

Williamson's Sapsucker (*Sphyrapicus thyroideus*) Sap Trees in British Columbia

Les W. Gyug¹, Chris Steeger², and I. Penny Ohanjanian³

¹Okanagan Wildlife Consulting, 3130 Ensign Way, Westbank, B.C. V4T 1T9 les_gyug@shaw.ca

²Pandion Ecological Research Ltd., 532 Park Street, Nelson, B.C. V1L 2G9 csteeger@netidea.com

³4481 LD Ranch Road, Kimberley, B.C. V1A 3L4 pohanj@xplomet.com

Abstract: Williamson's Sapsucker sap trees in British Columbia were characterized based on incidental observations of sap trees from 2004 to 2008, and sap tree frequency of occurrence was based on systematic and random tree samples near nests in 2006 and 2007. Douglas-fir was the most common sap tree (85%), but western larch, lodgepole pine, and ponderosa pine sap trees were also found. The majority of sap trees (75%) were between 23 and 47 cm diameter-at-breast-height (DBH). Sap trees were found up to 460 m from nest trees, but most occurred within 100 m. Douglas-firs 23-52 cm DBH, with injuries to the trunk, and within 60 m of nests were six times more likely to be sap trees than any other class of trees. Overall, the majority of sap trees occurred in classes of trees that have very low frequency of sap trees (<4%) which suggests that sap tree availability is not limiting.

Key words: Williamson's Sapsucker, *Sphyrapicus thyroideus*, sap trees, British Columbia.

Introduction

Williamson's Sapsucker, *Sphyrapicus thyroideus* (Cassin, 1852), is a medium-sized woodpecker specialized for feeding on tree sap. It breeds in pine, fir and larch higher elevation forests of the mountains of western North America. In Canada, it is restricted to the southern interior of British Columbia where it was considered an uncommon summer resident (Campbell *et al.* 1990) and more recently has been assessed as Endangered (COSEWIC 2005).

On the breeding range, sap and phloem fibers form the primary diet in the pre-nestling period, and may constitute the entire diet in early spring when insects (ants in particular) are not yet active (Crockett 1975; Dobbs *et al.* 1997). Adults continue to feed on sap and phloem fibers throughout the breeding season, although ants are the primary food fed to nestlings (Crockett 1975). In Colorado, Williamson's Sapsucker pairs were reported to maintain 4-5 coniferous sap trees—typically healthy Douglas-fir or unhealthy pine trees—in a breeding territory, based on opportunistic observations of banded birds made while conducting detailed foraging studies (Crockett 1975). Sap trees in other localities have included a variety of other coniferous species including true firs and junipers (Bull *et al.* 1986; see summary in Crockett 1975). Only two studies have quantified the characteristics of Williamson's Sapsucker sap trees (Oliver 1970; Crockett 1975), and only one study (Oliver 1970) has estimated frequency of sap tree occurrence in a stand. Bull *et al.* (1986) used focal animal techniques to quantify the trees

upon which Williamson's Sapsucker foraged, but did not separate ant-foraging trees from sap trees.

In this paper we first describe the species, size, and condition of sap trees used by Williamson's Sapsucker in British Columbia and the distance of those sap trees to active nest trees based on incidental observations made during nest tree inventories and other research on Williamson's Sapsucker. We secondly estimate the frequency of sap tree occurrence among tree species, size classes and health from samples of trees near Williamson's Sapsucker nests. The characterization of sap trees is one of several concurrent studies to describe the breeding resources used by Williamson's Sapsucker to assist in development of habitat management plans for this endangered species in British Columbia.

Methods

The study area was the interior of southern British Columbia within the breeding range of Williamson's Sapsucker (Figure 1). This included three geographical regions: the *Western*, west of the Okanagan valley; the *Okanagan*, east of the Okanagan valley; and the *East Kootenay* near Cranbrook. In the East Kootenay and Okanagan, Williamson's Sapsucker associates primarily with mixed western larch and Douglas-fir forests, and in the Western region primarily with mixed forests of ponderosa pine, Douglas-fir and trembling aspen (Gyug *et al.* 2007).

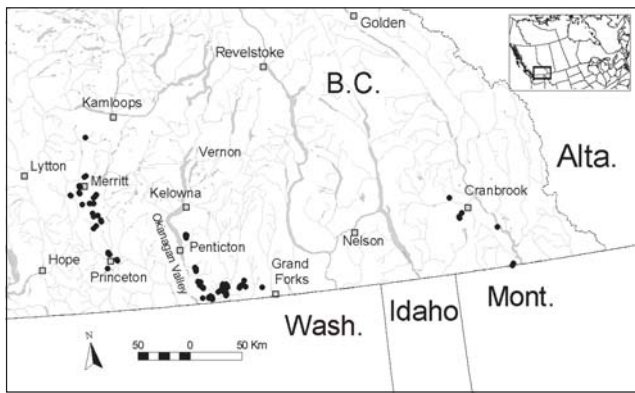


Figure 1. Location of Williamson's Sapsucker nests (black dots) for which vegetation data were collected in the southern interior of B.C., 2006-2007.

From 2004 to 2008, Williamson's Sapsucker nests were located by call and drum playback surveys with follow-up

nest searches where Williamson's Sapsucker were detected, or by nest searches alone at some sites (Gyug *et al.* 2007). In the Okanagan and Western regions, sap trees were located by observing Williamson's Sapsuckers at sap wells, usually near nests. Sap tree information was collected within several different projects and by a number of field crew incidentally to the primary focus on nest trees. Therefore information on location relative to nest, and on tree species, size and health were not collected consistently for all sap trees. Sap tree observations were not collected in the East Kootenay region except for one western larch sap tree for which no other data were recorded.

The presence of sap wells alone could not be used as evidence of Williamson's Sapsucker use because the sympatric Red-naped Sapsucker (*Sphyrapicus nuchalis*) also makes sap wells. Oliver (1970) characterized use of ponderosa pine sap trees in California in a stand where both Williamson's Sapsucker and Red-breasted Sapsucker

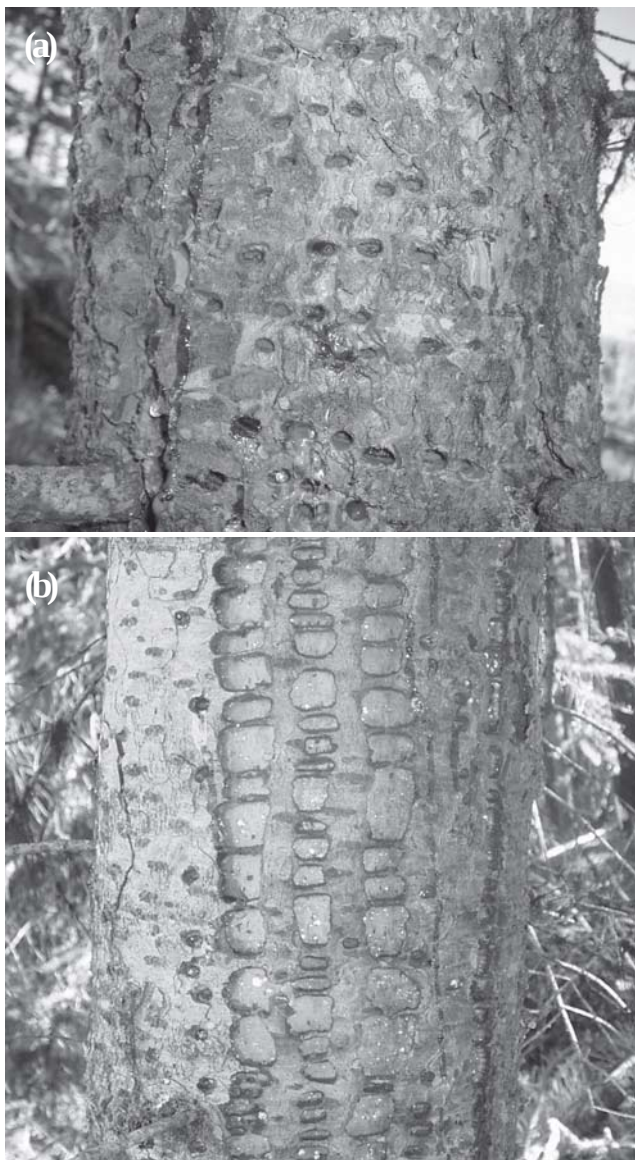
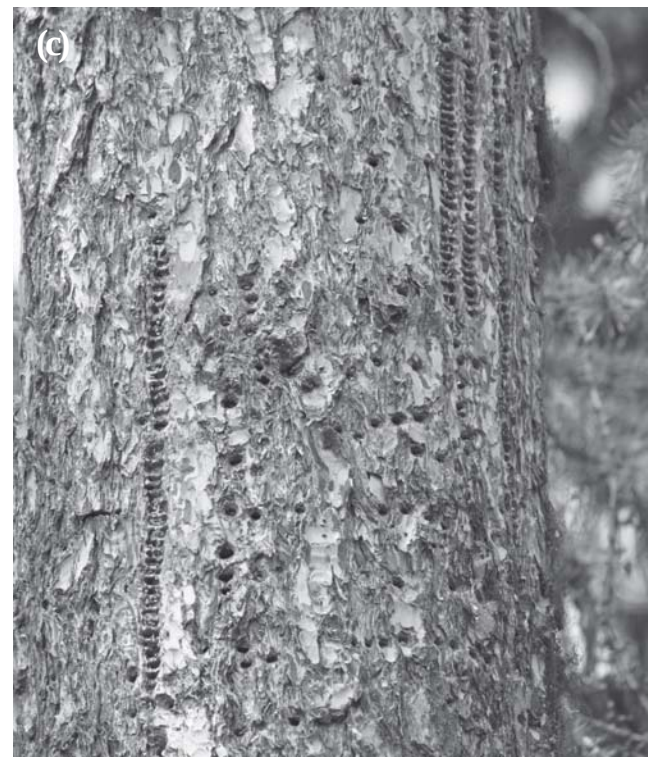


Figure 2. (a) Williamson's Sapsucker xylem or exploratory sap wells on Douglas-fir tree. (b) Williamson's Sapsucker phloem sap wells on Douglas-fir tree. (c) Williamson's Sapsucker xylem or exploratory sap wells dispersed across the trunk, and phloem sap wells "laddering" up the trunk of a western larch tree. All photos were taken near McCuddy Creek, east of Oliver, B.C. by Les W. Gyug.

(*Sphyrapicus ruber*) occurred but either could not, or did not, attempt to distinguish between the sap wells of the two species. However, in the southern interior of British Columbia there are differences in some types of sap wells of Williamson's Sapsucker and Red-naped Sapsucker that can sometimes be used to distinguish sap trees of the two species. In addition, other woodpeckers occurring in southern British Columbia may create and use sap wells including American Three-Toed Woodpeckers (*Picoides dorsalis*) (Imbeau and Desrochers 2002), and Downy Woodpeckers (*Picoides pubescens*) (Jackson and Ouellet 2002). However, Downy Woodpecker sap wells are smaller, less rectangular, and less deep than sapsucker wells (Jackson and Ouellet 2002).

Sapsuckers create two types of sap wells (Tate 1973; Eberhardt 2000). The first type, termed xylem sap wells, are small (usually <8 mm diameter) and relatively deep pits either to access xylem sap (particularly in the spring), or as exploratory wells (Figure 2, a and c). The second type, termed phloem sap well, are larger (usually >10 mm), rectangular, shallow wells to access the phloem sap through the remainder of the summer (Figure 2, b and c). The difference in the two types of sap wells had been previously described only for other sapsuckers, but our field observations showed that this was also the case for Williamson's Sapsucker. In the Hat Creek area of British Columbia, Red-naped Sapsuckers made xylem sap wells in coniferous trees, particularly in the spring before leaf out, while through the remainder of the nesting season they used mainly deciduous trees, rather than coniferous trees, and large shrubs for phloem sap wells (Walters *et al.* 2002). In general, the phloem sap wells on conifers that look like honeycomb lattices (Figure 2b) or else "ladder" up the tree trunk (Figure 2c) could be attributed to Williamson's Sapsucker in our study area based on our field observations of birds at sap

trees in stands where both species of sapsuckers occurred. To avoid errors in classifying sap trees as belonging to one species of sapsucker or the other, we only considered incidentally encountered sap trees to belong to Williamson's Sapsuckers if we observed them at the sap wells, or if the sap tree was <50 m from an active nest and there were no nesting Red-naped Sapsuckers in the immediate area.

The frequency of sap tree occurrence among tree species, size classes and health was estimated from systematic and random samples of trees near Williamson's Sapsucker nests. Tree count plots were conducted anytime from July to October in 16-ha (225-m radius) areas around 33 nests in the Western region and 67 nests in the Okanagan region in 2006 and 2007, and 9 nests in the East Kootenay region in 2006 (Figure 1). The plot size of 16-ha around each nest was chosen because this was assumed to be close to the smallest breeding territory size within which a pair could meet all its foraging requirements in moderate to high quality breeding habitat based on the mean nearest-neighbor nest distances of 450 m (Gyug *et al.* 2007).

We used a vegetation sampling protocol for standing live and dead trees based on the Birds and Burns Network (2005). While all standing trees (live or dead) were tallied, for this sap tree analysis we considered only live coniferous trees. At each nest tree four 50-m transects were laid out in cardinal directions with the north and south transects beginning at the nest tree, and the east and west transects beginning 10 m from the nest tree. Fifteen additional 50-m transects were placed randomly within the remainder of the 16-ha area between 60 and 225 m from the nest tree. On each 50-m transect, the sampled plot was 1-m to each side of centerline for small trees 8–22 cm diameter-at-breast-height (DBH), 3-m for large live trees 23–57 cm DBH, and 10-m for very large live trees ≥58 cm DBH. Recorded for each live conifer within a plot was the species, DBH rounded to the near-

Table 1. Williamson's Sapsucker sap tree species, condition, and diameter-at-breast-height (DBH) in British Columbia, 2004-2008, based on incidental observations of sap trees. DBH and tree health were not recorded (NR) for every sap tree. See text for descriptions of tree condition. SD = Standard Deviation.

	Total (n)	Tree Condition				DBH (cm)		
		NR	Healthy	Unhealthy		Mean	SD	Range
				Other	Injury			
Western Region								
Douglas-fir	27	13	7	4	3	36.7 ¹	11.4	14-52
Lodgepole Pine	5	0	1	2	2	33.8	5.9	29-43
Ponderosa Pine	3	0	0	2	1	44.3	12.4	30-52
Total	35	13	8	8	6			
Okanagan Region								
Douglas-fir	71	18	43	4	6	37.7	13.5	8-75
Western Larch	9	2	6	0	1	30.6	6.7	24-42
Total	80	20	49	4	7			

¹ n = 20 for Western region Douglas-fir because DBH was not recorded for 7 sap trees.

est 5-cm, condition as healthy or unhealthy, and if unhealthy, the outward signs that caused us to put it in that class. Sap wells alone were not considered signs of poor health. Conifers with sap wells tallied on plots within 60 m of the nest tree were considered Williamson's Sapsucker sap trees. Conifers with sap wells 60–225 m from the nest tree were only considered Williamson's Sapsucker sap trees if they had phloem sap well structure, examples of which are shown in Figure 2, b and c. Trees were only recorded as sap trees if they had relatively fresh sap wells that were judged to be have been made in the same year.

Results

Based on incidental observations, Williamson's Sapsucker sap trees in British Columbia were mainly Douglas-fir in both the Okanagan and Western regions (Table 1). The proportion of Douglas-fir sap trees of the total sap trees observed did not differ significantly between the Okanagan and Western regions ($\chi^2 = 2.46$, $p > 0.05$), and overall was 85%. Western larch sap trees were found in the Okanagan, but not in the Western region where they did not occur. Lodgepole pine and ponderosa pine sap trees were only found in the Western region, even though these species both occurred in the Okanagan region. For those trees for which tree health was recorded, 64% of sap trees in the western region were unhealthy, but only 18% of the sap trees in the Okanagan were unhealthy (Table 1). Considering both regions together, 52% of the unhealthy sap trees had notable injuries to the trunk. The injuries in 8 of the 13 trees had been noted as being due to rub damage from timber harvesting, with the rest from unrecorded causes.

Sap trees between 23 and 47 cm DBH made up 76% of the total incidental sample of 108 sap trees for which we had diameters (Figure 3). Using a two-factor ANOVA analysis, the mean DBH of Douglas-fir (Table 1) and other species grouped were not significantly different ($F_{1,104} = 0.79$, $p = 0.38$), and did not vary significantly by region ($F_{1,104} = 0.80$, $p = 0.37$).

We found actively used sap trees up to 460 m from the nest tree (Figure 4). We only found sap trees >100 m from the nest tree when the sap trees were found before the nest tree was discovered. During nest searches, we first detected Williamson's Sapsuckers from as far as 850 m from the nest tree (Gyug *et al.* 2007), so that would be the maximum distance from the nest that we would have been able to find sap trees. However, the mean distance of a nest tree from our first detection of the birds was 258 m (Gyug *et al.* 2007) so at most nests, any sap trees that may have been beyond that distance would not likely have been discovered.

The majority of sap trees (41% within 50 m and 69% within 100 m) were found close to the nest tree, but this is biased and therefore cannot be used to predict frequency of

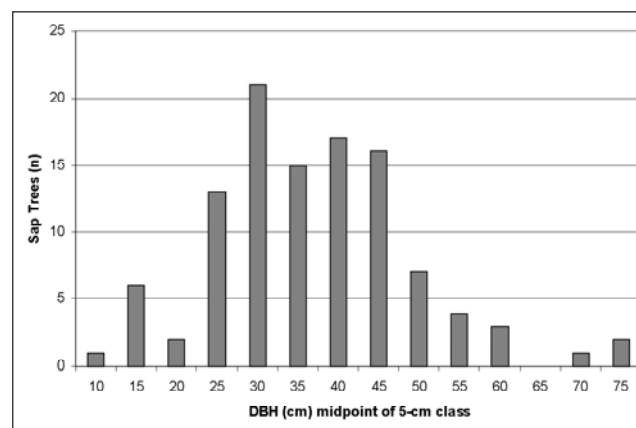


Figure 3. Diameter-at-breast-height (DBH) distribution of 108 Williamson's Sapsucker sap trees based on incidental observations from 2004–2008.

occurrence of sap trees in relation to distance from nest. Firstly, our criteria for including sap trees was less stringent <50 m from the nest, as birds were not necessarily observed on all these sap trees. Secondly, sap trees near the nest were easier to discover because birds could be observed flying directly to sap trees from the nest, with up to six active sap trees found within 100 m of one nest.

Based on the systematic and random samples of live conifers around nests, 42 Williamson's Sapsucker sap trees were tallied of which 32 (76%) were Douglas-fir (Table 2). Other species of sap trees found were western larch (6), ponderosa pine (2) and spruce (2). No sap trees were found in the 973 lodgepole pine trees sampled. Only one of the sap trees in this sample was a known sap tree that had also been counted in the incidental sample, i.e. the tree had been seen to be used when the nest was active. The remainder were judged to be Williamson's Sapsucker sap trees based on location <60 m from the nest, or on fresh phloem sap well occurrence if between 60 and 225 m from the nest.

The frequency of sap tree occurrence among moderately-sized injured Douglas-firs within 60 m of the nest was more than six times higher than for any other class of tree (Table

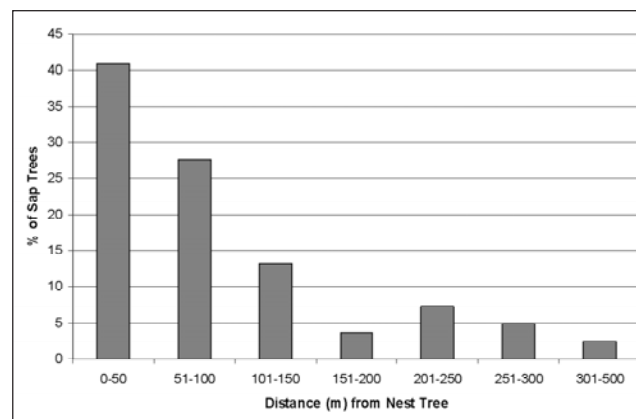


Figure 4. Distance of 83 Williamson's Sapsucker sap trees from 40 known nests, British Columbia, 2003–2008.

2). Except for Douglas-firs >23-cm DBH within 60 m of the nest, all other healthy tree classes had <1% sap tree frequency. Sap tree frequency of occurrence in other unhealthy tree classes was variable, but was >1% in more classes of Douglas-fir than for other conifers (Table 2). Overall, sap trees made up 1.6% of Douglas-fir within 60 m of a nest, while sap trees were only 0.2–0.3% of other conifers at any distance from a nest, or of Douglas-fir within 60–225 m of a nest (Table 2).

Discussion

The findings of our study concurred with the findings of both Crockett (1975) and Oliver (1970) that found Williamson's Sapsucker sap trees to be small to medium-sized conifers. In British Columbia and elsewhere, the species of sap trees used varied depending on what was available. In Colorado, where Williamson's Sapsucker lives in mixed ponderosa pine, Douglas-fir and aspen habitats similar to that of the Western region of the southern interior of British Columbia, sap trees were similar in species compo-

sition, i.e., predominantly Douglas-fir with lower amounts of pines (Crockett 1975), to our study. In northeastern Oregon, where western larch occurs, Bull *et al.* (1979) found 47% of foraging observations were on Douglas-fir, 30% on ponderosa pine, and 14% on western larch. While Bull *et al.* (1979) did not separate sap trees from other foraging trees, about 75% of their observations were of Williamson's Sapsucker at sap wells, and we might assume that Douglas-fir there was the predominant sap tree, just as in our study in the regions of British Columbia where western larch occurred.

We found 1.6% of Douglas-fir to be sap trees within 60 m of nests, and Oliver (1970) found a similar percentage of ponderosa pine (1.4%) in a pure ponderosa pine stand in northeastern California. However, Oliver's (1970) data included both Williamson's Sapsucker and Red-breasted Sapsucker wells since both birds were found on the study site, and the counts did not separate one species from the other.

There is only one published account of Williamson's Sapsucker sap well activity on broad-leaved trees (Grinnell and Storer 1924). They reported "workings attributable to this sapsucker" on aspen in Yosemite, but did not actually

Table 2. Coniferous sap tree frequency of occurrence by tree species or species group, status, and diameter at breast height (DBH) in the systematic plots within 60-m of nests, and random plots 60-225 m from nests.

Species/Status	DBH range (cm)	Within 60 m of nests			60-225 m from nests		
		Total Trees (n)	Sap trees (n)	Frequency (%)	Total Trees (n)	Sap trees (n)	Frequency (%)
Douglas-fir							
Healthy	8-22	425	1	0.2	1631	1	0.1
	23-52	518	11	2.1	2198	5	0.2
	>52	73	1	1.4	245	0	0.0
Unhealthy (Injury)	8-22	19	0	0.0	67	2	3.0
	23-52	20	4	20.0	92	2	2.2
	>52	3	0	0.0	1	0	0.0
Unhealthy (Other)	8-22	44	0	0.0	140	0	0.0
	23-52	66	1	1.5	216	3	1.4
	>52	28	1	3.6	113	0	0.0
Total Douglas-fir		1196	19	1.6	4703	13	0.3
Other Conifers							
Healthy	8-22	440	0	0.0	1438	0	0.0
	23-52	457	1	0.2	1597	3	0.2
	>52	74	0	0.0	177	1	0.6
Unhealthy (Injury)	8-22	12	0	0.0	72	2	2.8
	23-52	29	0	0.0	75	0	0.0
	>52	3	0	0.0	1	0	0.0
Unhealthy (Other)	8-22	62	0	0.0	158	0	0.0
	23-52	166	2	1.2	373	1	0.3
	>52	148	0	0.0	221	0	0.0
Total Other Conifers		1391	3	0.2	4112	7	0.2

see any Williamson's Sapsuckers using these aspen. We do not feel it is possible to reliably separate the species of sapsucker that has made the wells on a coniferous tree simply by the pattern of the sap wells on the tree trunk when Red-breasted Sapsuckers (which occurred in Yosemite) may use conifers as sap trees throughout the breeding season. Only in a situation like that occurring in the southern interior of British Columbia where Red-naped Sapsucker phloem sap well activity appeared to be largely concentrated on deciduous species would there be more confidence in classifying sap wells to one species or the other based solely on tree species use and sap well pattern.

The majority of sap trees were found in classes of trees where there was a relatively low frequency (<4%) of sap trees among the particular class of trees. This would imply there is an abundance of such trees from which the birds are choosing particular trees as sap trees. Our counts of sap trees depended on opportunistic observations of birds using sap trees, and on encountering probable sap trees on relatively small sample plots. Neither of these methods allowed us to determine how the birds choose one apparently similar tree over another as a sap tree, and no study of sapsuckers has ever been successful at determining how such a choice is made. Our study has shown that injured Douglas-fir trees near nests are more likely to be sap trees than other trees. Others have shown the same for other tree species for Yellow-bellied Sapsuckers either anecdotally (Kilham 1983) or quantitatively (Eberhardt 2000) where sap tree use was correlated with re-use of sap trees from previous seasons, or an overall index of tree health.

Sap tree selection might be better studied by conducting censuses of sap trees in breeding stands with very different tree densities. Williamson's Sapsucker breeds in a variety of stands with tree densities ranging from 50 to 350 trees per ha (unpublished data). Where apparently suitable trees are highly abundant, Williamson's Sapsucker should be more selective than in sites with relatively low densities of such trees, and where they may use sub-optimal sap trees that they might not otherwise select. Such a study would best be achieved with radio-telemetry since sap trees that are up to 460 m from nests are generally very difficult to discover by observational techniques alone.

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