Nest Habitat Selection of Western Screech-Owls (*Megascops kennicottii macfarlanei*) at Multiple Spatial Scales in Southeast British Columbia

Discussion Paper

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Abstract

The interior Western Screech-Owl (*Megascops kennicottii macfarlanei*) has been assessed as a species at risk. Regionally, survival rates are low, particularly during nesting. This study uses forward stepwise logistic regression to assess habitat selection at the tree, patch (150m^2), and stand scales for twelve nests (the largest sample in any one region). At the patch scale, nest sites had more coniferous cover (33% versus 16%) than random. At the stand level, owls selected medium-age forests within an agricultural landscape, highlighting the need to conserve these habitats. While black cottonwood (*Populus trichocarpa*) and trembling aspen (*P. tremuloides*) are important nest tree species, riparian forests with coniferous cover, particularly western redcedar (*Thuja plicata*), may be more important for nesting in regional populations than previously realized.

KEYWORDS: Western Screech-Owl; *Megascops kennicottii macfarlanei*; radio telemetry; nest; habitat selection; spatial scale; coniferous; British Columbia

Introduction

In Canada, the interior Western Screech-Owl (*Megascops kennicottii macfarlanei*), confined to southern British Columbia, is assessed federally as threatened (COSEWIC 2012). Provincially it is red-listed (BCCDC 2016) and managed under the Identified Wildlife Management Strategy (B.C. Ministry of Water, Land and Air Protection 2004). Provincial population declines have been primarily driven by low-elevation habitat loss and degradation (COSEWIC 2012). The population in the West Kootenay region has low annual survival (50%, n = 19), and specifically low female survival (28%, n = 10) during nesting, a time when owls are most conspicuous (Hausleitner et al. 2015). As owl survival can vary with habitat quality (Dugger et al. 2005; Hakkarainen et al. 2008), it is imperative to understand habitat selection to prioritize habitat for protection, enhancement, or restoration.

Animals select resources at different scales depending on what is available to them (Johnson 1980); multiple scale analysis provides greater depth to understanding habitat use patterns (Mayor et al. 2009). Western Screech-Owl nests typically occur in natural cavities that are large in diameter— > 25 cm diameter at breast height (DBH)—in deciduous trees such as black cottonwood (*Populus trichocarpa*), trembling aspen (*P. tremu-*

Hausleitner, D., Dulisse, J., Manley, I., & Waterhouse, I., 2017. Nest Habitat Selection of Western Screech-Owls (*Megascops kennicottii macfarlanei*) at Multiple Spatial Scales in Southeast British Columbia. *Journal of Ecosystems and Management 17*(2):1–8.
http://jem-online.org/index.php/jem/article/view/592/512

loides), paper birch (*Betula papyrifera*), and water birch (*B. occidentalis*) occurring in riparian areas (Cannings & Angell 2001; COSEWIC, 2012). No other studies in British Columbia have examined nest site selection beyond the nest tree. The objectives of this study were to document Western Screech-Owl habitat selection at nest sites at the tree, patch, and stand scale, to better inform habitat conservation for this species.

Method

Seventeen adult owls were captured, radio-tagged, and released at 12 territories from 2009–2012 as part of a research study in southeastern British Columbia (Hausleitner et al. 2015). These territories were in low elevation (< 1000 m) riparian areas within the Southern and Central Columbia Mountains and Southern Purcell Mountains ecosections (Demarchi 1995) (see Figure 1). They are within the West Kootenay Dry Warm Interior Cedar Hemlock biogeoclimatic zone (ICHxw, ICHdw1 variants) (MacKillop & Ehman 2016). This forest ecosystem contains a diversity of tree species, including Douglas-fir (*Pseudostuga menziesii*), western hemlock (*Tsuga heterophylla*), lodgepole pine (*Pinus contorta*), western redcedar (*Thuja plicata*), grand fir (*Abies grandis*), paper birch, ponderosa pine (*P. ponderosa*), trembling aspen, and black cottonwood; common snowberry (*Symphoricarpos albus*), beaked hazelnut (*Corylus cornuta*), chokecherry (*Prunus virginiana*), tall Oregon grape (*Mahonia aquifolium*), falsebox (*Paxistima myrsinites*), Saskatoon (*Amelanchier alnifolia*), red-osier dogwood, (*Cornus stolonifera*), thimbleberry (*Rubus parviflorus*), and Douglas maple (*Acer glabrum*) are common shrubs. Owls were directly tracked to nest sites using an H-antenna and Lotek STR 1000 receiver (Newmarket, Ontario). A wireless camera (TreeTopPeeper; Sandpiper Technologies, Inc, Manteca, California) was used to assess whether old nest cavities were occupied and evaluate the presence and status of nestlings.

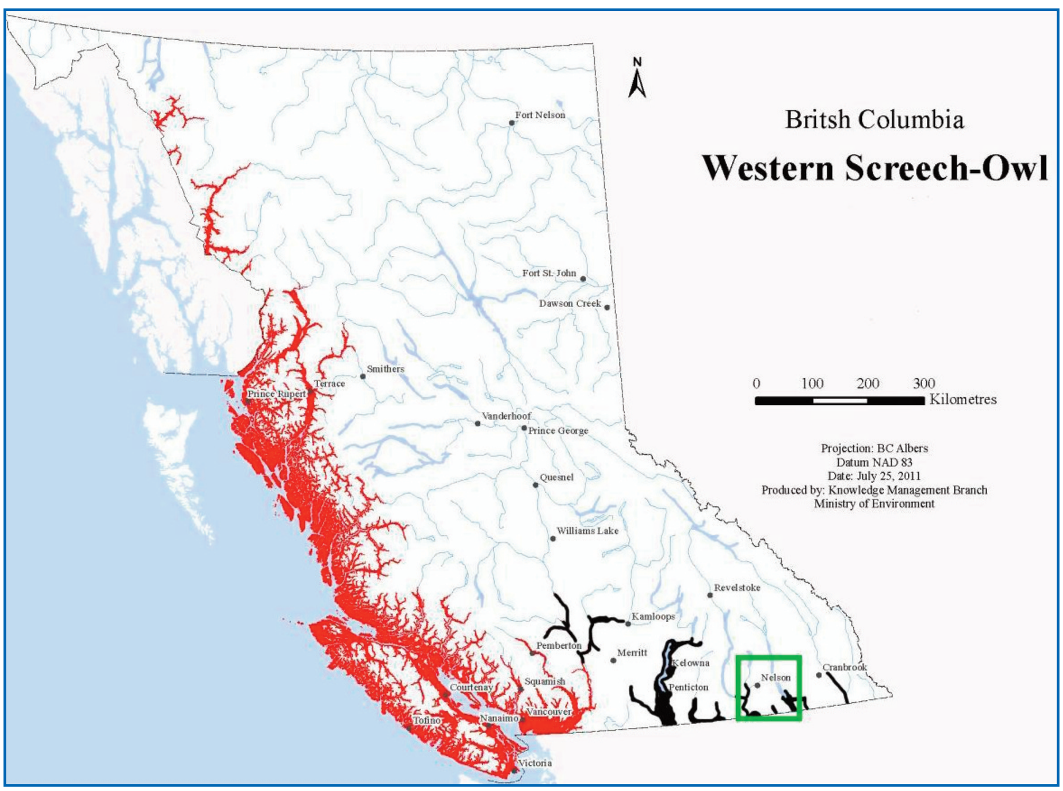

Figure 1. Distribution of Western Screech-Owls, coastal kennicottii sub-species in red, and the interior macfarlanei in black. Study area is outlined in green. Map adapted from COSEWIC (2012).

Habitat selection was examined at three spatial scales: 1) the tree (nest tree characteristics), 2) patch (forest structure within a 150 m^2 plot centred on the nest tree), and 3) stand (land use cover types within the owl's breeding home range). Random samples of available resource units were drawn within each spatial scale in a "used-available" model design (Johnson et al. 2006). Forward stepwise logistic regression was used to model the importance of habitat variables in predicting each of two binary variables: nest or available. A significance level of $P < 0.10$ was used to determine which variables entered and remained in the model. The variables chosen for each spatial scale were selected a priori based on a combination of previous modelling (Davis & Weir 2008[1]) and hypothesized relationships (Table 1).

Table 1. Variables used to examine Western Screech-Owl nest selection at three scales: tree, patch, and stand level, in the West Kootenay Region, British Columbia, 2003–2012.

Scale	Number of Variables	Candidate Models
Tree	9	Tree species
	1	DBH
	1	Tree height
	1	Cavity aspect
	1	Height to canopy
	6	Decay class
	2	Status (alive or dead)
Patch	1	Density of trees 20-40 cm DBH (stems/ha)
	1	Density of trees > 40 cm DBH (stems/ha)
	1	Percent cover of trees
	1	Percent cover of shrubs (>2m)
	1	Percent cover of low shrubs
	1	Average height to canopy
	1	Density of deciduous trees (stems/ha)
	1	Percent cover of black cottonwood
	1	Slope
	1	Aspect
	1	Sum of deciduous cover
	1	Sum of coniferous cover
Stand	5	Cover type
	8	Structural stage

At the tree scale, a tree was considered available if it had an existing cavity and was within the same stand as the nest tree (Marks 2001). At the patch scale, available habitat was a randomly selected plot occurring within the same stand. At the stand scale, breeding home range estimates (from eight owls for there were $\geq$ 20 locations) were overlaid on 1: 250 000 Baseline Thematic Mapping (BTM) (Surveys and Resource Mapping Branch 1995), which delineated land use (Table 2). Vegetation Resource Inventory (VRI; British Columbia Ministry of Forests, Lands and Natural Resource Operations 2015) was used to determine the age class of the stand (Table 2). Available habitat at this scale was determined by generating ten random locations for each nest site inside the breeding home range using Hawth's Analysis Tools for ArcGIS 9.x (Beyer 2004). A Chi-square test was used to determine whether selection across habitat types was non-random (Manly et al. 2002).

Table 2. Description of main land use cover types and projected age and class codes from Baseline Thematic Mapping (BTM) and Vegetation Resource Inventory (VRI) derived for analyses of Western Screech-Owl nest habitat selection at the stand scale in the West Kootenay region, British Columbia, 2003–2012.

Land use label	Cover type	Land use description
Agricultural	BTM	Land-based agricultural activities undifferentiated as to crop (i.e., land is used as the producing medium).
Residential agricultural mixtures	BTM	Areas where agriculture activities are intermixed with residential and other buildings with a density between 0.2 to 2.0 hectares.
Young forest	BTM	Forest less than 140 years old and greater than 6 metres in height. Areas defined as "recently logged" and "selectively logged" land uses are excluded from this class.
Urban	BTM	All compact settlements including built up areas of cities, towns, and villages as well as isolated units away from settlements, such as manufacturing plants, rail yards, and military camps. In most cases residential use will predominate in these areas.
Fresh water	BTM	Rivers and lakes
Other	BTM	All other cover types
1	VRI	Stand age 1 to 20 years
2	VRI	Stand age 21 to 40 years
3	VRI	Stand age 41 to 60 years
4	VRI	Stand age 61 to 80 years
5	VRI	Stand age 81 to 100 years
6	VRI	Stand age 101 to 120 years
7	VRI	Stand age 121 to 140 years
8	VRI	Stand age 141 to 250 years
9	VRI	Stand age 251 + years

Parameters recorded at each nest tree and random tree included elevation, slope, and aspect of the nest site, aspect of the cavity, and the height of the nest cavity. Nest tree species, DBH, height, and decay class were also recorded. Forest structure at the patch scale was determined by establishing a 6.9 m radius (150 m^2) plot centred on the nest tree or random site (Davis & Weir 2008[1]). Structural stage was described using the following categories: shrub; pole/sapling; young forest; mature forest; and old forest (British Columbia Ministry of Forests and Range 2010). The percent cover of each vertical layer was estimated within the plot: tree (>10 m height), total shrub (0.15–10 m), small shrub (0.15–2 m), and tall shrub (2–10 m) herb and moss layers (British Columbia Ministry of Forests and Range 2010). The percent cover for each species of tree within the plot was determined. Additionally the DBH, height, and height to live crown were recorded for trees with a DBH >10 cm within the plot. The height of one tree was measured using a clinometer and tape for reference, and then estimated for the remaining trees.

Results

Nest trees in southeastern British Columbia had a mean DBH of 61.8 cm (SD = 16.7, n = 12) and cavity height of 11.3 m (SD = 7.1, n = 12). Most nests were in black cottonwood (n = 9; 75%), while the remainder were in trembling aspen (n = 3). Nest cavities were formed naturally or were excavated by Pileated Woodpeckers (*Dryocopus pileatus*) or Northern Flickers (*Colaptes auratus*). Two nest trees, one in black cottonwood and one in a trembling aspen, were reused, one by the same owl pair and one by a new pair. Both were used twice during the study, with a year break in between use. Three nest trees, all black cottonwood, blew over in the winter following their use.

At the tree scale, none of the variables (Table 1) selected entered the logistic regression model as a predictor of nest use. At the patch scale, logistic regression with forward stepwise entry found the sum of coniferous cover to be a significant predictor (Z = 1.9, P = 0.06) of Western Screech-Owl nest occurrence. The logistic regression equation was Logit (Y) = -1.10 (SE = 0.69) + 0.04 (SE = 0.02) (Percent coniferous cover) + e. The mean coniferous cover at nest sites (33.3%, SD = 25.6, n = 12) was higher than available (16.0%, SD = 17.3, n = 12). The coniferous species most represented by cover in nest patches was western redcedar, followed by western hemlock and grand fir (Table 3). Although not a significant predictor (P = 0.13), the mean percent cover of black cottonwood was lower at nest sites (10.3%, SD = 12.9, n = 12) than available (26.3%, SD = 30.8, n =12).

Table 3. Sum of the percent cover of deciduous and coniferous trees at the patch scale at Western Screech-Owl nest and random sites in the West Kootenay region, British Columbia, 2003–2012.

	Tree species	Sum of percent cover	
		Nests (n = 12)	Random (n = 12)
Coniferous	grand fir (*Abies grandis*)	15	5
	hybrid white spruce (*Picea engelmannii x glauca*)	5	17
	ponderosa pine (*Pinus ponderosa*)	0	5
	western hemlock (*Tsuga heterophylla*)	30	15
	western redcedar (*Thuja plicata*)	330	150
	western white pine (*Pinus monticola*)	0	5
Total		**400.0**	**192.0**
Deciduous	black cottonwood (*Populus trichocarpa*)	139	311
	Douglas maple (*Acer glabrum*)	37.5	0
	paper birch (*Betula papyrifera*)	35	25
	speckled alder (*Alnus incana*)	0	20
	trembling aspen (*Populus tremuloides*)	130	80
	willow species (*Salix spp.*)	5	0
Total		**345.5**	**436.0**

The land cover type within the breeding home range of eight owls was residential agricultural mixtures (43.7%), young forest (36.9%), urban (11.9%), agricultural (5.4%), and fresh water (1.9%). Agriculture cover type use was higher (χ^2 = 15.0, P = 0.005) at nest sites (17%) than available (0%) and stand age (81 to 100 years) was older (χ^2 = 26.9, P > 0.001) at nest sites (42%) than available (1%).

Discussion

Western Screech-Owls in the region nested in natural cavities, some of which were excavated by woodpeckers, in either black cottonwood ($n = 9$) or trembling aspen ($n = 3$). Nest trees in the study were smaller in diameter (61.8 cm, SD = 16.7) and had lower height (21.8 m, SD = 9.2) than in the Shuswap (DBH = 79.3 cm, height = 33.5, SD = 11.9 m, $n = 6$) (Davis & Weir 20081) or the Okanagan (DBH = 90 cm, range 55–116 cm, $n = 3$) (Cannings & Davis 2007). At the tree scale, none of the variables selected were predictors of nest selection from random sites. It may be that the specific cavity dimensions, which were only possible to measure for three nests (due to tree decay or nest height) may be dictating habitat selection at the fine scale.

At the patch scale, riparian coniferous cover comprised mostly of western redcedar and hemlock predicted nest use. While the preferred nest tree species was black cottonwood, owls appeared to select patches with less black cottonwood than available. The presence of conifers surrounding a nest tree may afford greater concealment from avian predators. Both genders roosted in trees adjacent to nests sites to access the nest entrance. During incubation and nestling phases, males would solicit females with a prey delivery in adjacent trees and both males and females, later in the nesting period, roosted in nearby trees.

These data highlight the need for regional variation in species management. In the Okanagan, the species is strongly associated with deciduous-dominated riparian habitat (Cannings 1997[2]). Similarly, Davis and Weir (2010) suggest that males in the Shuswap establish their territories around large old deciduous trees and recommend 12 ha of cottonwood riparian forests occur within each home range. In contrast, Western Screech-Owls selected coniferous trees in the riparian patch surrounding a nest tree in the southern Columbia Mountains. Coniferous-dominated riparian forest has not been previously considered as an important component for nesting Western Screech-Owls. At the stand scale, forest patches within agriculture cover type use and stand age 81 to 100 years were selected more than available. These two features combined (a moderate to old-aged stand within agricultural cover type) may be selected as they provide an optimal ratio of cover to prey abundance, both important factors for breeding success and individual fitness.

Given the low survival of Western Screech-Owls in the southern Columbia Mountains, and in particular females during nesting, nesting habitat in the southern Columbia Mountains should be comprised of several large diameter deciduous trees surrounded by mixed riparian coniferous forests with a high western redcedar component. Given that much of these nesting patches occurred in agricultural landscapes, programs that enhance these riparian values should be encouraged.

Acknowledgements

These research activities were completed with financial support from Columbia Basin Trust, the Fish and Wildlife Compensation Program (FWCP), the Habitat Conservation Trust Fund, and the Habitat Stewardship Program. Thank you to Eva Schindler, John Krebs, Trevor Oussoren, Angus Glass, and Beth Woodbridge of the FWCP for administration and logistics. Thank you to Richard Cannings for guidance in capture. Thanks to Rich Weir and Helen Davis for advice, equipment, and leading the way on data collection. Thanks to Ted Antifeau and Orville Dyer from the BC Ministry of Environment for continued support. Thanks to field technicians Louie Zsoldos, Verena Shaw, and Kelsey Syvchuck. Big thanks go to the landowners that granted us access for inventory and radio-telemetry.

Notes

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