

Pre-Construction Bird Monitoring Program
For Burnt Ridge, Newfoundland

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Introduction

Bonavista Wind Project Inc. has proposed to construct and operate a wind farm on Burnt Ridge, NL consisting of sixteen to twenty five wind turbine generators. These would consist of steel towers with a hub height of 65 to 80m and a three bladed rotor with a diameter of 70 to 90m.

There are not many examples of wind turbines impacting bird populations and in general they seem to be safe for birds (Curry and Kerlinger, 2002). However, there have been documented cases of increased bird mortality associated with wind turbines in coastal areas (Kerlinger 2001) and raptors in upland areas (Sterner, 2002).

Most studies involving wind turbine/bird interactions are done at the post construction phase. For this reason it is difficult to assess the true impact of wind power development on resident and migratory birds. The purpose of this project was to monitor the types, numbers and seasonal activities of birds found within the proposed wind farm boundaries on Burnt Ridge, NL.

Study Area

Burnt Ridge is an upland area located to the South West of Elliston, NL (Figure 1, Map 2C/11 & 2C/10). It consists of a plateau which rises to an elevation of more than 450 feet. The proposed wind farm lies on top of the ridge within a boundary defined by the 400' contour line. The total area within this boundary is 356 ha. About 41% of Burnt Ridge is covered with vegetation, the remaining 59% is comprised of exposed rock in the form of Felsenmeer (Anon, 2005). Heathland and coniferous stands occur in about the same proportion within the study area (Figure 2).

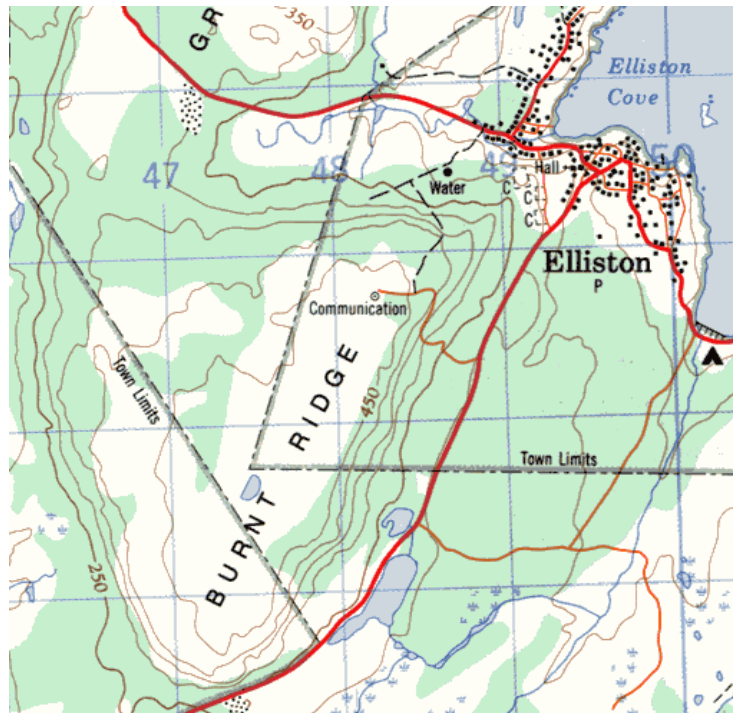


Figure 1. Location of Burnt Ridge, NL. Taken from NTS map 2C/10 & 2C/11.

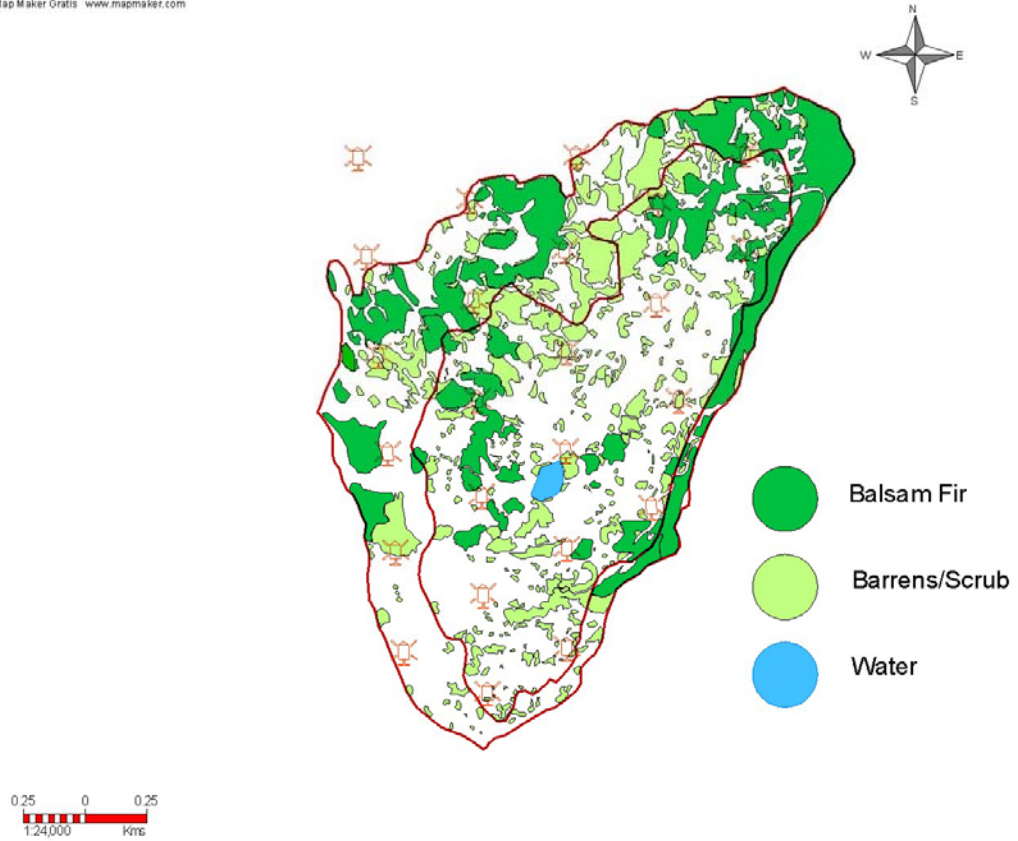


Figure 2. Habitat classification of Burnt Ridge based on 1988 aerial photographs and topographic map 2c11/2c10. Proposed turbine locations are shown in red as are the 400' and 450' contour lines. White areas within the contour lines represent exposed rock (Anon, 2005).

Methods

Six transects were used to sample the three major habitat types found on the ridge. In addition a transect was placed adjacent to the only pond found on the ridge. Each transect was 500m long and birds were counted if they were within 150 metres of the line. The total area covered by each transect was therefore 220713 m². The start of each transect was established by randomly selecting six of the 23 proposed turbine positions. The direction of the transect lines was then determined by selecting a random bearing from 1 to 360°. All transects were placed so that no overlap occurred between them (Figure 3). Transect lines were proof walked on April 30 and marked with flagging tape.

To monitor the spring migration and breeding bird populations, surveys were conducted from May 1 to July 7, 2005. The fall migratory period was surveyed from August 15 to October 31, 2005. Surveys were carried out every third day and commenced at sunrise starting always with transect 1 and ending with transect 6. During the survey each line was walked slowly by two observers and all birds heard and/or seen were recorded. Data collected included date, start and end times, transect number, weather conditions (temperature, wind speed, wind direction, precipitation and visibility), bird species, number of birds, distance from the observer, flying height (to the nearest 10m) and method of observation (sight and/or sound). The distance along the transect line and bearing (magnetic) from the observer was also recorded for each bird (Figure 4). Surveys were not conducted during heavy rain. Habitat types were recorded for each transect, however, no sampling was carried out to quantify species composition, cover etc.

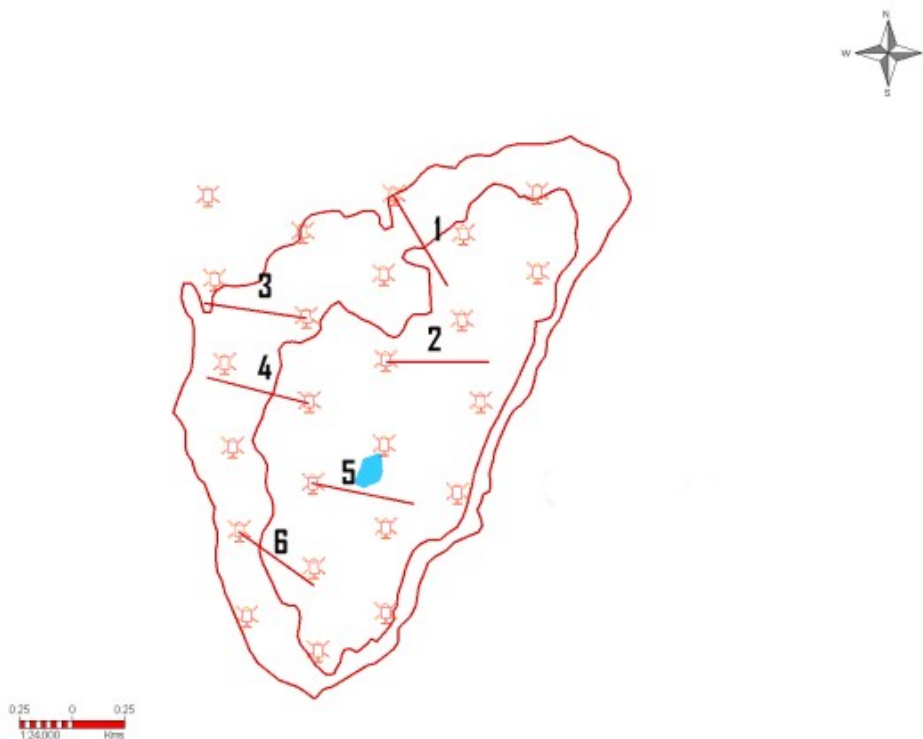


Figure 3. The positions of the 500 metre transect lines used for the Burnt Ridge bird monitoring survey from May 1 – October 31, 2005.

Avian Monitoring Program
Burnt Ridge, NL

Date:	Start Time:	End Time:
Transect Number:	Observer(s):	
Temperature:	Wind Speed:	Wind Direction:
Visibility:	Weather:	

Species	Distance Along Line (m)	Bearing From Line	Distance From Line (m)			Flying Height (m)	V	S
			0 - 50	51 -100	>100			

Figure 4. Avian monitoring data sheet used for Burnt Ridge, NL from May 1 to October 31, 2005.

Results

Habitat Assessment

Due to the fragmented nature of the main habitat types on Burnt Ridge (Figure 2) all transect lines crossed more than one habitat. Habitats recorded for each transect are shown in Table 1.

Transect Number	Habitat Description
1	Primarily Kalmia Barrens with small stands of balsam fir/black spruce and patches of larger shrubs including small tamarack and birch. A larger stand of balsam fir/black spruce was present at the start of the transect.
2	Primarily Felsenmeer (boulders) with small stands of balsam fir/black spruce. Becoming more wooded towards the last 100 m of the transect.
3	Primarily balsam fir/black spruce (>10m high) along the entire transect. More open to the north of the transect line.
4	Starting with kalmia barrens, progressing into Felsenmeer (boulders) and ending with Balsam Fir/Black Spruce Stands. Ratio of habitat types 1:1:1.
5	Primarily Felsenmeer (boulders) with small stands of balsam fir/black spruce. A small pond was located to the north of the transect line.
6	Primarily Empetrum heath with a low density of larger shrubs. A small stand of balsam fir/black spruce was present at the start and end of the transect lines. Felsenmeer is located to the north of the transect line along most of its length.

Table 1. Habitat descriptions for transect lines sampled during the bird monitoring surveys on Burnt Ridge, NL from May 1 to October 31, 2005.

Effort

Effort was measured by recording the start and end times for each transect sampled. Sampling time varied slightly between transects (Table 2) and ranged from an average of 13 minutes to 21 minutes.

Transect Number	Average Time (minutes)	Standard Deviation
1	0.19	0.05
2	0.16	0.03
3	0.21	0.06
4	0.16	0.04
5	0.15	0.03
6	0.13	0.03

Table 2. the average time and associated standard deviation to complete transects on Burnt Ridge, NL from May 1 to October 31 2005 (n=48 sampling days)

Spring Migration and Breeding Bird Survey

A total of 1289 bird observations representing 31 species were made during the 23 sampling days between May 1 and July 7, 2005 (Table 2). The majority of these observations (84%) resulted from vocalization (Figure 5). From the 1289 observations, 32 passerines and 6 geese were unidentified (Table 2) due to limited viewing time or non recognizable calls. No raptors or shorebirds were observed during the spring migration and breeding bird survey. The six geese observed flying north on May 7, 2005 were the only waterfowl seen during this phase of the survey.

Species	Transect Number						Total
	1	2	3	4	5	6	
Willow Ptarmigan	2	0	0	0	1	0	3
Unidentified Sparrow	9	5	1	0	4	1	20
Unidentified Geese	0	0	0	0	6	0	6
Unidentified passerine	4	1	0	2	3	0	10
Unidentified Warbler	1	0	0	0	1	0	2
Greater Black-Backed Gull	0	0	0	0	0	1	1
Herring Gull	2	2	1	6	119	21	151
Northern Flicker	0	1	1	0	0	0	2 (0.01)
Yellow Bellied Flycatcher	10	2	5	6	2	1	26 (0.09)
Common Raven	0	0	1	0	2	0	3 (0.01)
Pine Grosbeak	6	0	2	3	1	0	12 (0.04)
Common Redpoll	0	0	0	2	0	0	2 (0.01)
Pine Siskin	0	3	1	0	1	0	5 (0.02)
Savannah Sparrow	0	2	0	0	10	7	19 (0.06)
White Throated Sparrow	76	56	44	38	23	30	267 (0.88)
Slate Coloured Junco	30	16	17	34	20	31	148 (0.49)
Song Sparrow	3	0	2	0	0	0	5 (0.02)
Swamp Sparrow	8	2	3	0	1	0	14 (0.05)
Fox Sparrow	44	11	21	13	4	1	94 (0.31)
Cedar Waxwing	3	0	0	0	0	0	3 (0.01)
Black and White Warbler	1	0	4	3	0	0	8 (0.03)
Yellow Warbler	2	0	0	0	0	0	2 (0.01)
Yellow Rumped Warbler	9	7	35	16	8	7	82 (0.27)
Magnolia Warbler	1	0	0	0	0	0	1 (0.00)
Black Poll Warbler	28	30	47	37	17	5	164 (0.54)
Northern Waterthrush	1	0	0	0	0	0	1 (0.00)
Common Yellowthroat	11	1	1	0	0	0	13 (0.04)
Wilson's Warbler	2	0	2	0	0	0	4 (0.01)
American Redstart	0	0	0	1	0	0	1 (0.00)
Red-breasted Nuthatch	1	0	0	0	0	0	1 (0.00)
Black Capped Chickadee	1	0	1	0	2	0	4 (0.01)
Boreal Chickadee	4	0	5	7	0	3	19 (0.06)
Ruby Crowned Kinglet	23	5	33	13	5	4	83 (0.27)
Hermit Thrush	4	0	4	7	0	0	15 (0.05)
American Robin	10	24	23	12	18	11	98 (0.32)
Total	296	168	254	200	248	123	1289

Table 3. Bird species observed by transect number on Burnt Ridge, NL from May 1 to July 7, 2005. Figures in brackets represent density/10 ha.

When data was pooled for all transects eight species of bird made up 84% of the total observations (Figure 6). The most frequently observed species was the white throated sparrow (*Zonotrichia albicollis*) followed by the blackpoll warbler (*Dendroica striata*), herring gull (*Larus argentatus*), slate coloured junco (*Junco hyemalis*), American robin (*Turdus migratorius*), fox sparrow (*Passerella iliaca*), ruby crowned kinglet (*Regulus calendula*) and yellow rumped warbler (*Dendroica coronata*).

The white throated sparrow and fox sparrow were most abundant in transect one and showed a steady decline in abundance as transects progressed (Figure 7). Blackpoll warbler, yellow rumped warbler and ruby crowned kinglet were most abundant in forest habitat; and slate coloured junco appeared to be more abundant in barrens habitat (Figure 7). Herring gulls were associated with the small pond located within transect 5 (Figure 7). Two flocks were observed preening in and around the pond on the 5th (n=83) and 27th (n=31) of May, 2005.

Statistics on the most abundant breeding bird species (based on 23 sampling days) can be seen in Table 4. Variations in abundance were most pronounced with the warblers which did not arrive until Mid May to Early June. To compensate for this the mean and standard deviation for blackpoll warbler and yellow rumped warbler were also calculated using data collected after their first arrival date (Table 4).

Species	Mean	Standard Deviation
White Throated Sparrow	11.61	6.11
Fox Sparrow	4.09	1.37
Slate Coloured Junco	6.43	3.19
American Robin	4.26	2.34
Blackpoll Warbler	7.13	7.21
	13.67*	2.53*
Yellow Rumped Warbler	3.56	3.93
	4.82**	3.84**
Ruby Crowned Kinglet	3.61	2.93

Table 4. Average abundance and associated standard deviation of the most common breeding birds observed on Burnt Ridge, NL from May 1 to July 7, 2005. * represents statistics on blackpoll warblers observed after June 4, 2005. ** represents statistics on yellow rumped warblers observed after May 18, 2005.

Species richness appears to be related to habitat with the most species being associated with woodland and/or woodland/barrens and the least number of species with the presence of Felsenmeer (Figure 8).

Figure 9 shows that there was steady increase in the number of white throated sparrows as the survey progressed with a peak occurring during week 5 when an average of 21.5 birds was observed. The fox sparrow, slate coloured junco and American robin showed little temporal variation in abundance during the first 10 weeks of the survey. Fox sparrows and juncos were however, slightly more abundant in week one. Yellow rumped warblers began arriving in week three and a peak in observations for this species occurred in week five. Blackpoll warblers arrived later in week five and their number of observations peaked in week six when an average of 16.5 birds was observed. Most observations on the ruby crowned kinglet occurred earlier in the season. The presence of herring gulls on the ridge was most noticeable in week four when 122 gulls were counted.

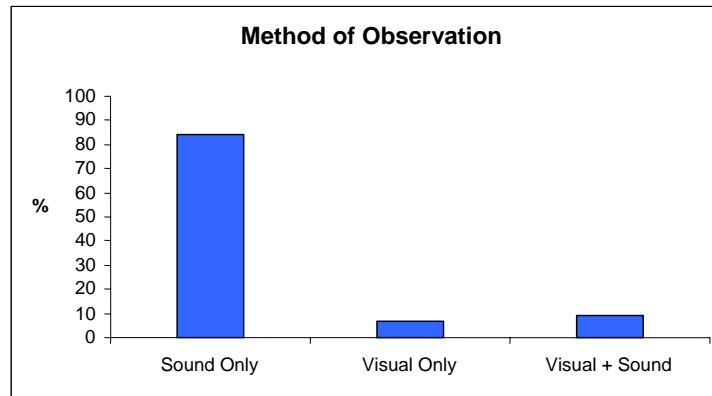


Figure 5. Method of observation for birds (individuals and flocks) identified on Burnt Ridge, NL from May 1 to July 7, 2005.

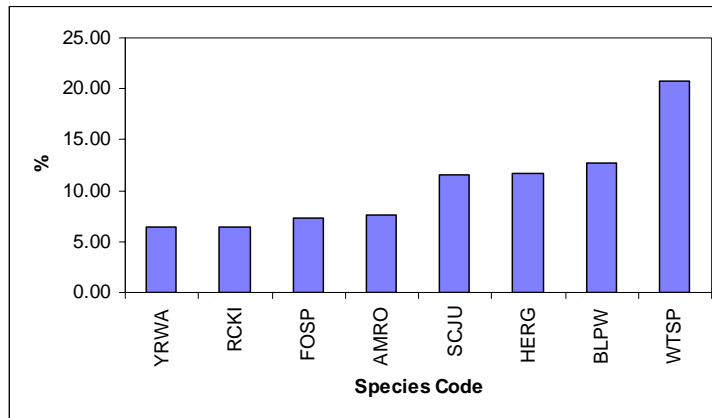


Figure 6. Species composition for birds observed on Burnt Ridge, NL on all transects between May 1 and July 7, 2005. Only species making up 5% or more of the observations are shown (n=1087). Bird species acronyms are as follows: YRWA – yellow-rumped warbler, RCKI – ruby crowned kinglet, FOSP – fox sparrow, AMRO – American robin, SCJU – slate coloured junco, HERG – herring gull, BLPW – blackpoll warbler, WTSP – white throated sparrow.

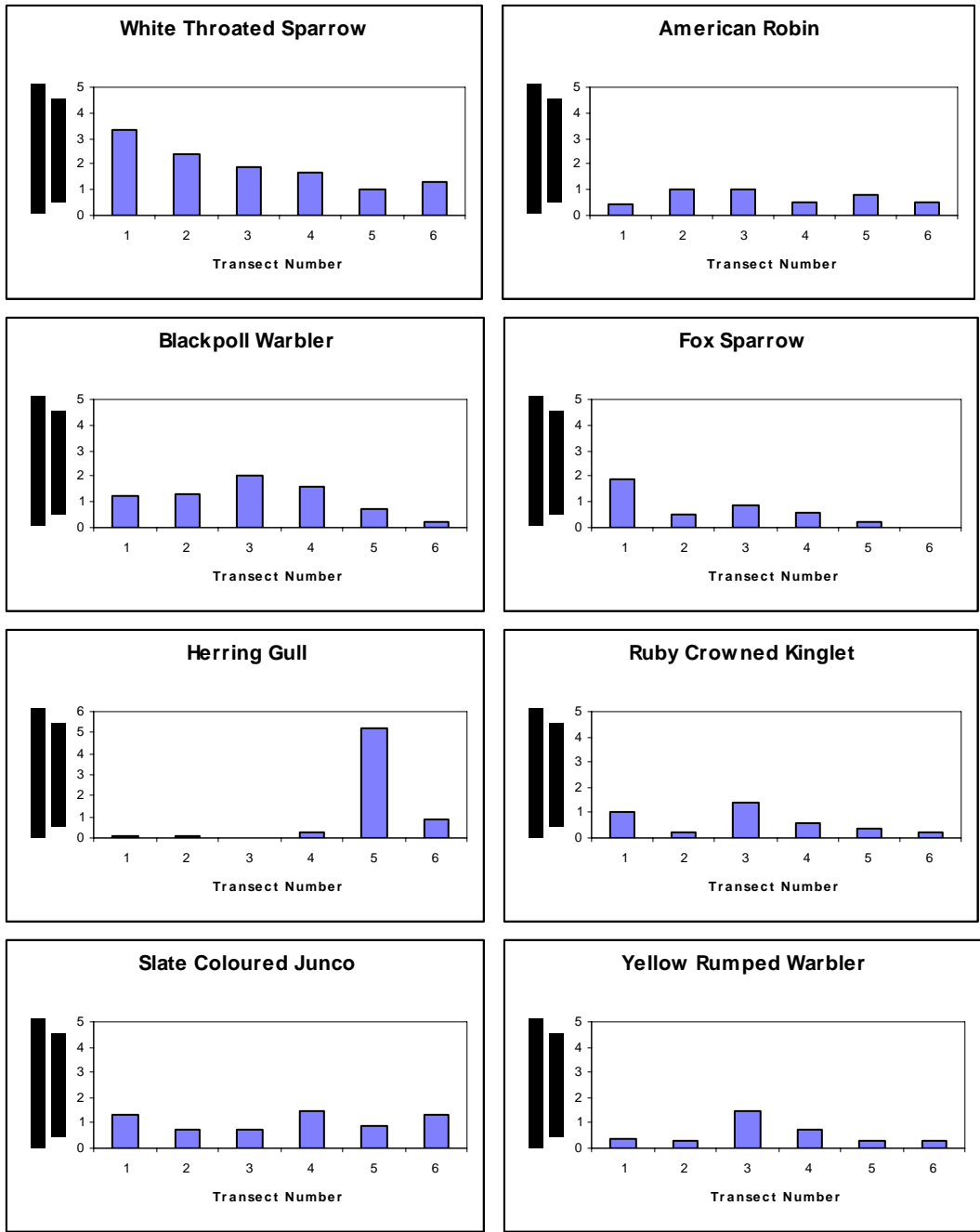


Figure 7. Average numbers of sightings per day by transect number for the eight most common species observed on Burnt Ridge for May 1 to July 7, 2005.

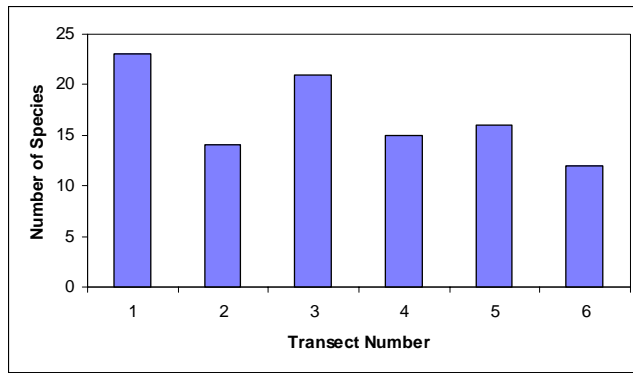


Figure 8. Species richness by transect number for observations made on Burnt Ridge, NL from May 1 to July 7, 2005.

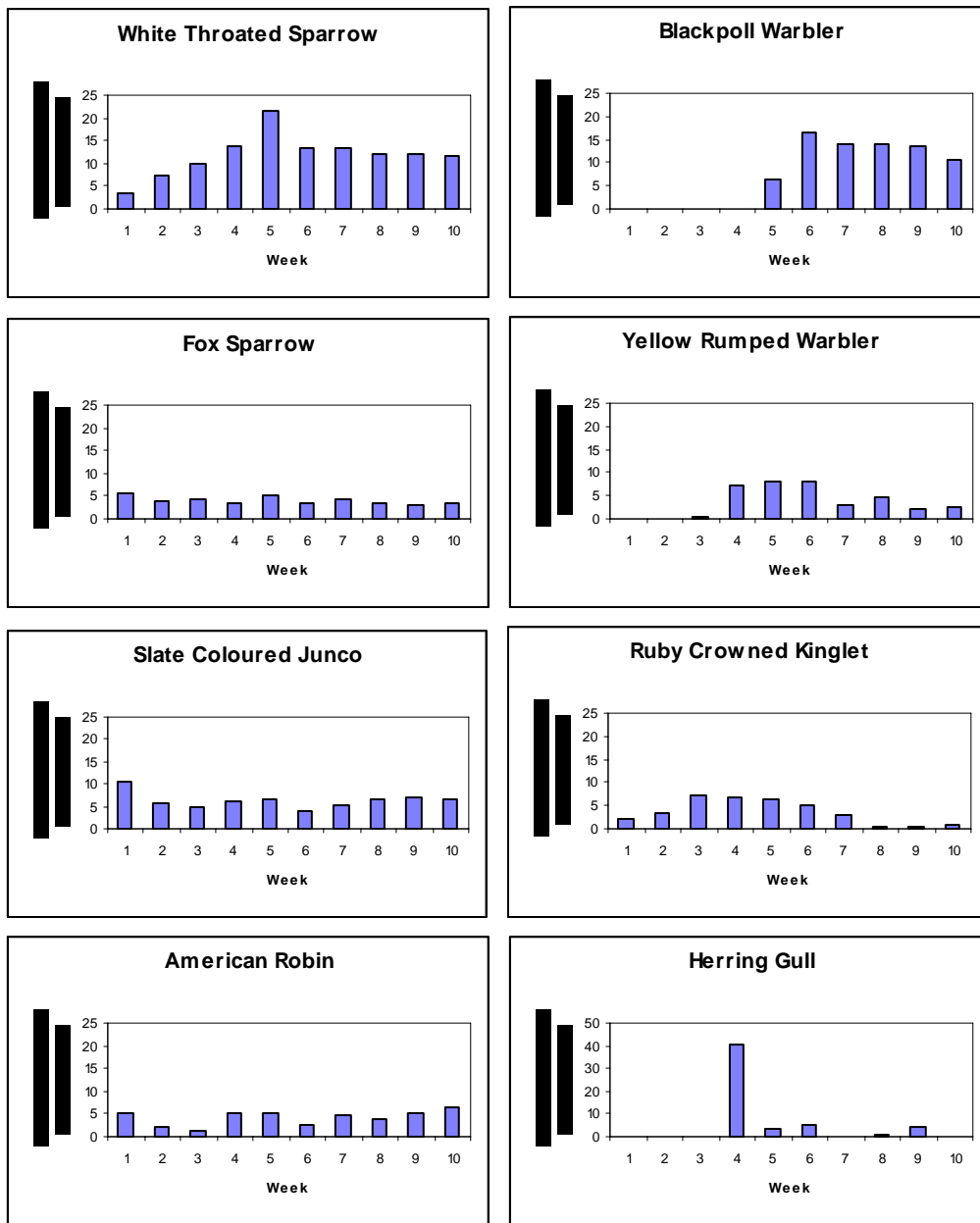


Figure 9. The average number of observations by week for the eight most common species found on Burnt Ridge, NL from May 1 to July 7 2005.

Fall Migration Survey

A total of 459 bird observations representing 31 species were made during the 25 sampling days between August 15 and October 31, 2005 (Table 5). Most birds were identified either by sound alone (44%) or by sight alone (39%). From the 459 observations, 50 passerines were unidentified due to limited viewing time and/or non recognizable calls. Two species of raptor were observed on transect two during the fall survey, a northern goshawk (*Accipiter gentilis*) on August 21 and a sharp shinned hawk (*Accipiter striatus*) on September 24. On October 10 a hooded merganser (*Lophodytes cucullatus*) was seen on Anchor pond (transect 5). This represented the only waterfowl species observed during the fall survey. The two whimbrel observed during the fall survey represented the only shorebirds seen, one was put to wing on transect five on September 4 and the other was flying over transect four on September 17. Most birds (91.8%) were observed less than 50m from the transect line (Table 6).

Seven species of bird made up 71% of the total observations on Burnt Ridge between August 15 and October 31, 2005 (Figure 11). The most observed species was the slate coloured junco (*Junco hyemalis*) followed by the herring gull (*Larus argentatus*), white throated sparrow (*Zonotrichia albicollis*), boreal chickadee (*Poecile hudsonica*), yellow rumped warbler (*Dendroica coronata*), blackpoll warbler (*Dendroica striata*), snow bunting (*Plectrophenax nivalis*) and common raven (*Corvus corax*).

Slate coloured junco were observed in the more open barren or Felsenmeer habitat and were most abundant in transects 2, 4 and 5 (Figure 12). The yellow rumped warbler and blackpoll warbler were observed in small numbers in woodland associated with transect 2, 3 and 4. Boreal chickadee were also associated with woodland in transects 3 and 4. Forty one herring gulls were observed on September 4, 2005 in transect 6 (Figure 12). This accounted for 66% of all gulls seen during the fall surveys. White throated sparrow occurred in small numbers throughout all transects. Three flocks of snow bunting (n= 3, 18 and 3) were observed on transect 2 in October. Common raven were occasionally seen flying within the area and were most commonly observed in transect 5.

Statistics on the eight most abundant bird species showed a high variance for each of them (Table 7). The average number of birds seen was much lower than in the spring migration/breeding bird survey season. Open habitats consisting of barrens and Felsenmeer (transects one, two, five and six) had more species associated with them than the wooded or partially wooded areas (transects three and four).

The most abundant species during the fall survey was the slate coloured junco. Figure 14 shows that this species decline steadily in numbers after week six of the fall survey. The yellow rumped warbler, blackpoll warbler and herring gull all disappeared after week four (September 7). White throated sparrows observations began to decline following week one of the survey and they were no longer seen after week eight (October 5). Numbers of boreal chickadee remained relatively constant up until week nine after which there was a slight decrease in observations. Snow buntings first appeared on the transects in week nine with the first sightings being made on October 10.

Species	Transect Number						Total
	1	2	3	4	5	6	
Willow ptarmigan	0	0	0	0	0	2	2
Unidentified Sparrow	5	8	4	1	1	2	21
Unidentified Passerine	8	6	5	0	1	3	23
Unidentified Warbler	0	0	1	0	5	0	6
Greater Black-Backed Gull	0	0	0	0	1	0	1
Herring Gull	0	1	4	4	5	48	62
Hooded Merganser	0	0	0	0	1	0	1
Whimbrel	0	0	0	1	1	0	2
Sharp Shinned Hawk	0	1	0	0	0	0	1
Northern Goshawk	0	1	0	0	0	0	1
Common Raven	0	2	2	3	13	1	21
Pine Grosbeak	2	1	3	2	0	0	8
Common Redpoll	0	2	2	0	0	7	11
Pine Siskin	0	0	0	2	0	0	2
Snow Bunting	0	24	0	0	0	0	24
Savannah Sparrow	0	0	0	0	1	0	1
White Throated Sparrow	12	9	9	3	1	9	43
Slate Coloured Junco	9	22	8	27	16	11	93
Swamp Sparrow	3	0	0	0	2	0	5
Fox Sparrow	3	0	0	0	0	0	3
Cedar Waxwing	0	0	0	0	12	0	12
Yellow Warbler	0	1	0	0	0	0	1
Black-Throated Blue Warbler	0	1	0	0	0	0	1
Yellow Rumped Warbler	2	7	10	7	0	2	28
Blackpoll Warbler	1	4	9	7	3	0	24
Common Yellowthroat	1	0	0	0	0	0	1
American Redstart	1	0	0	0	0	0	1
Gray Catbird	0	0	0	0	1	0	1
Redbreasted Nuthatch	1	0	0	0	1	0	2
Black Capped Chickadee	0	0	0	0	2	5	7
Boreal Chickadee	1	0	15	12	0	1	29
Golden Crowned Kinglet	0	0	0	0	0	2	2
Ruby Crowned Kinglet	0	0	0	0	0	1	1
American Robin	2	1	0	14	0	1	18
Total	51	91	72	83	67	95	459

Table 5. Bird species observed by transect number on Burnt Ridge, NL from August 15 to October 31, 2005

Season	Distance From Line (m)			Total
	0-50	50-100	100- 150	
Spring/Breeding	561 (50.0%)	240 (21.4%)	320 (28.6%)	1121
Fall	212 (91.8%)	15 (6.5%)	4 (1.7%)	231

Table 6. Number and percentage of birds/bird groups observed by distance class from all transect lines combined for the spring/breeding and fall bird surveys.

Species	Mean	Standard Deviation
Slate Coloured Junco	3.58	3.82
Herring Gull	2.48	9.00
White Throated Sparrow	1.72	2.78
Boreal Chickadee	1.20	1.41
Yellow Rumped Warbler	1.12	1.96
Black Poll Warbler	0.96	1.62
Snow Bunting	0.96	3.64
Common Raven	0.84	1.52

Table 7. Average abundance and associated standard deviation of the most common breeding birds observed on Burnt Ridge, NL from May 1 to July 7, 2005.

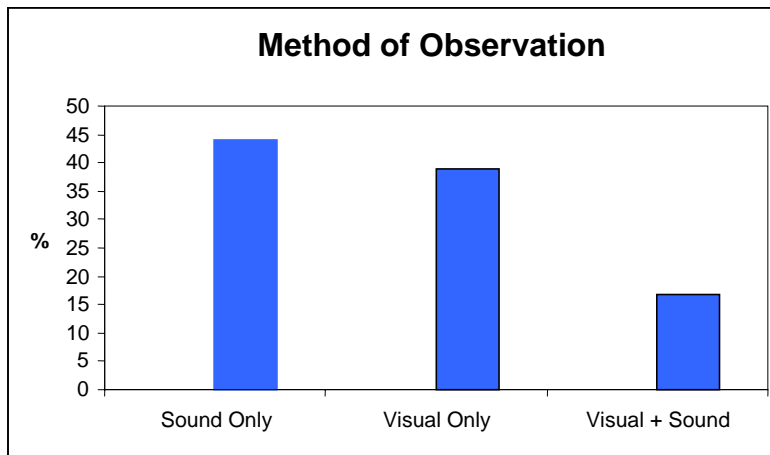


Figure 10. Method of observation for birds (individuals and flocks) identified on Burnt Ridge, NL from August 15 to October 31, 2005 (n=231).

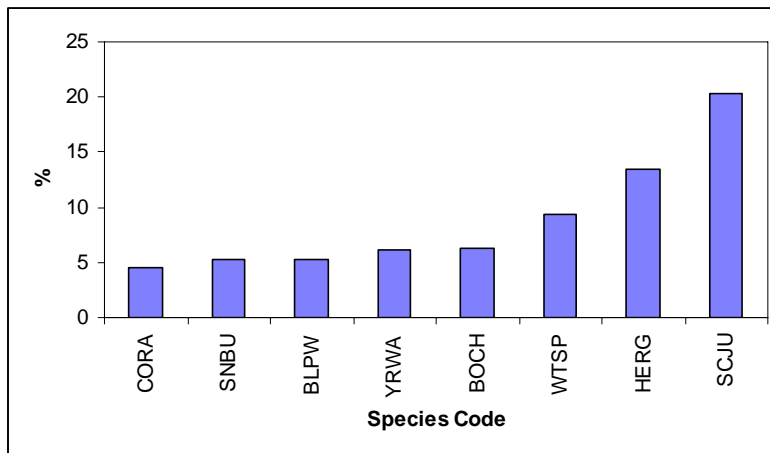


Figure 11. Species composition for birds observed on Burnt Ridge, NL on all transects between August 15 and October 31, 2005. Only species making up 5% or more of the observations are shown (n=324). Bird species acronyms are as follows: CORA – common raven, SNBU – snow bunting, BLPW – blackpoll warbler, YRWA – yellow rumped warbler, BOCH – boreal chickadee, WTSP – white throated sparrow, HERG – herring gull, SCJU – slate coloured junco.

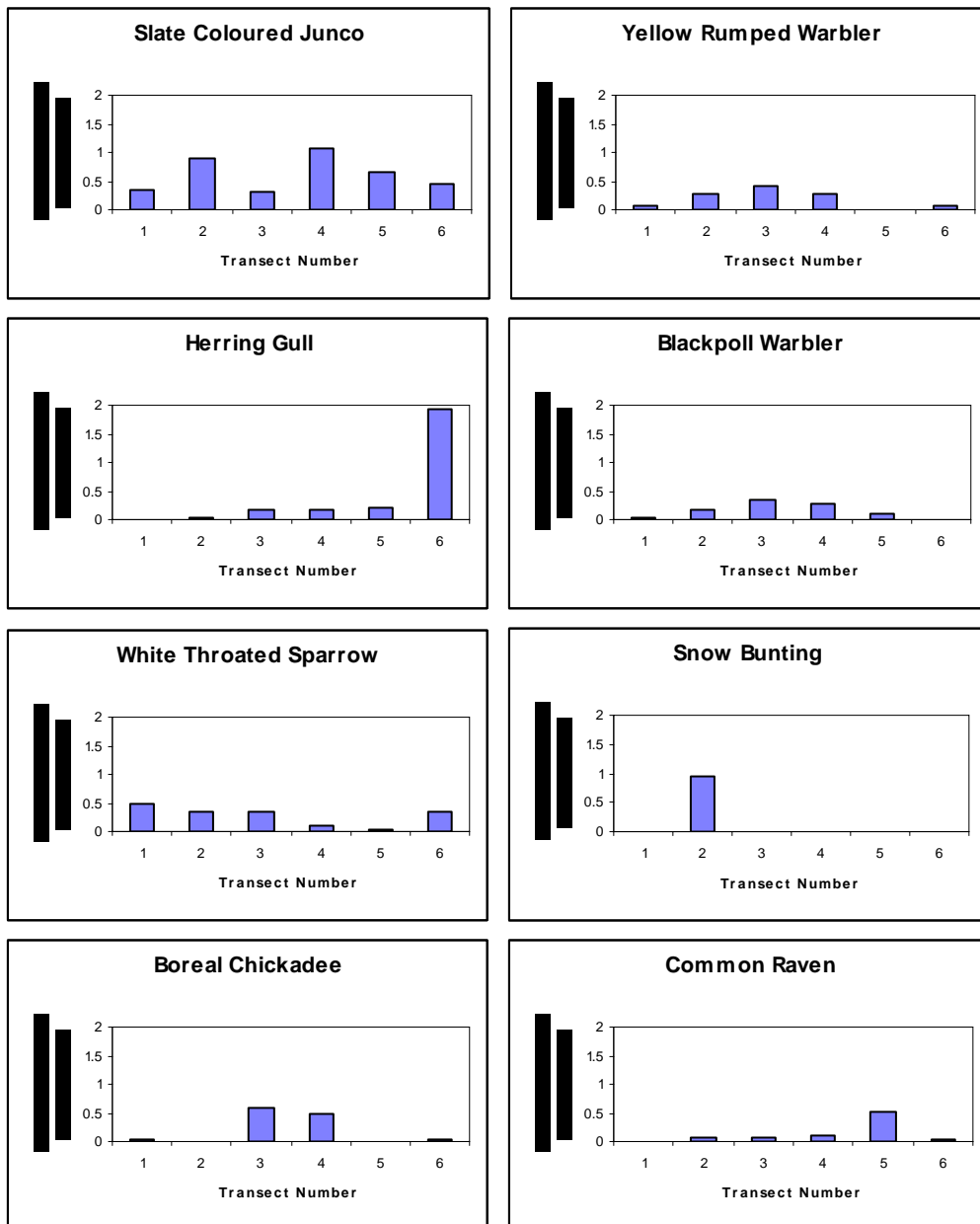


Figure 12. Average numbers of sightings per day by transect number for the eight most common species observed on Burnt Ridge for August 15 to October 31, 2005.

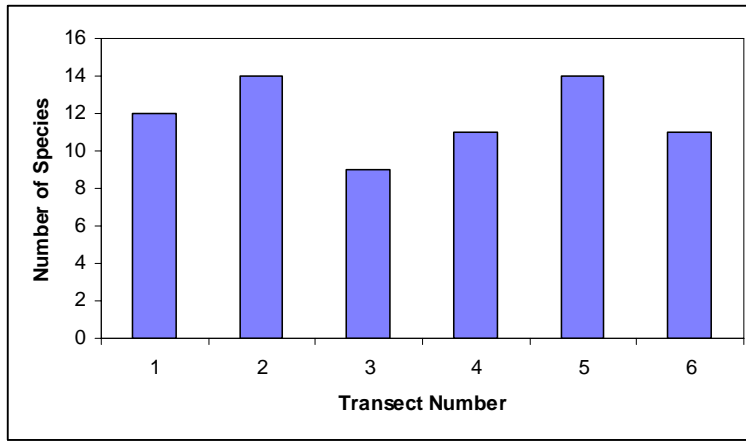


Figure 13. Species Richness by transect number for observations made on Burnt Ridge, NL from August 15 to October 31, 2005.

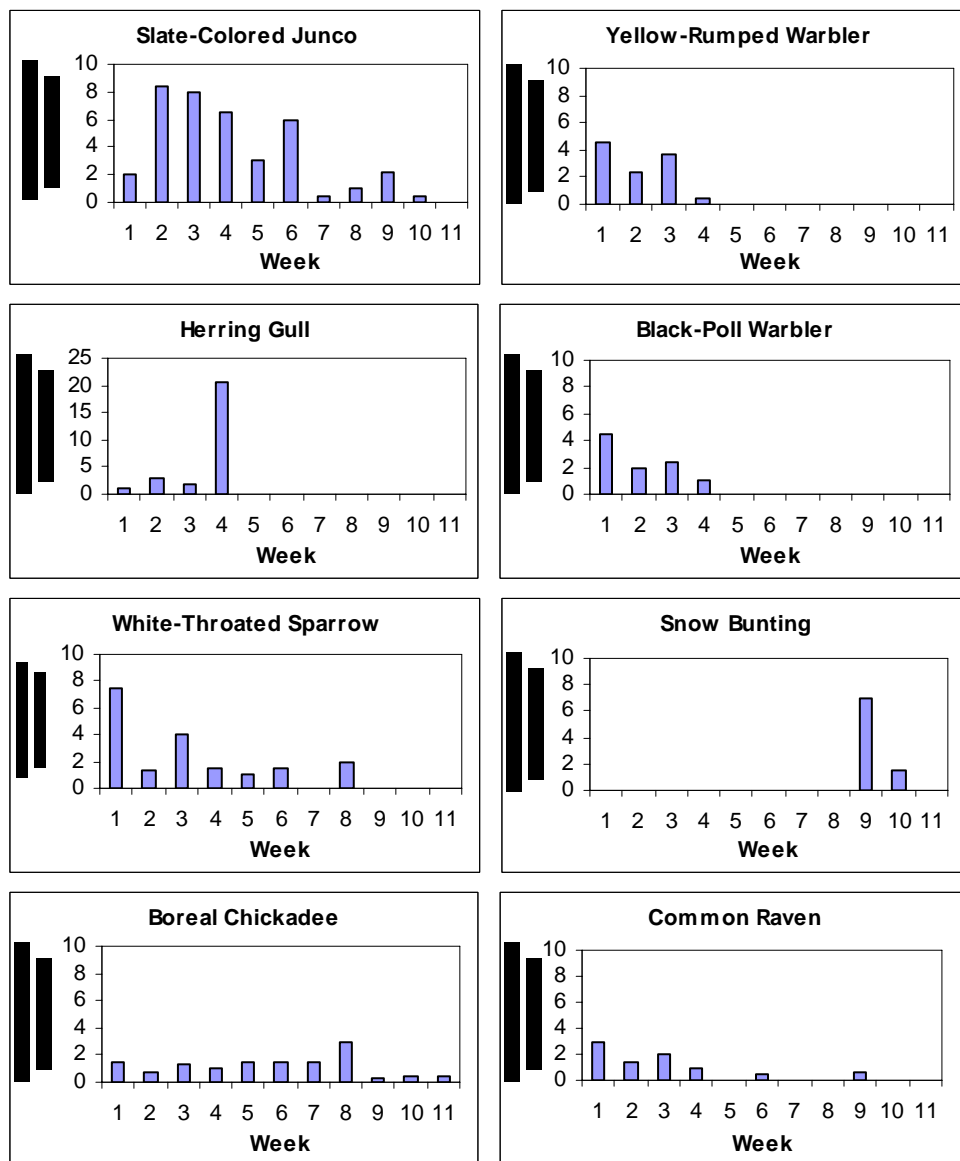


Figure 14. The average number of observations by week for the eight most common species found on Burnt Ridge, NL from August 15 to October 31, 2005.

Flying Heights

A total of 186 birds were seen flying throughout the study period. The majority of these (n=97) were identified to 14 species (Table 8). The remaining 16 birds were unidentified (6 geese, 4 sparrow, 1 warbler and 5 unknown passerines). The majority of birds observed flying were herring gulls (52.2%) followed by the common raven (11.8%), snow buntings (11.3%) and American Robin (9.7%).

The danger zone for turbines lies within the rotor radius. Depending on the model installed, the blades will range in height from 30m above ground at their lowest point to 125m above ground at their highest point. Fifty birds were observed flying between these heights the majority being snow buntings (n=18) and herring gulls (n=17).

Species	Flying Height (m)							Total
	0-29	30-59	60-89	90-119	120-149	150-179	180-209	
Herring Gull	73	12	3	2			7	97
Common Raven	18	3		1				22
American Robin	17	1						18
Willow Ptarmigan	1							1
Unidentified Sparrow	4							4
Unidentified Geese				6				6
Unidentified Passerine	4			1				5
Unidentified Warbler	1							1
Greater B-B Gull		2						2
Sharp Shinned Hawk	1							1
Northern Goshawk	1							1
Pine Grosbeak	1							1
Pine Siskin		1						1
Snow Bunting	3	18						21
S.C. Junco	1							1
Yellow Warbler	1							1
Yellow Rumped Warbler	2							2
Blackpoll Warbler	1							1
Totals	129	37	3	10	0	0	7	186
%	69.3	19.9	1.6	5.4	0	0	3.8	

Table 8. Heights of birds observed flying during the 2005 bird monitoring program for Burnt Ridge, NL. The red area indicates the danger zone attributed to turbine blades.

Influence of Wind of Observations

There was a low correlation between the number of birds observed during each site visit and the mean wind speed recorded at Bonavista (Environment Canada data) for both the spring/summer and fall surveys (Figures 15 & 16). There was also no clear relationship between wind direction recorded at Bonavista and the number of birds observed during both survey periods (Figure 17).

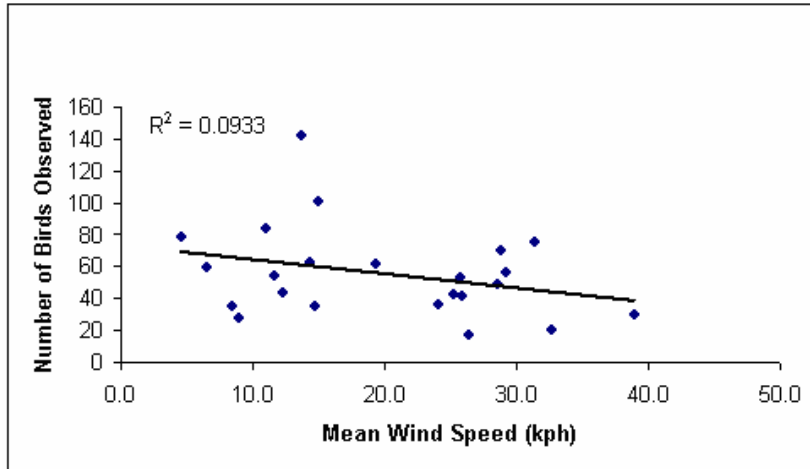


Figure 15. Regression analysis and corresponding correlation coefficient for the relationship between Mean Wind Speed (kph) and the number of birds observed on each site visit during the spring/summer bird surveys on Burnt Ridge, 2005.

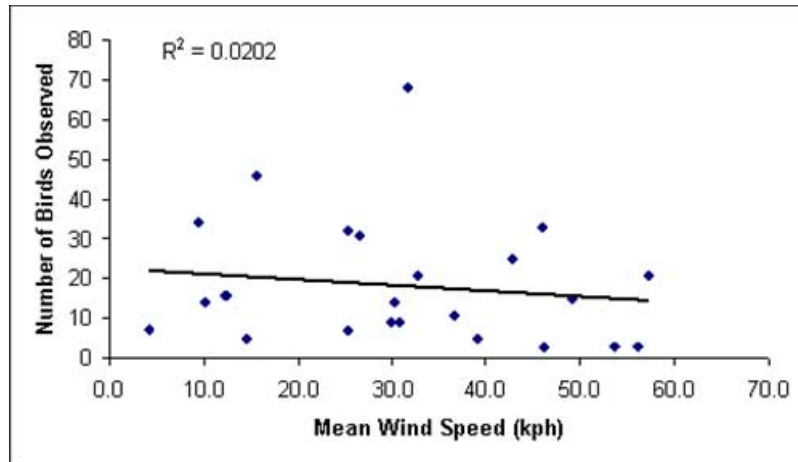


Figure 16. Regression analysis and corresponding correlation coefficient for the relationship between Mean Wind Speed (kph) and the number of birds observed on each site visit during the fall bird surveys on Burnt Ridge, 2005.

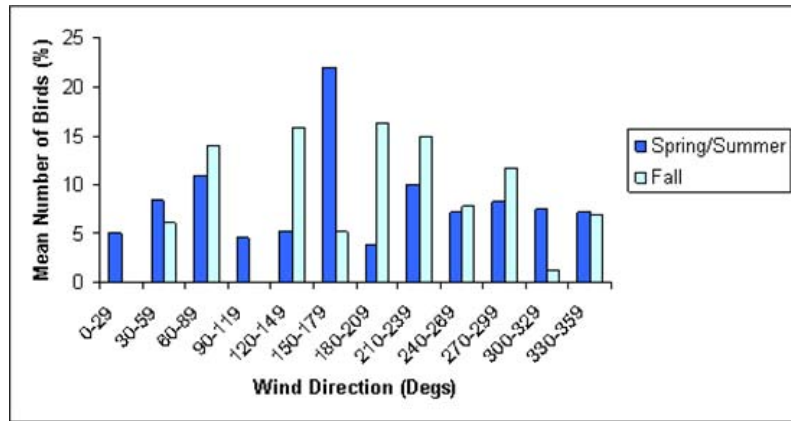


Figure 17. Relationship between wind direction (degrees) and the mean number of birds observed on each site visit during the spring/summer and fall bird surveys on Burnt Ridge, 2005.

Discussion

Spring and Breeding Bird Surveys

There were 31 species observed in the first part of the monitoring program. Twenty six of these are listed as common breeders and 5 as uncommon breeders in Newfoundland and Labrador (Mactavish *et al.*, 2003). The breeding bird survey conducted on July 5, 2005 (observer Jon Joy) had six point count stations adjacent to Burnt Ridge.

Of these 31 species observed during the first phase of the project 27 were potentially breeding songbirds. This represents a much lower diversity than seen in western Newfoundland forests where 42 species have been recorded (Thompson *et al.*, 1999). In addition the density of the commonly occurring song bird species was much lower than that found for the same species in western Labrador forests (Simon *et al.*, 2000). If we count all the observations of white throated sparrows (Table 3) on Burnt Ridge as being breeding males holding a territory then their density would equate to 0.88 territories/10 ha. This is slightly less than that found on scarified land in Labrador (1.0 territories/10ha) and much less than that found in regenerating clear cut forest (8.0 territories/10ha). The density of blackpoll warblers (assuming all breeding males) was similar to that found in Labrador at 0.5 territories/ha. All other potentially breeding species which were identified as common on Burnt Ridge (American robin, fox sparrow, ruby crowned kinglet, slate coloured junco and yellow rumped warbler) had much lower densities than those found in Labrador's forest habitat (Simon *et al.*, 2000).

Species diversity can also be compared to data from the breeding bird survey conducted on July 5, 2005 (observer Jon Joy) as there are six point count stations adjacent to Burnt Ridge. Results from these stations showed six sparrows and allied species and six warbler species (plus four other species). This can be compared to data from Burnt Ridge collected on July 4 and July 5, 2005 (under similar weather conditions) which showed six sparrows and allied species but only two warbler species (plus six other species). Presumably, the lack of warbler diversity on Burnt Ridge is a reflection of habitat differences.

The ruby crowned kinglet, blackpoll warbler, yellow rumped warbler, fox sparrow and American robin all showed a slight preference for the older balsam fir/black spruce stands found in transect three (Figure 7). It is not clear what the habitat preference of white throated sparrow or fox sparrow is due to the steady decline in observations made after transect one (Figure 7). This decrease is quite clear with the white throated sparrow and may be behavioral in nature caused by a decrease in singing activity seen in many songbirds after sunrise (Shields, 1977). However, white throated sparrow are known to prefer successional deciduous scrub (Canterbury and Blockstein, 1997; Simon *et al.*, 2002) which would make transect one the best nesting habitat for them on Burnt Ridge.

During the spring and breeding bird surveys the fox sparrow, slate coloured junco and American robin all showed an initial pulse in abundance during week one of the surveys (figure 9). White throated sparrow showed a gradual increase in abundance up to week five after which the number of observations declined slightly. Although

small, this possibly reflected a migratory movement of birds through the area. The arrival of warblers onto the ridge was clearly seen on May 18, 2005 when yellow rumped warbler arrived and on June 4, 2005 when blackpoll warbler arrived. The presence of herring gull on the ridge was intermittent. Most birds observed were washing and preening in Anchor pond during week 4. This coincided with a number of dead seals washing ashore in Elliston and Bonavista although it is unknown if there is a connection. Other observations of gulls are probably related to birds traveling from their breeding colonies in Elliston to the fish plant in Bonavista.

Fall Bird Survey

There was a 64.4% drop in the number of birds observed during the fall survey when compared to the spring/breeding season survey. Some of this may be explained by the decrease in counts of birds by sound alone. Eighty four percent of birds were observed by sound alone in spring/breeding survey but only 44% in the fall survey. This is not surprising given that the breeding season was over and singing males were no longer being recorded. For this reason most birds and groups of birds being observed in the fall were less than 50m (91.8%) from the transect line (Table 6). This may also explain why most species were observed in open habitats during the fall survey (Figure 13).

Thirty one species observed during the fall monitoring program. Twenty of these are listed as common breeders and 5 as uncommon breeders in Newfoundland and Labrador (Mactavish *et al.*, 2003). There was also one very rare breeder, a northern goshawk and one rare breeder, a gray catbird. Migrant visitors included snow bunting which first arrived in the surveys on October 10. Large groups of snow bunting (>100 birds) were also observed at Cape Bonavista during October (personal observation).

Two whimbrel were observed in September and they represented the only shorebirds seen during the bird surveys on Burnt Ridge. A group of twelve birds were put to wing near transect two on August 28, 2005 although these were not part of an official sample. The occurrence of whimbrel and non occurrence of other shorebirds can be compared to the shore birds surveys carried out on a 500m transect line at Cape Bonavista from July 24 to October 28, 2005 on upland barrens habitat (Observers: Jon Joy/Brenda Taylor). During the 15 sampling days an average of 9.5 whimbrel, 3.4 American golden plover, 3.6 semipalmated sandpiper and 0.7 other species per sampling day were seen at the Cape transect. This compares to an average of 0.1 whimbrel per sampling day on Burnt Ridge.

There were two rare vagrants seen during the fall surveys. A male hooded merganser was seen on Anchor Pond (transect 5) on September 24 (outside of the transect area) and again on October 10, 2005 (inside the transect area); and a male black-throated blue warbler was seen on transect two on August 21, 2005.

The most commonly observed species in the fall survey was the slate coloured junco. It was more frequently counted on transects two and four which are both open and contain Felsenmeer (Figure 12). This is slightly different from the spring/breeding surveys when a higher proportion of juncos were counted on

transect one than in transect two (Figure 7). Yellow rumped warbler, blackpoll warbler and boreal chickadee were all most abundant in the wooded habitat found in transect three. Snow bunting were seen feeding on barrens in the mainly Felsenmeer habitat of transect two. Herring gulls were again seen on Burnt Ridge but this time were associated more with transect six when a group of 41 birds were seen feeding (on berries?) towards the end of the transect. All commonly observed species showed a decline in abundance as the fall season progressed (Figure 14). This decline was least pronounced with the boreal chickadee possibly because they over-winter in the boreal forest.

Flying Heights

During the surveys almost twenty seven percent (n=50) of flying birds seen on Burnt Ridge were within the danger zone posed by wind turbines and could potentially be killed if they struck the turbine rotor blades. The most common of these was the snow bunting (n=18) followed by the herring gull (n=17) (Table 8).

Very few passerines were observed flying during the surveys possibly because they were migrating at night which is know to happen in most species (Richardson, 1978). Most migrating birds are thought to fly at altitudes higher than turbines (Hanowski and Hawrot, 2000).

Raptors are thought to be more vulnerable to mortality due to turbines, however only two raptors were counted during the surveys and neither bird was observed flying above 30m.

Conclusion

- Densities of breeding birds are low on Burnt Ridge probably due to poor habitat.
- Breeding birds make up the majority of observation on Burnt Ridge and are not thought to be endangered by turbines during the breeding season for behavioural reasons (Hanowski and Hawrot, 2000).
- There was little indication that Burnt Ridge is important for migrating shorebirds, passerines or raptors.
- Turbines could potentially cause mortality to some species (e.g. herring gulls) at certain times of year.
- Wind farm development will probably have little impact on bird habitat (other than disturbance) due to the fragmented nature of existing vegetation on Burnt Ridge.

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