

Using avian species monitoring and map-based data in a coarse-filter approach to sustaining biodiversity

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Abstract

The coarse-filter approach to sustaining biological diversity attempts to maintain all representative ecosystems and wildlife habitats within an ecological region or a management unit. Ideally, the approach uses information that is simple to acquire or readily available. For Tree Farm Licence (TFL) 48 in northeastern British Columbia, we describe a coarse-filter approach that combines bird monitoring data with vegetation resources inventory (VRI) and Biogeoclimatic Ecosystem Classification (BEC) data to develop statistical relationships between species occurrences and broad habitat types. The resultant models can be readily added to existing geographical information system (GIS) databases to scale up habitat suitability estimates to the regional (tenure) level. We found that habitat types based on forest cover/age class were a better predictor of habitat suitability than BEC variants for most species, but together the two classification systems provided more information for predicting species occurrences. Forest cover/age class would also provide managers with specific attributes of the landscape that could be manipulated through management actions. The ability to treat space explicitly using habitat-based models is necessary because relationships developed for individual species indicate that no management strategy will accommodate all species in all planning units. For this reason, the ability to link the models to existing databases should greatly facilitate conservation planning. Implementation of this approach could consider all terrestrial vertebrates and other organism groups within a management area.

KEYWORDS: *age class, biodiversity, biogeoclimatic variant, coarse filter, forest cover, forest songbirds, habitat suitability, monitoring.*

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Introduction

The conservation of native biodiversity in managed forests depends on the successful application of coarse- and fine-filter conservation strategies (Noss 1987). Coarse-filter strategies attempt to maintain all representative ecological systems or wildlife habitats within an ecological region or a management unit (Hunter *et al.* 1988; Haufler *et al.* 1996). Fine-filter strategies focus on the conservation of elements not captured by the coarse filter, such as vulnerable communities and species at risk. The strategies complement each other and are known as the “coarse-filter/fine-filter” approach to biodiversity conservation. When developing a coarse-filter approach, it is necessary to address as many species as possible using measures that are simple to acquire or that may already be available (e.g., monitoring data).

To be practical, results of biodiversity monitoring programs must be general enough for scaling up to a larger management area. One way of doing that is to exploit maps or layers within geographic information systems (GIS) that many companies use to record and analyze conditions within their management areas. Such map-based data can be combined with monitoring data to develop statistical relationships between species occurrences and habitat attributes using a variety of approaches, such as resource selection functions (Boyce and McDonald 1999; Guisan and Zimmermann 2000). Recent studies have applied similar approaches using ecosystem and forest cover maps (Scott *et al.* [editors] 2002; Wielgus and Vernier 2003; Johnson *et al.* 2004). In most cases, the resultant models can then be linked to a GIS to facilitate a coarse-filter assessment of biodiversity.

We describe a coarse-filter approach that uses available map-based inventory data to extend the results of ongoing large-scale species monitoring in northeastern British Columbia. The main objectives of the monitoring program are to (1) allow coarse-filter assessment of biodiversity over large areas, (2) detect trends in relative abundance, and (3) aid effectiveness monitoring by linking species trends to broad habitat or treatment types.

Our approach is part of the species accounting system for northeastern British Columbia being developed jointly by the University of British Columbia, Canadian Forest Products Ltd. (Canfor), and the B.C. Ministry of Environment (Bunnell and Vernier 2007). Species within the system are assigned to the least-costly form of monitoring appropriate to their natural history. The accounting system incorporates five species groups de-

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termined by their response to forest practices and their accessibility to monitoring:

- Group 1: generalist species that inhabit many habitat types or respond positively to forest practices
- Group 2: species that can be statistically assigned to broad forest types (e.g., older conifer stands)
- Group 3: species with strong dependencies to specific elements (e.g., snags or shrubs) that may be useful in effectiveness monitoring
- Group 4: species restricted to specialized and highly localized habitats
- Group 5: species for which patch size and connectivity are important (patches > 2 ha)

Several species that are known or expected to occur in the area but are not dependent upon forested environments, are not included in the classification.

A major premise of our approach is to keep the accounting system as simple and as cost effective as possible, and to introduce refinements as data suggest. The intention of the accounting system is not to accommodate all species within the map-based classes, so classes were deliberately kept broad (e.g., forest cover coupled with age class). This paper explicitly addresses Groups 1 and 2.

We focus on applying the coarse filter over large areas with two objectives in mind:

1. to quantify the relationship between species occurrences and broad habitat types using BEC variants and forest cover/age class (herein referred to as FOR); and
2. to illustrate the use of the species-habitat relationships to scale up habitat suitability estimates from the local level (individual stands/polygons) to the regional level.

Although the approach considers all terrestrial vertebrates as well as other organism groups, we used birds, the richest forest vertebrate group, to illustrate its application.

Methods

Study Area

The study area is Tree Farm Licence (TFL) 48 located within the southern half of the Peace Forest District in northeastern British Columbia (Figure 1). TFL 48 consists of harvested and unharvested forests that lie within the boreal white and black spruce (BWBS), sub-boreal spruce (SBS), and Englemann spruce–subalpine fir (ESSF) Biogeoclimatic Ecosystem Classification (BEC) zones (Table 1; Meidinger and Pojar [editors] 1991). Alpine tundra (AT) occurs at higher elevations along the eastern slopes of the Rocky Mountains, in the western half of the study area. All bird survey routes were located in the BWBSmw1, BWBSwk1, ESSFmv2, ESSFwk2, and SBSwk2 variants (see Table 1 for descriptions of the variants). Variants are currently the finest resolution data available within the BEC system over large geographic areas and reflect local variation in climatic and edaphic factors within particular zones and subzones. The major merchantable tree species in the study area are lodgepole pine (*Pinus contorta*), subalpine fir (*Abies lasiocarpa*), white spruce (*Picea glauca*), trembling aspen (*Populus tremuloides*), and spruce hybrid (*Picea* spp).

Bird Surveys

Data on avian abundance were derived from point-count surveys conducted annually in four summers from 2002–2005 (Preston *et al.* 2006). Methodology for the surveys was adapted from Bystrak (1981) and Sen (1981). Fifteen bird survey routes were located along mainline logging roads in and adjacent to TFL 48. All routes but one were 40 km long with 800 m between

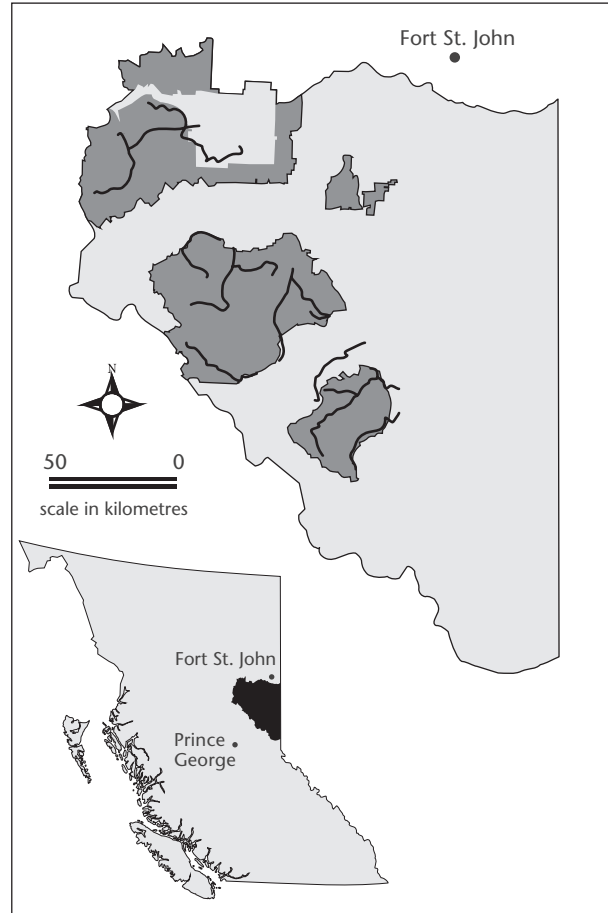


FIGURE 1. Location of bird survey stations in and around TFL 48 (shaded polygons) within the southern half of the Peace Forest District TSA in northeastern British Columbia. Only stations located inside the TFL were used in the analyses.

TABLE 1. Description, area, and number of bird survey stations in each BEC subzone/variant in TFL 48

BEC subzone/variant	Zone description (subzone/variant)	Area (ha)	Area (%)	Stations ^a
ATund	Alpine Tundra (undefined)	53 149.50	8.16	0
BWBSmw1	Boreal White and Black Spruce (moist warm/Peace)	132 505.50	20.34	220
BWBSwk1	Boreal White and Black Spruce (wet cool/Murray)	41 214.25	6.33	39
ESSFmv4	Englemann Spruce–Subalpine Fir (moist very cold/Graham)	66.25	0.01	0
ESSFmv2	Englemann Spruce–Subalpine Fir (moist very cold/Bullmoose)	155 247.75	23.83	56
ESSFwk2	Englemann Spruce–Subalpine Fir (wet cool/Misinchinka)	162 382.50	24.92	75
ESSFwk2	Sub-boreal Spruce (wet cool/Finlay–Peace)	106 962.25	16.42	436

a For the analyses, each station consisted of two observations, one each on the right and left side of the road.

TABLE 2. Description, area, and number of bird survey stations in each FOR in TFL 48

Habitat class	Description	Area (ha)	Area (%)	Stations ^a
Nonfor	Non-forested, non-vegetated, and water	83 330.00	12.76	0
Recent < 30 yrs	Recently disturbed stand types (e.g., clearcuts ≤ 30 yrs)	48 282.32	7.39	224
Decid 31–90 yrs	Deciduous forest 31–90 yrs (≥ 75% decid species)	28 170.74	4.31	26
Decid > 90 yrs	Deciduous forest > 90 yrs (≥ 75% decid species)	33 481.11	5.13	64
Conif 31–90 yrs	Coniferous forest 31–90 yrs (≥ 75% conifer species)	68 419.85	10.48	64
Conif > 90 yrs	Coniferous forest > 90 yrs (≥ 75% conifer species)	348 375.70	53.34	378
Mixed 31–90 yrs	Mixedwood forest 31–90 yrs (< 75% decid or conifer species)	14 237.11	2.18	15
Mixed > 90 yrs	Mixedwood forest > 90 yrs (< 75% decid or conifer species)	28 846.47	4.42	55

a For the analyses, each station consisted of two observations, one each on the right and left side of the road.

sampling stations; one route was shortened to 25 km for logistic reasons. There were a total of 725 sampling stations. Because of limited road access, private lands, and gated roadways transect start points could not be randomly selected. For our analysis of bird and forest habitat relationships we eliminated data from stations located: (1) outside of TFL 48 (for which no vegetation resources inventory (VRI) data were available), and (2) in non-vegetated or non-forested cover types. This resulted in 413 point-count stations that were georeferenced and linked to a spatial database that included VRI and BEC data. Point counts were conducted once each summer, enabling us to survey a much larger area than would be possible with repeated sampling of the same routes.

Upon arrival at a station, observers recorded all birds seen and heard during a 3-minute sampling interval within 50 and 50–200 m distance classes. Only detections within 50 m were used for this analysis because these are likely to be more robust to false negatives (i.e., not detecting a species when it is present). All individuals detected at a station were recorded as being on the right or left side of the road, and movements during the 3-minute sampling period noted, ensuring that individuals were recorded only once. Preston and Campbell (2003) and Preston *et al.* (2006) provide additional details on the survey protocol. The appendix provides common and scientific names for the species analyzed.

Data Preparation and Habitat Types

Data preparation consisted of five broad steps. First, we assembled relevant data (VRI, BEC variants, and bird surveys) into ArcView and Microsoft Excel. Second, we used the VRI data to create a habitat field based on forest cover and age classes (Table 2). Third, for each bird survey station, we digitized an additional point to the left and right of the road (within 50 m) to enable us to link individual bird detections to a specific habitat type (BEC variant and FOR). This was only possible where the area within 50 m of the left or right side of the road comprised one habitat polygon. Detections that could not reliably be located in one habitat polygon were not used in the analysis. Fourth, we intersected the bird survey locations (right and left detections) with the VRI and BEC coverages. Finally, we exported all of the intersected data to ASCII files for subsequent statistical analysis using Stata (Stata Corporation 2005). There were 413 stations (826 left and right side detection points) located along logging roads.

Data Analysis

Species Occurrence and Habitat Type

For our first objective, we tabulated and graphed species occurrences by FOR and BEC variant. For each species, we calculated a standardized selection index (Manly *et al.* 2002) that represented the ratio of observed to expected use of each habitat type. This indicates the extent to which species are selecting habitat types in proportion to their availability. We used a Chi-square test to determine whether selection across all habitat types was non-random (Manly *et al.* 2002). We also calcu-

