

Old-forest Thresholds for New Brunswick's Crown Forest

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INTRODUCTION

The New Brunswick *Crown Lands and Forests Act* (1980) calls for the integrated management of the resources of Crown land, which includes habitat for the maintenance of fish and wildlife populations, and the New Brunswick Biodiversity Strategy identifies healthy and resilient native ecosystems and viable populations of native species among its conservation outcomes (PNB 2009). Goals for the management of New Brunswick Crown land include maintaining the natural diversity and ecological characteristics of the Acadian forest and providing the habitat necessary to support populations of native wildlife at desired levels. To these ends, management targets for the Crown forest include maintaining specific amounts of a variety of old-forest conditions within each ecoregion.

A *Biodiversity Threshold* is the minimum amount or area of a biodiversity element that is considered necessary to maintain its viability. A *Biodiversity Target* is a desired management outcome for a biodiversity element. Targets are developed from identified thresholds, status and trend assessments, and analyses of competing resource demands. The intent here is to describe the process used to identify the thresholds for old-forest elements of biodiversity on Crown land.

Old Forest Communities (OFC) are the building blocks of the Province's strategy to supply old-forest conditions on Crown land. Eighteen unique communities, within 7 ecoregions, encompass the full range of naturally occurring old-forest conditions. They are described at the stand level by composition and structure, and at the landscape level by patch size. Old-forest Wildlife Habitats (OFWH) are groups of old forest communities that are further described at the stand level by abundance of woody debris and tree cavities, and at the landscape level by patch size and inter-patch distance. OFWHs were defined based on the requirements of the vertebrate species assigned to them. Detailed information is available in the companion document *Old Forest Community and Old-forest Wildlife Habitat Definitions for New Brunswick* (New Brunswick Department of Energy and Resource Development (ERD) 2017). Thresholds were established for OFCs with the intent of maintaining the integrity of old-forest ecosystems and, for OFWHs, at levels designed to maintain viable populations of all old-forest vertebrates across their natural ranges.

OFCs and OFWHs are components of a conservation strategy for Crown land which also includes areas designated as Protected Natural Areas, White-tailed Deer Wintering Areas and Watercourse or Wetland Buffers (New Brunswick Department of Natural Resources (DNR) 2012, DNR 2013a, DNR 2013b), and guidelines related to site-specific habitats, such as raptor and heron nests (DNR 2004).

OLD FOREST COMMUNITIES

The conservation of forest biodiversity cannot be undertaken on a species-by-species basis. Maintaining Old Forest Communities, which are forest ecosystems described by tree species composition and structure, was the alternative chosen. The intent was to express thresholds as numbers of hectares of each community, calculated as proportions of the expected areas of those communities in the absence of current and historical harvesting and land clearing.

Models predicting the natural distribution of forest types were developed, following the methods described by Zelazny et al. (1997) (DNR 2000; unpublished data). Predictions of the occurrence of forest communities as functions of elevation, soil, drainage and slope were generated, and then modified to account for likely photo-interpretation error, as identified from ground plots. Historical

composition of area either currently in agriculture or regenerated from abandoned fields was estimated using the forest community relationships.

Thresholds were set for 14 of the 18 Old Forest Communities. The others were considered to be either ephemeral or haphazard. Ephemeral communities are usually the result of significant disturbance, are frequently dominated by white birch or trembling aspen and, in the absence of further disturbance, tend to transition naturally into more stable communities. Haphazard communities contain large numbers of species in unlikely combinations, with no species or group being sufficiently abundant to describe community character. In an attempt to capture as much of the variability within the 14 community types as possible, thresholds were set separately for each of the 7 ecoregions identified in the Province’s ecological land classification (Zelazny 2007; Figure 1), and areas proposed to meet targets were well dispersed within ecoregions. Definitions of Old Forest Communities are provided in the document *Old Forest Community and Old-forest Wildlife Habitat Definitions for New Brunswick 2017* (ERD 2017).

Thresholds were set at 12% of the expected natural abundance of each community type (Table 1). The Greater Fundy Ecosystem Research Group (GFERG) used expected rates and types of natural disturbance in the Fundy region to determine that, in the absence of harvesting, 37% of the forest would likely be old (>100 years) at any given point in time. They described this as an ideal level of old forest but, recognizing that it was unattainable given wood-supply considerations, applied a professional consensus process to arrive at a management target of 12% (GFERG 1997). The Department of Natural Resources applied this threshold to forest management plans developed in 2002, and has maintained it through to the current process. It should be noted that in a subsequent document, the GFERG revised its landscape-scale guideline for old forest to between 35 and 40% for ecodistricts where natural disturbances tend to be stand-replacing, and to between 40 and 85% for ecodistricts where disturbances tend to occur in small gaps (GFERG 2005).

Table 1. Old Forest Community thresholds by ecoregion.

Eco-region	Old Forest Community ¹ Thresholds (ha)													
	HE	CE	RS	BSM	BSP	WS	BF	RP	WP	JP	TL	SWTH	THSW	THP
1	0	0	1,955	4,775	1,610	2,055	24,880	0	110	1,700	0	1,020	3,030	1,800
2	0	2,060	6,430	12,570	2,385	5,625	23,340	190	750	110	280	1,710	9,340	7,980
3	0	0	10,235	2,785	895	1,295	4,500	0	0	0	0	1,175	5,705	9,900
4	0	180	6,135	820	0	0	0	0	0	0	0	0	610	0
5	2,640	5,690	20,155	5,465	3,000	675	790	925	565	0	960	2,960	6,960	8,550
6	2,000	2,220	19,055	17,370	13,415	1,680	580	735	3,435	7,030	850	3,785	7,965	1,260
7	0	80	1,105	825	1,475	0	0	85	105	100	440	0	1,350	0
Totals	4,640	10,230	65,070	44,610	22,780	11,330	54,090	1,935	4,965	8,940	2,530	10,650	34,960	29,490

¹ Old Forest Communities are named for their dominant species or species group. They are, from left to right, hemlock, cedar, red spruce, black spruce with moderate site, black spruce with poor site, white spruce, balsam fir, red, white and jack pine, tamarack, softwood-tolerant hardwood, tolerant hardwood-softwood and tolerant hardwood pure.

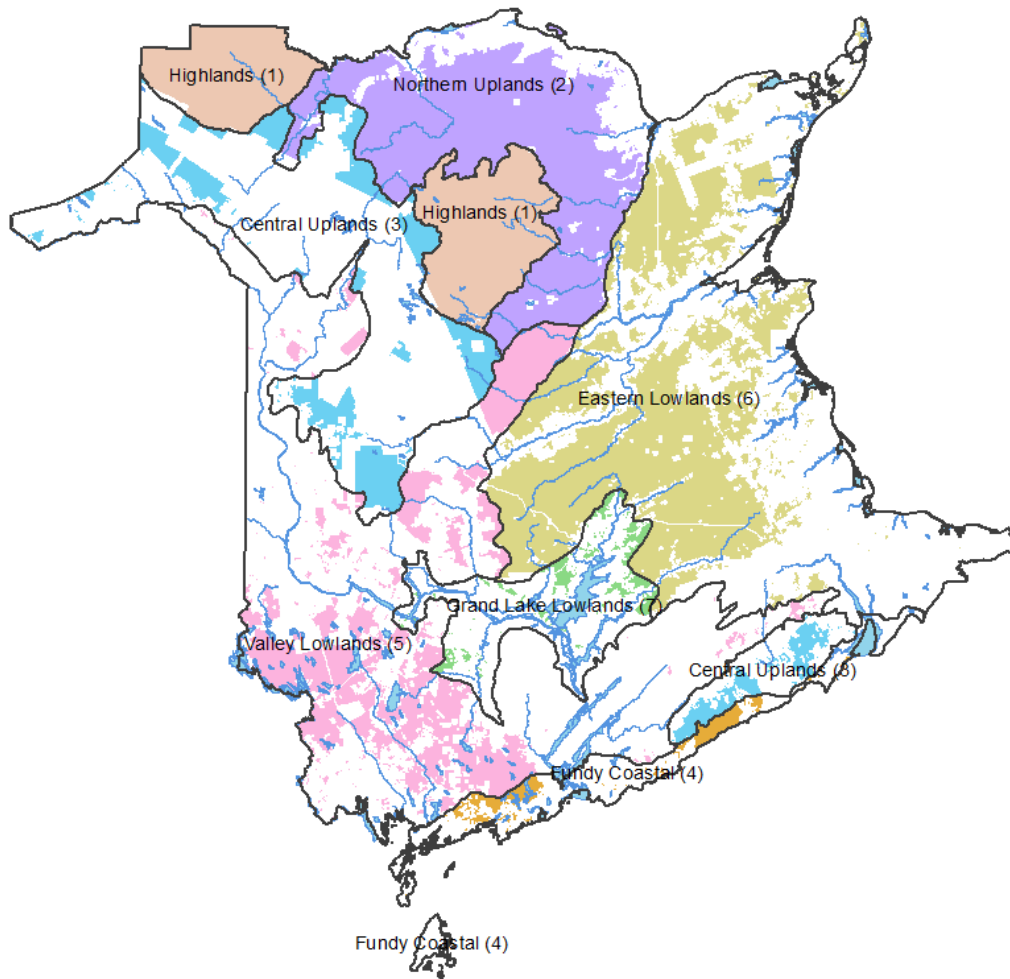


Figure 1. New Brunswick ecoregion boundaries (solid lines) and ecoregion extent on Crown land (fill colours). Unshaded areas are privately held. Note that Ecoregions 1 and 3 each have 2 discrete sections.

OLD-FOREST WILDLIFE HABITATS

Management Goal and Habitat Types

The goal of forest habitat management is to ensure that management activities on Crown land produce a forest that can support vertebrate populations at desired levels. For most species, this translates to providing sufficient habitat to maintain viable populations across the area of Crown land to which they are indigenous. Six OFWHs describe the requirements of the 44 vertebrate species identified as needing old forest to meet their habitat requirements. The habitats are named for the dominant overstorey tree species: Old Tolerant Hardwood (OTHH), Old Hardwood (OHWH), Old Spruce-fir (OSFH), Old Pine (OPIH), Old Mixedwood (OMWH), and Old Forest (OFH). Details on their composition and structure, and on species assignments, are available in the document *Old Forest Community and Old-forest Wildlife Habitat Definitions for New Brunswick 2017* (ERD 2017).

Thresholds: Area per Female

A habitat threshold intended to support viable populations is a function of the area required per breeding female, the number of breeding females in a population, and the number of populations desired across the landscape being managed. The area required per female was most often equal to the size of its home range. However, for 13 species with low habitat specificity for feeding and high specificity for nesting or denning sites, the area required was the minimum area required to continuously recruit the required habitat feature (Table 2).

Table 2. Habitat area required per breeding female for old-forest vertebrate species.

Species	Habitat	Habitat Area per Female	
		Intended Use	Area (ha)
Porcupine	OFH	Den	20
Raccoon	OFH	Den	20
American marten	OFH	Home range	188
Fisher	OMWH	Den site	20
Northern goshawk	OHWH	Nest site	10
Broad-winged hawk	OHWH	Nest site	10
Red-tailed hawk	OFH	Nest site	10
Barred Owl	OTHH	Nest site	20
Northern saw-whet owl	OFH	Nest site	20
Black-backed woodpecker	OSFH	Home range	38
Pileated woodpecker	OHWH	Nest site	10
Common raven	OFH	Nest site	10
White-breasted nuthatch	OTHH	Home range	10
Other old-forest species (31)	Various	Home range	1-5

Thresholds: Management Units and Population Sizes

Each geographic unit within which a population of a given species is supported is termed a management unit. The number of breeding females in a population was set at 500 for all species. Though this may be too few to ensure population viability over the long term, management units are mostly contiguous across the landscape and hence individuals are able to move among them.

Management units were identified for each species. The intent was that they be large enough to support the population in question, small enough to avoid excessive dispersion of habitat patches and, if possible, that they follow existing ecological boundaries. The Province's existing ecological landscape classification (Zelazny 2007) provided adequate scales for management units at the levels of ecoregion and ecodistrict. There are 7 ecoregions in the province, with Crown portions ranging in size from 69K to 1086K ha (mean area = 504K ha) (Figure 1). Nested within the ecoregions are 35 ecodistricts, of which 29 have sufficient Crown land to contribute to this process (mean Crown area = 118K ha).

Thresholds: Management Units and Species

Thirty of 44 old-forest vertebrates were assigned to management units described by ecodistricts. For these species, 29 populations of 500 yielded population targets of 14,500 breeding females. Home ranges for these species range from 1 to 5 ha (Table 1), generating habitat targets of between 14.5K ha and 72.5K ha (Table 3, last row).

American marten and pine warbler have limited distributions, the former due to a boreal affinity and the latter due to a requirement for stands dominated by red or white pine. Habitat thresholds were assigned for only the occupied areas (Table 3; maps in Appendix 1).

The remaining 12 species have per-individual area requirements that preclude maintaining a population in every ecodistrict. For these species, assessments of potential habitat abundance were used to assign larger management units (Table 3).

Table 3. Management units and thresholds for number of populations, number of breeding females, and habitat area on Crown land for old-forest vertebrate species.

Species	Management Units	Crown Land Thresholds		
		Populations	Females ¹	Habitat Area ²
Porcupine	7 Ecoregions	7	3,500	70,000
Raccoon	7 Ecoregions	7	3,500	70,000
American marten	Most Crown land	2	1000	187,500
Fisher	All Crown land	1.2	600	12,000
Northern goshawk	All Crown land	3	1,500	15,000
Broad-winged hawk	All Crown land	3	1,500	15,000
Red-tailed hawk	All Crown land	3	1,500	15,000
Barred Owl	All Crown land	1.5	750	15,000
Northern saw-whet owl	All Crown land	2.5	1,250	25,000
Black-backed woodpecker	7 Ecoregions	7	3,500	131,250
Pileated woodpecker	7 Ecoregions	7	3,500	35,000
Common raven	All Crown land	2	1,000	10,000
White-breasted nuthatch	Each 2 Ecodistricts	14.5	7,250	72,500
Pine warbler	21 ecodistricts	9.4	4,700	4,700
All other old-forest species (30)	29 Ecodistricts	29	14,500	14,500-72,500

¹ Numbers of breeding females are calculated as the product of number of populations and population size (500).

² Thresholds are calculated as the product of number breeding females and habitat required per female (Table 2).

Thresholds: Species and Habitats Combined

Individual thresholds for the same habitat type were overlapped to the extent possible to generate overall thresholds capable of supporting all assigned species. The total threshold areas were usually greater than the thresholds for the most area-demanding species because not all patches could be used by all species due to (1) differences in minimum patch sizes, (2) differences among minimum and maximum inter-patch distances, and (3) species being incompatible in the same patch, (e.g., raptors and mammalian carnivores). Final habitat thresholds are given in Table 4, and population and habitat thresholds are given for all species in Appendix 2.

Table 4. Old-forest Wildlife Habitat thresholds by ecoregion.

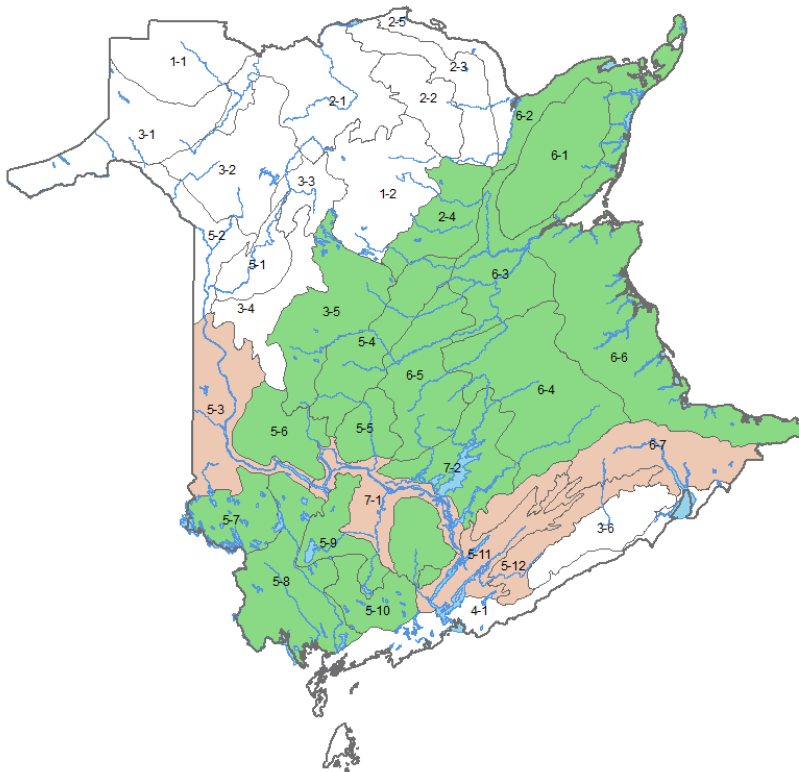
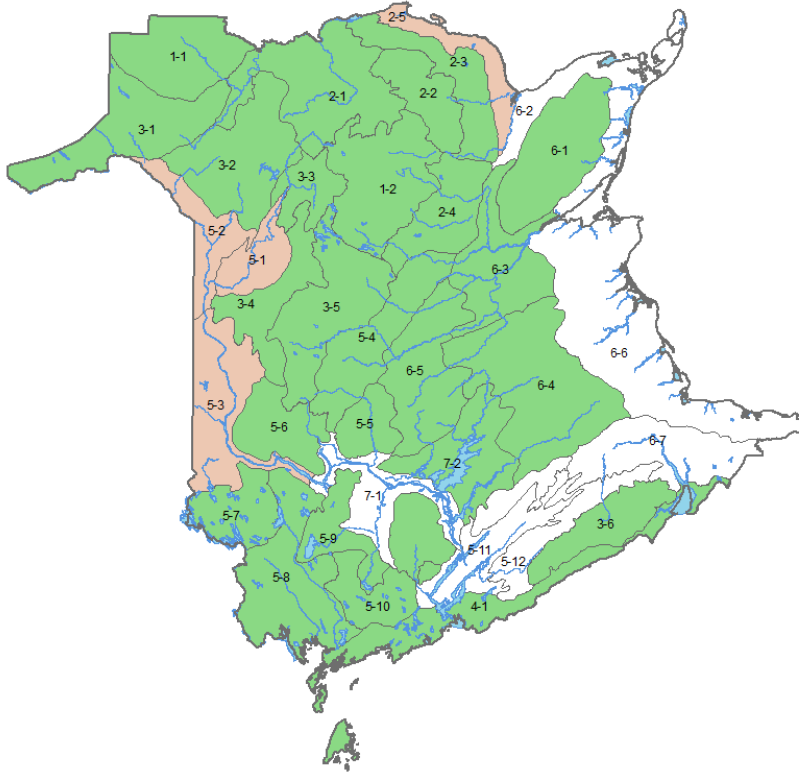
Ecoregion	Old-forest Wildlife Habitat Thresholds (ha)					
	OFH	OHWH	OMWH	OPIH	OSFH	OTHH
1	27,800	7,630	15,680	0	20,450	8,830
2	44,200	15,260	18,300	0	28,930	17,650
3	21,880	17,090	7,840	0	11,010	20,600
4	1,380	1,270	1,310	0	2,150	1,470
5	42,160	17,810	15,680	1,090	22,590	20,590
6	53,340	13,450	15,680	3,460	43,350	14,710
7	4,060	1,640	1,310	150	2,760	1,470
Totals	194,820	74,150	75,800	4,700	131,240	85,320

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APPENDIX 1

Ecodistricts in which American marten (top) and pine warbler (bottom) occur on Crown land (green) and elsewhere in the province (brown).



APPENDIX 2

Habitat type, patch and population characteristics, and habitat thresholds for old-forest vertebrates.

Species	Habitat Type	Habitat Patch			Management Unit	Number Pop'ns	Breeding Females	Habitat Threshold (ha)
		Habitat Area (ha)	Number Females	Primary Use				
Northern flying squirrel	OMWH	50	10	Home ranges	Ecodistrict	29	14,500	72,500
Porcupine	OFH	20	1	Den site	Ecoregion	7	3,500	70,000
Raccoon	OFH	20	1	Den site	Ecoregion	7	3,500	70,000
American marten	OFH	375	2	Home ranges	Most Crown	2	1,000	187,500
Fisher	OMWH	20	1	Den site	All Crown	1.2	600	12,000
Northern goshawk	OHW	10	1	Nest site	All Crown	3	1,500	15,000
Broad-winged hawk	OHW	10	1	Nest site	All Crown	3	1,500	15,000
Red-tailed hawk	OFH	10	1	Nest site	All Crown	3	1,500	15,000
Barred owl	OTHH	20	1	Nest site	All Crown	1.5	750	15,000
Northern saw-whet owl	OFH	20	1	Nest site	All Crown	2.5	1,250	25,000
Yellow-bellied sapsucker	OHW	30	10	Home ranges	Ecodistrict	29	14,500	43,500
Downy woodpecker	OHW	30	10	Home ranges	Ecodistrict	29	14,500	43,500
Hairy woodpecker	OHW	30	10	Home ranges	Ecodistrict	29	14,500	43,500
Black-backed woodpecker	OSFH	375	10	Home ranges	Ecoregion	7	3,500	131,250
Northern flicker	OHW	20	10	Home ranges	Ecodistrict	29	14,500	29,000
Pileated woodpecker	OHW	10	1	Nest site	Ecoregion	7	3,500	35,000
Olive-sided flycatcher	OSFH	40	10	Home ranges	Ecodistrict	29	14,500	58,000
Eastern wood-pewee	OTHH	40	10	Home ranges	Ecodistrict	29	14,500	58,000
Least flycatcher	OHW	30	10	Home ranges	Ecodistrict	29	14,500	43,500
Blue-headed vireo	OMWH	20	10	Home ranges	Ecodistrict	29	14,500	29,000
Red-eyed vireo	OHW	30	10	Home ranges	Ecodistrict	29	14,500	43,500
Blue jay	OHW	30	10	Home ranges	Ecodistrict	29	14,500	43,500
Common raven	OFH	10	1	Nest site	All Crown	3	1,500	15,000
Black-capped chickadee	OHW	30	10	Home ranges	Ecodistrict	29	14,500	43,500
Boreal chickadee	OSFH	50	10	Home ranges	Ecodistrict	29	14,500	72,500
Red-breasted nuthatch	OSFH	30	10	Home ranges	Ecodistrict	29	14,500	43,500
White-breasted nuthatch	OTHH	100	10	Home ranges	District pairs	14.5	7,250	72,500
Brown creeper	OFH	30	10	Home ranges	Ecodistrict	29	14,500	43,500
Winter wren	OSFH	20	10	Home ranges	Ecodistrict	29	14,500	29,000
Golden-crowned kinglet	OSFH	10	10	Home ranges	Ecodistrict	29	14,500	14,500
Swainson's thrush	OMWH	20	10	Home ranges	Ecodistrict	29	14,500	29,000
Ovenbird	OHW	10	10	Home ranges	Ecodistrict	29	14,500	14,500
Cape may warbler	OSFH	10	10	Home ranges	Ecodistrict	29	14,500	14,500
Northern parula	OFH	10	10	Home ranges	Ecodistrict	29	14,500	14,500
Bay-breasted warbler	OSFH	10	10	Home ranges	Ecodistrict	29	14,500	14,500
Blackburnian warbler	OMWH	20	10	Home ranges	Ecodistrict	29	14,500	29,000
Black-throated blue W	OTHH	40	10	Home ranges	Ecodistrict	29	14,500	58,000
Pine warbler	OPIH	10	10	Home ranges	21 districts	9.4	4,700	4,700
Black-throated green W	OFH	10	10	Home ranges	Ecodistrict	29	14,500	14,500
Scarlet tanager	OTHH	20	10	Home ranges	Ecodistrict	29	14,500	29,000
Red crossbill	OSFH	40	10	Home ranges	Ecodistrict	29	14,500	58,000
White-winged crossbill	OSFH	40	10	Home ranges	Ecodistrict	29	14,500	58,000
Pine siskin	OSFH	20	10	Home ranges	Ecodistrict	29	14,500	29,000
Evening grosbeak	OSFH	20	10	Home ranges	Ecodistrict	29	14,500	29,000