \text{Sum } (d_1^2, d_2^2, d_3^2, \dots)$

WISA Habitat Plot Data CWD

OBS: _____ Date: _____

Site: _____ WHA- _____ or CP _____

Stratum/Plot ID	Tran/ Length	SWD/ LWD	Record Intercept Diameters (d) (to closest cm) e.g. 20,35,8,15,11. . .

Trans = **N**(orth) or **E**(ast), Length should be 25 m for each transect
CWD = **SWD** (Small CWD LED <22.5 cm) OR **LWD** (Large CWD LED ≥22.5 cm)
LED (Large End Diameter) measured where DBH would be measured on log,
or at the large end if you cannot tell where DBH was
Only record Decay Classes 1 to 4 (i.e. not if majority of log is in duff layer)

When L = 25 m; $\text{m}^3/\text{ha} = 0.049348 \times \text{Sum } (d_1^2, d_2^2, d_3^2, \dots)$

When L = 50 m $\text{m}^3/\text{ha} = 0.024674 \times \text{Sum } (d_1^2, d_2^2, d_3^2, \dots)$

WISA Suitable Nest Trees

Obs _____ Date _____

This sheet is optional in a project. But if you do it for one plot, do it for all plots.

Can use large radius plot, or wide transect.

Expected WISA SNT densities are very low (<0.2/ha), so Zeros are often expected.

Stratum/ Plot ID	Plot Area (LxW) or Radius	Sp	WTC	DBH 5-cm Class	Number/Type/Size of Cavities and Comments

WTC -2 = live with decay, 3-8 = dead, progressively more decayed (see sheet)

Record any notes about type of decay e.g. BT = Broken-top, FS = Fire Scar.

To be a SNT, the tree or snag must have WISA-sized nest holes.

Alternatively, you can use this to record ALL trees/snags ≥22.5 cm DBH with nest cavities. Just specify whether you did so.

WISA Suitable Nest Trees

Obs _____ Date _____

This sheet is optional in a project. But if you do it for one plot, do it for all plots.

Can use large radius plot, or wide transect.

Expected WISA SNT densities are very low (<0.2/ha), so Zeros are often expected.

Stratum/ Plot ID	Plot Area (LxW) or Radius	Sp	WT C	DBH 5-cm Class	Number/Type/Size of Cavities and Comments

WTC -2 = live with decay, 3-8 = dead, progressively more decayed (see sheet)

Record any notes about type of decay e.g. BT = Broken-top, FS = Fire Scar.

To be a SNT, the tree or snag must have WISA-sized nest holes.

Alternatively, you can use this to record ALL trees/snags ≥22.5 cm DBH with nest cavities. Just specify whether you did so.