The Use of Alpine Habitats by Fall Migrating Birds on Vancouver Island 1996-1997

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Introduction

Alpine habitats have long been considered ecologically insignificant, contributing little to biological diversity. There is generally little concern for the alpine because of the perception that ample protection is afforded by parks and reserves, and that many unprotected areas are conserved by their inaccessibility. Remoteness and neglect by researchers has also limited our understanding of the community dynamics of alpine fauna. Recent increases in recreational use and alterations to surrounding montane forest habitats potentially threaten alpine species and habitats, prompting a greater need to examine their ecological value.

During the latter two years of an FRBC-sponsored inventory of Vancouver Island White-tailed Ptarmigan, conducted by the University of British Columbia and the Canadian Wildlife Service, information was collected opportunistically on the use of alpine habitats by a variety of wildlife species, especially migrating birds. We found that avian species diversity in the alpine is surprisingly high in late summer and fall, and that some species make extensive use of the alpine during fall migration. This report summarizes the bird observations for 1997, showing both temporal and spatial patterns of use by avian species. A species account highlights those birds which most commonly made use of alpine and sub-alpine areas for both 1996 and 1997. The intent is to raise awareness of the ecological value of the alpine, particularly as habitat for birds migrating from higher latitudes and lower elevations.

Methods

At present, our data consists mainly of presence/absence of species in three habitat types: alpine, sub-alpine and montane forest. Observations were mostly qualitative (ie. no standardized census techniques were used), and were recorded while searching for ptarmigan on ridges and mountain peaks. Birds were also recorded during our hikes in and out of study sites through sub-alpine habitats and montane forest. We surveyed 25 mountains in ten general locations on Vancouver Island, classified into South, Central, and North regions (Appendix A). The observers

normally worked in pairs, but sightings were recorded independently. Location and duration of trips, and time spent in different habitats varied throughout the season. More time was spent in alpine habitats in July and August since more favourable weather allowed for extended trips. The opposite occurred in early October, when more day-trips were taken.

A chronology of bird observations was constructed for 1997 in 10-day intervals, from 09 July to 26 October. Beginning in September, altitude, weather, and numbers of individual birds were recorded (see Appendix B for data card). This information is included in the species accounts. Note that the data in this report are preliminary, but they provide useful information on patterns that will be critical for designing more comprehensive studies.

Topography of Vancouver Island

Mountains are a dominant feature of Vancouver Island, with ranges running nearly the entire length. Most of the contiguous alpine is found on the ridges and peaks of Strathcona Provincial Park in the central Island. Alpine patches become progressively more fragmented as one moves north or south.

To the north, long ridges are less common and the mountains are relatively rugged and more isolated. Ranges extend northeast towards Johnstone Strait, where the Vancouver Island mountains most closely approach the alpine areas of the mainland. South of Strathcona Park, alpine patches become smaller and more scattered. Lowland areas extend towards the southwestern coast, and east into the Strait of Georgia. Alpine areas are not encountered again to the south until the Olympic Peninsula of Washington.

1997 Results

Diversity in the Alpine:

In 1997, we observed 53 bird species in alpine and sub-alpine habitats of Vancouver Island (Table 1). For June and July (when most high-elevation species are breeding) there was relatively low diversity in these habitats, with only 11 species being recorded. Numbers of species increased dramatically thereafter, probably indicating the onset of migration through the alpine and sub-

alpine (Figure 1). When including observations from forested habitats, we recorded a total of 63 species for 1997. Nine species were observed exclusively in the alpine. Only 11 (21%) of the 53 species sighted in the alpine or sub-alpine in 1997 regularly breed in these habitats on Vancouver Island (Campbell et al. 1990, 1996; Taylor 1994). Table 2 lists all "regular" species (those encountered at three or more locations in 1997) by date and mountain site.

Migration Patterns

In early August there is a dramatic increase in the number of species encountered in the alpine and sub-alpine (Figure 1, Table 3). Species richness fluctuates thereafter, but remains relatively high through September. In early October, there is a marked decrease in the number of species recorded at higher elevations. When corrected for observer effort (time spent in a particular habitat), the temporal distribution of species occurring in the alpine and sub-alpine is more normalized (Figure 2). This correction partially takes into account periods when coverage was reduced, or skewed in different habitats.

Figure 2 shows the ratio of species found in the forest relative to the alpine as a function of time. The period when species richness in the alpine/sub-alpine is greatest relative to the forest occurs from mid-August to early September. At this time, there is more than twice the number of species encountered per day at higher elevations than in the montane forest.

Species composition in each habitat changes as the season progresses. Early and late in the season, there is a greater proportion of resident species (see Table 1 for status) at higher elevations compared to the middle of the season when migrants are relatively more common (Table 3). The greatest number of Neotropical migrants occurs in the alpine in mid-August. There were several instances during August and September when nocturnal migrants were heard flying over alpine sites at or after dusk. Both Swainson's Thrush and Spotted Sandpiper were identified by flight call as they passed over camp at night (see species accounts).

Turnover of species in the alpine and sub/alpine is greatest in early August, but remains high across all periods. This is likely an indication of our low sampling effort, but may potentially reflect temporal patterns such as migration waves (Table 3).

Suitability of Alpine for Fall Migrants- Discussion

In late summer at high elevations, food resources (mostly in the form of insects and fruit) are at their highest levels. We found that avian species diversity in the alpine increased dramatically during this period. Since relatively few species breed in the alpine, most of these birds are likely migrants from other latitudes, or birds moving up from lower elevations. The transients from the north may use alpine and sub-alpine habitats as refueling points during fall migration. Stopover in these areas would allow migrants to capitalize on this late summer flush of resources. The first wave of migrants arrived at alpine sites in early August and large numbers continued through late September.

At lower elevations in August, food resources are likely on the decline. At this time, we observed a decrease in bird diversity in the forest. A significant portion of birds arriving in the alpine probably followed resources up from lower elevations. In 1997, the peak of this altitudinal migration appeared to occur during mid-late August when species diversity in the alpine was highest relative to the forest. The duration of time spent in the alpine by altitudinal migrants likely depends on resource availability, and appears to vary with species.

Resource use may not be the only reason that migrating birds make use of the alpine. Raptors were noted using updrafts that occur along cliff faces and ridges. Prey may be more available to aerial predators when migrating over mountain ridges due to the openness of the terrain. Nocturnal and diurnal migrants may also use mountain ridges for navigational purposes (Bruderer 1982).

It is clear that the extensive use of alpine habitats by migrating birds is not unique to Vancouver Island. In similar surveys conducted in the alpine of Garibaldi and Manning Parks on the British Columbia mainland, 28 species were recorded over three 1-day surveys in late August 1997, including seven species not observed in the alpine on Vancouver Island (Losito, unpublished data). At two sites in Washington State, 32 species were observed during eight surveys (Jul, Sep, Oct), nine of which were not found in Vancouver Island alpine (Steiner, unpublished data). A total of 80 species was recorded during four years (Apr-Oct) of alpine surveys in Colorado (Braun, 1969). Our results are also consistent with other observations within British Columbia of birds using the alpine during fall migration (Cannings 1996).

In summary, despite the fact that many naturalists acknowledge the extensive use of alpine habitats by migrating birds, the ecology of this phenomenon has not been studied. The next step in this investigation of alpine migration will be to determine from field studies, historical data, and contact with local naturalists, the full suite of species involved and the generality of migration patterns both geographically and temporally.

Species Accounts

The following provides a summary for species that were encountered frequently during 1996 and 1997, or were of special interest because they were migrants or exhibited migratory behaviour.

Shorebirds- There is likely a fall shorebird migration through the alpine on Vancouver Island. **Spotted Sandpipers** probably breed at high elevation ponds, although at least one was noted migrating over the Beaufort Range at dusk on 02 Sep 1997, at 1400m. **Baird's Sandpipers** were observed foraging on a partially frozen alpine lake in Strathcona Park on 17 Aug 1997 (see cover photos), while some unidentified **phalaropes** were swimming nearby on another lake at a slightly lower elevation. Shorebird tracks were encountered several times in the mud of ephemeral alpine ponds.

Waterbirds - **Barrow's Goldeneye**- We have sighted Barrow's and unidentified Goldeneye species on sub-alpine lakes up to 1100m in fall of 1996 and 1997. The largest count was three on one lake on Forbidden Plateau in Strathcona Provincial Park. The only other duck recorded this season (1997) in the sub-alpine was either a **Ring-necked** or **Scaup** on a lake at 1100m. **Greater White-fronted Geese** and **Sandhill Cranes** were observed migrating over the alpine in mid-September in large flocks. A flock of 40 Sandhill Cranes was at a lake on Forbidden Plateau on 10 Sep 1997.

Raptors- **Bald** and **Golden Eagles** were fairly common at high elevations in the fall. The latter probably bred at some north mountain sites. **Sharp-shinned** and **Cooper's Hawks** were common migrants along the ridges. One accipiter (suspected Cooper's Hawk) attacked and killed a ptarmigan chick on 18 Sep 1997 at Mt. Arrowsmith. **Merlin** were regularly encountered late in the season, hunting over deep lake basins; most were the dark coastal Northwest race.

Band-tailed Pigeon- This species was observed in large flocks in the sub-alpine. The following is a list of sightings:

Site	Mt. Hkusam	Albert Edward	Albert Edward	Mt. Curran	Mt. Cain	Mt Mc-Quillan	Sugar Ridge	Tom Taylor	Albert Edward
Location	North	SPP	SPP	South	North	South	SPP	SPP	SPP
Date	16Sep96	15Sep96	28Sep96	03Sep97	18Sep97	20Sep97	23Sep97	23Sep97	19Oct97
Est. #	25	50	flock	30	10	flock	flock	1	20

SPP= Strathcona Provincial Park

Rufous Hummingbird- Widely known as birds that capitalize on late-summer alpine wildflowers, this species was recorded at three central sites and one southern location in 1997 between 11 July and 29 August.

Woodpeckers - **Northern Flickers** were found foraging on stunted, exposed snags at treeline. Most of these trees are too small for nesting, so this species probably moves up to the sub-alpine to forage later in the summer. Hybrid **Red-breasted/Red-naped Sapsuckers** , or possibly pure Red-naped Sapsuckers were spotted both in 1996 and 1997, in montane forests. The status for the latter species is unknown for Vancouver Island.

American Pipit- These alpine breeders were found in small numbers in June and July, but as migration set in, flocks foraged among the rocks of the alpine. The largest flocks (ca. 30) were encountered on Mt. Squarehead in the Beaufort Range (south) and Mt. Albert Edward (central).

Black Swift- Locally common at King's Peak (central) and Mt. Squarehead (south), these birds were found foraging on mountain peaks in flocks of up to twelve. Flying ants were noted at these areas.

Corvids- **Common Ravens** were very common in the alpine all over the Island, as were **Gray Jays** at lower elevations. **Steller's Jays** had a probable altitudinal migration, as several were observed in true alpine in late August but at other times were lower down and often with flocks of Gray Jays.

Chestnut-backed Chickadees- These birds were very common, usually in flocks in the forest and sub-alpine. One individual was hopping from rock to rock next to a glacier at 1700m (Mt. Tom Taylor- 23 Sep 1997).

American Dipper- The dipper probably exhibits an altitudinal migration from forest to alpine. At both visits to Sugar Ridge and Mt. Tom Taylor in 1997, dippers were sighted in the same locations: at two lake outflows above 1100m and on a steep drainage at 600m. One bird at Tom Taylor was heard singing on 23 Sep 1997. Another dipper was found on a stream bordered by a clear cut at Mt. Abel on 20 Oct 1997. There were nine records in 1997 across Vancouver Island.

Red-breasted Nuthatch- Most often found in montane forests, this species was common and vocal throughout the late-season. We did not observe nuthatches in true alpine, but some occurred in sparse sub-alpine forests.

Winter Wren- One individual was noted in a mixed-species flock at King's Peak on a high ridge among stunted hemlock on 11 Aug 1997.

Kinglets- The **Ruby-crowned Kinglet** was a definite high-elevation migrant, found either on sub-alpine ridges, or among patches of alder in the alpine. There were four sightings at higher elevations, all in the central Island. **Golden-crowned Kinglets** were very common across the

Island in the sub-alpine. Large flocks were noted on 10 Oct 1997 at King's Peak, during a heavy snowfall. We continued to locate them at higher elevations through October.

Thrushes- **American Robins** were another altitudinal migrant on the Island. In late August through late September, they were found frequently in the sub-alpine, always in flocks and often with other species. **Hermit Thrush** were found both in forest valleys and sub-alpine meadows. **Varied Thrush** were most often encountered as we hiked up steep, forested slopes, but some were noted in the sub-alpine with robins. They were also found in greater numbers along the higher logging roads and logged areas, especially late in the season. **Swainson's Thrush** were observed several times in the sub-alpine, but most notably were heard as nocturnal migrants (by flight call) after dusk at our camps on Sugar Ridge (1 on 19 Aug 1997 at 1400m), the Beaufort Range (3+ on 02 Sep 1997 at 1300m), and Forbidden Plateau (2 on 10 Sep 1997 at 1100m). **Townsend's Solitaire** were found in both sub-alpine and alpine habitats: at two northern sites in August, two central sites in September, and at Mt. Moriarty in the south on 11 Oct 1997.

Warblers- **Yellow-rumped Warblers** frequented the sub-alpine in late summer and fall, often with flocks of sparrows. All that could be closely observed were of the Audubon's race. **Orange-crowned Warblers** and **Wilson's Warblers** were both recorded in mixed-species flocks in early August 1997 at King's Peak. Some were encountered on a high ridge at 1650m, while others were slightly lower down in an avalanche chute.

Sparrows- **Golden-crowned Sparrows** were observed at five different locations, from 08 Sep to 17 Oct 1997, always in sub-alpine habitat. **White-crowned Sparrows** were less common, but still found in sub-alpine in middle and late September. **Savannah Sparrows** were conspicuous when found in the sub-alpine shrub and alpine rock, and although only encountered at three locations, there were multiple sightings at each. **Dark-eyed Juncos** were very numerous and most often found in the sub-alpine, but in lower numbers later in the season.

Finches- The **Red Crossbill** was the most common alpine/sub-alpine bird species in 1997, found at almost all study sites. Counts that started in September had daily totals in the hundreds.

Pine Siskins were also frequently encountered in the sparsely treed areas of the sub-alpine. **Rosy finches** were present at several sites, always along the glacier or rock face of an alpine bowl. **Snow Buntings** began to show up in late October. They probably winter at some of the mountain sites, as they have been encountered on winter surveys in 1996/1997.

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Table 1: Species recorded in 1997, listing habitat types and migration status

Code	Species Name	Habitats			Probable Status in Alpine
GWFG	Greater White-fronted Goose	A			migrant
SHCR	Sandhill Crane	A		F	migrant
BAGO	Barrow's Goldeneye		S	F	migrant
SPSA	Spotted Sandpiper		S	F	migrant
BASA	Baird's Sandpiper	A			migrant
PHALsp	Phalarope spp.	A			migrant
GOEA	***Golden Eagle***	A			resident, migrant
BAEA	Bald Eagle	A	S		migrant
NOHA	Northern Harrier	A			migrant
SSHA	Sharp-shinned Hawk	A	S	F	migrant
COHA	Cooper's Hawk	A	S	F	migrant
NOGO	Northern Goshawk	A	S		resident/migrant
RTHA	Red-tailed Hawk	A			migrant
MERL	Merlin	A	S		migrant
WTPT	***White-tailed Ptarmigan***	A			resident
RUGR	Ruffed Grouse		S	F	moves up
BLGR	Blue Grouse	A	S	F	moves up
BTPI	Band-tailed Pigeon	A	S		moves up
NPOW	Northern Pygmy-Owl			F	winters?
CONI	Common Nighthawk	A			migrant, moves up
BLSW	Black Swift	A	S		moves up
VASW	Vaux's Swift		S	F	moves up
RUHU	Rufous Hummingbird	A	S		migrant
NOFL	Northern Flicker		S	F	moves up
RBSA	Red-breasted Sapsucker			F	unknown
DOWO	Downy Woodpecker			F	unknown
TTWO	Three-toed Woodpecker			F	some resident
PSFL	Pacific-slope Flycatcher			F	migrant?
STJA	Steller's Jay	A	S	F	some resident?, moves up
GRJA	***Gray Jay***	A	S	F	resident
NWCR	Northwestern Crow	A			moves up?
CORA	***Common Raven***	A	S		resident
CBCH	***Chestnut-backed Chickadee***	A	S	F	some resident
BRCR	Brown Creeper			F	moves up?
RBNU	Red-breasted Nuthatch		S	F	moves up?
WIWR	Winter Wren		S	F	migrant
GCKI	***Golden-crowned Kinglet***	A	S	F	resident
RCKI	Ruby-crowned Kinglet	A	S	F	migrant
TOSO	***Townsend's Solitaire***	A	S		resident
SWTH	Swainson's Thrush	A	S	F	migrant
HETH	Hermit Thrush		S	F	migrant, moves up
VATH	Varied Thrush		S	F	moves up
AMRO	American Robin	A	S	F	migrant, moves up
AMPI	***American Pipit***	A	S		resident, migrant
AMDI	American Dipper		S	F	moves up

Note: Species in bold italics indicate probable breeders in alpine or sub-alpine habitat on Vancouver Island (Campbell et al. 1990, 1996; Taylor 1994); A= alpine, S= sub-alpine, F= montane forest

Table 1: Species recorded in 1997, listing habitat types and migration status

SOVI	Solitary Vireo			F	migrant?
OCWA	Orange-crowed Warbler		S		migrant
YRWA	Yellow-rumped Warbler		S	F	migrant
WIWA	Wilson's Warbler		S		migrant
SAVS	Savannah Sparrow	A	S		migrant
DEJU	***Dark-eyed Junco***		S	F	resident, moves up
WCSP	White-crowned Sparrow		S	F	migrant, moves up
GCSP	***Golden-crowed Sparrow***		S		resident, migrant
FOSP	Fox Sparrow		S	F	migrant
LISP	Lincoln's Sparrow			F	migrant?
SNBU	Snow Bunting	A			winters
PISI	Pine Siskin	A	S	F	moves up
RECR	Red Crossbill	A	S	F	moves up
WWCR	White-winged Crossbill		S		moves up
ROFI	***Rosy Finch***	A			resident
EVGR	Evening Grosbeak			F	unknown
Additional species					
DUCKsp	Unidentified Duck			F	
RN/SC	Unidentified Duck		S		
Totals		34	41	38	
Combined Total			53		
Additional codes:					
GOLDsp	Goldeneye spp.			F	
ACCsp	Accipiter Spp.	A	S		
UNWA	Warbler spp.	A			

Note: Species in bold italics indicate probable breeders in alpine or sub-alpine habitat on Vancouver Island (Campbell et al. 1990, 1996; Taylor 1994); A= alpine, S= sub-alpine, F= montane forest

Table 2: Species observed at more than three sites on Vancouver Island, 1997

	South Island												
Trip	5040		McQuillan	Arrowsmith					Moriarty				ElCapitan
Dates	16-20Jun	3-5Jul	02-Jul	09-Jul	28-Jul	18-Sep	11-Oct	17-Oct	14-Aug	19-Sep	11-Oct	24-Oct	4-6Aug
Observers	JY TD	MC TD	MC TD JY	ST TD MC	ST MC TD	ST KV	ST KM	SO MC	SO ST	ST KV	MC SO	MC ST	MC TD
Spotted Sandpiper													
Blue Grouse		X									*		
White-tailed Ptarmigan	*	*	*	*	*	*		*		*			
Sharp-shinned Hawk						X		*	X				
Cooper's Hawk						*				*			
Golden Eagle		*											
Bald Eagle		*	*								*		
Merlin								*		*			
Band-tailed Pigeon													
Rufous Hummingbird													
Northern Flicker						X		*					
American Pipit						*				X			*
Black Swift									*				
Common Raven					*	*	*	*	*	*	*		*
Steller's Jay							X		X		X	X	X
Gray Jay							*	X		X	*	X	
Chestnut-backed Chickadee				X	X		X	*	X		X	X	X
American Dipper	X												
Red-breasted Nuthatch					X				X	X	X	X	
Brown Creeper									X		X		
Winter Wren				X	X		X		*		X		
Ruby-crowned Kinglet													
Golden-crowned Kinglet						X	X		X	X	X	X	
American Robin										X	X		
Varied Thrush						X		X			X		
Swainson's Thrush		*			X								
Hermit Thrush													
Townsend's Solitaire											*		
Yellow-rumped Warbler													
Golden-crowned Sparrow								*					
Savannah Sparrow													
Dark-eyed Junco	X			X	*	X			*	X			
Rosy Finch	X												
Red Crossbill								*	*		*	*	
Pine Siskin						X			*	X		*	

Alpine/sub-alpine= *; forest only= X

Table 2: Species observed at more than three sites on Vancouver Island, 1997

	South Island						Central Island								
Trip	Klitsa		Curran		Stubbs		McBride	Albert-Edward					King's Peak		
Dates	09-Aug	28-29Aug	11-Aug	2-4Sep	06-Sep	18-Oct	11-15Jul	23-26Jun	19-23Jul	1-2Aug	10-13Sep	18-21Oct	9-11Aug	05-Oct	10-Oct
Observers	MC TD	ST JG	MC KR	ST SO	SO KR	SO MC	ST TD MC	JY TD	ST TD MC	MC TD	MC SO KV	ST LH	SO ST	ST MC	ST MC SO
Spotted Sandpiper				*											
Blue Grouse						*	*	X		*		X			
White-tailed Ptarmigan		*			*	*	*	*	*	*	*	*	*		
Sharp-shinned Hawk					*										
Cooper's Hawk															
Golden Eagle											*				
Bald Eagle			*	*											
Merlin						*					*				
Band-tailed Pigeon				*								*			
Rufous Hummingbird		*					*						*		
Northern Flicker		*		*			X				X				
American Pipit			*	*	*				*	*	*	*	*		
Black Swift				*									*		
Common Raven			*			*	*				*	*	*		
Steller's Jay		X	*	*		*					X				
Gray Jay	X	*		*	*	*		X	X	X	*	*	*	X	
Chestnut-backed Chickadee	X			X		*	*	X	X	X	X	*	*	X	X
American Dipper	X														
Red-breasted Nuthatch	X			*	X	*				X	X	X			
Brown Creeper											X	X	X		X
Winter Wren									X		X		*		
Ruby-crowned Kinglet				*							*				
Golden-crowned Kinglet				*	X	*			X		*		*		*
American Robin				*			X			*	*				
Varied Thrush	X								X	X	*		*	X	X
Swainson's Thrush				*			X		X	*	X				
Hermit Thrush													*		X
Townsend's Solitaire											*				
Yellow-rumped Warbler				*											
Golden-crowned Sparrow											*				
Savannah Sparrow				*											
Dark-eyed Junco		X	*	*	*	*			X	*	*		*		
Rosy Finch													*		
Red Crossbill		*		*		*						*	*		*
Pine Siskin		*		*		*						*	*		

Alpine/sub-alpine= *; forest only= X

Table 2: Species observed at more than three sites on Vancouver Island, 1997

	Central Island				North Island					
Trip	Sugar Ridge		Tom Taylor		Rugged	Hkusam		Cain/ Abel		
Dates	17-20Aug	22-24Sep	17-19Aug	22-24Sep	08-Sep	4-5Aug	21-Oct	6-7Aug	18-20Sep	19-20Oct
Observers	SO KM	ST KV	ST MC	SO ST	SO KM	ST SO	SO MC	ST SO	MC SO	SO MC
Spotted Sandpiper	X		*							
Blue Grouse	*		X							
White-tailed Ptarmigan	*	*	*	*	*	*		*	*	*
Sharp-shinned Hawk						*				
Cooper's Hawk		X		*						
Golden Eagle	*								*	
Bald Eagle						*			*	
Merlin				*						
Band-tailed Pigeon		X		*					*	
Rufous Hummingbird	*									
Northern Flicker	*					X				
American Pipit	*							*	*	
Black Swift										
Common Raven	*			*		*	*	*		*
Steller's Jay	*		X	X						
Gray Jay		X						X	*	*
Chestnut-backed Chickadee	X	X	X	*		*	X	*	*	*
American Dipper	*	X	*	*						X
Red-breasted Nuthatch			X			X	X		*	
Brown Creeper				X					X	
Winter Wren	*		X	*		X	X	X	*	
Ruby-crowned Kinglet	*		*						X	
Golden-crowned Kinglet	X	X	X	X		X	*	X	X	
American Robin	*			*	*	*			*	
Varied Thrush				*		X		X	X	X
Swainson's Thrush	*								X	
Hermit Thrush						X	X			
Townsend's Solitaire				*		*		*		
Yellow-rumped Warbler				*					X	
Golden-crowned Sparrow				*	*				*	
Savannah Sparrow					*				*	
Dark-eyed Junco	*		*	*	*	*	X	*	*	X
Rosy Finch				*				*	*	*
Red Crossbill	*		*	*		*	X			*
Pine Siskin	*		*	*		*			*	*

Alpine/sub-alpine= *; forest only= X

Table 3: Time series of bird species occurring in alpine/sub-alpine and montane forest habitats in 1997

	Total Species in all habitats	Species observed in alpine or sub-alpine	Total	% Turn over	Species in Forest	Total	% Turn over
09Jul-18Jul	10	WTPT, BLGR, RUHU, CORA, CBCH	5		NOFL, PSFL, CBCH, WIWR, SWTH, AMRO, DEJU	7	
19Jul-28Jul	12	WTPT, CORA, NWCR, AMPI, DEJU	5	60	PSFL, GRJA, CBCH, RBNU, WIWR, GCKI, SWTH, VATH, DEJU	9	56
29Jul-07Aug	24	BAEA, COHA, SSHA, RTHA, WTPT, CONI, CORA, CBCH, WIWR, SWTH, TOSO, AMRO, AMPI, DEJU, PISI, ROFI	16	75	GOLDsp, RUGR, NOFL, GRJA, CORA, CBCH, RBNU, WIWR, GCKI, HETH, VATH, AMRO, DEJU, PISI, FINsp	15	53
08Aug-17Aug	29	STJA, GRJA, CORA, CBCH, WIWR, GCKI, RCKI, HETH, VATH, AMPI, AMDI, OCWA, WIWA, DEJU, PISI, RECR, ROFI	25	64	SPSA, SSHA, BLGR, VASW, DOWO, STJA, CBCH, BRCR, RBNU, WIWR, GCKI, HETH, VATH, AMDI, DEJU, FOSP, RECR	17	59
18Aug-27Aug	21	BASA, PHALsp, GOEA, ACCsp, WTPT, RUHU, NOFL, STJA, RBNU, WIWR, RCKI, SWTH, AMRO, AMPI, AMDI, UNWA, DEJU, PISI, RECR, ROFI, FINsp	21	38	CBCH, WIWR, DEJU	3	0
28Aug-06Sep	24	SPSA, SSHA, WTPT, RUGR, BTPI, BLSW, RUHU, NOFL, STJA, GRJA, CORA, CBCH, RBNU, WIWR, GCKI, RCKI, SWTH, AMRO, AMPI, YRWA, SAVS, DEJU, PISI, RECR	24	42	NOFL, STJA, GRJA, CBCH, RBNU, GCKI, RCKI, AMRO, DEJU, LISP	10	80
07Sep-16Sep	24	GWFG, SHCR, NOGO, MERL, WTPT, NOFL, GRJA, CORA, GCKI, RCKI, VATH, TOSO, AMRO, AMPI, SAVS, DEJU, WCSP, GCSP	18	44	SHCR, DUCKsp, GRJA, CORA, CBCH, BRCR, RBNU, WIWR, GCKI, RCKI, SWTH, VATH, AMRO, DEJU	14	50
17Sep-26Sep	36	BAGO, RN/SC, GOEA, BAEA, NOHA, COHA, ACCsp, RTHA, MERL, WTPT, BTPI, NOFL, CORA, CBCH, RBNU, WIWR, VATH, TOSO, AMRO, AMPI, AMDI, YRWA, SAVS, DEJU, WCSP, GCSP, PISI, RECR, ROFI	29	62	BAGO, BTPI, NOFL, STJA, GRJA, CBCH, BRCR, RBNU, WIWR, GCKI, RCKI, SWTH, VATH, AMRO, AMPI, YRWA, DEJU, WCSP, GCSP, PISI, RECR	21	48
27Sep-16Oct	15	BAEA, GRJA, CORA, TOSO, GCKI, RECR	6	33	RUGR, STJA, GRJA, CBCH, BRCR, RBNU, WIWR, GCKI, HETH, VATH, AMRO, RECR	12	17
17Oct-26Oct	28	SSHA, NOGO, ACCsp, MERL, WTPT, BTPI, NOFL, STJA, GRJA, CORA, CBCH, RBNU, GCKI, AMPI, DEJU, GCSP, PISI, RECR, ROFI, SNBU	20	80	SSHA, BLGR, NPOW, RBSA, DOWO, TTWO, STJA, GRJA, CORA, CBCH, RBNU, WIWR, GCKI, VATH, AMDI, DEJU, PISI, RECR, EVGR	19	58
	63	Number of days in alpine/sub-alpine = 43	**53**		Number of days in forest = 26	**38**	

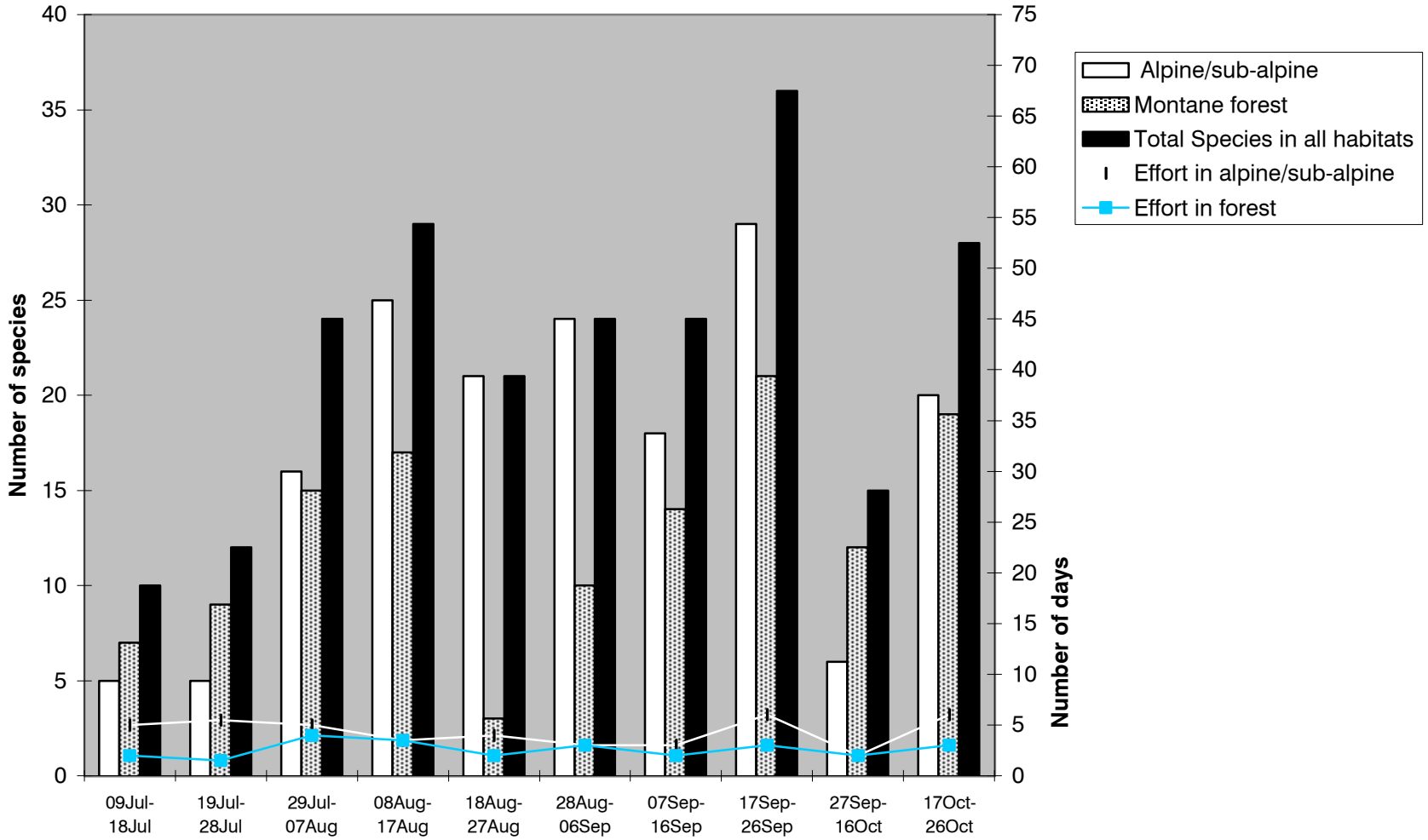
Note: The interval of 27 Sep to 16 Oct encompasses 20 days to compensate for low coverage; Turnover is the percentage of species observed in a given time interval that were **not** observed in the previous interval.

Table 4: Late-season observations of birds in alpine/sub-alpine habitat in 1997

Mountain	Location	Approx Elevation (m)	Dates	Number of Species	Species
Mt.Arrow-smith	South	1820	17Oct	8	SSHA, MERL, NOFL, CORA, CBCH, GCSP, RECR, FINsp- (SNBU?)
Mt. Stubbs	South	1500	18Oct	11	MERL, BLGR, STJA, GRJA, CORA, CBCH, RBNU, GCKI, DEJU, PISI, RECR
Mt. Albert-Edward	Central	2100	18-21Oct	9	COHA, BTPI, GRJA, CORA, CBCH, AMPI, PISI, RECR, WWCR
Mt. Cain	North	1850	19Oct	6	GRJA, CORA, CBCH, ROFI, RECR, PISI
Mt. Abel	North	1850	20Oct	5	CORA, CBCH, GCKI, ROFI, SNBU
Mt. Hkusam	North	1600	21Oct	3	NOGO, CORA, GCKI

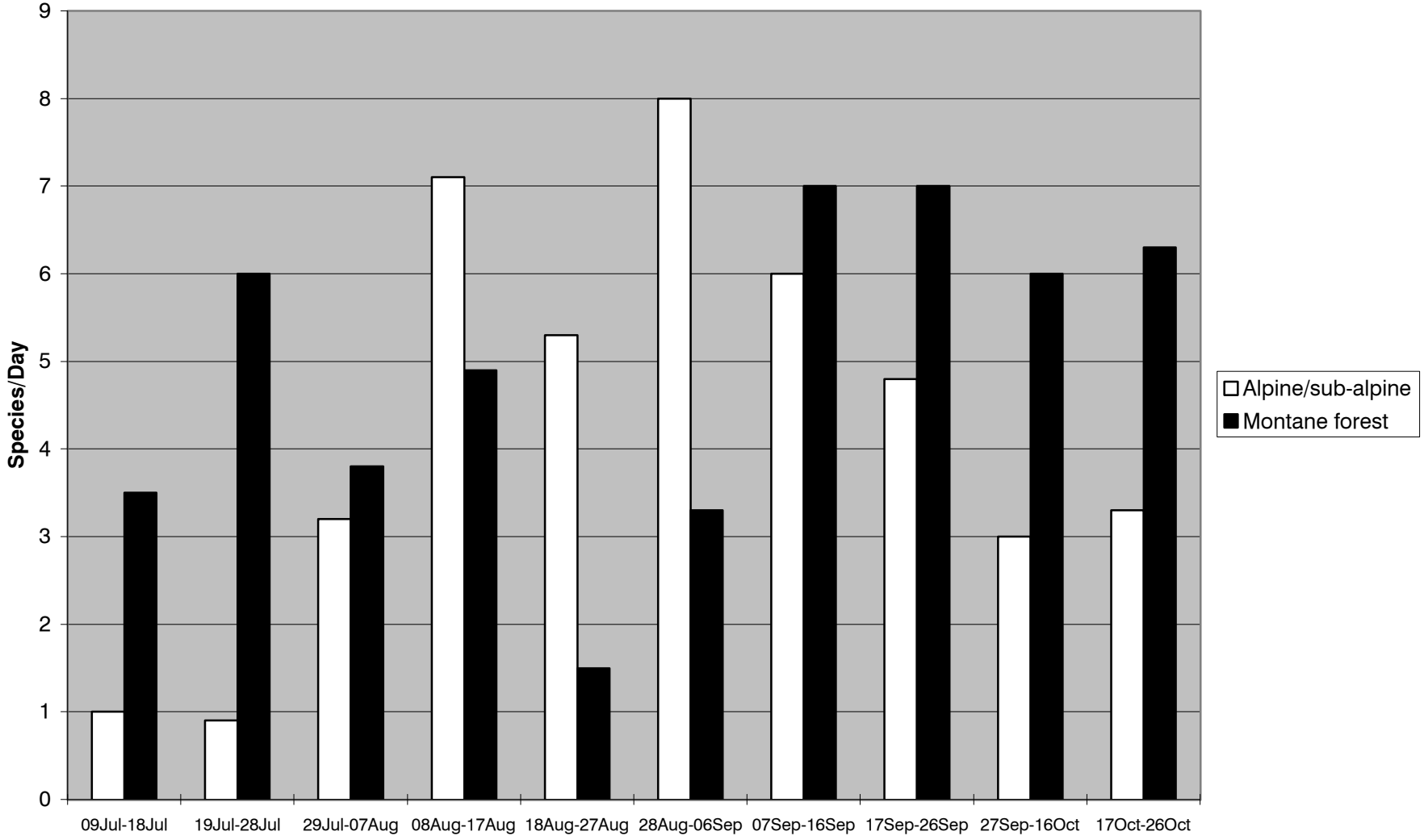
We were surprised to find that many birds continued to be observed in the alpine late into the season. The species list for a series of day-trips in mid-late October is provided in Table 4. There were few longer-distance migrants passing through the alpine at this time, but many lower-elevation species were still present, especially those considered to be residents. Table 4 also shows a regional pattern of decline in species as we moved from south to north.

Figure 1: Number of bird species observed in alpine and montane-forest habitats during 1997 fall migration



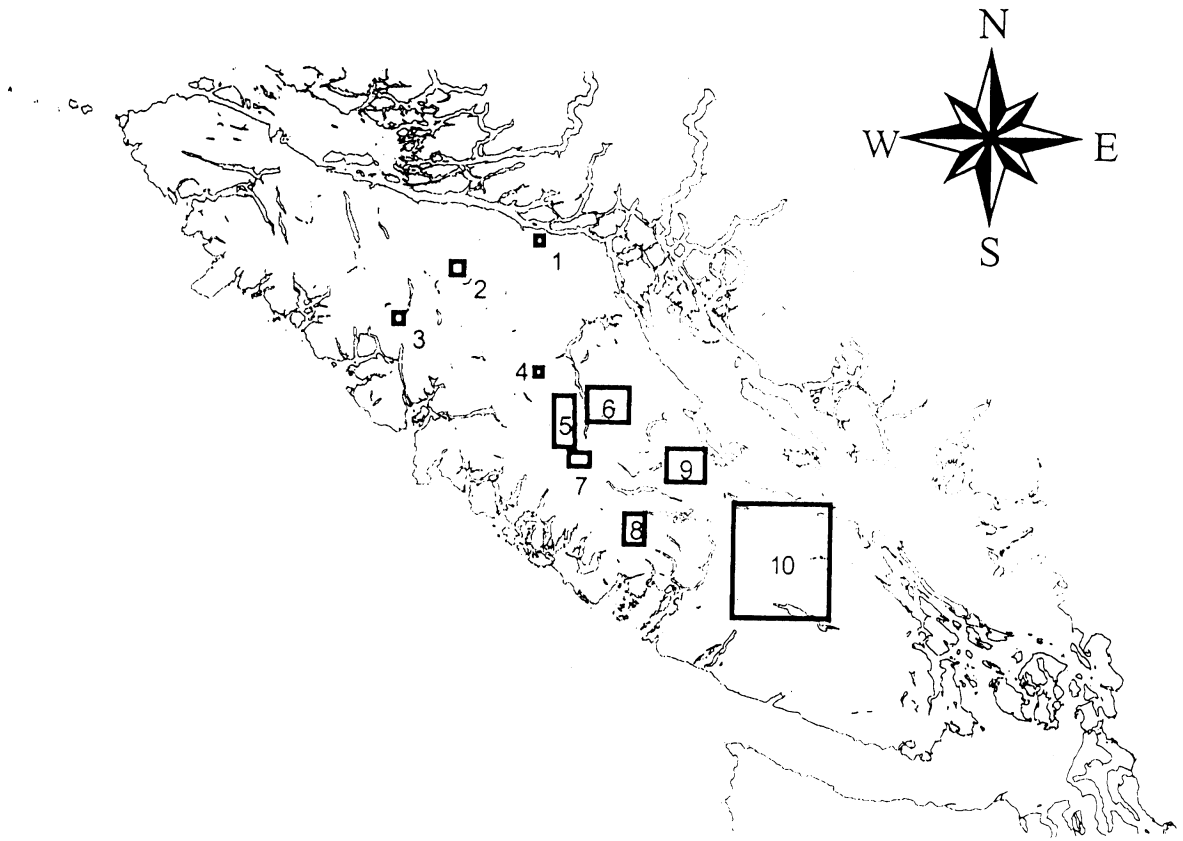
Note: The interval of 27 Sep to 16 Oct encompasses 20 days to compensate for low coverage

Figure 2: Number of avian species observed per day by habitat type



Appendix A:

Study Areas for Alpine Birds on Vancouver Island



1. Mount Hkusam

2. Mt. Cain and Mt. Abel

3. Rugged Mountain

4. King's Peak

5. Mount McBride
Mt. McBride, Limestone Cap

6. Strathcona Park
Mt. Albert-Edward, Mt. Jutland, Mt. Frink

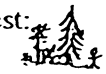
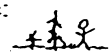
7. Big Interior
Big Interior, Tom Taylor

8. 5040
5040 Peak, Mt. Klitsa

9. Beaufort Range
Squarehead, Mt. Joan, Mt. Curran, Mt. Stubbs

10. South Island
El Capitan/Mt. Landale, Mt. McQuillan,
Mt. Arrowsmith, Mt. Cokely, Mt. Moriarty

Appendix B:
Bird Observation Card

Forest:  Sub-alpine:  Alpine: 

Date: _____
Time in: _____ Time out: _____
Observer: _____ Temp/cloud: ____-____ /_____
Route: _____
Alt ~ F: ____-____ S: ____-____ A: ____-____

	F	S	A		F	S	A
BLGR				RCKI			
COHA				GCKI			
SSHA				AMRO			
ACCsp				VATH			
RTHA				TOSO			
GOEA				YRWA			
MERL				OCWA			
BTPI				WCSP			
RUHU				GCSP			
NOFL				SAVS			
AMPI				SPAsp			
BLSW				DEJU			
CORA				ROFI			
STJA				RECR			
GRJA				PISI			
CBCH				FINsp			
RBNU							
BRCR							
WTWR							

Date: _____
Time in: _____ Time out: _____
Observer: _____ Temp/cloud: ____-____ /_____
Route: _____
Alt ~ F: ____-____ S: ____-____ A: ____-____

	F	S	A		F	S	A
BLGR				RCKI			
COHA				GCKI			
SSHA				AMRO			
ACCsp				VATH			
RTHA				TOSO			
GOEA				YRWA			
MERL				OCWA			
BTPI				WCSP			
RUHU				GCSP			
NOFL				SAVS			
AMPI				SPAsp			
BLSW				DEJU			
CORA				ROFI			
STJA				RECR			
GRJA				PISI			
CBCH				FINsp			
RBNU							
BRCR							
WTWR							