Does Habitat Matter in an Urbanized Landscape? The Birds of the Garry Oak (*Quercus garryana*) Ecosystem of Southeastern Vancouver Island, British Columbia[1]

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Introduction

The Garry oak (*Quercus garryana*) ecosystem was once a dominant habitat type on southeastern Vancouver Island, British Columbia, but urbanization has lead to massive habitat loss and fragmentation (Hebda 1993). Most bird species are expected to respond negatively to urbanization because of increased patch isolation, increased predation pressure, and negative edge effects (Marzluff and Ewing 2001). On southeastern Vancouver Island, Garry oak remnants form a mosaic along with coastal Douglas-fir (*Pseudotsuga menziesii*) forests. Since the two ecosystems differ in habitat structure and composition, there is an *a priori* expectation that their bird communities differ. However, urbanization may have fragmented the landscape to the extent that only generalist species use both habitat types. This study tests whether bird abundance in patches of Garry oak and Douglas-fir is related to habitat type or patch size and/or urbanization in the landscape. It also compares bird community composition of Garry oak patches surrounded by urbanization to those patches surrounded by Douglas-fir forest.

Methods

Bird surveys were conducted in May and June 2000, at seven Garry oak patches and four adjacent Douglas-fir patches. Two transects of 400 m each were surveyed in each patch. Five-minute counts were made at stations every 50 m; each site was visited 4 to 5 times. Bird territory densities were delineated through territory mapping (Bibby et al. 1992). Habitat type was measured as Garry oak stem volume (oakvol), which was calculated for randomly chosen trees along the transects. Patch size (area) was measured via GIS and urbanization was measured as as human population density surrounding the patch (humans). Relationships between environmental variables and abundance of 16 species of birds were inferred by selecting the best linear regression model by Akaike Information Criterion.

Results

Human population density, our measure of urbanization in the landscape, was the most common factor associated with bird species abundance. For American Robins, Brown Creepers, Chestnut-backed Chickadees, Dark-eyed Juncos, Golden-crowned Kinglets, Orange-crowned Warblers, Townsend's Warblers, and Winter Wrens there was evidence for a negative relationship between abundance and human population density (*table 1*). Anna's Hummingbirds and Spotted Towhees, on the other hand, preferred urbanized patches. The Red-breasted Nuthatch was the only species for which patch size was the most important variable associated with abundance.

For seven species the best model as chosen by AIC included Garry oak stem volume. Brown-headed Cowbirds, Chipping Sparrows and Orange-crowned Warblers were positively associated with Garry oak, while Brown Creepers, Chestnut-backed Chickadees, Golden-crowned Kinglets and Winter Wrens were negatively associated with Garry oak (*table 1*). A null model describes the situation where abundance is equivalent across patches and not related to any of the environmental variables. The null model was selected for Bewick's Wrens, Pacific-slope Flycatchers, and overall species richness.

The abundances of 15 species were compared between Garry oak patches surrounded by coniferous forest to Garry oak patches surrounded by urbanization (*table 2*). Only the House Finch was consistently more abundant in Garry oak patches surrounded by urbanization. In fact, it was not found in Garry oak surrounded by forest. Eight species (Brown Creepers, Chipping Sparrows, Dark-eyed Juncos, House Wrens, Northern Flickers, Pacific-slope Flycatchers, Townsend's Warblers, and White-crowned Sparrows) were found only in Garry oak patches surrounded by forest. An additional species, the Orange-crowned Warbler, was consistently more abundant in Garry oak surrounded by forest than Garry oak surrounded by urbanization. The remaining five species (American Robins, Bewick's Wrens, Brown-headed Cowbirds, Chestnut-backed Chickadees, and Spotted Towhees) had similar abundances in the Garry oak patches surrounded by both habitat types.

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Table 1— *The best linear regression equations describing the relationship between bird abundance and environmental variables. The best model was selected from a model set and chosen as the model with the minimum AIC value. For some species, multiple models are depicted because more than one model had similar AIC values and model weights. Parameter estimates for terms used in the final model were calculated along with the unconditional 95% confidence interval (Anderson et al. 2000). Equations without regression coefficients correspond to a null relationship.*

Best approximating models	(Intercept ± 95% conf. int.) + (estimate ± 95% conf. int.) parameter
American Robins	(0.200 ± 0.092) - (0.044 ± 0.056) humans
Anna's Hummingbirds	(-0.015 ± 0.078) + (0.051 ± 0.064) humans
Bewick's Wrens	0.105 ± 0.091
Brown-headed Cowbirds	(0.023 ± 0.193) + (0.100 ± 0.073) oakvol
Brown Creepers	(0.333 ± 0.194) - (0.134 ± 0.076) oakvol - (0.160 ± 0.109) humans
Chestnut-backed Chickadees	(0.330 ± 0.103) - (0.041 ± 0.005) oakvol - (0.074 ± 0.036) humans
Chipping Sparrows	(0.012 ± 0.012) + (0.023 ± 0.035) oakvol
	(0.069 ± 0.094) - (0.033 ± 0.059) area
Dark-eyed Juncos	(0.131 ± 0.017) - (0.107 ± 0.106) humans
Golden-crowned Kinglets	(0.279 ± 0.183) - (0.099 ± 0.071) oakvol - (0.132 ± 0.102) humans
Orange-crowned Warblers	(0.136 ± 0.122) - (0.109 ± 0.090) humans
	(0.135 ± 0.023) - (0.109 ± 0.090) humans + (0.023 ± 0.036) oakvol
Pacific-slope Flycatchers	0.156 ± 0.116
Red-breasted Nuthatches	(-0.056 ± 0.080) + (0.080 ± 0.059) area
Spotted Towhees	(0.200 ± 0.179) + (0.200 ± 0.173) humans
Townsend's Warblers	(0.110 ± 0.089) - (0.104 ± 0.086) humans
Winter Wrens	(0.251 ± 0.194) - (0.100 ± 0.079) oakvol - (0.093 ± 0.092) humans
Species Richness	17.09 ± 3.28

Table 2— *Abundances in territories ha^{-1} (mean ± 95% confidence interval) of 17 species in Garry oak patches surrounded by urbanization (N = 3) and in Garry oak patches surrounded by coniferous forest (N = 4)*

	Surrounded by urbanization			Surrounded by coniferous forest			
Species	**Highrock**	**Mt. Tolmie**	**Uplands**	**Mt. Douglas**	**Rocky Point**	**Thetis Lake**	**Mary Hill**
American Robin	0.400	0.750	0.375	0.375	0.714	0.875	0.875
Bewick's Wren	0.400	0.375	1.875	0.625	0.143	0	0.250
Brown-headed Cowbird	0.200	0.500	0.625	0.125	0.714	0.125	0.875
Brown Creeper	0	0	0	0.125	0.429	0.125	0
Chestnut-backed Chickadee	0.600	0.125	0.500	0.625	0.571	1.250	0.875
Chipping Sparrow	0	0	0	0.500	0.143	0.375	0.500
Dark-eyed Junco	0	0	0	0	0.286	1.000	0.125
House Finch	0.200	0.125	0	0	0	0	0
House Wren	0	0	0	0.125	0.429	0.250	0
Northern Flicker	0	0	0	0	0.143	0.375	0.250
Orange-crowned Warbler	0	0.250	0	0.375	0.429	0.500	1.125
Pacific-slope Flycatcher	0	0	0	0.250	0.714	0	0.625
Spotted Towhee	0.400	1.500	3.000	1.500	0.143	1.125	0.250
Townsend's Warbler	0	0	0	0.125	0.571	0.375	0
White-crowned Sparrow	0	0	0	0.250	0.143	0	0.875

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Conclusions

Most birds analyzed in this study were negatively associated with the urbanization of British Columbia's Garry oak ecosystem. This was further supported by the fact that some species were consistently more abundant in Garry oak patches surrounded by forest than in Garry oak patches surrounded by urbanization. These species included common forest birds (e.g. Brown Creepers, Pacific-slope Flycatchers) but also open woodland species (e.g. Chipping Sparrows, White-crowned Sparrows). Urban Victoria was not an inhospitable environment for all species. Anna's Hummingbirds, House Finches and Spotted Towhees were positively associated with urbanization, possibly due to the proliferation of feeders and other supplemental resources.

While it is unlikely that any species is obligate on Garry Oak ecosystems, some were more strongly associated with oak than with coniferous forest. Furthermore, most woodland species were not found in Garry oak surrounded by urbanization. This result could be due to landscape and habitat factors. Surrounding forest may act as a buffer against negative urban edge effects such as cat predation. Garry oak patches surrounded by forest have more shrub cover and more conifer trees than Garry oak surrounded by urbanization (Feldman 2002). It is possible that further conifer encroachment into Garry oak patches will lead to declines in open woodland species as has been shown in Oregon (Hagar and Stern 2001). Further study is needed on the effects of conifer encroachment on bird community composition in this region.

Since the majority of birds analyzed in this study are associated with urbanization and there are relatively fewer differences in composition between Garry oak and coniferous forest patches (see also Feldman 2002), management for most birds should be done at the landscape-scale and consider oak and forest habitats together. Site-level management may be required to maintain the open woodland bird assemblage. More importantly, restoring Garry oak woodlands to a savanna is a necessary first step for the conservation of endangered coastal grassland species: (Lewis' Woodpeckers [*Melanerpes lewis*, Georgia Depression Population], Western Meadowlarks [*Sturnella neglecta*, Georgia Depression Population], Western Bluebirds [*Sialia mexicana*, Georgia Depression Population], Vesper Sparrows [*Pooecetes gramineus affinis*] and Streaked Horned Larks [*Eremophilia alpestris strigata*]), most of which are extirpated from Vancouver Island.

Acknowledgments

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