

EVALUATING NORTHERN GOSHAWK WILDLIFE HABITAT AREAS: SELECTING MONITORING INDICATORS

Prepared by: *Laura Darling*

Under the Forest and Range Evaluation Program, the Wildlife Resource Value Team assesses habitat management practices enabled under the *Forest and Range Practices Act* (FRPA) that are directed at individual species (species specific), such as the establishment of Wildlife Habitat Areas (WHAs). WHAs are legally designated areas of important habitat for species at risk or regionally important wildlife¹.

The Wildlife Resource Value Team implements a provincial framework² that recommends a standardized approach to evaluate the effectiveness of WHAs; the approach involves several important steps to ensure that appropriate indicators and methods are implemented.

This extension note describes indicators selected for evaluating the effectiveness of WHAs for the coastal subspecies of Northern Goshawk (*Accipiter gentilis laingi*). It is a summary of a FREP report prepared by Todd Mahon (FREP Report # 26)³.

THE NORTHERN GOSHAWK

The coastal subspecies of Northern Goshawk (*Accipiter gentilis laingi*), hereafter referred to as Goshawk, is a year-round resident on Vancouver Island, Haida Gwaii and along the mainland coast, where it is an effective forest predator, preying mainly on squirrels, forest birds and grouse.

STATUS

Goshawks are designated Threatened under the federal *Species at Risk Act*, and are Red-listed in British Columbia. The subspecies is identified as a species at risk under the *Forest and Range Practices Act*, which enables the

- 1 Regionally important wildlife are species that are not at risk but are of importance in a region of BC, rely on habitats that are not otherwise protected under FRPA and may be adversely impacted by forest or range practices.
- 2 see <http://www.for.gov.bc.ca/hfp/frep/values/wildlife.htm>
- 3 see <http://www.for.gov.bc.ca/hfp/frep/publications/reports.htm#rep26>

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To be a world leader in resource stewardship monitoring and effectiveness evaluations; providing the science-based information needed for decision-making and continuous improvement of British Columbia's forest and range practices, policies and legislation.
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EXTENSION NOTE #15

December 2010

designation of WHAs and associated management practices (General Wildlife Measures - GWMs) to protect important Goshawk habitats as specified in the *Accounts and Measures for Managing Identified Wildlife* (2004)⁴. Loss and fragmentation of mature and old-growth coniferous forest to forest harvesting, and the resulting reduced availability and condition of Goshawk nesting and foraging habitats, is probably the most significant factor threatening Goshawks in coastal British Columbia.



Adult Northern Goshawk (Photo credit: Mike Stini)

GOSHAWK WILDLIFE HABITAT AREAS

Goshawk breeding territories consist of a core breeding area (~200 ha) surrounded by a foraging area (~4000 ha). WHAs for Goshawks focus on the breeding area, with nest trees recognised as a critical life requisite, and may include foraging areas. As of August 2010, 28 WHAs totalling 14 765 ha had been established for Goshawks in coastal B.C., ranging in size from 32 to 2593 ha (average: 527 ha).

GWMs are established in Goshawk WHAs to: (1) maintain important breeding and foraging habitats within the core area; (2) prevent disturbance and abandonment of breeding Goshawks; and (3) maintain important structures for prey habitats. Forestry and/or range activities within the WHA may be constrained or prohibited by GWMs.

- 4 see <http://www.env.gov.bc.ca/wld/frpa/iwms/accounts.html>

MONITORING OBJECTIVES AND QUESTIONS

The Wildlife Resource Value Framework poses a general provincial scale question for WHA effectiveness monitoring:

“Do WHAs maintain the habitat, structure and functions necessary to meet the goals of the area, and is the amount, quality and distribution of WHAs contributing effectively with the surrounding land base to ensure the survival of the species now and over time?”

The specific aspects of this general question that are the focus of the current evaluation of effectiveness of Goshawk WHAs are:

1. Assessment of WHA **implementation**: When the WHA was established, did it adhere to the recommended management guidelines in the *Accounts and Measures for Managing Identified Wildlife (2004)*⁴ in terms of size, location, habitat condition, habitat features, etc.; and does the WHA retain the desired condition and features over time?
2. Evaluation of WHA **effectiveness**: Does WHA occupancy and Goshawk breeding success continue at expected rates in established WHAs?
3. **Validation** of assumptions of current management guidelines: Do management practices reflect valid assumptions about relationships of occupancy and breeding success to habitat characteristics, especially those affected by forest management?



Northern Goshawk on nest (Photo credit: Mike Stini)

CONCEPTUAL MODEL

A conceptual ecological model (Figure 1) was developed to illustrate our best understanding of relationships among Goshawk breeding outcomes and key environmental and ecological variables. The model was used to identify important knowledge gaps and potential indicators for implementation assessment, effectiveness evaluation and validation monitoring.

INDICATORS

Potential implementation, effectiveness and validation indicators for evaluating Goshawk WHAs (Table 1) were selected from the conceptual model based on the ecological importance of breeding habitat, foraging habitat and prey availability, as it relates to foraging habitat quality, (see sidebar) within the model. Their relationship to forest management and the simplicity and reliability of each potential indicator were also important considerations.

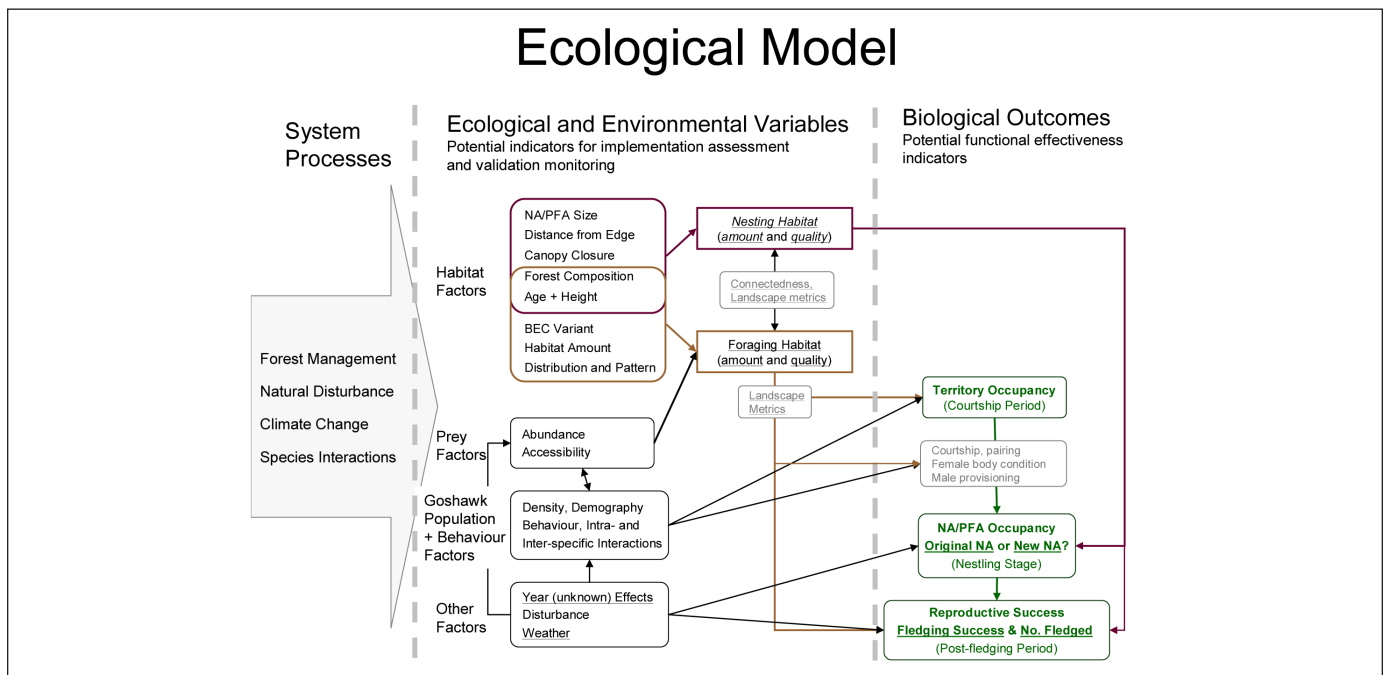


Figure 1. Ecological concept model showing relationships among goshawk breeding outcomes and factors that affect these outcomes. Key indicators recommended for effectiveness evaluation at the Implementation Assessment, Functional Effectiveness, and Validation Monitoring levels are identified by their corresponding formatting.

Table 1 Indicators recommended for evaluating effectiveness of Goshawk WHAs. Suitable nesting and/or foraging habitat is typically old or mature coniferous forest (see sidebars), or can be determined from habitat suitability models.

INDICATOR AND DESCRIPTION	RATIONALE
IMPLEMENTATION	
Administrative size of WHA (ha) at establishment	WHA size (and hence size of the protected breeding area) varies considerably. Size of breeding area affects occupancy and breeding success.
Quality/composition of habitat in the WHA (ha or proportion of suitable nesting habitat in WHA)	Amount of suitable habitat affects occupancy and breeding success.
EFFECTIVENESS	
Pair occupancy at nestling stage (presence of nestlings or brooding adults)	Egg laying and incubation confirm commitment to the nest and breeding area, and confirm use of the WHA.
Breeding success (fledglings present) and reproductive output (number of fledglings)	Confirm successful reproduction in the breeding area and WHA.
Establishment of new breeding area outside of WHA (within 800 m of boundary of original breeding area)	If not detected in the original breeding area (WHA), establishing a nest nearby confirms the breeding area has become unsuitable but the broader territory is still functional.
VALIDATION	
Effective size (ha) of breeding area (extent of contiguous, suitable breeding habitat within 800 m of breeding area centroid)	Suitable breeding habitat beyond the WHA boundary supplements habitat protected within the WHA; larger effective size likely makes a WHA site more attractive to Goshawks.
Amount and quality of suitable breeding habitat in the effective breeding area (ha or proportion)	Amount of suitable breeding habitat affects occupancy and breeding success; the relationship between the extent of contiguous suitable habitat and breeding success needs to be more accurately quantified.
Amount and quality of suitable breeding and foraging habitats in the home range (ha or proportion)	Amount of suitable breeding and foraging habitat affects occupancy and breeding success. WHAs with better quality habitats in the surrounding breeding territory are likely to have higher occupancy rates and increased breeding success.
Connectedness and proximity of breeding area to adjacent suitable foraging habitats	Breeding areas isolated from sufficient suitable nesting or foraging habitat are often abandoned. WHAs isolated from suitable habitat are likely to be less successful. The distance that constitutes isolation or connectedness is uncertain.
Presence of “hard edges” (habitats of significant height differences) within 800 m of breeding area centroid, and distance from known nests	Disturbance and mortality related to hard edge habitats (e.g., roads, clearcut edges) has potential to reduce occupancy and breeding success.
Landscape metrics (habitat patchiness, patch sizes, distribution, amount of “hard edge” habitat)	Mechanisms behind correlative relationships between landscape-level habitat patterns and breeding success need to be confirmed.
Year effect (categorical random effect)	Unexplained substantial annual variations in occupancy and breeding success need to be investigated.
Weather effect during incubation and brooding (accounting for weather conditions and events – rainfall, temperature, severe weather)	Need to investigate what is acknowledged as accounting for significant variations in occupancy and breeding success.

Sidebar #1

Breeding Habitat

Goshawks typically build large stick nests in the subcanopy of mature and old-growth coniferous forests (structural stage 6-7); a few nests are found in young stands (structural stage 5) that are highly productive growing sites. Key structural attributes for breeding habitat include a closed canopy and open subcanopy flyways. The breeding area (nest area and post-fledging area) is the centre of breeding activities throughout the reproductive season; in coastal B.C. the breeding area is estimated to range between 100 and 200 ha and typically encompasses two or more nest trees within 800 m of each other. Nest areas on the coast are usually on moderate or productive sites with stands dominated or co-dominated by western hemlock or Douglas-fir, typically ≥ 140 years old (or 80-100 year-old second growth), ≥ 28 m tall, $\geq 50\%$ canopy closure, and on slopes $< 100\%$ gradient. Goshawks exhibit very strong fidelity to a breeding area once established. New pairs re-occupy breeding areas that become vacant.

Sidebar #2

Foraging Habitat

The breeding area is surrounded by a foraging area with sufficient prey to support the adults and their young. Physical attributes of foraging habitat are similar to those of breeding area habitat, with mature, closed-canopy forests and an open subcanopy; however, researchers report more variability in structural attributes of foraging habitat, probably depending on regional and temporal variations in prey availability.

Sidebar #3

Prey Availability

Prey abundance and accessibility are probably limiting factors to the fitness of individual Goshawks and population growth. Prey availability is a factor that contributes to the quality of foraging habitat. Whether a female breeds or not depends on her body condition in the spring and the success of her mate in providing food to her before egg-laying. Prey availability during nesting and post-fledging periods determines the number of young successfully fledged each season. Starvation often accounts for as much as 85% of all juvenile Goshawk deaths in their first year.

NEXT STEPS

The next step in developing an effectiveness evaluation for Goshawk WHAs is development and testing of data collection protocols for the recommended indicators. Some indicators, especially the validation indicators, require refinement, and a process must be developed for assessing effectiveness in terms of combined results from all indicators. A statistical analysis framework will be established for the pilot study to address statistical design, sampling regimes, indicator sensitivity and sample size requirements. We will prioritize WHAs to evaluate and the framework will be refined for implementation of the final effectiveness protocol. Results from the pilot and long-term monitoring will be provided to wildlife and forest managers responsible for conservation of Goshawks and their habitat in B.C.



Fledgling Northern Goshawk (Photo credit: Todd Luoma)

ACKNOWLEDGEMENTS

Todd Mahon developed the initial effectiveness evaluation framework for Goshawk WHAs that this Extension Note is based on, with assistance and review from members of B.C.'s Northern Goshawk Recovery Team and FREP Wildlife Resource Value Team.

For more information about FREP visit:

<http://www.for.gov.bc.ca/hfp/frep/>

For information about the FREP Wildlife Resource Value Team, or this project, contact:

Laura Darling, Ministry of Forests, Mines and Lands
Laura.Darling@gov.bc.ca

Kathy Paige, Ministry of Environment
Kathy.Paige@gov.bc.ca

