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Work Product #4
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Bird Conservation Area Design for the Yellowstone to Yukon Ecoregion

1. Introduction

Y2Y's avian conservation area design aims to protect the region's current avian species diversity and population viability. My MSc thesis study identified candidate core areas in the conservation area design that represented high quality avian breeding habitat within 19 Y2Y broad scale habitat cover types (Table 1). I defined high quality habitat as areas that had higher amounts and more stable resources for birds, and lower levels of predation, parasitism and anthropogenic disturbance[1,2,3]. Due to the large size of the Y2Y region (1.36 million square km), direct determination of avian habitat quality by measurement of bird habitat use and breeding success was logistically impossible. Hence, I adopted a broad-scale modelling approach to prioritize habitat based on a home range level of habitat selection, i.e. the geographic area where a species conducts its daily and seasonal activities[4], for each focal species.

My study first identified a group of focal birds (Table 2) from 109 Y2Y conservation priority species. The focal birds' primary habitats collectively represented the 19 broad-scale habitat cover types. The focal birds also had extensive geographic ranges within Y2Y that allowed them to act as umbrellas for the remaining Y2Y conservation priority species. The methods and results for the focal species analysis were presented in previous report "Focal Bird Species Selection for Y2Y Avian Core Area Identification", November 30, 2003. I hypothesized that avian habitat quality within Y2Y could be predicted for the focal birds at the regional scale using biophysical factors (climatic and topographic conditions) and anthropogenic stressors (level and type of human activity). Biophysical factors influence avian habitat quality by affecting the levels and stability of resources important to survival and reproductive success[5]. Human activities result in habitat loss and fragmentation that reduce bird survival and reproductive success[6,7]. I used several biophysical and anthropogenic variables (Table 3) as broad-scale correlates of the amounts and stability of food and water, and levels of predation, parasitism and anthropogenic disturbance that I could not directly measure in the vast Y2Y region.

For my Masters thesis I developed habitat selection models for 11 of the 20 focal birds, and used the models to predict habitat selection, and thus relative habitat quality, for each focal bird in its primary and secondary habitat cover types throughout its breeding range within Y2Y. I then integrated the model predictions across species to identify prime habitat within each Y2Y habitat cover type. The methods and results for this work were described in a previous report "Identification of Prime Avian Habitat in the Y2Y Ecoregion", April 14, 2004. The present contract extends my thesis work by completing the models for the remaining 9 focal birds, and integrating the results for these species with those done for my thesis. This report summarizes changes to the methods used, results and potential conservation applications for the Y2Y avian conservation design.

2. Methods

Resource selection function (RSF) models provide a relative estimate of the probability an organism will use a site based on a statistical analysis of the association between its presence in a landscape and selected habitat attributes[8]. I developed an RSF model for the 9 focal birds in this contract using the methods described in the report "Identification of Prime Avian Habitat in the Y2Y Ecoregion", April 14, 2004, with one major change for 8 species. RSFs compare habitat selection among sample locations "used" by a species to either sample locations known to be "unused", or to those that may be "available" to the species throughout its range. I compared "used" to "available" sample locations in my thesis work, but changed to a "used/unused" approach for this contract. This addressed a concern raised in my thesis defence that the geographic sampling bias of the "used" samples may have contributed to artefacts in the models. The bird surveys (Figure 1) may not have adequately sampled the full range of each predictor variable within Y2Y. This meant that the "used" samples might have appeared to select a portion of a predictor's values when compared to what was available. However, this may have been simply because the bird survey locations only sampled that range of the predictor's values. The models were also biased to predict higher habitat selection in geographic locations that contained surveys. Accordingly, I modified my methods to incorporate a used/unused sampling strategy, and included a coarse measure of survey effort (number of point count stations within a square kilometre) to mitigate bird detection biases that may have resulted from varying survey effort within a sample unit. I also redid the models with the "used/unused" approach for the 11 focal species in my thesis.

I derived "unused" samples for a species by selecting square kilometres within Y2Y whose point count locations were associated with the species' primary or secondary habitat types, and at which no survey point detected the species. I allowed the number of "unused" samples to be up to double the number of "used" samples, randomly selecting the "unused" samples from all possible candidates if their number needed to be reduced. I was unable to derive sufficient "unused" samples for Brewer's Sparrow, as the habitat classification I was using identified little sagebrush steppe habitat within Y2Y. Instead, I developed an RSF model for Brewer's Sparrow using the available/used approach. Brewer's Sparrow was well sampled throughout its geographic range, so artefacts due sampling bias were likely reduced in this species.

3. Results

3.1 Models

The models for the 20 focal birds explained from 10.5% (Brown Creeper) to 77.0% (Lewis' Woodpecker) of the deviance (Table 4). The average deviance explained was 32.8%. The models included from 2 to 11 significant predictors ($p < 0.05$). Seventy one percent of predictor relationships were non-linear, with second order polynomials predominating. Geographic location, precipitation, elevation, variation in precipitation and temperature, and at least one measure of average or variation in primary productivity were important predictors in several models. Distance to the nearest industrial site (mine, oil or gas well) was significant in 12 species, with 9 birds avoiding these structures. Survey effort was an important predictor in 10 species, although the expected positive relationship occurred in only 6 species. One striking result was that different species responded to different combinations of predictor variables, and often had quite different response curves to a predictor.

3.2 Species and habitat suitability maps

The species habitat ranking maps (PowerPoint presentation "Species Habitat Suitability Maps") showed the most suitable habitat tended to be patchy and spread throughout a species' range. This may be reflecting the patchy nature of many habitat types that were modelled (e.g. marsh, bog, riparian and lakes), and the variation in topography and associated climatic conditions that occur over short distances in mountainous terrain. Concentrations of high quality habitat could be seen, however, for most species. Species generally showed little overlap among the most suitable habitat, with the exception of the following two areas in the Y2Y region:

i. The extreme northwest corner of Y2Y in the Yukon Territory (American Tree Sparrow, Blackpoll Warbler, Golden Eagle, Gray-crowned Rosy-Finch, Spotted Sandpiper, White-crowned Sparrow and Yellow Warbler)

ii. North-central British Columbia (American Dipper, American Wigeon, Common Loon, Gray-crowned Rosy-Finch, Ruffed Grouse, White-crowned Sparrow and Wilson's Warbler)

The regions of high quality habitat shared some common biophysical traits (Table 5). These included low to moderate elevation, relatively high numbers of growing degree days for the north, moderate precipitation and high average primary productivity (NDVI).

The maps for the best quality habitat in each habitat cover type indicated similar patterns to the species habitat maps (PowerPoint presentation "Habitat Quality Maps"). The high quality habitat in the northwest part of Y2Y (Yukon Territory) was due to high quality alpine, deciduous riparian and northern shrubfields habitat. Alpine, all riparian habitats, lakes, and northern shrubfields also showed a concentration of high quality habitat in north-central British Columbia. When similar habitats were combined in a map, some additional concentrations of high quality habitat were apparent. The map for alpine, subalpine and northern shrubfields showed some patches in Wyoming. Bog, lakes and wetland habitats showed a concentration around Williston Lake, and scattered patches throughout southern Y2Y. Grasslands and sagebrush steppe also had scattered patches of high quality habitat throughout southern Y2Y. The forest habitat types had some large patches in south central BC, along the southern Alberta-BC border, in south Yukon, and on the eastern border of Y2Y in the NWT, and around Dawson Creek, B.C. The riparian habitats had several large patches of good habitat in the north part of Y2Y, and showed more scattered patches in the south.

3.3 Most suitable habitat protection

The amount of highest quality habitat that was covered by protected areas ranged from 4.3% for boreal mixed wood to 68.6% for whitebark pine (Table 6). Alpine/tundra, bog, coniferous riparian, ponderosa pine and subalpine spruce/fir were represented quite well by protected areas having > 20% of their prime habitat protected. Aspen, boreal spruce, deciduous riparian, grassland and wetland habitats were poorly protected with less than 10% of their prime habitat overlapped by protected areas.

4. Discussion

The broad-scale modelling approach to predict habitat quality was an effective method to address the large size of the Y2Y region, and the poor survey data in the northern half, that made it logistically impossible to directly determine avian habitat quality by measuring bird habitat use and breeding success. The broad-scale modelling approach allowed the use of Geographic Information System (GIS) layers as predictors that were provided by various agencies rather than time consuming and expensive field surveys. The models demonstrated that birds in the Y2Y ecoregion are broadly associated with climatic and topographic features. Other studies have also found temperature, precipitation, geographic location and elevation to be important predictors of bird species distribution[9,10,11]. I found that most of these factors had non-linear relationships with focal bird occurrence, and it is important to realize that high levels of these factors do not necessarily correspond to a high probability of species occurrence. Simply looking for high levels of these factors within Y2Y will not identify high quality bird habitat.

The species occurrence models varied considerably in explanatory power. My approach assumed that variation in a bird's occurrence resulted from the direct effects of relatively few habitat factors, such as climate, topography and vegetation[12]. However, most bird-habitat models explain only a portion of the variance[13], as habitat selection occurs over multiple scales. My models also did not incorporate the effect of historical factors such as past climatic or geological events on the distribution of organisms[14]. Some of the models with poor explanatory power, such as those for Clark's Nutcracker and Common Loon, are for species that are closely associated with specific habitat types. For example, Clark's Nutcracker is found where there is whitebark pine, and other predictors may not be important (pers. comm. Cyndi Smith). Similarly the Common Loon is strongly associated with lakes of specific size, depth and shoreline composition[15]. These factors may override biophysical factors in explaining its occurrence.

One drawback to a modelling approach is that the high quality habitat I identified was based on several assumptions and subject to sources of error. Since the bird survey data were sparse in northern and high elevation habitats, the "used" samples likely did not sample the full ranges of the response curves and all environmental combinations for the predictors used in my models. I performed an exhaustive search to locate data in missing regions of Y2Y, but there are little available. The bias in the bird survey data may have produced truncated response curves that did not reflect the true relationship between a predictor and the species occurrence[16], and may also have weakened model predictions, as multiple regression models that predict species occurrence are based on the relationship between the species' detections and associated values of predictor variables. This means that the model is only useful over the numerical range of the habitat variables used to construct the model, and predictions resulting from extrapolation beyond these ranges are unreliable[17]. Thus, model predictions of high quality habitat in the northern half of Y2Y are weak and should be treated with caution. As well, using the regression models of umbrella species occurrence to predict high quality avian habitat assumes that the response curves for an umbrella species are the same as those for the species it represents. Modelling species assumed to be protected by an umbrella and then comparing the response curves could test this assumption. Modelling target species would also allow predictions of high quality habitat for a "protected" species to be used to test how effectively the high quality habitat for an umbrella overlaps that for species it aims to protect.

The North America seasonal land cover data classification[18] that I used is estimated to be about 75% accurate[19]. The whitebark pine layer I used was of uncertain origin and accuracy. As well, the riparian habitat cover type GIS layers that I constructed were based on broad scale GIS stream layers that did not include small streams, thus potential riparian habitat was underrepresented. In particular, the stream GIS layers for Montana and Oregon showed a much lower stream density than other states, even though the stream GIS layers were at the same scale. This meant that riparian habitat in Montana and Oregon was underrepresented even more. I used the land cover classes to identify "unused" species samples, and for model extrapolation throughout Y2Y. The inaccuracies in habitat cover type certainly introduced errors in identifying unused samples for a species, and likely caused the locations of some of the high quality avian habitat for a Y2Y habitat cover type to be incorrectly identified.

5. Management recommendations and future work

1. Several habitat types (alpine/tundra, bog, coniferous riparian, ponderosa pine, subalpine spruce/fir and whitebark pine) were well covered by existing protected areas in Y2Y. However, aspen, boreal mixed wood, boreal spruce, deciduous riparian, grassland and wetlands were poorly protected, and some planning effort should be directed at conserving the high quality habitat identified for these cover types. My analysis did not assess how habitat protection was distributed across Y2Y or partitioned among Y2Y ecological priority areas. This would be worth analyzing to verify that all habitat types are protected throughout their range in Y2Y.

2. My models were weakened by the scarcity of bird surveys in northern and high elevation areas. This sampling bias may have introduced substantial error into the models' predictions of high quality habitat locations. Furthermore, the lack of survey data also meant that I could not test model predictions on independent data. I used survey data from several different sources with a variety of survey protocols. The variation of sample effort across the bird data also introduced error into the models. Thus, it is imperative to do some level of ground-truthing to verify that the high quality habitat identified by the models within each Y2Y habitat cover type does indeed correspond to good bird breeding season habitat for both the focal birds representing the habitat type and their target species.

3. I performed an exhaustive search to locate data in poorly sampled regions of Y2Y, but there are little available. I recommend that Y2Y try to establish collaborations with conservation groups and researchers to obtain more representative survey data and redo the models with these additional data.

4. A broad scale modelling approach has limitations in predicting distributions for microhabitat specialists whose habitat needs cannot be modelled at a broad scale. These Y2Y conservation priority species include those requiring banks and cliffs for nesting sites (Prairie Falcon, Peregrine Falcon, Bank Swallow and Northern Rough-winged Swallow).

5. Specific management plans should be considered for Y2Y conservation priority species that are Canadian species at risk, i.e. endangered (Burrowing Owl, White-headed Woodpecker, Sage Grouse), threatened (Loggerhead Shrike) and species of special concern (Short-eared Owl, Ferruginous Hawk, Flammulated Owl, Lewis' Woodpecker, Long billed Curlew, Tundra Swan and Peregrine Falcon), as well as American endangered/threatened species (Bald Eagle). These species may also require specific habitat features to ensure their persistence that were not considered in the identification of high quality avian habitat by my models.

6. Using regression models of umbrella species occurrence to predict high quality avian habitat assumes that the response curves for an umbrella species are the same as those for the species it represents. It is imperative to test this assumption by modelling some species assumed to be protected by an umbrella, and then comparing the response curves. Predictions of high quality habitat for a "protected" species could also then be used to test how effectively the high quality habitat for an umbrella overlaps that for species it aims to protect.

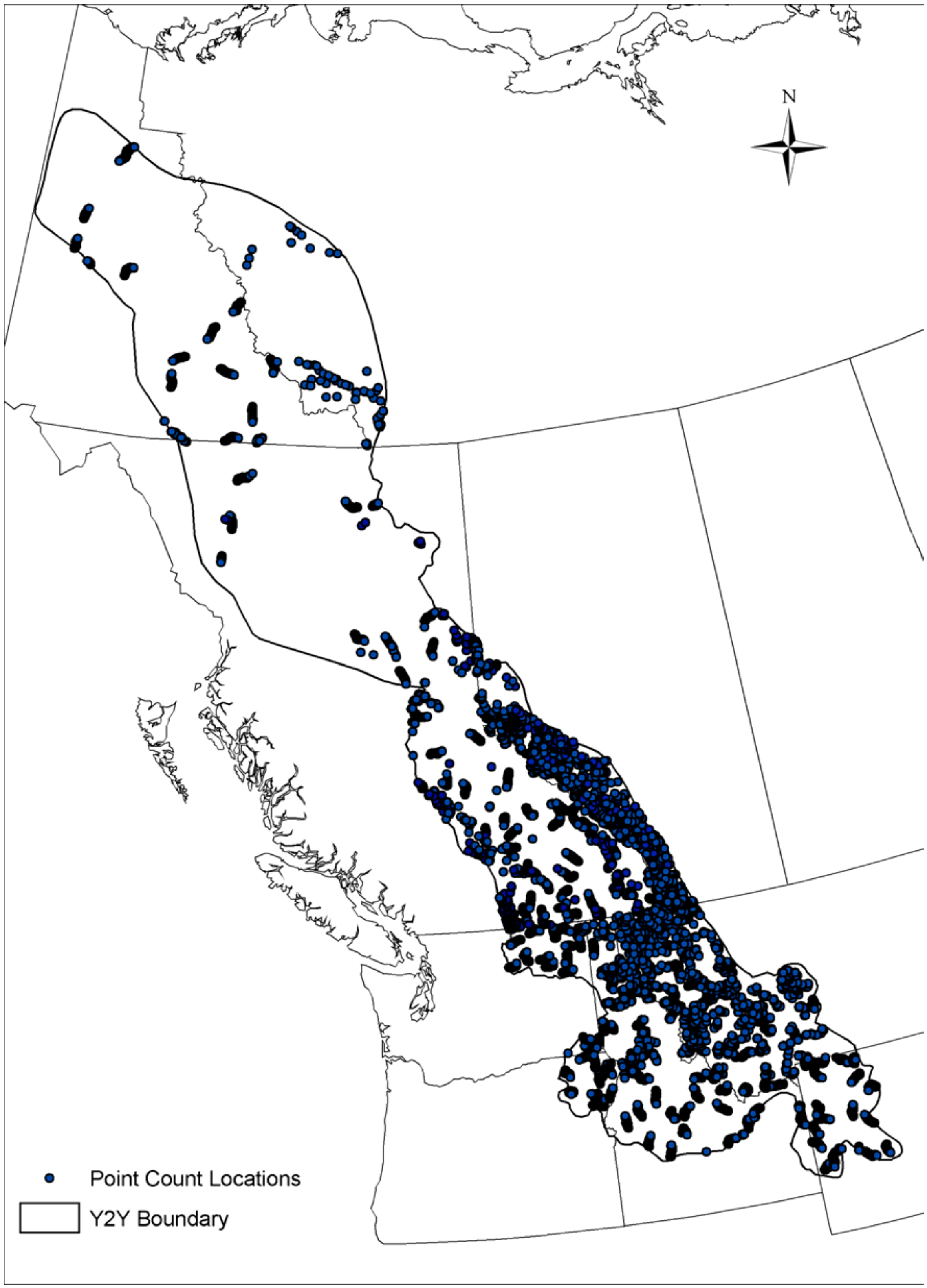

Figure 1: Point count locations (N = 18,700) for all bird survey data collected throughout the Y2Y region.

Table 1: Nineteen Y2Y broad-scale habitat cover types used by bird communities within the Y2Y region. These are based on cover types identified by Montana Partners in Flight as important to bird conservation, and extended by the Y2Y avian working group to include missing northern habitats.

Alpine/Tundra
Aspen
Boreal mixed wood (spruce/pine/aspen)
Boreal spruce (predominantly black and white spruce)
Cedar/Hemlock
Coniferous riparian
Deciduous riparian
Dry ponderosa pine/Douglas fir mix
Grassland
Lakes
Lodgepole pine
Marsh
Moist Douglas fir/Mixed/Grand fir
Northern shrubfields (willow/birch/alder shrubs)
Sagebrush steppe
Spruce/tamarack bog
Subalpine spruce/fir
Whitebark pine
Willow riparian

Table 2: Twenty focal bird species used to determine high quality breeding season habitat within Y2Y. Primary habitat is indicated in **BOLD.** The 11 species used for the first round of model development are indicated in **BOLD.**

Focal Bird Species	**# of Detections**	**Habitat types**
American Dipper	151	**Coniferous Riparian** specialist
American Tree Sparrow	146	**Northern Shrubfields, Alpine/Tundra**
American Wigeon	128	**Marsh**; **Lakes**
Blackpoll Warbler	235	**Boreal Spruce**; Bog; Marsh, Subalpine Spruce/Fir
Brewer's Sparrow	960	**Sagebrush Steppe** specialist
Brown Creeper^{+}	509	**Cedar/Hemlock, Subalpine Spruce/Fir**, Lodgepole pine, Moist Douglas fir/Mixed/Grand fir
Cassin's Vireo	1287	**Moist Douglas fir/Mixed/Grand fir**; Lodgepole pine, Aspen
Clark's Nutcracker	1180	**Whitebark pine**; Subalpine Spruce/Fir; Dry Ponderosa pine/Douglas fir mix
Common Loon	220	**Lake** specialist
Golden Eagle	66	**Subalpine Spruce/Fir; Grassland**; Alpine/Tundra
Grasshopper Sparrow	158	**Grassland** specialist
Gray-crowned Rosy-Finch	60	**Alpine/Tundra** specialist
Lewis' Woodpecker	53	**Dry Ponderosa Pine/Douglas fir mix**; Deciduous Riparian
Long-billed Curlew	280	**Grassland**; Sagebrush Steppe
Ruffed Grouse	921	**Aspen**; Deciduous Riparian; Willow Riparian; Boreal Mixed Wood
Spotted Sandpiper	944	**Deciduous Riparian,** Lakes, Coniferous Riparian
Veery	635	**Deciduous Riparian**, Aspen
White-crowned Sparrow	1756	**Subalpine;** Alpine/Tundra, Northern Shrubfields
Wilson's Warbler	1550	**Bog, Deciduous Riparian; Willow Riparian;** Northern Shrubfields
Yellow Warbler	2598	**Willow Riparian, Deciduous Riparian**, Marsh, Boreal Mixed Wood

Table 3. Biophysical and anthropogenic variables used as predictors in focal species models, and to extrapolate the models throughout the Y2Y region. All variables were represented as 1 square kilometre raster grids except NDVI data that was at 500m resolution.

Variable Code	**Description**
AET	Actual evapotranspiration for Canada
ndavsea	NDVI average for May 9 to September 13, 2001-2003
ndavmj	NDVI average for May 9 to June 9, 2001-2003
ndavjj	NDVI average for June 10 to July 11, 2001-2003
ndavja	NDVI average for July 12 to August 12, 2001-2003
ndavas	NDVI average for August 13 to September 13, 2001-2003
ndsdsea	NDVI standard deviation for May 9 to September 13, 2001-2003
ndsdmj	NDVI standard deviation for May 9 to June 9, 2001-2003
ndsdjj	NDVI standard deviation for June 10 to July 11, 2001-2003
ndsdja	NDVI standard deviation for July 12 to August 12, 2001-2003
ndsdas	NDVI standard deviation for August 13 to September 13, 2001-2003
Elevation	Elevation (m)
TEMPSEAS	Average temperature seasonality from 1970 - 2001
PRECIPSEAS	Average precipitation seasonality from 1970 - 2001
DAY1GROW	Average Julian day number of start of growing season
ENDGROW	Average Julian day number of end of growing season
GDD	Growing degree days above 5 degrees Celsius base temperature during the growing season
Precipitation	Total precipitation (mm) during the growing season
Easting	UTM Easting for the sample unit
Northing	UTM Northing for the sample unit
IndustDis	Distance from a bird point count location within a sample unit to nearest mine/oil or gas well in m
PerWet	Percentage of wetland
StreamLen	Total metres of stream
StreamDis	Distance from a bird point count location within a sample unit to the nearest stream (m)
NumStations	Number of point count stations within a square kilometre sample unit.

Table 4: Species Model Results (parameters shown have $p<0.05$) in decreasing order of significance. Superscripts denote the type of non-linear transformation used for the predictor: natural log transformation^1, second order polynomial^2, third order polynomial^3 and threshold^4 (value).
NumStations(+) denotes positive effect of number of point count stations per square kilometre.
NumStations(-) denotes negative effect of number of point count stations per square kilometre.

Species	**% Deviance Explained**	**Predictor Variables**
American Dipper	15.3	Easting^2, PRECIPSEAS^2, NumStations(-), PerWet, ndavmj
American Tree Sparrow	51.1	ENDDAYGROW^2, TEMPSEAS^2, Precipitation^2
American Wigeon	20.4	Northing^3, PRECIPSEAS^2, ndavmj^2, ENDDAYGROW^4 (295), PerWet^1
Blackpoll Warbler	31.4	PRECIPSEAS^2, Northing^2, DAY1GROW^2, Elevation^4(1575), AET, Precipitation^2, ndsdmj
Brewer's Sparrow	36.9	ndavja^3, Easting^3, Elevation^2, TEMPSEAS^2, IndustDis^2, ndsdja, PRECIPSEAS^4 (30)
Brown Creeper	10.5	Ndavsea, IndustDis^2, NumStations(+), TEMPSEAS^2, ENDDAYGROW^2, ndsdas^4 (0.15), ndsdmj, Northing^2
Cassin's Vireo	25.3	GDD^2, Easting^3, Precipitation^2, ndsdsea^2, PRECIPSEAS^1, IndustDis^2, NumStations(-)
Clark's Nutcracker	15.5	Easting^2, PRECIPSEAS^2, NumStations(+), DAY1GROW^2, TEMPSEAS^3, ndavas, ndsdas, ndsdsea^2, Precipitation^4(290), ndsdjj, IndustDis
Common Loon	21.7	Elevation^4 (1400), Precipitation^4 (325)
Golden Eagle	14.8	ndavmj^2, ndsdas^3, Precipitation^2, ENDDAYGROW^2, TEMPSEAS^2, ndsdja, NumStations(-)
Grasshopper Sparrow	59.3	Northing^2, ndavja, ndsdsea, PRECIPSEAS^3, Precipitation^2, Elevation^2, IndustDis
Gray-crowned Rosy-Finch	59.1	TEMPSEAS^2, GDD^2
Lewis' Woodpecker	77.0	ndavas, Elevation^2, Northing^2, TEMPSEAS^2
Long-billed Curlew	40.9	Northing^3, ndsdsea, Easting^2, IndustDis^2, ndavmj, PerWet, ndsdjj, Precipitation^2, NumStations(-)
Ruffed Grouse	34.7	Northing^2, ndavas^3, Elevation^3, NumStations(+), IndustDis, PRECIPSEAS^2, ndsdas^2, Precipitation^2, ENDDAYGROW^3
Spotted Sandpiper	13.8	Northing^2, IndustDis^2, ndavas ^{4} (0.7), NumStations(-), elevation^3, ndavmj^1, Precipitation^1, ndsdas
Veery	42.7	Northing^2, IndustDis, ndsdsea^2, GDD, Precipitation^2, TEMPSEAS^2, ndavjj^2, ndsdas^2
White-crowned Sparrow	22.3	Easting^2, IndustDis^2, Precipitation^2, NumStations(+), PRECIPSEAS^3, Day1Grow^3, ndsdas^4 (0.11)
Wilson's Warbler	25.7	Elevation^3, Easting^3, ndavas^1, PRECIPSEAS^4(35), NumStations(+), ndsdjj, ndsdas, IndustDis^2, ndsdsea

Species	% Deviance Explained	Predictor Variables
Yellow Warbler	37.2	Northing[2], IndustDis[2], PerWet[1], elevation, PRECIPSEAS[3], Precipitation[2], NumStations(+), ndsdas[2]

Table 5: Mean values for biophysical factors found in the two areas of high quality avian habitat. The range of the biophysical factor throughout the Y2Y ecoregion is shown for comparison.

Biophysical Factor	Range	Yukon	BC
Elevation (m)	76 - 3932	861	1331
Growing Degree Days	0 - 2753	445	437
Growing Season Precipitation (mm)	17 - 553	177	271
Temperature Seasonality	2.3 – 6.3	5.8	3.4
Precipitation Seasonality	10 - 74	54.2	31.9
Start Growing Season (Julian Day)	57 - 204	151	148
End Growing Season (Julian Day)	212 - 343	251	269
Length Growing Season (Days) [Start – End]	NA	100	121
Average Primary Productivity (NDVI)	-0.85 to 0.95	0.65	0.56

Table 6: Percent of "Best" habitat by Y2Y habitat cover type in protected areas by IUCN categories (1,2, 4 and 5)[1] (IUCN 2004). IUCN category 3 (Natural Monument, 2 sites in Y2Y) only protected 0.2% of prime sagebrush steppe habitat. IUCN category 6 (Managed Resource Area, 1 site in Y2Y) did not overlap with any high quality habitat for a cover type.

Y2Y Habitat Cover Type (Most Suitable Habitat Area km^2)	1: Strict Nature Reserve	2: National Park	4: Habitat/ Species Management Area	5: Protected Landscape/ Seascape	No Designation	Total % of most suitable habitat protected
Alpine/Tundra (45183)	2.0	18.3			2.0	22.0
Aspen (14309)	1.2	2.3	0.2	0.2	1.2	5.2
Bog (946)	1.6	18.4			0.9	20.9
Boreal Spruce(15610)	0.2	7.9			0.4	8.5
Cedar Hemlock (4274)	3.6	11.1	0.1	0.3	1.5	16.7
Coniferous Riparian (47096)	10.9	14.3		1.2	2.5	28.8
Deciduous Riparian (46283)	0.6	3.2			1.7	5.6
Douglas Fir (13757)	0.9	8.6	0.1	0.1	1.7	11.4
Grassland(9209)	1.4	1.8	0.3	0.4	1.2	5.0
Lakes (13665)	5.0	10.2		0.9	0.8	17.0
Lodgepole (9595)	1.6	9.7	0.1	0.1	1.5	13.0
Mixed Wood (8027)	0.7	2.5	0.1	0.1	0.9	4.3
Northern Shrubfields (33669)	1.4	14.5			2.3	18.2
Ponderosa (5765)	17.6	7.2	0.7	0.9	1.6	28.1
Sagebrush (1999)	4.7	12.1	0.4	0.2	0.4	18.0
Subalpine (10965)	19.3	14.8	0.1	0.1	1.3	35.5
Wetlands (3274)	0.7	5.3	0.9	0.1	1.6	8.6
Whitebark Pine (280)	58.3	10.2			0.1	68.6
Willow Riparian (6501)	0.1	9.2			1.1	10.4

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