

Electronic Supplementary Material for
THE CONSERVATION VALUE OF HIGH ELEVATION HABITATS TO MIGRANT
BIRDS

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Detailed description of the four regions and locations of 10 study sites within those regions

(1) *Western Coast Range*: The rugged, granitic coast range ascends rapidly from sea level with most peaks being <2500 masl. Steep-walled fjords and deep valleys characterize the western slope of the coast range. Low elevations near our western coast range sites receive on average 2342 mm of precipitation^{-yr}, of which 1517 mm falls as during winter (Nov–Mar) months, typically resulting in snow at higher elevations. High elevations in this region typically receive >11 m of snow^{-yr} which leads to late springs and short summers. The heavy snow pack, hard granitic rock, and extensive glaciation results in a relatively small area of alpine meadows and more bare rock in this region compared to the others in our study (<http://www.env.gov.bc.ca/ecology/ecoregions/humidtemp.html#coast>).

We sampled three sites in this region; Seymour Mountain (SM; 49.38°N, 122.94°W), Cypress Mountain (CM; 49.40°N, 123.20°W), and Garibaldi (GA; 49.85°N, 123.03°W). The SM site was located within Mt. Seymour Provincial Park on the main ridge oriented N-S. Typical of the west coast, this site has a montane zone dominated by Mountain Hemlock (*Tsuga mertensiana*), with relatively small expanses of subalpine parkland giving way to steep, rocky outcrops. The CM site lies within Cypress Mountain Provincial Park (surveys were conducted prior to expansion of the ski resort and construction of a high elevation lodge for the 2010 Winter Olympics). CM transects lay primarily within the south-facing Cypress Bowl to the east of Howe Sound and north of Burrard Inlet. CM was not surveyed in 1999 due to record snow pack (i.e., 10 m) that made it impossible to access site and locate transects in mid-August. Neither SM or CM sites provided access to alpine vegetation. The GA site was located within Garibaldi Provincial Park along Brohm Ridge running west from Mt. Garibaldi. Brohm Ridge's north side is covered in alpine vegetation, and in subalpine and montane vegetation on its south face. We sampled the GA site only in 1998 as snowpack made access impossible in both 1999 and 2000 and logistical constraints prevented resurvey in 2001.

(2) *Interior Coast Range*: The interior leeward side of the coast range differs dramatically from the western slope in precipitation regime, and consequently, plant communities, vegetation structure, glaciation, and erosional processes. Low elevations near our interior coast range sites receive on average only 436 mm of precipitation^{-yr}, of which 192 mm falls during winter months. Characteristic trees of subalpine and montane zones in this region include Subalpine fir (*Abies lasiocarpa*) and Engelmann spruce (*Picea engelmanni*).

We sampled four sites in this region with the northernmost site being located ~370 km NW of the southernmost site; Stein Divide (ST; 50.39°N, 121.88°W), Shulaps Mountain (SH; 50.84°N, 122.29°W), Perkins Peak (PP; 51.81°N, 125.08°W), and Rainbow Ridge (RR; 52.59°N, 125.86°W). The southernmost of the interior coast sites (ST) was located just north of Stein Valley Nlaka'pamux Heritage Park at the headwaters of Siwhe Creek. The ST site was situated in a large east-facing bowl with expanses of alpine tundra and relatively low-angle subalpine and montane forests. We surveyed this site in 1998 and in 2001, but not in 1999 or 2000 as a large landslide blocked road access. The SH site was situated at the southern end of the Shulaps range at the head of a north-facing valley draining into the Yalakom River. Prior logging and the steepness of the terrain resulted in restricted pockets of montane forest at SH. The PP site was located on the broad expanse of the NE flank of Perkins Peak located west of and facing the Chilcotin plateau to the east. RR was the northernmost site, located within the southern sector of Tweedsmuir Provincial Park ~40 km NW of the town of Anahim Lake, and is situated on the south side of the Rainbow Range. The RR featured a broad, sloping plateau dotted with lakes. Both PP and RR were only surveyed in 1998 because constraints of time and personnel in subsequent years required that we reduce the number of sites surveyed.

(3) *North Cascades*: The North Cascades extend S. from near the town of Hope, BC into NW Washington State, USA. Their peaks typically rise to <3,000 m, and our sites were located on extensive, plateau-like expanses of alpine meadows rising above montane forests dominated by Silver fir (*Abies amabilis*) in wetter areas, and Grand Fir (*Abies grandis*) and Douglas Fir (*Pseudotsuga menziesii*) in drier areas. Subalpine areas are characterized by Mountain Hemlock in wetter areas grading to Subalpine Fir (*Abies lasiocarpa*) and Subalpine Larch (*Larix lyallii*) in drier areas. Precipitation in the valley (702 masl) between the Cascades sites receives on average 347 mm precipitation^{-yr}, of which 158 mm falls during winter months.

We sampled two sites in this region; Manning Provincial Park (MA; 49.16°N, 120.76°W) and Crater Mountain (CR; 49.18°N, 120.08°W). The MA site was located in the vicinity of Three Brothers Mountain. We sampled on both slopes of the main ridge oriented NW-SE. The CR site was located on the eastern, drier side of the N. Cascades, 18 km west of the town of Keremeos and 5 km north of Cathedral Provincial Park. This isolated defunct volcanic peak featured large grassy areas maintained in part by grazing of native and non-native mammals with relatively little bare rock.

(4) *Cariboo Mountains*: The Cariboo is the northernmost sub-range of the Columbia mountains, lying just west of the Rocky Mountain Trench and east of the Cariboo plateau. A site located 95 km to the west at 1060 masl receives on average only 477 mm of precipitation^{-yr}, of which 164 mm falls during winter months. We sampled one site within the Cariboo Mountains; Wells Gray (WG; 51.78°N, 119.93°W) site was located at the south end of Wells Gray Provincial Park in the Trophy range. The WG site is on the western side of a broad, gently sloping ridge oriented N-S, known as Trophy Meadows, 15 km north of the town of Clearwater.

Supplementary Table S1

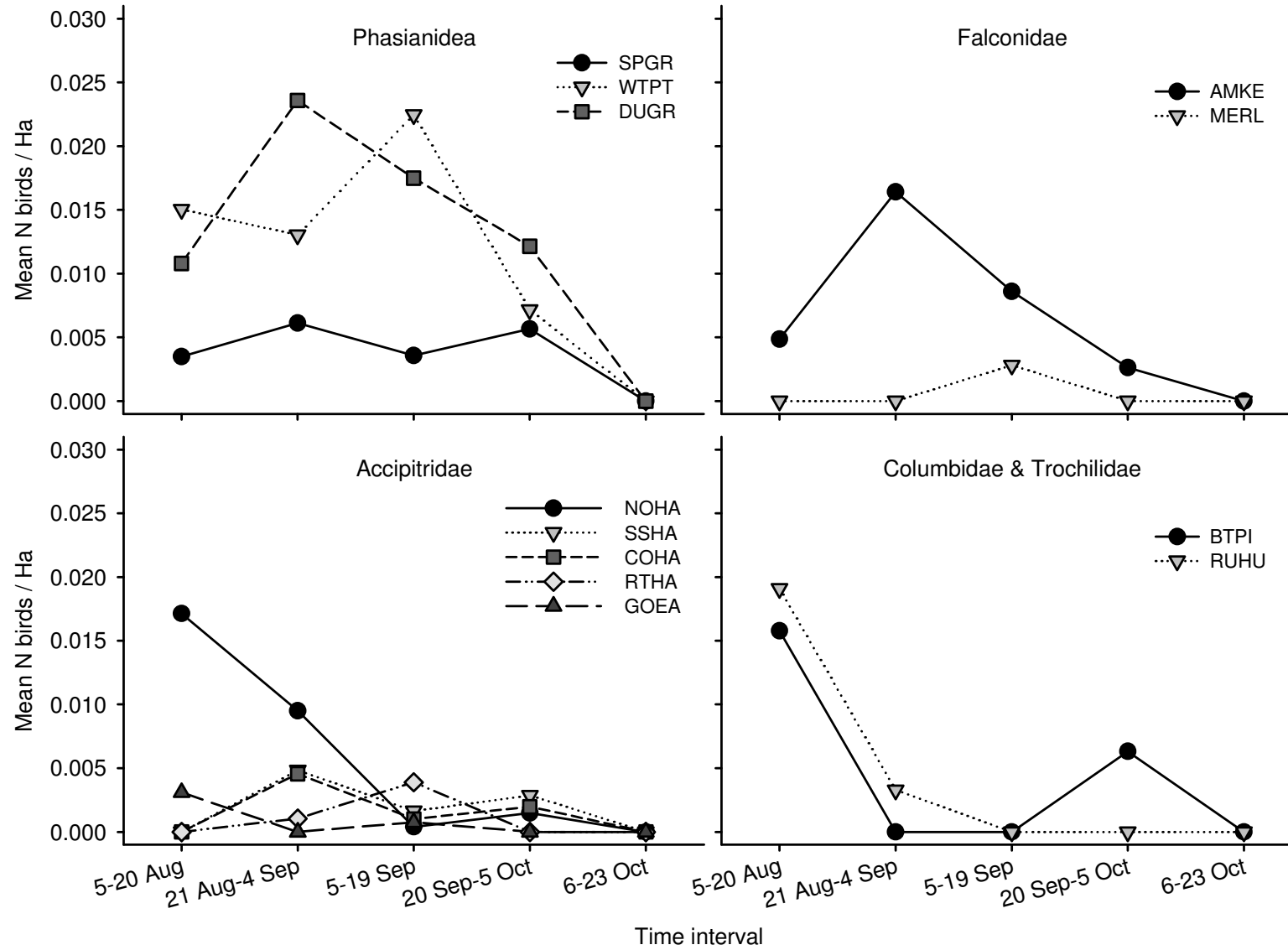
Summary of sampling effort by site, habitat, and year

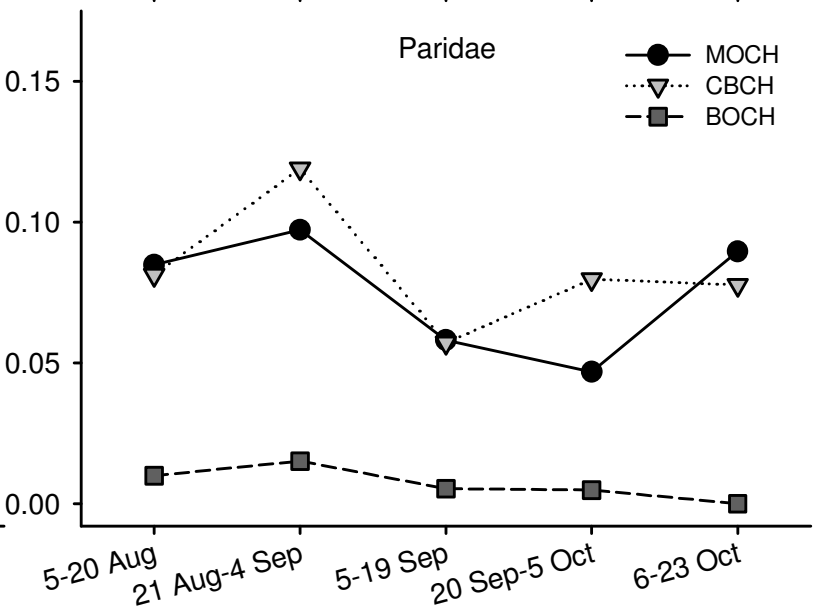
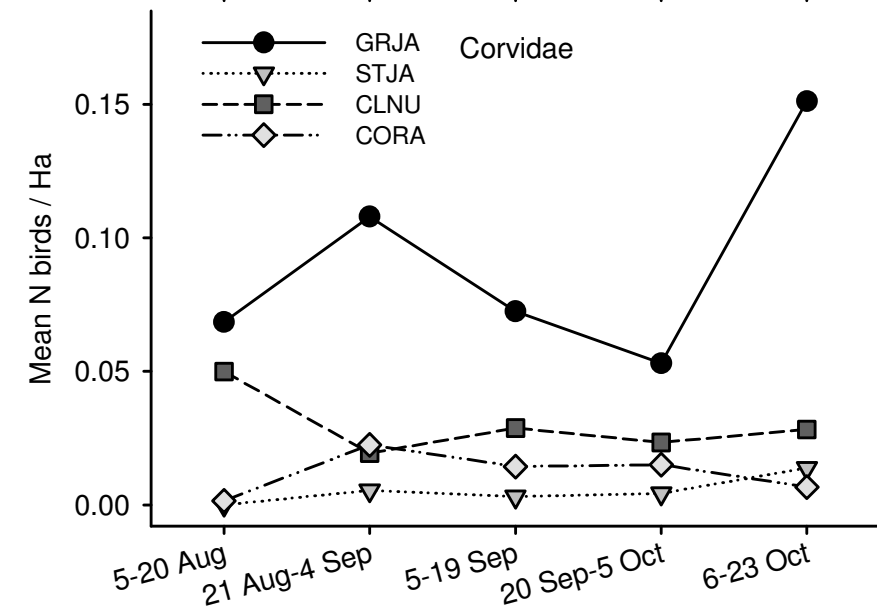
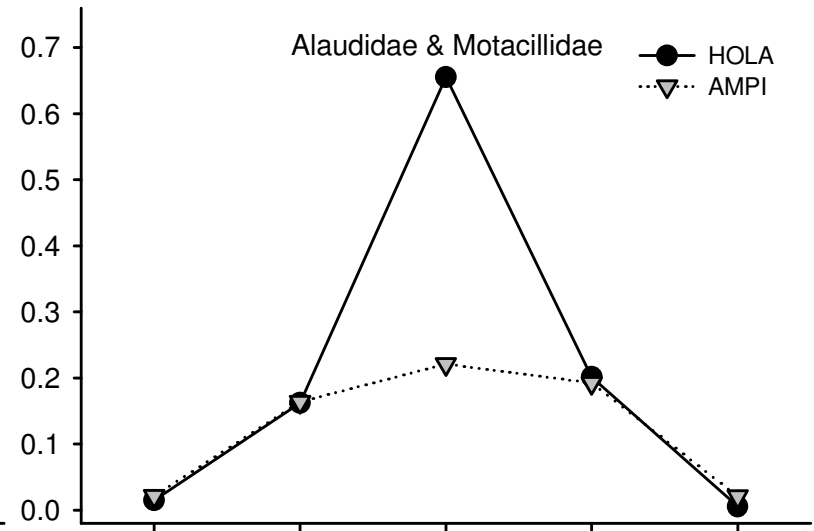
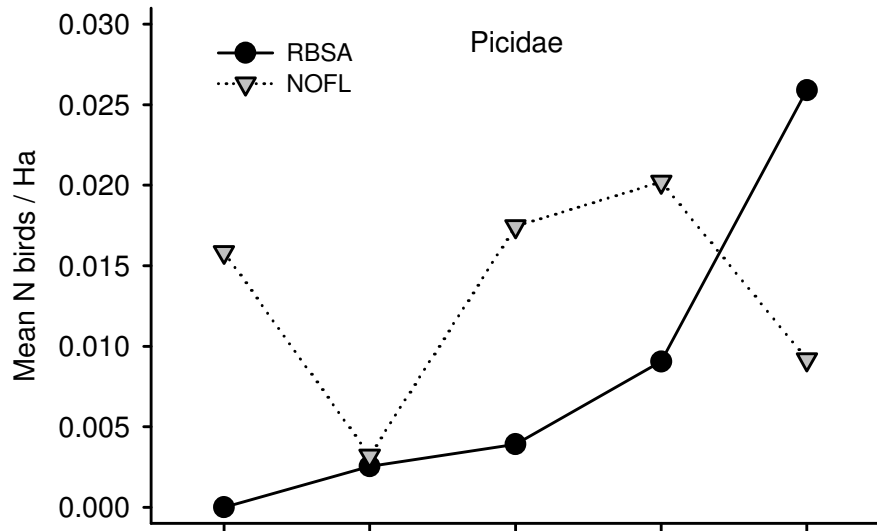
Range and site	Habitat	N transects	Total transect length (m)	Year	N surveys	Total survey duration (hr)
WESTERN COAST RANGE						
<i>Cypress Mountain (CM)</i>						
	Subalpine (S)	2	550	1998	5	3.52
				2000	18	3.80
				2001	18	4.62
	Montane (M)	2	800	1998	4	3.88
				2000	18	9.27
				2001	18	10.55
<i>Seymour Mountain (SE)</i>						
	Subalpine (S)	4	800	1998	12	5.47
				1999	14	2.12
				2000	31	4.97
				2001	40	6.47
	Montane (M)	4	650	1998	12	5.50
				1999	24	3.95
				2000	32	6.67
				2001	40	9.02
<i>Garibaldi Park (GA)</i>						
	Alpine (A)	10	3450	1998	20	27.95
	Subalpine (S)	4	1400	1998	8	4.30
	Montane (M)	3	1200	1998	6	7.63
INTERIOR COAST RANGE						
<i>Stein Divide (ST)</i>						
	Alpine (A)	7	2650	1998	24	18.55

Range and site	Habitat	N transects	Total transect length (m)	Year	N surveys	Total survey duration (hr)
				2001	32	14.38
	Subalpine (S)	7	2250	1998	20	16.72
				2001	33	17.82
	Montane (M)	3	1275	1998	12	13.28
				2001	17	11.97
<i>Shulaps Mountain (SH)</i>						
	Alpine (A)	7	2800	1998	24	15.27
				1999	29	11.62
				2000	38	20.32
				2001	43	14.18
	Subalpine (S)	5	1700	1998	15	21.38
				1999	19	20.12
				2000	23	15.12
				2001	31	23.80
	Montane (M)	4	675	1998	11	4.22
				1999	12	2.63
				2000	20	5.65
				2001	21	3.87
<i>Perkins Peak (PP)</i>						
	Alpine (A)	4	1525	1998	20	5.72
	Subalpine (S)	4	1575	1998	20	6.53
	Montane (M)	4	1475	1998	20	6.10
<i>Rainbow Ridge (RR)</i>						
	Alpine (A)	8	2500	1998	21	10.33
	Subalpine (S)	6	1925	1998	19	5.78
	Montane (M)	6	2325	1998	24	9.03
NORTH CASCADES						
<i>Manning Park (MA)</i>						
	Alpine (A)			1998	12	5.23
				1999	14	5.30
				2000	20	6.68
				2001	24	7.02
	Subalpine (S)	6	2000	1998	18	17.50
				1999	24	16.37
				2000	27	16.85
				2001	42	23.28
	Montane (M)	3	900	1998	9	11.20

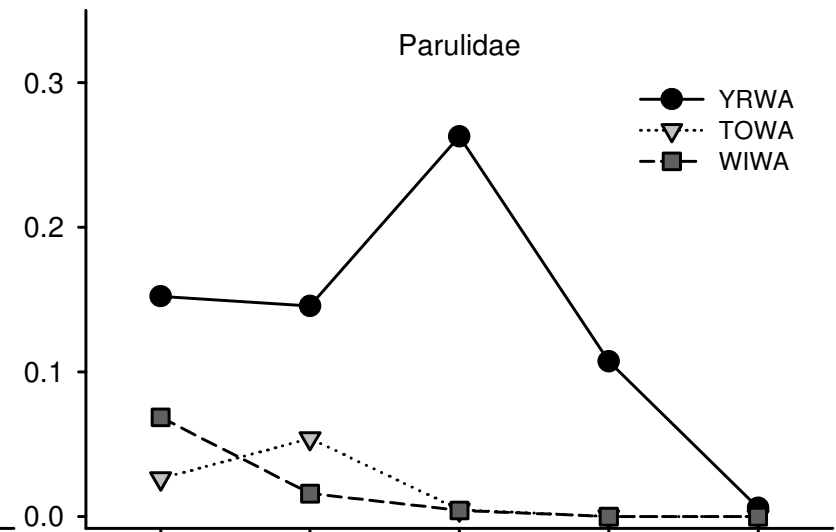
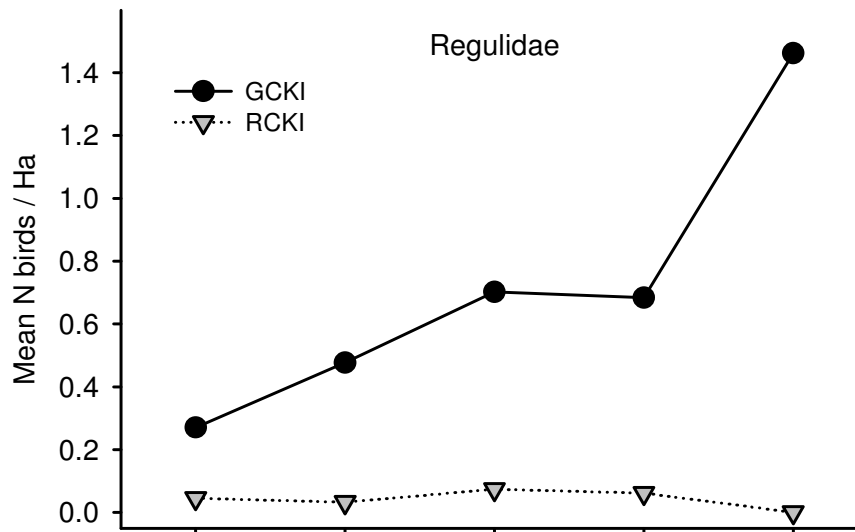
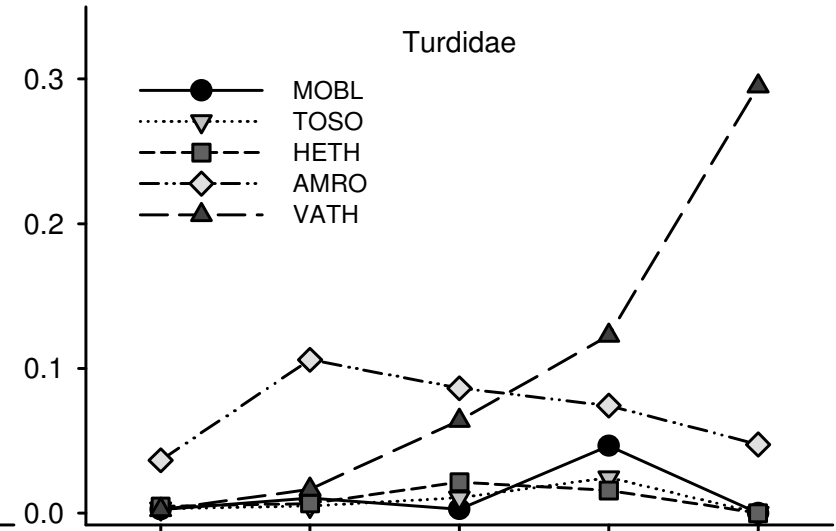
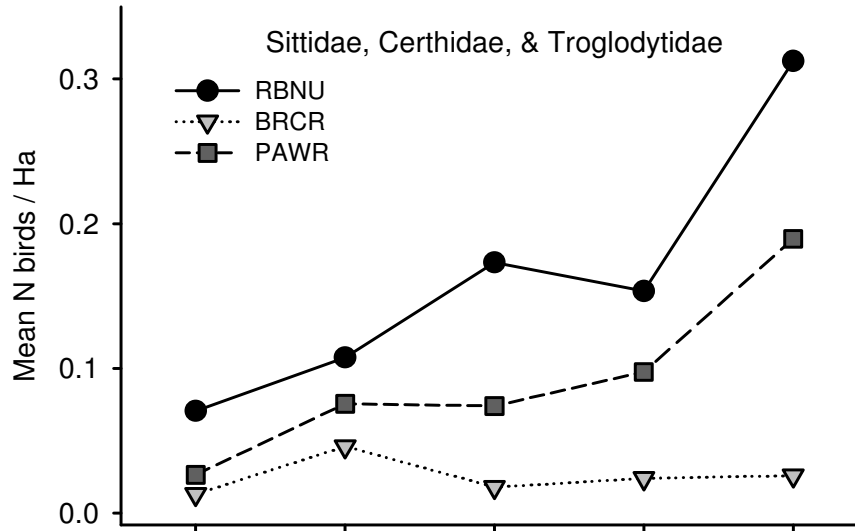
Range and site	Habitat	N transects	Total transect length (m)	Year	N surveys	Total survey duration (hr)
				1999	12	11.40
				2000	18	12.80
				2001	21	16.75
<i>Crater Mountain (CR)</i>						
	Alpine (A)	8	2300	1998	21	8.18
				1999	42	11.02
				2000	43	10.67
				2001	64	13.65
	Subalpine (S)	4	1050	1998	12	5.13
				1999	21	6.23
				2000	24	5.00
				2001	31	6.87
	Montane (M)	3	850	1998	9	4.52
				1999	15	5.05
				2000	18	4.80
				2001	24	5.22
CARIBOO						
<i>Wells Gray (WG)</i>						
	Alpine (A)	9	2700	1998	8	3.00
				1999	24	5.58
				2000	33	4.82
				2001	37	5.83
	Subalpine (S)	6	1900	1998	13	4.52
				1999	20	4.70
				2000	30	6.13
				2001	34	7.50
	Montane (M)	5	1500	1998	17	6.88
				1999	16	4.47
				2000	24	5.62
				2001	26	6.63

Supplementary Figure 1 Temporal patterns of all species detected in ≥ 10 surveys, grouped taxonomically





Time interval



5-20 Aug 21 Aug-4 Sep 5-19 Sep 20 Sep-5 Oct 6-23 Oct

Time interval

