

Distribution and density of Williamson's Sapsucker in British Columbia, Canada

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Abstract: Relative densities of adult Williamson's Sapsuckers (*Sphyrapicus thyroideus*) in British Columbia were assessed between 1997 and 2006 using call-and-drum playbacks (CPB) with follow-up nest searches to confirm relative breeding densities. Nesting density was determined at two census sites. A review of available records showed that the breeding range had expanded 50 km north of Kamloops and 65 km north of Cranbrook since last reviewed in 1995. The average relative adult density was 6.7 detected/100 CPB points (N = 4266). Highest adult densities (10-15) were in portions of the Interior Douglas-fir biogeoclimatic zone in the Okanagan and in the Western population. Much lower densities (2-3) were found in the East Kootenay population. Nesting was confirmed at 61% of the sites where Williamson's Sapsucker were detected with CPB surveys in the Okanagan but only at 44% in the East Kootenay, and 22% in the Western population. The high relative density of adults in the Western population appeared to consist of many non-breeding males or unsuccessful breeders. Fewer nest trees were discovered in the East Kootenay (10), than in the Western population (33) or in the Okanagan (127). In the East Kootenay, several nests were discovered prior to 1938 but only a single nest was found between 1938 and 2004, and it was thought they might have been extirpated, or that the population was very small. We do not know if the 8 active nests discovered in 2006 represent an actual population increase, or if intensive CPB surveys were required to reveal a small population that was always present. The nest density of 3.1/km² (7 nests in 2.26 km²) in a census site east of Okanagan Falls is the highest density yet found in B.C., and is one of the highest known throughout the range of the species. Large areas in B.C., particularly to the west of the Okanagan and in the East Kootenay, still remain to be surveyed for presence of Williamson's Sapsucker or confirmation of breeding.

Key words: Williamson's Sapsucker, *Sphyrapicus thyroideus*, relative density, nest density, British Columbia, distribution

Introduction

Williamson's Sapsucker, *Sphyrapicus thyroideus* (Cassin, 1852), is one of the four woodpecker species of this North American genus, all of them specialized for feeding on tree sap. Williamson's Sapsucker reaches southern Canada in its northern distribution (Dobbs *et al.* 1997). The breeding range within Canada is entirely in southern British Columbia where it is considered an uncommon summer resident (Campbell *et al.* 1990), although there have been three accidental records from Alberta (Pinel 1993), and three from Saskatchewan (Godfrey 1986). Cooper (1995) summarized the population size of Williamson's Sapsucker in B.C. as being unknown, but likely small, and its status in Canada was assessed as Endangered in 2005 (COSEWIC 2005).

The two weakly-defined subspecies both occur in Canada

(Cowan 1938). The nominate race, *S. t. thyroideus* (Cassin), occurs in the western portion of the Canadian range in the Okanagan and westward, while *S. t. nataliae* (Malherbe) occurs in the East Kootenay in Rocky Mountain Trench near Cranbrook (Figure 1). There is no known zone of contact of the two subspecies in Canada, and since the two subspecies cannot be identified based on visual observations alone, we do not refer to them further.

Over the past century, consistent and regular observations of Williamson's Sapsuckers within B.C. have been only in a relatively small area extending north 35 km from the U.S. border to near Okanagan Falls (Cowan 1938), and east for 50 km from the Okanagan valley to the Midway area (Brooks and Swarth 1925) (see Figure 1 for general locations). There had been occasional records from the Similkameen valley west of the Okanagan (Cowan 1938;

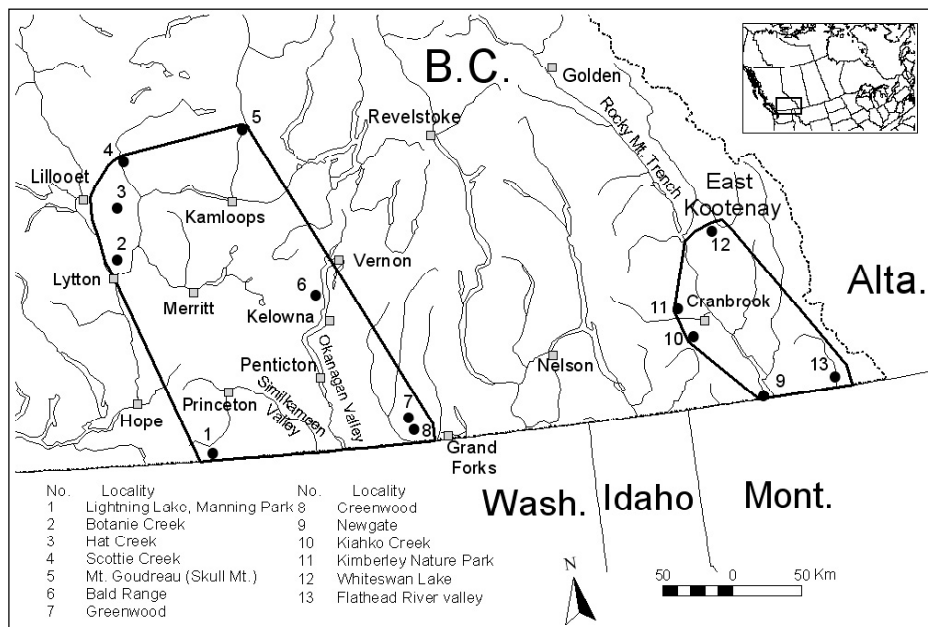


Figure 1. Extent of Occurrence (EO) of Williamson's Sapsucker in southern B.C., delimited by heavy black lines. Each numbered black dot is a locality used to define the boundaries of the EO as discussed in the text.

Guiguet 1954) but only in about 1970 did they appear to greatly expand their range to 180 km north of the Similkameen (Campbell *et al.* 1990; Cooper 1995). A "small breeding population" (Cowan 1938) was known to occur in the East Kootenay since at least 1925 (Brooks and Swarth 1925) but the lack of any records between 1947 and 1990 led Campbell *et al.* (1990) to suggest that this population might have been extirpated. Cooper (1995) uncovered one breeding record from 1979, and other sight records from the Flathead River valley from 1986 to 1992, indicating the population had not been extirpated but was likely extremely small.

Relative densities of Williamson's Sapsuckers have been very poorly sampled by standard Breeding Bird Survey (BBS) routes for several reasons. Firstly, BBS routes are sparse and widely separated in the western U.S. (Dobbs *et al.* 1997), secondly, Williamson's Sapsucker have generally low population levels, and thirdly, they are relatively quiet during the late-spring BBS period with <1 spontaneous territorial drum or vocalization per hour (Crockett 1975). Most state, regional or national trends for Williamson's Sapsucker populations derived from the BBS have not been considered reliable because of low sample sizes and infrequent occurrence (Sauer *et al.* 2005).

There had been no habitat or other biological studies on Williamson's Sapsuckers in B.C. prior to 1996, and there was very little information available from Canada. Campbell *et al.* (1990) summarized the 230 known records in B.C. which included only 32 breeding records. Studies to gain a better understanding of the distribution, population sizes and habitat requirements of this uncommon species in B.C. began in 1996 because it was considered to be potentially vulnerable to timber harvesting and land clearing, given that

the most commonly cited habitat association had been with western larch (*Larix occidentalis*) forests (e.g. Cannings *et al.* 1987). In the East Kootenay, Cannings (1997) conducted 11 days of searching for Williamson's Sapsuckers using call playbacks, but was unable to find any. In the Okanagan, Manning and Cooper (1996) began a radio-telemetry project which did not continue beyond the pilot year for lack of funding.

The purposes of the studies reported here were: (1) to update the geographical distribution of Williamson's Sapsucker within B.C. from the previously known distribution as summarized by Cooper (1995); (2) to determine broad-scale habitat affinities using relative adult densities derived from call-playback surveys with follow-up nest searches to confirm relative breeding density; and (3) to determine absolute densities of nesting pairs in selected areas that might act as habitat benchmarks. Additional information on other aspects of the biology of the species including the chronology of nesting, spacing of nests and territory re-occupancy rates is reported here. Detailed habitat descriptions, habitat modeling, and nest productivity studies also began in 2006 but will be reported separately.

Materials and methods

Distribution

The study area was the southern interior of B.C. in or near areas previously known to be occupied by Williamson's Sapsuckers as described by Cooper (1995). The range was considered to be divided into three populations (Figure 1).

The East Kootenay population is in the Rocky Mountain Trench from the U.S. border north 65 km to Cranbrook. The Okanagan population is on the east side of the Okanagan River valley from the U.S. border north 90 km to near the village of Naramata, and east 75 km to the city of Grand Forks, B.C. The Western population extends as much as 125 km west of the Okanagan valley through the Similkameen River valley to the Cascade Mountains, and as much as 250 km north of the U.S. border.

The distribution was described using a method called the *Extent of Occurrence* (EO), which is a minimum convex polygon covering all known breeding locations (IUCN 2001). Within the very broad EO, the *Area of Occupancy* (AO) consists of the area currently occupied for breeding. The AO was only estimated for the Okanagan population where sufficient surveying had been undertaken to accurately map the boundaries. Observations other than from our surveys included information known prior to 1995 as published in Cooper (1995), nests found during preliminary surveys in 1995 and 1996, sightings made by individuals and reported to the authors, sightings in the B.C. Conservation Data Centre database, and 65 nest record cards from the B.C. Nest Record Scheme. Only breeding locations that define the limits of the EO have been listed and discussed here.

Call playbacks—relative density

Surveys were undertaken using call-and-drum playbacks (CPB) at points set out at 400-m intervals. At least 30 seconds of silent listening preceded playbacks at each CPB point, and at least two minutes of silent listening followed the playbacks. The playback protocol consisted of three sets of 10-15 seconds of drums and calls, with 20-30 seconds of silent listening between each of the sets, and with the broadcasting megaphone turned 120° between sets. Several different 1- to 10-watt megaphones were used, all of which were audible by the human ear up to 600 m in ideal conditions. The majority of CPB surveys (92% of 4266 points) were carried out between May 1 and June 12. CPB surveys were conducted from dawn until dusk, although <3% of the points were conducted after 16:00. Surveys were discontinued in the rain, or if the wind consistently exceeded Beaufort 3 (12-19 km/h).

CPB was immediately discontinued at a point if any Williamson's Sapsuckers were detected. For each detection we recorded estimated distance and compass direction to the bird, type of observation (drum, call and/or visual), number of birds, sex of birds and whether birds were interacting with each other (e.g., two males counter-drumming, or whether male and females were a suspected breeding pair). Other data recorded at each CPB point included date, time and conditions of sky (clear, partly overcast, overcast, fog, drizzle, rain, snow) and wind (Beaufort-scale). If there was any doubt as to the species identity because of incomplete

or irregular calls or drums, additional CPB of Williamson's Sapsucker and/or Red-naped Sapsucker were played to attempt to get more definitive responses or to visually identify the bird. To avoid duplicate counting on successive CPB points, the distance between CPB points was extended to 600 or 800 m after a positive detection. If it was thought that the bird detected at the next point might be the same bird as previously detected, it was considered to be a possible duplicate and was not counted in the data analysis. Detections of a male and female that appeared to be a breeding pair were counted as a single detection so that each detection might be considered the potential location of a breeding pair.

Between 1996 and 1999, study areas were limited to areas proposed for timber harvesting in mature western larch or ponderosa pine (*Pinus ponderosae*) habitats within the broad range of potential habitat in southern B.C. In 1997 and 1998, 216 CPB survey points were conducted in the Okanagan and 33 in the Western population. In 1996 and 1999 only nest searches were conducted because of the late start of field work due to funding delays.

Between 2003 and 2006, extensive CPB surveys were conducted over a much broader area in addition to surveys of some areas proposed for timber harvesting. Survey effort was aimed primarily at sites with stands of mature western larch or ponderosa pine. CPB survey routes were usually set out along roads, and once a route was chosen, all habitats in the area were sampled. Limited surveys were conducted on foot in proposed timber harvesting areas, or in extensive stands of large-diameter western larch where there were no roads. Survey routes were generally not set out in habitats not favoured by Williamson's Sapsucker. These included lodgepole pine (*Pinus contorta*) forests unless there was mature western larch present, Engelmann spruce (*Picea engelmannii*) forests at high elevations and open grasslands. In the East Kootenay, 873 CPB points were surveyed from 2005 to 2006; in the Okanagan, 1553 points from 2003 to 2006; and in the western area, 1591 points from 2004 to 2006.

Nest searches—relative breeding density

Detections made on CPB surveys yielded a relative density of adults, but to confirm that this reflected the density of breeding adults, nest searches were conducted from mid-June to early July in places where birds had previously been detected. CPB was frequently used during nest searching as an aid to elicit responses to locate adult birds, but these were not considered to be part of the CPB surveys. In 2006, we also returned to most nest sites previously known from 1996 to 2005 in the Okanagan population to determine current occupancy.

Relative densities derived from CPB surveys and nest searches cannot be converted into absolute densities because we do not know the distance effectively sampled by the sur-

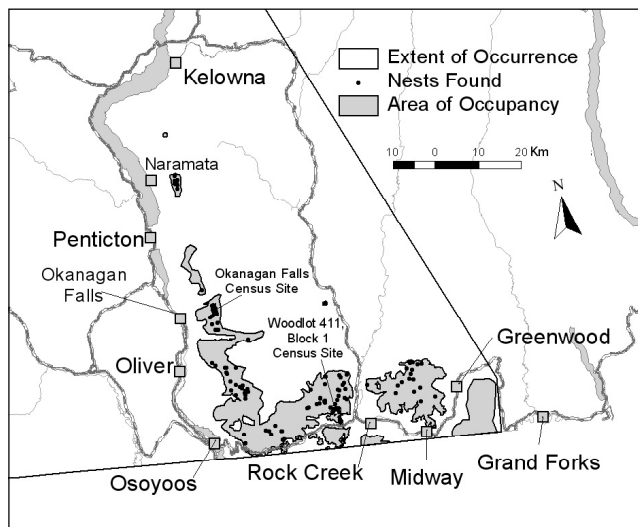


Figure 2. Area of Occupancy (the area known or suspected to be occupied for breeding) of Williamson's Sapsuckers in the Okanagan population in 2006.

veys, nor the probability of detecting all birds or pairs within any given distance. We cannot reliably estimate either of these because we do not know absolute density at each CPB point. The distances from the CPB point where a bird or pair was first detected to the later-discovered nest were tabulated to give some estimate of the effectively sampled area around a CPB point.

Locations of CPB points and of any Williamson's Sapsucker observations made during nest searches were recorded using instruments for global positioning (GPS). Locations of Williamson's Sapsuckers detected during CPB surveys were estimated from the direction and estimated distance from the survey point. Elevation was either recorded with a GPS unit at the site, or interpolated later to the nearest 10-m or 50-m contour using Geographic Information Systems (GIS) software. The broad potential vegetation types inhabited by Williamson's Sapsucker in B.C. were described by tabulating the Biogeoclimatic Ecosystem Classification (BEC) subzone or variant in which each CPB point, nest and observation occurred using the most recent version of the BEC system (Ministry of Forests and Range 2006). The full name of each BEC variant or subzone is provided in the Appendix.

Census areas—nest density

There had been no previous estimates of breeding densities of Williamson's Sapsuckers in Canada. Two nest census areas were established to attempt to establish a benchmark density, i.e. the highest density in what might be considered ideal habitat. In each area we searched for nests in mid to late June attempting to find all the nests (or nesting pairs) present. The first census area was in Block 1 of Woodlot 411, 5 km northwest of Rock Creek, and 3 km north

of Highway 3 (see Figure 2). The site was 4.14 km² of western larch—Douglas-fir (*Pseudotsuga menziesii*) forest, and was censused from 1997 to 1999 and again in 2006. A second census area of 2.26 km² that was 12.5–15 km east of Okanagan Falls (see Figure 2) was censused in 2003 and 2004 where higher densities of Williamson's Sapsuckers were suspected than in Woodlot 411. The site was chosen because it had been considered the most reliable place for birders to find Williamson's Sapsuckers in Canada in the past 10 years, and had probably been continuously occupied at least since Anderson (1914) collected museum specimens there in 1913. Prior to the 1990s, Anarchist Mountain along Highway 3 had been considered the most reliable place to find Williamson's Sapsuckers in Canada (Cannings *et al.* 1987) but that area had undergone recent land clearing and small parcel subdivision, and we could no longer find Williamson's Sapsuckers there.

Both of the nest census areas were within the IDFdm1 BEC variant (see Appendix). Basic descriptions of forest stands were available from Vegetation Resource Inventory (VRI) mapping provided by Weyerhaeuser Ltd and by the B.C. Ministry of Forests. Detailed stand information for portions of each area was available from vegetation plots conducted for separate habitat modeling studies in 2006. The majority of the Okanagan Falls census area (67%) was western larch and Douglas-fir forest estimated to be 200–310 years old by the VRI. The stands were not uniform but were multi-layered with old veteran trees that had survived past fires, a dominant layer of moderately-sized trees and younger regenerating trees. The census area also contained three cutblocks harvested and regenerated in the mid-1980s (23% of the area) and minor amounts (10%) of younger forest. At the time of harvest a few mature trees and patches of pole-sized trees were reserved from harvest. Woodlot 411 was mostly forested (95%) with stand ages of 59–219 years estimated by the VRI. The woodlot had been selectively logged beginning in the 1940s and 1950s, and since 1985 has been actively managed for timber values along with maintenance of old veteran larch and other trees to promote wildlife use (G. Delisle, Westbridge, B.C., pers. comm. 2006).

Basal area of the unharvested forest area within the Okanagan Falls census area was twice that of Woodlot 411 (36.5 and 18.1 m²/ha respectively). Density of moderate-sized trees 23–57 cm diameter at breast-height (DBH) was about 25% less in the Okanagan Falls area than on Woodlot 411 (108 and 147 trees/ha) and density of large veteran trees >57 cm DBH was much higher at Okanagan Falls than at Woodlot 411 (35.0 and 2.2 trees/ha). The density of snags (standing dead trees) was higher at Okanagan Falls than at Woodlot 411 (11.2 and 4.9/ha). Volume of logs >22 cm large-end-diameter was also higher at Okanagan Falls than at Woodlot 411 (54.7 and 18.7 m³/ha).

In the text, any averages are presented as the mean with the standard deviation (SD) and sample size (N). Relative

density was expressed as the number of Williamson's Sapsuckers detected per 100 CPB points. For statistical testing of differences in proportions, the Chi-square goodness-of-fit test was used with significance level set at $p = 0.05$.

Results

Distribution

The current estimate of the size of the EO of Williamson's Sapsucker in B.C. is 35801 km² for the Okanagan and Western populations, and 8983 km² for the East Kootenay population (Figure 1). The locations that define the EO are given in the following list, numbered as on Figure 1, and are provided here along with any information as to the current status from our surveys or from other sources.

(1) Lightning Lake, Manning Park, as reported on B.C. Nest Record Scheme (BCNRS) cards from 1978 to 1981. We were unable to determine the number of years after 1981 that the site may have been occupied, but it does not now appear to be occupied.

(2) Botanie Creek, as cited in Cooper (1995) from BCNRS. The original nest record was not seen, and we could not confirm the presence of Williamson's Sapsuckers based on a limited sample of only one day of CPB surveys in 2004.

(3) Hat Creek, as reported by Cooper (1995), Walters (1996) and Walters and Miller (2001). Population size is unknown although W. Campbell (Victoria, B.C., pers. comm. 2004) reported three nests in one year. No CPB surveys were conducted in this area.

(4) Scottie Creek, as reported in Cooper (1995) from BCNRS. The original nest record was not seen, and no CPB surveys were conducted in this area.

(5) Mt. Goudreau, as recorded in the B.C. Conservation Data Centre (CDC) database. The site burned in the McLure fire of 2003 and would no longer be considered suitable habitat, but in any case Williamson's Sapsuckers had not been reported at the site since the 1990s (D. Falat, Kamloops, B.C., pers. comm. 2004). D. Oaten (Kamloops, pers. comm. 2006) had a single record of a Williamson's Sapsucker 12 km southeast of this point in 2005, so Williamson's Sapsuckers still probably occur in the general area although the CDC was not able to confirm this in only one day of CPB in 2006. The previously known northern extent at Isobel Lake 19 km northwest of Kamloops (Cooper 1995) has been occupied irregularly from the early 1990s onwards (BCNRS; R. Howie, Kamloops, pers. comm. 2005).

(6) Bald Range Creek, west side of Okanagan Lake, as reported on a BCNRS card submitted in 1977. Williamson's Sapsuckers used the same nest tree for three successive years, but have never returned despite annual checks (H. Almond, Kelowna, B.C., and R. Bazett, Kelowna, pers. comm. 2005). No Williamson's Sapsuckers were found in one day of CPB surveys in this area in 2004.

(7) and (8) Several nests found 5 km northwest of Greenwood (this study). In addition, four males were detected on CPB surveys 7-11 km south and east of Greenwood in 2005. Follow-up nest searches three weeks later did not result in confirmed breeding, and even the originally detected birds could not be found. (9) 6 km west of Newgate and Lake Koocanusa. The breeding pair and nest found in this study (2006) were the first found in that area since specimens were collected in 1930 (Munro and Cowan 1947). The nest is actually a few metres on the U.S. side of the border although the birds were first detected and observed on the Canadian side.

(10) Kiahko Creek, 14 km southwest of Cranbrook (this study). Three nests found in 2006 in an area previously not known to be occupied.

(11) Kimberley Nature Park on the western boundary of the city of Kimberley. A nest first reported in 2004 (K. Goodwin, Kimberley, pers. comm. 2004), with the same nest tree and one other used in 2005 (this study). One nest (1 km east of the nature park) was used in 2006 (this study).

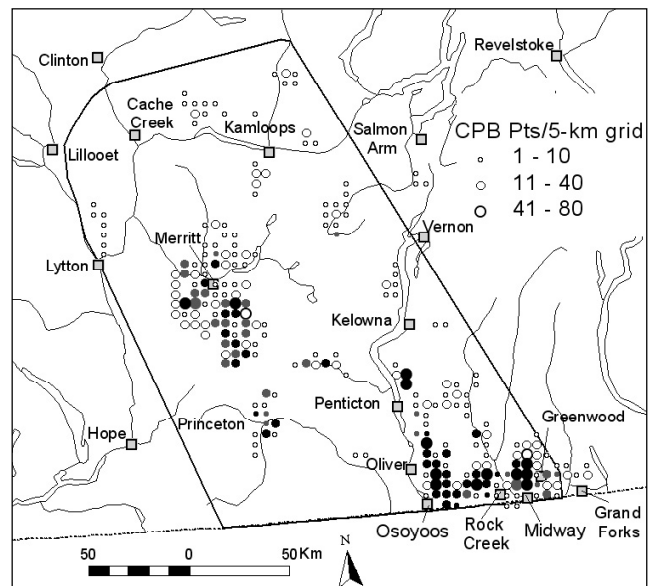


Figure 3. Locations of survey points for call-and-drum playback (CPB) searches, detections and nests in the Okanagan and Western study areas, 1997-2006. Black-filled circles indicate nesting was found; grey-filled circles indicate birds were detected but no nests found.

Table 1. Relative densities of Williamson's Sapsucker adults and nests in British Columbia from 1997 to 2006. Findings included are for call-and-drum playback (CPB) surveys and all nest trees found. Data are provided for each variant of the Biogeoclimatic Ecosystem Classification (BEC), sorted from highest to lowest relative nest density.

Population	BEC variant or subzone	CPB survey points (n)	CPB points with detections (%)	Adults Detected ¹ /100 CPB points	Nest trees found ² (n)	Nests found/100 CPB points
Okanagan	IDFdm1	813	9.2	10.6	83	10.2
Okanagan	IDFxh1&4	178	11.2	11.2	17	9.6
Western	IDFxh1	252	12.3	14.7	15	6.0
Okanagan	MSdm1	575	7.3	7.5	27	4.7
E. Kootenay	MSdk	368	2.7	3.3	8	2.2
Western	PPxh2 ³	50	10.0	16.0	1	2.0
Western	IDFdk1	600	5.7	6.2	10	1.7
Western	IDFdk2	298	2.3	2.3	4	1.3
Western	IDFxh2	369	4.1	4.6	3	0.8
E. Kootenay	IDFdm2	411	2.7	2.9	2	0.5
Okanagan	ICHmk1	183	2.7	2.7	0	0
E. Kootenay	ICHmk1	50	0	0	0	0
-	Others ⁴	119	0	0	0	0
ALL	ALL	4266	6.0	6.7	170	4.0

¹ Detections of breeding pairs counted as one detection. n = number.

² Nest trees were only counted once even if later found to be used in multiple years.

³ Four of the 5 detections in the PPxh2 were within 200 m of the IDFxh2, and the placement of the CPB survey points were not likely representative of the PPxh2 as a whole.

⁴ Other BEC variants with <50 CPB survey points included: BGxh1, ICHdm, ICHdw2, IDFmw1, IDFww1, MSdm2, MSdm3, MSxk1, MSxk2, PPdh1, PPdh2, PPxh1

(12) Whiteswan Lake, 67 km north of Cranbrook, as reported on a BCNRS card cited in Campbell *et al.* (2000). We were unable to confirm presence in 5 days of CPB surveys and 147 CPB points in 2005 and 2006. (13) Flathead River. Breeding is suspected based on sightings from several personal sources contributed to Cooper (1995). We were unable to confirm presence in one day of CPB surveys in 2006.

The range boundary has been extended only slightly from the estimated range of Williamson's Sapsucker in B.C. described by Cooper (1995). In particular, the limits of the Western population have been extended 50 km north of Kamloops to Mount Goudreau, and 65 km north of Cranbrook to Whiteswan Lake in the East Kootenay. Cooper (1995) did not map any records east of Anarchist Mountain, although much older records indicated that the species occurred there (Brooks and Swarth 1925). Our surveys showed it was still found in the larch forests north of Midway from Rock Creek to Greenwood where we detected 22 Williamson's Sapsuckers from 529 CPB points, and found 19 nest trees.

Only in the south Okanagan do we have any degree of certainty about the extent of the currently-occupied breeding area because of the large number of CPB points

(almost 2000, Figure 3), and at least 56 other nest searches in areas not necessarily covered by CPB surveys. The area of occupancy is estimated to be about 750 km² (Figure 2).

Call playbacks—relative adult density

Overall, 284 detections were made of Williamson's Sapsuckers on 6.0% of all CPB points (n = 4266) for an average of 6.7 detected per 100 CPB points (Figures 3 and 4, Table 1). They were detected at elevations from 610 m to 1580 m with nests found at elevations from 800 m to 1560 m (Table 2). In the Western population, the highest relative densities (6.6-13.6 per 100 CPB points) were between 800 and 1175 m. In the Okanagan, highest relative densities (6.6-11.1) were between 975 and 1575 m. In the East Kootenay, relative density was lower (1.6-4.9) and relatively evenly spread between 775 and 1375 m.

Williamson's Sapsuckers were most commonly detected in a Ponderosa Pine BEC variant (PPxh2), although this relative density was probably not representative of this variant as a whole, because the number of survey points was not very high (50) and placements of the points were generally very close to the boundaries in sites not generally typical of that variant. They were next most commonly detected in

Table 2. Relative detection densities of adults, and numbers of Williamson's Sapsucker nests at various elevations. Results are for the Western population (WEST), the Okanagan population (OKAN) and the East Kootenay population (EK).

Elev. ¹ (m)	CPB survey points (n)			Adults Detected/ 100 CPB points			Nest trees found ² (n)		
	WEST	OKAN	EK	WEST	OKAN	EK	WEST	OKAN	EK
<450	2	1	0	0			0	0	0
500-550	17	1	0	0	0		0	0	0
600-650	41	7	0	7.3	0		0	0	0
700-750	72	13	6	0	0	0	0	0	0
800-850	169	49	42	13.6	2.0	4.8	8	2	0
900-950	171	104	98	9.4	1.0	2.0	5	3	1
1000-1050	426	212	173	6.8	6.6	2.9	9	15	1
1100-1150	381	404	255	6.6	8.4	1.6	11	28	1
1200-1250	234	375	142	3.4	10.9	4.9	0	35	4
1300-1350	88	361	113	1.1	11.1	3.5	0	29	3
1400-1450	21	191	36	0	9.9	0	0	12	0
1500-1550	2	51	8	0	7.8	0	0	3	0
All Elev.	1624	1769	873	6.5	8.7	2.7	33	127	10

¹ Elevations rounded to nearest 50-m contour before analyses so that, e.g., the 500-550 class includes elevations from 475-574 m.

² Individual nest trees were only counted once even if later found to be used in multiple years.

three variants of the Interior Douglas-fir BEC zone (IDF_{xh1}, IDF_{xh4} and IDF_{dm1}) with 9-12 detected per 100 CPB points (Table 1, Figure 3). These are probably the BEC variants where they could be considered most common or at their peak of abundance in B.C. There were 4-7 detections per

100 CPB points in a Montane Spruce variant (MS_{dm1}), and in two of the Interior Douglas-fir variants (IDF_{dk1} and IDF_{xh2}). In the East Kootenay, there were 2.9-3.3 detected per 100 CPB points in a Montane Spruce subzone (MS_{dk}) and in an Interior Douglas-fir variant (IDF_{dm2}). Lower relative densities were detected in an Interior Cedar-Hemlock variant (ICH_{mk1}) in the Okanagan and in an Interior Douglas-fir variant (IDF_{dk2}) in the Western population (Table 1). Extrapolating the CPB relative densities found in each BEC variant to the full extent of the variant indicates the possible extent of the potential range of Williamson's Sapsucker in B.C. (Figure 5). Large areas within the potential range of the species in B.C. have yet to be surveyed (Figures 3 and 4).

CPB detection rates were not affected by wind speed within the range of Beaufort 0-3 (0-19 km/h). Williamson's Sapsuckers were detected at 5.6%, 6.5%, 6.1% and 4.9% of CPB points at windspeeds of Beaufort 0-3 respectively and these ratios were not significantly different (Chi-square = 1.04, $p > 0.05$). CPB detection rates were higher during the morning (6.8% from 05:00-10:59) than later in the day (4.2% from 11:00-19:59; Chi-square = 10.13, $p < 0.05$).

The time of year did appear to have an effect on CPB detection rates. While there were no significant differences in overall CPB detection rates within the bounds of the times and conditions sampled, differences in response levels appeared to have been masked by the wide range of areas surveyed that had different bird densities. Williamson's Sapsuckers were detected at 4.9%, 7.1% and 6.9% of CPB points during the two-week periods of May 1-14, May 15-

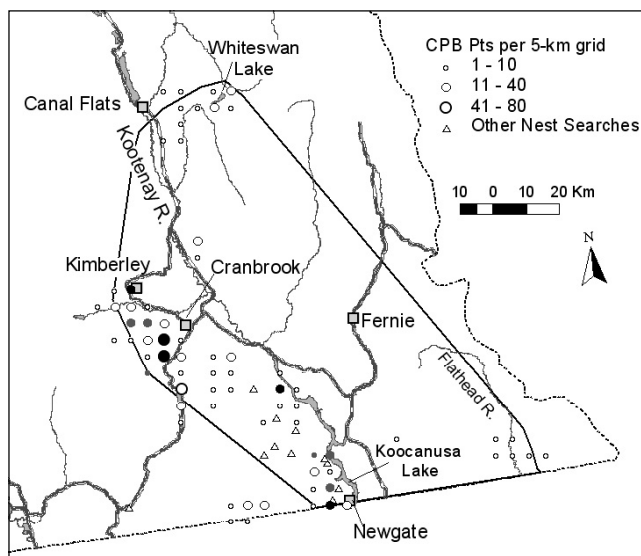


Figure 4. Locations of survey points for call-and-drum playback (CPB) searches, detections and nests in the East Kootenay study area, 2005-2006. Also included are the 1996 CPB points and nest search areas of Cannings (1997). Black-filled circles indicate nesting was found; grey-filled circles indicate birds were detected but no nests found.

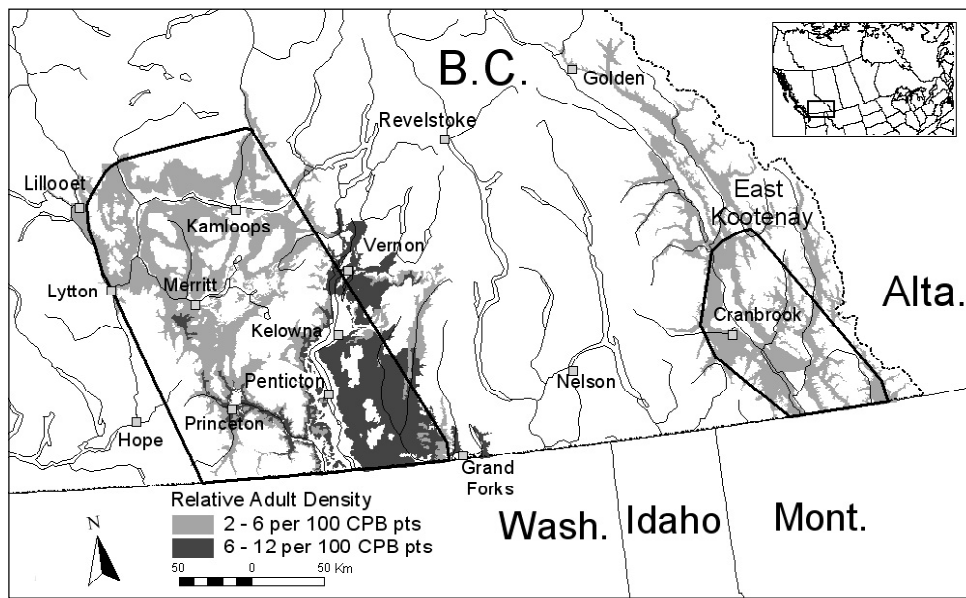


Figure 5. Potential variants and subzones of Biogeoclimatic Ecosystem Classification (BEC) in B.C. that could be occupied by Williamson's Sapsucker. Based on relative adult densities from call-and-drum playback (CPB) point surveys, 1997-2006.

28 and May 29-June 11 respectively ($n = 570, 1509, 1838$ total CPB points respectively; Chi-square = 3.36, $p > 0.05$). However, this result was counter-intuitive since it was generally the male of a pair that would respond to the CPB rather than the female, and when males were incubating eggs or brooding young < 1 week old, they would not respond from inside the nest (which also made nests very hard to find in that period). Males and females share daytime incubating and brooding duties about equally (Crockett 1975). To remove possible effects of differences in population levels in average CPB detection rates, just the CPB results from within the AO of the Okanagan population was examined. No CPB surveys had been conducted before May 13 in the Okanagan population but the detection rate for the 2-week period of May 15-28 was 16.4% of CPB points ($n = 287$ points), while it was only 9.6% for the May 29-June 12 period ($n = 908$ points). This difference was significant (Chi-square = 10.11, $p < 0.05$), and is a result that might be expected if the male was inside the nest and unavailable for a call playback response about half of the time.

Nest searches—relative breeding density

In 2006, eight active Williamson's Sapsucker nests were found in the East Kootenay, 17 (of which 15 were newly discovered) in the western population, and 53 (of which 25 were newly discovered) in the Okanagan population. Overall from 1996 to 2006, many more nest trees were found in the Okanagan population than in the East Kootenay or Western populations (Table 2). Accounting for relative effort (numbers of CPB points), more nests were found in the BEC variants of the Okanagan population than in the Western or East Kootenay populations (Table 1).

Relative detection density of adults was not always

equivalent to relative breeding or nest density (Table 1). Highest relative nest densities were in several Interior Douglas-fir variants in the Okanagan population, followed by an Interior Douglas-fir variant in the Western population. Even though detection densities of adults were high in some other BEC variants, nests could not necessarily be found upon return searches. Nest search success was highest in the Okanagan, followed by the East Kootenay, and by the Western population (Table 3). The proportion of adult detections where only apparently unmated males could be found, or where no birds could be found upon return to the sites, was much higher in the Western population than either of the other populations (Table 3).

The mean nest distance from the initial detection CPB point to the eventually-discovered nest was 258 m. Most of

Table 3. Results of nest searches initiated in June at sites where Williamson's Sapsucker had been detected in earlier CPB surveys. Results are separated according to the three populations in B.C.

Results of nest search	CPB detection sites (%)		
	Western (2006) ($n = 67$)	Okanagan (1997-2005) ($n = 99$)	East Kootenay (2006) ($n = 18$)
Nest discovered	22	61	44
Pair; nest not found	10	15	6
Male only found	25	9	6
No birds found	42	15	44
	100	100	100

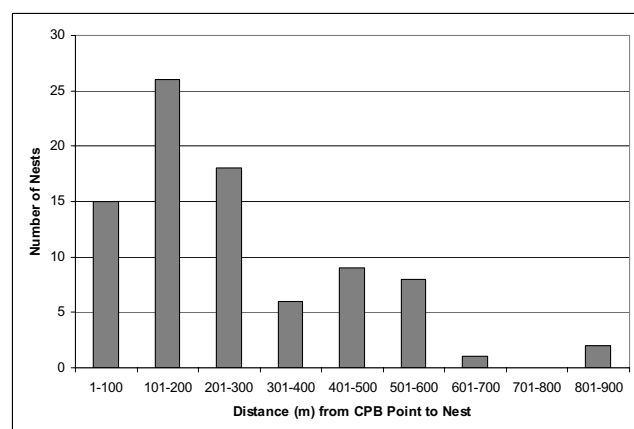


Figure 6. Distance from the first detection point to the nest location of a Williamson's Sapsucker, based on CPB surveys during 1997-2006. This figure uses only those locations for which a nest was discovered.

the nests (79%) were discovered within 300 m of the CPB point (Figure 6). While it is impossible to know the number of missed nests, we suspect the number was fairly low in the Okanagan where only 39% of searches that were initiated failed to find a nest. The search failure rate was higher in the Western population (78%) and in the East Kootenay population (56%).

Hatching and fledging dates

Mean estimated fledging date for the 27 successful nests monitored in the Okanagan and Western populations in 2006 was July 2 with a range from June 26 to July 10. Three other nests that were monitored failed and did not fledge any young. Mean estimated hatch date (fledging date minus 28

days) was June 4 with a range from May 29 to June 12. There was a single nest that was estimated to have hatched on June 25, which was the only one later than June 12. This last nest failed between July 8 and 14 and no young fledged and the predicted fledgling date would have been about July 23. The earliest that fledged young were seen in 2006 was June 24. In 2004 fledged young were found as early as June 18 and timing of fledging in 2004 appeared to be generally earlier in 2004 than in 2006 although we did not monitor any nests.

Breeding density and territory occupancy

The average nest density in the Okanagan Falls census area was 3.1 nests/km² with 7 nests present in both 2003 and in 2004. Only 7 of the 9 total known nest locations were used in any one year. In 2005 another nesting territory was discovered where only an apparently unmated male could be found in 2004, for a total of 10 known nesting territories, of which only 7 were occupied in any one year. The breeding territory occupancy rate for both years was therefore 70%.

The average nest density in the Woodlot 411 census area was 0.91 nests/km² with 3, 4, 3 and 5 nests present in 1997-1999 and 2006 respectively. No more than 5 of the 8 known nesting territories were used in any one year, so that average occupancy of the 8 territories over the 4 census years was 47%. This had previously been reported as the possible benchmark density in B.C. (Gyug and Peatt 2000), but the density was clearly lower than in the Okanagan Falls census area.

Only 51% of the 89 previously-known nesting territories in the Okanagan population that were rechecked in 2006 were still occupied (Table 4). A low percentage of the territories (3.4%) were no longer considered suitable because of habitat changes due to wild fire or timber harvesting. An-

Table 4. Occupancy in 2006, of territories previously used for nesting by Williamson's Sapsucker, as known from surveys during 1996-2005. Results are for the Okanagan population.

Territory status in 2006	Territories	
	(n)	(%)
Territory still occupied		
Nest in a previously known nest tree	27	30.3
No nest in former nest tree but nest found in a different tree	6	6.7
No nest in former nest tree and could not find any nest (because of incorrect search timing, failed nesting, or lack of a nest)	12	13.5
Territory apparently unoccupied		
Former nest tree still standing and apparently suitable (or at least 1 of previously known nest trees if there were >1)	33	37.1
Former nest tree still standing and apparently suitable but territory considered less suitable because of habitat changes including clearcut timber harvesting (1) or wildfire followed by salvage logging (2)	3	3.4
Former nest tree cut down (2), fallen down (5), or decayed to unsuitability (1) and no alternative nest tree either available or used	8	9.0
Total previously known nest territories rechecked in 2006	89	100.0

other 9% were probably unsuitable because the previously-used nest tree had been cut down, fallen down, or decayed beyond suitability. Approximately one-third of the territories appeared to be still suitable, but did not appear to be occupied in 2006.

The relatively regular spacing of nests in the Okanagan Falls census area suggested territorial behaviour. To examine this in other areas where we did not have complete censuses, we tabulated the distances between the nearest and the second-nearest conspecific nests within 850 m for all nests in areas where we were confident we had located the nearest neighbour nests.

The mean distance to the nearest-neighbour nest in the Okanagan and East Kootenay populations was 450 m (SD = 109; $n = 32$ pairs of nests). This mean distance did not change greatly when the mean distance to the second-nearest neighbour nest was included (mean = 481 m; SD = 109; $n = 48$ pairs of nests; Figure 7). Only 3 pairs of nests were <360 m apart and there was only one nest pair >650 m apart. In the Western populations, only four nearest-neighbour nests could be found that were within 1 km of each other. This was not for a lack of search effort which was similar to the search effort in the Okanagan. These nearest-neighbour nests were 618, 730, 860 and 975 m apart (Mean = 795 m; SD = 155; $n = 4$ nest pairs).

Discussion

Relative density

Our surveys using calls and drums have been shown here to be very effective compared to silent listening surveys such as the BBS. Williamson's Sapsuckers have only been reported on 1 of the 17 BBS routes within their known breeding range in Canada, with an average of 0.4 detected per year from 1983 to 2003 on the Oliver BBS route (Patuxent Wildlife Research Center 2007). However, our surveys showed them to be much more abundant on that same route. On silent listening surveys in western Montana and northern Idaho, Hutto and Young (1999) found this species at 0.3% of all locations, and only at 2% of those in the habitat with the highest relative density. We found them at 6% of our CPB survey points, which was considerably higher than would have been expected on silent listening surveys.

CPB detection rates were lower in the afternoon than in the morning. They were also lower during the incubation and early nestling period (late May and early June) than in the pre-nesting period. Rushmore (1973) found the same pattern for Yellow-bellied Sapsuckers with response rates of 81% to drum imitations, from known territories in the pre-nesting period, and 61% in the nesting period.

Although we knew that response rates might be lower in the afternoon, surveys were often continued if winds re-

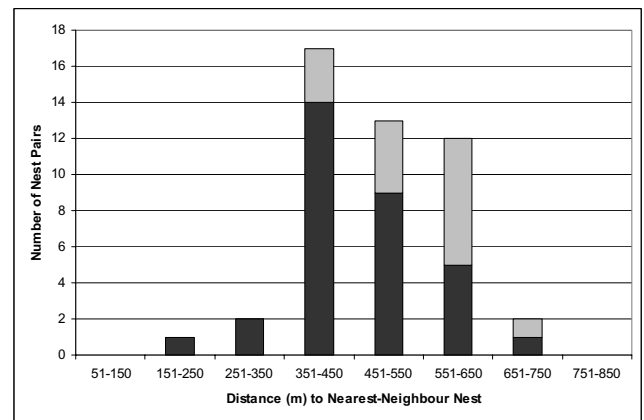


Figure 7. Distances between nearest-neighbour nests of Williamson's Sapsucker in the Okanagan and East Kootenay populations, 1997-2006. Black bars are for nearest neighbour nests ($n = 32$ nest pairs) and grey portions of bars for second nearest-neighbour nests ($n = 16$ nest pairs).

mained calm because the cost of getting to remote areas was high, and the initial results showed that many Williamson's Sapsuckers continued to respond, i.e. the response rate did not fall to zero. We felt that the value of the additional Williamson's Sapsucker observations was more important than the resultant statistical compensations that would be required to make robust comparisons of relative densities.

Detection rates of 8-12 per 100 CPB points were found in the BEC variants with the highest relative densities in the Okanagan and Western populations. However, all the relative densities were based on selected areas where we thought Williamson's Sapsuckers might be present rather than randomly-selected areas. Therefore the relative densities presented here may represent the highest relative densities within these BEC variants rather than the average densities. To derive a reliable index of relative density, we suggest a minimum of 100 randomly placed CPB points in any given BEC variant. The results for the Ponderosa Pine variant (PPxh2), which represented the highest density of any BEC variant, is an example of an estimator that is probably biased because of the low number of survey points, and because 80% of the CPB detections come from points within 200 m of the edge of the variant.

The population of Williamson's Sapsucker in the East Kootenay is probably smaller than other populations of Williamson's Sapsucker in B.C. with only eight nests found in 2006, and the lowest relative adult density of the three populations studied. However, this nest count was the largest number found in any year in the East Kootenay. Prior to this study only one nest had been recorded between 1938 and 2004, with several reported before 1938. It is unknown if this higher number of nests found was the result of a recent population expansion, or if it was the result of more efficient and more intensive searches. Large areas in the

East Kootenay still remain to be searched, so even the minimum size of the current population cannot be accurately estimated yet.

Before 2006, the Western population was thought to be very small and scattered with the only known concentration of breeding birds in a small area south of Princeton where they had been regularly monitored since the 1980s (J. Herzig, Princeton, pers. comm. 2000). The 2006 surveys found unexpectedly high numbers in the Merritt area and a relative adult density equivalent to the Okanagan population. Again, we do not know if this represents a population increase, or if our CPB surveys detected a population that was always present at similar abundances. The area occupied in the Western population may be larger than our current surveys show since there are large areas that have yet to be intensively surveyed. Breeding is suspected but not confirmed in the Salmon River and Douglas Lake areas northeast of Merritt. Rogers (1985) reported one non-breeding record from Salmon Lake, two were detected in one day of CPB surveys in 2006 by the CDC, and D. Oaten (Kamloops, pers. comm. 2006) reported them from two other sites 7 km west of Westwold in 2005. Numerical trends in these western populations are unknown because there are no previous baseline estimates for comparison, nor is it currently possible to estimate the population size reliably.

Despite the high relative densities of adults in both the Okanagan and Western populations, this was not reflected in the number of nests we could find in the Western population. Therefore the relative breeding density in the Western population, i.e., that proportion of the adult population that successfully nests and raises young, appeared to be about one-third of that in the Okanagan. Crockett (1975) found that about 10% of the territories in his Colorado study area were occupied by males that established territories but were unsuccessful in attracting a mate. We similarly found an estimated 9% of potential territories to have unmated males during the Okanagan nest searches. However, this percentage appeared to be considerably higher at 25% in the Western population.

Large areas of most of the BEC variants outlined in Figure 5 remain to be searched by CPB surveys, so the areas occupied by breeding populations, i.e. their distribution within the EO, remains uncertain except in the Okanagan. Even in the Okanagan, only about one-third of that fairly limited area has been searched, if we assume an effectively searched radius of 300-m around CPB points. We do not have sufficient data from any method that would allow us to reliably estimate population sizes.

Census areas—nest density

Breeding densities have been published for Williamson's Sapsuckers in the U.S. but have all come from plots <20 ha in size (Stallcup 1968; Bock and Lynch 1970;

Winternitz 1976; Franzreb and Ohmart 1978; Smith 1982; Scott and Oldemeyer 1983; Raphael and White 1984; Raphael *et al.* 1987). Based on the 54.2-ha breeding range size reported for the only radio-tagged male Williamson's Sapsucker (Manning and Cooper 1996), any estimates of density on small plots will likely not be valid since the plots will not be big enough to take in the entire breeding territory of even a single pair. The most reliable previous estimate of breeding territory size was 4-9 ha based on visual detections of banded pairs (Crockett 1975). However, it is clear from the radio-telemetry results cited above that either the 4-9 ha estimate was seriously low, or breeding territory sizes may be very different in different habitats. Since the 54-ha breeding territory overlapped another active Williamson's Sapsucker nest (Manning and Cooper 1996), any estimates of territory size based on observations of territorial encounters between adjacent pairs are likely inaccurate.

Nest densities of Williamson's Sapsuckers from large plots have been made available in preliminary results from a recent major research initiative in the western U.S. called the Bird and Burns Network (URL <http://www.rmrs.nau.edu/lab/4251/birdsnburns/>). The program is examining the use of ponderosa pine forests by cavity-nesting birds in response to controlled burning. Preliminary results before burning are available from areas of Washington, Oregon and Colorado where this species was present. There was a mean nest density of 1.16/km² (SD = 0.72, N= 14, range 0-4.8 nests/km²) in plots ranging in size from 1.6-4.0 km² (Vos and Yoder 2003; Lehmkuhl *et al.* 2004; McGrath 2004; Bienz *et al.* 2004a; Bienz *et al.* 2004b). Only one plot had a nest density higher than the 3.1 nests/km² that we found in the census area for Okanagan Falls. The Sheep Creek South plot in the San Juan National Forest of Colorado had 4.8 nests/km² in 2004 (8 nests in 1.65 km²; McGrath 2004). That plot was in "warm, dry mixed conifer" forest dominated by ponderosa pine with white fir (*Abies concolor*), trembling aspen (*Populus tremuloides*) and Douglas-fir also present (McGrath 2004). It would appear that the densities in what we have considered benchmark breeding habitat for this species in western larch forests in B.C. is among the highest known breeding densities for the species anywhere in its range.

The nearest-neighbour nest spacing in western larch habitats of the Okanagan had a 450-m average and a practical lower limit of 350 m except in a few circumstances. These limits would appear to be controlled by territorial behaviour. The larger nearest-neighbour nest distances in the Western population would indicate that either this population was less dense overall, or that defended space, i.e., territorial spacing, was larger in the ponderosa pine, Douglas-fir and aspen forests than in the western larch forests of the Okanagan. Conway and Martin (1993) reported inter-nest distances of 175 to 375 m in Arizona with an average of 278 m (SD = 67; n = 11 pairs of nests). This average

is lower than found in B.C., and it remains to be shown whether these differences in nearest-neighbour distances might be due to differences in habitat quality.

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Appendix. The names of variants and subzones in the Biogeoclimatic Ecosystem Classification (BEC), their codes, and the elevation ranges cited in this report. The classification was developed by Lloyd *et al.* (1990) and Braumandl and Curran (1992). BEC updates to 2006 are based on Ministry of Forests and Range (2006).

BEC Code	Elevation Range (m)	Variant or subzone BEC Name
Okanagan and West		
BGxh1	300-900	Okanagan Very Dry Hot Bunchgrass variant
ICHdw2	450-1200	Boundary Dry Warm Interior Cedar.Hemlock variant
ICHmk1	750-1550	Kootenay Moist Cool Interior Cedar Hemlock variant
IDFdk1	1200-1600	Thompson Dry Cool Interior Douglas.fir variant
IDFdk2	1150-1400	Cascade Dry Cool Interior Douglas.fir variant
IDFdm1	1100-1425	Kettle Dry Mild Interior Douglas.fir variant
IDFmw1	750-1250	Okanagan Moist Warm Interior Douglas.fir variant
IDFww1	230-1050	Leeward Pacific Ranges Wet Warm Interior Douglas.fir variant
IDFxh1	400-1250	Okanagan Very Dry Hot Interior Douglas.fir variant
IDFxh2	400-1450	Thompson Very Dry Hot Interior Douglas.fir variant
IDFxh4	500-1200	Boundary Very Dry Hot Interior Douglas.fir variant
MSdm1	1275-1700	Okanagan Dry Mild Montane Spruce variant
MSdm2	1250-1600	Thompson Dry Mild Montane Spruce variant
MSdm3	1050-1550	North Thompson Uplands Dry Mild Montane Spruce variant
MSxk1	1425-1900	Similkameen Very Dry Cool Montane Spruce variant
MSxk2	1400-1800	South Thompson Uplands Very Dry Cool Montane Spruce variant
PPdh1	500-950	Kettle Dry Hot Ponderosa Pine variant
PPxh1	400-1050	Okanagan Very Dry Hot Ponderosa Pine variant
PPxh2	400-1050	Thompson Very Dry Hot Ponderosa Pine variant
East Kootenay		
ICHdm	500-1450	Dry Mild Interior Cedar Hemlock subzone
ICHmk1	750-1550	Kootenay Moist Cool Interior Cedar Hemlock variant
IDFdm2	800-1200	Kootenay Dry Mild Interior Douglas-fir variant
MSdk	1100-1650	Dry Cool Montane Spruce subzone
PPdh2	700-950	Kootenay Dry Hot Ponderosa Pine variant

