Utilization of Residual Patches of Old-growth Douglas-fir by Forest Birds

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Introduction

Fragmentation of previously extensive forest into smaller, isolated patches has resulted in a loss of habitat for many bird species, particularly neotropical migrants (e.g., Whitcomb *et al.* 1981; Askins and Philbrick 1987). Species richness in isolated patches is strongly correlated with area of habitat (e.g., Blake and Karr 1987). Yet minimum habitat needs may include several patches of different habitat types (Haila *et al.* 1989). Explanations for reduced diversity in smaller patches include: increased parasitism and nest predation near forest edges (e.g., Yahner and Scott 1988); competition with edge species (Askins and Philbrick 1987); lower reproductive output and narrow tolerance ranges of neotropical migrants (Terborgh 1989); and additional stresses due to destruction of overwintering habitat.

Objective

The objective was to monitor bird populations in residual patches of old-growth Douglas-fir to determine the minimum size needed to retain viable populations of old-growth dependent bird species.

Methods of Investigation

The study area was situated in the Nimpkish watershed, Port McNeill Forest District on Vancouver Island. Eleven residual patches (a fairly homogeneous stand of old-growth Douglas-fir surrounded by early seral forest), ranging in size from 2 to 500 ha, were examined. Forest bird monitoring plots (10 ha) were established as far inside each patch as possible (Table 1). For patches less than 10 ha, the plot was extended beyond the patch edge into the surrounding habitat. Censuses were later differentiated by habitat (interior, edge, and surrounding vegetation). Analyses do not include surrounding vegetation.

TABLE 1. Description of study patches

Patch	Size (ha)	Elevation (m)	Water*	Harvest
6x	3.2	600	4 s	-
2x	4.2	1300	1 s	-
2r	2.0	1000	1 l	-
2	10.0	1000	1 s	1991
7	7.0	1300	3 s	-
10	9.4	600	1 r	-
1	25.0	1000	2 s	-
8	48.0	1000	2 s, 1 l	1993
5	56.0	600	1 s	1993
6	72.0	700	1 r	42 ha 1992
3	500.0	1000	1 s	-
4	500.0	800	2 s	-

* within or adjacent to the patch; s= stream, l= lake, r= river

Each patch was site typed and extensive vegetation measurements taken to relate habitat features within territories of selected bird species with habitat available throughout the patch (Noon 1981). Principal components analysis will be used to relate species counts to habitat variables.

Densities of birds were estimated using the spot-mapping method and territories were mapped for all species (Svensson 1970). Additional censuses were conducted during early evenings in May and June to verify breeding of those species that could not be adequately surveyed with the mapping technique. Each patch was also surveyed for owls, with the use of tape recorded territorial songs.

Species were coded by habitat use (incidental, foraging, nesting), then categorized by migratory status (resident, migrant) and preferred breeding habitat (interior, edge). Abundance and diversity (Shannon-Weiner index) data for these categories were regressed against the log of patch size.

To quantify the presence of predators in relation to patch size and the amount of edge, we put artificial nests in patches of 2, 3, 9, 48, and 500 ha, along transects at stations 0, 10, 75, 300, 450, and 600 m from the edge (178 nests). Each station had a ground and arboreal nest. Predation rate was calculated as number of nests lost per nests placed. Nests were checked 3 times over 19 days. Differences in predation rate were tested using a 2-way ANOVA.

Reproductive success was measured using mist nets and nest checks. We developed a system of aerial nets, but still too few birds were captured to compare between patches.

Results and Discussion

Contrary to studies in eastern North America, there were no apparent trends for increased species diversity or richness with patch size, for either all species or individual groups (old-growth or disturbance-related; tree, ground, or cavity nesters) (Figure 1). Furthermore, there was a significant decrease in abundance (individuals per hectare) with increased patch size for all species and individual groups except old-growth related species (Figure 2). Although not significant, there was also an increase in number of species and abundance of old-growth related species around 10 ha, notably Hammond's flycatcher, the varied thrush, and the golden-crowned kinglet.

Species present in the larger patches were resident interior forest birds (the pileated woodpecker, red-breasted sapsucker, gray jay, red-breasted nuthatch), except for the marbled murrelet. Species preferring the smaller patches were the western screech-owl, yellow-rumped warbler, and orange-crowned warbler. Raptors generally were more common in smaller patches, a finding that is consistent with that of other authors (e.g., Small and Hunter 1988).

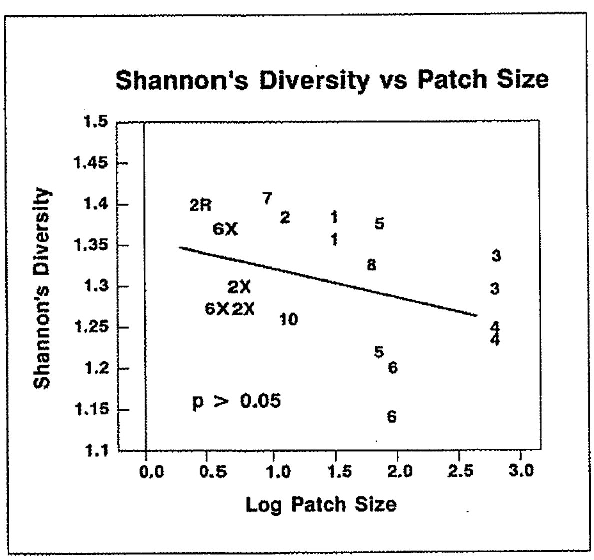

FIGURE 1. Relationship between bird species diversity and log of patch size.

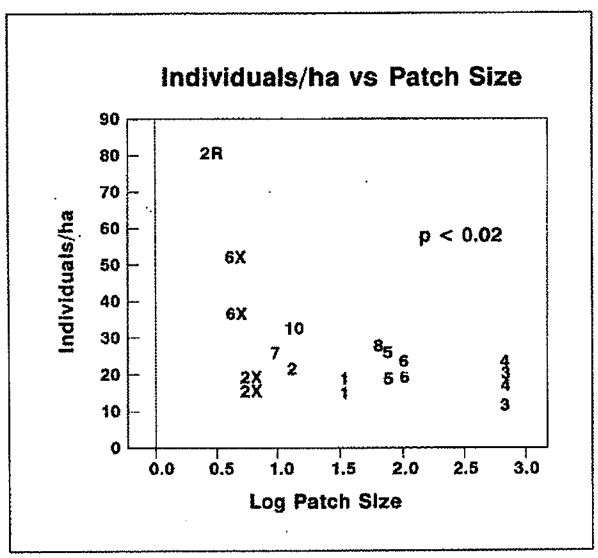

FIGURE 2. Relationship between bird density and log of patch size.

Species apparently not related to patch size were the hairy and downy woodpeckers, pine siskin, red crossbill, and western flycatcher. Although other authors have reported a minimum patch size of 15 and 40 ha for the downy and hairy woodpeckers, respectively (see Stauffer 1980), Robbins (1979) estimated the minimum forest area for the hairy woodpecker to be 4 ha. Our smallest patches may have been just large enough to support these species and others apparently unrelated to patch size. With the exception of the solitary vireo and cedar waxwing, long-distant migrants had distributions independent of patch size. This is contrary to the literature in which species with relatively low dispersal rates, narrow tolerance ranges, and low reproductive potential are considered to be most vulnerable to a rapid change in the forest landscape.

Factors associated with bird abundance in other studies have been tree species composition, tree size and height, canopy closure, canopy volume, and vertical layering (e.g., Rice *et al.* 1983). The patches in this study were selected to be homogeneous, and therefore may not have differed enough to indicate any influence of these factors. Main canopy cover characteristics are similar between the patches, although the proportion of forest interior habitat to disturbance-related habitat on the census plot decreased with patch size. Factors seemingly important in this study were the presence of water and vegetation structure.

Predation rate was significantly higher near forest edges and in smaller patches (Figure 3) (ANOVA, $p < .001$; Table 2, Sheffe's multiple comparison test, $p < .05$). Patch 8 was eliminated from the analyses because a predator followed the observers and destroyed 95% of the nests during the first sampling period. Distances 75 m and greater were combined for analyses to increase statistical power.

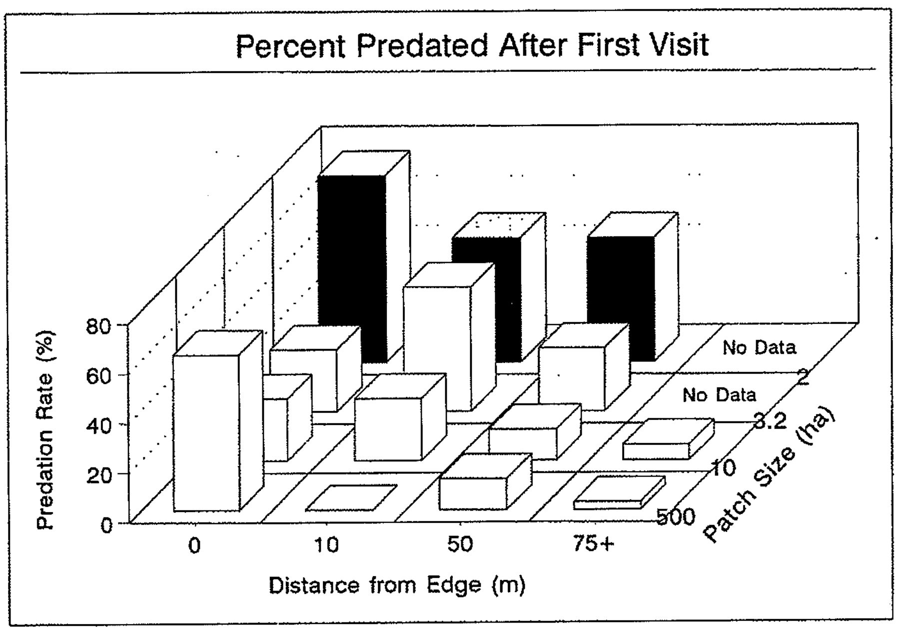

FIGURE 3. Relationship between predation rate, log of patch size, and log of distance from the edge.

TABLE 2. Sheffe's multiple comparison test

Patch size	2.0	3.2	10	500
Mean predation rate	58.3	33.5	15.0	12.5
Distance from edge	0	10	50	75+
Mean predation rate	46.9	31.3	25.0	4.2

Conclusion

Although, as predicted from other studies, predation was significantly higher near forest edges and in smaller patches and abundance of edge species was higher in smaller patches, we found no relationship between area of patch and species diversity or richness for all species or individual groups. Possible reasons are: 1) absence of cowbirds, so parasitism is not a problem; 2) lower prominence of neotropical migrants in this bird community; 3) delayed effects due to site tenacity or comparatively short time since isolation; and 4) other factors such as water, riparian vegetation or disturbances including mainly logging, roads, and windfall. Galli *et al.* (1976) found the minimum size for forest interior species to be 0.8 ha. Our patches were larger. Furthermore, as Haila *et al.* (1989) stated, minimum habitat needs may include several patches of different habitat types.

Future Work

Because there may be a time delay in the impact of fragmentation, it is important that population trends be measured over the long term and that more sensitive measures of population sustainability be used, such as reproductive output and energetic costs related to patch size.

So that forest structure can more accurately be related to distribution of birds and territory size, further vegetation analysis should be conducted in territories of forest interior species. Characteristics of foraging sites, including prey densities related to bark condition, tree size and species, and snag condition, should be compared at different bird densities as an indirect measure of habitat requirements. In this way, overwintering habitat needs of residents and non-breeders can also be measured. Bird territories need to be mapped over several years and the frequency of use of habitat types within the territory collated, to indicate minimum combinations of habitat needed by various bird species (see Haila *et al.* 1989). For a more accurate indication of minimal habitat needs, this study should be replicated in other watersheds. A larger commitment of funds is needed earlier in the breeding season.

References

Askins, R.A. and M.J. Philbrick. 1987. Effect of changes in regional forest abundance on the decline and recovery of a forest bird community. Wilson Bull. 99:7–21.

Blake, J.G. and J.R. Karr. 1987. Breeding birds of isolated woodlots: area and habitat relationships. Ecology 68(6):1724–1733.

Galli, A.E., C.F. Leck, and R.T.T. Forman. 1976. Avian distribution patterns in forest islands of different sizes in central New Jersey. The Auk 93:356–364.

Haila, Y., I.K. Hanski, and S. Raivio. 1989. Methodology for studying the minimum habitat requirements of forest birds. Ann. Zool. Fennici 26:173–180.

Noon, B.R. 1981. Techniques for sampling avian habitat. *In* The use of multivariate statistics in studies of wildlife habitat. D.E. Capen (editor). U.S. For. Ser. Gen. Tech. Rep. RM-87, pp. 45–52.

Rice, J., R.D. Ohmart, and B.W. Anderson. 1983. Habitat selection attributes of an avian community: a discriminant analysis investigation. Ecol. Monogr. 53:263–290.

Robbins, C.S. 1979. Effect of intensive forest management on breeding birds of Vancouver Island: problem analysis. B.C. Min. Environ. and For. Res. Branch, Victoria, B.C. IWIFR-25. 148 p.

Small, M.F. and M.L. Hunter. 1988. Forest fragmentation and avian nest predation in forested landscapes. Oecologia 76:62–64.

Stauffer, D.F. 1980. Habitat selection by birds of riparian communities: evaluating effects of habitat alterations. J. Wildl. Manage. 44(1):1–15.

Svensson, S. 1970. Recommendations for an international standard for a mapping method in bird census work. Audubon Field Notes 24(6):723–726.

Terborgh, J. 1989. Where have all the birds gone? Princeton Univ. Press, Princeton, N.J. 207 p.

Whitcomb, R.F., C.S. Robbins, J.F. Lynch, B.L. Whitcomb, M.K. Klimdiewicz, and D. Bystrak. 1981. Effects of forest fragmentation on avifauna of the eastern deciduous forest. *In* Forest island dynamics in man-dominated landscapes. R.L. Burgess and D.M. Sharpe (editors). Springer-Verlag, New York, N.Y., pp. 123–205.

Yahner, R.H. and D. P. Scott. 1988. Effects of forest fragmentation on depredation of artificial nests. J. Wildl. Manage. 52:158–161.