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Importance of Area and Habitat Heterogeneity to Bird Assemblages in Temperate Forest Fragments

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ABSTRACT

Relationships among area, habitat heterogeneity and bird assemblages were examined for 21 forest fragments (3 to 7620 ha) in an agricultural landscape near Ottawa, Canada. Habitat heterogeneity within forests was measured by an index of spatial variability (HH) in plant species and forest structure. HH based on tree species or shrub species increased with forest size. Larger and more heterogeneous forests had more species and pairs of birds, according to multiple regressions for two summers combined. Number of species and pairs of birds at individual points within forests increased with greater HH but not with larger size. Birds also were more patchily distributed in more heterogeneous, but not necessarily large, forests, because of relatively uncommon species. Larger forest size was more important for increasing species number in forest-interior and resident-related classes of birds. Some classes, e.g. forest interior species, were infrequent in smaller forests. Habitat heterogeneity was more important to edge-related classes. To maintain a diverse forest avifauna, regional conservation strategies should maximise both size and habitat heterogeneity of forests.

INTRODUCTION

Throughout the world, extensive forests continue to be fragmented as population pressure converts land to agricultural, industrial, suburban and urban uses. As forests become more limited, preservation of many

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APPENDIX 1—Continued

Species	Habitat use	Territory size (ha)	Nesting stratum	Foraging stratum	Migratory status	Regional abundance (no.)
Common grackle						
<i>Quiscalus quiscula</i> (Linnaeus)	E	<2	C	G	SD	>50
Brown-headed cowbird						
<i>Molothrus ater</i> (Bobbaert)	E	<2	O	G	SD	>50
Northern oriole						
<i>Icterus galbula</i> (Linnaeus)	E	2-5	C	C	LD	11-50
Purple finch						
<i>Carpodacus purpureus</i> (Gmelin)	1/E	2-5	C	S	R	11-50
American goldfinch						
<i>Carduelis tristis</i> (Linnaeus)	E	2-5	S	S	R	>50
House sparrow						
<i>Passer domesticus</i> (Linnaeus)	E	<2	H	G	R	>50

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APPENDIX I—Continued

Species	Habitat use	Territory size (ha)	Nesting stratum	Foraging stratum	Migratory status	Regional abundance (no.)
Yellow warbler						
<i>Dendroica petechia</i> (Linnaeus)	E	<2	S	S	LD	11-50
Chestnut-sided warbler						
<i>Dendroica pennsylvanica</i> (Linnaeus)	E	<2	S	S	LD	<11
Magnolia warbler						
<i>Dendroica magna</i> (Wilson)	I	<2	S	S	LD	<11
Black-throated blue warbler						
<i>Dendroica caerulescens</i> (Gmelin)	I	<2	S	S	LD	<11
Black-throated green warbler						
<i>Dendroica virens</i> (Gmelin)	I	<2	C	C	LD	<11
Blackburnian warbler						
<i>Dendroica fusca</i> (Muller)	I	<2	C	C	LD	<11
Pine warbler						
<i>Dendroica pinus</i> (Wilson)	I	<2	C	C	SD	<11
Blackpoll warbler						
<i>Dendroica striata</i> (Forster)	I	<2	S	C	LD	<11
Black-and-white warbler						
<i>Mniotilta varia</i> (Linnaeus)	I	2-5	G	T	LD	11-50
American redstart						
<i>Setophaga ruticilla</i> (Linnaeus)	I	<2	S	S	LD	<11

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Brown creeper									
<i>Certhia americana</i> Bonaparte	I	2-5	S	T	R	<11			
Winter wren									
<i>Troglodytes troglodytes</i> (Linnaeus)	I	2-5	G	S	SD	<11			
Golden-crowned kinglet									
<i>Regulus satrapa</i> Lichtenstein	I	<2	C	C	SD	<11			
Veery									
<i>Catharus fuscescens</i> (Stephens)	I	<2	G	G	LD	11-50			
Swainson's thrush									
<i>Catharus ustulatus</i> (Nuttall)	I	<2	S	G	LD	<11			
Hermit thrush									
<i>Catharus guttatus</i> (Pallas)	I	<2	G	G	SD	<11			
Wood thrush									
<i>Hylocichla ustulata</i> (Gmelin)	I/E	<2	S	G	LD	11-50			
American robin									
<i>Turdus migratorius</i> Linnaeus	E	<2	C	G	SD	>50			
Gray catbird									
<i>Dumetella carolinensis</i> (Linnaeus)	E	<2	S	S	SD	11-50			
Brown thrasher									
<i>Toxostoma rufum</i> (Linnaeus)	E	2-5	G	G	SD	11-50			
Cedwar waxwing									
<i>Bombycilla cedrorum</i> Vieillot	E	2-5	C	S	R	>50			
European starling									
<i>Sturnus vulgaris</i> Linnaeus	E	<2	H	G	R	>50			
Warbling vireo									
<i>Vireo gilvus</i> (Vieillot)	E	2-5	C	C	LD	11-50			
Red-eyed vireo									
<i>Vireo olivaceus</i> (Linnaeus)	I/E	<2	C	C	LD	11-50			
Tennessee warbler									
<i>Vermivora peregrina</i> (Wilson)	I/E	<2	G	S	LD	<11			
Nashville warbler									
<i>Vermivora ruficapilla</i> (Wilson)	E	<2	G	S	LD	<11			
Northern parula									
<i>Parula americana</i> (Linnaeus)	I	<2	C	C	LD	<11			(continued)

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Broad-winged hawk	I	>5	C	O	LD	<11
<i>Buteo platypterus</i> (Vieillot)						
Red-tailed hawk	E	>5	C	O	SD	<11
<i>Buteo jamaicensis</i> (Gmelin)						
American kestrel	E	>5	H	O	SD	11-50
<i>Falco sparverius</i> Linnaeus						
Ruffed grouse	I/E	>5	G	G	R	<11
<i>Bonasa umbellus</i> (Linnaeus)						
American woodcock	E	2-5	G	G	SD	<11
<i>Scolopax minor</i> Gmelin						
Mourning dove	E	2-5	C	G	SD	>50
<i>Zenaidura macroura</i> (Linnaeus)						
Black-billed cuckoo	E	2-5	S	S	LD	<11
<i>Coccyzus erythrophthalmus</i> (Wilson)						
Barred owl	I	>5	H	G	R	<11
<i>Strix varia</i> Barton						
Red-throated hummingbird	E	2-5	C	S	LD	<11
<i>Archilochus colubris</i> (Linnaeus)						
Yellow-bellied sapsucker	I/E	2-5	H	T	SD	11-50
<i>Sphyrapicus varius</i> (Linnaeus)						
Downy woodpecker	I/E	2-5	H	T	R	11-50
<i>Picoides pubescens</i> (Linnaeus)						
Hairy woodpecker	I	>5	H	T	R	<11
<i>Picoides villosus</i> (Linnaeus)						
Northern flicker	I/E	2-5	H	G	SD	11-50
<i>Colaptes auratus</i> (Linnaeus)						
Pileated woodpecker	I/E	>5	H	T	R	<11
<i>Dryocopus pileatus</i> (Linnaeus)						
Eastern wood-pewee	I/E	2-5	C	S	LD	11-50
<i>Contopus virens</i> (Linnaeus)						
Least flycatcher	E	<2	C	S	LD	11-50
<i>Empidonax minimus</i> (Baird & Baird)						
Eastern phoebe	I/E	>5	O	S	SD	11-50
<i>Sayornis phoebe</i> (Latham)						
Great crested flycatcher	I/E	2-5	H	C	LD	11-50
<i>Myiarchus crinitus</i> (Linnaeus)						

(continued)

APPENDIX 1

Ecological Classifications of Bird Species Recorded from Forest Fragments during Breeding Seasons 1980-81. (Classes are: habitat use (E, edge; I/E, forest interior and edge; I, forest interior), territory size, nesting stratum (G, ground; S, shrub; C, canopy; H, hole; O, other), foraging stratum (G, ground; S, shrub, C, canopy; C, canopy; T, trunk; O, other), migratory status (R, resident; SD, short distance; LD, long distance) and regional abundance from 1980 Breeding Bird Surveys. Nomenclature follows AOU checklist (1982).)

Species	Habitat use	Territory size (ha)	Nesting stratum	Foraging stratum	Migratory status	Regional abundance (no.)
Northern goshawk						
<i>Accipiter gentilis</i> (Linnaeus)	I	> 5	C	O	R	< 11
Red-shouldered hawk						
<i>Buteo lineatus</i> (Gmelin)	I/E	> 5	C	O	SD	< 11
Broad-winged hawk						
<i>Buteo platyterius</i> (Vieillot)	I	> 5	C	O	LD	< 11
Red-tailed hawk						
<i>Buteo jamaicensis</i> (Gmelin)	E	> 5	C	O	SD	< 11
American kestrel						
<i>Falco sparverius</i> Linnaeus	E	> 5	H	O	SD	11-50
Ruffed grouse						
<i>Bonasa umbellus</i> (Linnaeus)	I/E	> 5	G	G	R	< 11
American woodcock						
<i>Scolopax minor</i> Gmelin	E	2-5	G	G	SD	< 11

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Brown creeper									
<i>Certhia americana</i> Bonaparte	I	2-5	S	T	R		<11		
Winter wren									
<i>Troglodytes troglodytes</i> (Linnaeus)	I	2-5	G	S	SD		<11		
Golden-crowned kinglet									
<i>Regulus satrapa</i> Lichtenstein	I	<2	C	C	SD		<11		
Veery									
<i>Catharus fuscescens</i> (Stephens)	I	<2	G	G	LD		11-50		
Swainson's thrush									
<i>Catharus ustulatus</i> (Nuttall)	I	<2	S	G	LD		<11		
Hermit thrush									
<i>Catharus guttatus</i> (Pallas)	I	<2	G	G	SD		<11		
Wood thrush									
<i>Hylocichla ustulata</i> (Gmelin)	I/E	<2	S	G	LD		11-50		
American robin									
<i>Turdus migratorius</i> Linnaeus	E	<2	C	G	SD		>50		
Gray catbird									
<i>Dumetella carolinensis</i> (Linnaeus)	E	<2	S	S	SD		11-50		
Brown thrasher									
<i>Toxostoma rufum</i> (Linnaeus)	E	2-5	G	G	SD		11-50		
Cedar waxwing									
<i>Bombycella cedrorum</i> Vieillot	E	2-5	C	S	R		>50		
European starling									
<i>Sturnus vulgaris</i> Linnaeus	E	<2	H	G	R		>50		
Warbling vireo									
<i>Vireo gilvus</i> (Vieillot)	E	2-5	C	C	LD		11-50		
Red-eyed vireo									
<i>Vireo olivaceus</i> (Linnaeus)	I/E	<2	C	C	LD		11-50		
Tennessee warbler									
<i>Vermivora peregrina</i> (Wilson)	I/E	<2	G	S	LD		<11		
Nashville warbler									
<i>Vermivora ruficapilla</i> (Wilson)	E	<2	G	S	LD		<11		
Northern parula									
<i>Parula americana</i> (Linnaeus)	I	<2	C	C	LD		<11		

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APPENDIX I—Continued

Species	Habitat use	Territory size (ha)	Nesting stratum	Foraging stratum	Migratory status	Regional abundance (no.)
Yellow warbler						
<i>Dendroica pitechta</i> (Linnaeus)	E	<2	S	S	LD	11-50
Chestnut-sided warbler						
<i>Dendroica pensylvanica</i> (Linnaeus)	E	<2	S	S	LD	<11
Magnolia warbler						
<i>Dendroica magnaolia</i> (Wilson)	I	<2	S	S	LD	<11
Black-throated blue warbler						
<i>Dendroica caerulescens</i> (Gmelin)	I	<2	S	S	LD	<11
Black-throated green warbler						
<i>Dendroica virens</i> (Gmelin)	I	<2	C	C	LD	<11
Black burnian warbler						
<i>Dendroica fusca</i> (Muller)	I	<2	C	C	LD	<11
Pine warbler						
<i>Dendroica pinus</i> (Wilson)	I	<2	C	C	SD	<11
Blackpoll warbler						
<i>Dendroica striata</i> (Forster)	I	<2	S	C	LD	<11
Black-and-white warbler						
<i>Mniotilta varia</i> (Linnaeus)	I	2-5	G	T	LD	11-50
American redstart						
<i>Setophaga ruticilla</i> (Linnaeus)	I	<2	S	S	LD	<11

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