

# Bird Monitoring at Three Tree Encroachment Reduction Projects in the Chilcotin Grassland Benchmark

**Inventory Report 2 Years Post-treatment, 2010**



Prepared for:

Grasslands Conservation Council of British Columbia and  
Cariboo Chilcotin Ecosystem Restoration Steering Committee



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## **Executive Summary**

Beginning in 2008, the Cariboo Chilcotin Ecosystem Restoration Steering Committee initiated knockdown of tree encroachment and conducted prescribed burning in select sites of three grassland restoration areas within the Cariboo-Chilcotin Grassland Benchmark. The point count method of inventorying was employed as part of effectiveness monitoring efforts in year zero (2008) and two years following forest encroachment knockdown (2010) in the three study areas. Indices of relative abundance, mean numbers of individual species and species commonness for songbirds (Order *Passeriformes*) and woodpeckers (Family *Picidae*) are being tracked over time to monitor for changes in biodiversity and to potentially contribute to adaptive management decisions.

Fifty-one point count stations over three study areas were resurveyed in 2010. A total of 728 bird detections of 39 species were inventoried and an additional 16 species were observed incidentally. Songbird and woodpecker species richness was similar among the three study areas between 2008 and 2010 with an average,  $14.3 \pm 0.5$  songbird and woodpecker species detected per station. The species encountered in the highest numbers and at the largest proportion of all stations were the same in 2010 as they were in 2008. Vesper Sparrow, the only grassland and open habitat nester in this group, may occur in sufficient numbers to serve as an indicator species of grassland conditions over time. Some uncommon species inventoried in 2008 were not encountered in 2010, while some new but uncommon species were inventoried in 2010. Several years of monitoring are required to accommodate for year-to-year variation before trends can be analyzed.

## Table of Contents

Executive Summary.....	i
Table of Contents.....	ii
List of Figures and Tables.....	ii
Introduction.....	1
Study Areas.....	1
Methods .....	2
Point Count Stations.....	3
Point Count Surveys.....	3
Data Analysis.....	4
Results.....	4
Discussion.....	8
Conclusion.....	9
References.....	10
APPENDICES.....	11
A: UTM coordinates of point count stations at three study areas (NAD 83 datum, grid10U).....	11
B: Maps of point count station locations in three study areas (from iMapBC).....	12
C: Species codes of all birds encountered defined by common and scientific names..	15
D: Relative indices of songbird and woodpecker abundance from point counts conducted in June 2008.....	17

## List of Tables

Table 1: Total detections, species richness and percent by species of all birds detected in three study areas, June 2008 and 2010.....	5
Table 2: Species surveyed on one year only plus addiitonal species encountered outside of survey protocol.....	6
Table 3: Relative indices of songbird and woodpecker abundance from point counts conducted in June 2010.....	7

## List of Figures

Figure 1: Meldrum Creek Road Area.....	2
Figure 2: Chilcotin District Area 1.....	2
Figure 3: Chilcotin District Area 2.....	2
Figure 4: Point count station plot centre and environs (Chilcotin District Area 1, Iron Wood Springs Station #7).....	3





## INTRODUCTION

The Cariboo Chilcotin Ecosystem Restoration Steering Committee, consisting of First Nations, provincial government, economic sectors, conservation and wildlife interest groups, and others, was established in fall of 2007 to oversee, promote and support ecosystem restoration of grasslands in the Cariboo-Chilcotin<sup>1</sup>. Forest encroachment has been occurring onto the region's grasslands since the early 1900s as fire suppression efforts increased. The Cariboo-Chilcotin Grassland Strategy established a "Grassland Benchmark" based on aerial photographs dated between 1962 and 1974. Areas mapped as open range during this first systematic forest inventory are considered benchmark and are to be managed, and in many cases restored, as native grassland (Cariboo-Chilcotin Grasslands Strategy Working Group, 2001).

Monitoring for changes in biodiversity following restoration activities is an important phase of adaptive management. As many birds exhibit high degrees of habitat affinity and are sensitive to change, they can be monitored as ecological indicators. A songbird (Order *Passeriformes*) and woodpecker (Family *Picidae*) monitoring project was initiated in June 2008<sup>2</sup> and remeasured in June 2010 at three sites where encroachment has been cut and in some cases burned. The point count method of inventorying was used to estimate relative abundance and population trends over time. Baseline indices of relative abundance have been generated for the treatment areas as a basis for long-term effectiveness monitoring.

## STUDY AREAS

Point count surveys were conducted in three study areas on the west-central side of British Columbia's Fraser River (regionally known as the Chilcotin). Appendices A and B contain coordinates and maps of study areas and point count stations. All areas fall within the Grassland Benchmark Area (Cariboo-Chilcotin Grasslands Strategy Working Group, 2001) and occur in the Interior Douglas-fir Very Dry Mild (IDFxm) biogeoclimatic subzone. The Meldrum Creek Road area (~150 ha) is west of Meldrum Creek Road, two km north of Highway 20 (Fig. 1). The Iron Wood Springs section of Chilcotin District Area 1 (~145 ha) is 26 km west of Alexis Creek, south of the confluence of the Chilko and Chilcotin Rivers (Fig. 2). These areas are mosaics of existing grassland, including areas where encroachment has been cut, trembling aspen copses and Douglas-fir forest edges. Chilcotin District Area 2 (Deer Creek) is west of the Chilcotin River and accessed from the south via the Hanceville crossing and Stone Reserve (20 km from Lee's Corner), or from the north via the Chilcotin River bridge at Alexis Creek (Fig. 3). About 125 ha of this ~1230 ha restoration area were surveyed in this project and consisted of a string of relatively small openings surrounded by forest, with some aspen content.

Cutting of encroachment (predominantly pole-sized Douglas-fir) in all areas was completed in the spring and summer of 2008. Prescribed burning was conducted on a portion of Chilcotin District Area 1 (Iron Wood Springs) in spring 2009. Point count stations CDA1-4, CDA1-5, CDA1-6, CDA1-7, CDA1-9, and CDA1-10 were within the burn perimeter. Point count station CDA2-7 at Deer Creek is within an area burned by wildfire in spring of 2009. Data from these

<sup>1</sup> Cariboo Chilcotin Ecosystem Restoration Steering Committee (Draft) Terms of Reference, 7 Feb. 2008.

<sup>2</sup> C. Koot. 2008. Bird Monitoring at Three Tree Encroachment Reduction Projects in the Chilcotin Grassland Benchmark - Implementation Report to Grasslands Conservation Council of British Columbia and Cariboo Chilcotin Ecosystem Restoration Steering Committee, Unpubl. report.



**Fig. 1:** Meldrum Creek Road Area



**Fig. 2:** Chilcotin District Area 1



**Fig. 3:** Chilcotin District Area 2



stations are pooled in the indices for each study area.

## METHODS

### Point Count Stations

The same point count stations established in 2008<sup>3</sup> were revisited in June 2010 using a hand-held Global Positioning System (Garmin GPSMAP 76CSx). There are 18 stations at the Meldrum Creek Road area, 17 in Chilcotin District Area 1, and 16 at Chilcotin District Area 2 (station CDA2-16 was surveyed in 2010 within the allowable survey time-frame but not in 2008) for a total of 51 stations.



**Fig. 4:** Point count station plot centre and environs (Chilcotin District Area 1, Iron Wood Springs Station #7)

### Point Count Surveys

As in 2008, point count surveys were conducted according to RIC (1999) and Ralph *et al.* (1995). Surveys were conducted once during breeding seasons from 0.5 hours before official sunrise up to five hours following sunrise on June 14, 16 and 17, 2010. Surveys lasted five minutes with demarcation between the 0-3 minute interval and the 3-5 minute interval so as to be compatible with Breeding Bird Survey protocol. Standard 4-letter species codes were used (BC Species and Ecosystems Explorer, <http://www.env.gov.bc.ca/atrisk/toolintro.html>) (See Appendix C). All species seen and heard calling or singing were identified and categorized according to distance codes (1=0-50 m, 2=51-100 m, 3=>100 m). Gender and relative age (adult, immature) were recorded if observations allowed. Birds flying over the station were identified as “fly-overs”. An adaptation of the RIC Animal Observation Form- Songbird Point Count (1998) data sheet was used for field data collection. Collected at the beginning of each count were start times and environmental conditions including cloud cover (1 = clear; 2 = scattered clouds (<50%); 3 =

<sup>3</sup> C. Koot. 2008.

scattered clouds (>50%); 4 = unbroken clouds), wind speed (Beaufort scale), precipitation (N = None; F = Fog; M = Misty drizzle; D = Drizzle), and temperature. Generally, counts in central British Columbia should be conducted in temperatures above 3 degrees Celsius, winds less than Beaufort 3 and precipitation less than light rain (RIC, 1999). So as to take into account the unsheltered conditions and cooler Chilcotin climate, standards were modified so as to include Beaufort 3 winds and temperatures above freezing. Comments and additional information useful to the British Columbia Breeding Bird Atlas (2008-2012), including nest observations, were additionally collected. Surveys were conducted by a competent observer of birds by both sight and sound (the author). Stations were accessible by a combination of 4x4 pick-up truck and walking.

### **Data Analysis**

Data analysis in 2010 is consistent with methods used 2008<sup>4</sup>. Data were entered into a standard Ministry of Environment Wildlife Species Inventory MS Excel template, modified to reflect this project. Species that were not songbirds or woodpeckers were culled from the dataset before analysis of relative abundance as they are not suitably detectable using the point count survey method. Fly-overs not associated with station habitat use (i.e. not aerially foraging) were also culled.

So as to allow for comparisons of the same area over time, bird detections from within fixed, 100 m radius stations were used to generate indices of relative abundance. They include:

- 1) Mean number of birds by species per station within 100 m radius.
- 2) Proportion of fixed radius stations within which a species was detected.
- 3) Proportion of unlimited radius stations within which a species was detected.

Determinations of the proportion of species detected in an unlimited radius (inclusive of all distance classes, including >100 m) assist with assessing whether certain species are detected more commonly at further distances from the observer or from adjacent habitats. This index is limited, however, as the >100 m class lacks complete independence between surveys (there is a possibility that individuals can be double-counted).

## **RESULTS**

Fifty one point count stations over three study areas were surveyed once in 2010. A total of 760 detections of 49 species of birds (not just songbirds and woodpeckers) were made during surveys and an additional six species were observed incidentally. Songbirds and woodpeckers (less culled fly-overs) accounted for 39 of those species and 728 individuals (Table 1). Mean number of detections of bird species encountered per station during surveys were comparable overall and among study sites to those in 2008 (Table 1). Species encountered in only one of the two survey years, both during point counts and incidentally, are listed in Table 2.

Songbird and woodpecker species richness remained similar between years at the three areas, though with some variation. Thirty-one species were detected at Meldrum Creek Road (30 in

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<sup>4</sup> C. Koot. 2008.

**Table 1:** Total detections, species richness and percent by species of all birds detected in three study areas, June 2008 and 2010.

Study Area by Year		# Point Count Stations	Total Detections Over 5-min. Survey		Mean # Detections/ Station	Species Richness		% Total Species <sup>c</sup>
			All Spp. <sup>a</sup>	Song/Wood <sup>b</sup>	Song/Wood <sup>b</sup>	All Spp. <sup>a</sup>	Song/Wood <sup>b</sup>	Song/Wood <sup>b</sup>
Meldrum Creek Road	2008	18	269	257	14.1	35	30	75
	2010	18	269	253	14.1	39	31	79
Chilcotin District Area 1 (Iron Wood Springs)	2008	17	260	243	14.1	34	32	80
	2010	17	250	236	13.9	32	25	64
Chilcotin District Area 2 (Deer Creek)	2008	15	229	223	14.7	31	28	70
	2010	16	241	239	14.9	35	33	85
Total	2008	50	758	712	-	46	40	100
	2010	51	760	728	-	49	39	100
Mean +/- SE	2008	-	-	-	14.3 +/- 0.4	-	30 +/- 2	75 +/- 5
	2010	-	-	-	14.3 +/- 0.5	-	30 +/- 4	76 +/- 11

<sup>a</sup> Number of all bird species detected during surveys in study area, including fly-overs.

<sup>b</sup> Number of songbird and woodpecker species in study area taking into account culled data.

<sup>c</sup> Percent of species detected in study area as a proportion of total species detected in entire project area.

2008), 25 species in Chilcotin District Area 1 (32 in 2008), and 33 species in Chilcotin District Area 2 (28 in 2008). On average,  $14.3 \pm 0.5$  songbird and woodpecker species were detected per station with very little difference between study areas and years (Table 1).

Table 3 summarizes the three indices of relative abundance for the songbirds and woodpeckers encountered in point count surveys. A similar table with 2008 data is in Appendix D for comparison. The most numerous species in 2010 (mean number of birds by species per station within 100 m radius) were Chipping Sparrow (1.89-2.13/ station vs. 1.0-2.12/ station in 2008), Dark-eyed Junco (0.44-1.65/station vs. 0.39-1.06/station in 2008), American Robin (0.69-1.18/ station vs. 0.33-1.06/station in 2008), Dusky Flycatcher (0.69-1.00/station vs. 0.7-1.18/station), Warbling Vireo (0.50-0.82/station vs. 0.39-0.73/station in 2008), Vesper Sparrow (0.50-0.78/ station vs. 0.61-1.18/station in 2008), and Yellow-rumped Warbler (0.44-0.59/station vs. 0.24-1.17/station in 2008) (Table 2). These 7 species were the most numerous in both survey years with  $>0.5$  individuals/station by species. Also encountered in numbers (mean  $>0.2$ /station in at least one study area) were Tree Swallow, Mountain Chickadee, and Brown-headed Cowbird, Ruby-crowned Kinglet, Western Wood Pewee, Western Tanager, Mountain Bluebird, Red-breasted Nuthatch, and Hermit Thrush.

The most numerous species were also the most common species in 2010 (i.e. those that occurred at the greatest proportion of 100 m fixed-radius stations). They were Chipping Sparrow (94-

**Table 2:** Species surveyed on one year only plus additional species encountered outside of survey protocol

Species	Year	Meldrum	CDA 1	CDA 2	Point Count	Species	Year	Meldrum	CDA 1	CDA 2	Point Count
AMWI	2008					MALL	2008				
	2010	X					2010	X			
ATTW	2008					MODO	2008		X		
	2010			X	*		2010				
BBMA	2008		X			PISI	2008	X	X	X	
	2010						2010	X	X	X	
BCCH	2008					RECR	2008				
	2010			X	*		2010	X			
BRBL	2008			X	*	RUGR	2008	X	X		
	2010						2010	X	X		
BUFF	2008	X				RTHA	2008			X	*
	2010	X					2010				
CAFI	2008			X		RWBL	2008				
	2010		X				2010	X			
COLO	2008					SACR	2008				
	2010	X					2010	X	X		
CONI	2008	X				TOWA	2008	X			*
	2010	X		X			2010				
EVGR	2008	X	X	X		WIWA	2008		X		*
	2010	X	X	X			2010				
GCKI	2008					WEME	2008	X	X		*
	2010		X				2010				
GRJA	2008				*	WWCR	2008		X		
	2010	X					2010				
KILL	2008	X		X		YHBL	2008				
	2010	X					2010				
LBCU	2008		X	X							
	2010		X								

100% stations vs. 80-94% in 2008), Dusky Flycatcher (56-71% stations vs. 73-88% stations in 2008), Dark-eyed Junco (44-76% stations vs. 28-65% in 2008), American Robin (50-76% stations vs. 33-71% in 2008), Warbling Vireo (50-61% stations vs. 44-59% in 2008), and Vesper Sparrow (47-52% stations vs. 13-82% in 2008). In 2010, Yellow-rumped Warbler was encountered in less than 50% of stations in all study areas (vs. 24-67% in 2008).

Species detected beyond the 100 m fixed radius only in at least one study area were American Crow, Common Raven, Eastern Kingbird, Olive-sided Flycatcher, Pileated Woodpecker, Pacific-slope Flycatcher, and Townsend's Solitaire (Table 3). These species, aside from Pacific-slope Flycatcher, have far-reaching voices and may have been in habitats other than those of point count stations. Detected more often at greater distances from station centres than from within 100 m were: American Robin, Hermit Thrush, Red-breasted Nuthatch, Ruby-crowned Kinglet,



**Table 2:** Relative indices of songbird and woodpecker abundance from point counts conducted in June 2010. The most numerous and commonly detected species are in bold.

Species <sup>a</sup>	Mean#birds by species/station within 100 m radius			Proportion of stations in which species was detected within 100 m			Proportion of stations in which species detected in an unlimited radius		
	Meldrum <sup>b</sup>	CD1 <sup>c</sup>	CD2 <sup>d</sup>	Meldrum	CD1	CD2	Meldrum	CD1	CD2
AMCR	-	-	-	-	-	-	-	-	0.06
<b>AMRO</b>	0.94	1.18	0.69	0.56	0.76	0.50	0.78	0.82	0.88
ATTW	-	-	0.06	-	-	0.06	-	-	0.06
BCCH	-	-	0.13	-	-	0.06	-	0.12	0.13
<b>BHCO</b>	0.33	0.12	0.19	0.11	0.12	0.19	0.17	0.18	0.25
CAVI	0.11	0.06	-	0.11	0.06	-	0.17	0.18	0.19
CEWA	0.06	-	0.06	0.06	-	0.06	0.06	-	0.06
<b>CHSP</b>	1.89	1.94	2.13	0.94	0.94	1.00	0.94	0.94	1.00
CORA	-	-	-	-	-	-	0.06	0.24	0.31
<b>DEJU</b>	0.44	1.65	0.81	0.44	0.76	0.63	0.67	0.76	0.69
DOWO	0.06	-	-	0.06	-	-	0.06	-	-
<b>DUFL</b>	1.00	0.88	0.69	0.56	0.71	0.63	0.56	0.76	0.81
EAKI	-	-	-	-	-	-	-	0.06	-
GRJA	0.17	-	-	0.06	-	-	0.06	-	-
HAFL	-	-	0.06	-	-	0.06	-	-	0.06
HAWO	-	0.06	0.06	-	0.06	0.06	-	0.06	0.06
HETH	0.28	0.12	0.06	0.17	0.12	0.06	0.44	0.35	0.44
LEFL	0.06	-	-	0.06	-	-	0.06	-	0.06
LISP	0.17	-	-	0.11	-	-	0.33	-	0.06
MACW	-	0.06	-	-	0.06	-	-	0.06	0.06
MOBL	0.28	0.18	0.06	0.17	0.12	0.06	0.28	0.18	0.06
<b>MOCH</b>	0.17	0.29	0.19	0.28	0.24	0.19	0.28	0.29	0.31
NOFL	-	0.12	-	-	0.12	-	0.17	0.12	0.06
OCWA	-	-	0.13	-	-	0.13	0.11	-	0.19
OSFL	-	-	-	-	-	-	0.06	-	0.06
PIWO	-	-	-	-	-	-	0.06	-	-
PSFL	-	-	-	-	-	-	-	-	0.06
RBNU	0.11	0.24	0.13	0.11	0.18	0.13	0.44	0.35	0.31
RCKI	0.33	0.18	0.06	-	0.18	0.06	-	0.47	0.31
RNSA	0.06	0.06	0.19	0.06	0.06	0.19	0.11	0.06	0.19
SAVS	0.17	-	-	0.17	-	-	0.17	-	-
SWTH	0.06	-	-	0.06	-	-	0.22	0.29	0.13
TOSO	-	-	-	-	-	-	0.11	-	-
<b>TRSW</b>	0.28	0.06	0.81	0.28	0.06	0.31	0.28	0.12	0.31
<b>VESP</b>	0.78	0.53	0.50	0.50	0.47	0.50	0.56	0.47	0.53
<b>WAVI</b>	0.61	0.82	0.50	0.61	0.59	0.50	0.78	0.82	0.81
<b>WETA</b>	0.17	0.12	0.25	0.17	0.12	0.25	0.56	0.24	0.56
WWPE	0.17	0.06	0.31	0.17	0.06	0.31	0.33	0.18	0.50
<b>YRWA</b>	0.56	0.59	0.44	0.39	0.47	0.44	0.44	0.71	0.50

<sup>a</sup>Includes songbirds and woodpeckers only, less culls. Species codes are from BC Species and Ecosystems Explorer, <http://www.env.gov.bc.ca/atrisk/toolintro.html>.

<sup>b</sup>Meldrum Creek Road Study Area

<sup>c</sup>Chilcotin District Area 1 Study Area

<sup>d</sup>Chilcotin District Area 2 Study Area

Swainson's Thrush, Warbling Vireo, Western Tanager and Western Wood-pewee (Table 3). Aside from American Robin, which breeds ubiquitously in British Columbia, these species are associated with woodland habitats (Campbell *et al.* 1997) and reflect the presence of forest adjacent to the grassland openings in the study areas. Similar results were observed in 2008 (Appendix D).

Open- or edge-habitat bird species detected during surveys in 2010 included Vesper Sparrow, Mountain Bluebird, Mountain Chickadee, Cedar Waxwing, Savannah Sparrow, Lincoln's Sparrow, Brown-headed Cowbird, Northern Flicker, Western Wood-pewee, MacGillivray's Warbler, and Eastern Kingbird. Additionally encountered were Common Nighthawk displaying at Chilcotin District Areas 1 and 2, Killdeer at Meldrum Creek Road area, Sandhill Crane at each study area, and a pair of Long-billed Curlews east of station CDA1-14. The presence of these birds during peak breeding season suggests at least possible breeding status. Open- or edge-habitat species not present in 2010 but detected in 2008 were Western Meadowlark, Brewer's Blackbird, Black-billed Magpie, Mourning Dove, and Red-tailed Hawk (Table 2). These species were uncommon in 2008, so lack of detection in 2010 may be a function of sampling rather than an indication of decline. Likewise, there were uncommon species detected in 2010 that were not observed in 2008 (Table 2).

## DISCUSSION

The species encountered in the highest numbers and at the largest proportion of all stations were the same in 2010 as they were in 2008. Chipping Sparrow, Dark-eyed Junco, American Robin, and Yellow-rumped Warbler inhabit a range of habitats in British Columbia, including forests and forest-grassland interfaces (Campbell *et al.* 1997). The abundance and commonness of these species during the peak of breeding season indicates good habitat suitability for them. Again, as in 2008, Dusky Flycatcher and Warbling Vireo were associated with aspen copses that were interspersed with grassland openings. Vesper Sparrow is the only one of the abundant species surveyed that breeds solely in grasslands and open spaces. Unlike in 2008 where it occurred in 82% of stations in Chilcotin District Area 1, 61% of Meldrum Creek Road stations, and only 13% of those at Chilcotin District Area 2, this species was uniformly encountered at about 50% of all study area stations in 2010. Vesper Sparrow might serve as an effective indicator species for grassland conditions in this monitoring program over time.

As in 2008, several bird species appeared to be associated with the presence of aspen copses adjacent to grassland openings. They included Dusky Flycatcher, Warbling Vireo, Western Wood-pewee, Orange-crowned Warbler and Least Flycatcher, plus cavity nesters such as Mountain Bluebird, Mountain Chickadee, Northern Flicker, Tree Swallow and Bufflehead. Aspen copses in IDF forests and grasslands are known to have high avian biodiversity, especially of cavity-nesters (Aitkin and Martin, 2004; Martin *et al.* 2004).

Species richness for songbirds and woodpeckers remained relatively similar within study areas between 2008 and 2010. It is too soon in the monitoring process to be able to determine trends in indices, such as the apparent drop in songbird and woodpecker species richness at Chilcotin District Area 1 from 32 to 25, or the increase from 28 to 33 at Chilcotin District Areas 2 between

2008-2010. Surveying will need to be done over a longer time period to be able to assess whether such differences between years are a function of sampling or are actual trends.

For future reference it should be noted that according to the Ministry of Forests and Range Wildfire Branch interactive map (<http://bcwildfire.ca/hprScripts/WildfireNews/OneFire.asp>, accessed August 20, 2010), an active wildfire perimeter includes all point count stations in Chilcotin District Area 1 (Iron Wood Springs) aside from stations CDA1-8, CDA1-9, and CDA1-10.

## CONCLUSION

The point count method of bird inventorying has been conducted as part of effectiveness monitoring efforts in year zero (2008) and two years following forest encroachment knockdown (2010) in three grassland restoration areas within the Cariboo-Chilcotin Grassland Benchmark. Indices of relative abundance, mean numbers of individual species and commonness of species of songbirds and woodpeckers can be tracked over time to monitor for change. The indices derived from the two datasets to date appear to be quite similar between years and study areas, especially for species encountered in the highest numbers and at the highest proportion of point count stations. Vesper Sparrow, the only grassland species to have been abundant in both survey years, may generate sufficient sample sizes to be an effective indicator species of grassland conditions in this study. It is recommended that in order to generate a sufficient sample size of monitoring data from which inferences can be drawn, surveys be repeated annually or biannually such that at least 3-6 datasets are generated. Several years of monitoring are required to accommodate for variation due to differences between weather from year to year, as well as annual bird population fluctuations not related directly to breeding habitat conditions (Sauer *et al.* 2004). Monitoring frequency for ensuing years should be re-assessed following this time-frame.

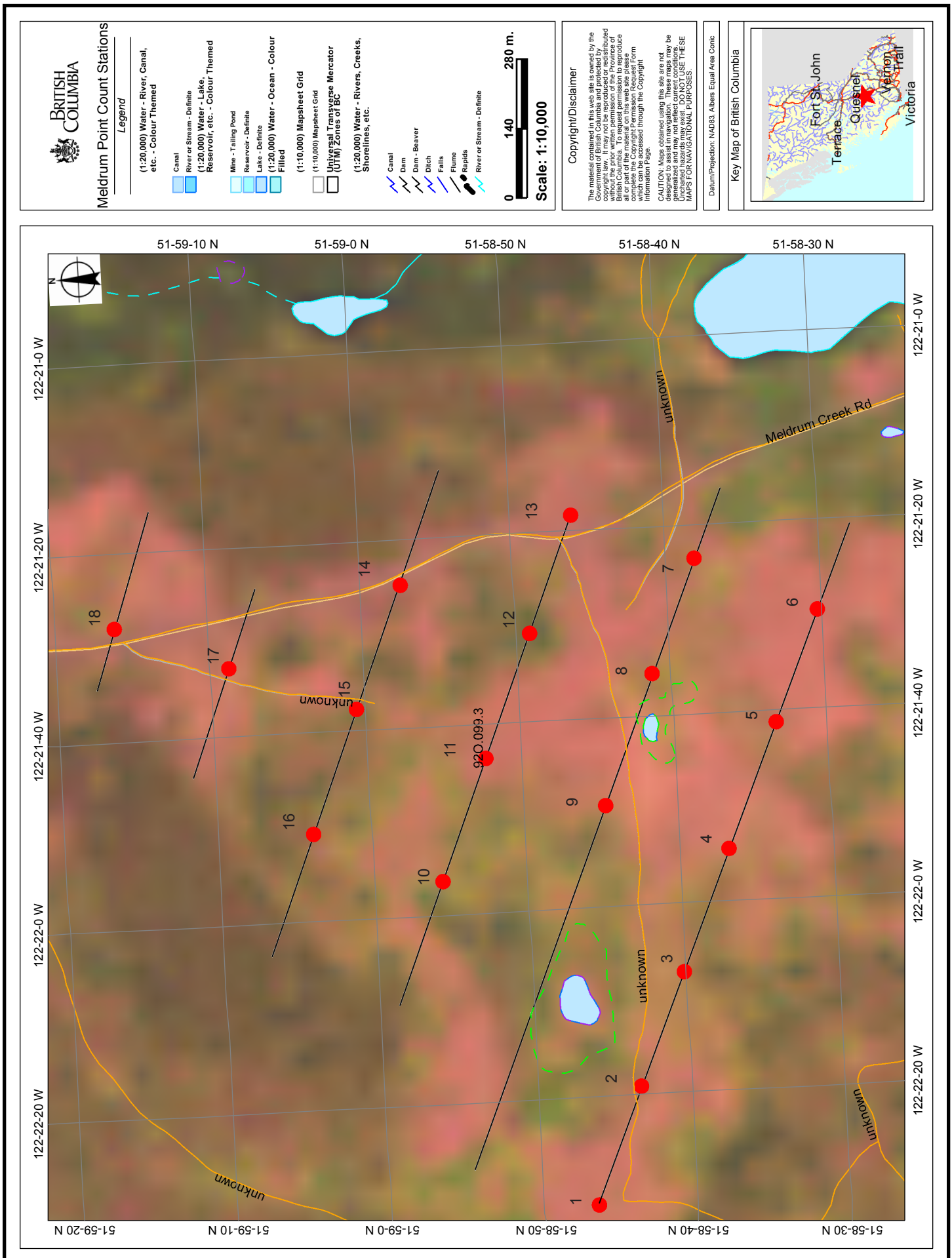
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**Appendix A:** UTM coordinates of point count stations at three study areas (NAD 83 datum, grid 10U)

Meldrum Creek Road			Chilcotin District Area 1 (Iron Wood Springs)			Chilcotin District Area 2 (Deer Creek)		
Plot	Easting	Northing	Plot	Easting	Northing	Plot	Easting	Northing
1	542898	5758952	1	463398	5768034	1	481315	5764824
2	543133	5758855	2	463636	5768119	2	481461	5764615
3	543361	5758761	3	463306	5768274	3	482294	5763376
4	543606	5758658	4	463723	5768676	4	482426	5763177
5	543859	5758554	5	463880	5768995	5	482561	5762976
6	544082	5758460	6	463639	5768914	6	482697	5762775
7	544195	5758705	7	463393	5768825	7	482969	5762372
8	543962	5758797	8	463152	5768744	8	484094	5760701
9	543704	5758901	9	463311	5769074	9	484510	5760085
10	543564	5759236	10	463562	5769160	10	485216	5759029
11	543808	5759141	11	464829	5769322	11	485364	5758812
12	544058	5759041	12	465073	5769406	12	485505	5758601
13	544292	5758948	13	465311	5769488	13	485650	5758387
14	544154	5759306	14	465390	5769247	14	485796	5758168
15	543918	5759397	15	465153	5769165	15	485943	5757954
16	543671	5759493	16	465238	5768933	16	486080	5757745
17	544012	5759649	17	465470	5769015			
18	544101	5759877						

## Appendix B: Maps of point count station locations in three study areas (from iMapBC).







# Iron Wood Springs Point Count Stations

## Legend

(1:20,000) Water - River, Canal, etc. - Colour Themed

Canal  
River or Stream - Definite  
(1:20,000) Water - Lake, Reservoir, etc. - Colour Themed

Mine - Tailing Pond  
Reservoir - Definite  
Lake - Definite  
(1:20,000) Water - Rivers, Creeks, Shorelines, etc.

Canal  
Dam  
Dam - Beaver  
Ditch  
Falls  
Flume  
Rapid  
River or Stream - Definite  
River or Stream - Dry  
River or Stream - Indefinite  
River or Stream - Left Bank  
River or Stream - Right Bank  
Dam - section Base  
Flooded Land - Inundated  
Lake - Definite

0 275 550 m.  
Scale: 1:20,000

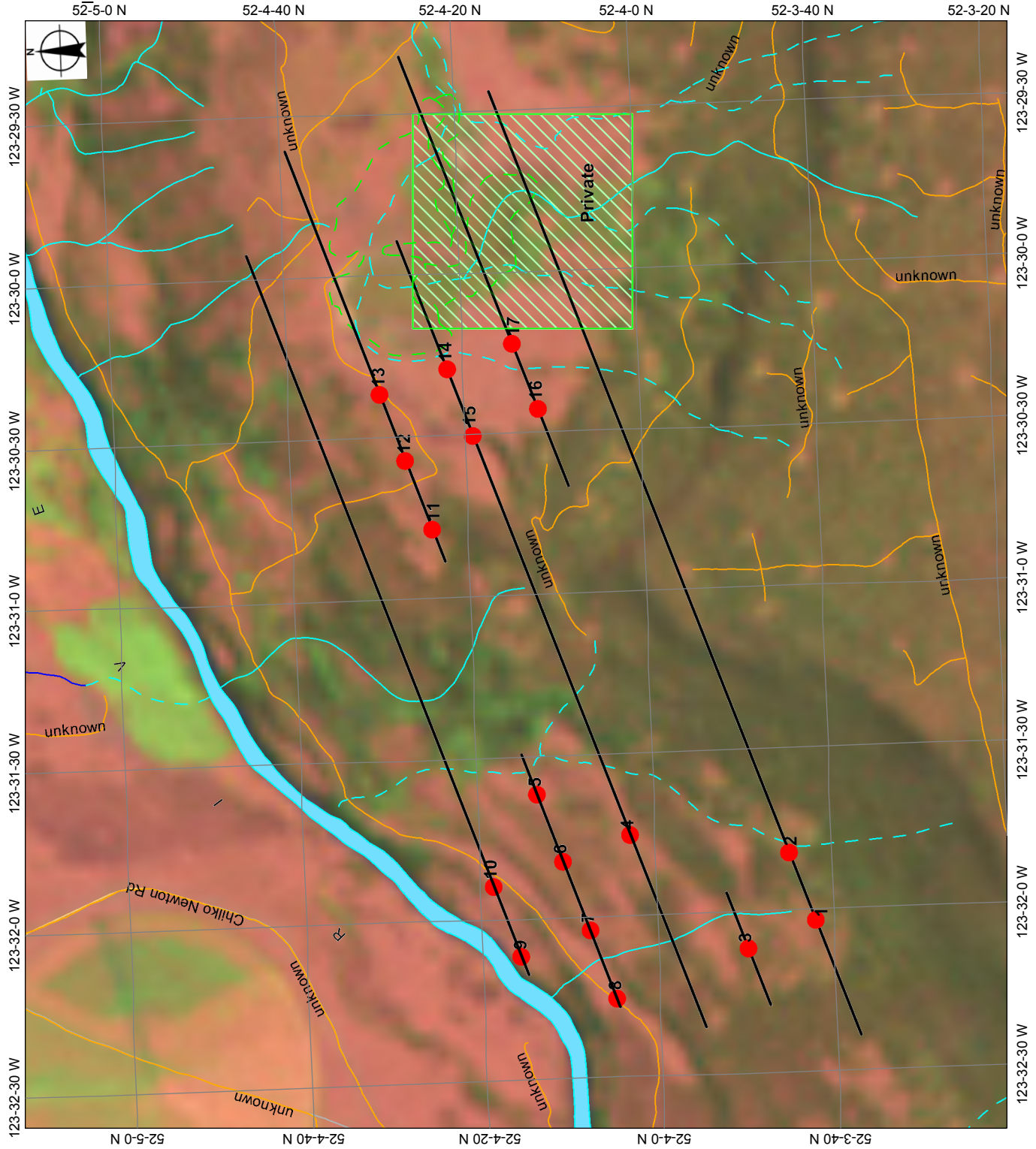
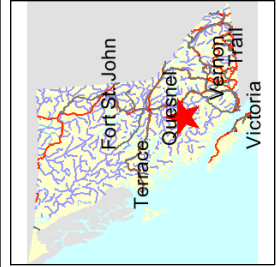
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Datum/Projection: NAD83, Albers Equal Area Conic

## Key Map of British Columbia







**Appendix C:** Species codes of all bird species encountered in 2008 and 2010 defined by common and scientific names

<b>Code</b>	<b>Common Name</b>	<b>Scientific Name</b>
AMCR	American Crow	<i>Corvus brachyrhynchos</i>
AMRO	American Robin	<i>Turdus migratorius</i>
AMWI	American Wigeon	<i>Anas americana</i>
ATTW	American Three-toed Woodpecker	<i>Picoides dorsalis</i>
BBMA	Black-billed Magpie	<i>Pica hudsonia</i>
BCCH	Black-capped Chickadee	<i>Poecile atricapillus</i>
BHCO	Brown-headed Cowbird	<i>Molothrus ater</i>
BRBL	Brewer's Blackbird	<i>Euphagus cyanocephalus</i>
BUFF	Bufflehead	<i>Bucephala albeola</i>
CAFI	Cassin's Finch	<i>Carpodacus cassinii</i>
CAVI	Cassin's Vireo	<i>Vireo cassinii</i>
CEWA	Cedar Waxwing	<i>Bombycilla cedrorum</i>
CHSP	Chipping Sparrow	<i>Spizella passerina</i>
COLO	Common Loon	<i>Gavia immer</i>
CONI	Common Nighthawk	<i>Chordeiles minor</i>
CORA	Common Raven	<i>Corvus corax</i>
DEJU	Dark-eyed Junco	<i>Junco hyemalis</i>
DOWO	Downy Woodpecker	<i>Picoides pubescens</i>
DUFL	Dusky Flycatcher	<i>Empidonax oberholseri</i>
EAKI	Eastern Kingbird	<i>Tyrannus tyrannus</i>
EVGR	Evening Grosbeak	<i>Coccothraustes vespertinus</i>
GRJA	Gray Jay	<i>Perisoreus canadensis</i>
HAFL	Hammond's Flycatcher	<i>Empidonax hammondi</i>
HAWO	Hairy Woodpecker	<i>Picoides villosus</i>
HETH	Hermit Thrush	<i>Catharus guttatus</i>
KILL	Killdeer	<i>Charadrius vociferus</i>
LBCU	Long-billed Curlew	<i>Numenius americanus</i>
LEFL	Least Flycatcher	<i>Empidonax minimus</i>
LISP	Lincoln's Sparrow	<i>Melospiza lincolnii</i>
MACW	MacGillavray's Warbler	<i>Oporornis tolmiei</i>
MALL	Mallard	<i>Anas platyrhynchos</i>
MOBL	Mountain Bluebird	<i>Sialia currucoides</i>
MOCH	Mountain Chickadee	<i>Poecile gambeli</i>
MODO	Mourning Dove	<i>Zenaida macroura</i>
NOFL	Northern Flicker	<i>Colaptes auratus</i>
OCWA	Orange-crowned Warbler	<i>Vermivora celata</i>
OSFL	Olive-sided Flycatcher	<i>Contopus cooperi</i>
PISI	Pine Siskin	<i>Carduelis pinus</i>
PIWO	Pileated Woodpecker	<i>Dryocopus pileatus</i>

<b>Code</b>	<b>Common Name</b>	<b>Scientific Name</b>
RBNU	Red-breasted Nuthatch	<i>Sitta canadensis</i>
RCKI	Ruby-crowned Kinglet	<i>Regulus calendula</i>
RECR	Red Crossbill	<i>Loxia curvirostra</i>
RNSA	Red-naped Sapsucker	<i>Sphyrapicus nuchalis</i>
RTHA	Red-tailed Hawk	<i>Buteo jamaicensis</i>
RUGR	Ruffed Grouse	<i>Bonasa umbellus</i>
RWBL	Red-winged Blackbird	<i>Agelaius phoeniceus</i>
SAVS	Savannah Sparrow	<i>Passerculus sandwichensis</i>
SWTH	Swainson's Thrush	<i>Catharus ustulatus</i>
TOSO	Townsend's Solitaire	<i>Myadestes townsendi</i>
TOWA	Townsend's Warbler	<i>Dendroica townsendi</i>
TRSW	Tree Swallow	<i>Tachycineta bicolor</i>
VESP	Vesper Sparrow	<i>Pooecetes gramineus</i>
WAVI	Warbling Vireo	<i>Vireo gilvus</i>
WEME	Western Meadowlark	<i>Sturnella neglecta</i>
WETA	Western Tanager	<i>Piranga ludoviciana</i>
WIWA	Wilson's Warbler	<i>Wilsonia pusilla</i>
WWCR	White-winged Crossbill	<i>Loxia leucoptera</i>
WWPE	Western Wood-pewee	<i>Contopus sordidulus</i>
YHBL	Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>
YRWA	Yellow-rumped Warbler	<i>Dendroica coronata</i>

**Appendix D:** Relative indices of songbird and woodpecker abundance from point counts conducted in June 2008. The most numerous and commonly detected species are in bold.

Species <sup>a</sup>	Mean#birds by species/station within 100 m radius			Proportion of stations in which species was detected within 100 m			Proportion of stations in which species detected in an unlimited radius		
	Meldrum <sup>b</sup>	CD1 <sup>c</sup>	CD2 <sup>d</sup>	Meldrum	CD1	CD2	Meldrum	CD1	CD2
AMCR	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06	0.00
<b>AMRO</b>	0.61	1.06	0.33	0.39	0.71	0.33	0.61	0.82	0.53
<b>BHCO</b>	0.78	0.00	0.27	0.61	0.00	0.13	0.61	0.00	0.13
BRBL	0.00	0.00	0.13	0.00	0.00	0.07	0.00	0.00	0.07
CAVI	0.06	0.06	0.13	0.06	0.06	0.07	0.11	0.12	0.13
<b>CHSP</b>	1.00	2.12	1.87	0.89	0.94	0.80	0.89	0.94	0.80
CORA	0.00	0.00	0.13	0.00	0.00	0.13	0.11	0.29	0.73
<b>DEJU</b>	0.39	1.06	0.60	0.28	0.65	0.53	0.28	0.65	0.53
DOWO	0.00	0.00	0.13	0.00	0.00	0.13	0.00	0.00	0.13
<b>DUFL</b>	1.11	1.18	0.73	0.83	0.88	0.73	0.89	0.88	0.73
EAKI	0.00	0.06	0.00	0.00	0.06	0.00	0.00	0.06	0.00
EVGR	0.00	0.12	0.00	0.00	0.12	0.00	0.00	0.12	0.07
HAFL	0.00	0.06	0.00	0.00	0.06	0.00	0.00	0.06	0.00
HAWO	0.06	0.06	0.07	0.06	0.06	0.07	0.06	0.06	0.07
<b>HETH</b>	0.22	0.29	0.27	0.22	0.29	0.27	0.39	0.29	0.47
LEFL	0.17	0.00	0.00	0.11	0.00	0.00	0.17	0.00	0.00
LISP	0.06	0.06	0.07	0.06	0.06	0.07	0.22	0.06	0.20
MACW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00
<b>MOBL</b>	0.33	0.24	0.13	0.33	0.24	0.13	0.39	0.24	0.13
<b>MOCH</b>	0.78	0.41	0.27	0.56	0.29	0.27	0.61	0.35	0.33
NOFL	0.11	0.18	0.07	0.11	0.18	0.07	0.11	0.18	0.07
OCWA	0.11	0.06	0.00	0.06	0.06	0.00	0.11	0.06	0.00
OSFL	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00
<b>PISI</b>	0.22	0.24	0.60	0.22	0.12	0.40	0.22	0.12	0.47
PIWO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.27
RBNU	0.17	0.06	0.20	0.17	0.06	0.13	0.39	0.29	0.27
<b>RCKI</b>	0.17	0.24	0.20	0.17	0.24	0.20	0.44	0.29	0.47
RNSA	0.00	0.06	0.00	0.00	0.06	0.00	0.00	0.06	0.00
SAVS	0.06	0.00	0.00	0.06	0.00	0.00	0.06	0.00	0.00
SWTH	0.06	0.12	0.47	0.06	0.12	0.40	0.06	0.35	0.73
TOSO	0.00	0.00	0.07	0.00	0.00	0.07	0.00	0.00	0.07
TOWA	0.06	0.00	0.00	0.06	0.00	0.00	0.06	0.00	0.00
<b>TRES</b>	0.28	0.12	0.13	0.22	0.06	0.07	0.28	0.65	0.13
<b>VESP</b>	0.61	1.18	0.67	0.61	0.82	0.13	0.78	0.88	0.73
<b>WAVI</b>	0.39	0.71	0.73	0.44	0.59	0.60	0.72	0.71	0.73
WEME	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06	0.00
<b>WETA</b>	0.28	0.29	0.13	0.17	0.24	0.13	0.22	0.47	0.60
WIWA	0.00	0.06	0.00	0.00	0.06	0.00	0.00	0.06	0.00
WWPE	0.11	0.18	0.33	0.11	0.18	0.33	0.11	0.29	0.40
<b>YRWA</b>	1.17	0.24	0.87	0.67	0.24	0.67	0.78	0.35	0.73

<sup>a</sup>Includes songbirds and woodpeckers only.

<sup>b</sup>Meldrum Creek Road Study Area

<sup>c</sup>Chilcotin District Area 1 Study Area

<sup>d</sup>Chilcotin District Area 2 Study Area