# COSEWIC
# Assessment and Status Report

on the

# Northern Saw-whet Owl *brooksi* subspecies
*Aegolius acadicus brooksi*

**in Canada**

**THREATENED**
**2017**

**COSEWIC**
Committee on the Status
of Endangered Wildlife
in Canada

**COSEPAC**
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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Previous report(s):

COSEWIC. 2006. COSEWIC assessment and status report on the Northern Saw-whet Owl *brooksi* subspecies *Aegolius acadicus brooksi* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 34 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

Production note:
COSEWIC would like to acknowledge Nyree Sharp for writing the status report on Northern Saw-whet Owl *brooksi* subspecies, prepared under contract with Environment and Climate Change Canada. This report was overseen and edited by Richard Elliot, Co-chair of the COSEWIC Birds Specialist Subcommittee.

For additional copies contact:

COSEWIC Secretariat
c/o Canadian Wildlife Service
Environment and Climate Change Canada
Ottawa, ON
K1A 0H3

Tel.: 819-938-4125
Fax: 819-938-3984
E-mail: ec.cosepac-cosewic.ec@canada.ca
http://www.cosewic.gc.ca

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Species Name — Photo by Berry Wijdeven, used with permission.


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# COSEWIC
# Assessment Summary

**Assessment Summary – November 2017**

**Common name**
Northern Saw-whet Owl *brooksi* subspecies

**Scientific name**
*Aegolius acadicus brooksi*

**Status**
Threatened

**Reason for designation**
This distinct subspecies endemic to Canada has a small population of fewer than 2000 breeding individuals, restricted to the islands of Haida Gwaii off the Pacific coast of British Columbia. It is a forest specialist, preferring older coniferous forests with abundant nesting snags and an open understory. Numbers of breeding birds are anticipated to further decline over the next 15 years as a consequence of ongoing forest harvesting. Other continuing low-level threats to this subspecies include problematic invasive, introduced and native species, accidental mortality from road collisions and effects of forest fires. As just over 70% of Haida Gwaii is now within protected areas reserved from forestry operations, including National Park Reserve, provincial park, and reserves under the Haida Gwaii Strategic Land Use Agreement, this subspecies is not at risk of imminent extinction.

**Occurrence**
British Columbia

**Status history**
Designated Threatened in April 2006. Status re-examined and confirmed in November 2017.

# COSEWIC
# Executive Summary

## Northern Saw-whet Owl *brooksi* subspecies
*Aegolius acadicus brooksi*

### Wildlife Species Description and Significance

The *brooksi* subspecies of Northern Saw-whet Owl is a small owl, about 20 cm in length. It has a relatively large head, with a prominent round facial disk and no ear tufts. Plumage is darker than in the continental *acadicus* subspecies, with an overall buffy appearance and dark stripes on the underparts. This endemic, non-migratory subspecies is found only on Haida Gwaii (formerly known as the Queen Charlotte Islands) in British Columbia. It is distinct from its continental counterpart in its behaviours, adaptations and genetics.

### Distribution

The global range of the *brooksi* subspecies of Northern Saw-whet Owl is restricted to the Haida Gwaii archipelago of Canada, off the Pacific coast of British Columbia.

### Habitat

During the breeding season, these owls are found primarily in mature and old forest habitats at low elevations (below 300 m), in the Coastal Western Hemlock biogeoclimatic zone. Northern Saw-whet Owls are secondary cavity nesters and rely on primary cavity excavators to create their nest sites. Habitat use during the non-breeding season is not well understood, although many individuals appear to move to coastal areas during the winter. The amount of suitable habitat available to this subspecies has been declining slightly as a result of forest harvest.

### Biology

The Northern Saw-whet Owl starts breeding at 1 year of age, and is believed to live at least 5 to 7 years on average. It likely breeds annually, with a clutch of 5 to 6 eggs. The *brooksi* subspecies does not migrate, but many individuals likely move towards the coastline in the winter, possibly to take advantage of an abundant food supply. This subspecies is more generalist and opportunistic in its food choices than the nominate subspecies. Competition from other species and predation of adults appear to be limited, although mammalian predators pose a threat to eggs and nestlings.

## Population Sizes and Trends

Population size and trends have not been measured directly. Based on recent estimates of home range size, occupancy and area of suitable habitat, the current population is estimated at about 1756 mature individuals, with a 95% confidence interval of 1042–2277. Projected trends in habitat loss suggest that a potential decrease in population size of 1.3% or more will occur over the next 3 generations (15 years).

## Threats and Limiting Factors

The *brooksi* Northern Saw-whet Owl is exposed to six threats ranked as Low impact, with an overall threat assessment impact level of Medium. Logging and forest harvesting removes and fragments suitable habitat, and reduces the availability of nesting trees. Several introduced species and problematic native species are believed to affect this subspecies through nest predation, reduction of prey species numbers, and competition for nest sites. Accidental mortality from road collisions occurs during fall and winter when some owls move to coastal areas to forage. Risks from forest fires, earthquakes and tsunamis also present threats to this subspecies and its forest habitat. The small population size, limited distribution and reliance by the *brooksi* Northern Saw-whet Owl on nesting cavities created by other species are inherent limiting factors.

## Protection, Status and Ranks

The *brooksi* Northern Saw-whet Owl was assessed by COSEWIC as Threatened in 2006 and 2017, and is listed federally in Schedule 1 of the federal *Species at Risk Act* as Threatened. It is protected from hunting, trafficking, or possession in the Gwaii Haanas National Park Reserve and Haida Heritage Site under the *Canada National Parks Act*. Just over 70% of Haida Gwaii is currently protected from forest harvest, although much of the more productive forest area is not protected. Globally, the subspecies is ranked as Imperilled by NatureServe, with a rank in Canada and British Columbia of Imperilled to Vulnerable. It is on the blue list of species at risk in British Columbia, and individual birds and their nests are protected under the *British Columbia Wildlife Act*. This subspecies is listed under Appendix II of the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), which protects it from international trade.

# TECHNICAL SUMMARY

*Aegolius acadicus brooksi*

Northern Saw-whet Owl *brooksi* subspecies

Petite Nyctale de la sous-espèce *brooksi*

Range of occurrence in Canada (province/territory/ocean): British Columbia

**Demographic Information**

| | |
|---|---|
| Generation time (usually average age of parents in the population) | 5 years, with the average age of breeding adults estimated of at least 2–5 years |
| Is there an [observed, inferred, or projected] continuing decline in number of mature individuals? | Yes, inferred and projected |
| Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations] | 0.87% within 2 generations (see discussion in **POPULATION SIZES AND TRENDS** section) |
| [Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations]. | 2.1% estimated reduction over the last 3 generations (see discussion in **POPULATION SIZES AND TRENDS** section) |
| [Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations]. | 1.3% projected reduction over the next 3 generations (see discussion in **POPULATION SIZES AND TRENDS** section) |
| [Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future. | Unknown |
| Are the causes of the decline a. clearly reversible and b. understood and c. ceased? | a. No<br>b. Yes<br>c. No |
| Are there extreme fluctuations in number of mature individuals? | No |

**Extent and Occupancy Information**

| | |
|---|---|
| Estimated extent of occurrence (EOO) | 13,799 km² |
| Index of area of occupancy (IAO) | Minimum estimate of 648 km² (2x2 grid value) |
| Is the population “severely fragmented” i.e. is >50% of its total area of occupancy is in habitat patches that are (a) smaller than would be required to support a viable population, and (b) separated from other habitat patches by a distance larger than the species can be expected to disperse? | a. No<br>b. No |
| .Number of “locations”* | Unknown, but greater than 10 locations |

* See Definitions and Abbreviations on COSEWIC website and IUCN (Feb 2014) for more information on this term

| | |
|---|---|
| Is there an [observed, inferred, or projected] decline in extent of occurrence? | No |
| Is there an [observed, inferred, or projected] decline in index of area of occupancy? | Possible; inferred and projected decline in biological area of occupancy which may result in decline in IAO |
| Is there an [observed, inferred, or projected] decline in number of subpopulations? | Not applicable |
| Is there an [observed, inferred, or projected] decline in number of “locations”*? | No |
| Is there an [observed, inferred, or projected] decline in [area, extent and/or quality] of habitat? | Yes, observed and projected declines in habitat area and quality |
| Are there extreme fluctuations in number of subpopulations? | No |
| Are there extreme fluctuations in number of “locations”∗? | No |
| Are there extreme fluctuations in extent of occurrence? | No |
| Are there extreme fluctuations in index of area of occupancy? | No |

**Number of Mature Individuals (in each subpopulation)**

| **Subpopulations (give plausible ranges)** | **N Mature Individuals** |
|---|---|
| Total | 1756 (95% CI: 1042–2277) |

**Quantitative Analysis**

| | |
|---|---|
| Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years]. | Quantitative analysis has not been undertaken |

**Threats (actual or imminent, to populations or habitats, from highest impact to least)**

A threat assessment calculator was completed for this species on 18 November 2016, by Dave Fraser, Jon McCracken, Nyree Sharp, Richard Elliot, Pam Sinclair, Berry Wijdeven, Ross Vennesland, Carmen Holschuh, Frank Doyle, Astrid M. van Woudenberg and Joanna James.

The overall calculated threat impact is Medium, and the following contributing threats were identified:

i. Logging and wood harvesting (Low impact)
ii. Invasive non-native species (Low impact)
iii. Problematic native species (Low impact)
iv. Road collisions (Low impact)
v. Fire (Low impact)
vi. Earthquakes and tsunamis (Low impact)

What additional limiting factors are relevant? Small population size, limited distribution and reliance on other primary nest cavity excavators to create suitable nesting cavities.

* See Definitions and Abbreviations on COSEWIC website and IUCN (Feb 2014) for more information on this term

**Rescue Effect (immigration from outside Canada)**

| | |
|---|---|
| Status of outside population(s) most likely to provide immigrants to Canada. | Not applicable - this endemic subspecies occurs only in Canada |
| Is immigration known or possible? | No |
| Would immigrants be adapted to survive in Canada? | Not applicable |
| Is there sufficient habitat for immigrants in Canada? | Not applicable |
| Are conditions deteriorating in Canada?[+] | Yes |
| Are conditions for the source population deteriorating?[+] | Not applicable |
| Is the Canadian population considered to be a sink?[+] | Not applicable |
| Is rescue from outside populations likely? | No - this subspecies occurs only in Canada |

**Data Sensitive Species**

| |
|---|
| Is this a data sensitive species? No |

**Status History**

| |
|---|
| COSEWIC: Designated Threatened in April 2006. Status re-examined and confirmed in November 2017. |

**Status and Reasons for Designation:**

| | |
|---|---|
| **Status:**<br>Threatened | **Alpha-numeric codes:**<br>Meets Endangered, C2a(ii), but designated Threatened, C2a(ii), because this subspecies is not at risk of imminent extinction. |
| **Reasons for designation:**<br>This distinct subspecies endemic to Canada has a small population of fewer than 2000 breeding individuals, restricted to the islands of Haida Gwaii off the Pacific coast of British Columbia. It is a forest specialist, preferring older coniferous forests with abundant nesting snags and an open understory. Numbers of breeding birds are anticipated to further decline over the next 15 years as a consequence of ongoing forest harvesting. Other continuing low-level threats to this subspecies include problematic invasive, introduced and native species, accidental mortality from road collisions and effects of forest fires. As just over 70% of Haida Gwaii is now within protected areas reserved from forestry operations, including National Park Reserve, provincial park, and reserves under the Haida Gwaii Strategic Land Use Agreement, this subspecies is not at risk of imminent extinction. | |

**Applicability of Criteria**

| |
|---|
| Criterion A (Decline in Total Number of Mature Individuals): Not applicable. Estimated reduction in total number of mature individuals does not meet thresholds. |
| Criterion B (Small Distribution Range and Decline or Fluctuation): Not applicable. The population is not severely fragmented, occurs at more than 10 locations, and is not subject to extreme fluctuations. |

[+] See Table 3 ( Guidelines for modifying status assessment based on rescue effect)

| |
|---|
| Criterion C (Small and Declining Number of Mature Individuals): Meets Endangered, C2a(ii). The population size is estimated to be less than 2,500 mature individuals, there is an inferred continuing decline in numbers of mature individuals, and one subpopulation is estimated to contain greater than 95% (100%) of all mature individuals. Also meets Threatened, C2a(ii), as the population size is estimated to be less than 10,000 mature individuals, there is an inferred continuing decline in numbers of mature individuals, and one subpopulation is estimated to contain 100% of all mature individuals. |
| Criterion D (Very Small or Restricted Population): Not applicable. Population estimate and IAO exceed all thresholds. |
| Criterion E (Quantitative Analysis): Analysis not conducted. |

## PREFACE

This report is an update of the previous status report (COSEWIC 2006) for the *brooksi* subspecies of Northern Saw-whet Owl. The extent of occurrence has been revised from 10,000 $km^2$ (the area of Haida Gwaii) to 13,799 $km^2$ (to include ocean area within the polygon created from observations), and the index of area of occupancy has been revised from 5488 $km^2$ to 648 $km^2$, as determined using new methodology. The 2016 revised population estimate was 1756 [95% CI: 1042, 2277] mature individuals, based on revised estimates of home range size, occupancy rates and area of suitable breeding habitat (Bergman 2016). The estimated area of suitable habitat continues to gradually decrease. However, the overall area of forest protected from harvesting on Haida Gwaii has increased significantly since the last status report (from about 25% to 71%), which will likely slow the future loss of habitat.

The *brooksi* subspecies of Northern Saw-whet Owl is listed in Schedule 1 of the *Species at Risk Act* as Threatened. A federal recovery strategy was completed in 2014 (Parks Canada 2014). It set the short-term population and distribution objective of maintaining approximately 1800 adult *brooksi* Northern Saw-whet Owls across the subspecies' extent of occurrence (10,000 $km^2$ across the Haida Gwaii archipelago, the extent of occurrence at the time), until more precise population and distribution targets can be formulated. The recovery strategy partially identifies Critical Habitat, and includes a schedule of studies to complete the identification of habitat required to meet recovery strategy objectives (Parks Canada Agency 2014). An action plan is scheduled for completion by March 2019.

## COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

## COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

## COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

## DEFINITIONS
## (2017)

| | |
|---|---|
| Wildlife Species | A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years. |
| Extinct (X) | A wildlife species that no longer exists. |
| Extirpated (XT) | A wildlife species no longer existing in the wild in Canada, but occurring elsewhere. |
| Endangered (E) | A wildlife species facing imminent extirpation or extinction. |
| Threatened (T) | A wildlife species likely to become endangered if limiting factors are not reversed. |
| Special Concern (SC)* | A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats. |
| Not at Risk (NAR)** | A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances. |
| Data Deficient (DD)*** | A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction. |

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

Environment and Climate Change Canada
Canadian Wildlife Service
Environnement et Changement climatique Canada
Service canadien de la faune
Canada

The Canadian Wildlife Service, Environment and Climate Change Canada, provides full administrative and financial support to the COSEWIC Secretariat.

# COSEWIC Status Report

on the

# Northern Saw-whet Owl *brooksi* subspecies

*Aegolius acadicus brooksi*

**in Canada**

2017

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# WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

## Name and Classification

The *brooksi* subspecies of Northern Saw-whet Owl *Aegolius acadicus brooksi* (J.H. Fleming, 1916) belongs to the family Strigidae, the “typical owls”. Common names for this endemic subspecies include: Queen Charlotte Owl (Bent 1961; Johnsgard 1988), Haida Gwaii Saw-whet Owl and Queen Charlotte Saw-whet Owl. The Haida name for saw-whet owls observed during daytime is St’aw, and those observed at night are called Sgas sgas (Parks Canada Agency 2016). This subspecies of the Northern Saw-whet Owl is referred to in French as “petite nyctale brooksi” (NatureServe 2015).

## Morphological Description

The *brooksi* subspecies is a small owl about 20 cm in length and weighing 75–145 g (Figure 1). Sexual dimorphism is strong, with females up to 20% larger than males (Cannings 1993). This owl has a relatively large head with a prominent round facial disk and no ear tufts. Its eyes are yellow to orange. Upper parts are a buffy brown colour, with buffy and white streaking on the crown that converges in a V-like pattern between the eyes. White “eyebrows” are prominent in some individuals. Underparts are buffy and broadly striped with dark reddish-brown. The rounded wings are buffy reddish-brown, with lighter spotting on the scapulars.

Overall, the *brooksi* subspecies has a darker plumage than the widespread continental *acadicus* subspecies, is slightly smaller despite having a longer tail, and characteristically has a more buffy appearance on the underparts (Fleming 1916; Bent 1961; Guiguet 1978; Johnsgard 1988; Cannings 1993; Sealy 1998; Koenig *et al*. 1999).

Figure 1. Northern Saw-whet Owl, *brooksi* subspecies. Photo by Berry Wijdeven, used with permission.

## Population Spatial Structure and Variability

The *brooksi* Northern Saw-whet Owl is non-migratory and restricted to a single population on the Haida Gwaii archipelago (formerly the Queen Charlotte Islands) of British Columbia. Genetic diversity within the subspecies is low (Pruett *et al*. 2013), and it is believed to have diverged from the mainland population during the Wisconsin glaciation that ended about 16,000 years BP (Withrow *et al*. 2014).

Although individuals of the *acadicus* subspecies have been recorded on Haida Gwaii during post-breeding season movements, they are not known to breed there and hybrids between *acadicus* and *brooksi* have never been reported (Sealy 1998). The maintenance of a separate *brooksi* genetic lineage from the *acadicus* subspecies despite current contact suggests that divergence resulted from heteropatric differentiation, likely driven by the loss of migratory behaviour in *brooksi* together with its local adaptations to Haida Gwaii habitats (Withrow *et al*. 2014).

## Designatable Units

The *brooksi* subspecies of Northern Saw-whet Owl forms a single designatable unit, representing a discrete and evolutionarily significant taxon, with no overlap in breeding range with the *acadicus* subspecies, which occurs widely across mainland North America. This non-migratory subspecies is distinct from its migratory mainland counterpart in its morphology, behaviours, adaptations and genetics (Withrow *et al*. 2014). The *brooksi* subspecies has never been observed outside of Haida Gwaii, despite numerous owl banding projects across mainland British Columbia.

## Special Significance

The *brooksi* Northern Saw-whet Owl is a non-migratory, endemic subspecies, restricted to the Haida Gwaii archipelago, and the only owl resident in the archipelago. It has significance to local Aboriginal people, as the Haida from Cumshewa are called St'awaas Xaaydgaay, meaning the Saw-whet Owl People (B. Wilson pers. comm. *in* COSEWIC 2006). However, no additional Aboriginal Traditional Knowledge of this owl was publicly available at the time of writing this report.

# DISTRIBUTION

## Global Range

The distribution of the nominate subspecies of Northern Saw-whet Owl is widespread throughout North America, including the islands on the Alaska panhandle just north of Haida Gwaii (Sealy 1998; Figure 2). The range of the *brooksi* subspecies, however, is limited to the Haida Gwaii archipelago off the Pacific coast of British Columbia in Canada (Figure 3).

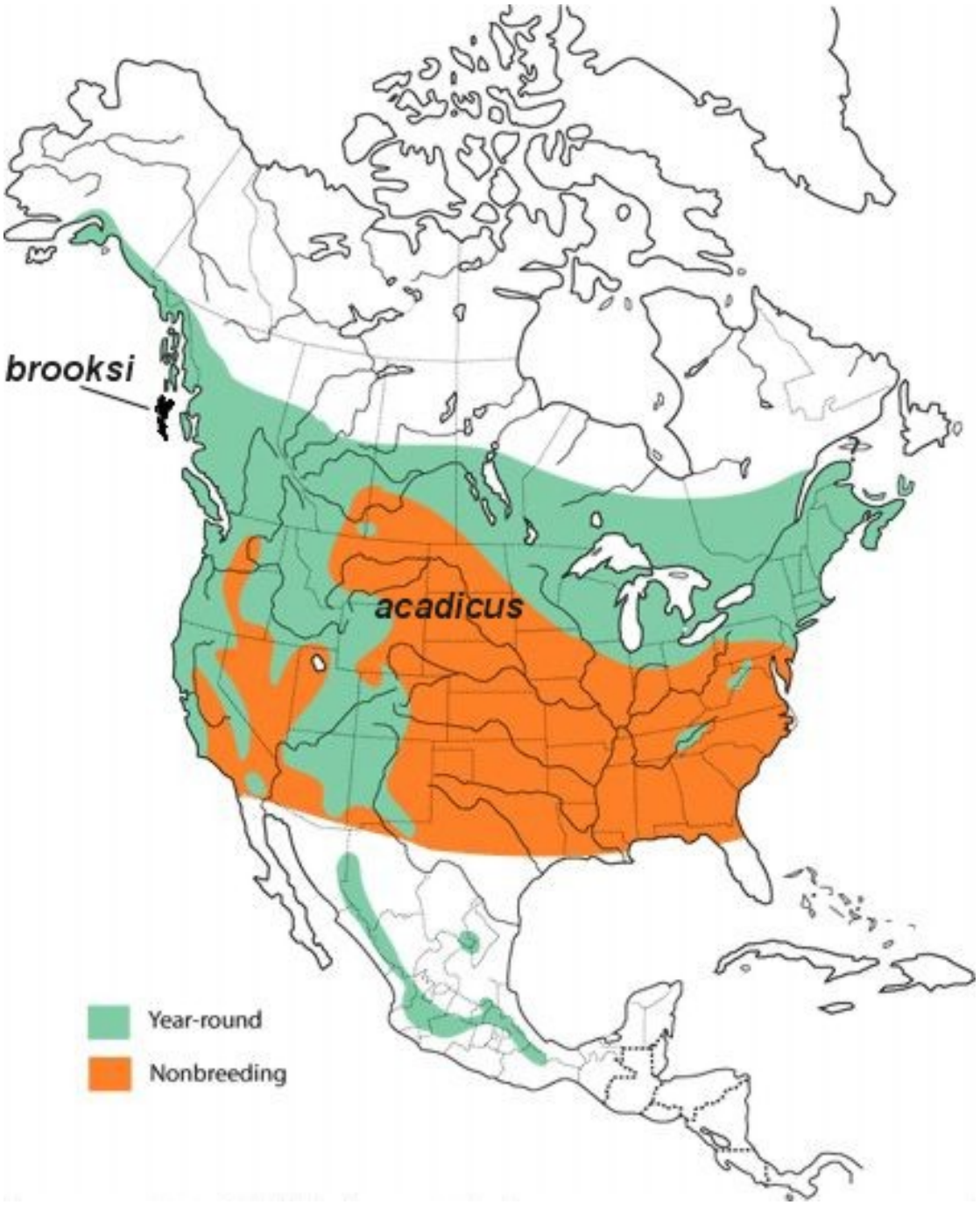


Figure 2. Breeding range of the two subspecies of Northern Saw-whet Owl. *Aegolius acadicus acadicus* occurs across continental North America and *A. a. brooksi* (black) is found only on Haida Gwaii, where it remains year-round (COSEWIC 2006, adapted from Cannings 1993).

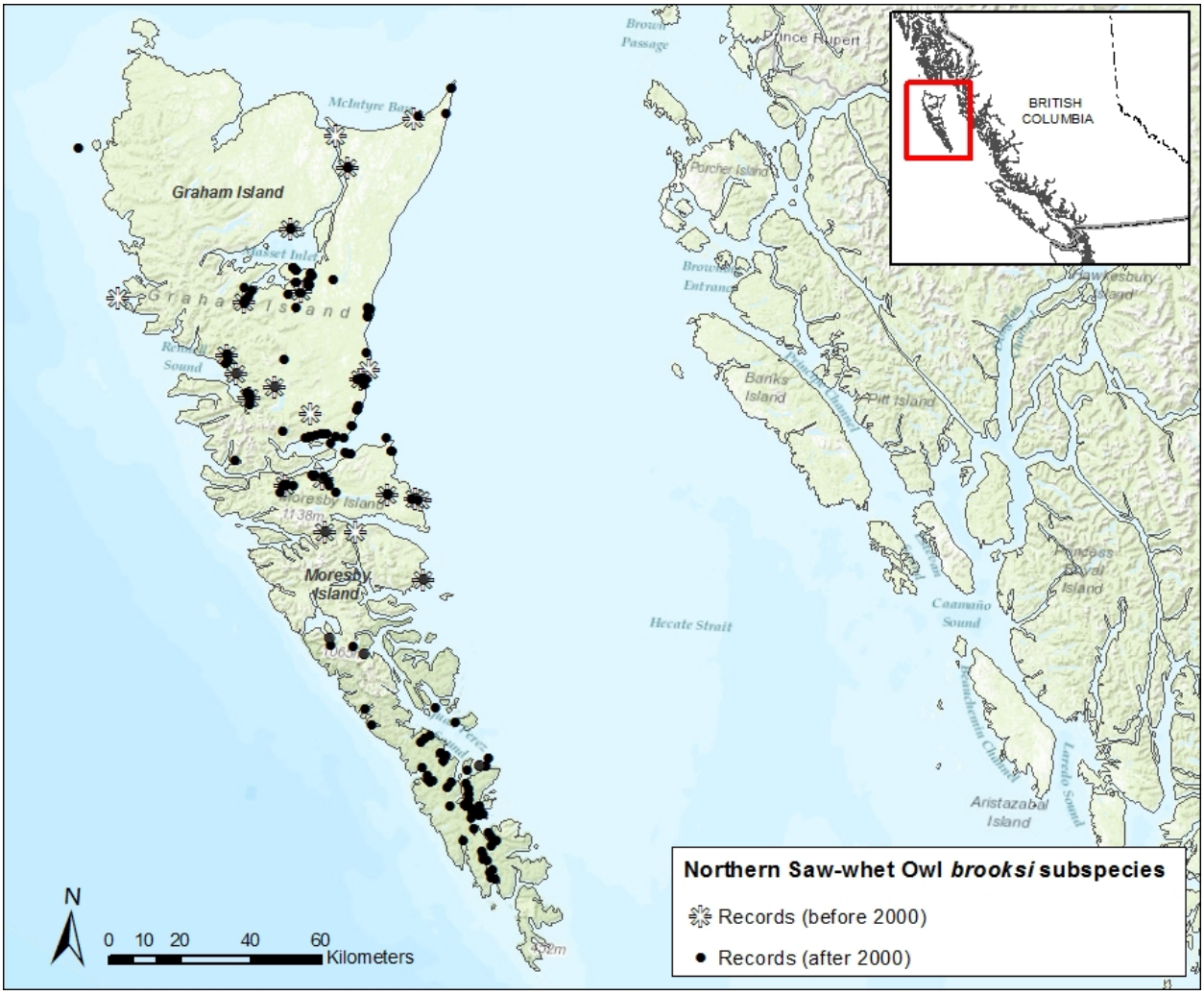


Figure 3. Distribution of the Northern Saw-whet Owl, *brooksi* subspecies. Records (1983–2016) provided by Bird Studies Canada and Cornell Lab of Ornithology (2008), eBird Basic Dataset (2016), British Columbia Conservation Data Centre (unpubl. data), and *brooksi* Northern Saw-whet Owl Recovery Team (unpubl. data).

## Canadian Range

The *brooksi* subspecies of Northern Saw-whet Owl is endemic to Haida Gwaii and is non-migratory. It occurs on both of the large islands of Haida Gwaii (Graham and Moresby Islands; Gill and Cannings 1997; Sealy 1998) as well as on smaller islands throughout the archipelago (Sealy 1998 and references therein; Figure 3).

## Extent of Occurrence and Area of Occupancy

The total land area of the Haida Gwaii archipelago is about 10,000 km$^2$. The extent of occurrence for the *brooksi* Northern Saw-whet Owl was calculated using records from 1983 to 2016, based on the minimum convex polygon around observations of the species (Bird Studies Canada and Cornell Lab of Ornithology 2008, eBird Basic Dataset 2016, British Columbia Conservation Data Centre unpubl. data, *brooksi* Northern Saw-whet Owl Recovery Team unpubl. data). It includes ocean area contained within the polygon between the islands of the Haida Gwaii archipelago, and is 13,799 km$^2$ (Figure 4). The index of area of occupancy, based on a 2 km by 2 km grid over these observations and identified areas of Critical Habitat, is 648 km$^2$. This is a minimum estimate, as it does not include territories occupied by those pairs not recorded in surveys (see **Abundance** section, below). This IAO is smaller than that reported in the first status report (5488 km$^2$; COSEWIC 2006) due to a change in methodology of calculation, and these values cannot be compared directly.

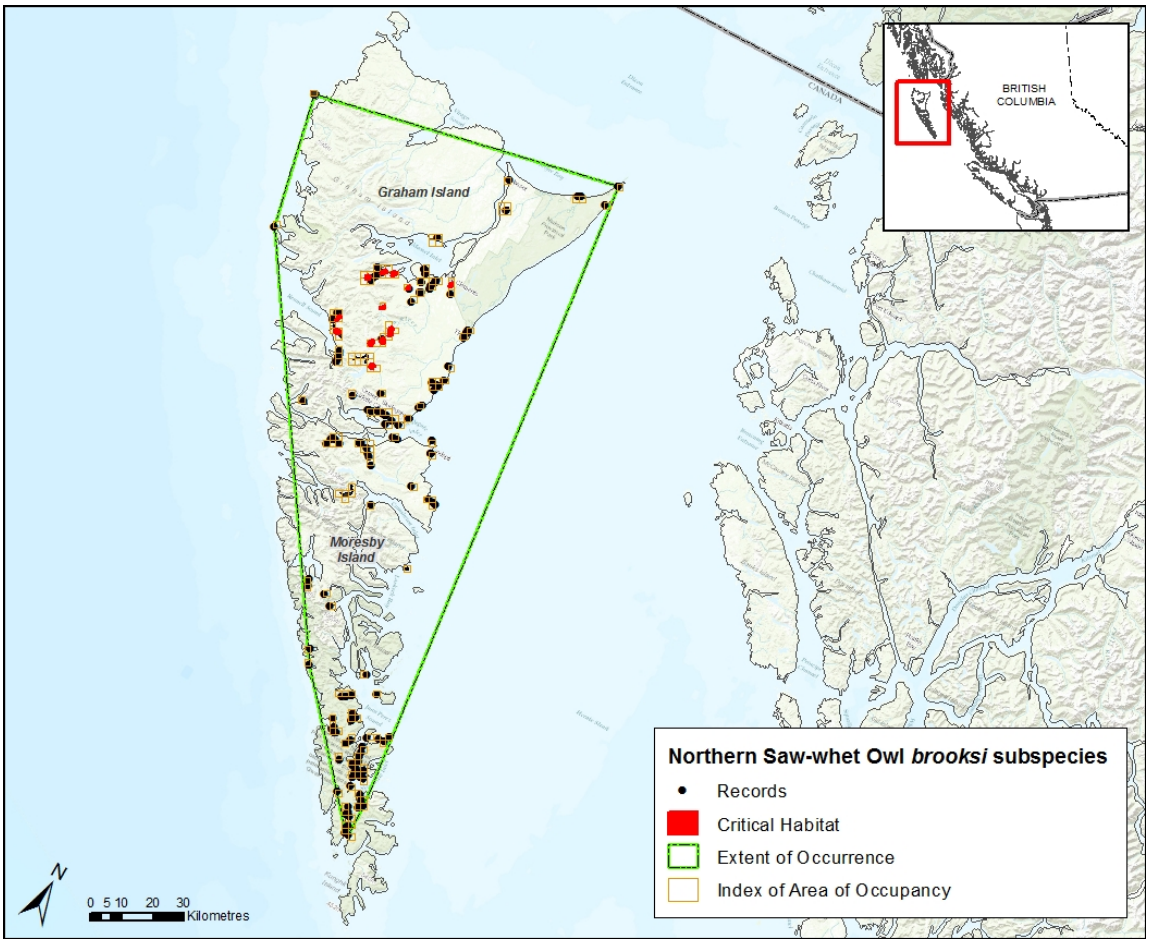


Figure 4. Extent of occurrence and index of area of occupancy of the Northern Saw-whet Owl, *brooksi* subspecies. Records (1983–2016) provided by Bird Studies Canada and Cornell Lab of Ornithology (2008), eBird Basic Dataset (2016), British Columbia Conservation Data Centre (unpubl. data), and *brooksi* Northern Saw-whet Owl Recovery Team (unpubl. data).

## Search Effort

Three surveys had been conducted of the *brooksi* subspecies of Northern Saw-whet Owl at the time of the first status report (COSEWIC 2006), (see **POPULATION SIZES AND TRENDS** for more information). In 1996, Gill and Cannings (1997) performed a systematic survey across habitat types on Graham and northern Moresby Islands. In 2002 and 2003, Holschuh (2004a) undertook two years of targeted searches for saw-whet owls on the southern half of Graham Island in maturing and old forested habitats. In 2004, Holschuh (2004b) undertook a systematic survey of Gwaii Haanas National Park Reserve and Haida Heritage Site on Moresby Island. All were call surveys performed during spring, when male saw-whet owls are highly vocal.

From 2010 to 2013, spring surveys were undertaken yearly by the Northern Saw-whet Owl recovery team at coastal and interior sites on Graham Island, together with radio-tagging of some individuals (Wijdeven pers. comm. 2015). In 2016, acoustic monitoring was applied systematically across a landscape grid in contiguous old forest (Bergman 2016, pers. comm. 2017).

This subspecies is not sampled well by large-scale bird monitoring programs such as the Breeding Bird Survey, Christmas Bird Count or the BC Nocturnal Owl Survey, due to the lack of volunteer surveyors and very limited road access on Haida Gwaii. It was recorded in some accessible squares during the recent BC Breeding Bird Atlas (Bird Studies Canada and Cornell Lab of Ornithology 2008).

# HABITAT

## Habitat Requirements

Breeding habitat

During the breeding season, the *brooksi* Northern Saw-whet Owl is generally found in mature and old forest, often close to riparian areas (Gill and Cannings 1997). All owl territory sites found have been below 300 m elevation, despite searches at higher levels. Ongoing fieldwork indicates that these owls may be more flexible than previously thought in using a wider age range of habitat classes (Parks Canada 2014). Recent surveys have found more owls in second-growth forest than previously expected, although it is not known whether owls are breeding successfully there (Wijdeven pers. comm. 2015). When these second-growth areas were originally logged, old veteran trees were left behind that may have provided nesting sites, although current forestry practices do not leave these tall, older veteran trees (Wijdeven pers. comm. 2015). Body condition of male owls in the breeding season appears to be appreciably lower when their territories contain less mature and old forest (COSEWIC 2006). Significantly lower calling rates, thought to be an indirect measure of physiological condition, have been noted in territories where mature and old forest cover was less than 60–70% within 500 m of the territory core (Holschuh 2004a).

Most occupied sites have been found in Submontane Wet, and Central Very Wet, Hypermaritime Coastal Western Hemlock biogeoclimatic zones, with some in the Montane Wet Hypermaritime Coastal Western Hemlock zone. No occupied sites have been detected in Mountain Hemlock or Alpine Tundra zones. In habitat surveys of 25 occupied sites in 2002 and 2003, Holschuh (2004a) found most sites to have structurally complex mature or old forest types with relatively abundant snags. The mean height of veteran trees was 37.4 m (± 8.74 m S.D.), while the main tree canopy averaged 28.2 ± 7.24 m and the sub-canopy 17.5 ± 5.53 m in height. The main tree canopy generally had the greatest density (25–50% cover), while other tree layers generally had less than 25% cover. The most common tree species at occupied sites were Western Hemlock (*Tsuga heterophylla*), Sitka Spruce (*Picea sitchensis*), Western Redcedar (*Thuja plicata*), and to a lesser degree Mountain Hemlock (*Tsuga mertensiana*), Yellow Cedar (*Chamaecyparis nootkatensis*) and Shore (or Lodgepole) Pine (*Pinus contorta*). These structurally complex old forests tend to contain the highest densities of appropriate nesting cavities, which appear to be a limiting factor across the landscape (Doyle unpubl. data, in COSEWIC 2006).

As a secondary cavity nester, the *brooksi* Northern Saw-whet Owl requires existing cavities with an opening of at least 75 mm in diameter. Most cavities used on Haida Gwaii are probably excavated by Northern Flicker (*Colaptes auratus*) or Hairy Woodpecker (*Picoides villosus*). Only four nests of the *brooksi* Northern Saw-whet Owl have been found and described. Two were in Western Hemlock and two in Sitka Spruce snags that ranged from 61 cm to 130 cm in diameter at breast height (Tarver 2001; Holschuh 2004b; Charest and Epners pers. comm. in COSEWIC 2006).

Males defend core areas that appear to be about 70–100 ha in size. Recent studies using radio telemetry have documented home range sizes during the breeding season of 153–410 ha (Parks Canada Agency 2014).

Feeding habitat requirements are likely similar to those of the nominate subspecies, with owls foraging in openings or along forest edges (Cannings 1993). For instance, an unmated male that was radio-tagged in late April was found along forest edge, >1 km from the territory core, presumably foraging along the riparian and road corridors (Holschuh and Otter unpubl. data). Mature and old forest habitats also provide an open interior that is ideal for owl foraging, while young, dense forests are generally avoided (Cannings 1993).

Non-breeding habitat

Habitat use outside the breeding season has not been specifically documented on Haida Gwaii. Nevertheless, data on the diet of birds killed by cars along the coastal highway, primarily during the fall, showed high levels of marine invertebrate consumption (Hobson and Sealy 1991; Sealy 1999), suggesting that owls may shift to habitats closer to the coast during the fall and winter (Wijdeven pers. comm. 2015). Recent studies using radio telemetry documented home range sizes of 178–908 ha during the non-breeding season (Parks Canada Agency 2014).

## Habitat Trends

The amount of suitable contiguous old forest habitat is declining on Haida Gwaii, largely due to forest harvesting. However, the overall area of forest protected from harvesting on Haida Gwaii has increased from about 25% to 71% since the 2006 status report (Parks Canada Agency 2014). While a large proportion of Haida Gwaii is now protected from forestry, some of the most productive forest habitat remains largely unprotected, and current forestry practices do not leave behind veteran trees suitable for nest sites (Wijdeven pers. comm. 2015). Many of the most productive watersheds on interior Graham Island and northern Moresby Island have been logged extensively, and the forest regenerating there lacks many of the structural attributes necessary for high-quality habitat, such as snags and open flyways for foraging. Over the past 15 years (2001–2016), 21,307 ha of land were approved for harvest (Louis pers. comm. 2016), equivalent to 2.1% of the area of Haida Gwaii. Although not all of this land would be harvested, as it includes buffers for riparian areas and areas of cultural significance, there is likely to be significant overlap between areas targeted for logging and *brooksi* Northern Saw-whet Owl habitat. Development area restrictions continue to become more stringent, and may reduce the proportion actually harvested.

Detailed logging plans for Haida Gwaii for the next 15 years (3 generations) are not available. Based on the 8-year period 2008–2016 when approximately 6938 ha were harvested (Louis pers. comm. 2016), the best estimate of harvest over the next 15 years is 13,000 ha, or approximately 1.3% of the area of Haida Gwaii, assuming that harvest continues at the same rate. If logging is randomly distributed on the landscape with respect to owl breeding habitat, about 1.3% of the biological area of occupancy would be harvested over that period. This number could be higher if areas to be logged tend to overlap with saw-whet owls' preferred mature and old forest breeding habitat. Indeed, if all logging occurs in preferred breeding habitat, it could potentially impact up to 20% of the area of occupancy. However, impacts of logging on owl habitat and numbers in the previous 15 years, which affected about 2% of the archipelago, did not appear to have such an effect on owl habitat and population size (see **Abundance** section). Conversely, if efforts are made to avoid harvesting owl habitat, the proportion harvested could be less than 1.3% of the area of occupancy over the next 15 years.

However, spatially explicit information as to which areas on Haida Gwaii are likely to be logged in the near future and the degree of overlap between areas to be harvested and owl breeding habitat is not yet available. Given this uncertainty, 1.3% is taken here as the best available estimate of loss of breeding habitat over the next 15 years. However, this proportion may be higher, as prime breeding habitat for *brooksi* Northern Saw-whet Owl generally shares traits with those areas targeted for forest harvest.

# BIOLOGY

Information on the biology of the *brooksi* Northern Saw-whet Owl comes from various sources, including past and ongoing research on habitat (Gill and Cannings 1997; Holschuh 2004a,b), diet, and related life history characteristics (Hobson and Sealy 1991; Sealy 1998, 1999). Knowledge of general biology of Northern Saw-Whet Owls is mainly taken from Rasmussen *et al*. (2008). Relevant information gathered through the personal observations of researchers and naturalists is also presented below.

## Life Cycle and Reproduction

The Northern Saw-whet Owl first breeds at one year old, with average age of breeding adults estimated as being at least 2–5 years (COSEWIC 2006). Individuals of the migratory nominate subspecies are thought to survive typically between 5 and 7 years (Cannings 1993), although the longevity record for the *acadicus* subspecies is 10 years, 4 months in the wild, based on banding data (Klimkiewicz 2002 *in* Rasmussen *et al*. 2008), and 16 years in captivity (Cannings 1993). Survivorship of *brooksi* individuals is unknown, but may be somewhat longer than for *acadicus* due to their non-migratory habits. The generation time for *brooksi* Northern Saw-whet Owls is assumed to be 5 years (COSEWIC 2005).

Timing of onset of the breeding season seems to be highly asynchronous in *brooksi* Northern Saw-whet Owls, with some birds defending their territories as early as late February, while others do not become territorial until mid-May (COSEWIC 2006). The later dates of territorial activity may represent two possibilities: owls at some territories may begin breeding later than most, or owls at some territories may begin breeding even earlier in February and establish a second nest later in the spring. Although some evidence of the latter has been collected in *A. a. acadicus* (Marks *et al*. 1989), there is no evidence of second broods or polygyny in the Haida Gwaii subspecies. The main breeding period for these owls appears to be from early March until August.

No data are available on the fecundity or breeding success of *A. a. brooksi*. In the nominate subspecies, the average clutch size is 5–6 eggs (Rasmussen *et al*. 2008).

Possible factors limiting breeding success may be shortage of prey (rodents) or a lack of suitable nest cavities. Individuals occupying areas with less old-growth forest appear to be in relatively poorer body condition (Holschuh 2004a), which may affect their reproductive output.

## Physiology and Adaptability

Studies of the energetic food requirements of captive birds found that a female Northern Saw-whet Owl consumes about 18% of her body weight daily (COSEWIC 2006). The daily energetic intake is about 95 kcal/day for males and 125 kcal/day for females (Cannings 1993 and references therein).

The *brooksi* Northern Saw-whet Owl exhibits behavioural differences compared to its continental counterpart, likely related to adaptations to the local environment on the archipelago. One important difference appears to be fall and winter movement of the Haida Gwaii owls towards the coastline, where there are abundant and easily accessible food sources, including intertidal amphipods and isopods (Sealy 1999). Furthermore, *brooksi* Northern Saw-whet Owls seem to be more generalist in their foraging than the nominate subspecies, taking locally available food items other than rodents, which are thought to be the major food source of Northern Saw-whet Owls elsewhere. For example, on East Limestone Island, which hosts a breeding colony of Ancient Murrelets (*Synthliboramphus antiquus*), a Northern Saw-whet Owl has been observed preying upon downy murrelet chicks (Gaston 1992). Overall, the flexibility in responding to local differences in food availability is likely an important factor in the persistence of this subspecies, as is illustrated by the high mortality rate of other owl species, apparently due to starvation, when they move through Haida Gwaii (Hamel pers. comm. *in* COSEWIC 2006).

## Dispersal and Migration

The *brooksi* Northern Saw-whet Owl is a non-migratory resident of Haida Gwaii, and no vagrants have been detected outside the archipelago. There are no data on dispersal of young, and because of their non-migratory nature, comparisons cannot be made with the nominate subspecies. Evidence based on diet and behaviour (increased detections and collisions with cars on roads along the coastline in fall and winter) suggests that many birds shift from interior-island habitats to more coastal habitats for the winter, presumably to capitalize on relatively rich intertidal food sources (Hobson and Sealy 1991; Sealy 1999; Wijdeven pers. comm. 2015).

These owls are known to move within the archipelago, in particular towards the coast in winter (Sealy 1998, 1999), and have low genetic diversity across the range (Pruett *et al*. 2013), suggesting that there is likely sufficient ongoing demographic and genetic exchange to maintain this small group of birds as one subpopulation.

## Interspecific Interactions

Given that no other owl species nest on Haida Gwaii, niche-specific competition is probably insignificant (COSEWIC 2006). There are likely few avian predators of Northern Saw-whet Owl adults, although they are occasionally taken by Northern Goshawk (*Accipiter gentilis*) on Haida Gwaii and elsewhere (Doyle pers. comm. 2017).

Although rates of nest predation have not been studied, the *brooksi* Northern Saw-whet Owl is probably vulnerable to mammalian nest predators such as the American Marten (*Martes americana*). Furthermore, introduced species, including Red Squirrel (*Tamiasciurus hudsonicus*; Martin and Joron 2003) and Common Raccoon (*Procyon lotor*), likely pose a greater predatory threat to saw-whet owls, as both are effective nest predators (Eder and Pattie 2001). Introduced Black (*Rattus rattus*) and Norway Rats (*R. norvegicus*) may also depredate Northern Saw-whet Owl nests, and their presence has been linked to a decrease in abundance of Keen's Mouse (*Peromyscus keeni*) and shrews (*Sorex* spp.),

which are important food species for these owls (Kaiser *et al*. 1997 *in* Parks Canada Agency 2014).

Because Northern Saw-whet Owls are secondary cavity nesters, the *brooksi* population may be affected by fluctuations in numbers of primary cavity excavators, such as Northern Flicker, Hairy Woodpecker and Red-breasted Sapsucker (*Sphyrapicus varius*), that excavate potential nest cavities (Parks Canada Agency 2014). The Hairy Woodpecker on Haida Gwaii is also an endemic subspecies (*Picoides villosus picoides*) which occurs at low densities across the landscape. It is likely that potential nesting cavities have accumulated as a function of time, rather than reflecting high densities of woodpeckers. Declines in nesting habitat for primary cavity nesters (suitable snags) could therefore have long-term effects on the *brooksi* Northern Saw-whet Owl. Although it only occurs in small numbers in the archipelago, the European Starling (*Sturnus vulgaris*) may occasionally compete with the owls for nesting cavities and is known to harass cavity holders, which could lead to nest abandonment.

The *brooksi* Northern Saw-whet Owl is thought to be an opportunistic feeder, taking a variety of species for food. It appears to rely heavily on invertebrates, including amphipods (*Orchestria traskiana, O. californiana*), isopods (*Ligia pallasii*), and diptera (*Coelopa vanduzeei*; Parks Canada Agency 2014) in winter. Keen's Mouse and shrews are important prey items for the *brooksi* subspecies. Other vertebrate prey items that have been documented on Haida Gwaii include Western Toad (*Bufo boreas*), Ancient Murrelet, Chestnut-backed Chickadee (*Poecile rufenscens*), Golden-crowned Kinglet (*Regulus satrapa*) and Hermit Thrush (*Catharus guttatus*) (Parks Canada Agency 2014).

## POPULATION SIZES AND TRENDS

### Sampling Effort and Methods

The *brooksi* Northern Saw-whet Owl is sparsely distributed and difficult to survey directly, because of its secretive, nocturnal nature. In 1996, Gill and Cannings (1997) undertook a systematic habitat-association survey in which 238 survey stations across a variety of habitat types on Graham and northern Moresby Islands were sampled twice during the spring breeding season, leading to the detection of 61 owls. In 2002 and 2003, Holschuh (2004a) performed targeted searches for saw-whet owls on the southern half of Graham Island in maturing and old forest habitats. In total, 24 and 26 occupied sites were found in 2002 and 2003, respectively. In 2004, Holschuh (2004b) undertook a systematic survey of Gwaii Haanas National Park Reserve (southern Moresby Island), where survey stations were accessed by boat and located in protected inlets, passages and bays. They also targeted adjacent terrestrial habitats to help determine range and density. Saw-whet owls were found at 26 of the 59 stations surveyed (many of which were surveyed twice), with the highest detection success in the Gwaii Haanas survey.

From 2010 to 2013, the recovery team undertook annual spring surveys on north Graham Island in order to increase knowledge of habitat use and suitability, and to improve a developing habitat suitability model (Waterhouse *et al*. in press; Wijdeven pers. comm. 2015). During the course of the surveys, 51 owls were caught (including 48 new individuals) and 19 were radio-tagged (Waterhouse *et al*. in press). In 2016, acoustic monitoring was applied systematically across a landscape grid in Gwaii Haanas National Park in contiguous old forest. Occupancy was estimated from recordings made over a two-week period in each of 19 grid squares of approximate home range size (Bergman 2016, pers. comm. 2017).

## Abundance

Population sizes and trends have not been measured directly, so an estimate of abundance was calculated from data collected by Bergman in 2016. Passive acoustic monitoring indicated that breeding territory occupancy was 64% +/- 12%, corrected for probability of detection (Bergman 2016). Using an average male home range size of 400 ha (Waterhouse *et al*. in press) and a total suitable habitat area of 5488 $km^2$, Bergman (2016) calculated a population size of 1756 breeding individuals, with a 95% confidence interval of 1042–2277. This is close to the population estimate from the previous status report (COSEWIC 2006) of 1852 mature individuals (+/- 580), with high overlap of confidence intervals.

The 2016 population estimate may be a slight overestimate for a number of reasons (Bergman 2016). New information on the amount of mature/old forest versus younger (logged) forest on the landscape was not available for the calculations, so numbers from 2006 were used, although the amount of mature/old forest has decreased somewhat since 2006. Also, the grid cells that were sampled for occupancy were not selected randomly, but represented the highest quality habitat areas available for the *brooksi* Northern Saw-whet Owl. A lower occupancy rate might have been recorded if more poor quality habitat were sampled. Also, the maximum number of territories that could fit into the habitable area was used, but it is possible that not all small islands and shoreline areas are used by the *brooksi* Northern Saw-whet Owl. Finally, home range sizes were calculated using data collected near a shoreline, where prey availability is assumed to be greater. Home ranges inland might therefore be larger, meaning that fewer breeding pairs would be present.

Factors that could contribute to an underestimate of population size with the approach used in 2016 include the fact that only vocal individuals were included in estimating occupancy. It was also assumed that the *brooksi* Northern Saw-whet Owl does not inhabit alpine, mountain hemlock or young forests (Bergman 2016). It should finally be noted that home range calculations were based on a relatively small sample size (n=19).

Bergman (2016) concludes that the 2006 population estimate may also have been slightly high, because transects were placed non-randomly for ease of access. Also, densities on the east and west coasts were assumed to be equal, whereas Bergman found that the proportion of occupied sites on the west coast was much smaller than that on the east coast. As with the 2016 estimate, the maximum number of territories that could fit into

the habitable area was used, and home range sizes may have been underestimated because sampling took place along the shoreline.

Factors that could contribute to an underestimation of population size in 2006 include the fact that only vocally responsive individuals were included, and that it was assumed that no *brooksi* Northern Saw-whet Owls inhabited alpine or mountain hemlock habitat. Overall, it appears that estimates from 2006 and 2016 may both have been somewhat high, but are likely to be comparable.

## Fluctuations and Trends

There is little information on population fluctuations and trends for either subspecies of Northern Saw-whet Owl (Rasmussen *et al*. 2008). There is some suggestion that populations of the nominate subspecies may cycle with food abundance (Cannings 1993 and references therein), although the more opportunistic and generalist nature of foraging by *A. a. brooksi* (Sealy 1999) may have a buffering effect in comparison to mainland saw-whet owls that rely primarily on only one or few prey sources (COSEWIC 2006).

In the absence of regular monitoring data to indicate population trends, changes in the amount of available breeding habitat have been used as an index of population change (COSEWIC 2006). As the amount of unfragmented mature and old forest habitat continues to gradually decline on Haida Gwaii due to forest harvesting, the number of owls can also be expected to decrease, if the availability of breeding habitat is currently limiting their numbers.

Forest harvest plans indicate that about 1.3% of Haida Gwaii will be logged in the next 15 years (3 generations) (see **Habitat Trends** section). The best available estimate of the inferred rate of population decline over the next 15 years is therefore 1.3%, although this may be an underestimate if mature and old-growth forests used by breeding *brooksi* Northern Saw-whet Owl are harvested at a higher rate than other areas. In the unlikely event that all logging were to occur in preferred breeding habitat, it would impact a maximum of 20% of the biological area of occupancy over the next 15 years.

The potential added effects of other threats on population trends, including the impacts of introduced species, are not well understood.

## Rescue Effect

As the *brooksi* subspecies of Northern Saw-whet Owl is endemic to the Haida Gwaii archipelago, there is no opportunity for a rescue effect.

# THREATS AND LIMITING FACTORS

## Threats

Continuing threats to the *brooksi* subspecies of the Northern Saw-whet Owl were considered using the threats assessment calculator (NatureServe 2014) for this subspecies (Appendix 1). The threats reviewed below are categorized following the IUCN-CMP (International Union for the Conservation of Nature – Conservation Measures Partnership) unified threats classification system, based on the standard lexicon for biodiversity conservation of Salafsky *et al.* (2008). Six threats were each considered to have a Low impact: logging and wood harvesting; invasive and introduced species; problematic native species; accidental mortality from road collisions; forest fires; and earthquakes and tsunamis. The overall calculated threat impact is Medium (see Appendix 1 for details).

Logging and wood harvesting (Low impact)

Breeding habitat of the *brooksi* Northern Saw-whet Owl is associated with mature and old forest, and removal of these types of forest by industrial forestry reduces the availability of snags suitable for nesting. Forest harvesting may also reduce the availability of prey and the ability of saw-whet owls to hunt effectively (Cannings 1993; Fraser *et al*. 1999; Parks Canada Agency 2014). Forest removal also fragments suitable habitat, which may result in increased risk of predation of saw-whet owls, reduced pairing opportunities and reproductive success, reduced foraging efficiency, and reduced populations of primary cavity excavators (Hinam and St. Clair 2008; Parks Canada Agency 2014). The future impact of this threat will likely be mitigated by continuing efforts to remove forested areas suitable for nesting from the harvestable land base.

Invasive non-native species (Low impact)

Haida Gwaii has experienced introductions of several mammalian and bird species (Kaiser *et al*. 1997; Eder and Pattie 2001), some of which threaten *brooksi* Northern Saw-whet Owls either directly (through competition or predation) or indirectly (through effects on prey availability). Common Raccoons and Red Squirrels are both effective nest predators (see **Interspecific Interactions** section), and Black and Norway rats may also prey on nests. Although Sealy (1999) reported a juvenile saw-whet owl killed by a domestic cat on Haida Gwaii., this is likely to be a negligible threat as cats are not widespread in the archipelago. The European Starling may harass nesting owls and cause nest abandonment, and compete locally with the *brooksi* Northern Saw-whet Owl for nest cavities. Red Squirrels may also compete for nest cavities, but may also create them.

The introduction of Sitka Black-tailed Deer (*Odocoileus hemionus sitkensis*) has likely had a significant effect through over-browsing, with a consequent decrease in the density and diversity of understorey vegetation in interior forest ecosystems (RGIS-FRBC 2001). This likely affects the availability of important rodent prey species to *brooksi* Northern Saw-whet Owls during the breeding season (Cannings 1993), and is known to have reduced populations of various forest invertebrates (RGIS-FRBC 2001), many of which are likely

important food sources (Parks Canada 2014). Rats may also have an indirect effect on *brooksi* Northern Saw-whet Owls, as they have been linked to a decrease in populations of native mice and shrews, which are important food species for these owls (Kaiser *et al*. 1997).

Problematic native species (Low impact)

Some native species also have the potential to affect the population of *brooksi* Northern Saw-whet Owl. The American Marten is an abundant nest predator on Haida Gwaii, although its effects on *brooksi* Northern Saw-whet Owls are not known. Populations of Ancient Murrelets nesting on Haida Gwaii have declined in recent years (Environment Canada 2015), reducing the availability of fledging murrelets which may have been a locally important, seasonally available prey source.

Road collisions (Low impact)

Many *brooksi* Northern Saw-whet Owls apparently move to coastal areas for feeding during fall and winter, where they may be hit by vehicles on the highway between Skidegate and Tlell, which closely follows the eastern coastline of Graham Island (Sealy 1999; S. Sealy pers. comm. *in* COSEWIC 2006). Up to 50-100 individuals (mostly young birds) may be killed each year (e.g., Hobson and Sealy 1991; Sealy 1999), although neither the number of roads within the subspecies' range nor traffic on existing roads is expected to increase.

Fire (Low impact)

Although infrequent, uncontrolled wildfires in old-growth forests of Haida Gwaii within the past 100 years have sometimes been serious, especially in recent years with drier summers. Large fires have the potential to eliminate up to 10–15% of *brooksi* habitat on the archipelago, and are more likely to occur during nesting, which could lead to high nest and nest tree loss and mortality. With changing and warming climates, more frequent minor fires are also likely.

Earthquakes and tsunamis (Low impact)

As the Pacific coast of British Columbia is located near subduction zones (Clague *et al*. 2003), earthquakes or tsunamis could affect Haida Gwaii within 10 years, although the probability of a significant event in that period is very low. Potential effects on habitat are unknown, as actual impacts would be related to the time of year of the event, and its magnitude and location. Tsunamis caused by earthquakes present a greater threat than the earthquakes themselves, and a large tsunami could potentially affect a significant portion of the population (up to 20%) during the breeding season, particularly in low-lying areas near the coast, by destroying nests and nest-sites and perhaps killing some adults. This could contribute to a population decline. Nest trees could be impacted and fall, reducing nest-site availability and removing habitat in the short-term, but dead trees could result in new nesting sites in the longer term.

Other Threats (Negligible impact)

Several other threats to this subspecies were identified but ranked as negligible. Residential and commercial development is not significant, because of the small and declining human population of the archipelago. Tourism is concentrated in coastal areas in summer, when breeding owls are further inland, minimizing the potential for conflict. Dam development and flooding is not likely to be important on Haida Gwaii.

*Brooksi* Northern Saw-whet Owls have been killed by eating rats poisoned in an eradication program on small outer islands (Kaiser *et al*. 1997). This threat was restricted to a very small part of the population (~2%), and numbers are expected to rebound after such events.

Climate data from north-coastal and north-central BC indicate a trend of increased precipitation and temperatures over the past 20 years (Frank Doyle unpubl. data *in* Parks Canada Agency 2014). Climate change has the potential to alter the dynamic forest ecosystems of Haida Gwaii; for example, wetter conditions may increase the occurrence of stands dominated by Western Redcedar, which have the lowest availability of nesting cavities (Parks Canada Agency 2014). Increased precipitation could also destabilize snags, resulting in reduced longevity of nest trees. Overall, climate change is unlikely to significantly affect the habitat of this subspecies in the short term.

## Limiting Factors

The *brooksi* Northern Saw-whet Owl has a low population density and abundance across its range, which is limited to the Haida Gwaii archipelago. This endemic subspecies has no external population source available to buffer the effects of population decline. This owl relies on other primary nest excavator species to create nest cavities, so its numbers may be limited by the availability of suitable cavities, which is predicted to decline somewhat with the decrease in mature and old forests.

## Number of Locations

The *brooksi* Northern Saw-whet Owl is widely but sparsely distributed within its range (NatureServe 2015), and is capable of dispersal within the Haida Gwaii archipelago. A single threatening event is unlikely to rapidly affect many individuals, except in relatively localized areas affected by threats such as forest harvesting. As a consequence, the number of discrete locations cannot be accurately estimated, but is likely to be substantially greater than 10.

# PROTECTION, STATUS AND RANKS

## Legal Protection and Status

Individual *brooksi* Northern Saw-whet Owls and their nests are protected under the *British Columbia Wildlife Act*. It is listed under Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) which prevents international trade of the subspecies. Federally, it is protected from hunting, trafficking, or possession in Gwaii Haanas National Park Reserve under the *Canada National Parks Act.* COSEWIC assessed the *brooksi* Northern Saw-whet Owl as Threatened in April 2006 and November 2017 and this subspecies is also listed as a Threatened in Schedule 1 of the *Species at Risk Act*. It is subject to prohibitions protecting individuals and their residences wherever it occurs, and to prohibitions protecting areas of Critical Habitat that were identified in the federal recovery strategy completed in 2014 (Parks Canada Agency 2014). Additional Critical Habitat will be identified in future recovery documents, and an action plan for the species is scheduled to be completed by March 2019. Actions implementing the *brooksi* Northern Saw-whet Owl recovery strategy were included in the Multi-species Action Plan for Gwaii Haanas National Park Reserve, National Marine Conservation Area Reserve and Haida Heritage Site (Parks Canada Agency 2016).

## Non-Legal Status and Ranks

This subspecies has not been assessed for the IUCN Red List (IUCN 2015). Globally, its status rank is G5T2T3 (species globally secure, but subspecies Imperilled to Vulnerable), with a rounded global status of T2 - Imperilled (NatureServe 2015). Its national status is N2N3 (Imperilled to Vulnerable), and its status in British Columbia is S2S3 (Imperilled to Vulnerable). It is included in British Columbia's Blue List (British Columbia Conservation Data Centre 2015).

## Habitat Protection and Ownership

About 71% of Haida Gwaii (7219 $km^2$) is currently reserved from forest harvesting operations (Parks Canada Agency 2014), compared to only about 25% protected from forestry at the time of the last assessment (COSEWIC 2006). Although spatially explicit habitat information is not available for all protected areas, and habitat requirements of the *brooksi* Northern Saw-whet Owl are not completely understood, it appears that more than half the range used by this owl is now protected.

The largest protected area is Gwaii Haanas National Park Reserve and Haida Heritage Site, occupying the southern half of Moresby Island and adjacent islands, with a total area of 1470 $km^2$. The northeastern corner of Graham Island is protected from resource extraction in Naikoon and Pure Lake Provincial Parks (690 $km^2$). However, much of this area is boggy habitat, which lacks many of the attributes associated with suitable breeding habitat for Northern Saw-whet Owls. Other existing conservation areas (including Indigenous conservation areas Daawuuxusda, Damaxyaa, Duu Guusd, Kamdis, Kunxalas, Nang Xaldangaas, Scaay Taaw Siiwaay K'Adjuu, Yaaguun Gandlaay, N'uuna Gwaay, and

Tlall) total approximately 3962 km$^2$ (B. Wijdeven pers. comm 2016). In addition, about 2641 km$^2$ of new conservancies have been created through the Haida Gwaii Strategic Land Use Agreement (2007), and 616 km$^2$ of reserves have been set aside under the Haida Gwaii Land Use Objectives Order (2010) through an Ecosystem-Based Management initiative. These reserves include 12 polygons (at 11 locations) put in place to protect the Critical Habitat identified in the *brooksi* Northern Saw-whet Owl federal recovery strategy (Parks Canada 2014; Schedule 12 of the Haida Gwaii Land Use Objectives Order).

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### Authorities Contacted

R. Millikin, Canadian Wildlife Service, Environment and Climate Change Canada, Delta, BC

B. Howes, Parks Canada Agency, Gatineau, QC

P. Nantel, Parks Canada Agency, Gatineau, QC

D. Fraser, Ministry of Environment, Government of British Columbia, Victoria, BC

British Columbia Conservation Data Centre, Government of British Columbia, Victoria, BC

S. Schnobb, COSEWIC Secretariat, Canadian Wildlife Service, Environment and Climate Change Canada, Gatineau, QC

N. Jones, COSEWIC Secretariat, Canadian Wildlife Service, Environment and Climate Change Canada, Gatineau, QC

J. Wu, COSEWIC Secretariat, Canadian Wildlife Service, Environment and Climate Change Canada, Gatineau, QC

P. Shepherd, Parks Canada Agency, Vancouver, BC

R. Vennesland, Parks Canada Agency, Vancouver, BC

M. Gosselin, Canadian Museum of Nature, Ottawa, ON

D. Leaman, Ottawa, ON

R. Page, Page and Associates Environmental Solutions, Victoria, BC

L. Corkum, University of Windsor, Windsor, ON

A. Cober, Forests, Lands and Natural Resource Operations, Government of British Columbia, Queen Charlotte, BC

B. Wijdeven, Forests, Lands and Natural Resource Operations, Government of British Columbia, Queen Charlotte, BC

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## BIOGRAPHICAL SUMMARY OF REPORT WRITER

Nyree Sharp prepared the 2014 status report on Piping Plover for COSEWIC, and worked on the Piping Plover action plan for the western subspecies. She has worked with Alberta's Fish and Wildlife Division (Department of Sustainable Resource Development), where she reviewed environmental impact assessments and wrote, edited and reviewed various species at risk project and summary reports, fact sheets and technical summaries. She has worked with the Alberta Conservation Association on a variety of species at risk projects since early 2001, where she acted as series editor preparing Alberta's detailed status reports on species at risk (analogous to COSEWIC's status reports), as part of the provincial status assessment process. She also taught an introductory biology course and ecology lab at Grant MacEwan College. She completed her B.Sc. (Honours) in Environmental Biology at the University of Alberta and her M.Sc. in Conservation Biology at the University of British Columbia. Her M.Sc. thesis examined the predicted effects of logging on bird habitat in the aspen boreal mixed-wood forest.

## COLLECTIONS EXAMINED

No collections were examined in the preparation of this report.

# Appendix 1. Threats Assessment for Northern Saw-whet Owl *brooksi* subspecies.

| | |
|---|---|
| **Species or Ecosystem Scientific Name** | *Northern Saw-whet Owl (Aegolius acadicus brooksi)* |
| **Element ID** | **Elcode** ABNSB15022 |
| | 18-Nov-16 |
| **Assessor(s):** | Dave Fraser (facilitator), Frank Doyle, Richard Elliot, Carmen Holschuh, Jon McCraken, Nyree Sharp, Pam Sinclair, Ross Vennesland, Berry Wijdeven, Astrid M. van Woudenberg, Joanna James (COSEWIC Secretariat) |
| **References:** | (1) Parks Canada Agency. 2015. Recovery Strategy for Northern Saw-whet Owl brooksi subspecies (Aegolius acadicus brooksi) in Canada [Final]. Species at Risk Act Recovery Strategy Series. Parks Canada Agency. Ottawa. vii + 34 pp. (2) COSEWIC 2006. COSEWIC assessment and status report on the Northern Saw-whet Owl brooksi subspecies Aegolius acadicus brooksi in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 23pp. (3) COSEWIC 2016. Draft COSEWIC assessment and status report on the Northern Saw-whet Owl brooksi subspecies Aegolius acadicus brooksi in Canada. COSEWIC BIrds Specialist Sub-committee. vi + 25pp. (4) "Queen Charlotte" Northern Saw-whet Owl Aegolius acadicus brooksi. Accounts and Measures for Managing Identified Wildlife - Accounts V. 2004. |

| | | **Level 1 Threat Impact Counts** | |
|---|---|---|---|
| **Threat Impact** | | **high range** | **low range** |
| A | Very High | 0 | 0 |
| B | High | 0 | 0 |
| C | Medium | 0 | 0 |
| D | Low | 5 | 5 |
| **Calculated Overall Threat Impact:** | | Medium | Medium |
| **Assigned Overall Threat Impact:** | | **C = Medium** | |
| **Impact Adjustment Reasons:** | | The high range is driven largely by the uncertain threats of catastrophic forest fire and tsunamis, both with uncertain timing, but possible within the next ten years. | |
| **Overall Threat Comments** | | The generation time for this species is taken as 5 years. | |

| **Threat** | | **Impact (calculated)** | | **Scope (next 10 Yrs)** | **Severity (10 Yrs or 3 Gen.)** | **Timing** | **Comments** |
|---|---|---|---|---|---|---|---|
| 1 | Residential & commercial development | | Negligible | Negligible (<1%) | Negligible (<1%) | High (Continuing) | Small human population on Haida Gwaii, and its northern situation and remoteness, result in little to no impact from urban, commercial or tourism development that removes habitat. |
| 1.1 | Housing & urban areas | | Negligible | Negligible (<1%) | Negligible (<1%) | Moderate (Possibly in the short term, < 10 yrs/3 gen) | As there is little human habitation on Haida Gwaii, urban development is not an appreciable threat. Human population is declining and no new residential developments are planned. |

| Threat | | Impact (calculated) | | Scope (next 10 Yrs) | Severity (10 Yrs or 3 Gen.) | Timing | Comments |
|---|---|---|---|---|---|---|---|
| 1.2 | Commercial & industrial areas | | Negligible | Negligible (<1%) | Negligible (<1%) | Moderate - Low | The main industrial activity on Haida Gwaii is forestry, which is considered as a threat in 5.3. It is unlikely that any new buildings will be erected here within the next 10 years. |
| 1.3 | Tourism & recreation areas | | Negligible | Negligible (<1%) | Negligible (<1%) | Moderate (Possibly in the short term, < 10 yrs/3 gen) | Tourism and recreation development are not mentioned in the Recovery Strategy (2014). As tourism is concentrated in coastal areas in summer (May-Sept), there is likely little conflict wth owls, whose mature-old forest breeding habitat is mostly inland and which tend to occur in coastal areas only in fall and winter. They are unlikely to be impacted by coastal facility construction or use. No tourism and recreation development projects are planned at this time, although possible in the future. |
| 2 | Agriculture & aquaculture | | | | | | |
| 2.1 | Annual & perennial non-timber crops | | | | | | Not applicable |
| 2.2 | Wood & pulp plantations | | | | | | This category is not applicable as it applies to tree plantations, which are not found on Haida Gwaii. |
| 2.3 | Livestock farming & ranching | | | | | | Not applicable |
| 2.4 | Marine & freshwater aquaculture | | | | | | Not applicable, but could possibly become a threat if aquaculture using inland pools became an organized industry (one experimental facility on coastal mainland to date). |
| 3 | Energy production & mining | | Not Calculated (outside assessment timeframe) | Unknown | Unknown | Low (Possibly in the long term, >10 yrs/3 gen) | Currently not applicable, although proposed wind farms on Haida Gwaii could have impacts which currently are unknown. |
| 3.1 | Oil & gas drilling | | | | | | Currently not applicable, due to the present moratorium on offshore oil and gas development. The prospect of petroleum extraction is a potential future threat, though likely beyond 10 years, when it should be reassessed. |
| 3.2 | Mining & quarrying | | | | | | There is potential for mining on Haida Gwaii, but there are no current or proposed operations. |
| 3.3 | Renewable energy | | | | | | Wind farms previously proposed for Haida Gwaii could have impacts on owls, but specific threats are unknown, and the projects are unlikely to proceed. Offshore wind turbines are unlikely to affect this subspecies which does not venture far from land. Private landowner turbines are also unlikely to have an effect. |

| Threat | | Impact (calculated) | | Scope (next 10 Yrs) | Severity (10 Yrs or 3 Gen.) | Timing | Comments |
|---|---|---|---|---|---|---|---|
| 4 | Transportation & service corridors | D | Low | Small (1-10%) | Slight (1-10%) | High (Continuing) | Collisions with vehicles are the only threat identified in this category, and although reported to occur, are not considered a significant threat to population numbers (Recovery Strategy 2014) |
| 4.1 | Roads & railroads | D | Low | Small (1-10%) | Slight (1-10%) | High (Continuing) | Although collisions with vehicles are reported, they are relatively infrequent and typically occur only in fall, when it is assumed that post-breeding owls move to coastal areas to access rich inter-tidal prey. Up to 50-100 individuals may be hit by vehicles in some years (mostly young birds), about 5% of the population. The length of roads within the subspecies' range is not expected to increase. |
| 4.2 | Utility & service lines | | | | | | Not applicable |
| 4.3 | Shipping lanes | | | | | | Not applicable |
| 4.4 | Flight paths | | | | | | Not applicable |
| 5 | Biological resource use | D | Low | Small (1-10%) | Serious (31-70%) | High (Continuing) | This threat is primarily due to timber harvesting in mature-old forests, which removes breeding habitat. Current conservation efforts may mitigate this threat over the next 10 years, although forest practices have resulted in habitat declines of about 15% in the past decade, with projections of about similar rates of decline in breeding habitat and population size in next 10 years. |
| 5.1 | Hunting & collecting terrestrial animals | | Negligible | Small (1-10%) | Negligible (<1%) | High (Continuing) | There have been reported incidents of owls killed by rat poison on two small islands in Haida Gwaii. This threat is restricted to short-term effects and a very small part of the population (~2%). Population expected to rebound after such events. |
| 5.2 | Gathering terrestrial plants | | | | | | Not applicable |
| 5.3 | Logging & wood harvesting | D | Low | Small (1-10%) | Serious (31-70%) | High (Continuing) | Harvesting of mature forest is the main threat to breeding habitat, resulting in loss and fragmentation of nesting and foraging habitat. Harvesting mature stands removes nest trees with suitable cavities, as well as foraging habitat as loss of understory in old-mature stands may reduce songbird and rodent prey. Logging of nest-trees removes habitat so individuals must find new nest sites. This threat may be mitigated by designation of Critical Habitat and of additional reserves that now protect 71% of the land base from forestry operations. |
| 5.4 | Fishing & harvesting aquatic resources | | | | | | Not applicable |
| 6 | Human intrusions & disturbance | | | | | | Not applicable |

| Threat | | Impact (calculated) | | Scope (next 10 Yrs) | Severity (10 Yrs or 3 Gen.) | Timing | Comments |
|---|---|---|---|---|---|---|---|
| 6.1 | Recreational activities | | | | | | Not applicable; likely due to limited access to Haida Gwaii. |
| 6.2 | War, civil unrest & military exercises | | | | | | Not applicable |
| 6.3 | Work & other activities | | | | | | Not applicable |
| 7 | Natural system modifications | D | Low | Small (1-10%) | Extreme - Serious (31-100%) | High (Continuing) | |
| 7.1 | Fire & fire suppression | D | Low | Small (1-10%) | Extreme - Serious (31-100%) | Moderate - Low | In Haida Gwaii, uncontrolled wildlfire would eliminate habitat, although the probability of such fires occurring is unknown. There have been few fires within the past 100 years, but those that did occur tended to be quite serious, especially in recent dry summers. Past large fires have affected 10-15% of the island. Large fires may be more likely to occur during summer which could lead to high nest loss and mortality. More frequent minor fires are possible if habitats get drier. |
| 7.2 | Dams & water management/use | | Negligible | Negligible (<1%) | Extreme - Serious (31-100%) | High (Continuing) | Dam construction is not generally an issue on Haida Gwaii, although a proposal to heighten one existing dam by 1.5 m could lead to a minor loss of foraging and nesting habitat. |
| 7.3 | Other ecosystem modifications | | Negligible | Negligible (<1%) | Slight (1-10%) | High (Continuing) | Risk from ecosystem modification apaet from other threats identified here is unknown. Mature forest is harvested every 60 years, resulting in second-growth forest that is not as attractive to this owl but does provide some foraging habitat and prey availability. |
| 8 | Invasive & other problematic species & genes | D | Low | Pervasive (71-100%) | Slight (1-10%) | High (Continuing) | |
| 8.1 | Invasive non-native/alien species/diseases | D | Low | Pervasive (71-100%) | Slight (1-10%) | High (Continuing) | In the Recovery Strategy (2014), 'habitat alteration from introduced species' was identified as a 'medium' level of concern that was 'widespread' with 'low' severity, although definitions of these terms do not compare directly with Threat Calculator terms. Introduced Sitka Black-tailed Deer pose a threat by heavily browsing understorey vegetation in mature-old forest, removing cover for owl prey including rodents and invertebrates. Introduced Black and Norway Rats may further reduce owl prey availability by reducing Keen's mouse and shrew numbers, and may take eggs from owl nests. Introduced Common Raccoons and Red Squirrels also pose a threat through nest predation. European Starlings associated with human development have been observed harrassing nesting owls. Red Squirrels may compete for nest sites, but may also have a positive impact by creating primary nest cavities. |

| Threat | | Impact (calculated) | | Scope (next 10 Yrs) | Severity (10 Yrs or 3 Gen.) | Timing | Comments |
|---|---|---|---|---|---|---|---|
| 8.2 | Problematic native species/diseases | D | Low | Small (1-10%) | Slight (1-10%) | High (Continuing) | American Marten populations are high, but their effect on NSWO is unclear. Severe declines in Ancient Murrelet populations and abundance of fledging murrelets, have reduced what may have been a locally important, seasonally-available prey source for NSOW. |
| 8.3 | Introduced genetic material | | | | | | No information available. There is no evidence of interbreeding with mainland subspecies. |
| 8.4 | Problematic species/diseases of unknown origin | | | | | | No information available. |
| 8.5 | Viral/prion-induced diseases | | | | | | No information available |
| 8.6 | Diseases of unknown cause | | | | | | No information available |
| 9 | Pollution | | | | | | Although some level 2 threats in this category could potentially threaten owl habitat over time, most are likely not applicable on Haida Gwaii, given the current low level of human habitation and development. |
| 9.1 | Domestic & urban waste water | | | | | | Pollution from waste water is likely not applicable, but because NSOW uses riparian areas for foraging during breeding season and coastal areas during fall, waste water effects could possibly be present, although any threat is unlikely and unknown. |
| 9.2 | Industrial & military effluents | | | | | | Not applicable |
| 9.3 | Agricultural & forestry effluents | | | | | | It is unknown whether effluents from forestry operations could pose a threat to owls if riparian areas are contaminated by a spill or if effleunts enter the ground water. Impacts are presumed to be unlikely. |
| 9.4 | Garbage & solid waste | | | | | | Not applicable |
| 9.5 | Air-borne pollutants | | | | | | Not applicable |
| 9.6 | Excess energy | | | | | | Not applicable |
| 10 | Geological events | D | Low | Small (1-10%) | Serious - Slight (1-70%) | Moderate - Low | Occurrence of these stochastic events is unknown, but possible; their potential impacts for habitat loss could range from localized to quite widespread. |

| Threat | | Impact (calculated) | | Scope (next 10 Yrs) | Severity (10 Yrs or 3 Gen.) | Timing | Comments |
|---|---|---|---|---|---|---|---|
| 10.1 | Volcanoes | | | | | | Not applicable |
| 10.2 | Earthquakes/tsunamis | D | Low | Small (1-10%) | Serious - Slight (1-70%) | Moderate - Low | Although earthquakes and/or tsunamis could possibly occur within 10 years, the probability is very low and potential effects on habitat are unknown, as impacts would be related to magnitude and timing of the event. A tsunami could affect a significant portion of the population during the breeding season (up to 20% of the population, particularly in low-lying areas near the coast. Nest trees could be impacted and fall, reducing nest-site availability. An earthquake or tsunami could remove habitat in the short-term, but could also create new nesting sites in dead trees in the longer term. |
| 10.3 | Avalanches/landslides | | Negligible | Negligible (<1%) | Extreme - Serious (31-100%) | High (Continuing) | The incidence of landslides or avalanches is unknown but possible and the potential loss of habitat is unknown. Impacts would likely be localized and affect only a very small portion of the population, largely through habitat loss. |
| 11 | Climate change & severe weather | | Negligible | Pervasive (71-100%) | Negligible (<1%) | High (Continuing) | Likely the only Level 2 threat that may have an effect in 3 generations or the next decade is severe storms. |
| 11.1 | Habitat shifting & alteration | | Negligible | Pervasive (71-100%) | Negligible (<1%) | High (Continuing) | Anticipated effects of climate change shown in the Recovery Strategy (2014) suggest that if precipitation and temperature increase over time, Western Red-cedar may become the dominant forest species, one which provides the fewest nesting sites for NSOW. However, if understorey development increases, prey numbers could be enhanced. Increased precipitation could also result in less stable snags, potentially reducing nest tree longevity. The net effect on woodpecker populations, the primary cavity excavators, is unknown. Effects unlikely in next 3 generations, and habitat is not expected to change appreciably over the short term. Over the long term, there is the risk of sea level rise in coastal areas, changes to forest composition and the migration of forests to higher altitudes. |
| 11.2 | Droughts | | Unknown | Unknown | Unknown | Moderate (Possibly in the short term, < 10 yrs/3 gen) | Drought has the potential to reduce prey availability and/or exacerbate effects from forest health agents. The consequent effect on populations of nest excavators (woodpeckers) is unknown. There is some evidence that recent summers have been drier, which could impact prey availability and forest composition, although direct impacts on the owls is unknown. |
| 11.3 | Temperature extremes | | | | | | Not applicable |

| Threat | | Impact (calculated) | | Scope (next 10 Yrs) | Severity (10 Yrs or 3 Gen.) | Timing | Comments |
|---|---|---|---|---|---|---|---|
| 11.4 | Storms & flooding | | Negligible | Pervasive (71-100%) | Negligible (<1%) | High (Continuing) | Storms are an ongoing threat, and appear to have been increasing in frequency and severity in the past decade globally. Their effects include reducing suitable nest tree availability through blow downs. Storms could negatively impact coastal owls and nest trees, but owls in these areas represent only a small part of the population. |
| 11.5 | Other impacts | | | | | | None anticipated. Warmer winters are unlikely to cause negative effects. |

Classification of Threats adopted from IUCN-CMP, Salafsky *et al.* (2008).