Development of a Northern Goshawk Habitat Suitability Index for Forest Types of the Kootenay Region

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ABSTRACT

The northern goshawk (*Accipiter gentilis*) is a rare to uncommon species in British Columbia and throughout the holarctic. The interior subspecies (*A. gentilis atricapillus*) has been declared "Identified Wildlife" and therefore requires special management attention, including the establishment of wildlife habitat areas (WHAs). We recently developed a habitat suitability index (HSI) to investigate the effects of current forest management practices on northern goshawk habitat in southeastern British Columbia. The index describes goshawk habitat requirements based on a spatially hierarchical framework of nested components (i.e., nest area, post-fledging family area, foraging area) within a home range. Without site-specific information, we used goshawk habitat indicator and criteria values in the HSI from the literature and adjusted them to reflect ecosystem-dependent natural disturbance regimes, forest types, and stand dynamics. This study summarizes empirical data gathered on goshawk breeding habitat use in southeastern British Columbia to further develop the nest area component of the HSI. We conducted call playback surveys and intensive nest searches in the Enhanced Forest Management Pilot Project (EFMPP) area of the Invermere Forest District during July 1998. In areas with confirmed breeding activity, we described the characteristics of active and alternate nest trees and assessed the breeding habitat using variable-radius prism plots in 8 randomly selected sites within each nest area. Many historical northern goshawk nest areas in 4 biogeoclimatic zones of the Kootenay Region were similarly assessed. We summarize empirical data on goshawk breeding habitat characteristics and use this information to recommend ecosystem-specific improvements to the nest area component of the HSI. We also discuss possible practical applications of HSI model output to the Invermere EFMPP area.

Key words: *Accipiter gentilis*, breeding habitat, habitat suitability index, Kootenay, nest trees, northern goshawk.

The northern goshawk (*Accipiter gentilis)* is receiving increased attention from resource managers because of an association with mature and old-growth forests throughout its range. This species has recently been declared "Identified Wildlife" under the British Columbia Forest Practices Code and therefore requires special management attention, including the establishment of wildlife habitat areas (WHAs).

To evaluate the effects of forest management practices on the availability of goshawk habitat in southeastern British Columbia, we recently developed a northern goshawk habitat suitability index (HSI). The index is based on a framework of nested components (i.e., nest area, post-fledging area, foraging area; Fig. 1) within an overall home range.

Without information for the interior subspecies (*A. gentilis atricapillus*) in southeastern British Columbia, we used goshawk habitat indicator and criteria values from the literature and adjusted them to reflect local forest types, stand dynamics, and natural disturbance regimes (Table 1).

We summarize preliminary empirical data gathered at active and historical goshawk nest areas in 4 biogeoclimatic variants of the Kootenay Region. These data will be used to further develop the nest area component of the HSI.

METHODS

CALL PLAYBACK SURVEYS AND NEST SEARCHES

We conducted call playback surveys and intensive nest searches from 13 to 20 July 1998 in the Enhanced Forest Management Pilot Project (EFMPP) area of the Invermere

Table 1. Proposed habitat indicators and criteria for northern goshawk nest areas in southeastern British Columbia.

Habitat indicator	Weighting	Criteria and level			
		Good (3)[a]	Moderate (2)	Poor (1)	Unsuitable (0)
Very large trees 60 cm	1.0	>50/ha	30–50/ha	10–30/ha	<10/ha
Large trees 40 cm	1.0	>60/ha	40–60/ha	20–40/ha	<20/ha
Crown closure	1.0	>75%	60–75%	50–60%	<50%
Canopy complexity	1.0	>2 layers	2 layers	1 layer	no canopy
Slope	0.5	<30%	30–45%	45–60%	>60%
Aspect	0.3	SW, S, SE, nil	W, E	NW, N, NE	—
Patch size	0.8	>40 ha	20–40 ha	5–20 ha	<5 ha
Distance to water source	0.5	<0.5 km	>0.5–2 km	>2–4 km	>4 km
Distance to active road	0.3	>1,000 m	500–1,000 m	250–500 m	<250 m

[a] Numbers in parentheses are suitability values associated with each level of criteria; nest area suitability (a weighted arithmetic mean of individual indicator values) values range from 0 to 1 and correspond to the following subjectively defined classes: good, >0.8; moderate, 0.6–0.8; poor, 0.4–0.6; unsuitable, <0.4.

Forest District (Fig. 2). Areas with high goshawk nesting potential within the study area were prioritized for surveys using a themed geographic information system (GIS) map generated by British Columbia Ministry of Forests staff, based on the following criteria: >40% crown closure, age class 6–9, <50% slope, and south or west aspects.

ASSESSMENT OF ACTIVE AND HISTORICAL NEST AREAS

We assessed the following characteristics at 18 active and alternate nest trees and sites: 1) nest tree species, diameter at breast height (dbh) (cm); height (m); decay class, defects and disturbance agents; nest height (m), and position; and 2) age class, forest cover type, slope position, elevation (m), site series, and location (with global positioning system [GPS]). In plots centred on active and alternate nest trees and in 8 other

randomly chosen locations ≤ 200 m distance from nest sites), we sampled the following parameters: 1) species, dbh (cm), height (m) and decay class of all trees >7.5 cm dbh in variable-radius prism plots; 2) percent crown closure and number of tree layers in 11.28-m fixed-radius plots; and 3) percent slope and aspect. Patch sizes and distances to permanent water and active roads were estimated from air photos and field reconnaissance. We also assessed goshawk breeding habitat at 7 historical nest areas in the Interior Douglas-fir (IDF), Montane Spruce (MS), and Engelmann Spruce–Subalpine Fir (ESSF) biogeoclimatic zones of the East Kootenay. Data gathered at 4 historical nest areas in the Interior Cedar–Hemlock (ICH) zone of the West Kootenay (as part of a separate study) are included for comparison.
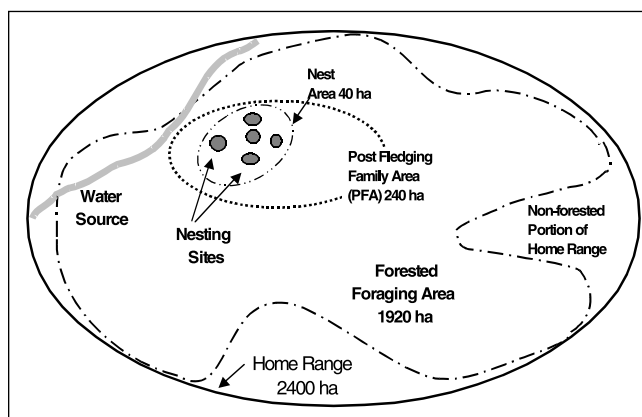

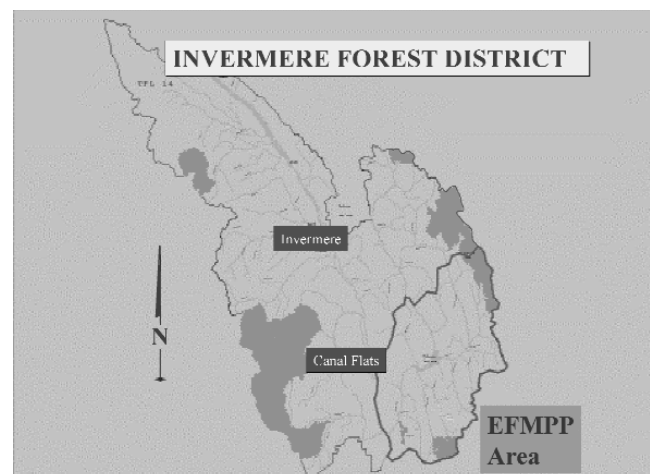**Figure 1.** Schematic diagram of northern goshawk habitat requirements.

Figure 2. Location of the Enhanced Forest Management Pilot Program (EFMPP) area, Invermere Forest District.

Table 2. Characteristics of active and alternate nest trees and sites found in the East and West Kootenay (mean ± SE [range], unless otherwise indicated).

	East Kootenay (n = 18)	West Kootenay (n = 4)
Nest trees		
Species (%)	56%Fd; 44%Lw	40%Fd; 20%Pl; 20%Pw; 20%Py
Dbh (cm)	54.8 ± 0.2 (36.3–80.0)	63.1 ± 2.2 (38.9–81.0)
Height (m)	29.4 ± 2.1 (26.0–34.0)	33.9 ± 3.3 (27.0–46.0)
Decay class (%)	56% 2; 44% 1	25% 1; 50% 2; 25% 3
Nest height (m)	14.0 ± 0.8 (7.5–22.5)	16.9 ± 2.7 (9.0–24.0)
Nest sites:		
Elevation (m)	849–1,373	799–972
Slope position (%)	44% mid; 33% low; 17% level; 6% upper	67% mid; 33% low
Age class (%)	40% 8; 20% 6 & 7; 10% 5 & 4	50% 8; 33% 6; 17% 7
Forest cover	Fd, Lw, Pl, Sxw, and Bl	Fd, Pl, and Lw

RESULTS

CALL PLAYBACK SURVEYS AND NEST SEARCHES

Three goshawk responses were received at 198 call stations (response rate = 1.52/100 stations) and fledgling begging calls were heard at 2 additional stations before playing taped calls. These 5 detections resulted in the discovery of 3 active goshawk nest areas in the pilot area. New active nests were also found in 2 historical nest areas. Productivity was 1.8 ± 0.2 (mean fledged birds ± standard error [SE]) at 5 successful nests in the East Kootenay.

ASSESSMENT OF ACTIVE AND HISTORICAL NEST AREAS

Characteristics of active and alternate goshawk nest trees and sites are summarized in Table 2. All goshawk nests were found close to the bole in the lower third of tree crowns. Nest trees were among the largest (upper 10% of diameter and height distribution) available in the stands sampled and 8 of 10 nest trees found in western larch had symptoms of dwarf mistletoe. With the exception of 2 nest sites in the Soowa Mountain nest area (in an age class 4 fire origin lodgepole pine stand bordering a >100-ha, age class 8 patch), nest sites were found at middle, lower, or level slope positions in age class 5–8 stands.

Results of assessments for 9 habitat indicators at 14 northern goshawk nest areas are summarized in Table 3. Nest areas were found on a range of aspects (south and west aspects accounted for >70%) with relatively gentle slopes (≤ 40%), single- to multilayered canopies, 44–76% crown closure, sparse understories, and variable densities of large trees.

In general, nest areas sampled in the West Kootenay had higher suitability values based on the proposed HSI.

We recommend the following site-specific improvements to the HSI until additional data can be obtained: 1) reduce the very large tree diameter limit from >60 to >50 cm; 2) adjust criteria for the very large tree habitat indicator (>20, 5–20, 3–5, and <3 stems per hectare for good, moderate, poor, and unsuitable ratings, respectively) in forest types of the East Kootenay; 3) modify criteria for the percent crown closure habitat indicator (>55 good, 45–55 moderate, 40–45 poor, and <40% unsuitable for East Kootenay; >60 good, 50–60 moderate, 40–50 poor, and <40% unsuitable for West Kootenay), and 4) remove the distance to active road habitat indicator because intensity of road use varies seasonally and over time making it difficult to estimate this parameter.

More intensive northern goshawk field surveys and breeding habitat assessments are planned in the Invermere Forest District for the 1999 breeding season.

APPLICATION OF THE HSI

We recently used the Simulation Forest (SIMFOR) model to evaluate effects of changes in coarse spatial patterns of forest cover on the quantity and quality of northern goshawk foraging habitat in the Invermere EFMPP area of southeastern British Columbia. SIMFOR uses harvest schedules from an external source to define future stand ages for a set of user-mapped stand types. Habitat quality and species response in the model are interpreted by employing user-defined relationships between: 1) the supply of habitat attributes (e.g., crown closure and density of large snags, trees, and coarse woody debris were used for goshawk foraging areas) in different stand ages and types ("habitat supply curves"; Fig. 3); and 2) the relative importance of those attributes to a given species ("habitat suitability curves"; Fig. 4). The degree to which the predicted levels of attributes in a given stand at a specified time match a user-defined optimal habitat determines relative habitat suitability for that site. SIMFOR provides maps and data summaries of habitat quality over time for a site-specific stand or home range (1,920 and 1,440 ha forested foraging areas were used in the simulation runs).

Output maps (examples in Fig. 5) indicated a short to medium term decrease in goshawk habitat suitability with

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Table 3. Results for 9 habitat indicators at 14 northern goshawk nest areas in the East and West Kootenay.

Nesting area	Habitat indicators								
	Very large trees (stems/ha)	Large trees (stems/ha)	Crown closure (%)	Canopy layers (no.)	Slope (%)	Aspect	Patch size (ha)	Water source (m)	Active road (m)
EAST KOOTENAY									
IDFdm2									
Whiteswan Lake	11	124	49	2-3	0	nil	61	800	100
Nine Mile Creek	1	45	52	2	19	W	26	750	125
Parson	7	102	57	1	31	N	109	450	45
Newgate	1	39	58	1	22	N	164	1,200	750
Soowa Mountain	1	3	69	2	39	N	123	450	250
Horse Creek	5	48	52	2	20	SW	57	500	200
MSdk1				2					
Whitetail Lake	1	25	44	2	29	W	18	2,000	50
Cedrus Creek	4	119	58	2	13	W	268	400	300
Maryann Creek	22	78	56	2-3	25	SW	19	250	1,500
ESSFdk									
Munroe Lake	2	50	46	2	23	SW	116	400	250
WEST KOOTENAY									
IDFdw									
Koch Face	20	313	60	2	40	SE	67	100	100
ICHmw2									
Rusty Creek	10	83	43	2	40	SE	118	250	200
Whatshan Lake	55	300	76	2-3	20	W	20	250	1,500
Merry Creek	16	155	66	2	23	E	180	700	300

Suitability: Unsuitable · Poor · Moderate · Good

subsequent increases 50–100 years from now. Differences between site and home range level habitat suitability indicated that although numerous individual stands have good quality habitat, many are too fragmented to provide a sufficient area of high quality habitat within individual home ranges. This result may be partly caused by the use of circular home ranges in the model (elongated home ranges may have provided more realistic habitat suitability estimates for the narrow valleys and intervening alpine zones found in the study area). Sensitivity analysis showed that the subjective setting of class limits for habitat quality may be one of the most important factors in the overall habitat assessment outcome.
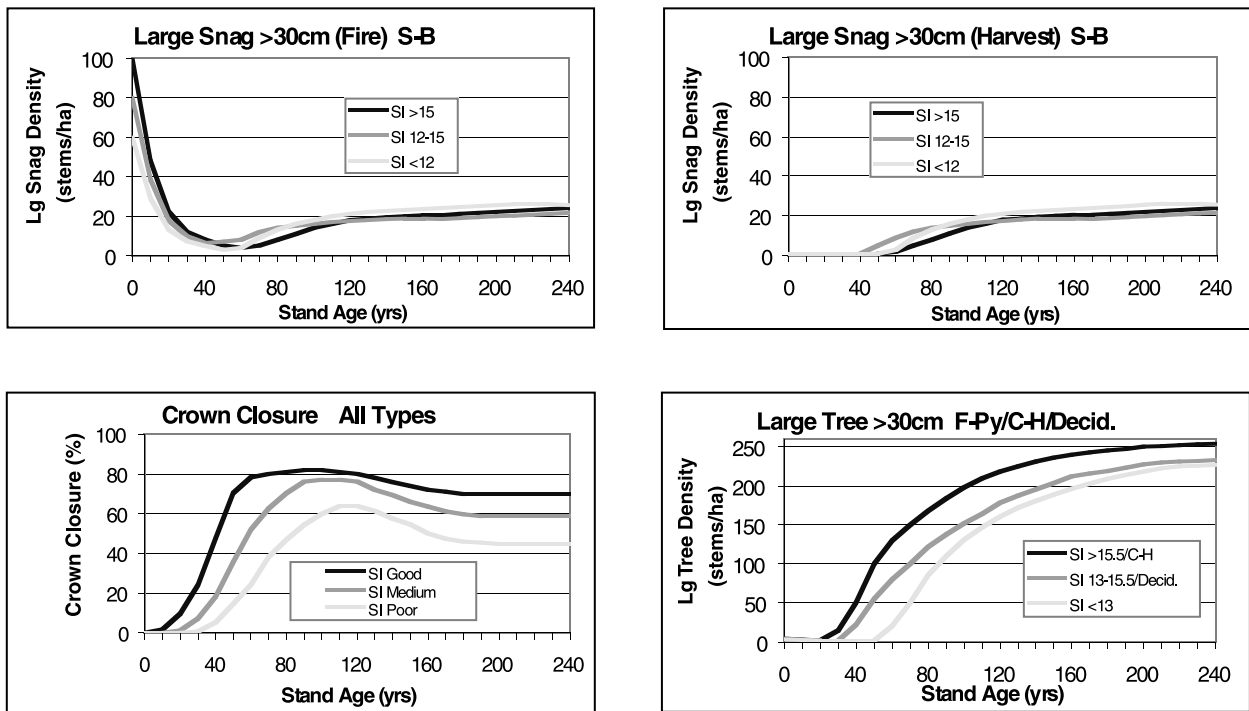
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Figure 3. Examples of northern goshawk foraging habitat supply curves at 3 suitability index classes.
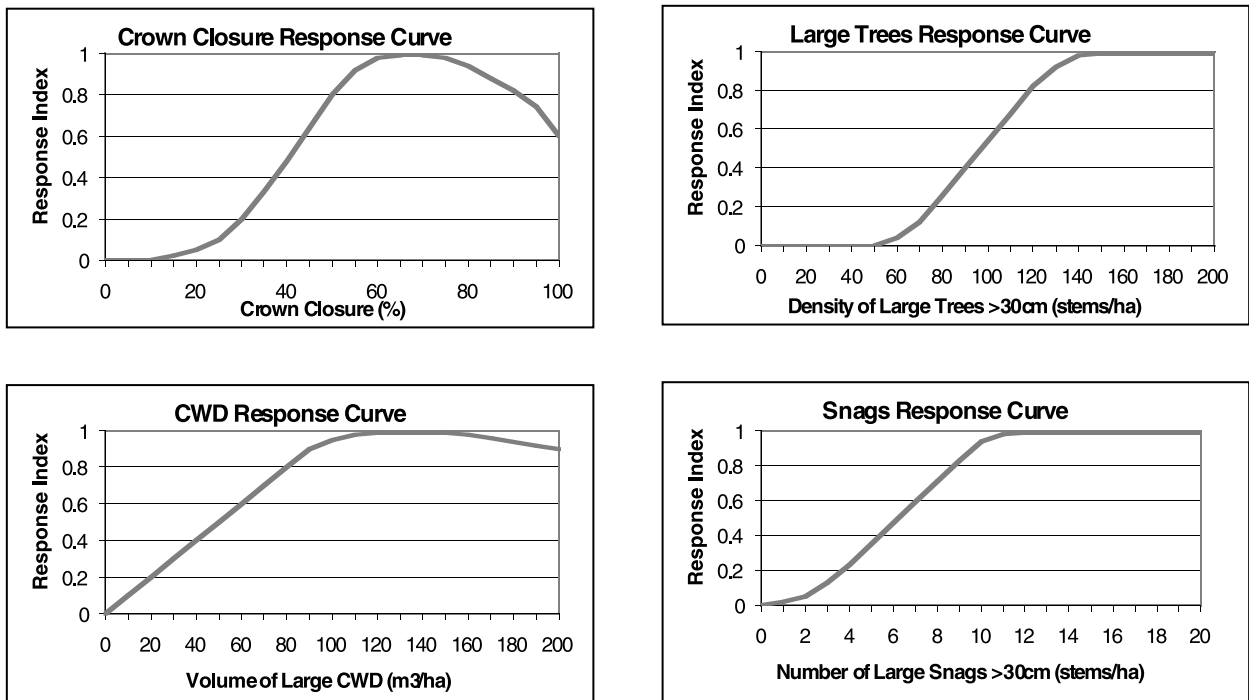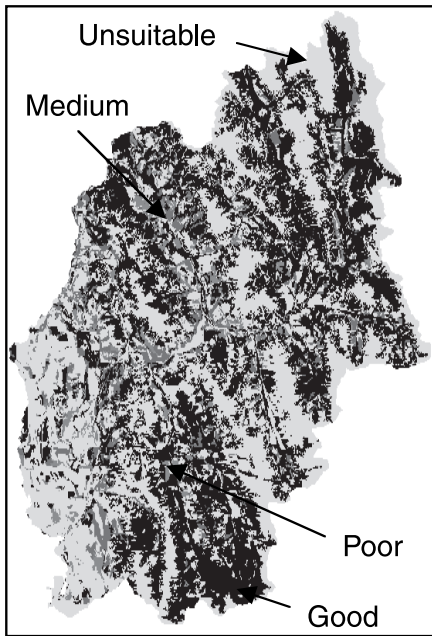

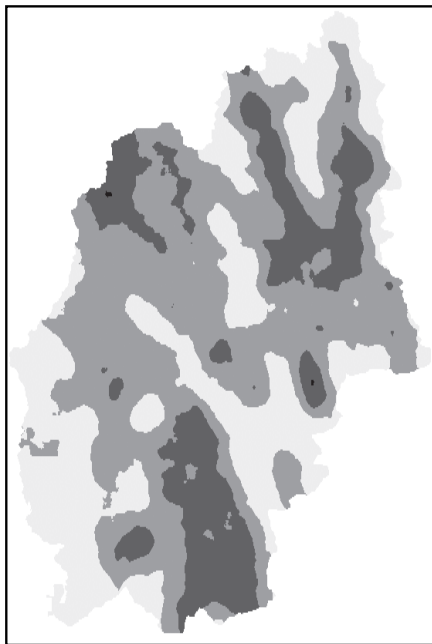**Figure 4.** Examples of northern goshawk foraging habitat suitability curves.

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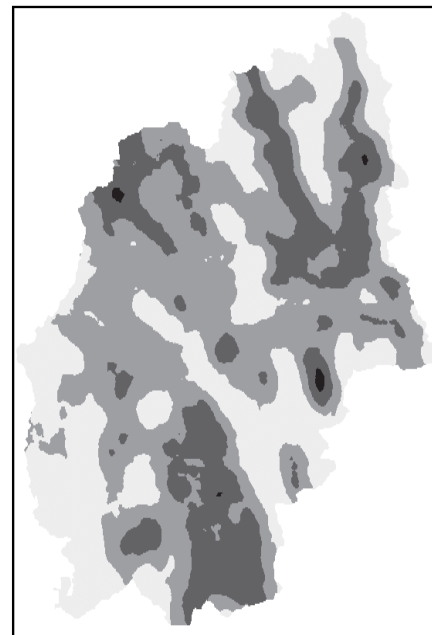
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Site level foraging habitat suitability –
Year 100.
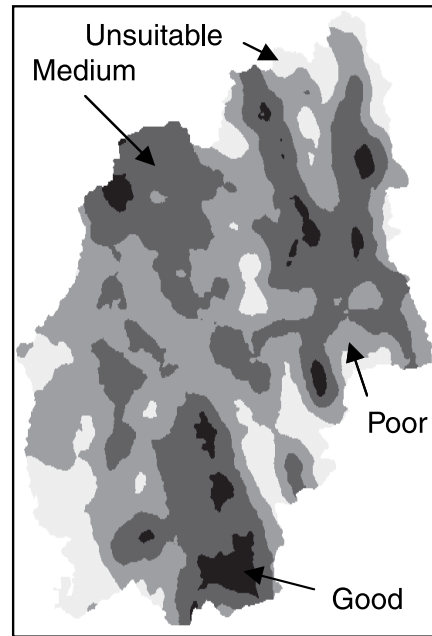
Home range level foraging habitat
suitability – Year 100 (HR = 1920 ha,
class limits 0.3, 0.5, 0.7).

Home range level foraging habitat
suitability – Year 100 (HR = 1920 ha,
class limits 0.4, 0.6, 0.8).

Home range level foraging habitat
suitability – Year 100 (HR = 1440 ha,
class limits 0.4, 0.6, 0.8).

Figure 5. Examples of northern goshawk foraging habitat suitability output for the EFMPP area generated by
the SIMFOR habitat analysis module.