

May 8, 2019

Via email and courier

The Honourable Catherine McKenna
Minister of Environment and Climate Change
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Dear Minister McKenna:

RE: Habitat Action Plan for Northern Spotted Owl pursuant to the *Species at Risk Act*

We act for the Wilderness Committee and write on its behalf regarding the Northern Spotted Owl (*Strix occidentalis caurina*) (“**Spotted Owl**”); in particular, we write to request that you to produce a long overdue Spotted Owl action plan pursuant to the *Species at Risk Act*, 2002, c.29 (“**SARA**”).

Introduction

The Wilderness Committee (formerly the Western Canada Wilderness Committee) is one of British Columbia’s oldest wilderness and wildlife conservation organizations. For nearly three decades it has been working to protect the Spotted Owl and its habitat. It has also demonstrated a longstanding interest in the administration of and compliance with *SARA*. For example, it has brought several lawsuits under *SARA* in an effort to protect at-risk species, including the Spotted Owl.¹

The Wilderness Committee is requesting that you take immediate action with respect to preparing and publishing a *SARA*-compliant habitat action plan for the Spotted Owl.

The Spotted Owl has been listed as endangered under *SARA* since 2003. In 2006, the “Recovery Strategy for the Northern Spotted Owl (*Strix occidentalis caurina*) in British Columbia” (the “**Recovery Strategy**”) was published on the species at risk public registry in accordance with *SARA*. The Recovery Strategy included only a partial definition of the Spotted Owl’s critical

¹ See e.g., *Western Canada Wilderness Committee, et al v Canada (Fisheries and Oceans)*, 2014 FC 148; *Alberta Wilderness Association, et al v Canada (Environment)*, 2009 FC 710; *Western Canada Wilderness Committee, et al v Canada (Minister of Environment)* (application filed December 5, 2005), Vancouver, FC T-2150-05 (application discontinued September 12, 2006).

habitat – that is, the habitat that is “necessary for its survival or recovery”.² However, through the Recovery Strategy, your predecessor committed to completing a habitat action plan within a year that would, among other things, fully identify the Spotted Owl’s critical habitat (the “**Habitat Action Plan**”).³

As of the date of this letter – over 12 years later – the Habitat Action Plan has still not been produced. In short, the failure to publish the Habitat Action Plan has:

- Deprived the Spotted Owl of legal protection for habitat necessary for its survival and recovery that was not identified in the Recovery Strategy;
- Slowed the recovery action – namely, the identification and protection of critical habitat – crucial to protecting the Spotted Owl and preventing further loss of genetic diversity; and,
- Allowed the primary threat to the Spotted Owl and its habitat – that is, commercial logging of old-growth forest – to continue widely unaddressed and unmonitored.

Without your timely intervention, the Wilderness Committee considers the Spotted Owl’s near-term extirpation from Canada certain.

Background

The Spotted Owl faces imminent extirpation

The Canadian population of the Spotted Owl is found exclusively in southwestern British Columbia. It is estimated that prior to European contact the population of Spotted Owl was 500 pairs.

In 1986, the Committee on the Status of Endangered Wildlife in Canada (“COSEWIC”) designated the Spotted Owl as “endangered”, meaning that the species is “threatened with imminent extirpation throughout all or a significant portion of its Canadian range.”⁴

Between 1992 and 2002, while the BC government prioritized commercial logging of Spotted Owl habitat, the population declined by as much as 67%, at an annual rate of 10.4%. At the time the Recovery Strategy was published in 2006, the known population was 22 individuals.

The latest estimate is that there are no more than six owls remaining in the wild.⁵

² SARA, s. 2(1).

³ See Recovery Strategy at p 17 under heading “6.2 Critical Habitat”: “... The amount and spatial distribution of critical habitat for Spotted Owls have not yet been defined by the [Canadian Spotted Owl Recovery Team (CSORT)]. Recommendations regarding the amount and distribution of critical habitat required to recover the population in British Columbia will be included in the Habitat Action Plan.”; see also, Recovery Strategy at p 53 under heading “18.2 Statement of When Action Plans will be Completed”: “1. Habitat Action Plan: to define survival and recovery habitat, review and evaluate effectiveness of [BC’s habitat protection regime], and provide recommendations of additional habitat recovery actions (within a year of release of the recovery strategy).”

⁴ COSEWIC re-examined and confirmed this endangered status in April 1999, May 2000, and April 2008.

⁵ Wilderness Committee has been informed that there are an additional 21 owls in the BC-based captive breeding program. However, this program has yet to successfully release an owl into the wild after 12 years of operation.

BC's historic and continued mismanagement of Spotted Owl and its habitat

The primary threat to the Spotted Owl has been and continues to be loss and fragmentation of its habitat, which is predominantly comprised of old-growth forest. The principal cause of habitat loss and fragmentation is commercial logging regulated and approved by the BC government.

From the early 1990s until the Spotted Owl was listed as endangered under SARA the BC government openly prioritized logging of Spotted Owl habitat over its protection and recovery.

In 2006, at around the same time the final Recovery Strategy was published, the Wilderness Committee and others sued your predecessor, Rona Ambrose, for failing to recommend that the Governor in Council make an emergency order to protect the Spotted Owl and its habitat under s. 80 of SARA.⁶

During the course of those court proceedings Ms. Ambrose concluded that there was not an imminent threat to the Spotted Owl's survival. The record of Ms. Ambrose's decision (the **"Emergency Order Decision Record"**) filed with Federal Court revealed:

- Based on BC's mismanagement, Environment Canada officials initially recommended Ms. Ambrose form the opinion that there was an imminent threat to the Spotted Owl;⁷
- Shortly thereafter, then BC Minister of Agriculture and Lands, Pat Bell, sent Ms. Ambrose a letter setting out three actions the BC government was taking to protect the Spotted Owl. These were:
 - Institute a population enhancement program (translocation, captive breeding, competitor management and prey enhancement);
 - Immediately protect active Spotted Owl areas; and,
 - Secure recovery habitat guided by science.⁸
- After reviewing BC's commitments, Environment Canada officials recommended Ms. Ambrose form the opinion that there was no longer an imminent threat to the Spotted Owl.

The 2006 "no imminent threat" recommendation from Environment Canada officials was premised on several findings that are highly relevant to Wilderness Committee's current request for a Habitat Action Plan, including:

- "Population enhancement work will not be successful in the long-run if adequate habitat does not exist to support the growing population. This issue must be addressed through the identification and protection of critical habitat. Information is available to complete this

⁶ *Western Canada Wilderness Committee, et al v Canada* (application filed September 15, 2006), Vancouver, FC T-1681-06 (application discontinued June 7, 2007) [WCWC 2006].

⁷ WCWC 2006, Documents Provided Pursuant to Rule 318 of *Federal Courts Rules* ["Emergency Order Decision Record"], Appendix A, Tab 4, Memorandum to Minister (MIN-82502) (April 26, 2006) at 6.

⁸ WCWC 2006, Emergency Order Decision Record, Appendix A, Tab 3, Memorandum to Minister (MIN-87052) (August 4, 2006), Attachment (IV), Memorandum to Minister (MIN-85130) (June 20, 2006), attachment (vi) Letter from the Honourable Pat Bell, Minister of Agriculture and Lands, British Columbia to the Minister of the Environment (May 8, 2006).

analysis ([citing to a draft Habitat Action Plan]) and it is possible to complete it within the next 12 months.”⁹

- “[the] partial definition of critical habitat in the [Recovery Strategy] was the subject of much debate and the definition included is one that all members of the [“Canadian Spotted Owl Recovery Team” or “CSORT”] could support. BC has since directed the recovery team to not spatially identify critical habitat, but rather to provide a “recipe” that BC can use in their determination of critical habitat ... Section 49(1)(a) of SARA requires an identification of critical habitat in action plans, and presumably BC will add this identification to the action plan ... The Schedule of Studies appended to the [Recovery] Strategy in April 2006, outlines what is required to complete the identification of critical habitat in the [Habitat] Action Plan. Most of these studies have already been completed by CSORT, as has a draft Action Plan. The Schedule of Studies states that the Action Plan, with guidance for BC to spatially identify critical habitat, will be complete in 2006 and that BC would then have the information they needed to identify critical habitat and a revised habitat management plan by 2007.”¹⁰
- “BC’s plan for action, if carried out under the direction of a science team and within the proposed timeframes as indicated, and their proposed actions, will allow for protection of all occupied sites, longer-term habitat protection and population enhancement ... you should be aware, however, that BC has been known to delay or not take actions that were recommended by previously constituted science teams.”¹¹

Excerpts from the Emergency Order Decision Record containing these statements are attached to this letter at **Tab 1** of the Appendix. At **Tab 2** of the Appendix we have attached for your reference the “draft Action Plan” discussed throughout the Emergency Order Decision Record.

Your predecessor assessed imminent threat based on BC’s current and proposed actions, placing faith in their proactive and protective implementation, guided by science. Unfortunately, this faith was misplaced.

Attached at **Tab 3** of the Appendix is an expert report commissioned by the Wilderness Committee from British Columbia’s former and foremost Spotted Owl field biologist and advisor to the CSORT, Jared Hobbs (“**Hobbs 2019**”).¹²

The Wilderness Committee commissioned this report to definitively assess the actions BC took after its 2006 commitments, their implications for the Spotted Owl, the species’ current status, and its chances of survival and recovery.

⁹ WCWC 2006, Emergency Order Decision Record, Appendix A, Tab 3, Memorandum to Minister (MIN-87052) (August 4, 2006), attachment (IV), Memorandum to Minister (MIN-85130) (June 20, 2006), attachment (iv), “Scientific Assessment of the Status of Northern Spotted Owl in British Columbia” (April 12, 2006 (revised April 25, 2006, updated on May 31, 2006) at 13 (underlining added).

¹⁰ WCWC 2006, Emergency Order Decision Record, Appendix A, Tab 3, Memorandum to Minister (MIN-87052) (August 4, 2006), attachment (IV), Memorandum to Minister (MIN-85130) (June 20, 2006), attachment (iii), “Summary of the Northern Spotted Owl Recovery Strategy” (June 1, 2006) at 2 (underlining added).

¹¹ WCWC 2006, Emergency Order Decision Record, Appendix A, Tab 3, Memorandum to Minister (MIN-87052) (August 4, 2006), attachment (IV), Memorandum to Minister (MIN-85130) (June 20, 2006) at 5 (underlining added).

¹² Hobbs, J. *Spotted Owl Survival and Recover in British Columbia: Expert Report* (February 14, 2019) (“Hobbs 2019”).

The Hobbs 2019 report confirms that, not only did the BC government fail to produce the Habitat Action Plan, it stalled for years before adopting a piecemeal habitat management policy which in many respects replicated the Province's pre-2007 efforts. In other words, the Spotted Owl's critical habitat was never identified and BC maintained an approach that put the species on a path to extirpation from Canada in the first place.

This continued mismanagement is captured by several maps produced by the Wilderness Committee that are attached at **Tabs 4(a)-(c)** of the Appendix. These maps demonstrate in stark terms how much Spotted Owl habitat – undoubtedly much of it critical habitat – has been destroyed under the BC government's watch since the species was first recognized as endangered by COSEWIC and then under SARA.

In sum, the Emergency Order Decision Record, Hobbs 2019 report, and Wilderness Committee maps confirm the following:

- Your predecessor erred in trusting that the BC government would provide a Habitat Action Plan as required by SARA;
- In the 12 intervening years since the release of the Recovery Strategy the BC government has done little to fulfill its commitment to act in accordance with, as Minister Bell put it at the time, the “best science available” and to take actions that “provide the best opportunity for recovery of the spotted owls in British Columbia”;¹³ and
- The result of these failures is truly alarming– less than six owls remain in the wild and survival and recovery habitat has still yet to be identified, let alone protected.

Despite this dismal circumstance, the Hobbs 2019 report confirms that the survival and recovery of the Spotted Owl in Canada is still technically and biologically feasible.¹⁴ Consequently, it is incumbent upon you to take immediate action.

Actions sought

We have advised the Wilderness Committee that there are clear grounds upon which the Federal Court could rely to order you to produce the requested Habitat Action Plan. But the Spotted Owl needs action now, not after potentially years of drawn-out litigation. Thus, the Wilderness Committee has directed us to first request confirmation that you intend to immediately comply with your SARA obligations.

However, the Wilderness Committee is concerned about another ill-advised deferral to the BC government to prepare the Habitat Action Plan. It therefore also requests that at least one member tasked with preparing the Habitat Action Plan be an external and independent scientist who co-chairs the team and shares decision-making authority on the final draft.

¹³ WCWC 2006, Emergency Order Decision Record, Appendix A, Tab 3, Memorandum to Minister (MIN-87052) (August 4, 2006), Attachment (IV), Memorandum to Minister (MIN-85130) (June 20, 2006), attachment (vi) Letter from the Honourable Pat Bell, Minister of Agriculture and Lands, British Columbia to the Minister of the Environment (May 8, 2006) at 3.

¹⁴ Hobbs 2019 at 62-64.

Jared Hobbs has informed us that he is willing and able to assist in preparing the Habitat Action Plan. As stated above (and confirmed in his *curriculum vitae*),¹⁵ Mr. Hobbs has the independence and expertise necessary to fulfill the important external and independent scientist role. The CSORT relied heavily on him in preparing the Recovery Strategy and draft Habitat Action Plan,¹⁶ and so should you.

In summation, in order to ensure the Spotted Owl's survival and recovery, and to comply with your SARA obligations, Wilderness Committee requests that you:

1. By **June 30, 2019** inform the Wilderness Committee of steps taken to date to prepare a proposed Habitat Action Plan, with confirmation of (i) whether Jared Hobbs has been or will be invited to co-chair the action plan team, and (ii) whether you intend to comply with the timelines set out below in (2) and (3);
2. By **September 30, 2019** publish the proposed Habitat Action Plan in the Species at Risk Public Registry; and
3. By **December 31, 2019** publish the final Habitat Action Plan in the Species at Risk Public Registry.¹⁷

To be clear, while the Wilderness Committee seeks your cooperative response in the first instance, and will accommodate and looks forward to a reasonable process for Habitat Action Plan preparation, this correspondence is a legal demand that you act in accordance with your SARA obligations.

Accordingly, if a SARA-compliant Habitat Action Plan is not added to the public registry by **December 31, 2019**, the Wilderness Committee is prepared to sue to enforce your legal obligations under the *Species at Risk Act*.

Sincerely,



Devon Page
Counsel for Wilderness Committee



Kegan Pepper-Smith
Counsel for Wilderness Committee

¹⁵ Attached at Tab 5 of the Appendix.

¹⁶ See e.g., Hobbs 2019 at p 48 where Mr. Hobbs states: "In 2004, I developed a new (revised) BC habitat suitability model that was quickly adopted by CSORT and Coretex Consulting [the consulting agency retained by CSORT for habitat modeling] ... This (2004) model has been used consistently, since 2004, to define and describe spotted owl habitat in BC. The attributes used in this model were field verified, accepted and used by CSORT (Chutter et al. 2004), by Coretex (Sutherland et al. (2007)), and by COSEWIC (COSEWIC 2008)."

¹⁷ This must be completed in compliance with SARA, including ss 38, 49(1), 50(2)-(3). In particular, the Habitat Action Plan must include, among other things, an identification of the Spotted Owl's critical habitat "based on the best available information and consistent with the recovery strategy" (SARA, s 49(1)(a)).

Appendix

Tab 1 – *Western Canada Wilderness Committee, et al v Canada* (application filed September 15, 2006), Vancouver, FC T-1681-06, Excerpts of Documents Provided Pursuant to Rule 318 of *Federal Courts Rules*.

Tab 2 – Chutter, M.J., et al. 2007. *Guidance and some components of action planning for the Northern Spotted Owl (Strix occidentalis caurina) in British Columbia*. BC Ministry of Environment, Victoria, British Columbia.

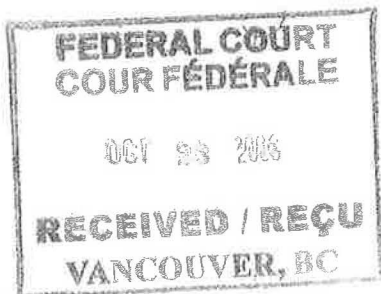
Tab 3 – Hobbs, J. 2019, *Spotted Owl Survival and Recovery in British Columbia: Expert Report*

Tab 4 – Wilderness Committee Spotted Owl Habitat Maps

- **Tab 4(a)** – Estimated Historic Spotted Owl Habitat in Canada
- **Tab 4(b)** – Logging and Spotted Owl Habitat in Canada in 2003
- **Tab 4(c)** – Logging and Spotted Owl Habitat in Canada in 2018
- **Tab 4(d)** – Logging near and in Spotted Owl Protection Area

Tab 5 – *Curriculum Vitae* of Jared Hobbs, M.Sc., R.P.Bio.

TAB 1



Court File No. T-1681-06

FEDERAL COURT

BETWEEN:

WESTERN CANADA WILDERNESS COMMITTEE,
DAVID SUZUKI FOUNDATION, FORESTETHICS and
ENVIRONMENTAL DEFENCE CANADA

Applicants

and

MINISTER OF THE ENVIRONMENT

Respondent

RULE 318 CERTIFICATE

I, the undersigned, Michele Brenning, Director General, Canadian Wildlife Service, Environment Canada, do hereby certify that the materials listed in Appendix A and attached hereto, constitute all of those documents requested by the Applicants pursuant to Rule 317 which are relevant to this Application and which are in the possession of the Minister of the Environment, the tribunal whose order is the subject of this application, but which are not in the possession of the Applicant, other than those for which production is objected to pursuant to Rule 318(2).

Copies of all the documents listed are attached. I further certify that the attached copies constitute true and complete copies of such materials.

DATE: October 20, 2006


Michele Brenning

TO: The Applicants
 c/o A. Devon Page
 Sierra Legal Defence Fund
 #214 - 131 Water Street
 Vancouver, British Columbia V6B 4M3
 Tel: (604) 685-5618
 Fax: (604) 685-7813

AND TO: Federal Court Registry

Appendix A

To Certificate of Michele Brenning

Documents Provided Pursuant to Rule 318 FC Rules

#	Date	Subject	Attachments
1	August 16, 2006	News Release: <i>Federal Environment Minister Supports British Columbia Efforts to Protect the Endangered Northern Spotted Owl</i>	None
2	August 16, 2006	Signed letters from the Minister of the Environment to: - the Honourable Pat Bell, Minister of Agriculture and Lands, British Columbia; and - Devon Page, Counsel, Sierra Legal Defence Fund.	None
3	August 4, 2006	Memorandum to the Minister of the Environment from the Deputy Minister (MIN87052).	(I) News Release dated April 28, 2006: <i>B.C. Announces Spotted Owl Recovery Action Plan</i> (II) Draft of letter from the Minister of the Environment to the Honourable Pat Bell, Minister of Agriculture and Lands, British Columbia (III) Draft of letter from the Minister of the Environment to Devon Page, Counsel, Sierra Legal Defence Fund (IV) Memorandum to the Minister of the Environment from the Deputy Minister, dated June 20, 2006 (MIN85130) and attachments: (i) Draft letter from the Minister of the

			<p>Environment to the Honourable Pat Bell, Minister of Agriculture and Lands, British Columbia</p> <p>(ii) Draft letter from the Minister of the Environment to Devon Page, Counsel, Sierra Legal Defence Fund</p> <p>(iii) Summary of the Northern Spotted Owl Recovery Strategy</p> <p>(iv) Scientific assessment of the Status of the Northern Spotted Owl in British Columbia</p> <p>(v) Analysis of BC's Commitments with respect to the Spotted Owl</p> <p>(vi) Letter from the Honourable Pat Bell, Minister of Agriculture and Lands, British Columbia to the Minister of the Environment, dated May 8, 2006</p> <p>(vii) Summary of Sierra Legal Defence Fund Recommendations for Spotted Owl</p> <p>(viii+ix) Routing Slips</p>
4	April 26, 2006	Memorandum to the Minister of the Environment from the Deputy Minister (MIN82502).	<p>(I) PowerPoint presentation: "Northern Spotted Owl: Brief for Minister Ambrose"</p> <p>(II) Scientific assessment of the Status of the Northern Spotted Owl in British Columbia</p> <p>(III) Analysis of BC's Commitments with respect to the Spotted Owl</p>
5	April 13, 2006	Memorandum to the Minister of the Environment from the Deputy Minister (MIN81878).	<p>(I) PowerPoint presentation : "Northern Spotted Owl: Preliminary Brief for Minister"</p> <p>(II) Routing Slip</p> <p>(III) Approval/Consultation Form</p>
6	April 6, 2006	"Advice to Minister" from Liam Stone	None

7	March 24, 2006	Advice to Minister of the Environment from Liam Stone	None
8	March 23, 2006	Memorandum to the Minister of the Environment from the Deputy Minister (MIN80785).	Routing slip



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PROTECTED

MIN- 85130

MEMORANDUM TO MINISTER

STATUS OF THE SPOTTED OWL

(For Decision)

PURPOSE

To provide you with new analysis to help inform your opinion on the status of the Northern Spotted Owl in British Columbia and whether or not to recommend an Emergency Order under subsection 80(2) of the *Species at Risk Act* (SARA). A proposed letter to Minister Bell and a proposed letter to the Western Canada Wilderness Committee, the David Suzuki Foundation, ForestEthics, Environmental Defence Canada and Sierra Legal Defence Fund (SLDF) are attached for your signature (should you form an opinion that there is no imminent threat).

SUMMARY

- BC recently provided new information about measures being taken to protect the Northern Spotted Owl. The province is committing to immediate and longer-term actions to reverse the decline in owl numbers, protect occupied spotted owl area, and secure habitat for recovery. BC has also confirmed that no logging will be taking place in areas occupied by the owl in 2005.
- Furthermore, Environment Canada has recently received the province's Recovery Strategy for the owl, which will be posted on the SARA registry in early July for a 60-day comment period in accordance with SARA requirements. The Strategy was prepared by the Canadian Spotted Owl Recovery Team (CSORT), which consisted of provincial and federal biologists, as well as experts from academia, industry and Washington State. A summary of the Recovery Strategy is attached to this memo (Appendix 1).
- Departmental biologists have updated the science assessment on the status of the owl previously submitted to you (attached in Appendix 2) and an analysis of commitments made by the province of British Columbia has been prepared (attached in Appendix 3) to assist you in forming your opinion on whether the species faces an imminent threat to its survival or recovery.

CURRENT STATUS

You were provided with a memo (82502) to guide the formation of your opinion as to whether or not the owl faces imminent threats to its survival or recovery. Subsequently, you received a letter dated May 8, 2006 from Minister Bell (attached Appendix 4). In this letter, he outlined BC's plans to protect active spotted owl areas, enhance the owl population and identify and protect suitable habitat to support a growing number of owls.

Canada

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Environment Canada staff have spent considerable time assessing and confirming information received from BC Ministry staff to determine the specifics behind the actions described by Minister Bell. The BC commitments are analyzed and summarized in this memorandum (Appendix 3).

Spotted Owl Status:

In 2004, 28 individual owls were found, including 3 juveniles. In 2005, 23 individual owls were found but one has since died, indicating that there are only 22 known individual Spotted Owls left in Canada, of which only 6 were pairs in 2005. As of May 23, 2006, 10 individual owls have been found; however, the 2006 inventory is not yet completed.

Under the accepted survey protocol, a Spotted Owl site is considered "active" until surveys do not detect an owl for 2 consecutive years. As of May 23, 2006, 2 owls have been sighted in areas outside of the 2005 sites; at least 1 of these owls seems to have been among the 22 owls seen in 2005, but found in a different place in 2006. The survey protocol used in 2005 resulted in an 80 to 90 percent chance of detecting an owl if 1 were present. The 2006 survey is ongoing. Until the 2006 survey is complete, areas where the owls were sighted in 2004, but not in 2005, would be considered active. It is also possible that new owls will be found.

CONSIDERATIONS

Science assessment

A science assessment of the status of the owl is attached as Appendix 2. A brief summary is in Annex 1 (Supplemental Information) of this memorandum.

BC's Planned Actions

Actions to Immediately Protect Active Spotted Owl Areas

You will recall that memo 82502 advised that the immediate concern was the potential for logging in 9 areas where the owl was found in 2005. In his letter, Minister Bell confirmed that no logging is taking place in these 9 areas in the immediate future and that BC will ensure no future logging will occur in them. The province committed to do so by:

- redirecting proposed timber harvesting,;
- securing habitat around sites where owls were observed in 2005, and, if necessary;
- using their legislative authorities to prevent forest harvesting within areas set aside for spotted owls.

BC has since identified alternative harvesting areas for forest licensees which are in less suitable owl habitat.

BC's commitment to suspend timber harvest, however, does not necessarily extend to those sites occupied in 2004, or to new sites where owls are found in surveys in 2006 or beyond. BC has said they will inventory the 2004 sites this year and that they will "quickly act to remove any immediate threats and immediately ensure additional protection or management" for any additional owl sites that are found to be occupied, in consultation with the new science team that

BC has committed to put in place in the coming weeks. In the meantime, other sites identified as being occupied in the 2004 or 2006 surveys will have, at a minimum, the protection afforded by the 1997 Spotted Owl Management Plan (SOMP). The SOMP requires leaving at least 67 percent of the forest cover within owl areas, and protecting a 500 m buffer around nesting sites.

There is one area (Fire Creek) where 43 hectares are currently being logged in an area where an owl was sighted in 2004 survey but was not sighted in 2005 and has not yet been sighted in 2006 (the survey has not yet been completed within this area). The level of logging taking place in Fire Creek is within the rules of the SOMP (i.e. well less than the 33 percent that can be removed under the SOMP rules).

There may also be logging in the fall in another area (the Lillooet site, see Appendix 3, page 2) where an owl was found in 2004 and 2006, but not in 2005. BC has advised us that they will consult with the new science team before any logging takes place and follow any recommendations they may make.

BC has indicated to EC officials that they have not yet secured the full budget needed to conduct the 2006 survey but are seeking funding from other sources, including Industry. Given the importance of the survey, EC has offered funding through the work planning exercise being done under the Canada-BC SARA Bilateral Agreement.

The issues regarding the adequacy of protection of the remaining owls will be in how and when BC takes actions. To be successful, they will have to diligently follow the recommendations of the science team and move quickly to ensure adequate protection. Protection will have to cover all remaining owls which means that the 2006 survey must be done properly and that BC must follow the protocol of considering a site active until two successive surveys demonstrate otherwise, as BC has informed us they will do.

BC is demonstrating concrete action: on June 13, BC advised us of another step that has been taken toward achieving the goal of protecting remaining owls. Their Deputy Minister of Environment signed off legal orders under the Government Actions Regulation of the *Forest and Range Practices Act* to establish Wildlife Habitat Areas over the 9 2005 owl sites totaling just over 23 000 ha. The general Wildlife Measures for these areas prohibit: forest harvesting, road construction, removal of trees harvested to address worker safety or danger trees adjacent to currently existing roads, and salvage harvesting. The BC government will be making a public announcement on this legal protection in the coming weeks.

Actions to Reverse the Decline in Spotted Owl Numbers

Minister Bell indicates that the province will "immediately invest in an aggressive" program to halt the current population decline. Precise actions are still to be determined, in consultation with members of a science team which is being established and will include Environment Canada officials. Actions may include moving single owls to facilitate potential breeding pairs, captive breeding, competitor management, and prey enhancement. The effectiveness of the actions will be evaluated after five years. The province hopes to have an action plan from the

new science team on population enhancement recommendations by the end of August. They have also indicated that they intend to implement the recommendations as soon as they are available and to ensure an adequate monitoring program to evaluate success.

Actions to Secure Recovery Habitat

There are currently 388 000 ha of suitable habitat configured in large enough patches to be used for Spotted Owls. This means that there is more than enough forest of the appropriate age to support up to 250 owls, which is the recovery goal. However, less than half of this suitable habitat is currently protected and it is also highly fragmented. Approximately one third is fully protected in parks, less than one third is being managed through SOMP, and the remainder of the suitable habitat is not protected (approximately 100 000 ha).

BC has confirmed to EC that their intent is to act on the advice of the science team to identify the best habitat required to achieve the recovery goals, including the amount required in the appropriate configuration, and give this habitat proper protection using their legislative authorities. The total amount of suitable habitat does not all have to be available immediately as the population will take time to grow and the recovery goal will take decades to achieve. However, as suitable habitat is a minimum of 80 to 100 years old, action is required now to ensure that enough habitat in the right spatial distribution will be available as required.

It will take proper planning for BC to successfully balance owl protection with their policy commitment to not affect the timber supply. BC has noted that there will be challenges of ensuring adequate habitat of the right age and structure in 20 to 30 years, but note that this could be achieved with proper planning. BC will have to diligently follow the recommendations of the science team and move quickly to ensure adequate habitat protection for a growing number of owls.

BC's Recovery Strategy

A recovery strategy for the owl has been prepared for BC by the Canadian Spotted Owl Recovery Team (CSORT). CSORT consisted of experts from government, industry and academia, led by the BC government. The BC government has submitted to EC the recovery strategy for posting on the SARA registry for the 60-day comment period. The measures outlined in Minister's Bell letter to you are consistent with the themes of the Recovery Strategy.

The Recovery Strategy states that an action plan will be complete in 2006 and recommends that the BC government identify critical habitat by 2007. This is consistent with Minister Bell's indication to you that it would take about a year for the science team to identify the necessary critical habitat. A summary of the Recovery Strategy is attached (Appendix 1).

Departmental staff has reviewed the commitments in Minister Bell's letter and have provided an analysis, drawing upon the recommendations in the draft Recovery Strategy prepared for BC by the Canadian Spotted Owl Recovery Team (CSORT). This table is attached as Appendix 3.

Summary

BC's plan for action, if carried out under the direction of a science team and within the proposed timeframes as indicated, and their proposed actions will allow for protection of all occupied sites, longer-term habitat protection and population enhancement. They have already taken steps to protect the sites occupied in 2005. You should be aware, however, that BC has been known to delay or not take actions that were recommended by previously constituted science teams. They also face a number of resource constraints. This is why it will be essential that EC be an active member of the new science team and use this process, plus the management committee associated with the Canada-BC SARA Bilateral Agreement to continue to advise and monitor BC's actions. Should we become concerned of a lack of action or disregard for valid scientific advice, we will inform you.

OPTIONS

Under *SARA*, if you are of the opinion that the owl faces imminent threats to its survival or recovery, you are obliged to make a recommendation to the Governor-in-Council for an Emergency Order. The Governor-in-Council decides whether or not to make the Order.

We have assessed reports and statements by SLDF and their clients that describe their rational and approach to protect and recover the owl (see a summary in Appendix 5). This is the basis of their application for judicial review. Their recommendations, including the protection of large areas of old growth forest, have been considered in the formation of options and our recommendation.

1. **Form the opinion that there is no imminent threat to the survival or recovery of the remaining owls.**

General Considerations

There is no major threat now to the survival of the known owls from logging in the coming weeks. BC has identified alternate cut-blocks for affected licensees that had rights within the 2005 sites and their Environment Deputy Minister signed off legal orders that will prohibit timber harvesting in the sites occupied in 2005.

There are 43 hectares of logging now within Fire Creek where an owl was found in 2004, but not in 2005 and not yet in 2006. There is one other site where harvesting could take place in the fall but BC has said that they will consult with the new science team and follow their recommendations before any logging takes place.

BC has also said they will inventory the 2004 and 2005 sites this year using their science-based surveying protocol (the same protocol as followed in 2005) and that they will "quickly act to remove any immediate threats and immediately ensure additional protection or management" for any additional owl sites that are found to be occupied, in consultation with the science team. There are no other impending activities that would threaten the known owls or their territories. BC has also committed to take other measures to halt the population decline (such as captive breeding and competitor management).

BC has two mechanisms to continue to monitor progress, participation in the new science team and the management committee of the Canada-BC SARA Bilateral Agreement. Through these mechanisms we can provide advice to BC and react quickly to inform you if new concerns arise.

2. Form the opinion that there is an imminent threat to the owl's survival or recovery and recommend that the Governor-in-Council make an Emergency Order

General Considerations

While there is more than enough habitat currently available for the 22 owls and BC has taken action to protect the sites occupied in 2005, more needs to be done to secure habitat for the long-term recovery. For the long-term recovery, the most advantageous habitat (in terms of quality, quantity and spatial configuration) must be identified and protected.

BC has committed to doing the appropriate planning with the science team over the next year and committed to protect the habitat required for both long-term recovery and any additional owls found in the 2006 survey that are not being protected by the measures covering the sites occupied in 2005.

It would not be possible to put immediately in place a federal Order to protect the best habitat required for the long-term recovery. The work of the science team needs to proceed first to identify the best habitat.

BC and the forest sector would strongly object to a federal Order that prohibits logging in potentially suitable owl habitat. Such an Order would likely lead to compensation claims.

3. Wait to form an opinion until the BC action plan has been completed

You could choose to wait to form an opinion regarding the imminent threat to recovery of the Spotted Owl pending assessment of the effectiveness of BC's actions and initial results of the plans for recovery habitat and population enhancement. However, it would be very difficult to explain why you are waiting to form an opinion, given the steps that BC took in response to your discussions with Minister Bell to address immediate risks, and the considerable time BC officials have spent assessing and confirming the specifics of these steps.

RECOMMENDATION

I recommend that you form the opinion that there is no imminent threat to the survival or recovery of the Northern Spotted Owl in light of the information available about the status of the owl and the actions being taken or committed to by the province of BC.

I further recommended that you:

- send the attached reply to Minister Bell outlining your views on the status of the owl and your support for/expectations regarding BC's commitments.
- send the attached letter to the Sierra Legal Defence Fund informing them of your decision.


Michael Horgan

I concur,

Rona Ambrose

Attachments (8)

Drafting Officer's Name:	K. Torck
Branch/Division:	ESR
Phone No:	819-994-8174
Date Drafted:	June 14, 2006

Summary of the Northern Spotted Owl Recovery Strategy

Recovery Strategy approach and style

The recovery strategy, submitted to BC in April 2004 by CSORT (Canadian Spotted Owl Recovery Team), takes an "enabling" approach – it describes things that are important to do, but does not constrain government by specifying exactly what should or should not be done. The strategy has been written by consensus and it is SARA-compliant (although needs some clarification in an Addendum around critical habitat). The strategy has been updated through a letter from CSORT to BC government on February 7, 2006. This strategy has the support of the experts and industry, and is based on science. The next step is to complete the action plan. The strategy was submitted to EC for approvals on April 4, 2006. It is planned to be posted on the SARA registry in July, in accordance with SARA timelines.

Recovery Strategy Contents

Background and Threats [compatible with SARA, S.41(1)(b)]: The recovery strategy contains comprehensive sections on distribution, population abundance, biologically limiting factors and threats to the species.

Recovery Feasibility [compatible with SARA, S.40]: The recovery strategy has a 4 page discussion of feasibility that concludes that while there are significant challenges, recovery is feasible. The update letter from CSORT clarifies feasibility in regard to draft federal policy guidance, resulting in a justification compatible with SARA.

Recovery Goal: The recovery goal is "to down-list the Spotted Owl in BC from its current Endangered status by establishing a stable or increasing, self-sustaining population (more than 250 mature individuals) that is distributed throughout its natural range." The goal is ambitious (but technically feasible) and will take decades to achieve. Suitable habitat needs to be managed on a minimum 80 year rotation, so a longer planning horizon is justified.

Recovery Objectives and Strategies to meet them [compatible with SARA, S.41(1)(d)]:

- to immediately stop the population decline to prevent extirpation;
 - immediately protect all Spotted Owls and the habitat they occupy (including find all Spotted Owls);
 - identify and conserve sufficient survival habitat to maintain the current population
- to increase the population size to a self-sustaining level;
 - population assessment (including monitoring the population trend and determining the minimum viable population size)
 - population augmentation (including juvenile over wintering, translocations, and captive breeding – it doesn't prefer any one technique)
 - increase survivorship and fecundity (through augmenting prey, supplemental feeding of juveniles, and competitor/predator control – again it doesn't express a preference);
- to conserve and restore sufficient habitat to support the population;
 - Habitat supply modeling
 - identify and conserve critical habitat
 - developing habitat management guidelines
 - promote habitat and population stewardship; financial support; adaptive management; public awareness; and solutions to socio-economic consequences

- to increase communications, partnering, and funding to support the first three objectives.

Habitat Identification, Critical Habitat, and Schedule of Studies [compatible with SARA, S.41(1)(c) and [SARA S. 41(1)(c.1)], although see below]: The recovery strategy contains a number of sections on habitat, including: general, nesting, foraging, roosting, and dispersal habitat; recovery, survival, and critical habitat; habitat protection; and habitat trends.

The critical habitat section provides a partial definition of critical habitat: "it would be prudent to consider all suitable habitat within currently occupied Long-term Activity Centres to be critical habitat . . . currently occupied is defined as having Spotted Owls (pairs or singles) present during the immediately previous or current breeding season", it goes on to include all occupied sites (not just those in LTACs) and newly discovered sites; "suitable habitat" is defined in an Appendix. Including this partial definition of critical habitat in the document was the subject of much debate and the definition included is one that all the members of the recovery team could support. BC has since directed the recovery team to not spatially identify critical habitat, but rather to provide a "recipe" that BC can use in their determination of critical habitat. The recovery strategy was updated with an Appendix in April 2006 to reflect that direction: it states that "Recommendations regarding the amount and distribution of CH . . . will be included in the Habitat Action Plan", however the intention is to not be specific about the amount, distribution, and connectivity of habitat patches in the action plan. Section 49(1)(a) of SARA requires an identification of critical habitat in action plans, and presumably BC will add this identification to the action plan.

The strategy also appends the Interim Recommendations prepared by CSORT in January 2003 that outlined recommendations for management of SPOW while the recovery strategy was under development and decisions were being made.

The Schedule of Studies, appended to the Strategy in April 2006, outlines what is required to complete the identification of critical habitat in the Action Plan. Most of these studies have already been completed by CSORT, as has a draft Action Plan. The Schedule of Studies states that the Action Plan, with guidance for BC to spatially identify critical habitat, will be complete in 2006 and that BC would then have the information they needed to identify critical habitat and a revised habitat management plan by 2007.

Identification of Activities Likely to Result in Destruction of Critical Habitat [compatible with SARA S. 41(1)(c)]: The Strategy states that activities such as logging, mining, other resource development, urban and rural development, transportation and utility corridors, and natural disturbances (forest fires and insect outbreaks) would likely destroy critical habitat.

Socio-economic considerations: The recovery strategy contains a 5 page section that discusses socio-economic costs and benefits in a general way. SARA requires an evaluation of socio-economic costs and benefits in the action plan, but not of a recovery strategy.

Knowledge Gaps [compatible with SARA, S.41(f)]: An appendix lists research topics such as demography, population trends, modeling, competition, habitat enhancement, and prey.

Statement of When Action Plans will be Completed [compatible with SARA, S.41(1)(g)]: States it will be within a year of the release of the recovery strategy. CSORT has already produced a draft action plan that does not spatially define critical habitat, but does provide specific practical recommendations on the amount of habitat required, the priority for habitat protection, and ways to enhance connectivity and LTAC suitability.

Prepared by David Cunningham and Trish Hayes, June 1, 2006.

Scientific Assessment of the Status of Northern Spotted Owl in British Columbia

The following is a scientific assessment of the current situation of the Northern Spotted Owl (Spotted Owl) in British Columbia (BC). This review draws heavily upon the work of the Canadian Spotted Owl Recovery Team (CSORT) which was established by the Province of British Columbia in 2002. CSORT is comprised of individuals from academia, provincial, federal and regional governments, industry and the State of Washington. Several of these biologists (provincial, academic and US) have direct experience with Spotted Owls. Input from a biologist with experience with Spotted Owls from the environmental non-government community was included in CSORT's draft recovery strategy. Canadian Wildlife Service (CWS) staff have attempted to acquire a good understanding of the situation and of Spotted Owl biology, however, CWS does not have a Spotted Owl nor forest management expert on staff. This assessment has attached a summary of the draft *Northern Spotted Owl Recovery Strategy* (2004) and its 2006 update that has been transmitted to Environment Canada by the Province of British Columbia for consideration for adoption under Section 44 of SARA.

General Status

The (Northern) Spotted Owl occurs in the Pacific Northwest region of North America, with the Canadian portion (southwest mainland of BC) accounting for approximately 8% of the global range (Chutter et al. 2004). The total global population is estimated as 3000-6000 pairs. Throughout its range it is associated with mature late-successional coniferous and mixed-coniferous forests characterized by a multi-layered, multiple aged, relatively closed canopy with numerous snags and woody debris (Chutter et al 2004).

The Spotted Owl is listed as Endangered in Canada, as Threatened nationally in the United States (US) and as Endangered in Washington State. The Spotted Owl is declining in the US at an annual rate of 3.9% (7% in Washington State) (Franklin et al. 1999). It is believed that the Spotted Owl population in the US continues to decline despite habitat protection measures due to lingering effects of historic habitat loss, exacerbated to an unknown extent by the effects of Barred Owls (Buchanan pers. comm.).

Island Marmot, an endangered herbivore. Ensuring the survival of young SPOW, a higher level predator, will be even more challenging than for marmots

Experience in the US shows that measures to address the Spotted Owls decline will likely not have immediate, measurable results⁴. The Canadian population will likely experience a similar response pattern in terms of measurable results as actions are implemented; however the Canadian population will be less able to accommodate short-term population fluctuations.

Summary

The Spotted Owl population in BC is at high risk of extirpation from Canada (over 90% decline from historic levels), but recovery is considered to be biologically feasible by the CSORT. Recovery of the Spotted Owl requires immediate measures to ensure the survival of the current population. Also, survival of the species and its eventual recovery requires additional landscape-oriented measures to ensure recovery options remain, to allow for a reversal in population trend, and to support an eventual "recovered" population. Habitat loss and fragmentation, both direct effects and indirect consequences, are the root cause for the state of this species. Any recovery plan that is to succeed must adequately address both of these issues. This is compounded by the fact that Spotted Owls require forests that are a minimum of 80-100 years old. A key fact is that currently suitable mature forest habitat that is cut now will take at least this long to become suitable Spotted Owl habitat again. Thus, cutting permits approved in 2006 constrain conservation or management options for most of the next century.

BC has been managing Spotted Owls under SOMP for almost 10 years and the population has continued to decline at a high rate and recruitment has been zero in the past 3 years. With only 22 owls left, management under SOMP is clearly inadequate. Provincial biologists have concluded that habitat protection afforded by SOMP is inadequate to stabilize the owl population, and that additional management actions are necessary to prevent extirpation which is "imminent" if current trends continue (Blackburn and Godwin 2003; Blackburn *et al.* 2002). It is important that the currently occupied sites are fully protected until a longer-term plan is in place, the habitat requirements are fully understood, and the population is stable and increasing. Full protection of the currently occupied sites has been recommended by CSORT since January 2003 (CSORT 2003; Chutter *et al.* 2004).

Ensuring that the currently occupied sites are fully protected is critically important to the survival of the remaining 22 birds, but this action alone does not address the high probability of extirpation, nor the longer-term issue of ensuring adequate quantity, quality and spatial configuration of habitat to recover the Spotted Owl. **Population enhancement work will not be successful in the long-run if adequate habitat does not exist to support the growing population. This issue must be addressed through the identification and protection of critical habitat. Information is available to complete this analysis (CSORT 2005) and it is possible to complete it within the next 12 months.** In addition to protecting habitat now, additional habitat needs to be

⁴ The main US habitat protection effort takes place in federal forests, primarily managed under the Northwest Forest Plan (Courtney *et al.* 2004). On state and private lands, management of Spotted Owl habitat includes Habitat Conservation Plans, forest practices regulations, and some areas that are essentially exempt from protection under state rules (Pierce *et al.* 2005). While habitat protection measures in the majority of the Spotted Owl range on federal forests has generally been successful, it has been more difficult to protect habitat on state and private land.

recruited to attain the long-term recovery goal and deal with fragmentation and connectivity issues.

The second essential component to ensure recovery of the Spotted Owl is population enhancement to help overcome survivorship and recruitment issues. Although very important for recovery of this species, enhancement is not straightforward, and efforts need to be assessed and designed by scientists with expertise in the pertinent areas. It is also important to reiterate that population enhancement should only be undertaken if habitat protection and management is also addressed; direct intervention such as these are usually only attempted as a last resort after all else has failed (Blackburn *et al.* 2002). Embarking on a population enhancement program without adequately protecting sufficient habitat in the appropriate spatial configuration will likely fail as habitat options for the future (or at least the next 80 to 100 years) will have been lost.

The CSORT has produced a draft Action Plan that outlines the actions necessary to recover the Spotted Owl. It includes recommendations for habitat protection, population augmentation, population monitoring and socio-economic analysis. It includes a description of a model that is capable of spatially identifying critical habitat while considering economic factors. A report on the model methodology and some results will be published shortly. The CSORT has also produced a set of recommended actions with respect to population enhancement and has stressed the importance of obtaining appropriate scientific advice prior to embarking on such a program (CSORT 2005). According to the Schedule of Studies in the Recovery Strategy, the Action Plan will be complete in 2006. BC has committed to produce a plan within one year.

Prepared by Trish Hayes and Dave Cunningham, Species at Risk Section, Pacific and Yukon with input and review by Dr. Kathy Martin, Science and Technology Branch

April 12, 2006, revised April 25, 2006, updated on May 31, 2006



MAY 08 2006

Reference: 140660

The Honourable Rona Ambrose, MP, PC
Minister of Environment
Wellington St
Ottawa ON K1A 0A6

FAXED

Dear Minister Ambrose:

Let me first take this opportunity to thank you for our recent communications regarding spotted owl. As we discussed, the survival and recovery of spotted owl is an important issue for both of our governments. (That is why the province has embarked on a comprehensive plan to recover spotted owls in British Columbia.)

On April 28th British Columbia announced its \$3.4M, five-year plan to address the survival and recovery of spotted owls in southwest B.C. This plan recognises the urgency of the situation and aims to put in place owl enhancement measures while at the same time securing currently occupied owl sites outside parks and ensuring that recovery habitat required for owls is in place.

This is a comprehensive plan that builds on three main themes:

1. *Reverse the Decline in Spotted Owl Numbers*

The province will immediately invest in an aggressive spotted owl enhancement program to attempt to halt the current population decline. The precise actions necessary will be quickly determined by an expert science team built around the current Canadian Spotted Owl Recovery Team (CSORT) on which members of your staff participate. It is expected that potential enhancement activities may include translocation, captive breeding, competitor management and prey enhancement. This is a necessary, short-term step to secure a stable spotted owl population that will be evaluated for its effectiveness after five years.

.../2

2. *Immediately Protect Active Spotted Owl Areas*

In consultation with affected forest licensees, the province has acted to address all currently approved timber harvesting at nine locations where owls were detected in 2005 outside of provincial parks. We can confirm that no critical spotted owl habitat is at risk from approved forest harvesting in the short-term (i.e., next two months). This provides time to work with the forest harvesting companies to find alternative harvesting sites for them and, as necessary, prepare and implement any actions necessary under the *Forest or Forest and Range Practices Act* to remove any future threat posed by future forest harvesting.

Over the next two months, staff will:

- a) Assess future forest harvesting plans and, where necessary, re-direct proposed timber harvesting to suitable areas where no spotted owls have been detected during surveys over the past few years.
- b) Secure active spotted owl habitat around sites where owls were observed in 2005 using tools under the *Forest and Range Practices Act*.
- c) Apply Part 13 of the *Forest Act* as necessary to prevent forest harvesting within areas set aside for spotted owls.

3. *Secure Recovery Habitat*

Over the next year, the province will engage forest tenure holders and First Nations to - within the context of the recovery action plan and as directed by the science team - assess how the 204,000 ha currently managed for spotted owl under the 1997 Spotted Owl Management Plan (SOMP) can be reallocated on the land base to provide better long-term recovery opportunities for spotted owl. The intention of this work is to ensure that on-the-ground management activities are well aligned with enhancement and protection measures to contribute more effectively to long-term recovery.

While this work is underway, all 204,000 ha of the 363,000 ha not already fully protected in parks will continue to be managed under the strict forest retention requirements for areas already identified as spotted owl habitat. Within these areas, forest harvesting must maintain 67% of old growth forest cover and maintain at least 50% of the forest in a natural state. Further, a 500m no-harvesting buffer must be maintained around all known nesting sites.

In summary, British Columbia is actively implementing its spotted owl recovery plan through population enhancement, protection of active spotted owl habitat by ensuring that no harvesting takes place, and by securing large areas of spotted owl habitat through aggressive forest retention management practices. These specific actions are based on the recommendations of the Canadian Spotted Owl Recovery Team (CSORT) and are consistent with the Recovery Strategy recently submitted to you for inclusion in the SARA Registry

under sec.44 of the *Species at Risk Act*. They are also consistent with the best science currently available and, when taken together, we believe these actions provide the best opportunity for recovering spotted owls in British Columbia.

Sincerely,

A handwritten signature in black ink, appearing to read 'Pat Bell', with a stylized, flowing script.

Pat Bell
Minister

pc: Honourable Rich Coleman
Minister of Forests and Range

Honourable Barry Penner
Minister of Environment

Dana Hayden, Deputy Minister
Office of the Premier

TAB 2

**GUIDANCE AND SOME
COMPONENTS OF ACTION
PLANNING**

for the

NORTHERN SPOTTED OWL
(Strix occidentalis caurina)

in

BRITISH COLUMBIA

DRAFT

Prepared by
The Canadian Spotted Owl Recovery Team

FINAL DRAFT: Feb 28 2007

Recommended Citation

Chutter, M.J., I. Blackburn, D. Bonin, J.B. Buchanan, D. Cunnington, L. Feldes, A. Harestad, D. Heppner, L. Kiss, S. Leech, J. Smith, J. Surgenor, W. Wall, L. Waterhouse, and L. Williams, 2007. Guidance and some components of action planning for the Northern Spotted Owl (*Strix occidentalis caurina*) in British Columbia. BC Ministry of Environment, Victoria, British Columbia. 92 pp.

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RANGE JURISDICTIONS

Government of British Columbia
Ministry of Environment
Wildlife Act

Government of Canada
Canadian Wildlife Service
Species At Risk Act

DISCLAIMER

This guidance document was prepared by the Canadian Spotted Owl Recovery Team (CSORT) to identify reasonable actions required to protect and recover the Northern Spotted Owl in Canada. It is a companion document to the previously submitted CSORT recovery strategy (Chutter et al. 2004), but it is not a SARA compliant recovery action plan. This guidance document does not necessarily represent the individual views of the people involved in its formulation, nor the official positions of the organizations represented by CSORT members; rather it represents consensus of the team member's views on what is required to recover the Spotted Owl in British Columbia. The information and recommendations identified in this document are based on the best available science and are subject to future modifications resulting from changed objectives and new findings. This document considered and drew from all relevant published and unpublished materials listed in the Literature Cited section. We recognize that implementation of advice and recommendations in the guidance document will be subject to appropriations, priorities, and budgetary constraints imposed by participating jurisdictions and organizations.

ACKNOWLEDGEMENTS

This guidance document is dedicated to the memory of Dr. Jamie Smith, a respected biologist and devoted family man, as well as a valuable member of the Canadian Spotted Owl Recovery Team, who passed away before the document was completed. We thank Susan Leech and Kym Welstead of FORREX for holding the pen during the process of preparing this document. The document has also benefited greatly from the population and habitat modeling work done for CSORT by the modeling team of Glenn Sutherland and Dan O'Brien of Cortex Consultants Inc. and Andrew Fall of Gowlland Technologies Ltd. Their continuing dedication, support and patience throughout the project were greatly appreciated. Mark Messmer of the provincial Biodiversity Branch coordinated the preparation of the baseline socio-economic analysis by Pierce Lefebvre Consulting. Jared Hobbs attended many CSORT meetings to share his field experiences and extensive practical knowledge of the species and its habitat requirements, and in doing so contributed greatly to the information in this document. We greatly appreciate all these contributions to the team's deliberations. English and format editing was done by

.....

FOREWARD

This guidance document was originally to be submitted to the British Columbia Government by the CSORT as a companion document to the team's previously submitted recovery strategy. It was our intent that the two combined documents would constitute a single recovery plan for submission to Environment Canada to meet the province's requirements under the federal *Species at Risk Act* (SARA). As such, early drafts were prepared in accordance with RENEW operations manual (ROMAN) guidelines that were current at the time of writing. Since that time, discussions regarding changes in recovery planning protocols have resulted in the Province of British Columbia deciding to develop its own action plan for submission with the CSORT recovery strategy. As a result, this report is now being submitted solely to the provincial Ministry of Environment as an advisory document to assist them in preparation of the British Columbia Government action plan. Therefore, this document is not SARA compliant, does not follow the most recent ROMAN guidelines, does not provide a final spatial definition of Critical Habitat, and does not contain a final socio-economic assessment. However, it provides a summary of the best and most recent scientific information available about Spotted Owls in British Columbia (including consistent reference to the result of the Spotted Owl model developed during the writing of this report); provides an outline of a baseline socio-economic assessment report prepared by a contractor; provides recommendations for actions that should be implemented to reach the recovery goals and objectives set out in the recovery strategy; and provides advice on considerations for Critical Habitat. The original draft was completed in 2004 and was to cover the 5-year period from 2004 through 2009. Since 2004, some of the implementation measures identified in Section 2 and Table 1 have been initiated or completed. In the interest of expediency, it was decided not to revise the document, nor to adjust the timeframe to accommodate these actions, nor to extend the focus two years further. Rather we have identified measures that have been "completed" or are "ongoing" in both the text and Table 1. It is hoped that the Ministry of Environment will find this document a useful guide in their recovery planning efforts and will consider the recommendations and advice given.

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1. INTRODUCTION

1.1 COSEWIC Species Information

Common Name: Northern Spotted Owl

Scientific Name: *Strix occidentalis caurina*

COSEWIC Status: Endangered

Last Examination and Change: May 2000 (No Change)

Canadian Occurrence: British Columbia

Reasons for Designation: Numbers of this habitat specialist are very small in Canada. It requires old growth coniferous forests, which are decreasing in extent and becoming highly fragmented.

Status History: Designated Endangered in April 1986. Status re-examined and confirmed in April 1999 and in May 2000. Last assessment based on an existing status report.

1.2 Background

This guidance document for the Northern Spotted Owl (*Strix occidentalis caurina*) in British Columbia was prepared as the companion document to the “Recovery Strategy for Northern Spotted Owl (*Strix occidentalis caurina*) in British Columbia” (Chutter et al. 2004). Please refer to the recovery strategy for more complete information about Northern Spotted Owl biology, history, and recovery goals and objectives for British Columbia.

The Northern Spotted Owl occurs in the Pacific Northwest region of North America from California to British Columbia. The southwest mainland portion of British Columbia is the northern extent of the Spotted Owl’s range and the only place that it occurs in Canada.

It has been estimated that British Columbia may have supported 500 pairs of Spotted Owls prior to European settlement, but that by 1991 the population had likely declined to about 100 pairs. Trend analysis estimates indicate that the decline continued at an average rate of 10.4% from 1991 to 2002 when the population was estimated at less than 33 pairs and extirpation was considered likely if actions were not taken to reverse this trend. In 2004 and 2005, the most extensive and intensive survey effort to-date was conducted within the range of the owl in British Columbia resulting in the detection of only 25 owls (8 pairs and 9 single adults) in 2004, and 23 owls (6 pairs and 11 single adults) in 2005. To cover as many potential sites as possible between the two years, site coverage differed substantially except that all sites that were active in 2004 were resurveyed in 2005. Seven of the 17 sites that were active in 2004 were not occupied in 2005 and two others dropped from pairs to singles. The 2005 surveys in areas not

covered in 2004 resulted in the discovery of 7 additional sites – 5 of which were entirely new and 2 of which had not been surveyed or found active since the 1990s. Survey effort in 2006 was restricted resulting in many of the known active sites from 2004 and 2005 not being visited. Priority was given to surveying the pair locations that were occupied in any year between 2003 and 2005, and in 2006 there was again a substantial drop (~50%) in the number of known paired sites in British Columbia. We emphasize, however, that this survey effort was not a random sample and the reduction in owl pairs may not represent that level of change to the entire population.

The original population decline is believed due to the loss and fragmentation of old-growth habitat to urban and rural development, and forestry activities. This loss of habitat resulted in diminished quantity and quality of habitat, reduced connectivity of owl sites across the landscape, increased isolation from the larger population in the United States, and likely heightened negative effects of stochastic events associated with very small populations. Current known and potential threats include further loss and fragmentation of habitat, competition from Barred Owls, predation, climate change, disease and negative effects from environmental and genetic factors. Populations in the United States are also suffering declines. The U.S. declines have been most pronounced towards the northern parts of the owl's range.

In Canada, because Northern Spotted Owls only occur in British Columbia and raptors are not included under the federal *Migratory Birds Convention Act*, the province is responsible for the owl's conservation under its *Wildlife Act*. British Columbia, therefore, is the lead jurisdiction with management responsibility for its recovery. The Director of the Ecosystems Branch of the Ministry of Environment is the official responsible for leading British Columbia's recovery efforts. Consistent with the requirements of the *Species At Risk Act* (SARA) and the Accord for the Protection of Species At Risk, British Columbia formed a recovery team in October 2002 to develop a recovery strategy for the Northern Spotted Owl in Canada. Following the development of the recovery strategy, the next step in the recovery planning process is the preparation of an action plan outlining how the provincial government will attempt to address the goals and objectives of the recovery strategy. This guidance document was prepared by CSORT to assist the government in preparing its action plan. In addition to requiring recovery planning, SARA also prohibits the killing, harming, harassing, capturing and taking of Northern Spotted Owls, damaging or destroying their residences and any part of their "critical habitat". The British Columbia *Wildlife Act* similarly prohibits any direct harm to the birds, and various provincial acts, regulations, policies, protocols and agreements are available to protect their habitat.

It is recognized that, due to the owls' dependence on mature and old-growth forest habitat, recovery efforts will likely have significant socio-economics consequences that need to be considered during recovery planning.

1.3 Recovery Strategy Goal and Objectives

The recovery goal for the Northern Spotted Owl in British Columbia is to:

Down-list the Spotted Owl from its current Endangered status by establishing a stable or increasing, self-sustaining population that is distributed throughout the species' natural range.

The long-term population goal is to increase the number of owls to at least 250 adult owls, so that the species meets the minimum COSEWIC population size requirement for down-listing from Endangered to Threatened.

Six recovery objectives were established to address the immediate, short- and long-term needs of the population. These needs include identifying immediate actions required to address the critically low population size and high risk of extirpation, as well as identifying benchmarks required to down-list the species and remove the threat of extirpation over the long term. The six objectives are listed below. The numbers assigned to them are used to identify them in Table 1.

1. Halt the population decline to prevent extirpation in British Columbia.
2. Increase the number of Spotted Owls to maintain a stable, self-sustaining population distributed throughout its natural range in British Columbia.
3. Conserve and restore sufficient habitat throughout the species' natural range to support a self-sustaining population of Spotted Owls in British Columbia.
4. Increase the communication aspects of recovery.
5. Develop appropriate partnerships to facilitate actions that promote recovery.
6. Identify and obtain sources of funding to implement actions that promote recovery.

The strategies recommended for reaching these goals and objectives can be grouped into the following categories:

- Population assessment and protection
- Identification and protection of critical habitat
- Population augmentation and enhancement
- Population and habitat research
- Communications
- Socio-economic assessment
- Funding acquisition

These strategies have been further grouped into three separate recommended plans of action in section 2 of this report.

2. RECOVERY GUIDANCE DOCUMENT IMPLEMENTATION MEASURES

The following section contains recommendations of the measures that need to be taken to implement the recovery strategy. They are grouped into three distinct plans addressing population, habitat, and funding/communication issues. This organization improves readability and gives decision makers the option of accepting individual plans separately if preferred or necessary, thus avoiding delays in implementation of one component of the recovery plan at the expense of another. In order to enable each plan to be a stand-alone document, some repetition of measures is necessary. Each plan shows the logic flow that directly links the plan to the threats to the species, and the approaches to the goals and objectives of the recovery strategy that the measures address. The goals and objectives are summarized in the preceding section (1.3).

The recovery strategy divides the known and potential threats into two categories: primary and secondary. Primary threats are those that cause (or are otherwise strongly associated with) long-term sustained effects that may limit the carrying capacity or total capable population size of a species. Secondary factors are those that can cause (or are otherwise strongly associated with) short-term effects in population size, but populations would normally recover soon after the influence of the factor changes to a more favourable condition. Although primary factors generally limit population size and may ultimately cause extirpation, secondary factors are often the proximal cause of extirpation of small populations. The known and potential threats listed in the recovery strategy are:

Primary:

- loss and fragmentation of suitable habitat
- competition from Barred Owls
- climate change

Secondary:

- increased environmental, demographic and genetic stochasticity due to small population size
- WNV and other diseases
- human disturbance

A logic flow chart (Figure 1) illustrates graphically how the various activities are related to the overall recovery goal. An implementation schedule table (Table 1) for the next 5 years is presented at the end of this section.

2.1 Population Inventory and Augmentation Plan

Threats Addressed:

A comprehensive population inventory forms the basis of virtually all measures required to enable recovery of the Spotted Owl in British Columbia. It is needed to locate active owls for potential protection and population augmentation measures, as well as to help determine the location of survival habitat and critical habitat needed to create and implement a successful habitat management plan. Population inventory and augmentation are needed to evaluate and address the primary threat of competition from Barred Owls (see section 2 for discussion of primary and secondary threats). In addition, given the extremely small population in British Columbia, the secondary threat of environmental, demographic and genetic stochastic events is elevated, and the risk of extirpation due to random events that would usually not be of concern is greatly increased. Therefore, population inventory and augmentation are also required, particularly in the near-term, to alleviate impacts to an extremely small population. Other identified secondary threats such as West Nile Virus (and other diseases) and human disturbance also require knowledge of the location of owls to evaluate and address these potential impacts. The sections below contain approaches and measures recommended to address these threats. Some of the recommended measures have been completed or are ongoing (identified in brackets and in Table 1); some of the completed measures may need to be repeated in the future.

2.1.1 Find All Owls

Goals and Objectives Addressed:

A comprehensive, range-wide survey for Spotted Owls was conducted in 2004 and 2005 in British Columbia and it is believed that the full extent of the species' range in the province is now known. Continued population inventory is critical to meeting the recovery strategy's immediate goal to stop the population decline and prevent extirpation in British Columbia as, to accomplish this, the owls must first be located and protected. The current population will provide the founder population for the species' recovery in British Columbia and therefore each owl found is important to attaining the overall recovery goal. Locating owl sites is also critical to the success of the Habitat Plan and its objectives.

Measures:

- Prepare an inventory plan that outlines a statistically designed sampling scheme involving site prioritization and coordination of independent sampling efforts. The plan should be designed to enable the best population estimate attainable and should be based on the British Columbia Spotted Owl survey protocol. [ongoing]
- Secure funding for, and hire and support survey crews (training may be necessary). [ongoing]

- Survey all suitable habitat (including existing managed areas, protected areas, and other suitable habitat) and locate all owls using established survey protocol. [ongoing]
- Analyse the results of surveys and prepare an accurate population estimate and an accurate GIS-based distribution map. [ongoing]
- Create a robust electronic database with an access protocol appropriate for sensitive species.

2.1.2 Monitor Population Trend

Goals and Objectives Addressed:

It will be necessary to monitor the population trend to measure and evaluate progress towards the longer term goal of increasing the number of Spotted Owls to maintain a stable, self-sustaining population distributed throughout its natural range in British Columbia. Monitoring the population is also necessary to ascertain if and when the overall population goal of 250 adult owls can be reached, and to assess the performance of population and habitat measures adopted to achieve this goal.

Measures:

- Develop a monitoring plan that combines the need for periodic comprehensive range-wide surveys (as detailed in 2.1.1 above) with the need for less comprehensive but more frequent surveys needed to determine and monitor the population trend and confirm continued activity at known sites. The monitoring plan should be as statistically rigorous as possible given the small size of the population. [ongoing]
- Prioritise monitoring needs (while maintaining a robust sampling design) in anticipation of potential funding shortfalls. [ongoing]
- Secure funding for monitoring efforts; hire and support survey crews (training may be necessary). [ongoing]
- Implement a monitoring program to ensure adherence to established survey protocols, minimize human disturbance, and facilitate collection of any dead owls for autopsy to determine cause of death and to collect genetic samples. [ongoing]
- Analyse results, and prepare and release a standardised population trend report on a regular (e.g., annual or biennial) basis.
- Incorporate survey data into robust electronic database with an access protocol appropriate for sensitive species.

2.1.3 Determine the Minimum Population Size Required to Attain a Stable, Self-sustaining Population Distributed across the Species' Natural Range in British Columbia.

Goals and Objectives Addressed:

The overall population goal of 250 adult owls is based on the COSEWIC criteria necessary to downlist the species from Endangered to Threatened. It is unknown whether 250 adult owls is sufficient to establish a self-sustaining population in British Columbia, or whether a stable population could be attained with a smaller number of appropriately distributed owls. Determination of the sustainable population size (e.g., 250 adult owls, or some other value) will allow an evaluation of its appropriateness, especially with regards to whether it is possible to maintain a British Columbia population isolated from the population in the United States. The answer to these questions will influence potential amendments of goals and objectives in future updates to the Spotted Owl Recovery Plan, as well as to provincial management efforts for the species.

Measures:

- Develop and refine a spatially explicit habitat/population model. [*modeling framework done*]
- Convene modeling workshops to gain input and acceptance from stakeholders. [*done*]
- Parameterize the model to account for the variety of factors that are known to, or potentially could, influence Spotted Owl distribution, habitat use, and population performance. [*done, but additional parameters to be evaluated e.g., Barred Owl*]
- Test assumptions of the model through sensitivity analysis and learning experiments. [*done*]
- Conduct independent biological assessment of the model.
- Use models to determine minimum Spotted Owl population size to attain a self-sustaining population across its natural range in British Columbia.
- Re-assess recovery strategy goals and objectives, and the feasibility of recovery.

2.1.4 Evaluate and Implement Appropriate Population Augmentation Measures

Goals and Objectives Addressed:

Due to the small size of the remaining population and its downward trend, population augmentation measures will likely be necessary to attain the immediate goal of stopping the decline and preventing extirpation. These measures could include overwintering of juveniles, translocation of birds, and captive breeding. Such measures could impact the time required to reach the longer term objective of maintaining a stable, self-sustaining population distributed throughout its natural range in British Columbia, and the overall recovery goal of 250 adult owls. As augmentation measures are directed at filling currently vacant and recruited owl habitat, they will also affect the habitat-related goal, objectives and measures.

Measures:

- Evaluate the feasibility, practicality, costs and benefits of the various augmentation approaches contained in the recovery strategy. These activities should include, but not be limited to: capture, overwintering and release of juveniles; translocation of birds to vacant or single-occupancy sites; removal of competitors; and; captive breeding and release.

- Develop a detailed augmentation plan with an adaptive approach that includes implementation protocols and a post-release monitoring plan.
- Integrate the augmentation plan into the population model (see 2.1.3).
- Conduct pilot studies and assess the results.
- Develop partnerships to assist with the costs of accommodating the construction and maintenance of any facilities, and the care of any captive birds, if and when required.
- Following assessment of pilot studies, implement recommended augmentation measures and monitor their effectiveness over time.

2.1.5 Artificially Increase Survival and Fecundity

Goals and Objectives Addressed:

Due to the small size of the remaining population and its downward trend, measures that artificially increase the survival and fecundity of the population may be necessary to attain the immediate goal of stopping the decline and preventing extirpation. These measures could include augmenting prey abundance, supplemental feeding of juveniles during winter, and control or manipulation of predators and competitors. Such measures could have a major impact on the time required to reach the longer term objective of maintaining a stable, self-sustaining population distributed throughout its natural range in British Columbia, and the overall recovery goal of 250 adult owls. Use of some of these techniques may be most effective and appropriate in areas where more direct population augmentation efforts are being applied.

Measures:

- Evaluate the feasibility, practicality, cost and benefits of the various measures contained in the recovery strategy that address increasing survival and fecundity of Spotted Owls. These actions should include, but not be limited to: augmenting prey availability at active owl territories; capturing, affixing telemetry transmitters to, tracking, and supplemental feeding of juvenile owls through the winter; and removal of predator and/or competitor species from Spotted Owl habitat.
- Develop a detailed plan with an adaptive approach that includes implementation protocols and post-implementation monitoring plans. Ensure that any control measures for competitors/predators in the plan adheres to all relevant government policies, procedures and legislation.
- Integrate the survival and fecundity enhancement plan into the population model (see 2.1.3).
- Conduct pilot studies and assess the results.
- Implement recommended measures, monitor all target populations, and assess effectiveness over time.

2.1.6 Promote Adaptive Management and Research to Address Information Gaps and Improve the Effectiveness of Recovery

Goals and Objectives Addressed:

The recovery strategy contains an appendix of research topics that need to be addressed. These topics address aspects of the threats to the owl and therefore will influence the effectiveness of any population management plan designed to meet the goals and objectives of the strategy. Population augmentation for Spotted Owls is a good example of a measure about which little is known for this species, but which could have a significant effect on the feasibility and rate of recovery.

Measures:

- Identify knowledge gaps essential to recovery efforts for the Spotted Owl in British Columbia. [ongoing]
- Use an adaptive approach to develop a prioritized list of research needs to guide future research efforts. Research topics should relate to population and habitat management factors that potentially influence recovery success and species responses to specific management activities.

2.1.7 Promote Solutions to Address Socio-economic Consequences

Goals and Objectives Addressed:

The potentially high cost of population inventory and augmentation measures may be a major impediment to reaching all population recovery goals and objectives for the Spotted Owl in British Columbia. Therefore, inventory plans and population augmentation options need to include socio-economic assessments. In addition to the cost-side aspects of the equation around economics and jobs, these assessments should include evaluation of the positive potential values of conservation for tourism, carbon storage, ecosystem function, industrial certification, etc.

Measures:

- Assess the population inventory and monitoring plans for socio-economic values and ensure the plans include viable step-down options for various funding levels.
- Assess the population augmentation options to determine their relative cost-effectiveness.
- Assess the measures for increasing the survival and fecundity of Spotted Owls to determine the most cost-effective options.
- Use these assessments to determine the best combination of solutions for reducing the costs of population inventory and augmentation that still allow for the recovery of the species.
- Encourage and build partnerships and stewardship agreements that increase cost-effectiveness where appropriate. [ongoing]

2.2 Habitat Plan

Threats Addressed:

Loss and fragmentation of habitat is a significant threat to Spotted Owls throughout their range. Loss and fragmentation of habitat is considered to be a primary threat (see section 2 for discussion of primary and secondary threats). Other threats such as climate change, Barred Owl competition, stochastic events and human disturbance may also be partly addressed by appropriate habitat management planning. The following approaches and measures are recommended to address these threats.

2.2.1 Immediately Identify and Conserve Survival Habitat.

Goals and Objectives Addressed:

Survival habitat is defined as the minimum amount and distribution of habitat needed to maintain the current population size. The recovery strategy identifies the immediate identification and conservation of survival habitat as the most pressing habitat need as it is required to enable the success of the immediate objective of stopping the population decline and preventing the extirpation of the Spotted Owl from British Columbia. It is also the first and most important step towards reaching the longer-term objective of conserving and restoring sufficient habitat throughout the species' natural range to support an as yet undefined self-sustaining population. Attaining these objectives is the first step if the overall goal of the recovery strategy of increasing the population to at least 250 adult owls is likely to be achieved in the long term.

Measures:

- Implement interim habitat recommendations outlined in Appendix 1 of the recovery strategy to preserve options for recovery planning.
- Use the results of a comprehensive population survey (see 2.1.1 in Population Inventory and Augmentation Plan) to assess the occupancy of all potential survival habitat. [*done*]
- Develop appropriate terminology to define types of site occupancy. [*done*]
- Identify and map all confirmed occupied sites. [*done*]
- Assess the adequacy of current levels of protection at occupied sites. [*ongoing*]
- Assess the current estimated population size and the amount and distribution of survival habitat. [*ongoing*]
- Delineate survival habitat, taking into consideration the overall distribution and connectivity needed to make it functional (as discussed in the recovery strategy), and forward recommendations for its conservation to decision makers. [*ongoing*]
- Apply appropriate land management tools to protect all survival habitat. [*ongoing*]
- Monitor sites and evaluate effectiveness of protection. [*ongoing*]

2.2.2 Identify and Conserve Critical Habitat

Goals and Objectives Addressed:

Critical habitat is defined as the habitat that is necessary for the survival or recovery of a listed wildlife species. Identification and conservation of critical habitat for Spotted Owls in British Columbia is necessary to attaining the objective of conserving and restoring sufficient habitat throughout the species' natural range to support a self-sustaining population of Spotted Owls in British Columbia. This in turn is a necessary step towards reaching the overall recovery goal of increasing the population to at least 250 adult owls. For the Spotted Owl in British Columbia, critical habitat should therefore include all currently occupied habitat (as per 6.2 of the recovery strategy), and sufficient survival and recovery habitat distributed over time in such a manner as to sustain a population of 250 adult owls.

Measures:

- Based on surveys and GIS work, create a base map of known sites and potential new sites. [done]
- Define nesting, roosting, foraging and dispersal habitat. [done]
- Develop a spatially explicit habitat supply model for the Spotted Owl based on the best science available. [done]
- Refine the model and test its assumptions. [done]
- Use the model to test assumptions about the effects of different habitat, territory and population characteristics, as well as threats on a potential stand-alone provincial population versus the need for connectivity to the United States populations (planning may need to be revised if a British Columbia population may not be viable without connectivity to the United States). [ongoing]
- Conduct an independent biological assessment of the model.
- Apply the model to help create a map of all potentially suitable habitat. [done]
- Apply the model to help define attributes necessary to define and delineate critical habitat in British Columbia. This should incorporate survival habitat, and individual, population and landscape level requirements. [done]
- Use the model to assess the existing Spotted Owl management plan. [done]
- Use the model to help determine the minimum amount and distribution of critical habitat needed to maintain a stable self-sustaining population of Spotted Owls throughout their range in British Columbia, and the time frame reasonably expected to reach it.
- Provide a map of potentially suitable habitat along with a description of critical habitat in the recovery action plan. These products should contain sufficient information to enable and guide decision makers to select and implement a spatially explicit habitat management plan that meets the overall recovery goal for the owl, while at the same time allowing flexibility to address socio-economic and regulatory issues, and consider temporal aspects that reflect changes in the habitat over time (as habitat is lost and new habitat is recruited). [ongoing]

- Establish Spotted Owl objectives under the *Forest and Range Practices Act*. [done]
- Promote habitat stewardship agreements with stakeholders where appropriate. [ongoing]
- Develop comprehensive guidelines to create, enhance and maintain critical habitat and reduce threats.
- Using adaptive management principles, evaluate the effectiveness of created or enhanced habitat to provide for the life requisites of the Spotted Owl or its prey populations.
- Implement a map-based Spotted Owl habitat management plan that conserves critical habitat and meets recovery goals and objectives. [ongoing]
- Assess and monitor the effectiveness of the habitat management plan.
- Revise and adapt the habitat management plan as necessary.

2.2.3 Promote Adaptive Management and Research to Address Information Gaps and Improve the Effectiveness of Recovery

Goals and Objectives Addressed:

The recovery strategy contains an appendix of potential research topics that need to be addressed. These topics address some aspect of the threats the owl is under and therefore will impact upon the effectiveness of any habitat management plan meeting the goals and objectives of the strategy. Climate change is a good example of a topic about which little is known and therefore more research is needed to determine its potential effect on recovery.

Measures:

- Identify knowledge gaps essential to recovery efforts for the Spotted Owl in British Columbia. [ongoing]
- Use an adaptive approach to develop a prioritized list of research needs to guide future research efforts. Research topics should relate to population and habitat management factors that potentially influence recovery success and species responses to specific management activities.

2.2.4 Promote Solutions to Address Socio-economic Consequences

Goals and Objectives Addressed:

The potential impact on resource revenues and jobs necessary to conserve Spotted Owl habitat is likely the largest non-biological threat to the species. Depending on management options considered, there could be impacts on the likelihood of meeting the strategy's immediate and longer-term habitat goals and objectives.

Measures:

- Conduct a detailed spatial assessment of the socio-economic costs and benefits of proposed habitat management plans.
- Use the assessment to identify solutions to reducing the costs of managing habitat for recovery of the species.
- Encourage participation and partnerships with stakeholders in habitat planning exercises. [*ongoing*]
- Identify opportunities to use silvicultural techniques to recruit or enhance Spotted Owl habitat. [*ongoing*]
- Identify opportunities to address economic issues associated with habitat protection or recruitment, including but not limited to, forest certification and carbon sequestration.

2.3 Funding and Communications Plan

Threats Addressed:

Implementation of many of the recovery measures identified in the habitat and inventory plans are dependent on the acquisition of sufficient funding, which in turn is dependent on effective communication of the issues to the potential funding agencies. It is likely that much of the range of the Spotted Owl falls within land claims of First Nations, and as an affected stakeholder they must be made aware of the recovery objectives. While lack of funding and communication in itself does not constitute a direct threat to the recovery of the Spotted Owl in British Columbia, it can seriously impede the progress of measures identified in the other plans that do directly address threats. This is particularly true in the case of lack of funding for any required monitoring and augmentation measures. Therefore, the CSORT has included this plan and is recommending the following approaches and measures.

2.3.1 Acquire Financial Support for Recovery Actions

Goals and Objectives Addressed:

This approach directly addresses the longer-term objective of finding sources of funding. It is also critical to enabling many of the measures in the other plans and therefore to attain all the objectives and the overall goal of the recovery strategy. For example, the immediate objective of preventing extirpation and stopping the decline requires sufficient funding to conduct a comprehensive population inventory, and reaching the longer-term population objective and overall recovery goal will likely require continuing population augmentation measures and regular monitoring which would require consistent annual funding for the foreseeable future. Several measures listed in the Habitat Plan are also dependent on funding to reach their objectives.

Measures:

- Develop a list of potential funding sources with a brief description of their acceptance criteria and their application dates.
- Select appropriate measures from the plans and research topics from the research topic list and apply for funding. [*ongoing*]
- Assess the potential options for creating a Spotted Owl recovery fund (see example proposal in Appendix 3 of the recovery strategy). [*ongoing*]
- Develop and implement a Spotted Owl recovery fund if a feasible option is identified that is likely to be supported from government, stakeholders and the public. Guidelines should be prepared that govern spending authority and project ranking/selection processes.
- Consider other non-traditional funding sources.

2.3.2 Promote Solutions to Address Socio-economic Consequences

Goals and Objectives Addressed:

The potential impact on lost revenues and jobs necessary to conserve Spotted Owl habitat combined with the potentially high cost of population inventory and augmentation measures may be a major impediment to reaching all population recovery goals and objectives for the Spotted Owl in British Columbia.

Measures:

- Conduct a detailed spatial assessment of the socio-economic costs and benefits of proposed habitat management plans.
- Use the assessment to determine solutions to reducing the costs of managing habitat for recovery of the species.
- Assess the population inventory and monitoring plans for socio-economic values and ensure the plans include viable step-down options for various funding levels.
- Assess the population augmentation options to determine their relative cost-effectiveness.
- Assess the measures for increasing the survival and fecundity of Spotted Owls to determine the most cost-effective options.
- Use these assessments to determine the best combination of solutions for reducing the costs of population inventory and augmentation that still allow for the recovery of the species.
- Encourage and build partnerships that increase cost-effectiveness where appropriate. [*ongoing*]

2.3.3 Promote Stewardship

Goals and Objectives Addressed:

As British Columbia moves towards a results-based system of management, industry tenure holders, landowners and other stakeholders are being given greater responsibility for the conservation of wildlife resources affected by their activities. Hence, population and habitat stewardship could become increasingly important in the attainment of all recovery goals and objectives.

Measures:

- Consult with stakeholders, including First Nations. Make sure all stakeholders are aware of and involved in the relevant issues surrounding the species and its recovery. [*ongoing*]
- Identify opportunities for habitat enhancement and recruitment, as well as opportunities for population inventory, monitoring and augmentation that could benefit from stewardship efforts. [*ongoing*]
- Apply for funding to appropriate sources.
- Where feasible and applicable, form partnerships, prepare and implement stewardship agreements.

2.3.4 Promote Adaptive Management and Research to Address Information Gaps and Improve the Effectiveness of Recovery

Goals and Objectives Addressed:

The recovery strategy contains an appendix of potential research topics that need to be addressed. These topics all address some aspect of the threats the owl is under and therefore will impact upon the effectiveness of any habitat or population management plan meeting the goals and objectives of the strategy. Climate change is a good example of a topic about which little is known and therefore more research is needed to determine its potential effect on recovery. Population augmentation for Spotted Owls is a good example of a measure about which little is known for this species, but which could have a significant effect on the feasibility and rate of recovery.

Measures:

- Identify knowledge gaps essential to recovery efforts for the Spotted Owl in British Columbia. *[ongoing]*
- Use an adaptive approach to develop a prioritized list of research needs to guide future research efforts. Research topics should relate to population and habitat management factors that potentially influence recovery success and species responses to specific management activities

2.3.5 Promote Awareness

Goals and Objectives Addressed:

Recovery planning for potentially high socio-economic impact species like the Spotted Owl can be controversial. The ability to reach recovery goals and objectives may be constrained by the lack of an effective and functioning extension strategy that successfully promotes awareness of the issues and any progress made to government, stakeholders, scientists and the public. Hence, planning for appropriate extension activities could greatly assist attainment of recovery goals and objectives for the owl.

Measures:

- Prepare an extension strategy that incorporates educational and training needs for all audiences. Ensure that First Nations are included.
- Develop appropriate release mechanisms for relevant scientific papers and documents that make them available to appropriate audiences as quickly as possible. *[ongoing]*
- Develop and release public awareness pamphlets.
- Create a central digital database for all appropriate Spotted Owl information.
- Either create a local Spotted Owl Recovery Team website, or adapt the national RENEW site to accommodate the recovery team's needs.

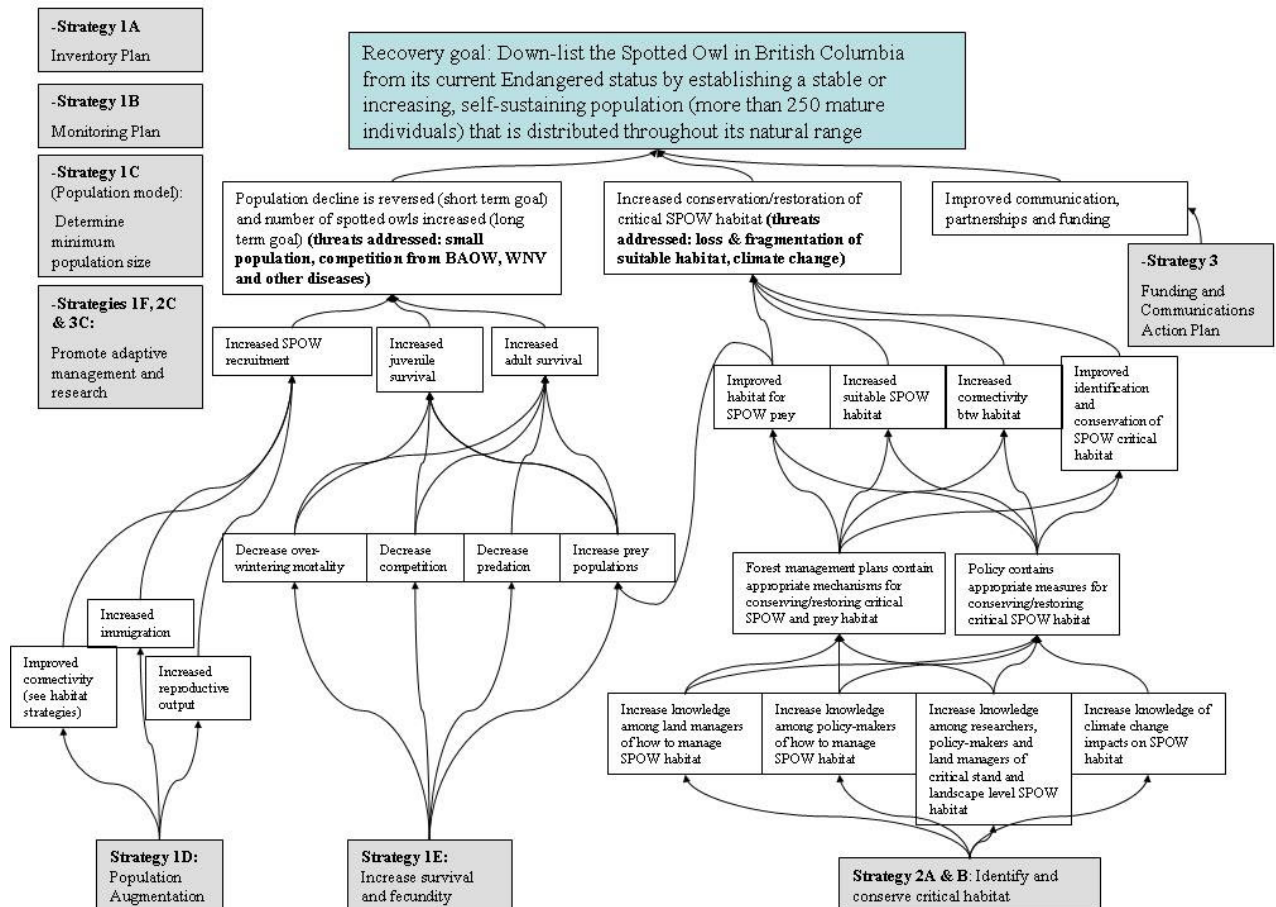


Figure 1: Conceptual model showing the logic flow between the Spotted Owl guidance document strategies and the long-term goals and objectives outlined in the Spotted Owl recovery strategy.

Threats identified are noted under the appropriate objectives. Strategies 1A, 1B and 1C are not directly tied to long term outcomes but are critical pieces of information needed to address the actions under Strategies 1D, 1E and 2A & B. Likewise Strategies 1F, 2C and 3C are process related objectives that will ensure that information gaps to be filled. The funding and communications plan will link to information needs identified within other strategies.

Table 1: Implementation of recovery recommendations for Northern Spotted Owl in BC (2004-2009)

1. POPULATION INVENTORY AND AUGMENTATION PLAN

Approach	Objectives Addressed	Measures	Priority (1,2,3)	Cooperators		Target Date for Starting and Completion				
				Lead	Other	Year 1 (04/05)	Year 2 (05/06)	Year 3 (06/07)	Year 4 (07/08)	Year 5 (08/09)
A. Find All Owls	1; 2; 3	Prepare inventory plan.	1	MoE	CSORT, Industry	X Ongoing	X Ongoing	X Ongoing		
		Secure funding/crews	1	MoE/CSORT	MAL, MoFR, Industry	X Ongoing	X Ongoing	X Ongoing		
		Survey all suitable habitat	1	MoE	Industry, CSORT	X Ongoing	X Ongoing			
		Analyse results: Prepare accurate pop'n estimate and dist'n map	1	MoE	MAL, MoFR, Industry, CSORT	X Ongoing	X Ongoing	X Ongoing		
		Create electronic database	2	MoE	MAL, MoFR, Industry, CSORT	X	X			
B. Monitor Population Trend	1; 2; 3	Develop monitoring plan	1	MoE	CSORT, Industry	X Ongoing	X Ongoing	X Ongoing		
		Prioritise monitoring needs	1	MoE	CSORT, Industry	X Ongoing	X Ongoing	X Ongoing		
		Secure funding and crews	1	MoE/SORT	MAL, MoFR, Industry	X Ongoing	X Ongoing	X Ongoing	X	X
		Implement monitoring in accordance with protocols	1	MoE	MAL, MoFR, Industry, CSORT	X Ongoing	X Ongoing	X Ongoing	X	X
		Analyse results; prepare annual trend report	1	MoE/CSORT	MAL, MoFR, Industry	X	X	X	X	X
		Incorporate data into electronic database	2	MoE/MAL	MoFR, Industry, CSORT	X	X	X	X	X

Approach	Objectives Addressed	Measures	Priority (1,2,3)	Lead	Other	Year 1 (04/05)	Year 2 (05/06)	Year 3 (06/07)	Year 4 (07/08)	Year 5 (08/09)
C. Determine Minimum Population Size	2; 3	Develop/refine population model	1	CSORT/ modelers	MAL, MoE, MoFR, Industry	X Ongoing	X Ongoing	X Frame-work done		
		Hold modeling workshop(s)	1	CSORT/ modelers	MAL, MoE, MoFR, Industry	X Done	X Done	X Done		
		Parametise model	1	CSORT/ modelers	MAL, MoE, MoFR, Industry	X Done & Ongoing	X Done & Ongoing	X Done & Ongoing		
		Test assumptions of model	1	CSORT/ modelers	MAL, MoE, MoFR, Industry	X Done	X Done	X Done		
		Conduct peer assessment of model	1	CSORT	Academia	X	X			
		Use model to determine min pop'n size; include BBN	1	CSORT/ modelers		X	X			
		Re-assess recovery goals, objectives and feasibility	2	CSORT		X	X	X	X	X
D. Evaluate/Implement Augmentation	1; 2; 3	Evaluate feasibility, practicality, cost/benefits	2	MoE/Spotted Owl Population Enhancement Team (SOPET)	Partners, CSORT	X	X			
		Develop adaptive augmentation plan	2	SOPET	MoE, CSORT		X			
		Integrate plan into population model	2	CSORT /modelers	SOPET		X	X		
		Conduct pilot studies and assess results	2	MoE/SOPET	Partners, CSORT		X	X		
		Develop partnerships	2	MoE/SOPET	Partners, CSORT	X	X	X	X	X
		Implement and assess recommended measures	2	MoE /SOPET	Partners, CSORT		X	X	X	X

Approach	Objectives Addressed	Measures	Priority (1,2,3)	Lead	Other	Year 1 (04/05)	Year 2 (05/06)	Year 3 (06/07)	Year 4 (07/08)	Year 5 (08/09)
E. Increase Survival and Fecundity	1; 2	Evaluate feasibility, practicality, cost/benefits	3	MoE /SOPET	CSORT, Partners	X	X			
		Develop adaptive plan	3	MoE /SOPET	CSORT, Partners		X			
		Integrate plan into pop'n model	3	SORT/modelers	SOPET		X	X		
		Conduct pilot studies & assess results	3	MoE /SOPET	CSORT, Partners	X	X	X		
		Implement and assess recommended measures	3	MoE /SOPET	CSORT, Partners		X	X	X	X
F. Promote Adaptive Mgmt & Research	1; 2; 3; 4; 5; 6	Identify knowledge gaps	2	CSORT		X Ongoing	X Ongoing	X Ongoing		
		Use adaptive approach to develop prioritized list of research needs	2	CSORT	MAL, MoE, MoFR, Industry	X	X			
G. Promote Solutions to Socio-Economic Issues	2; 3; 4; 5; 6	Assess pop'n inventory & monitoring plans for SE values	2	MoE	MAL, MoFR, CSORT, Industry	X	X			
		Assess augmentation options for SE values	2	MoE	MAL, MoFR, CSORT, Industry	X	X			
		Assess measures to increase survival & fecundity for SE values	2	MoE	MAL, MoFR, CSORT, Industry	X	X			
		Use assessments to maximise cost/benefits	2	MoE	MAL, MoFR, CSORT, Industry	X	X			
		Develop cost sharing partnerships & stewardship agreements	2	MoE	MAL, MoFR, CSORT, Industry	X Ongoing	X Ongoing	X Ongoing	X	X

Table 1 (Cont'd). Implementation of recovery recommendations for Northern Spotted Owl in BC (2004-2009)

2. HABITAT PLAN

[illegible]

B. Identify and Conserve Critical Habitat	1; 2; 3	Create a base map of known and potential new sites	1	MoE	CSORT, MAL, MoFR, Industry	X Done	X Done	X	X	X
		Define nesting, roosting, foraging, & dispersal habitat	1	CSORT		X Done				
		Develop spatially explicit habitat supply model	1	CSORT/ modelers	MAL, MoE, MoFR, Industry	X Ongoing	X Ongoing	X Frame-work Done		
		Refine model and test assumptions	1	CSORT/ modelers	MAL, MoE, MoFR, Industry	X Ongoing	X Ongoing	X Done		
		Use model to test viability of stand-alone BC population	1	CSORT/ modelers	MAL, MoE, MoFR, Industry	X Ongoing	X Ongoing			
		Conduct independent assessment of model	1	CSORT	Academia	X	X			
		Create a map of all potentially suitable habitat	1	CSORT/ modelers	MAL, MoE, MoFR, Industry	X Ongoing	X Ongoing	X Ongoing		
		Determine attributes needed to delineate CH; include BBN	1	CSORT/ modelers		X Ongoing	X Ongoing	X Done		
		Assess SOMP's ability to meet recovery goals and objectives	1	CSORT/ modelers	MAL, MoE, MoFR, Industry	X Ongoing	X Ongoing	X Done		
		Determine minimum amount and distribution of CH & provide decision makers with information necessary to create a habitat management plan	1	CSORT/ modelers	MAL, MoE, MoFR Industry	X	X Ongoing	X Ongoing		
		Establish objectives under <i>Forest & Range Practises Act</i>	1	MoE	MAL, CSORT, MoFR, Industry	X	X Done			

Approach	Objectives Addressed	Measures	Priority (1,2,3)	Lead	Other	Year 1 (04/05)	Year 2 (05/06)	Year 3 (06/07)	Year 4 (07/08)	Year 5 (08/09)
		Promote habitat stewardship	1	MoE	MAL, CSORT, MoFR, Industry	X Ongoing	X Ongoing	X Ongoing	X	X
		Develop guidelines to create, enhance and maintain CH and reduce threats	1	MoE	MAL, CSORT, MoFR, Industry	X	X			
		Implement SPOW habitat mgmt plan that meets recovery goals and objectives	1	MoE	MAL, CSORT, MoFR, Industry	X Ongoing	X Ongoing	X Ongoing		
		Assess effectiveness of habitat mgmt plan	1	MoE	MAL, CSORT, MoFR, Industry		X	X	X	X
C. Promote Adaptive Mgmt and Research	1; 2; 3; 4; 5; 6	Identify knowledge gaps	2	CSORT		X Done	X Done			
		Use an adaptive approach to develop prioritized list of research needs	2	CSORT	MAL, MoE, MoFR, Industry	X				
D. Promote Solutions to Socio-Economic Issues	2; 3; 4; 5; 6	Conduct detailed spatial assessment of habitat mgmt plans for SE values	2	MoE / MAL	MoFR, CSORT, Industry	X	X			
		Use assessment to maximise cost/benefits	2	MoE / MAL	MoFR, CSORT, Industry	X	X			
		Develop cost sharing partnerships and stewardship agreements	2	MoE / MAL	MoFR, CSORT, Industry	X Ongoing	X Ongoing	X Ongoing	X	X
		Identify opportunities to use silviculture to enhance/recruit habitat	2	MoE / MAL	MoFR, CSORT, Industry	X Ongoing	X Ongoing	X Ongoing	X	X
		Identify opportunities to address economic issues assoc'd with habitat protection/recruitment	2	MoE / MAL	MoFR, CSORT, Industry	X	X	X	X	X

Table 1 (Cont'd). Implementation of recovery recommendations for Northern Spotted Owl in BC (2004-2009)

3. FUNDING AND COMMUNICATIONS PLAN

Approach	Objectives Addressed	Measures	Priority (1,2,3)	Cooperators		Target Date for Starting and Completion				
				Lead	Other	Year 1 (04/05)	Year 2 (05/06)	Year 3 (06/07)	Year 4 (07/08)	Year 5 (08/09)
A. Acquire Financial Support for Recovery Actions	1; 2; 3; 4; 5; 6	Develop list of potential funding sources	1	MoE/ CSORT	MAL, MoE, MoFR, CWS, Industry	X				
		Apply for funding as per recovery plan priorities	1	MoE/ CSORT	MoF, MAL, CWS, Industry	X Ongoing	X Ongoing	X Ongoing	X	X
		Assess options for creating "SPOW Recovery Fund"	1	MoE/ CSORT	MoF, MAL, Industry	X Ongoing	X Ongoing			
		Develop SPOW Recovery Fund if determined feasible	1	MoE/ CSORT	Lawyers	X	X			
		Consider non-traditional funding sources	1	MoE/ CSORT		X	X	X	X	X
B. Promote Solutions for Socio-Economic Consequences	2; 3; 4; 5; 6	Conduct detailed spatial assessment of habitat mgmt plans for SE values	2	MoE / MAL	MoFR, CSORT, Industry	X	X			
		Use habitat assessment to maximise cost/benefits	2	MoE / MAL	MoFR, CSORT, Industry	X	X			
		Assess pop'n inventory & monitoring plans for SE values	2	MoE	MAL, MoFR, CSORT, Industry	X	X			

Approach	Objectives Addressed	Measures	Priority (1,2,3)	Lead	Other	Year 1 (04/05)	Year 2 (05/06)	Year 3 (06/07)	Year 4 (07/08)	Year 5 (08/09)
		Assess augmentation options for SE values	2	MoE	MAL, MoFR, CSORT, Industry	X	X			
		Assess measures to increase survival & fecundity for SE values	2	MoE	MAL, MoFR, CSORT, Industry	X	X			
		Use population assessments to maximise cost/benefits	2	MoE	MAL, MoFR, CSORT, Industry	X	X			
		Develop cost sharing partnerships and stewardship agreements	2	MoE / MAL	MoFR, CSORT, Industry	X Ongoing	X Ongoing	X Ongoing	X	X
C. Promote Stewardship	1; 2; 3; 4; 5; 6	Consult with all stakeholders	3	MoE	CSORT	X Ongoing	X Ongoing	X Ongoing	X	X
		Identify opportunities for stewardship in habitat and population initiatives	3	MoE/ CSORT	MoFR, MAL, CWS, Industry	X Ongoing	X Ongoing	X Ongoing	X	X
		Apply for funding from appropriate sources	3	MoE/ CSORT	MoFR, MAL, CWS, Industry	X	X	X	X	X
		Form partnerships, prepare and implement agreements	3	MoE	CSORT, lawyers	X	X	X	X	X
D. Promote Adaptive Mgmt and Research	1; 2; 3; 4; 5; 6	Identify knowledge gaps	2	CSORT		X Ongoing	X Ongoing	X Ongoing		
		Use an adaptive approach to develop prioritized list of research needs	2	CSORT	MAL, MoE, MoFR, Industry	X				

Approach	Objectives Addressed	Measures	Priority (1,2,3)	Lead	Other	Year 1 (04/05)	Year 2 (05/06)	Year 3 (06/07)	Year 4 (07/08)	Year 5 (08/09)
E. Promote Awareness	1; 2; 3; 4; 5; 6	Prepare an extension (education & training) strategy	3	CSORT	FORREX?					
		Develop mechanisms for prompt public release of scientific documents	3	MoE	Authors	X Ongoing	X Ongoing	X Ongoing		
		Develop and release public awareness pamphlets	3	CSORT	MoE					
		Create a central digital database for SPOW info	3	MoE /MAL	CSORT					
		Develop a Spotted Owl Recovery Team website	3	CSORT	MoE /CWS					

3. CRITICAL HABITAT

3.1 Introduction

Habitat loss, degradation, and fragmentation are generally the primary causes of species endangerment (Wilcove et al. 1998, Kerr and Cihlar 2004), and protection of habitat is widely recognized as essential to preventing species extirpation and extinction (*Accord for the Protection of Species at Risk*). Loss and fragmentation of habitat is recognized as a primary threat to the Spotted Owl throughout the Pacific Northwest (USDI 1992; Dunbar and Blackburn 1994; Gutiérrez et al. 1995), and is identified as such in the Spotted Owl recovery strategy (Chutter et al. 2004). The ongoing identification and effective protection of critical habitat is an indispensable part of the recovery of the Spotted Owl in British Columbia, and as such, will be essential to reducing the probability of extirpation. In the following pages the rationale and identification of the amount and spatial distribution of critical habitat is presented. This document builds upon and complements previous advice of the CSORT on habitat management, including the recovery strategy's partial definition of critical habitat as all suitable habitats within currently occupied Long-Term Activity Centres, and the Interim Recommendation's advice to protect all known Spotted Owl occupied sites within the range of the Spotted Owl.

The legislative basis for the identification of critical habitat is primarily provided in the Federal *Species at Risk Act* (SARA), in conjunction with the *Accord for the Protection of Species at Risk*. The government of British Columbia emphasizes the importance of habitat protection in the *Wildlife Act* and *Wildlife Amendment Act*, and the *Forest and Range Practices Act* and its accompanying *Identified Wildlife Management Strategy*. These various acts, programs, and agreements reflect government's commitment to protect important habitat for species at risk, and they provide a variety of tools (e.g., critical habitat, higher level plans, critical species protection areas, Wildlife Habitat Areas) to manage this important habitat.

The SARA defines critical habitat as:

the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species.

In the case of the Spotted Owl, the Federal Minister of Environment is responsible for identification of critical habitat, in cooperation with the British Columbia Minister of Environment. The recovery team's role is to provide advice on the format and content of the formal identification. For this reason, this document outlines "proposed critical habitat." The CSORT has drawn primarily from two policy documents (Government of Canada 2004a, 2004b) and two background papers (Government of Canada 2003, 2004c) to guide the preparation of this summary of Spotted Owl critical habitat.

There is enough scientific information available at this time to proceed with a critical habitat definition. The Spotted Owl is one of the most intensively studied species in the world. Spotted Owl habitat use information for British Columbia is available from internal provincial government reports, expert opinion of British Columbia biologists, and by extrapolating findings from peer reviewed studies and government reports from the United States, particularly from Washington State. In addition, a detailed study of Spotted Owl landscape dynamics in British Columbia, in combination with demographic modeling of the Spotted Owl population (Sutherland et al. 2005), is providing an integrated quantitative assessment of the importance of areas to Spotted Owl survival and recovery in the province. The British Columbia Ministry of Environment is also conducting an analysis of the socio-economic implications of Spotted Owl habitat management (see summary in section 4). While there are acknowledged limitations and gaps in the information, the standard of quality is high, and the existing evidence is sufficient to propose critical habitat. Some further analysis work on spatial definition is required to better delineate the amount and distribution of critical habitat best suited for recovery. CSORT recommends this be addressed through further modeling using a Bayesian Belief Network and has started to undertake such work. CSORT is of the opinion that there are no scientific or technical reasons to delay acting on the recommendations regarding critical habitat contained in this document.

The process used to identify proposed critical habitat is taken from the federal “Policy on critical habitat” (Government of Canada 2004a), and follows these common-sense steps:

1. Describe the biophysical attributes of the habitat required by the species at risk.
2. Locate all habitat in the range.
3. Determine the habitat required to meet the population target.

Habitat management for the Spotted Owl follows an area-based approach, and in this document, proposed critical habitat refers to *areas* necessary for the survival or recovery of the Spotted Owl (as defined in the recovery strategy: Chutter et al 2004). Due to past land management decisions, sufficient suitable habitat does not appear to exist currently in the spatial distribution required to meet the long term recovery goal for the Spotted Owl. Recruitment of new areas of suitable habitat through natural succession and active enhancement of capable habitat is needed for recovery (this was also recognized in the 1997 Spotted Owl Management Plan [SOMIT 1997a]). Temporal dynamics such as succession are part of the description of biophysical aspects of critical habitat, and as such, restorable areas may be considered critical habitat (Government of Canada 2004b). The time needed for recruitment will depend on the current age of the recruitment stand, and in most cases, preference will be directed towards older stands closest to reaching suitability standards for the owls. The areas identified for recruitment will require protection to become suitable habitat. The approach taken by the CSORT is to identify areas essential for recovery of the Spotted Owl, regardless of the regulatory mechanisms available for effective protection of the habitat.

Habitat management for Spotted Owls faces a high degree of scrutiny because of the economic value of the habitat, the high risk of extirpation faced by the species, and public

valuation of this species and its late-successional habitat. The CSORT has drawn on the best available knowledge to ensure the advice in this guidance document is trustworthy, defensible, and inclusive of all viewpoints. The advice is based on peer-reviewed and other literature, expert opinion, and quantitative modeling. The methods, assumptions, and results are carefully documented, and the process has taken place in conjunction with several meetings/workshops involving various industry/government stakeholders and topic experts. The advice is based on the best available evidence, using an explicit determination of acceptable levels of risk. Substantial changes to or partial implementation of the plan described herein may effectively consign the Spotted Owl to an unacceptably high risk of extirpation. Implementation of Spotted Owl habitat management will be delivered primarily through the British Columbia Ministries of Forests and Range, and Environment, and it will be their responsibility, in cooperation with affected industries, to determine how best to make these recommendations operational.

Revision of the proposed critical habitat definition in this document will be an on-going process because our understanding of Spotted Owl critical habitat will grow and evolve over time, and the habitats are also intrinsically dynamic and will change due to succession and disturbance events such as fire or insect outbreaks. The population targets may also be amended based on new information. It is essential that the mechanism for protecting proposed critical habitat be flexible, to allow new information about population distribution and/or performance to be incorporated. New field data will need to be integrated, assumptions in the model will need to be verified, and model parameter settings will need to be refined. Finally, an essential yet often overlooked part of conservation planning is monitoring the end results, evaluation of success, and revision of the program. Proposed critical habitat for the Spotted Owl in British Columbia should be re-evaluated every five years to determine its effectiveness.

3.1.1 Process Used to Define Critical Habitat

The methodologies and requirements for defining critical habitat in recovery plans are presently in active development by federal agencies (Government of Canada 2004c, 2005). In the case of Spotted Owls, the CSORT developed (2003-2006) a strategic, spatially explicit modeling framework, in collaboration with a team of modelers from Cortex Consultants Inc. and Gowlland Technologies Ltd. (Sutherland et al. 2003), to integrate available sources of information that were considered relevant to Spotted Owl habitat use in British Columbia and to model habitat supply and population trends under different management options (Sutherland et al. 2007). The CSORT obtained external stakeholder opinion at the initiation of the model project (Zimmerman et al. 2004) and over the course of developing the model¹. Findings from the model project that are relevant to determining and assessing critical habitat (Government of Canada 2004) of the Spotted Owl are discussed in the following sections. Sutherland et al. (2007) present a compilation of the methods, results, and conclusions of the model framework, and we

¹Two stakeholder workshops involving the CSORT, Industry, and Government decision-makers were sponsored (June 2004, March 2005) during model development to define and test an initial broad set of policy options around owl management using the model.

recommend users of this guidance document refer to that report to fully understand the framework and the potential interpretation of findings.

Efforts to define critical habitat also need to consider existing Spotted Owl habitat conservation mechanisms (such as the Spotted Owl Management Plan; SOMP: SOMIT 1997a and b) and how they changed during the development of this document and the model (Sutherland et al. 2007). Under the SOMP, a total of 21 Special Resource Management Zones (SRMZs) were established in the Chilliwack and Squamish forest districts, each protecting between 2 and 13 Long-Term Activity Centres (LTACs) for Spotted Owls. Each of the total of 101 LTACs covered by the SOMP were designed to represent a breeding territory for a pair of owls and are referred to in the interim recommendations from the CSORT and the recovery strategy (Chutter et al. 2004). An additional eight Spotted Owl locations (Matrix Activity Centres or MACs) were temporarily protected under SOMP, but designed to be phased out as other habitat in LTACs became suitable (see SOMIT 1997, and Chutter et al. 2004, for details regarding SOMP). By 2002, eight new Spotted Owl sites had been discovered in the Cascades Forest District, significantly extending the range of the owl in the province. Using various tools such as a Memorandum of Understanding (MOU), voluntary deferrals and Section 7 notices under the *Forest and Range Practices Act*, seven of these sites were afforded SOMP-equivalent protection. All the preceding information was considered at the time of the development of the management scenarios for the model project. In 2006, nine Wildlife Habitat Areas (providing greater protection than SOMP as they allow no harvesting) were created at sites that were found occupied during surveys conducted in 2005. Of the nine, five were SOMP LTACs, three were covered by a SOMP equivalent MOU, and one was a matrix area. This extra protection was not considered during the development of the model scenarios. As of 2007, fifteen potential LTACs (discovered since 1995) remain without any formal protection.

It should be noted that currently active sites, as defined in the recovery strategy (Chutter et al. 2004), are included in that document's partial definition of critical habitat to ensure that these areas are captured in the analysis of proposed critical habitat for Spotted Owls. This information was considered and incorporated for the latter stages of the modeling project addressing the critical habitat question.

Modeling Framework

Spotted Owl habitat in British Columbia occurs in five different management units (Fraser TSA, So0 TSA, Merritt TSA, Lillooet TSA and Tree Farm License 38). For the modeling project a seamless landscape database rasterized to a 1 ha cell resolution (100 m x 100 m raster cells) was produced for the spatial modeling using forest cover (current through 2002), biogeoclimatic ecosystem, and TRIM layers. The management zones and constraint categories are also spatialized to that resolution. The distribution of the Spotted Owl provided in the recovery strategy was used for the analyses presented in this report. In Sutherland et al. (2007) this distribution was adjusted for developing the habitat quality Bayesian Belief Network (BBN) and Resource Location Model (i.e., the contribution of the Elaho Landscape Unit was given less weight because the research

sub-group believed there was a lack of suitable climate conditions and evidence of SPOW use. Details of model parameterization are provided in Sutherland et al. (2007). Consideration will need to be given to the distribution during development of further action planning, and adjustments may be necessary to the tables provided in this report if it becomes necessary to adjust the defined species distribution.

The modeling framework itself is composed of six integrated, spatially explicit model components. These components are: (1) a landscape dynamics model capable of spatial timber supply analysis that projects forest growth and stand-replacing natural disturbances; (2) a habitat supply model that can be tailored for particular species; (3) a spatial model for calculating locations of potential territories for a territorial species; (4) a structural connectivity model for assessing spatial arrangement and proximity of habitat, territories and management areas; (5) a spatial population model for projecting population dynamics on projected landscapes; and (6) an evaluation post-processor (Resource Location Model) that implements rules for identifying and ranking potential habitat reserves based on biological and other criteria measured at multiple scales (Sutherland et al. 2007).

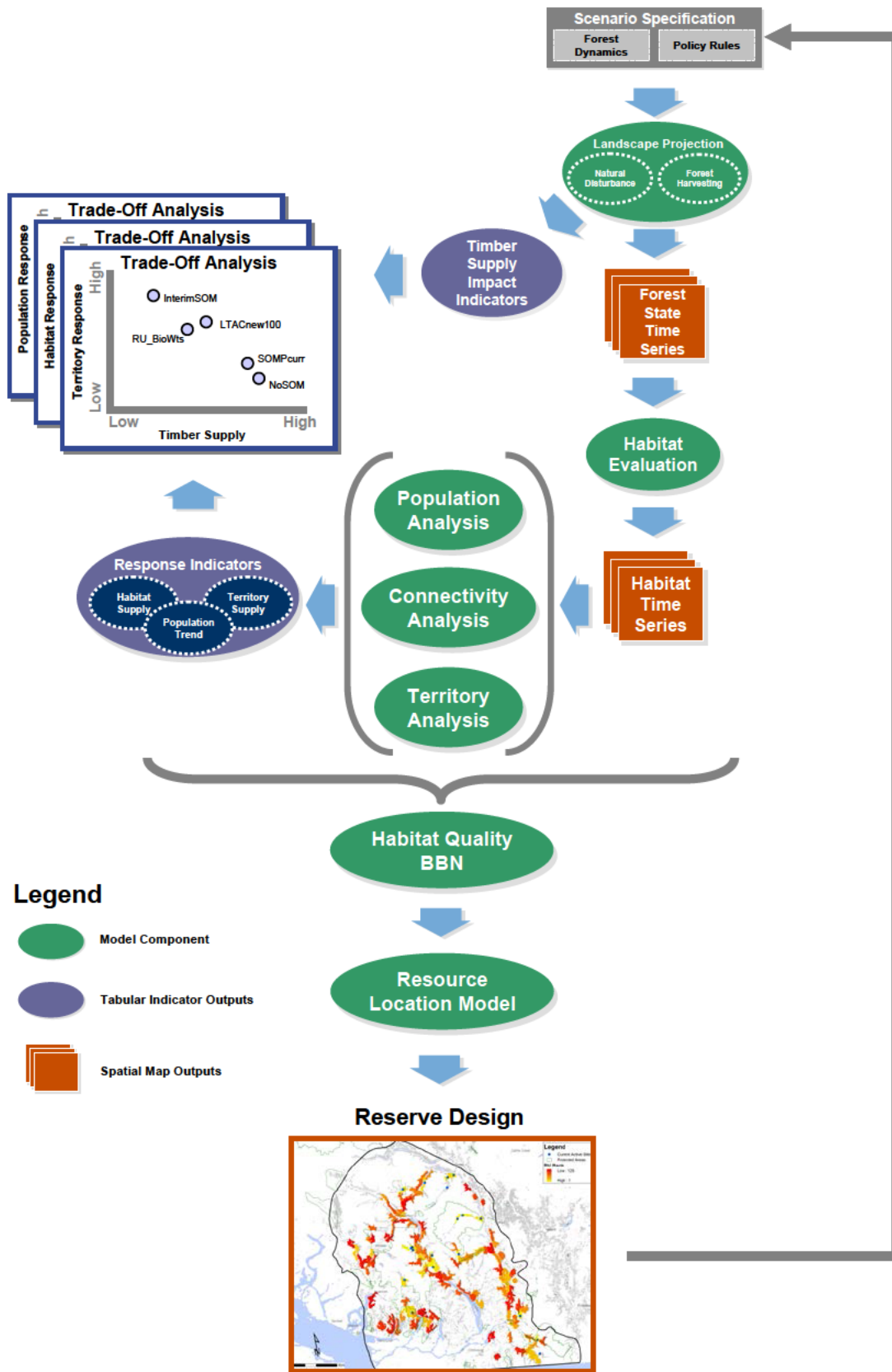


Figure 2: Overview of the modeling analysis framework

The Landscape Projection Model uses the seamless database to produce a Forest State Time Series that includes timber supply indicators and a spatial time series of age, height and growth site potential for each modeled hectare. This information is used by the Habitat Evaluation Model to produce a Habitat Map Time Series. The Habitat Map Time Series identifies habitat on a hectare basis by habitat type (nesting, foraging, etc.) and by cost surface indicators (i.e., the cost to the owl of moving through that particular habitat type). Suitable habitat and cost surface parameters and values were limited to those available in the seamless database and defined by using expert opinion and extrapolating data from British Columbia and the United States. Where possible, sensitivity analyses were undertaken to understand the uncertainty of the habitat values used in the model.

For the post processing step a habitat quality assessment tool was built using a BBN that applies weightings to selected habitat attributes measured at the site, territory, and population scales to obtain an integrated measure of biological habitat quality for each location. This type of habitat quality evaluation can be used independently to facilitate selection of critical habitat locations for the Spotted Owl. For the modeling project this concept was advanced by using a Resource Location Model that selects candidate habitat reserve areas that meet biological and/or risk criteria for recovery goals at different times in the future (Sutherland et al. 2007).

Circles represent the main model components. Stacked boxes represent time series inputs/outputs, generally stored as maps. List bullets indicate indicators stored as stratified textfiles.

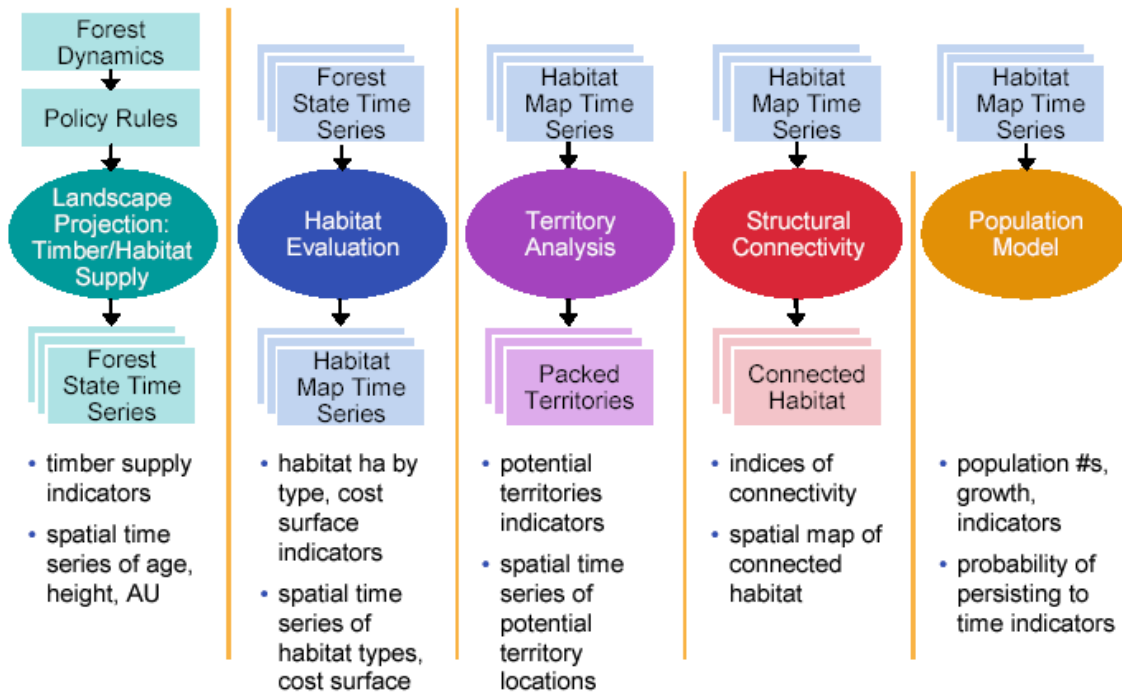


Figure 3: Implementation of the modeling components of the analysis framework as a “pipeline”

Limitations to the approach used to define Proposed Critical Habitat

While detailed stand structure descriptions of Spotted Owl habitat exist (SOMIT 1997), all this information was not available in appropriate datasets for modeling habitat supply and identifying locations of critical habitat. The modeling supported by the CSORT thus only provides a strategic definition of Spotted Owl habitat, and it therefore needs to be recognized that any proposed amounts of critical habitat or spatial locations of critical habitat, based on model outputs, will be strategic and will require field verification prior to implementation (Sutherland et al. 2007). In addition, the assumptions and sensitivities of the parameters used to define suitable habitat, territories and habitat quality for the current modeling affect the results and may need further testing and evaluation (i.e., based on new information) if these results are to be implemented (Sutherland et al. 2007).

3. 2 Biophysical Attributes of Spotted Owl Habitat

In general, the Spotted Owl is closely associated with relatively large areas of mature and old coniferous forests that exhibit uneven-aged, multi-layered, multi-species canopies that contain numerous large trees with broken tops, deformed limbs, and large cavities; numerous snags; large accumulations of large woody debris; and canopies open enough to allow owls to fly within and beneath (Chutter et al. 2004). Spotted Owls establish large home ranges within areas that contain suitable nesting and foraging habitat. It is essential for Spotted Owls to disperse between territories, so some amount of habitat is also required to facilitate this dispersal. In this section, we summarize stand and landscape level habitat needs, focusing on a strategic habitat definition for how nest sites, foraging habitat, potential Spotted Owl territories and dispersal habitat are defined within the Spotted Owl model.

3.2.1 Suite of Stand Level Attributes

The present definition of the suite of stand level attributes describing Spotted Owl habitat is adapted from the Spotted Owl Management Plan (see Appendix 1) (SOMP 1997; Chutter et al. 2004). In this document, however, we use a strategic definition of Spotted Owl habitat (see next section 3.2.2) as the basis for modeling an approach to define critical habitat for this species. In the future, these SOMP stand-level definitions of Spotted Owl habitat will be useful from an operational perspective for delineating specific habitat areas to manage for this species on the ground. However, the stand level definitions in SOMP have been defined using a two-zone approach, grouping wetter and drier ecosystems and we recommend an assessment be conducted to determine whether these definitions need to be refined to align with the three-subregion approach (maritime, subarctic and continental) that better reflects Spotted Owl biology in British Columbia (see Section 3.2.2).

3.2.2 Strategic Definition of Spotted Owl Habitat (adapted from Sutherland et al. 2007)

Key strategic level attributes of Spotted Owl habitat were incorporated into the Spotted Owl modeling to define nesting (Type A) and foraging (Type B) habitat for the owl (note: dispersal habitat is defined separately within the model, using the concept of a “cost surface”). Each one-hectare cell was classified as nesting or foraging habitat using the strategic habitat parameters provided in Table 2. By definition, nesting (Type A habitat) is also foraging (Type B) habitat. A brief summary of how the available information was incorporated into the model to define foraging and nesting habitat is provided below. The rationale for defining nesting and foraging habitat, including the assumptions made and potential limitations of the approach are presented in Sutherland et al. (2007).

Stand structure, topography and vegetation associated with Spotted Owls is well described for some areas. However, within the Spotted Owl model, only those parameters available in spatial British Columbia databases could be used. These parameters were limited to: biogeoclimatic subzone/variant, elevation, slope, aspect, stand age class and stand height class. The values for each of these parameters (Table 2) define if and when a hectare of habitat may become suitable for Spotted Owls.²

Sensitivity analyses, conducted using the model, have provided important information regarding the level of uncertainty around some habitat parameters used in the model. For example, outcomes from the habitat model are most sensitive to lower elevation limit assumptions, as well as to the stand age and height assumptions (Sutherland et al. 2007). These results indicate that the habitat definitions outlined are best considered as providing upper and lower bounds of habitat potential. The territories model was most sensitive to the assumption about mean area of suitable habitat required to establish a viable territory, while the population model was most sensitive to adult survival rates. These parameters should be prioritized for evaluation and possible refinement through empirical studies, and decisions about owl recovery, including delineation of critical habitat, should be updated based on these new data.

The BEC variants, maximum elevation, minimum stand age and tree heights all vary between the three ecological subregions used by Spotted Owls in British Columbia, whereas slope and aspect do not seem to be selection factors (Table 2). Maximum elevation increases from the wetter coastal areas towards the drier more interior areas, whereas minimum stand age and tree height requirements tend to decrease. Some of the

² Because the strategic definition of Spotted Owl habitat within the model was limited to the available digital datasets, additional information can be used to further refine the classification of habitat as nesting or foraging. In addition, tree species composition, was not used in the strategic habitat definition other than through its broad characterization through biogeoclimatic zones and by some area specific adjustments where large areas of deciduous species were captured under the strategic definition. Due to the large (1:250,000) scale at which BEC lines were drawn, there exists the potential exclusion of some suitable habitats and inclusion of some non-suitable habitats (e.g., forest stands with high elevation tree species).

values listed in Table 2 vary depending on whether they are classified as “general” or “specific” and “structure present” or “structure absent.” These qualifiers are explained below.

- Structure present or structure absent: The age at which a particular one-hectare cell of habitat becomes suitable will depend greatly on the origin of the stand. For those stands that were logged before 1998 but after about 1920, it is likely that no remnant structure from the previous stand remains. In contrast, those areas logged before 1920 and after 1998 (due to changes in forest management practices) will likely have some structural attributes (e.g., remnant large-diameter trees or snags) that would make the areas suitable at a younger age. The assumption is that retained structure decreases the age at which a stand becomes suitable for an owl. This qualifier is only relevant for the Minimum Stand Age parameter.
- General or specific: General and specific values were assigned for those parameters with more than one potential interpretation (e.g., stand age and stand height). For a particular parameter, the general value is less restrictive, resulting in greater amounts of habitat being defined as suitable or capable. The specific value is more restrictive, identifying smaller amounts of habitat as suitable or capable.

The general and specific definitions provide upper and lower bounds for describing the potential range of habitat. The information used to classify landscape level attributes of habitat using the model was restricted to the “general” definition. The full suite of scenarios has been assessed under the “general” definition, while the “specific” definition has only been explored in sensitivity analyses (Sutherland et al. 2007). Because “general” values provide a broader scope of potential habitat occupancy (and encompass a greater proportion of uncertainty about the fine-scale factors determining habitat suitability), it made sense to run the “general” values first. The projected indicators of owl responses under the more restrictive “specific” values are likely to have a lower response than those under the “general” definition. While recognizing that they may need to be refined in the future, the general/specific qualifiers determined in the original habitat rationale are included at the bottom of Table 2 for reference.

Table 2: Habitat parameters – description of habitat parameters for maritime, sub-maritime and continental ecological subregions for stands classified as ‘structure present’ or ‘structure absent’

Parameter	Maritime		Sub-maritime		Continental	
	Nesting	Foraging	Nesting	Foraging	Nesting	Foraging
BEC variant (all definitions)	CWHvm1 CDFmm* CWHvm2 CWHdm CWHxm1	CWHvm1 CDFmm* CWHvm2 CWHdm CWHxm1	CWHds1 CWHms1 IDFww	CWHds1 CWHms1 IDFww	IDFun IDFxb2 IDFdk IDFxm IDFdk1-4 IDFxb IDFxb1	IDFun IDFxb2 IDFdk IDFxm IDFdk1-4 IDFxb IDFxb1 PPxb2
Slope (all definitions)	All	All	All	All	All	All
Aspect (all definitions)	All	All	All	All	All	All
Maximum Elevation (general- structure present or absent)	≤ 900	None	≤ 1000 m	None	≤ 1100m	none
Minimum Stand Age (general - structure present)***	≥ 140 years	≥ 120 years	≥ 110 years	≥ 100 years	≥ 110 years	≥ 80 years
Minimum Stand Age (general - structure absent)***	≥ 200 years	≥ 140 years	≥ 200 years	≥ 120 years	≥ 200 years	≥ 100 years
Minimum Tree Height (general - structure present or absent)	≥ 28 m	≥ 19.5 m	≥ 23 m	≥ 19.5 m	≥ 23 m	≥ 19.5 m
Maximum Elevation (specific)	≤ 900	≤ 1000 m	≤ 1000 m	≤ 1100 m	≤ 1100m	≤ 1200m
Minimum Stand Age (specific)	≥ 200 years	≥ 140	≥ 200 years	≥ 120 years	≥ 200 years	≥ 100 years
Minimum Tree Height (specific)	≥ 40 m	≥ 28 m	≥ 30	≥ 23	≥ 24	≥ 19.5

*Although CDF is listed little area actually falls in the owl’s BC range, and all of that occurs in developed regions of Vancouver.

**Forest cover height classes: 3 = 19.5-28.4; 4 = 28.5 - 36.4, 5+ ≥36.5

*****Structures absent** stands are defined as stands harvested prior to 1998 and currently < 80 years old. This date is set to separate Pre-British Columbia Forest Practices Code 1995 and pre-British Columbia Spotted Owl Management Plan 1997 stands which would likely not have had stand-level retention (British Columbia Ministry of Forests and British Columbia Ministry of Environment 1999, SOMIT 1997). **Structure present** includes stands of natural disturbance origin, stands with structural retention harvested during or after 1998, and current stands ≥80-years old. We assumed these latter (if logged pre-1925) are now “thrifty” stands following high-grade logging and this follows the definition (e.g., *Forest Practices and Range Act*) for mature stands used in British Columbia (Province of British Columbia 1998).

In summary, during the process of developing the Spotted Owl model, Spotted Owl habitat definitions (Sutherland et al. 2007) were revised from those used in the Spotted Owl Management Plan (SOMIT 1997; Appendix 5 of the Spotted Owl recovery strategy) based on more recent literature, research and expert opinion. For purposes of modeling, BEC subzones/variants were grouped in one of three ecologically-based subregions: maritime, sub-maritime or continental. The maritime and sub-maritime groups are similar to those used for the current management plan for Spotted Owls in British Columbia (SOMIT 1997), but the continental group was added based on new locations of Spotted Owls which has expanded their known range in the province. In addition, higher elevation variants (Sub-alpine zones) previously included in nesting and foraging habitat definitions (SOMIT 1997) were eliminated from all groups based on research that has shown that Spotted Owls do not breed in British Columbia in these habitats (Sutherland et al. 2007). Throughout the following pages, results from the model are presented by subregion to reflect important ecological differences in Spotted Owl habitat within the three subregions.

3.2.3 Temporal Considerations of Stand Level Attributes

The amount of suitable Type A and B Spotted Owl habitat available at any one time is impacted by both management activities and natural disturbance. Within Spotted Owl habitat, the frequency of stand replacing disturbances in each biogeoclimatic variant has been determined through an approach which combines information from field studies, expert opinion and an empirical approach where possible (Table A in Appendix 2). The methods used to determine the frequencies of disturbance within each variant are described in Sutherland et al. (2007). These values may vary significantly in the future with climate change and this could be tested in the model framework.

To illustrate how natural disturbance can impact the amount of suitable Type A and B Spotted Owl habitat available at any one time within each sub-region, natural disturbance was modeled separately as a sole disturbance factor to determine how the amount of expected suitable habitat varies naturally in the owl range by variant (Table B in Appendix 2). These data are summarised by subregion for suitable (Type A + Type B) and for Type A alone (Table 3).

Based on the information obtained from the long-term disturbance-only modeled scenario, the range of natural variability suggests that total area of suitable habitat in the long-term could vary by ~5% (i.e., 5% more or less habitat might occur than compared to the predicted mean amount in the model). The range of natural variability is greater in the continental subregion (between 6 to 7 %) reflecting the greater potential effect of fire there. Type A habitat (usually more suitable for nesting) appears to have similar maximum ranges to those of suitable habitat. See Appendix 2 for more information on how suitable habitat is expected to vary by BEC variant under natural disturbance.

Table 2: Areal extent of expected suitable habitat at any given time period under natural disturbance conditions, where the expected range of natural variability (mean, maximum and minimum) of expected suitable habitat was estimated using a very long run of disturbance-only scenario.¹

Habitat Strata	Area	Maritime	Submaritime	Continental
Mean Suitable	846,000 ha	271,000 ha	481,000 ha	94,000 ha
Max Suitable	887,000 ha	284,000 ha	504,000 ha	101,000 ha
Min Suitable	818,000 ha	258,000 ha	467,000 ha	88,000 ha
Mean Type A	594,000 ha	223,000 ha	325,000 ha	46,000 ha
Max Type A	621,000 ha	236,000 ha	339,000 ha	49,000 ha
Min Type A	571,000 ha	211,000 ha	315,000 ha	42,000 ha

¹ This was calculated based on running the landscape dynamics model with natural disturbances turned on (but without new human disturbances) and projected out for 10,000 years, producing a long term equilibrium landscape after approximately 2000 years.

The impact of natural disturbance on Spotted Owl habitat is an important consideration when managing an amount of critical habitat into the future. The management plan that is implemented needs flexibility to allow for replacement areas if critical habitat is lost to natural disturbance, thus accounting for similar rates of natural disturbance to occur within each sub-region.

3.2.4 Required Distribution and Density of Critical Habitat Polygons in the Landscape

While the amount of suitable Type A and B Spotted Owl habitat is extremely important, its spatial arrangement across the landscape will ultimately determine its functionality and use. Therefore, to recover the population, it may be important that the critical habitat definition take into account habitat availability at different scales including nest sites, territories, territory clusters, as well as connectivity/dispersal corridors between these areas and south to the population in the United States. The CSORT and the modeling team gathered the available information on this topic and incorporated it into the model, as appropriate, to address questions of potential distribution and density of critical habitat polygons (Sutherland et al. 2007). Information on connectivity between British Columbia and the United States is lacking. Therefore, habitat modeling was restricted to British Columbia and the provincial population was treated as “closed” for population modeling (see Connectivity to US Population section below, and Sutherland et al. 2007). Testing of habitat connectivity to the United States and immigration and emigration in the model framework could be considered in the future.

Nest Site Description

Nesting habitat structure is described in some detail in section 6.2.1 of the recovery strategy (Chutter et al. 2004). In general, Spotted Owl nests are found primarily in large diameter trees, either in cavities or on nesting platforms, within territories that contain a high proportion of suitable Type A (nesting) and Type B (foraging) habitat. To encompass the available scientific information on nest sites, for the modeling by Sutherland et al. (2007) nest sites were established at random in cells with a high proportion of Type A habitat within a radius of 1100 m (based on a minimum required natal rearing area of 400 ha; Herter and Hicks [unpubl. data] in Hanson et al. 1993). Cells with higher proportions of Type A habitat in the surrounding buffer area have a higher probability of being selected as a nest site (Bart 1995).

Territory Size and Description

Within the modeling framework, territories were located (in simulation) using the territory packing model which identified each location based on a minimum amount of habitat that is needed to support a viable owl territory. Once a nest site is initiated in the model at a particular cell, it attempts to “grow” a territory around the site until the minimum amount of habitat is acquired or until a predefined maximum size is reached (Table 4). If the latter is reached without acquiring the minimum amount of suitable habitat, the amount of habitat in the territory is considered insufficient and therefore non-functional. Adult survival is modeled (non-linear) to improve as the amount of suitable habitat in a territory increases, i.e., all potential territories created by the model are not necessarily equal in habitat quality, and the higher the proportion of suitable habitat in a territory the more likely it is to be successful. This relationship was incorporated into the modeling as an assumption based on referenced literature (see Chapter 7, Sutherland et al. 2007). Territories are allowed to overlap up to 25% with neighbouring territories. (See Sutherland et al. 2005 for further details.)

In general, home range area requirements (minimum area of suitable habitat required per territory and maximum feasible territory size) modeled for Spotted Owls are reduced as the habitat changes from coastal (Maritime) to interior (Continental) subregions (Table 4 from Sutherland et al. 2007). Within the Maritime subregion, the minimum amount of suitable habitat required for a territory is 3,010 ha within a maximum polygon of 11,047 ha. For the Submaritime, the figures are 2,224 and 7,258 ha; for the Continental, they are 1,907 and 6,306 ha. We emphasize that this information is extrapolated from the literature and expert opinion and is therefore subject to uncertainty. During action planning, experts will need to reconcile differences in arrangement of standard management units (e.g., 3200 ha LTACs) with projected results from this modeling based on a range of projected territory areas (including those resource units produced under the Resource Location Model).

Table 3: Parameters and default values for specifying the extent and arrangement of Spotted Owl breeding pair territories (see Sutherland et al. 2007 for details)

Parameter	Maritime	Submaritime	Continental Mean	Source & Comments
Area of suitable (Type A & B) habitat required within the home range.	3,010 ha (i.e., 52% of 5,760 ha median home range in Olympic Penn)	2,224 ha (i.e., 69% of 3,240 ha median for West Cascades)	1,907ha (i.e., 71% of 2,675 ha median HR in East Cascades)	Hanson et al. 1993 WFPB FEIS 1996 Target amounts (area of suitable habitat) represent discussion between J Hobbs & I. Blackburn, referring to Hansen et al values & local expertise.
Maximum area that a territory can grow to incorporate the minimum area of suitable habitat.	11,047 ha	7,258 ha	6,305 ha	Hanson et al. 1993
Maximum percent overlap with adjacent ranges	25%	25%	25%	Based on expert opinion from Carey et al. 1992 report in Oregon that overlap of member pair territories 28-75% 50-60-% J. Buchanan pers. com.

Meta-population Structure and Dispersal Habitat from the Literature

Northern Spotted Owls across their range are increasingly concentrated within islands of suitable habitat within a human-modified landscape. This type of population structure, in which a total population consists of smaller subpopulations that are isolated in space, has been termed a metapopulation (Shaffer 1985). Dispersal is a key ingredient of the metapopulation model, for animals dispersing between patches may buttress existing subpopulations, fill openings in populations caused by turnover, provide a rescue effect for subpopulations that are declining, or facilitate recolonization. For this reason, the frequency and magnitude of successful Spotted Owl dispersal has been the subject of considerable research effort involving both radio-telemetry (e.g., Miller summarized in Thomas et al. 1990; Gutiérrez et al. 1985; Miller and Meslow 1985) and simulation modeling (Thomas et al. 1990; Doak 1989). Thomas et al. (1990), based on an estimated 32.5% of the total landscape being suitable Spotted Owl habitat and a 3% search efficiency of the total landscape by dispersing owls, suggested that clusters of 15-20 pairs would be stable assuming moderate connectivity (dispersal) between clusters (see Lamberson et al. 1994). Habitat clustering for Spotted Owls in British Columbia may be important and should be assessed (Lamberson et al. 1994).

Defining Dispersal Habitat in the Model (adapted from Sutherland et al. 2007)

Currently, we do not have a definition that prescribes structure of dispersal habitat for Spotted Owls, as definitions of dispersal habitat in the scientific literature are not based on empirical studies (Buchanan 2004). For the strategic modeling framework, an estimate of the relative cost of movement through different cover types for dispersing owls was produced based on expert opinion. Values in the movement cost surface represent the cost of movement through different land cover types, where cost to the owl is lowest in suitable habitat and highest in areas that act as barriers (Table 5). Under this definition, structure and availability of forest (defined in this case by age only) is considered the main influence to impede or attract movement of owls, because structure directly influences spacing and access for movement. Dispersal habitat does not therefore necessarily require the same resources an owl might select when establishing a territory with permanent nesting and foraging areas. In the different models (i.e., territory and population) owls keep moving through the landscape until requirements regarding nest sites or foraging and nesting habitat are met.

Table 4: Rules for calculating the cost for a Spotted Owl to disperse through a cell type.

ALL BEC	Non-forest cells*	Forest cells:
	1) if a cell is a glacier, then cost = 20	1) if the stand age < 30 then cost = 5
	2) if a cell is water, urban or alpine, then cost = 10	2) if the stand structure type = "Structure Present", and stand age > minimum age for foraging habitat for structure present, then cost = 1 (the lowest value)
	3) otherwise, remaining types of non-forest land (scrub, rock, etc) is treated like forests < 30 years old, and cost = 5	3) if the stand structure type = "Structure Absent", and stand age > minimum age for foraging habitat for structure absent, then cost = 1
		4) if the stand age is between 30 and the minimum age for foraging (for the given structure type), then interpolate the cost from 5 down to 1 with increasing stand age.
BEC MH and ESSF only	if the cell is either a MH or an ESSF variant, add 2 cost units to whatever cost you have for that cell.	if the cell is either a MH or an ESSF variant, add 2 cost units to whatever cost you have for that cell.

*Note that rock is treated differently than ice - as talus slopes, if they can be distinguished on the digital GIS maps, may be used by owls as they provide habitat for a potential prey source (wood rats)

Connectivity between Habitat Clusters: modeling approach adapted by Sutherland et al. (2007)

Landscape connectivity refers to the degree to which a landscape facilitates or impedes movement of organisms among resource patches (Taylor et al. 1993). The strategic definitions of dispersal habitat used within the model identify “least-cost paths” through the landscape, and these consist of pathways between habitat patches that have a minimum overall accumulated cost using the cost surface described above by Sutherland et al. (2007). In areas of equal cost, least-cost paths will be straight lines, while in areas with variable cost (e.g., with mixtures of forest ages and non-forest), least-cost paths will be sinuous, finding the lowest cost way through the landscape. For helping to identify more connected habitat, distances (in cost space) from Type A habitat surrounding occupied sites were used, such that unoccupied Type A habitat that is closely connected (i.e., by short least-cost links) to occupied Type A habitat was considered more important than habitat more distant from occupied Type A sites (since more closely connected habitat is considered to be more accessible and hence more available over short- to medium-term periods).

This approach was used in the model to identify broad areas of connected habitat in the British Columbia owl range and to identify potential corridors for movement as part of management planning scenarios (see Section 3.3.2 this report and Chapter 6 and Appendix D from Sutherland et al. 2007). Connectivity of habitat was also taken into account at a smaller scale with further modeling of habitat quality using the habitat quality BBN in Sutherland et al. 2007 (see Chapter 8 Sutherland et al. 2007) and subsequently with habitat quality information used in prioritizing candidate areas for management using the Resource Location Model (Chapter 9 in Sutherland et al. 2007). Refer to Sutherland et al. (2007) for details on how the connectivity concept was used in the modeling and the mechanisms and assumptions used to integrate this into the rating of habitat quality.

Connectivity to the US Population

As mentioned above, connectivity among subpopulation clusters is considered essential to maintain a population’s viability (Lamberson et al. 1994). Connectivity between owl populations in British Columbia and Washington State has been compromised by human development of the lower Fraser River valley and adjacent areas in Washington. Large unforested valleys are believed to impede dispersal (Forsman et al. 2002a); therefore, dispersal of owls between Washington State and British Columbia is no longer likely in the lower Fraser River valley between Vancouver and Chilliwack. Dispersal between owl subpopulation clusters in British Columbia and Washington is now likely restricted to the Skagit River Valley (Chutter et al. 2004).

3.3 Location of Spotted Owl Habitat

3.3.1 Mapping Currently Suitable, Restorable, and Capable Habitat

Using the definitions of suitable habitat (Type A: nesting; Type B: foraging; Suitable: nesting + foraging) in Section 3.2, the location of suitable habitat within the species' range in British Columbia is shown in Figure 4 below (the area amounts given in hectares by subregion and BEC variants are listed in Appendix 3). Capable habitat is forest cover that is not classed as suitable at the projection year, but could become suitable in future years as the landscape changes. Capable habitat is not further subdivided. The location of suitable and restorable habitat (within 20 years) is presented in Figure 5. Restorable habitat is a special case of capable habitat, defined to permit assessment of critical habitat (see section 3.1). Restorable habitat is defined as capable habitat that is likely to become suitable habitat within a short time frame if protected from disturbance. For the case study, this time frame was designated as 20 years because preliminary modeling results had shown a lag of approximately two decades before a stabilized Spotted Owl population could be expected to begin to recover. The extent of potential owl territories was determined for both the current and future conditions (current + 20 yrs) where the latter was calculated by projecting the landbase 20 years into the future under the assumption of no harvesting or disturbance (essentially aging the forest by 20 years). Suitable (Type A and B) habitat at time = 0 and time = 20 years was summarized, and the proportion of times each ha of habitat was incorporated in a viable territory (based on 10 runs of the packed territories model) was calculated for each time period. This method provided an indication of amounts of current suitable and of restorable habitat that may contribute to the functionality of a breeding territory (i.e., it is a 'territory scale' definition of suitable and restorable habitat) within 20 years. Areal summaries of both suitable and restorable habitat located within (belonging to) and outside of (not included within) potential territories are given in Table 9 in Section 3.4.5).

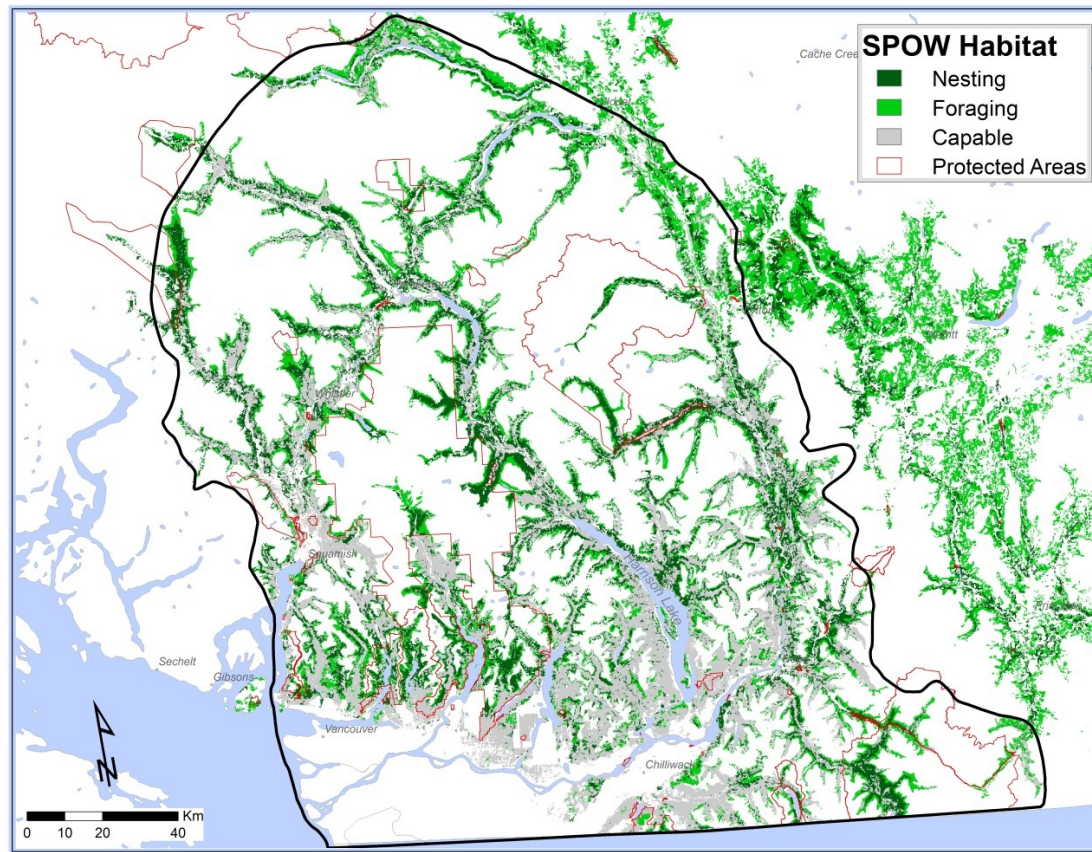


Figure 4: Location of current (2005) suitable habitat (nesting and foraging) within the Spotted Owl's range (black line). For reference, boundaries of legally defined protected areas are also shown (Sutherland et al. 2007).

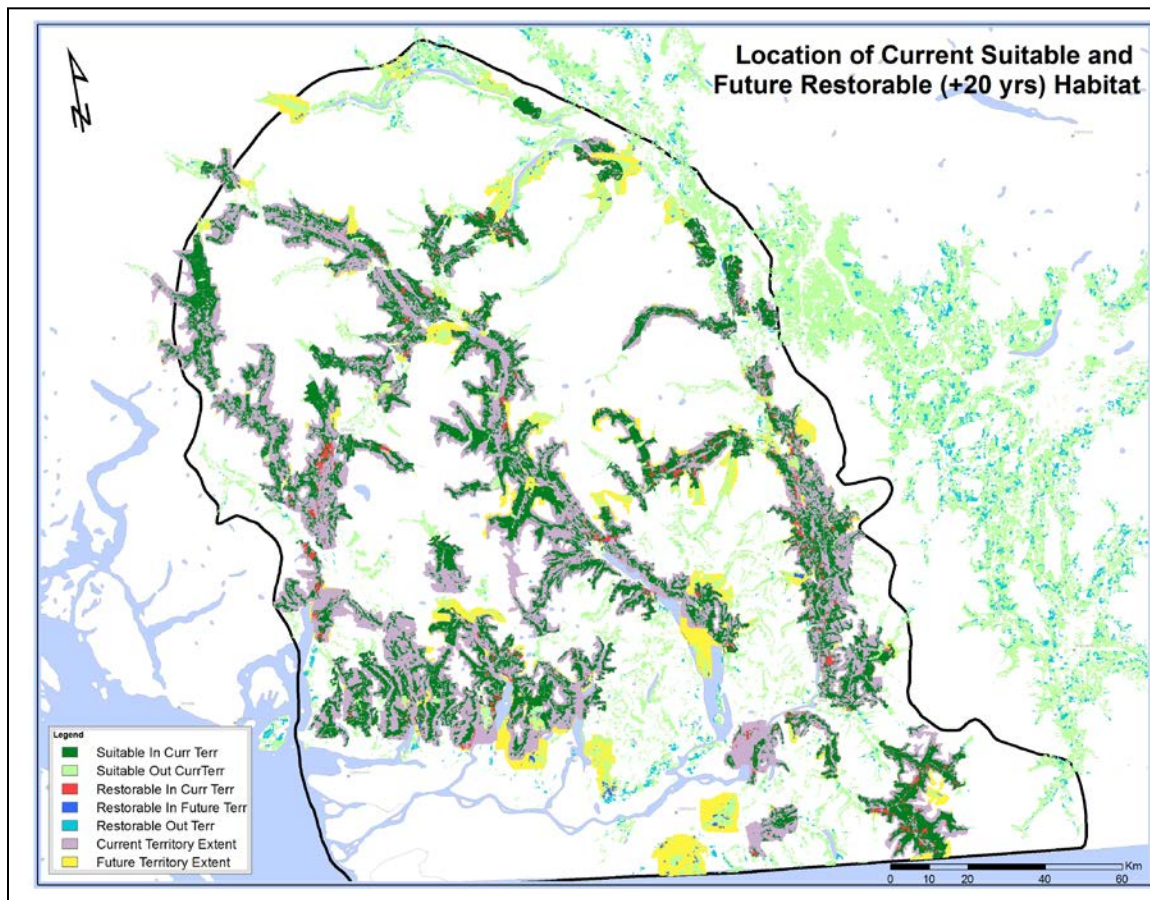


Figure 5: Currently suitable (2005) and restorable (within 20 years) habitat located within and outside of potential territories.

3.3.2 Locations of Broad Regions of Connected Habitat (i.e., Clusters)

Using the spatial graph approach, Sutherland et al. (2007) used the 2002-2004 inventory of active nest sites and locations of detections of single birds, and examined their distribution in relation to the distribution of patches of nesting habitat (i.e., well connected habitat was overlaid with habitat that can form a potential territory to identify locations of higher quality habitat). The preliminary analyses of connectivity in the model project indicated (at a broad scale) the clustering of habitat into three main areas, which roughly corresponded to the areas in which Spotted Owl nesting was confirmed at least once since 1991 and pair detections and/or nesting had occurred (or were highly probable) in the 1997-2004 period³ (i.e., the “recent historical population” $N=38^4$ sites; as used in Sutherland et al. 2007). The three main areas are referenced as the Greater Vancouver Regional District (GVRD) watersheds, Lillooet Valley and Fraser Canyon

³ Ian Blackburn, Ministry of Water, Land and Air Protection, 10 March, 2004

⁴ Recent historic population was $n = 38$ as of this analyses in 2005; recent historic population was increased to $n = 45$ for new updated analyses in Sutherland et al. 2007.

groups. The results can be useful as a basis to inform recovery planning, and details of these locations are available Appendix D in Sutherland et al. (2007).

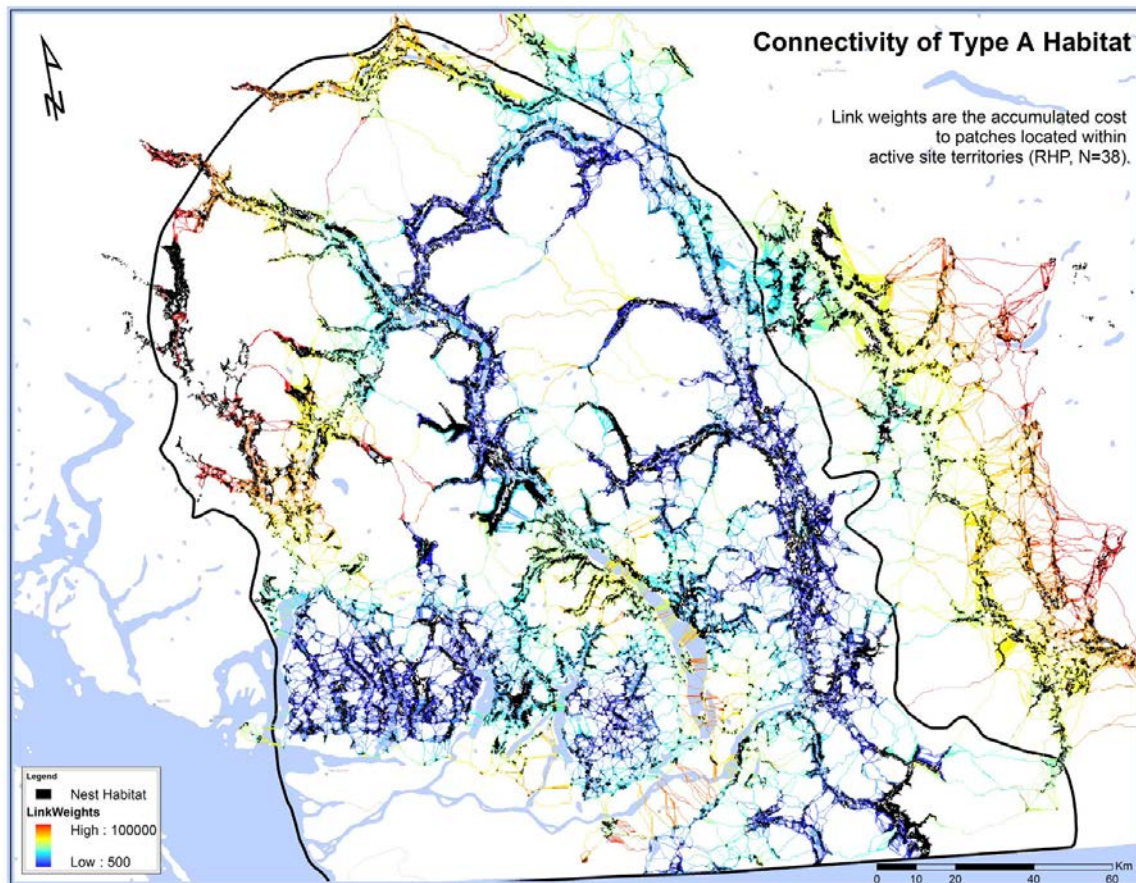


Figure 6: Connectivity of Type A (nesting habitat) within the range of the Spotted Owl (black line) in British Columbia

3.3.3 Mapping Habitat Quality and Locating Potential Critical Habitat

Connectivity between projected territories and relative to clusters of habitat in the landscape (i.e., centroids) was used by Sutherland et al. (2007) to produce integrated measures of habitat quality. Maps depicting the relative weightings of quality of suitable habitat and its location can be produced for any time period, and these can be compared temporally to indicate changes in the modeled value of recruited and current suitable habitat as connectivity is improved. These maps can be used to inform designation of critical habitat planning. Using the HQ BBN maps the locations of potential resource units that best meet biological and risk criteria can also be projected using the model framework – Resource Location Model. Sutherland et al. (2007) provide examples demonstrating the distribution of habitat by quality and potential resource units to manage for the future recovery goal (i.e., 125 pairs) and to meet critical habitat

requirements. Detailed information outlining definitions, assumptions, and mapped figures should be reviewed in Sutherland et al. (2007). This information as mentioned earlier is strategic in nature and would require expert knowledge of the landbase on implementation.

3.4 Amount of Habitat Required to Meet the Population Goal:

3.4.1 Population Goal and Rationale

The recovery goal is stated in section 14 of the recovery strategy and in section 1.3 of this guidance document. It includes a long-term population goal for the Spotted Owl in British Columbia of at least 250 adult birds. This number has not been thoroughly assessed for its biological feasibility. Rather it was selected by the recovery team based on assessments of COSEWIC ranking criteria balanced against historical and potential future population level estimates, as well as estimates of the amount of habitat required, available and recoverable (Chutter et al. 2004).

Reducing the “at risk” status of a species (ultimately such that it is no longer considered at risk) is the logical goal of any recovery plan. Under COSEWIC listing criteria, the major factor in the Endangered designation for the Spotted Owl is its current population of well below 250 adult birds (see Appendix 4 in Chutter et al. 2004). Hence, the first and most important step required to downlist the Spotted Owl to Threatened is to increase the population to at least 250 adult birds.

Blackburn et al. (2002) estimated that the pre-European Spotted Owl population in British Columbia may have been as high as 500 breeding pairs (including a 25% territory overlap and an assumed occupancy rate of 90%). This estimate was derived from the assumed carrying capacity of coniferous forests within the **then known** range of the owl in British Columbia **(and included rural and urban areas that were historically suitable but did not include the later range extension in the Cascades Forest District)** and can't be empirically evaluated at present. **The recent change in the definition of suitable habitat to lower the maximum elevation range for the species results in a smaller maximum estimate for the same area of approximately 400 breeding pairs (Ian Blackburn pers. comm.).** These estimates are consistent with a maximum upper limit of packed territories of 496, identified using the packed territories model on the long-term equilibrium landscape (i.e., only natural disturbances were simulated on the landscape, projected out for 10,000 years; Sutherland et al. 2005). Such a population would also have included immature birds and non-breeding adult “floaters” and therefore, the total population would have been larger. **This modeled estimate includes the range extension in the Cascades but does not include** historically suitable habitat **that** has been converted **to non-capable habitat by** urban and rural development in the Lower Mainland. Therefore, it would be unrealistic to expect to attain similar population levels again. In an aging-only landscape, projections of packed territories indicate that by year 50 at most 264 territories would pack into the landscape (range: 199–264) (Sutherland et al. 2007). The goal of 250 adults is about 25% of the original historic maximum estimate of 500 breeding pairs

by Blackburn et al (2002) and does not seem numerically unrealistic over the long-term if factors causing the decline can be reversed. Although substantial areas of the potential recovery habitat are currently unsuitable due to past forestry management objectives, the existing Spotted Owl Management Plan (SOMP: see section 18.1.3 in Chutter et al. 2004) covers 363,000 ha of habitat designated for conservation of 101 territorial pairs of Spotted Owls. In addition, four new areas (three in the Cascades Forest District and one Matrix area: see sections 3.1.1 and 3.4.9) are now protected as Wildlife Habitat Areas, and there are 15 known territories remaining that are currently without formal protection. While the levels of suitable habitat conserved under SOMP may need to be re-addressed and/or redistributed spatially on the landscape, this suggests that enough potentially suitable habitat exists to recover the species to the population goal of 250 adult birds.

The recovery team realises that 250 adult birds does not necessarily equate to 125 territories as a normal population includes a certain level of non-breeding adult floaters, and that some level of territory overlap occurs normally between neighbouring pairs. Accommodating the non-breeders in the assessment of required habitat may increase the amount to be set-aside, as single birds may also occupy large territories. Moreover, it is unlikely achieve 100% occupancy for all territories. The recovery team also realises that simply putting aside sufficient suitable habitat for a population of 250 adult birds will not guarantee recovery success. Other threats also need to be addressed, and reaching the population goal will also require population augmentation efforts. Future recovery plans should reassess, and may need to revise, the population goal. However, at this point in time, the recovery team feels that the 250 adult bird population goal is an appropriate one on which to base initial recovery planning efforts.

While the recovery team feels that reaching the 250 adult bird population goal over the long term is feasible, reaching the next level of 1000 adult birds required for downlisting the owl further to Special Concern is not. Sufficient habitat and population numbers needed to reach this level did not exist previously; hence, a status designation of Threatened, according to COSEWIC criteria is likely the best that can be expected to be attained for the Spotted Owl in Canada. However, a lower status may be possible if threats to the species can be removed and a sustained lower population warranted a “step-down” listing to the status of Special Concern. An example of such a precedent exists for the Peale’s subspecies of the Peregrine Falcon (*Falco peregrinus pealei*) in Canada. This falcon and its breeding habitat face few threats, and regular 5-yearly surveys have shown the population to be remarkably stable. Therefore, although there are less than 200 historical breeding sites on record and the number of known active eyries has usually been around 100, it is designated Special Concern. Although this status may be possible for the Spotted Owl over a longer term, it is not feasible for current the 5-year recovery planning period.

From a biological perspective, choosing an appropriate initial population goal for this species could be recast as building the population to a level at which the population is stable. Because the current Spotted Owl population in British Columbia is so small, it is difficult to obtain an interpretable estimate of recovery probability in the short- or long-term. The CSORT and modeling team explored this question and decision makers are

strongly encouraged to consult Sutherland et al. (2007). The modeling results demonstrate that even with stable vital rates and larger simulated starting populations there is high uncertainty in outcomes for the population. However, future population outcomes are potentially influenced by of the landscape management and the model indicates that actions to manage habitat for a future recovered population need to be considered now given the time lag for habitat recruitment (Sutherland et al. 2007). The most immediate question in British Columbia is whether measures can be taken to stabilize the population. Population augmentation is enabled in the recovery strategy (Chutter et al. 2004). However, population augmentation measures will only be viable if appropriate habitat protection measures are implemented to ensure suitable habitat is protected and recruited in appropriate areas. Projections of population augmentation actions can be tested in the model framework under different landscape scenarios.

3.4.2 Projected Timelines for Meeting Population Goal

As mentioned in the section above, much uncertainty exists regarding how quickly Spotted Owl populations can recover in British Columbia. Using the current vital rates for the British Columbia population, all projections using the population model, regardless of the amount of habitat protection provided, result in a very high likelihood of extirpation of the population within the next several years (Sutherland et al. 2007). It is thus strongly recommended that habitat protection be combined with some form of population augmentation to enable the species to recover.

Sutherland et al. (2007) demonstrated using the Resource Location Model and current habitat definitions that achieving habitat amounts necessary to meet the recommended population goal could be achieved within 50 years. In their examples they identified and prioritized areas that would best meet (i.e., based on biological and / or risk criteria) a goal of 125 breeding pairs 50 years from 2006. The resultant maps take into account the current locations of individuals and that the population would need to grow over the 50-year time period to achieve the recovery goal. The RLM examples also demonstrate that weighting of risk criteria ultimately affects where habitat is best set aside, and how this would in turn potentially effect recovery effort could be tested in the model framework (e.g., see Sutherland et al. 2007).

3.4.3 Description of Amount of Territory Needed for a Breeding Pair or Single Bird; Dispersal of Juveniles or Single Birds

The amount of territory needed for Spotted Owls, based on current model definitions specific to the three ecological subregions, varies depending on the ratio of suitable to unsuitable habitat within the territory. While the CSORT recognises that the recovery goal of 250 adult birds does not translate directly to 125 pairs/territories, we have equated the two for the sake of simplicity and have not attempted to estimate separate habitat requirement values for single non-breeding birds. The assumption is that successful achievement of the recovery goal is best assured with territories capable of supporting breeding. While it is possible that floaters may not require a territory, single birds that

hold territories probably require substantial amounts of habitat, so these two factors may tend to average each other out. This assumption is also consistent with the modeling, as the model's definition of territory is based on the amount of habitat needed by a breeding pair and does not distinguish this from what a single, territorial bird might require. Table 6 summarises and compares the recommendations for territory size and connectivity from three existing sources: the existing Spotted Owl Management Plan, the CSORT interim recommendations, and the assumptions and results from the model. These are discussed below.

Spotted Owl Management Plan

Based on the best available knowledge and management requirements at the time, the existing Spotted Owl Management Plan (SOMP: in SOMIT 1997) used a fixed area of 3200 ha to represent the Long Term Activity Centre (LTAC) of a breeding pair of owls (equivalent to a breeding pair territory). Of the 3200 ha area, 67% was to be maintained as suitable habitat. In general, suitable habitat had to be comprised of coniferous forests within the range of the owl that occurred below elevations of 1370-1500 m (depending on the BEC variant), were at least 100 years old, and had dominant trees taller than 19 m (see section 18 and Appendix 5 in Chutter et al. 2004).

CSORT Interim Recommendations

Initial recommendations by the CSORT (see Appendix 1 in Chutter et al. 2004) suggested maintaining the 3200 ha LTAC size throughout the specie's range, but stopping all further habitat removal within existing and unprotected LTACs (those found since SOMP was invoked by Cabinet). Essentially it called for 100% protection/restoration other than natural disturbances. This was agreed upon by the majority of CSORT members, though a few felt that while increased protection was needed, there was room for flexibility between 67% and 100% protection from human industrial activities.

Model

Current understanding of the biophysical attributes of Spotted Owl habitat (including suitability, temporal aspects, spatial distribution and connectivity) has been updated during the development of the model and is given in Section 3.2 above. The location of existing and potential Spotted Owl habitat is described in Section 3.3. Information from these sections shows that territory sizes needed by breeding pairs differ between the subregions, and that the range from minimum to maximum territory size is quite large depending on the distribution of suitable habitat within the territory. The mean amount of suitable habitat varies between subregions from 1906 to 3010 ha which would equate to territories in which all habitat was suitable. Allowing for territory expansion to include unsuitable habitat until the model determines the territory too large to be functional results in maximum territory sizes varying from 6305 to 11,047 ha depending on sub-region. However, these maximum sizes hold a large ratio of unsuitable to suitable habitat based on the extremes found in the literature and may not be able to support a breeding pair. In the model the assumption that adult survival improves as proportion of habitat in a territory increases captures the relationship on how fragmentation can reduce territory quality, although minimum amounts of habitat are still obtainable by the owl.

Mean territory sizes (ha on the landbase) generated by the model in the three subregions of British Columbia when the packed territories model is used are quite variable by subregion (see Table 8 in section 3.4.4 below). The means are 3333 ha for the continental, 4529 ha for the submaritime and 6941 ha for the maritime. Note that the projected means from the model are usually larger than the SOMP means in part because the areas included within the model's definition of 'territory' include all areas (including non-capable and non-forested habitat) that must be traversed to obtain enough suitable habitat to build a contiguous territory. In comparison, the SOMP calculations only include those areas deemed to have the potential to contribute to territory function based on expert opinion (which would not include non-capable and non-forested habitat).

Table 5: Comparison of current management strategies under SOMP, CSORT interim recommendations, and from using the packed territories modeling framework (Sutherland et al. 2007).

Item	SOMP (LTAC mgmt rules)	CSORT interim recommendations	Model (using biological assumptions for strategic packed territories model)
Mean size of LTAC/territory – maritime	3200 ha	3200 ha	6941 ha (\pm 2156) Range 3010 ha - 11,047 ha
Mean size of LTAC/territory – submaritime	3200 ha	3200 ha	4529 ha (\pm 1479) Range 2224 - 7258 ha
Mean size of LTAC/territory – continental	N/A (subregion was not included)	3200 ha	3333 ha (\pm 877) Range 1906 - 6305 ha
Overall % of LTAC that should be suitable	67%	Minimum 67%, but recommended temporary cessation of logging within suitable habitat in SRMZs (except for enhancement logging) until results of inventory were completed and SOMP reassessed.	Percent suitable can vary depending on size of territory. The minimum sizes listed above represent territories comprised entirely of suitable habitat. A key assumption is the relationship between breeding adult survival and habitat quality in a territory, where adult survival improves with percent of suitable habitat within a territory. Of the policy scenario options explored so far during modeling, 100% protection within LTACs provided the greatest benefit for owls, but the region from 67% to 100% was an unexplored.
Amount of suitable in Type A, B (or C...where C = core nest area/superior nesting habitat) around nest sites	500 m reserves around nest sites 67% Type A; rest Type B	100 % protection from industrial activities throughout LTAC	The model does not use a set amount of Type A, B or C habitat, rather it initiates territories from cells that have highest proportion of Type A within 1100-m radius to the cell.

Max distance between territories/clusters	Territories grouped together into SRMZs (clusters); Maximum distance between SRMZs = 20 km; SOMP mean = 15 km	Maintain and enhance SRMZs. Identify, protect and manage critical corridor habitat	Habitat clusters (see map and description in section 3.3.3)
Width and management of connectivity corridors	Minimum 1 km wide between patches > 500 ha within LTACs.	SOMP or better	Model has not yet directly tested effects of variable width of management corridors. Model projects increasing benefits to owl as level of protection of habitat in corridors increased from the 67% cover rule to 100% protection.
Territory grouping: Recommendations for grouping territories to increase their viability as successful breeding areas, including maximum overlap between territories.	Distributed across range. Multiple LTACs grouped into SRMZs to increase connectivity and ability for dispersal.	As per SOMP until it is reassessed.	Weighted by subregion. An assumption in the connectivity model was that each small owl management unit (<5000 ha) should have at least two links to another one, and each large management unit (>5000 ha) at least three links. But this assumption (explicitly chosen to show a max. difference between corridors and no corridors scenarios) needs further refinement.
Regional representation	Maintain habitat throughout range – however, sites in Lillooet not known of when SOMP created	Maintain habitat throughout range, including Lillooet	Representation proportional to area per sub-region

An additional comparison can be made against the median home range sizes reported from Washington State (WFPB 1996), percentages of which were used to determine the mean suitable habitat requirements for the three British Columbia subregions as reported for the model project (Sutherland et al. 2007). These median home ranges are 2675 ha in the eastern Cascades, 3240 ha in the western Cascades and 5760 ha in the Olympic Peninsula, three areas which correspond respectively to the continental, subarctic and maritime subregions in British Columbia. The figure for the western Cascades (3240 ha) is very close to the standard SOMP territory size of 3200 ha currently used across the owl's range in British Columbia, while that for the Olympic Peninsula is larger (5760 ha), and that for the East Cascades is smaller (2675 ha).

These sources all show a similar pattern of increasing territory size as one progresses from the drier interior habitat towards the wetter coastal areas. This suggests either that habitat is more contiguous in the continental than the other sub-regions (thus territories are less fragmented or smaller as a result of improved habitat distribution), or that resources are more abundant and/or available to owls in the drier ecosystems. The median home ranges in Washington areas (listed in Table 4 from WFPB 1996) are somewhat smaller than those projected for British Columbia by the model (as shown in

Tables 6 and 8) which tends to support the hypothesis that territories get larger as one progresses northwards through the species' range. The 3200 ha territory size used in SOMP appears to represent a consistent compromise for management purposes. However, it does restrict flexibility and may potentially be underestimating the amount of habitat required by owls in the maritime subregion. Given the higher natural disturbance rates in the drier continental subregion, overestimating the amount of habitat needed may provide a useful management approach as the extra habitat will likely be required to accommodate periodic losses to fire in this area.

3.4.4 Amount of Suitable Habitat Required for Survival and Recovery of the Population

Due to the complexity of the issue, it is not currently possible to come up with a single definitive estimate of the amount of habitat required for survival and recovery of the population. To attempt to address this, the CSORT compared three strategic, but aspatial, estimates of the amounts of suitable habitat required for recovery and survival. One of these was based on SOMP's management recommendations, while the other two used the model framework. Those amounts calculated using the model datasets encompassed the owl range as presented in the strategy document (Chutter et al. 2004); these amounts included the Elaho Landscape unit which may have less habitat value than originally thought. The estimates generated are therefore based on different assumptions. The amounts calculated using the model framework used the general suitable habitat definition (Section 3.2.1, Table 2). The strategic amounts calculated are intended to provide upper limits on amounts required, but may differ once critical habitat is spatially defined. Habitat requirements for survival of the current population were calculated using a modeled population of **50 breeding pairs**, to account for both uncertainties in the current inventory (1997-2004) and for the fact that not all territories will be occupied at any time. Habitat requirements for recovery of the population were calculated based on the long term recovery goal of 250 adult individuals, which we translate to **125 breeding pairs** to allow for a maximum number of territories.

SOMP-based Estimate

In the recovery strategy (Chutter et al. 2004), a crude preliminary estimation of recovery habitat was made based on the population goal of 250 adult owls and the territory size and suitability ratio used for LTACs in SOMP. Assuming the habitat for 250 adults would be contained within 125 breeding territories, we multiplied the recommended LTAC size of 3200 ha by 125 to come up with an estimation of 400,000 ha for recovery. Using the same methodology on the survival population of 50 pairs used in the modeling estimates, survival habitat would require 160,000 ha (50 x 3200). Note, however, that these calculations incorporate the SOMP rules of 67% suitable habitat per LTAC, so the required amounts of suitable habitat within the LTACs would actually be 268,000 ha for recovery habitat and 107,200 ha for survival habitat.

Modeling Estimates

Estimates using the model framework were produced based on the recent historic population (n=38) by initiating the active site territory model and "growing" territories

around these sites until the minimum amount of habitat by subregion was incorporated or until maximum territory size was met. Estimates were also produced from using means of 10 iterations of the packed territories model, where territories are initiated with potential nest sites. The first estimate reflects sites the recent historic population has used and uncertainty is associated with amounts for these sites if the sites are in poor quality habitats or do not meet the average conditions (i.e., minimum habitat amounts or maximum territory sizes) used in the model. The packed territories model locations should reflect these parameter definitions. In both cases, an estimate of the total area (ha) of suitable habitat required to meet a survival goal of 50 territories, and a recovery goal of 125 territories was obtained by multiplying a weighted average of suitable habitat in territories by the target number of territories for survival using the following formula:

$$Hab_{total} = \sum (a_i \cdot n \cdot p_i),$$

where:

a_i = mean area of suitable (Type A + B) habitat in territories for subregion i ,

n = target number of territories for survival / recovery, and

p_i = proportion of territories in subregion i .

Estimates for the amount of suitable habitat required to meet survival and recovery goals are given in Table 7 (from recent historic active sites modeled as territories) and Table 8 (from all packed territories). Amounts are slightly higher based on packed territory estimates.

Table 6: Estimated amounts (means; \pm SD) of habitat required to meet the survival and recovery goals for the Spotted Owl. Territory areas and amounts of habitat for recent historic active sites (n=38; 2005) estimated using the active site territory model (if upper maximum is exceeded in this model the territory stops growing).

Active Site Territories	Maritime	SubMaritime	Continental
N	8	25	5
Proportion of Sites	0.21	0.66	0.13
	6,745.00	4,270.25	3,669.60
Mean Area of Territory	(\pm 2,806.06) 2,969.88 (\pm 519.19)	(\pm 1,370.96)	(\pm 1,572.92)
Mean Area suitable Habitat in territory		2,199.75 (\pm 159.80)	1,829.60 (\pm 133.83)
Mean Proportion of suitable habitat in territory	0.51 (\pm 0.20)	0.56 (\pm 0.15)	0.56 (\pm 0.18)

Total ha Suitable Habitat for 125 territories:	289,530.41
Total ha Suitable Habitat for 50 territories:	115,812.16

Table 7 Estimated amounts (means; \pm SD) of habitat required to meet the survival and recovery goals for the Spotted Owl. Potential territory area and amounts of habitat estimated from all projected territories (n=166) from 10 iterations of the packed territory model initiated with potential nest sites (if territories exceed maximum size they are eliminated).

Packed Territories	Maritime	SubMaritime	Continental
N	27	125	14
Proportion of Sites	0.16	0.75	0.08
	6,941.22	4,529.24	3,333.42
Mean Area of territory	(\pm 2155.92)	(\pm 1,479.37)	(\pm 877.41)
	3,055.19	2,210.56	1,911.75
Mean Area of suitable Habitat in territory	(\pm 325.6)	(\pm 230.4)	(\pm 190.6)
	0.49	0.54	0.61
Mean Proportion of suitable habitat in territory	(\pm 0.16)	(\pm 0.16)	(\pm 0.14)

Total ha Suitable Habitat for 125 territories:	290,233.36
Total ha Suitable Habitat for 50 territories:	116,093.34

It is important to note that these three estimation methods arrived at similar amounts of suitable habitat required for survival and recovery ranging from 107,200 to 116,093 (for 50 territories) and 268,000 to 290,233 (for 125 territories) respectively. These numbers likely represent upper limits of the amount of suitable habitat required assuming spatial configuration does not strongly influence availability.

The differences between the model estimates and the SOMP are partially owing to the proportion of suitable habitat per territory vs LTAC. The proportion of suitable habitat per LTAC is higher (0.67) than mean estimates from packed territories from the modeling. This is expected as the LTAC is a unit defined using capable habitat and by expert opinion on areas required for consideration during management, whereas a packed territory is based on total area traversed by owls in utilizing a breeding territory (including high cost areas) which may not have habitat potential or require management (i.e., it includes areas likely excluded from LTACs). Thus, territories are on average larger than LTACs, which results in smaller proportions estimated for the same amount of habitat.

3.4.5 Amount and Distribution of Currently Suitable and Restorable Habitat

Substantial areas of currently suitable and restorable habitat are present in British Columbia (Figures 4 and 5 in section 3.3.1). The areas included in the maps amount to 534,442 ha of which 282,427 ha is Type A (nesting) habitat and 251,995 ha is Type B (foraging) habitat. Figure 5 in section 3.3.1 includes habitat restorable within 20 years. A total of 534,422 ha of suitable habitat exists within the owl's range of which 125,615, 320,122 and 88,685 ha occur in the Maritime, Submaritime and Continental subregions, respectively (see Appendix 3 for amounts of suitable habitat [Type A and B] in each subregion and by BEC variant).

Given the assumptions in the model, while a significant amount of suitable habitat appears to exist across the landscape within the owl's range, only a portion of it can be incorporated into potentially viable owl territories (Table 9). Furthermore, projecting 20 years into the future, a much smaller amount of suitable habitat was projected to have been restored into territories. Over all subregions combined, the model projects 534,422 ha of currently suitable habitat, but only 395,438 ha (74.0%) of it would be incorporated into territories and only an additional 62,741 ha (15.9% above currently suitable) would become available in 20 years. Comparing the ratios of the three subregions currently covered by SOMP to the same ratios using the model's projections shows that the continental subregion is currently underrepresented (6.1% of total in SOMP vs 16.6% projected available by model). Comparable figures for the submarine and maritime subregions (61.5% SOMP vs 59.9% model and 30.1% SOMP vs 23.5% model respectively) suggest the submarine projections are quite close while the maritime subregion is somewhat overrepresented by SOMP (Table 9).

Table 8: Area summaries (ha) of currently suitable and restorable (in 20 years) habitat in the range of the Northern Spotted Owl compared to the amount of existing suitable habitat within the current owl management areas (SRMZs).

Sub-region	Available as per model projections	Available as per model projections	Available as per model projections	Managed in SRMZs	Managed in SRMZs	Managed in SRMZs
	Total suitable	Amount suitable and available to incorporate in territories	Amount restorable in 20yrs and available to incorporate in territories	Type A	Type B	Total (A&B)
Maritime	125,615	85,668	19,355	27,904	24,300	52,204
Submaritime	320,122	270,134	28,779	66,812	39,961	106,773
Continental	88,685	39,636	14,607	6,118	8,528	14,646
All Regions	534,422	395,438	62,741	100,834	72,789	173,623

3.4.6 Amount of Habitat Needed over Time for Recovery

The Spotted Owl Management Plan (SOMIT 1997a) allocated 363,000 hectares of habitat for Spotted Owl management, which theoretically could be enough to maintain a

sustainable population. However, current habitat conditions of these areas may be too fragmented to allow for effective connectivity of subpopulations, re-colonization of currently vacant habitat, and juvenile dispersal.

The amount of habitat needed over time for recovery reflects the difference between what is currently available and what is needed for a sustainable population. A comparison of these amounts as presented in sections 3.4.4 and 3.4.5 suggests that more suitable habitat will be needed than currently exists in SRMZs to meet the goal over time. The three methods used to estimate the amount of suitable habitat required for recovery in section 3.4.4 arrive at estimates ranging from 268,000 to 290,233 ha, whereas an estimated 173,623 ha is currently suitable in existing SOMP SRMZs – a shortfall of around 100,000 ha. This deficit can be addressed through recruitment over the long-term, and in the shorter 20-year term, the restorable habitat could have a significant positive benefit if it is strategically placed on the landscape. Theoretically, there should be enough survival habitat available for the 50 territories discussed in section 3.4.4, as these only require 107,200 to 116,093 ha compared to the 173,623 ha currently available in SRMZs (Table 9).

The estimates above are aspatial and therefore are likely low, and may be increased to meet spatial requirements over time. As some of this habitat is currently available but not captured in SRMZs, it appears that there must be a reliance on restoration of habitat to meet the population goal of 125 territories. The fact that the population appears to be continuing its decline emphasizes the concern regarding the spatial distribution of habitat on the landscape, as well as pointing to other factors such as small population and competition effects discussed in the recovery strategy (Chutter et al. 2004). The examples of the Resource Location Model projections where territories might be placed today to meet the goal of 125 breeding pairs in 50 years, demonstrates the predicted use and relative value of habitat recruitment, and emphasizes the importance of the relationship of connectivity in the model (Sutherland et al. 2007).

3.4.7 Analysis of Threats to the Habitat

Loss and fragmentation of habitat is widely thought to be the primary threat to the Spotted Owl throughout the Pacific Northwest (USDI 1992; Dunbar and Blackburn 1994; Gutiérrez et al. 1995). More than 10% of the historic range of the owl within the Chilliwack and Squamish forest districts has been converted to urban and agricultural areas, roads, pipelines, reservoirs, hydroelectric dams and associated reservoirs, recreational developments, and utility corridors. Continued habitat loss will likely decrease the total amount of habitat available to the owl and may further fragment habitat. As well, natural disturbances (e.g., fire, insects, blowdown) may also result in habitat losses. In addition to habitat loss, conversion of old stands to young stands may impede dispersal of owls, depending on the spatial configuration of the landscape, because young stands may provide lesser resources to dispersing owls (e.g., fewer or less accessible prey, less cover from predators). If such constraints on dispersal occur, then

some areas of suitable habitat, although they are large enough to support owls, may not be occupied.

This section provides a brief overview and analysis of the primary threats to existing Spotted Owl habitat in British Columbia. Where possible, the assessment includes an estimate of the area potentially impacted by each threat. The primary threats to Spotted Owl habitat are: forest harvesting; energy and mineral development including Independent Power Projects (IPPs), mining, and associated roads and right-of-ways; natural disturbance (including fire, insects and disease); and urban infrastructure development (e.g., proposed reservoir expansions in the Greater Vancouver Regional District). In general, the area potentially impacted by each threat is expressed both in hectares and as a percentage of the total area of suitable Spotted Owl habitat available within the range of the owl. Where data are available, additional detail is provided on the potential impact of each threat within each of the subregions.

Forest Harvesting

In British Columbia, clearcut logging typically has reduced stand-level structural diversity in logged areas. More recent forest management practices may provide better management of biodiversity values, including provisions for maintaining more structural diversity in logged areas both at the stand-level (e.g., Wildlife Tree Patches and Riparian Management Areas), and at the landscape level (e.g., Old Growth Management Areas, Ungulate Winter Ranges, and indirectly through Visual Quality Objectives). However, these management practices, by themselves, do not provide large enough habitat patches to support breeding pairs of Spotted Owls. As well, rotation lengths between successive harvests may be shorter than required to achieve suitable habitat conditions for owls (i.e., shorter than 100 years), potentially resulting in a longer-term condition of non-functional habitat

The potential threat to Spotted Owl habitat from forest harvesting is substantial. Nearly one-third (31.2%: 169,725 ha) of all suitable Spotted Owl habitat falls within the Timber Harvesting Land Base (THLB: Table 13 in section 3.4.8). By subregion, these numbers are 24,937 ha or 19.9% in the maritime, 105,654 ha or 33.0% in the submaritime, and 39,134 ha or 44.1% in the continental. Of the 45,762 ha of habitat that will become suitable in the next 20 years, an additional 16,291 ha or 35.6% falls within the THLB. By subregion, these numbers are 5,053 ha or 31.0% in the maritime, 6,662 ha or 40.9% in the submaritime and 4,576 ha or 28.1% in the continental.

Because of the potential risk to Spotted Owls of many currently-used timber harvest practices, much attention is being focused on improving forest management policies related to Spotted Owl habitat to ensure that sufficient habitat is available for recovery of the species. In response to concerns raised about harvesting in Spotted Owl habitat, some major licensees have voluntarily stopped harvesting in Spotted Owl LTACs; thus, in recent years the amount of suitable Spotted Owl habitat that has been harvested within LTACs has been reduced.

Energy and Mineral Development

Independent Power Projects (IPPs) are considered to be a key emerging source of electricity in British Columbia. These projects include small-scale “run-of-river” hydroelectric projects, biomass energy systems, and wind power. In particular, small hydroelectric is being promoted as an energy option in the province, leading to a significant increase in the number of such projects being proposed, some of which occur within the range of the Spotted Owl.

Although IPPs are considered a clean energy source, “run-of-river” hydroelectric projects are not without their environmental impacts. From a terrestrial perspective, the largest concern involves the clearing of right-of-ways for powerlines to connect IPPs to the BC Hydro “grid”, as well as local scale impacts surrounding the development of the site itself, including access roads, construction of the water intake, the penstock, and the powerhouse. Within Spotted Owl habitat, the major threat from IPPs is related to this infrastructure development, particularly the development of new powerlines to connect the IPPs to the grid.

At the time of writing this report, Land and Water British Columbia Inc. is the Crown Corporation responsible for reviewing applications and issuing water licenses to IPPs. Environmental considerations are a very important component of the adjudication of waterpower projects (Neil Banera, pers comm). To ensure that any environmental issues are adequately addressed before new applications are approved, the review process currently requires at least two consultations with designated staff at the regional Ministry of Environment office. The CSORT recommends that this consultation include an assessment of the potential impact of any new IPPs on Spotted Owl habitat.

The CSORT has asked LWBC for updated statistics on the number of proposed IPPs within the range of Spotted Owl habitat, but they had not been received at the time this document was completed. As of 2005, on a provincial scale, 359 applications for IPPs had been made in British Columbia since 1988 (Neil Banera pers comm). The majority of these projects were concentrated in coastal areas (Fraser Basin Council 2003), with approximately 150 applications in the Lower Mainland/Coastal area as of 2003. LWBC expects that only a small number (25-30) of the 359 applications will actually receive approval in the next 10 years. Although there has been an increase in the rate of construction of IPPs in the past few years due to the province now looking to the private sector to assist in satisfying its energy needs, the annual average has been less than 2 per year provincially (Neil Banera pers comm).

Mining and mining exploration could have important local impacts on Spotted Owl habitat, especially where mining interests are located in existing or recently active sites. Unlike the forest industry, mining activities are not regulated by the Spotted Owl Management Plan (SOMIT 1997a) or any related agreements reached with the forest industry since that plan was implemented. Therefore, if a mineral claim exists in a Spotted Owl territory, the Spotted Owl Management Plan does not apply and access roads and associated forest clearings can be developed. There is an existing concern of this type for the nest stand of one of the most active Spotted Owl territories known in BC in recent years. However, it is possible to place a reserve on specific sites under S. 22 of

the *Mineral Tenure Act*. In the past, such reserves have been used to protect proposed protected areas, treaty settlement lands, hydro projects, roads, Ecological Reserves, etc., from mining activity. It is not necessary that lands proposed for reserves have a formal designation before a reserve is applied. If there is enough information provided and there is a compelling reason, the reserve may be established. Reserves can preclude issuance of mineral, placer or coal tenure, or they can place specific conditions on mining work that can be done within a reserve. Reserves are established through regulation established by the Chief Gold Commissioner; Cabinet approval is not required (Linda Bates, pers comm.).

Natural Disturbance

As noted in section 3.2.3, Spotted Owl habitat spans a number of different ecosystem types, from the very wet ecosystems on the mainland coast of British Columbia, to the drier ecosystems in the interior of the province. The ecosystems within this range are subject to a variety of natural disturbances, including mixed-severity wildfires, insect defoliators, bark beetles, root diseases, windthrow, avalanches and landslides (Pickett and White 1985; White 1979). The topographic and climatic diversity of the region creates diversity in both disturbance regimes and in their effects on stand structures. In general, lower severity disturbances that do not remove stand structure are considered to have a relatively small impact on Spotted Owl habitat and may in some cases enhance Spotted Owl habitat. For this reason, our analysis of threats to Spotted Owl habitat from natural disturbance focuses on “stand-replacing” disturbance.

As described above (section 3.2.3), a combined approach involving empirical data and disturbance history field work was used to determine that, overall, a 5% variation in suitable Spotted Owl habitat is expected within the range of the Spotted Owl due to stand-replacing disturbances. The range of variability is greater in the continental subregion (6-7%) due to the higher frequency of disturbance in these drier ecosystems. The majority of these stand-replacing natural disturbances are likely due to fire, so we can consider, overall, the threat to suitable Spotted Owl habitat from fire is in the range of 5%. However, the potential impact of this threat could be disproportionate if major fires were to occur in currently occupied territories.

Bark beetles are endemic within Spotted Owl habitat, particularly in the submaritime and continental subregions. A combination of both stand suitability and weather has led to an outbreak in mountain pine beetle within British Columbia. Some of the areas impacted by pine beetle fall within the range of the owl, and two other beetles (Douglas-fir beetle and spruce beetle) are also active within the range. In 2005, an estimated 12,200 ha within the owl's range was impacted by these beetles with 6240 ha occurring in the continental, 5960 ha in the submaritime and no appreciable beetle infestations in the maritime (Table 10). While the current impact is not large, the potential for spread (particularly for the mountain pine beetle) is real and could become a significant factor impacting Spotted Owl habitat in the future (Don Heppner, pers comm). In the future, if lodgepole pine proves to be an important foraging habitat for Spotted Owls, this impact will need to be assessed in that forest type.

Table 9: 2005 bark beetle impact areas within the Spotted Owl's range in British Columbia.

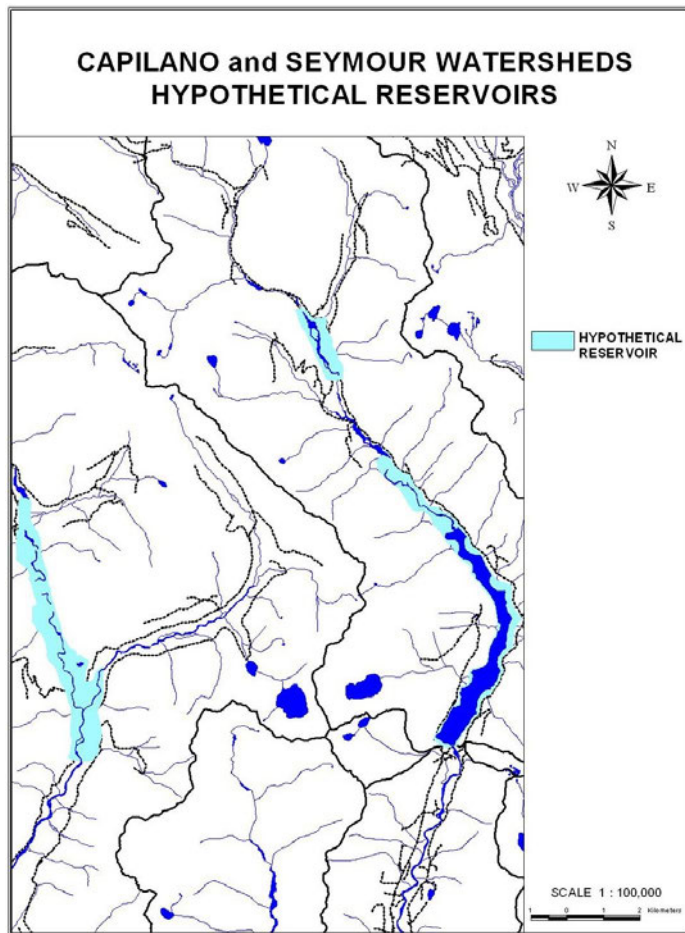
General Impact Area Locations	MPB (ha)	DFB (ha)	SB (ha)	Total (ha)
SUBMARITIME				
Nahatlatch/Mehatl		495		495
Mowhokam		115		115
Ainslie		155		155
Anderson		35		35
Boston Bar		130		130
Spuzzum		25		25
Hope - Yale		20		20
Skagit	1995	70		2065
Upper Lillooet	490	85		575
Whistler/Pemberton	370			370
Birkenhead	365	75		440
Lillooet Lk/Harrison	855	680		1535
Subtotal	4075	1885	0	5960
CONTINENTAL				
Lytton/Lillooet	2445	425	60	2930
Stein		30		30
Seton Lake	150		925	1075
Carpenter Lake	125		2080	2205
Subtotal	2720	455	3065	6240
Totals	6795	2340	3065	12200

MPB = mountain pine beetle; DFB = Douglas-fir beetle; SB = spruce beetle

Urban Development

Urban and rural development associated with the Vancouver municipal area and the Fraser Valley has effectively removed a significant portion of once suitable Spotted Owl habitat. The future threat to owl habitat associated with maintaining the urban population around Vancouver is mainly related to the requirement to expand the existing water reservoirs in the Greater Vancouver Regional District (GVRD) watersheds (Figure 7).

Figure 7: Potential future reservoir expansions (20-100 years) in the Capilano and Seymour watersheds of the Greater Vancouver Regional District.



Through this expansion, approximately 800 ha of forest considered capable Spotted Owl habitat is estimated to be flooded over the next 20-100 years in the Seymour and Capilano watersheds combined (Earth Tech 2003). Although, less than 70 hectares of this is in habitat currently suitable for Spotted Owls (Table 11), the flooding will eventually result in the permanent loss of the full 800 ha of suitable and/or capable habitat. The 800 ha of suitable and/or capable habitat amounts to 0.6% of the currently suitable Spotted Owl habitat that the model projects for the maritime subregion (Table 9) and 0.9% of the currently suitable habitat that the model projects can be incorporated into territories (85,668 ha; Table 9). The percentages described above would be less if compared to the total amount of capable habitat in this subregion, or to the amounts of suitable and capable habitat throughout the owl's range in British Columbia. This relatively minor amount of habitat loss within the province is not likely to provide much threat to recovery unless active sites are impacted in these areas or the losses impair connectivity.

Table 10: Area (ha) of capable Spotted Owl habitat in the Greater Vancouver Regional District that may become inundated in the next 20-100 Years.

Age Class	Seymour (ha)	Capilano (ha)	Total (ha)
0	3.3	96.6	99.9
1	16.3	0.0	16.3
2	189.5	3.1	192.6
3	6.5	40.0	46.5
4	15.8	318.5	334.3
5	5.7	31.2	36.9
6	0.0	0.0	0.0
7	0.0	2.7	2.7
8	6.5	0.0	6.5
9	59.9	0.0	59.9
Total	303.5	492.1	795.6

3.4.8 General and Specific Measures Available to Protect Habitat

Protected Areas

The 1997 Spotted Owl Management Plan (SOMP) covers 363,000 hectares distributed throughout the range of the Spotted Owl in the maritime and sub-maritime subregions of British Columbia. This area includes about 159,000 hectares within legally designated parks and protected areas, including Pinecone Lake/Burke Mountain, Indian Arm, Chilliwack Lake, Liumchen Creek, Sockeye Creek, Mehatl Creek, and the Tantalus Range. Some of these areas currently do not provide suitable habitat for Spotted Owls as they are comprised of young, non-suitable habitats created by earlier disturbance. The Greater Vancouver Regional District (GVRD) watersheds are not included in the 159,000 ha designated under SOMP as protected areas.

Of the 72 sites at which Spotted Owls have been detected since 1992, 11 are fully protected as they occur in parks/protected areas (Table 12). Nine of these occur within the boundaries of SOMP with seven in the Chilliwack and two in the Squamish forest districts. The remaining two sites were discovered in the Stein River Provincial Park in the Cascades Forest District in 2004 and 2005. The 2005 inventory data indicate that, of the 13 sites at which Spotted Owls have been detected, eight are located within parks/protected areas (Jared Hobbs, pers comm). The 2004 inventory indicates a similar pattern, with 8 out of 17 sites located within protected areas. Note that 8 of the 11 sites known to exist in parks/protected areas since 1992 remained active in 2005. This compares to 1 of 32 in SOMP/GVRD LTACs outside of parks, suggesting that ecological conditions within parks (possibly including factors such as habitat quality and/or Barred Owl densities), and/or habitat protection measures under the *Parks Act*, are more conducive to continued Spotted Owl presence.

Table 11: Spotted Owl sites detected in 2005, 2004, and from 1992 to 2005, according to conservation status.

Conservation Status	2005	2004	1992 to 2005
Parks/Protected Areas	8	8	11
GVRD	0	0	5
LTACs	1	4	27
Matrix	1	0	8
Cascades MOU LTACs	3	3	5
Unprotected Proposed LTACs	0	1	12
Unprotected/Dropped	0	0	4
Total	13	17	72

Overall, approximately 18.7% of the total habitat (534,422 ha) currently classified as suitable falls within protected areas (99,675 ha; Table 13)). The amount of currently suitable habitat estimated by the model to be in parks/protected areas is considerably less than the 159,000 ha reported in SOMP. This difference can be attributed to a) the suitable habitat definition was updated and now excludes some higher elevation forest that was included in the SOMP estimates, and b) the SOMP estimate was for forest potentially capable of providing suitable Spotted Owl habitat over the long term (SOMIT 1997a). Over the next 20 years, while PA areas can recruit an additional 14,378 ha of suitable habitat, the biggest gains can be made in the NC and THLB which can recruit up to 15,093 and 16,291 ha, respectively (Table 13). This summary is based on the model's critical habitat mapping which identified suitable habitat in the Spotted Owl's range in and outside of territories. This mapping also includes some suitable habitat outside of the known range when a territory was initiated in the range, but must expand outside the range to meet the areal requirements. Therefore, the total area of suitable habitat reported is slightly higher than other estimates mentioned in this report (also see section 3.4.5), but this difference is considered insignificant for the purposes of this discussion. In addition, the values in Table 13 refer to suitable and restorable habitat classified according to the model definitions on a hectare by hectare basis. On a territory scale, it will not be possible to incorporate all of these hectares of suitable habitat into a functional territory. Summaries for SRMZ's are given separately as the areas would not sum up properly if they were included together because SRMZ's can include THLB, NC and/or PA and are therefore not mutually exclusive.

Table 12: Area summaries of modeled suitable and restorable (within 20 years) habitat in the non-contributing land base (NC), protected areas (PA), and the timber harvesting land base (THLB); and the amount of suitable and restorable (within 20 years) habitat located within Spotted Owl SRMZs protected through SOMP.

Area of Suitable Habitat (ha)	Maritime	SubMaritime	Continental	Total
NC	60,956	162,244	41,822	265,022
PA	39,722	52,224	7,729	99,675
THLB	24,937	105,654	39,134	169,725
Total	125,615	320,122	88,685	534,422

Area +20 yrs Restorable Habitat (ha)	Maritime	SubMaritime	Continental	Total
NC	4,089	9,495	1,509	15,093
PA	3,002	3,127	8,249	14,378
THLB	5,053	6,662	4,576	16,291
Total	12,144	19,284	14,334	45,762

Area in current SOMP SRMZ's (ha)	Maritime	SubMaritime	Continental	Total
Suitable Habitat	52,204	106,773	14,646	173,623
Restorable Habitat (+20yrs)	2,935	6,981	779	10,695

Land Use Plans

Current forest management for Spotted Owls within the Spotted Owl Management Plan (SOMP) and Lillooet areas is intended to maintain 67% of suitable habitat within 'Long Term Activity Centres' (LTACs) over time. To date, this target has been reached in approximately half of the LTACs. The total area (363,000 ha) of the SOMP includes 204,000 ha of Crown forested land within the Chilliwack and Squamish forest districts in southwestern British Columbia (SOMIT 1997, Chutter et al. 2004). In addition, a Land and Resource Management Plan (LRMP) for the Lillooet area of the Cascades Forest District that includes consideration of Spotted Owls has been completed and is being reviewed by government for approval. In the meantime, in November 2003, a three-year Memorandum of Understanding was signed between the Ministry of Water, Land and Air Protection (now Ministry of Environment) and Ainsworth Lumber to maintain suitable owl habitat in 5 of the proposed Spotted Owl LTACs in the Cascades Forest District. Additionally, by 2005, Teal Cedar Products had deferred logging in the Kwoiek LTAC and discussions were ongoing with BC Timber Sales (BCTS) around the Lost Valley LTAC. These seven areas were identified as LTACs through a Section 7 Notice under the *Forest and Range Practices Act* and include 22,480 ha, of which 17,852 ha are within the forested landbase. As per SOMP guidelines, 67% or 11,960 ha of this must be retained as suitable habitat. A possible 8th LTAC in the Cascades Forest District along Anderson Lake was also under review with BCTS. As of 2007, three of the proposed

Cascades Forest District LTACs have received formal protection as Wildlife Habitat Areas (see section 3.4.9 below).

Forty-three of the 72 sites reported as active at least from 1992 to 2005 receive some form of long term habitat protection within the boundaries of SOMP as they occur in parks/protected areas (n= 11), the GVRD watersheds (n=5), or existing SOMP LTACs (n=27) which fall outside parks and the GVRD (Table 12). Eight other sites occur in SOMP Matrix Activity Centres, and will receive temporary protection until being harvested over the next 40 years as other habitat within SRMZs becomes suitable. Five sites in the Cascades Forest District were covered by a 3-year MOU with Ainsworth Lumber (that expired in November 2006) that agreed to manage them to SOMP standards until a new plan is in place. Of the remaining 16 sites, 12 are in proposed LTACs (eight within the boundaries of SOMP, and four in the Cascades Forest District) and four have been dropped from consideration for LTAC inclusion. For additional detail on the SOMP areas and forest management, see section 18.1.3 of Chutter et al. (2004). Also, see <http://wlapwww.gov.bc.ca/sry/fwh/wildlife/srmz.htm>

According to recent modeling work, an estimated 173,623 hectares of suitable habitat currently exists within current SOMP SRMZs, and an additional 10,695 ha will become suitable within the next 20 years (Table 13). The 173,623 ha of currently suitable habitat amounts to 32.5% of the total available suitable habitat (534,422 ha) predicted by the model (Table 13) and about 60% of the total suitable habitat that the model predicts is needed to meet recovery goals (Tables 7 and 8).

3.4.9 Forest Legislation and Policy

The Forest and Range Practices Act (FRPA)

The FRPA contains a number of provisions that contribute to managing Spotted Owl habitat. For example, Section 5 of the FRPA requires forest stewardship plans to be consistent with objectives set by government for a number of values including wildlife, biodiversity, soils, visual quality, and water and fish, all of which may contribute in part to managing Spotted Owl habitat.

Additionally, Section 7 of the FRPA Forest Practices and Planning regulation further defines objectives in terms of the amount, distribution and attributes of areas for the survival of species at risk, survival of regionally important wildlife, and the winter survival of specified ungulate species. The regulation provides for the spatial and temporal design of areas at the landscape level as well as objectives set at the stand level. Notices under Section 7 are established for each forest district by the Minister of the Ministry of Environment, and include objectives for Spotted Owl habitat in southwestern British Columbia. It should be noted that notices under Section 7 are intended to conserve wildlife habitat without unduly reducing the supply of timber from British Columbia's forests. Management of all species at risk is limited to an impact cap of one percent of mature forest in each forest district.

Section 7 notices are made spatial through the process of establishing wildlife habitat areas under the Identified Wildlife Management Strategy (IWMS). The term "Identified Wildlife" refers to those Species at Risk and Regionally Important Wildlife that the British Columbia Minister of Environment designates as requiring special management attention under the FRPA. The Spotted Owl is identified as a species at risk as it is affected by forest management on Crown land, is listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and is not adequately protected by other mechanisms.

The IWMS provides direction, policy, procedures, and guidelines for managing Identified Wildlife. The goals of the Strategy are to minimize the effects of forest and range practices on Identified Wildlife situated on Crown land and to maintain their limiting habitats throughout their current ranges and, where appropriate, their historic ranges. Identified Wildlife are managed through the establishment of wildlife habitat areas (WHAs), general wildlife measures (GWMs) and wildlife habitat area objectives, or through other management practices specified in strategic or landscape level plans (see above). WHAs are established spatially, and may incorporate up to one percent of mature forest, by area, of each forest district, as prescribed in the Section 7 notices. IWMS Guidelines for managing Spotted Owl can be found at http://wlapwww.gov.bc.ca/wld/identified/documents/Birds/b_spottedowl.pdf

In 2006, nine Spotted Owl WHAs were created to provide additional protection to owl territories found occupied during 2005 surveys. These nine areas encompassed six areas previously included under SOMP (five LTACs and one matrix area) and 3 areas previously protected to SOMP-equivalent standards by the Ainsworth MOU. Under the General Measures of these WHAs, no further timber harvest is allowed in these areas.

Old Growth Management Areas

The Old Growth Order (see <http://srmwww.gov.bc.ca/rmd/oldgrowth/pdf/Old%20Growth%20Order%20May18th%20FINAL%2004%20.pdf>) establishes provincial old growth objectives, the intent of which is to identify the amount of old forest that will be maintained to address biodiversity values across the province. Old growth retention targets are set for each biogeoclimatic zone and variant within a landscape unit. Landscape units (which may include a number of BEC variants) are assigned a biodiversity emphasis (high, medium, or low) which is also reflected in the retention target. The primary intent of Old Growth Management Areas (OGMAs) is to represent different ecosystem types. However, provincial policy is to overlap OGMAs with habitat for species at risk, including the Spotted Owl, wherever possible.

The Wildlife Act

Under Section 34 of the *Wildlife Act*, it is unlawful (except as provided by regulation), to possess, take, injure, molest or destroy a bird or its egg(s), or the nest of a bird when the nest is occupied by a bird or its egg(s). For tree-nesting species, this protection includes nest trees that contain occupied nests. Paragraph two of Section 34 further extends

protection of the nest and nest tree year-round (whether occupied or not) to a select group of species; however, this group does not include the Spotted Owl. Penalties Section 34 can run up to \$50,000 and 6 months in jail for a first offence.

Under section 5 of the *Wildlife Act*, if the minister requires habitat for an endangered or threatened species, the minister may designate land in a wildlife management area as a critical wildlife area, or as a wildlife sanctuary. Protective measures and emergency provisions for species-at-risk have been expanded through the passing of the *Wildlife Amendment Act* in 2004. Regulations for this Act are still pending, however, and these measures and provisions are not yet enforceable. The *Wildlife Act* is currently under review. Major revisions, including amalgamating and further enhancing the species at risk provisions of the *Wildlife Amendment Act* are being considered.

The Forest Act

Under Part 13 of the *Forest Act*, the Lieutenant Governor in Council may specify an area of Crown land as a designated area if they believe such an act serves the public interest. If a permit, licence or plan relates to all or part of a designated area, the minister may vary, suspend in whole or in part, or not issue, the permit, licence or plan. This provision refers to a wide variety of instruments, including cutting permits, road permits, timber sale licences, free use permits, licences to cut, special use permits, operational plans, and management plans.

Environment and Land Use Act

Section 7 of the *Environment and Land Use Act* provides a legal tool for protecting or managing an area with respect to the environment and land use. Subsection (1) specifies that “On the recommendation of the committee, and despite any other Act or regulation, the Lieutenant Governor in Council may make orders the Lieutenant Governor in Council considers necessary or advisable respecting the environment or land use.”

An order is a legally binding enactment, which in the case of the *ELU Act*, may override other acts and regulations where they exist over the same area (e.g., an *ELU Act* order would override the *Forest and Range Practices Act*, or tenure provisions under the *Forest Act*). The *ELU Act* is usually only used in exceptional circumstances. It was used in the 1990s for some protected areas, where certain activities (e.g., grazing) were not permitted under the *Park Act*.

Land Amendment Act

The only other potential legislative option for protecting sites of significance to Spotted Owls is through the Land Amendment Act (2003) (Bill 46, 2003) which can allow for land use objectives to be set on Crown land. Such objectives can guide the operations of land users, including resource development industries. However, some relevant sections of this Act are currently not in force and, because enacting them would enable objectives set by government to go beyond policy limits on timber supply (and potentially affect multiple stakeholders), this would require a Cabinet regulatory decision.

Forest Certification

A number of forest certification programs are applicable in British Columbia (see <http://www.for.gov.bc.ca/het/certification/>). These programs include the Canadian Standards Association (CSA) Z809, the International Organization for Standardization (ISO) 14001, the Forest Stewardship Council (FSC), the Programme for Endorsement of Certification Schemes (PEFC), and the Sustainable Forest Initiative (SFI). Forest certification programs include a variety of provisions that require forest companies to demonstrate their ability to meet environmental or other standards.

3.4.9 Unprotected Habitat

A substantial amount of Spotted Owl habitat is currently unprotected in British Columbia. Unprotected habitat (up to 2004) is defined as habitat areas outside of: legally defined parks and protected areas, SRMZ's (LTACs) defined under the current SOMP, and new LTACs in the Lillooet area covered to SOMP standards by a Memorandum of Understanding with Ainsworth Lumber. Unprotected habitat does not include non-contributing forest lands as these have no formal protection and while they may be currently considered not commercially viable for harvest, this can and does change on a regular basis.

Unprotected suitable habitat in territories identifies those hectares of unprotected suitable habitat that can be combined into owl territories by the model. This takes into account the spatial distribution of habitat within the owl's range. Approximately 246,985 ha of unprotected suitable and restorable (within 20 years) habitat is available to breeding owls within potential territories created by the packed territories model (Table 13). Broken down by subregion, this amounts to: 41,003 ha in the maritime subregion, 171,362 ha in the submaritime subregion, and 34,620 ha in the continental subregion.

Table 13: Summary of unprotected habitat (ha) from the most recent land base data (updated with recent disturbances to 2004)*.

Unprotected Habitat	Maritime	Submaritime	Continental	Total in Range
Unprotected Suitable	59,005	190,747	66,310	316,062
Unprotected Suitable in Territories	31,038	154,095	25,109	210,242
Unprotected Restorable	7,830	11,283	5,306	24,419
Unprotected Restorable in Territories	9,965	17,267	9,511	36,743

* Note that "territories" refers to packed territories and includes only that area of habitat in territories within the defined Spotted Owl range limit. As defined elsewhere in the text "restorable" habitat is forest that becomes suitable within 20 years of the present.

Using a range of 2000 to 3000 ha of suitable habitat per territory (a range roughly encompassing data from Tables 7 and 8, and the SOMP's 67% of 3200 ha), this suggests that there is enough unprotected suitable habitat available in modeled packed territories to create 70 to 105 territories, but that over the next 20 years only enough habitat for an additional 12 to 18 new territories will become suitable. These are aspatial projections and actual territory creation is dependent on how the habitat is spatially distributed across the landscape. This earlier exercise does not consider more recent results from the Resource Location Model (Sutherland et al. 2007).

3.4.10 CSORT Critical Habitat Recommendations

CSORT recognizes that their role is advisory in nature and that it is government's role to define and implement land-based management plans for critical habitat for the Spotted Owl. Accordingly, based on a) the information presented in section 3 of this report and the recovery strategy (Chutter et al. 2004), b) results from early test runs of the Spotted Owl population/habitat model (2005), c) other research results, and d) expert opinion, the CSORT recommends the following approach to critical habitat planning for Spotted Owls in British Columbia:

- Take into account the current endangered status and imminent threat of extirpation of the species in Canada.
- Consider recent history of occupancy for prioritizing protective measures.
- Consider representation across the species' range in the province.
- Consider maximization strategies for connectivity and clustering of territories and groups of territories to enable successful dispersal and territory establishment at subregional, provincial and international scales, especially between the habitat areas that the modeling framework analyses indicate have become isolated.
- Consider natural and human-caused disturbance impacts on habitat, and allow that more area may need to be set aside to mitigate the risk of stand replacing natural disturbance events (such as fire) in drier portions of the range.
- Consider minimizing fragmentation of Type A and Type B habitat areas within territories because this can both limit the success of a territory and can reduce the overall land area needed to manage in reserves (i.e., territories become more compact).
- Make consistent management decisions range-wide, while retaining opportunities for flexibility where appropriate (particularly to allow for replacement areas if critical habitat is lost to natural disturbances)
- Consider that habitat management decisions must be made now to provide desirable future habitat supply to meet the recovery goal.
- In the new range-wide habitat plan, consider how to balance the function of standard management units (e.g., LTACs) against the range of variability in territory sizes

observed in naturally occurring populations where a minimum amount of habitat is needed for a breeding territory and the likely success of that territory increases as habitat becomes more concentrated/less fragmented.

Accordingly, the Spotted Owl Recovery Team recommends the following prescriptions for planning for Spotted Owl critical habitat/protected areas:

1. Priority for habitat protection should be based on an area's history of occupancy.

The CSORT recovery strategy recommends that active sites be immediately deemed critical habitat (Chutter et al. 2004). As the Spotted Owl is at imminent risk of extirpation in British Columbia, the first priority for habitat protection should be for currently occupied territories, followed by recently occupied territories (since 1997), historically occupied territories, and areas established under SOMP that do not have a history of known occupancy. Recovery is dependent on maintaining and enhancing the existing distribution and population of owls remaining in the province. As various conservation efforts, including population augmentation, depend on having a sufficient supply of well-distributed suitable habitat, it is essential that habitat be protected over the long term to ensure that efforts to recover populations have the best possible opportunity for success.

2. Cluster territories and maintain/enhance connectivity.

Metapopulation theory and population modeling for Spotted Owls suggest that clustering territories into subpopulation groups is beneficial to the species. Modeling work supports this assumption by indicating a large network of clusters of 15-20 pairs would be stable over time assuming moderate connectivity (dispersal) between clusters (Lamberson et al. 1994). In British Columbia, preliminary analyses of connectivity suggest that we have three currently occurring subpopulations to work with (see section 3.3.2). Maintenance of these subpopulations is very dependent on retaining sufficient connectivity between both individual territories and groups of territories to allow for dispersal and pair establishment. In the broader perspective, it is important to maintain and enhance functional connectivity between subpopulations or clusters, and even beyond them to subpopulations in Washington State, to maintain genetic variability and enable immigration/emigration. Accordingly, efforts should be made to manage the landbase to increase clustering of territories now and in the future, maintain current and enhance future connectivity between territories and groups of territories, and maintain and enhance connections to the United States.

3. Consider using the existing SOMP mean territory size of 3200 ha throughout the species range in British Columbia as a minimum default standard until a new range-wide habitat management plan has been developed.

Implementation of this recommendation would enable consistency and familiarity with existing management plan prescriptions currently used by industry in British Columbia until such time as a new range-wide plan has been approved and implemented. This approach would be consistent with the recovery team's interim recommendations, whilst allowing for appropriate flexibility supported by the model.

Under SOMP, LTAC size is standardized at 3200 ha throughout the owl's range in British Columbia. The packed territory model's estimates of mean territory sizes needed within the subregions to maintain the appropriate amount of suitable habitat and meet the recovery population goal are all larger than the SOMP's 3200 ha LTAC size, ranging from 3333 ha in the continental to 6941 ha in the maritime (see Table 8, section 3.4.4). Where possible and practicable, the larger areas should be incorporated, as using 3200 ha as a default standard may result in undersized territories. Potential undersizing of territories using the 3200 ha default is especially likely in the wetter subregions; however, these areas are less subject to natural disturbances such as fire and insect outbreaks and also contain relatively more protected areas than the drier continental subregion. In addition, the continental subregion contains the majority of the remaining Spotted Owl population in British Columbia. Therefore, in the interim, there is relatively less risk defaulting to 3200 ha in the wetter areas; and the currently most important continental subregion (where threats of habitat loss from natural disturbance events are greatest) would receive close to the minimum size suggested by the model. This approach is also supported by recent British Columbia research in the sub-maritime subregion reported in Hilton et al. (in prep); however, the default standard may need immediate adjustment if the LTAC/territory needs to be expanded to incorporate any area shortcomings.

4. Consider continuing to protect 67% suitable habitat within territories as the minimum default standard throughout the species' range in British Columbia until a new range-wide habitat management plan has been developed.

Using the SOMP's 67% suitability rule results in an intended average of 2144 ha of suitable habitat per 3200 ha LTAC. This is considerably less than the mean minimum amounts of 3010 ha used in the model for the maritime subregion, close to the 2224 ha used for the sub-maritime, and slightly greater than the 1906 ha used for the continental (see Table 6, section 3.4.3). Larger amounts of suitable habitat in maritime territories should be used where possible and practicable, but defaulting to the SOMP's 2144 ha may be acceptable in the interim because natural threats to habitat are lesser there and most LTACs are already $\leq 67\%$ so there is a low likelihood of further timber harvest under current policies. As the threat of natural and harvest disturbance is greater in the continental subregion where most of the remaining known owls exist, using the larger minimum amount of suitable habitat would be wise to help address the greater potential for habitat loss (unless the number of territories managed for is maximized in the area) in that subregion. The habitat model's definitions of suitable habitat should be those used as they have been revised and updated since SOMP. This will require re-estimates of the amount of currently suitable habitat in all LTAC units. In LTACs of currently active sites where $< 67\%$ suitable habitat occurs, the LTAC boundaries should be expanded until the minimum

amount of suitable habitat is captured to ensure these territories maintain functionality.

Implementation of this recommendation will not always be possible due to the distribution of existing habitat on the landscape. For instance, many SOMP LTACs exist where <67% suitable habitat is available and habitat recruitment is necessary to bring them up to that level. While there is evidence to show that Spotted Owls can survive in territories with less than 67% suitable habitat, there is also evidence to suggest that a greater percentage is beneficial. Furthermore, while the 67% minimum is supported for the subarctic subregion by Hilton et al. (in prep), British Columbia's experience using the 67% level has not proven successful in stabilizing the population. A close evaluation of the "67%" rule needs to be undertaken to determine if this amount of suitable habitat in a territory is sufficient to support breeding pairs of owls throughout their range in British Columbia.

5. Where practicable, do not allow any further habitat removal from prescribed territories, except to assist in recruiting/restoring suitable habitat.

The results from the modeling framework (using the parameters assigned) suggest that the greatest immediate benefit to the owl's recovery can be gained by increasing the level of protection of suitable habitat within territories from 67% to 100% per territory. However, values other than 67% and 100% suitable habitat have not been assessed by the model. Due to the precarious status of this species in British Columbia, until this assessment has been conducted, further habitat removal from prescribed territories should be curtailed in the near future (and as stated in 3 and 4 above, it may be of benefit to increase the size of active territories to ensure that minimum habitat amounts can be met now). Prescribed territories are defined as those referred to in the habitat protection section of the CSORT interim recommendation that are included as Appendix 1 in Chutter et al (2004). These are defined as sites known to have been occupied by an owl or a pair of owls at least once since 1997 and include Special Resource Management Areas, Long Term Activity Centre's and Matrix areas identified in the Spotted Owl Management Plan, as well as any other sites discovered active since 1997 that were not included in the plan (e.g., areas in the Merritt Forest District currently receiving protection under an MOU with the licensee).

This is consistent with the Recovery Team's interim recommendation and should not impose a substantial loss of harvest opportunity as most existing territories are already at or below the 67% level and thus now exclude harvesting. This could cause greater loss of harvest opportunity in new territories not currently protected under the existing SOMP or MOUs, or in LTACs that require expansion to meet modeled territory habitat requirements, but these will likely only be created in areas with recent owl activity which are the most critical to maintain to enable recovery of the population.

The restriction on all harvesting within territories should last at least until a) territories (regardless of final decisions on managed size) meet minimum habitat amount requirements, b) a new range-wide management plan that addresses recovery needs and accounts for the time lag for habitat recruitment has been put in place by government, c) augmentation has managed to stabilize the population, and increased recruitment, survival and productivity has occurred for the population for a period of at least 20 years, or d) new and comprehensive data from British Columbia refine our understanding of home range size and habitat use in the subregions.

6. Where practicable maximize the amount of Type A habitat in territories.

Type A breeding habitat appears much more important to recovery than Type B foraging habitat, especially when it includes veteran old-growth nest stands. As much Type A habitat as possible should be maintained in territories until the population and/or habitat has recovered sufficiently (as per recommendation #5 above). Similarly, until that time, Type A habitat should not be removed and replaced with Type B when the latter meets suitability requirements. Type B habitat appears to be sufficient outside of territories for dispersal/connectivity corridors.

7. Consider ongoing updating, enhancing and testing of the habitat model.

Further testing and adjusting of the model could be done to increase its scope and usefulness for recovery planning in the future. For example, adjustment of parameters could affect the data in the tables in this report; empirical studies could test assumptions and improve predictability of management actions and natural disturbances; testing emigration/immigration effects could provide better information regarding the importance of habitat connectivity between populations, including those in the United States; and testing population augmentation scenarios and threats such as Barred Owl competition could help project potential outcomes of options for management actions.

4. SOCIO-ECONOMIC EVALUATION

A draft copy of the Baseline Socio-Economic Analysis to assist Northern Spotted Owl action planning has been completed (Pierce Lefebvre Consulting 2005). This draft is a compilation of all economic activity in/near the Spotted Owl study area that could potentially be impacted either positively or negatively by proposed recovery activity. It does not assess the impacts of potential recovery actions, and significantly, due to a lack of value data available, it provides very limited information on any of the non-market ecological values of maintaining Spotted Owl habitat in the province. A subsequent socio-economic impact analysis of the policy scenarios completed by the modeling group has been discussed and still needs to be completed. The draft report contains baseline information against which to measure the socio-economic impacts of a new range-wide management plan(s) for Spotted Owls once it has been developed. Such an assessment should try further to assess the ecological benefits side to the cost/benefit equation. The rest of this section contains the Executive Summary transcribed verbatim from the draft Pierce Lefebvre Consulting 2005 report:

EXECUTIVE SUMMARY

A Spotted Owl Recovery Team has been established to develop a Recovery Strategy and [help the government prepare a] Recovery Action Plan. The population of Northern Spotted Owls in B.C. has declined from an estimated 500 pairs in pre-European settlement times to possibly fewer than 30 pairs currently. The purpose of this analysis is to prepare baseline socio-economic data for the Spotted Owl Recovery Action Plan area, referred as Spotted Owl range throughout this report, to inform the planning process and to facilitate socio-economic assessment of the Recovery Action Plan.

The Spotted Owl range covers some 3.2 million hectares or 3.3% of the B.C. landbase. It includes almost all of the Chilliwack Forest District and the Squamish Forest District including Interfor's Timber Forest [Tree Farm] License 38. It also includes some 50% of the Lillooet Timber Supply Area (TSA) and 4% of the Merritt TSA.

The following tables summarize the key socio-economic values in the Spotted Owl range.

Table 14: Summary of Spotted Owl (SPOW) range socio-economic base case

Socio-Economic Impacts per Annum	Direct PYs of Employment - SPOW Range	B.C. Direct Government Revenues	B.C. Net Economic Value (\$ Million)	Base Case Owl Management SOMP LTACs and MACs
Forestry	3028 direct PYs of harvesting and processing employment	\$41.2 million (\$17.53 per m3) in stumpage revenues	\$46.9 million (\$20 per m3)	Harvesting LTACs without current restrictions could add stumpage revenues of \$8.2 million m3 and 631 PYs of direct employment
Backcountry Tourism/ Adventure Operators	931 direct PYs of employment	\$0.44 million	\$4.38 million	32.7% of the SPOW range is either protected (18.8%), in LTACs (8.8%) or in SOMP MACs (5.5%)

Agriculture	8,310 farm operators, but 98% are in GVRD & FVRD		3.7% of grazing lands in SPOW range are in PAs (0.9%) or in LTACs and SOMP MACs (2.9%)
Mineral Exploration	ARIS 1970-2002 Expenditures: \$4.7 million/yr (\$2004); 4.3% of B.C. Exploration; 45 PYs of direct employment		Current LTACs cover 10.8% of total area, 11.8% of very high metallic potential, and 9.9% of occurrences
Oil & Gas	No existing activity - no known potential		
Hydro-electric	Hydro-electric in SPOW region comprises 9% of power generation in B.C.		Most of SPOW range has moderate or high potential for small hydro projects
Recreation Values	Estimated 1.5 million recreation days - Various value per day estimates - some \$50 range; others \$10 to \$20 range	\$15 million	21.6% of trails are in PAs and in LTACs (6.4%) and SOMP MACs (0.3%) outside PAs
Socio-Community			
Community Sustainability/ Resilience	Lillooet is the largest community with significant risk exposure to timber impacts and impacts on agriculture range. Small rural communities such as Boston Bar, Bralorne, Lytton are also at risk. Squamish sub-area is most at risk in the event of negative impacts on recreation/tourism, but it is also in the best position to benefit from any positive recreation/ tourism impacts.		
First Nations	There are 50 First Nations communities with reserve lands in the SPOW range. Many are involved in timber harvesting activities.		

Notes: SOMP: 1997 Spotted Owl Management Plan; LTACs: Long Term Activity Centres; MACs: Matrix Activity Centres.

Table 15: Summary of key values for the Spotted Owl (SPOW) range

	Base Case
Environment:	
Protected Areas (PAs)	<ul style="list-style-type: none"> 18.8% of plan area.
Suitable Owl Habitat (A – Nesting and B – Foraging)	<ul style="list-style-type: none"> 18.3% of SPOW A & B habitat is protected. Another 23.0% of SPOW A & B habitat is in existing LTACs and 1.8% is in SOMP MACs. In all, 43.2% of A & B habitat are either protected or managed for owls.
Marbled Murrelet Habitat	<ul style="list-style-type: none"> 53.6% of Marbled Murrelet (MAMU) habitat overlaps with PAs (29.5%) or LTACs in non-protected areas (24.0%). Another 36.4% of MAMU habitat overlaps with other A & B owl habitat that is not protected nor in LTACs, bringing to 90% the degree to which MAMU habitat overlaps with PAs, LTACs and SPOW habitat.

	Base Case
Community Watersheds	<ul style="list-style-type: none"> 28.6% of community watershed areas overlap with current LTACs in non-protected areas
Forest Sector in SPOW Range:	
a) Economic Impact	<ul style="list-style-type: none"> The SPOW range accounts for 3.3% of the B.C. landbase and 2.8% of the THLB in B.C. The SPOW range AAC is 2.3 million m³. The average annual harvest for the last 10 years approximates the AAC. Average stumpage revenues add to \$41.2 million per annum (1994 to 2004 average, indexed to 2004 dollars), or \$17.53 per m³ of timber.
b) Long Term Sustainable Harvest	<p>The Ministry of Forests most recent Timber Supply Review (TSR) Base Case Long Term Sustainable Harvest (LTSH) projections for the TSAs and TFLs overlapping the SPOW range are:</p> <ul style="list-style-type: none"> Higher than the current AAC for the Fraser TSA; Equal to the current AAC for the Soo TSA; Equal to the current conventional Lillooet AAC (635,900 m³) for 2 decades before beginning stepdowns in decade 3 through 9 to a LTSH of 368,000 m³; and Equal to the current TFL 38 AAC of 250,000 m³ for 10 years, before stepping down to LTSH of 125,000 m³ by decade 9. <p>While the LTSH projections for the Lillooet AAC maintain the conventional AAC of 635,900 m³ for 2 decades, the Lillooet TSA scaled volumes averaged 487,682 m³ between 1994 and 2004, or 77% of the current AAC. The Lillooet region has one of the highest delivered wood costs in the BC Interior and the economics of harvesting stands is very sensitive to demand side market changes.</p>
c) Socio-economic impacts	<ul style="list-style-type: none"> The forest sector is a dominant basic sector in the Lillooet region with forest industry income accounting for 20% of total basic income. For certain communities in the Fraser Valley, the forest industry also contributes a significant portion of basic income. The SPOW range timber resource generates an estimated 3,028 direct Person Years (PYs) of harvesting and processing employment in the SPOW range.
d) Base Case Management Regime & LTACs	<ul style="list-style-type: none"> There is currently very limited timber harvesting in LTACs. The potential annual stumpage revenues and jobs, which could be generated from harvesting timber resources in LTACs without SPOW related restrictions are estimated at \$8.2 million for stumpage revenues, and 631 direct PYs of harvesting and processing employment.
Mineral values in the SPOW range	<ul style="list-style-type: none"> There are no metallic mines currently operating in the SPOW range. There are 9 producing industrial mineral sites. Almost all of these are gravel, granite and shale quarries in the Chilliwack Forest District.
	<ul style="list-style-type: none"> Mining and mineral exploration activities have been substantial and significant in the SPOW range particularly near Britannia, Pemberton, Bralorne and Lillooet, and the SPOW range accounts for 4.3% of provincial mineral exploration expenditures (based on 1980 through 2004 mineral expenditures for B.C. and the SPOW range).

	Base Case
	<ul style="list-style-type: none"> Current LTACs in non-protected areas account for 8.8% of the SPOW range, and contain 9.1% of mineral and industrial occurrences in the SPOW range.
Energy – Oil and Gas	<ul style="list-style-type: none"> The SPOW range is not known to have important oil and gas reserves and there is no oil and gas drilling in the region.
Hydro-Electric Energy	<ul style="list-style-type: none"> The SPOW range has several hydro-electric generation facilities, which together produce approximately 9% of the power generating capacity in B.C. This excludes the Burrard Thermal gas fired generating station located in the Lower Mainland. The SPOW range has several run-of-river hydro-electrical projects currently in operation and many more sites that are being considered for development. Much of the SPOW range is suitable for small hydro-electric projects due to the high precipitation levels and the mild winter temperatures.
Agriculture/Ranching	<ul style="list-style-type: none"> Agriculture is a major economic sector in the SPOW range, but almost all farm receipts are from the Fraser Valley/GVRD dairy and vegetable industry and are mostly from private lands. The SPOW range has some 303,000 hectares of grazing lands, of which 89% are in the Lillooet TSA sub-area. Some 3.7% of the grazing lands are either in PAs (0.9%) or in LTACs/MACs (2.9%). The Squamish-Lillooet Regional District accounts for 0.7% of beef cows in B.C., and in the Lillooet area, agriculture contributes 3% of total basic income.
Tourism – General	<ul style="list-style-type: none"> Tourism is important throughout the SPOW range. The Squamish Local Area depends on tourism for 29% of its basic income, the highest dependence on tourism for all of B.C.'s local areas. The 2010 Olympics in Vancouver/Whistler will substantially enhance the prominence of the SPOW region as an important tourist destination. Much of the nature-based tourism activities in the SPOW range consist of front country tourism such as downhill skiing, snowboarding and golfing that will not be impacted by the SPOW Recovery Action Plan.
Backcountry Tourism	<ul style="list-style-type: none"> The SPOW range includes approximately 300 nature-based adventure tourism businesses (based on data for the Vancouver Coast Mountain region, which corresponds fairly closely to the SPOW range). These businesses represent some \$57 million in total revenues; 931 PYs of direct employment and another 458 indirect and induced PYs of employment. Major activities include heli-skiing and cat-skiing, land based winter activities such as backcountry skiing and snowmobiling, land based summer activities such as mountain biking, ATV experiences, etc. and freshwater fishing.

	Base Case
Tourism and Recreation in PAs, LTACs and MACs	<ul style="list-style-type: none"> • PAs account for 18.8% of the SPOW range, but 16.2% of existing tourism features and 14.9% of total km of trails. • LTACs in non-protected areas account for almost 9% of the SPOW range, but 12% of existing tourism features and 6.4% of trails. • SOMP MACs account for 0.8% of the SPOW range and less than 1% of tourism features and trails.
Communities and Settlements - Population	<ul style="list-style-type: none"> • The SPOW range has a total population of 2.3 million people. Urban and suburban areas within the GVRD and the Fraser Valley account for most of that. • Some 30,000 people currently (2004) reside in the Squamish Forest District, up from approximately 20,500 people in 1991. • The population residing within the Lillooet TSA boundaries dropped by almost half between 1981 and 1991 to 6,141 people, but has stabilized since that time.
Communities and Settlements – Economic Well Being	<ul style="list-style-type: none"> • The GVRD and Fraser Valley communities have a highly diversified economy, although some individual communities rely more heavily than others on basic sectors such as forestry, agriculture, tourism and the transportation sectors. • Tourism represents 29% of basic income for the Squamish Local Area reflecting the economic importance of Whistler/ Blackcomb. The forest industry accounts for 12% of basic income for the Squamish Local Area, which is also significant. • The forest industry is a dominant basic sector in the Lillooet region with forest industry income accounting for 20% of total basic income. • Lillooet and the surrounding region is the most vulnerable to impacts of timber harvesting restrictions particularly since the Lillooet TSA has one of the highest delivered wood costs in the B.C. interior. Base case projections indicate that the current AAC can be maintained for 2 decades, before stepdowns in decades 3 through 9. Average stumpage revenues per m3 for the Lillooet TSA are also the lowest within the SPOW range, at \$11.50 (\$2004, and average between 1994 and 2004), primarily a result of higher harvesting costs.
First Nations	<ul style="list-style-type: none"> • There are 50 First Nations communities that have reserve lands in the SPOW range. • These 50 communities have some 21,000 registered band members or about 18% of the registered band members in B.C. (2004). • About half of these First Nations have entered the tripartite treaty negotiation process and declared traditional territory boundaries that overlap the SPOW range. • Many First Nations are directly involved in timber harvesting.

	Base Case
Provincial Net Economic Value	<ul style="list-style-type: none"> The Net Economic Value (also called net Resource Value or Economic Rent) estimates the net benefits gained from resource extraction and consumer surplus gained from the use and existence of a certain good, service or resource, over an above the production costs for obtaining the resource. The commercial sectors in the SPOW range generate \$51.3 million in Net Economic Value, of which \$41.2 million is stumpage revenues from the forest sector, \$5.7 million is from other forest sector economic rents and \$4.38 million is from the backcountry tourism/adventure operators. The consumer surplus associated with recreation values in the SPOW range is estimated to be approximately \$15 million based on 1.5 million backcountry recreation days.

The following table shows some of the Geographic Information Systems (GIS) data for the Spotted Owl range. The data indicate the distribution of various land resource values across selected land use management areas, namely protected areas, current LTACs, SOMP MACs, other non-protected nesting (A) & foraging (B) owl habitat, and other areas.

Table 16: Summary of Spotted Owl (SPOW) range GIS data

SPOW Range	Total Region	Unit	Protected Areas	Non-Protected Areas			
				Current LTACs	SOMP MACs	Other A & B Owl Habitat	Other / Not Owl Habitat
Plan Area	3,158,687	ha	18.8%	8.8%	0.8%	9.8%	61.9%
Suitable Owl Habitat (A - Nesting & B - Foraging)	542,209	ha	18.3%	23.0%	1.8%	56.8%	0.0%
Forests:							
THLB	610,828	ha	0.1%	16.3%	1.7%	21.0%	61.0%
Community Watershed	110,846	ha	7.4%	28.6%	0.0%	11.9%	52.1%
Woodlots - Private (ha)	1,325	ha	0.0%	8.5%	0.0%	22.3%	69.2%
Woodlots - Crown (ha)	12,067	ha	0.0%	11.9%	0.0%	30.4%	57.8%
Timber Licenses (ha)	59,382	ha	0.3%	17.9%	3.1%	15.3%	63.4%
Botanical FP: Mushroom Areas	112,085	ha	0.1%	37.9%	1.5%	29.8%	30.6%
Agriculture: Range Tenure	303,193	ha	0.9%	2.9%	0.0%	14.9%	81.4%
Metallic Mineral Potential: Very High	907,987	ha	16.3%	9.9%	1.0%	11.5%	61.3%
Industrial Mineral Potential: Extreme	400,428	ha	2.0%	8.5%	0.0%	11.8%	77.6%
Mineral Tenures	312,473	ha	0.2%	12.3%	1.6%	13.7%	72.1%
Total Occurrences	683	occ.	7.9%	9.1%	1.5%	14.6%	66.9%
Tourism and Recreation							
Existing Tourism Facilities	891	fac.	0.4%	0.8%	0.0%	3.0%	95.7%
Existing Tourism Features	760	feat.	16.2%	12.2%	0.8%	16.3%	54.5%
Metres of Trail	4,183,876	m	14.9%	6.4%	0.3%	12.9%	65.5%
Marbled Murrelet Habitat	88,160	ha	29.5%	24.0%	0.0%	36.4%	10.0%

Conclusions

The Spotted Owl range covers some 3.3% of the B.C. landbase. The area has important forestry values with approximately 2.8% of the provincial Timber Harvesting Land Base (THLB) and some 2.3 million m³ in AAC. The Spotted Owl range includes some of B.C. largest parks and the close proximity to the Lower Mainland population makes it a very important commercial backcountry tourism and recreation area. The Spotted Owl range includes 50 First Nations with reserve lands in the region. Other land based economic sectors in the Spotted Owl range includes agriculture, hydro-electric power, and mineral exploration.

LTACs for Spotted Owls have been identified throughout their range, and very limited timber harvesting is occurring in these LTACs. Under the current management regime, 43.2% of the suitable A & B habitat is either protected (18.3%), in managed LTACs in non-protected areas (23.0%) or in SOMP MACs (1.8%). The protection of Spotted Owl habitat also provides protection for other values. For example, some 54% of the Marbled Murrelet habitat is either in protected areas or managed Spotted Owl LTACs.

This baseline analysis establishes socio-economic data for the Spotted Owl range in anticipation of the need for a socio-economic assessment of the Recovery Action Plan, which is currently being developed. The scope of the Recovery Action Plan and the management guidelines defined under that plan will determine the scope of the socio-economic assessment.

5. MONITORING

Monitoring can be used to gather data to address a variety of ecological or management issues. For example, monitoring can be designed to capture, track and follow all individual owls. Monitoring programs can also be expanded to a generalized survey of all potentially suitable habitat throughout the species' range. However monitoring is applied, it must be designed to address specific issues and can be implemented on annual, bi-annual, or even longer intervals, such as every 5 years (similar to monitoring conducted for Peregrine Falcons). Purposes of monitoring can vary from simply assessing occupancy in part of all of the owl's range, to radio-tagging, tracking and following owls to determine dispersal routes, habitat use, survival, causes of death, ecological interactions (e.g., with Barred Owls), and to facilitate capture for population augmentation purposes. Overriding all these options is the ability to acquire the necessary funding to conduct the work.

We believe it is imprudent to create a final monitoring plan for the recovery of Spotted Owls in British Columbia until the government has provided direction regarding implementation of various components of the recovery strategy. For instance, if government supported some form of population augmentation, this would have major implications as to the type of monitoring needed to identify and possibly remove the remaining owls; in the absence of population augmentation, annual call-playback surveys at known sites and in areas of suitable habitat would be important to closely monitor the population. At this time, therefore, the best that can be done is to provide some strategic principles around the types of monitoring that need to be considered and the priorities around them.

At present, given the extremely low number of owls remaining in British Columbia, the highest priority for annual surveys is to track the occupancy of known active sites to assess their occupancy, and if possible, their productivity. This would allow for a tracking of the known population and also facilitate implementation of any potential augmentation efforts.

At the broadest scale, as identified in the CSORT interim recommendations (Appendix 1 *in* Chutter et al. 2004), a complete comprehensive range-wide survey of all suitable habitat needs to be conducted to fully delimit the species' range and attempt to find all remaining owls in British Columbia. Such a survey is very expensive, but it may only be required periodically, perhaps every 3-5 years, to evaluate recovery progress.

An alternate to a comprehensive range-wide survey would involve surveying a portion of the bird's range each year (e.g., randomly-selected landscape units). For instance, covering 1/3 of the range annually would enable a range-wide assessment every three years while requiring a lower level of annual survey effort.

Given the imminent possibility of extirpation due to the current low population level, along with the habitat bottleneck that requires at least a 20 year period before sufficient suitable habitat can be recruited to enable a population response, the CSORT supports

investigating and implementing some form of population augmentation as discussed in the recovery strategy (Chutter et al. 2004). Population management options include winter-feeding adults and juveniles, translocating single birds, captive-breeding and release, prey enhancement, and predator/competitor control. Each of these options would require specific monitoring considerations. In particular, efforts to investigate relationships between Spotted Owls and Barred Owls, including removal experiments or ongoing control of Barred Owls, will require various types of monitoring programs (Buchanan et al. in press, Gutiérrez et al. in press). Augmentation options should be considered in conjunction with an appropriate habitat management strategy.

It may be possible to design a monitoring strategy that combined the known active site survey approach with the partial range survey method such that all occupied sites were surveyed annually, plus enough others that over a period of, say, three to five years, the range was either completely surveyed or surveyed to an extent that provided substantially greater clarity about the abundance, distribution and demographic status of the species. This approach could also be used to monitor the population trend. Development of a final operational monitoring plan is dependent on strategic direction from government as to the approach they support taking. All potential monitoring plans should be assessed for socio-economic considerations.

Regardless of the strategic approach taken, to ensure consistency of method and comparability of results, all surveys should be conducted in accordance with the most current Resource Inventory Standards Committee's survey protocol and standards document for the Northern Spotted Owl (Hobbs et al. 2005). This document outlines different levels of surveying appropriate for various survey results.

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7. APPENDICES

Appendix 1: Suitable Spotted Owl habitat definitions for British Columbia (from SOMIT 1997)

Habitat Type	Superior Habitat (nest, roost, forage, and dispersal)	Moderate Habitat (roost, forage, and dispersal)
Wetter ecosystems: Maritime Coastal Western Hemlock and Mountain Hemlock Biogeoclimatic Zones		
Natural Disturbances: Rare to infrequent stand-initiating events.		
Suitable habitat characteristics	<ul style="list-style-type: none"> • Three or more canopy layers, multi-species canopy dominated by large (>75 cm dbh) overstorey trees (typically 37–185 stems/ha) • Moderate to high (60–80%) canopy closure. • Five or more large (>50 cm dbh) trees/ha with various deformities (e.g., large cavities, broken tops, dwarf mistletoe infections). • Five or more large (>75 cm dbh) snags/ha. • Accumulations ($\geq 268 \text{ m}^3/\text{ha}$) of fallen trees and other coarse woody debris on the ground. 	<ul style="list-style-type: none"> • Two or more canopy layers, multi-species canopy dominated by large (>50 cm dbh) overstorey trees (typically 247–457 stems/ha, although densities as low as 86 stems/ha are possible where large diameter trees are present). • Moderate to high (60–80%) canopy closure. • Five or more large trees/ha (>50 cm dbh) with various deformities (e.g., large cavities, broken tops, dwarf mistletoe infections). • Five or more large (>50 cm dbh) snags/ha. • Accumulations ($\geq 100 \text{ m}^3/\text{ha}$) of fallen trees and other coarse woody debris on the ground.
Dryer ecosystems: Sub-maritime Coastal Western Hemlock and Mountain Hemlock, and Interior Douglas-fir and Engelmann Spruce–Sub–Alpine Fir Biogeoclimatic Zone		
Natural Disturbances: Infrequent stand-initiating events to frequent stand-maintaining fires; however, fire suppression has increased the frequency of stand-initiating events.		
Suitable habitat characteristics	<ul style="list-style-type: none"> • Three or more canopy layers, multi-species canopy dominated by large (>50 cm dbh) overstorey trees (typically 173–247 stems/ha, although densities as low as 86 stems/ha are possible where large diameter trees are present). • Moderate to high (60–85%) canopy closure. • Five or more large trees/ha (>30 cm dbh) with various deformities (e.g., large cavities, broken tops, dwarf mistletoe infections). • Seven or more large (>50 cm dbh) snags/ha. • Accumulations ($\geq 268 \text{ m}^3/\text{ha}$) of fallen trees and other coarse woody debris on the ground. 	<ul style="list-style-type: none"> • Two or more canopy layers, multi-species canopy dominated by large (>30 cm dbh) overstorey trees (typically >247 stems/ha). • Stands must contain 20% Fd and/or Hw in the overstorey. • Greater than 50% canopy closure. • Five or more large trees/ha (>30 cm dbh) with various deformities (e.g., large cavities, broken tops, dwarf mistletoe infections). • Five or more large (>30 cm dbh) snags/ha. • Accumulations ($\geq 100 \text{ m}^3/\text{ha}$) of fallen trees and other coarse woody debris on the ground.

Appendix 2: Natural disturbance rates used in modeling framework

Table A: Frequency of stand replacing disturbances by BEC variant

BEC	Rotation	MeanFireSize	Annual Freq.
Atun	5000	6.69	0.0002
Atp	5000	6.69	0.0002
BGxh2	600	27.5	0.001667
BGxh3	600	27.5	0.001667
BGxw1	600	27.5	0.001667
BGxw2	600	27.5	0.001667
CDFmm	500	510	0.002
CWHdm	1000	510	0.001
CWHds1	1000	0.2	0.001
CWHms1	1000	14.48	0.001
CWHvm1	1000	4.9	0.001
CWHvm2	1000	275	0.001
CWHxm1	1000	510	0.001
ESSFdc	600	516.5	0.001667
ESSFdc2	600	516.5	0.001667
ESSFdv	600	12	0.001667
ESSFmw	600	17.07	0.001667
ESSFxc	600	10.05	0.001667
ESSF xv	600	510	0.001667
ESSF xv1	600	510	0.001667
ESSF xv2	600	510	0.001667
IDFdk	500	275	0.002
IDFdk1	500	14.7	0.002
IDFdk2	500	11.09	0.002
IDFdk3	500	275	0.002
IDFdk4	500	275	0.002
IDFun	500	5.24	0.002
IDFww	500	32.54	0.002
IDFxh1	500	20.61	0.002
IDFxh2	500	25.19	0.002
IDFxm	500	275	0.002
IDF xw	500	275	0.002
MHmm1	900	100	0.001111
MHmm2	900	7.14	0.001111
MSdc	900	12.03	0.001111
MSdc1	900	516.5	0.001111
MSdm2	900	516.5	0.001111
Msun	900	19.63	0.001111
MSxk	900	9.47	0.001111
MSxv	900	516.5	0.001111
PPxh2	900	17.02	0.001111

Table B. Expected range (mean, maximum and minimum) in suitable habitat by BEC variant with some capability (estimated using very long run of disturbance-only scenario). Values rounded to nearest thousand hectares.

Habitat Strata / BEC variant	Suitable			Type A		
	Mean	Max	Min	Mean	Max	Min
CWHdm	78,000 ha	84,000 ha	71,000 ha	76,000 ha	84,000 ha	70,000 ha
CWHds1	131,000 ha	134,000 ha	129,000 ha	124,000 ha	127,000 ha	122,000 ha
CWHms1	300,000 ha	312,000 ha	290,000 ha	155,000 ha	161,000 ha	149,000 ha
CWHvm1	73,000 ha	77,000 ha	68,000 ha	71,000 ha	76,000 ha	66,000 ha
CWHvm2	121,000 ha	126,000 ha	116,000 ha	77,000 ha	80,000 ha	73,000 ha
CWHxm1	500 ha	500 ha	200 ha	400 ha	500 ha	200 ha
IDFdk1	14,000 ha	15,000 ha	12,000 ha	2,000 ha	2,000 ha	2,000 ha
IDFdk2	55,000 ha	61,000 ha	51,000 ha	27,000 ha	30,000 ha	24,000 ha
IDFun	4,000 ha	5,000 ha	4,000 ha	4,000 ha	5,000 ha	4,000 ha
IDFww	50,000 ha	54,000 ha	47,000 ha	46,000 ha	49,000 ha	43,000 ha
IDFxh1	3,000 ha	3,000 ha	2,000 ha	3,000 ha	3,000 ha	2,000 ha
IDFxh2	11,000 ha	12,000 ha	10,000 ha	10,000 ha	11,000 ha	9,000 ha
PPxh2	7,000 ha	8,000 ha	7,000 ha	0 ha	0 ha	0 ha

Appendix 3: Areal summaries (ha) of current suitable habitat for Northern Spotted Owls within the species' range in BC (Habitat definitions (Type A, Type B) are given in Section 3.2.1)

By subregion

SubRegion	Type A	Type B	Suitable (A&B)	Total area of SubRegion
Maritime	67,449	58,166	125,615	869,253
SubMaritime	185,593	134,529	320,122	985,815
Continental	29,385	59,300	88,685	556,547
Total	282,427	251,995	534,422	2,411,615

By BEC variant

Maritime	Type A	Type B	Suitable (A&B)	Total area of BEC Variant
CDFmm	0	0	0	59,908
CWHdm	12,088	9,819	21,907	280,504
CWHvm1	23,152	6,767	29,919	110,484
CWHvm2	31,956	41,381	73,337	156,248
CWHxm1	253	199	452	122,244
MHmm1	0	0	0	139,865
Total	67,449	58,166	125,615	869,253

SubMaritime	Type A	Type B	Suitable (A&B)	Total area of BEC Variant
CWHds1	59,797	9,939	69,736	200,704
CWHms1	93,239	117,841	211,080	410,970
IDFww	32,557	6,749	39,306	90,848
MHmm2	0	0	0	283,293
Total	185,593	134,529	320,122	985,815

Continental	Type A	Type B	Suitable (A&B)	Total area of BEC Variant
ESSFdc2	0	0	0	18,718
ESSFdcp	0	0	0	1,001
ESSFdv	0	0	0	61,049
ESSFdvp	0	0	0	1,021

ESSFmw	0	0	0	227,129
ESSFmwp	0	0	0	1,434
ESSFxc	0	0	0	9,371
ESSFxcp	0	0	0	220
IDFdk1	1,485	11,442	12,927	20,595
IDFdk2	11,075	28,744	39,819	73,845
IDFdk2b	4,899	3,134	8,033	12,658
IDFun	2,927	1,893	4,820	6,767
IDFxb1	1,678	561	2,239	6,183
IDFxb2	6,590	3,943	10,533	19,014
IDFxb2b	731	360	1,091	1,889
MSdc1	0	0	0	26,508
MSdm2	0	0	0	19,277
MSun	0	0	0	8,600
MSxk	0	0	0	15,349
PPxb2	0	9,223	9,223	25,919
Total Area	29,385	59,300	88,685	556,547

TAB 3

Spotted Owl Survival and Recovery in British Columbia: Expert Report



Prepared for: Wilderness Committee

Requested by: Ecojustice

Prepared by: Jared Hobbs M. Sc. / R. P. Bio

J Hobbs Ecological Consulting Ltd.

Date: February 14, 2019

J Hobbs Ecological Consulting Ltd.
J Hobbs Ecological Consulting Ltd.

Preface

Wilderness Committee (WC) is formally requesting the federal Minister of Environment and Climate Change (the “Minister”) fulfill her obligation to publish an Action Plan for the northern spotted owl (*Strix occidentalis caurina*) (“spotted owl”) as required in the *Species at Risk Act* (the “Petition”). If the Minister fails to accede to this demand within an acceptable timeline, WC may file an application for judicial review with the Federal Court seeking to compel the Minister to do so (the “Lawsuit”).

This report provides an expert opinion for use in the Petition and Lawsuit. In the preparation of this report I have responded to questions with independence and objectivity and in a manner that does not advocate for any position taken by the WC despite being retained by that organization.

1. Name, address and area of expertise

My full name is Jared Hobbs; I am the director of J Hobbs Ecological Consulting Ltd. (Pender Island, British Columbia (BC)). My area of professional expertise is wildlife biology with a specialized focus on management of species at risk. I have over 25 years of relevant species at risk experience conducting ecological assessments to inform conservation and management and have worked professionally on spotted owl conservation and management throughout the duration of my professional career.

2. Qualifications, employment, and educational experience in my area of expertise

My first formal work experience with spotted owls began in May 1997. I was retained by the BC Provincial Government as a field technician tasked with conducting acoustic lure (i.e., call-playback) surveys for northern spotted owl. This initial work marked the beginning of a 15-year term of employment with the BC Provincial Government. In addition to my work in government, I continued to study and work on spotted owls independently in the United States (US) and Mexico in pursuit of content for a book I published on the northern spotted owl (Hobbs, J. and R.J. Cannings, 2007). During this period my proficiency in finding spotted owls and their nests, and my understanding of the ecology, conservation and management of spotted owls (range-wide) grew rapidly.

During this period (1997-2002) I was employed by the Provincial government as a full-time species-at-risk biologist; tasked as the provincial lead for field implementation of the Identified Wildlife Management Strategy (IWMS). My bailiwick included implementation of conservation and management for 82 species (including spotted owl). In this position my role was to identify occurrences of rare species in BC to promote legal designation of Wildlife Habitat Areas (WHAs).

To fulfill program objectives for spotted owl, between 2002 and 2006, I led a field survey program conducting spotted owl inventory within the Cascades, Chilliwack and Sea-to-Sky Natural Resource District (NRD) and provided scientific advice to the Canadian Spotted Owl Recovery Team (CSORT). In this capacity I played a strong role in the development of the BC Recovery Strategy for the Northern Spotted Owl (Chutter et al. 2004), and in the development of a companion document: Guidance and Some Components of Action Planning for the Northern spotted owl in BC (Chutter et al. 2007). Both

documents were produced to inform and guide spotted owl action plan development by the Provincial Government.

To further inform development of the BC spotted owl recovery strategy I also revised and improved a new habitat suitability model to more accurately identify spotted owl habitat within the species' range in BC¹. This revised model was adopted by CSORT as a more accurate and more appropriate model to be used by Cortex Consulting for predictive Spatially Explicit Landscape Event Simulation (SELES) modelling. The SELES model, using the new habitat suitability model I had developed, was used to define recovery planning objectives, in particular habitat management objectives, for spotted owl in BC. In addition, in 2005, I co-authored new Provincial spotted owl survey standards (endorsed and published by the Resource Inventory Standards Committee (RISC)) to ensure more specific guidance to spotted owl survey efforts and to incorporate a hierarchical ruleset for determination of spotted owl occupancy and productivity at newly detected active sites.

Finally, after a prolonged (phased) process commencing 2006 and continuing into 2009 (with the release of Best Management Practices for Managing Spotted owl Habitat (Blackburn et al 2009)) SARCO released the BC spotted owl recovery action plan to provide guidance for spotted owl habitat management in BC within revised SOMP1 spatially designated areas called Special Resource Management Zones (SRMZs). These SRMZs were eventually legally designated, under IWMS, in 2011 (Chilliwack NRD) and 2013 (Sea-to-Sky NRD) as Wildlife Habitat Areas (WHAs). I was assigned a role on the Spotted Owl Habitat Management Team to support development of SOMP2. In this capacity I shifted my focus towards providing support during development of a second (new) spotted owl (habitat) management plan (SOMP2) that was eventually formalized in 2006 (Cascades NRD), 2011 (Chilliwack NRD) and 2013 (Sea-to-Sky NRD) with prescriptive guidance for forestry presented as Best Management Practices by Blackburn et al (2009).

In 2013, I resigned from the Provincial government but retained an academic interest in spotted owl recovery in BC and continued to lead spotted owl field inventory for several clients as a consultant. For further details of my experience and expertise managing species at risk please see my CV (attached).

¹ the former 1996 BC spotted owl model (developed and applied, by I. Blackburn during development of the first iteration of the Spotted Owl Management Plan (SOMP1) adopted values for habitat attributes relevant to US literature; this failed to recognize and incorporate refinement of values more relevant in the BC/Canada portion of the species' range.

Recent Publications and Reports (Chronological)

- Nagorsen, D., Lausen, C., Brigham, M., and Hobbs, J. 2019. Field Guide to Bats of BC. Manuscript in prep.
- Hobbs, J., C.C. Helbing, C. Goldberg, I. Adams. 2018. Ecology and Distribution of Rocky Mountain tailed frog using eDNA methods in Eastern BC. PlosOne. Manuscript in Prep.
- Hobbs, J., J. M. Round, C.C. Helbing. 2018. Expansion of the known distribution of the coastal tailed frog, *Ascaphus truei*, in British Columbia, Canada using robust eDNA detection methods. PlosOne. Manuscript in Prep.
- Veldhoen, N., Hobbs, J., Ikonomou, G., Hii, M., Lesperance, M., and Helbing, C.C. 2016. Implementation of novel design features for qPCR-based eDNA assessment.
- Hobbs, J. and C. Goldberg. 2016. Standard Operating Procedure. Environmental DNA Protocol for Freshwater Aquatic Ecosystems. V2.0. Prepared for B.C. Ministry of Environment. 1-25.
- Livezey, K.B, M.F. Elderkin, P. A Cott, J. Hobbs and J. P. Hudson. 2008. Barred owls eating worms and slugs: the advantage in not being picky eaters. *Northwestern Naturalist*. 89: 185-190.
- Smith, J., G.D. Sutherland, D.T. O'Brien, F.L. Waterhouse, J.B. Buchanan; J. Hobbs and A.S. Harestad. 2008. Relationships between Elevation and Slope at Barred Owl Sites in Southwestern British Columbia. Research Section, Coast Forest Region, BC Ministry of Forests and Range. Nanaimo, BC. Technical Report TR-040.
- Hobbs, J., 2007, "Thermal Ecology of the Northern Pacific Rattlesnake." Masters of Science Thesis: Simon Fraser and Royal Roads University
- Hobbs, J. and Cannings, 2007, "The Spotted Owl – Shadows in an Old Growth Forest" (Book), Douglas and McIntyre. ISBN: ISBN 978-1-55365241-0.

3. WC has asked me to provide an opinion, based on my qualifications, on the following questions:

1. What is the history, population trend, and current status of the Spotted Owl in Canada?
2. What are the key threats to survival and recovery of the Spotted Owl?
3. What are the ecological requirements for the Spotted Owl, and which of these are key to their recovery in British Columbia?
4. How should ecological requirements influence recovery actions?
5. How has British Columbia managed for Spotted Owl survival and recovery? Please provide a chronology.

6. In reference to the BC Habitat Management Practices document and any other relevant materials you are aware of, how has British Columbia managed and protected Spotted Owl habitat since the release of the Recovery Strategy?
7. How has British Columbia's management and protection of habitat affected the survival or recovery of the Spotted Owl?
8. How has British Columbia managed key threats to Spotted Owl habitat?
9. How has British Columbia's management of key threats to the habitat affected the survival or recovery of Spotted Owl?
10. How has British Columbia managed key threats, other than to habitat, of the Spotted Owl?
11. How has British Columbia's management of these key threats affected the survival or recovery of the Spotted Owl?
12. In reference to the BC Habitat Model, how has British Columbia defined and described Spotted Owl habitat?
13. Does the BC Habitat Model identify and define Spotted Owl critical habitat as required by the SARA (that is, "habitat that is necessary for the survival or recovery of [the Spotted Owl]" identified "to the extent possible, based on the best available information") ("Critical Habitat")?
14. If you answered "no" to question 13, what is the Critical Habitat for the Spotted Owl as required by the SARA?
15. How is the Critical Habitat you define and describe different and similar to the BC Habitat Model?
16. How should the threats to Critical Habitat be managed to maximize the likelihood the Spotted Owl will survive and recover?
17. Can Critical Habitat be logged so as to enhance or not jeopardize the Spotted Owl's survival and recovery?
18. What are the key activities (such as habitat enhancement, predator control, prey augmentation, etc.) which should and should not accompany management and protection of Critical Habitat to maximize the likelihood the Spotted Owl will survive and recover?
19. The authors of the Recovery Strategy determined that the survival and recovery of the Spotted Owl was at the time technically and biologically feasible. Is the survival and recovery of the Spotted Owl in British Columbia still technically and biologically feasible?
20. Attached is a document prepared by the Canadian Spotted Owl Recovery Team ("**CSORT**") that we refer to as the Action Plan Guidance. What is your understanding of the nature of this document?

21. The CSORT states in the Action Plan Guidance that it was drafted to “identify reasonable actions required to protect and recover the Northern Spotted Owl in Canada” (at page v). How does BC’s current approach to protecting and recovering the Spotted Owl exceed, meet, or fall short of these actions?

4. Acronyms, Abbreviations, and Definitions

Acronym/Abbreviation/Term	Definition
AAC	Annual Allowable Cut
Age Class	Assignment used by BC Government to denote the age of forest cover. Forests are assigned an age class (1-9) based on estimated age, since origin, of the forest.
Allee Effect	Negative relationship between population density and population growth rate: illustrated by negative effects on juvenile recruitment
ASL	Above Sea Level
BACI	Before/After-Control/Impact
BEC Zone	Broad Ecosystem Classification Zone
BGC Unit	Bio-geoclimatic Unit
BCCF	BC Conservation Foundation
BCTS	BC Timber Sales
BMP	Best Management Practice
Capable Habitat	Used to refer to habitat that is forested, or capable of becoming forested, through maturation (or succession). Generally young forests (below 120 years, or age class 7) are regarded as capable, but not currently suitable, for use by spotted owl (as breeding or foraging habitat).
Cat-I (Category-Information)	Used to identify proposed cut-blocks being advanced, as “information”, to the BCMFLNRORD district manager for approval to harvest. Once approved a Cat-I block becomes a Cat-A (approved) block and is advanced for commercial forest harvest.
CDF	Coastal Douglas-Fir
CH	Critical Habitat
Class A (spotted owl) habitat	Habitat rated as suitable for breeding/nesting use by northern spotted owl in BC.
Congeneric	Belonging to the same genus
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CSORT	Canadian Spotted Owl Recovery Team
CWD	Course Woody Debris
CWH	Coastal Western Hemlock
DBH	Diameter at Breast Height
ECCC	Environment and Climate Change Canada
FMA	Forest Management Area
FRPA	Forest and Range Practices Act

GWM	General Wildlife Measure
GVRD	Greater Vancouver Regional District
HCA	Habitat Conservation Area
HEP	Habitat Enhancement Procedure
HSI	Habitat Suitability Index
HVR	Heavy Volume Removal
HWR	Harvest with Retention
IDF	Interior Douglas-Fir
IWMS	Identified Wildlife Management Strategy
LRMP	Land and Resource Management Plan
LTAC	Long-term Owl Activity Centre
LTOHA	Long-term Owl Habitat Area
LVR	Light Volume Removal
MFHA	Managed Future Habitat Area
MS	Montane Spruce
MOU	Memorandum of Understanding
NRD	Natural Resource District
NSOBP	Northern Spotted Owl Breeding Program
NWFMP	Northwest Forest Management Plan
Old Growth (forest)	In reference to late seral, or mature forest; generally greater than age class 8 (141-250 years of age) and often greater than age class 9 (>251 years of age).
PP	Ponderosa Pine
RISC	Resource Inventory Standards Committee
SARA	Species at Risk Act
SARCO	Species at Risk Coordination Office
SELES	Spatially Explicit Landscape Event Simulation
Stochastic	Randomly determined
SOHA	Spotted Owl Habitat Area
SOMIT	Spotted Owl Management Interagency Team
SOMP1	1997 – 2007 Spotted Owl Management Plan (original)
SOMP2	2009-2019 Spotted Owl Management Plan (revised)
Suitable Habitat	In reference to estimated or perceived foraging and nesting habitat for spotted owl based on consideration of several habitat attributes including BGC Zone, age-class, stand height, and crown (or canopy) closure.
SRMZ	Special Resource Management Zone
Sympatric	Co-occurring, existing in the same geographic area
THLB	Timber Harvesting Land Base
VRI	Vegetation Resource Inventory
WC	Wilderness Committee
WHA	Wildlife Habitat Area

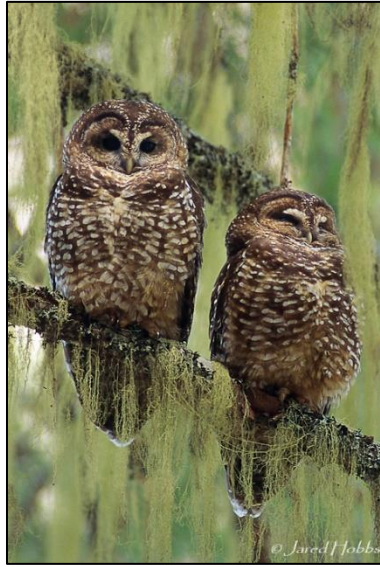
5. Detailed Responses to Questions 1-21

1. What is the history, population trend, and current status of the Spotted Owl in Canada?

Synopsis: Pre-European contact the population of northern spotted owl in BC is estimated at 500 pairs. The owl's historic distribution in BC (or Canada) extends from the international border east to Manning Park and north along the Cascades to Lillooet, and along the Coastal ranges to Bute Inlet. The first written recorded spotted owl detection in BC is from 1903. Between 1909 and 1965 spotted owls were recorded at 18 additional locations within their range. No trend data exists prior to 1991; however, monitoring efforts between 1991 and 2002 demonstrated an annual population decline of up to 10.4% per year. Surveys between 2002 and 2018 suggest an even more rapid rate of population decline. As of 2018, the remaining extant population of spotted owl in BC is restricted to three single owls in the Chilliwack NRD.

Distribution in BC:

The historic distribution of spotted owl in BC is from the international border, from Vancouver continuing east to Manning Park (east gate and Lightning Lake (Campbell 2014)) and continuing north along the Cascades and Coastal ranges north to Carpenter Lake, northwest of Lillooet. The first written records of spotted owl detected in BC was recorded in 1903 by Delbert Grovner Boyd Ryder at Mount Lehman; this was closely followed by a specimen from Chilliwack in 1909 (Campbell 2014). Between 1909 and 1965, spotted owls were reliably recorded at 18 additional locations (including four nest records) between Bute Inlet and Powell River along the west coast and as far east as Lightning Lake in Manning Park in the Cascades. There are no confirmed records on Vancouver Island; however, Clark reported repeated observations of spotted owl south of Courtenay in 1910 (as described in Campbell et al. 2014). The western extent of the species' range in BC was never well defined as no formal survey has ever been conducted within large portions of the species' former range within the Sunshine Coast NRD despite several confirmed records (near Bute Inlet) as documented by W. Campbell (Campbell 2014). The current 2018 extant population is restricted to only three sites near Boston Bar (Dulc 2018).

Appearance and Taxonomy:**Northern Spotted Owl****California Spotted Owl****Mexican Spotted Owl**

The northern spotted owl is a mid-sized brown owl with no ear-tufts and brown eyes. Individuals weigh between 600-800 grams, with a body length of 55cm and a wingspan of 150 cm. Within North America, there are three recognized subspecies: the northern spotted owl (*S. o. caurina*), the California spotted owl (nominate subspecies) (*S. o. occidentalis*), and the Mexican spotted owl (*S. o. lucida*). Only the northern spotted owl is found in British Columbia (BC); this subspecies is the focus of this report; it is referred to hereafter simply as “spotted owl”.

Conservation Status:

By the mid 1980's, concern over noted declines within the US, and suspected in BC, motivated increased attention in Canada. In 1984, protection for the species was recommended to the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (Campbell 2014) and by 2000 the owl's status was confirmed as Endangered based on an updated report by Kirk (1999) (as cited in Campbell 2014). The spotted owl was first designated as Endangered in Canada by COSEWIC in 1986 (Chutter et al. 2004). This status was reconfirmed in 1999 and again in 2002. Spotted owl was listed on Schedule One of the federal *Species at Risk Act* in 2004. In BC, spotted owl is red-listed by the Conservation Data Center, and is recognized as a “Priority 1” under Goal 3 of the BC Conservation Framework (to maintain the diversity of native species and ecosystems). Spotted owl is also identified by the BC Ministry of Environment in the Category of Species at Risk and as a priority species for conservation and management under the Government Actions Regulation component of the Forest and Range Practices Act (Blackburn and Godwin 2004). As such, sites detected on Crown land are entitled to consideration for protection through the designation of Wildlife Habitat Areas (WHAs) to conserve and maintain habitat values.

Status of the Captive Breeding Population:

A captive breeding program was initiated in 2006 with the goal of releasing 20 young per year between 2006 and 2026 (I. Blackburn pers. com.) with an originally projected 2019 goal of 240 owls bred and released. To date the program has produced eight young (one of which was blind and incapable of flight); the same program has removed ten spotted owls from the wild population in the same time period to augment breeding stock (including at least one that died within 24-hours of capture from blunt force trauma). Release goals are not publicly available and are not currently anticipated in 2019; to date no captive bred spotted owls have been released in BC. There are currently 21 owls in captivity (including eight captive bred juveniles, ten adults removed from the wild in BC, and four owls brought in from rescue centres in the United States (US)).

Population Trend in BC:

- **Long-term Trend (1903-1991):** Trend data is not available prior to 1991. Historic population estimates (pre-European contact) estimated as many as 500 pairs of northern spotted owl in BC (Blackburn et al. 2002). Large declines from historic population levels have occurred in BC over the past 50-100 years.
- **Short-term Trend (1991-2002):** Evaluation of short-term trends between 1992 and 2001 confirmed at least 64 occupied sites in British Columbia within the Sea-to-Sky, Chilliwack, and Cascades NRD. Analysis of the occupancy of owls at 40 of these sites in the Chilliwack and Sea-to-Sky forest districts between 1992 and 2001 confirmed a population decline of about 49% at an average annual rate of 7.2% (Blackburn et al. 2002). In 2002, Chutter et al. (2004) suggested a similar sharp population decline in BC (35%) resulting in an overall decline of 67% between 1992 and 2002 at an average rate of 10.4% per year (Chutter et al. 2004).
- **Overall Trend (1903-2018):** Regardless of subtle differences in reported rates of population decline, based on the historic population estimate of about 500 potential breeding pairs of owls (Blackburn et al. 2002), the current population estimate suggests that the population may have declined by as much as 99% since European settlement (**Figure 1**).

Population trends were not monitored using consistent monitoring protocols after 2002 - instead, more widespread surveys were conducted to document new occurrences on the landscape and to determine productivity and survivorship of juvenile spotted owls (Hobbs 2004a, 2004b, Hausleitner 2005, Hausleitner 2006). As such, a graph of known occupied sites per year between 2002 and 2018 shows a fluctuating trend, however, this fluctuation is a reflection of allocation of effort rather than a fluctuation in number of owls (**Figure 2**). Survey information collected between 2002 and 2018 suggests that the rate of population decline likely increased after 2002 (Hobbs 2004, 2005, Hausleitner 2007, Gillis 2016a, Gillis 2016b, Dulc 2018 (unpublished monitoring data provided by I. Blackburn 2017)).

Despite measures to control barred owl and extensive efforts from the BC spotted owl captive breeding program, the BC population of spotted owl has now declined to a current population of three single (non-paired) owls in 2018. Few areas of large contiguous old-growth forest habitat remain on the landscape in BC in a condition suitable for occupancy by spotted owls (Chutter et al. 2004).

Continued population decline and current status indicate that spotted owls are critically imperiled in BC. There are currently no remaining known extant spotted owl sites in the Cascades Natural Resource

District (NRD) and the Sea-to-Sky NRD²; in the Chilliwack NRD there are only three remaining single owls (no pairs). The remaining extant sites in BC are all restricted to the Fraser sub-population (J. Gillis, pers. comm., 2018 as cited in Dulc 2018).

Figure 1: Estimated number of occupied survey areas (n=40) from 1992-2002 (from Blackburn and Godwin 2003, as cited in Chutter et al. 2004).

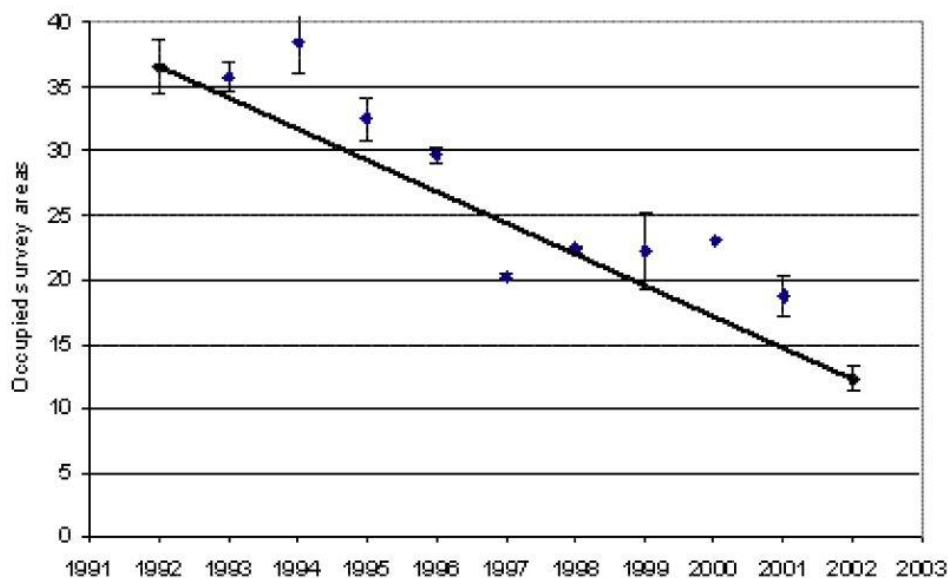
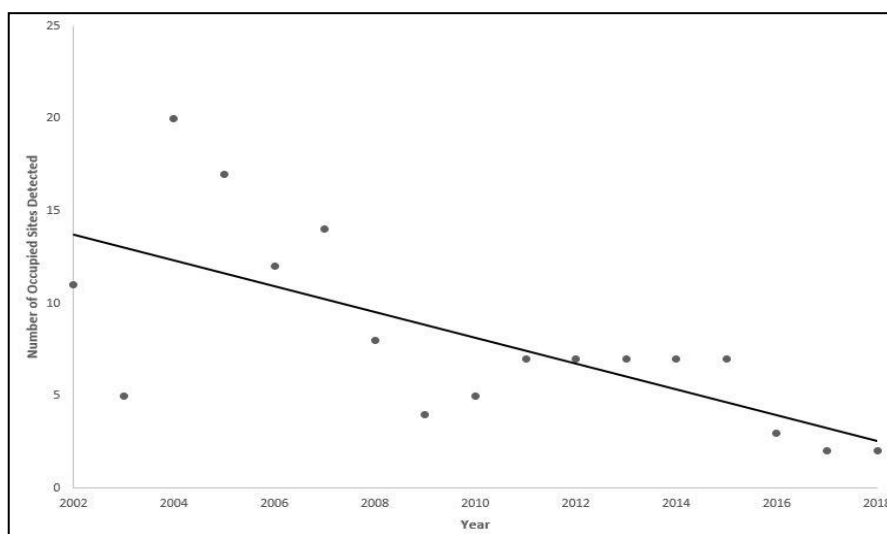


Figure 2: Estimated number of occupied sites from 2002-2017 (unpublished monitoring data provided by I. Blackburn 2017).



² Within the Lillooet and Squamish sub-populations, inventory efforts since 2004 have documented a 100% decrease in occurrences; no spotted owls were detected in this sub-population in 2016 or 2017 surveys (Dulc 2018).

2. What are the key threats to survival and recovery of the Spotted Owl?

Synopsis: Key threats to spotted owl survival and recovery include further loss and fragmentation of old-growth habitat, competition from barred owls, predation, climate change, disease, and negative effects from environmental and genetic factors. Of these, the primary threat is loss of habitat. Spotted owl prey abundance and availability is influenced by available suitable forested habitat; spotted owl reproduction and survival are directly influenced by habitat loss. Commercial forest management practices create fragmented landscapes and exacerbate a secondary threat in the form of barred owl competition and depredation, and a tertiary threat of depredation by great horned owl and northern goshawk. Natural environmental disturbances are considered quaternary threats but are still significant given the small population size of spotted owls.

In the treatment of “Threats to the Species” (P.12) of the spotted owl Recovery Strategy the authors distinguished primary factors from secondary factors based on the duration of the effect and assigned threat priority as follows: *“The original population decline is believed due to the loss and fragmentation of old-growth habitat to urban and rural development, and forestry activities. This loss of habitat resulted in diminished quantity and quality of habitat, reduced connectivity of owl sites across the landscape, increased isolation from the larger population in the United States, and likely heightened negative effects of stochastic events associated with very small populations. Current known and potential threats include further loss and fragmentation of habitat, competition from barred owls, predation, climate change, disease and negative effects from environmental and genetic factors.”* (From Chutter et al. (2007)). I agree with the classification and assignment of priority as described in the recovery strategy; however, I also considered guidance from the Canadian Environmental Assessment Agency (2013) to describe significance of each threat by examining magnitude, extent, duration, reversibility and frequency. I have followed this more fulsome approach in the summaries of each threat presented below.

Primary Threat: Loss of Habitat:

High magnitude (i.e., severe influence), large extent (i.e., range-wide), prolonged duration (i.e., not readily reversible) and frequent (i.e., occurs commonly).

Spotted owls are specialists – they persist by foraging on two key species that they hunt within the canopy of a mature forest. The northern spotted owl occupies large home ranges (2,800 – 3,400 ha) within suitable forested habitats (**Figure 3**). Reproduction and survival are strongly affected by fluctuations in prey abundance and availability; both attributes are negatively affected by loss of old-growth forest habitat (**Figure 4**). Commercial forest harvest is most commonly identified as the primary threat to spotted owl (Chutter et al. 2004), as clear-cut practices result in removal of large areas of coniferous forest. Conventional commercial forestry practices typically result in large areas of complete forest removal (i.e., clear-cuts) with an obvious direct effect upon the amount, distribution (i.e.,

fragmentation) and abundance of available suitable spotted owl habitat. This directly impacts spotted owl abundance at the landscape level³.



Figure 3: Spotted owl territory within Stein Provincial Park. This illustrates ideal spotted owl habitat conditions in BC.



Figure 4: Upper Pitt watershed illustrating typical landscape conditions on the THLB within the owl's range in BC.

³ In the past, urban encroachment within the Lower Mainland region likely displaced spotted owls but the influence of urban encroachment is no longer proximal to any active owl territories.

Secondary Threat: Competition from Barred Owls:

High magnitude (i.e., severe influence), large extent (i.e., range-wide), prolonged duration (i.e., not readily reversible) and frequent (i.e., occurs commonly).

In addition to direct loss of habitat, forest harvest promotes and exacerbates a more recent secondary threat; competition, and to a lesser extent, depredation, from the northern barred owl (*Strix varia varia*) (hereafter referred to as barred owl) (**Figure 5**). Unlike spotted owls, barred owls forage along the edge of a forest, hunting prey in forest openings. Barred owls are referred to as a “generalist” species in ecology (i.e., a species with general foraging requirements that can capitalize on a wider variety of prey) (Livezey et al. 2008). By converse, spotted owls are referred to as a “specialist” species (i.e., a species with specific foraging requirements that specialize on feeding on a relatively limited number of key prey items). As forest harvest increases the area of ‘edge’ habitat, relative to the area of available interior forested habitat⁴, foraging conditions are optimized for barred owl. These distinct ecologies are apparent when considering diet, home range size, fecundity, and survivorship in response to environmental perturbation.

Available literature from Oregon and California suggests that barred owl prey diversity is up to three times greater than spotted owl (Diller et al. 2016,). As such, barred owls persist within relatively smaller home ranges (600 ha) and exploit a more diverse prey base. Suitable prey for barred owl includes amphibians, other birds, and a diversity of small mammals (i.e. mice, voles, tree squirrels (including flying squirrel (*Glaucomys sabrinus*)) and bushy-tailed woodrat (*Neotoma cinereus*)) whereas spotted owls tend to specialize, feeding almost exclusively on woodrats and flying squirrels. The barred owl’s less restrictive diet allows it to forage within a range of forest types including younger forests and mixed species stands. Barred owls can select for alternate prey species when their populations of their preferred prey decline or fluctuate giving barred owls a competitive advantage over spotted owls when they co-occur in suitable forested habitat (Livezey and Flemming 2009).

Forested landscapes with a mosaic of forest age-classes are created by commercial forest harvest practices (**Figure 3**). Under the current fragmented age class structure in BC the barred owl has a competitive advantage (Livezey and Flemming 2009, Weins et al. 2014 as cited in Gillis 2016a). Barred owls have been observed displacing spotted owls from habitats (Diller et al. 2016); barred owls have also been recorded depredating both juvenile and adult spotted owls (Dark et al. 1998, Leskiw and Gutierrez 1998 as cited in Gillis 2016a). Fecundity and survivorship of adult spotted owls are both negatively affected by barred owls when they co-occur within 0.8 km of territory centres (Gillis 2016a). Recruitment and survivorship of juvenile spotted owls is also affected in areas where barred owls are established (Diller et al. 2016). In a long term (1985-1996) study that sampled 386 marked juvenile spotted owls 26.2% of the 386 marked juvenile spotted owls died from starvation (Forsman et al. 2002). Starvation induced mortality is undoubtedly exacerbated by barred owls (Diller et al. 2016).

⁴ Edge-effect is an ecological term used to describe the influence of increased edge-to-interior ratios in mature (primary, or old growth) forests. As mature forest is harvested and replaced by cleared openings the ratio of interior to edge habitat is reduced.

In summary, as barred owl abundance increases there is a concomitant increased level of competition for prey and security habitat. The more aggressive barred owl tends to displace both resident and non-resident (dispersing) spotted owls. In response, spotted owls will move to avoid barred owl thus subjecting themselves to increased thermo-energetic costs as they disperse from high-value foraging habitats (Diller et al. 2016) to sub-optimal habitats with fewer resources. This often results in mortality from starvation in dispersing juvenile spotted owls (**Figure 6**).



Figure 5: Barred owl in mixed age forest.



Figure 6: Emaciated (dead) juvenile spotted owl.

Tertiary Threat: Increased Predation Risk

High magnitude (i.e., severe influence), large extent (i.e., range-wide), prolonged duration (i.e., not readily reversible) but low frequency (i.e., occurs irregularly)

Fragmented forest landscapes (i.e., forests with a mosaic of age classes as created by commercial forest harvest practices) may also favor (for reasons similar to those described above for barred owl) great horned owl (*Bubo virginianus*) and northern goshawk (*Accipiter gentilis*) population abundance. As forest harvest increases edge-to-interior forest ratios more favourable habitat conditions for great horned owls are created. This not only affects competition for limited prey resources, but also affects predation rates. Avian predation on spotted owls is largely attributed to great horned owl and northern goshawk (Forsman et al. 2002). This is further exacerbated for dispersing spotted owls as increased movement, during dispersal, places spotted owls at greater risk of depredation by great horned owls. In a long term

(1985-1996) study that sampled 386 marked juvenile spotted owls 68% died from predation; 67 of 83 (81%) of the depredated owls were attributed to avian predators (Forsman et al. 2002).

Quaternary threats: Random Stochastic Events (including fire)

High magnitude (i.e., severe influence), low extent (i.e., localized), short duration (i.e., temporary) and infrequent (i.e., occurs irregularly).

Natural stochastic events also affect owl survival and recovery. Typically, these include natural environmental disturbances including fire, landslides, and unusual weather patterns as a result of climate change (Dulc 2018). These threats become more serious, and more likely to result in extirpation, when population sizes are small as these populations have reduced resilience to cope with change.

Unfortunately, decades of fire suppression have altered the tree species composition, structure and spatial distribution of conifer forests in at the drier (Cascades) and transition (Sea-to-Sky) NRD. Literatures from Washington suggests increased canopy cover and fuel loading on the forest floor has continued to intensify and expand risk from catastrophic wildfire events (Buchanan 2016). As a consequence, fires in these altered conditions are more intense and often remove substantial areas of forest resulting in landscape conditions that are unsuitable (or less suitable) for use by spotted owls. In summary, fire suppression has served to create spotted owl habitat in some areas but has altered forest attributes towards an unsustainable condition; in these modified forests large fires and impacts of insects and disease are more likely to degrade or destroy portions of these forests (Buchanan 2016). The U.S. Fish and Wildlife Service acknowledged the need to address this risk by proactively managing dry forest landscapes (Buchanan 2016).

3. What are the ecological requirements for the Spotted Owl, and which of these are key to their recovery in British Columbia?

Synopsis: Key ecological requirements include protection from predators; access to nesting and roosting habitat features; and access to suitable foraging habitat that features high prey availability and accessibility (i.e., open stands to allow flight within and beneath the forest canopy). These attributes are typically associated with old-growth forests (generally no less than 120-140 years old in the CWH and IDF bio-geoclimatic zones). As such, conservation of suitable spotted owl habitat is fundamental to species recovery.

Ecological Requirements:

Spotted owls are upper trophic level avian specialists that rely on forest characteristics typically associated with old-growth forests. Forest age class is an important attribute; however, several other forest attributes are also required. These include appropriate stand (tree) height, appropriate canopy closure, low stem density (approximately 240 stems/hectare (ha)), vertical structural heterogeneity, healthy understory component and presence of coarse woody debris. These structural attributes provide security habitat (i.e., protection from predators and the environment (e.g., inclement weather)), nesting and roosting structures; relatively high prey availability and accessibility; and suitable foraging conditions that permit flight within and beneath the forest canopy. The specific structural attributes that influence habitat quality varies between ecosystems and topography but, generally speaking, suitable spotted owl foraging habitat is comprised of mature forest at \geq age class 6 (least 100 - 120 years old) and below 1,200m elevation. Spotted owl nesting habitat is typically associated with old growth forested habitat \geq age class 8 (141-250 years of age) or age class 9 (>251 years of age)

In the northern part of their range spotted owls “*consistently select nest stands surrounded by a greater proportion of old or mature forest than are randomly available in the landscape*” (Manley et al. 2003). Although there is some variation across the range of the species, northern spotted owl habitat is described by consensus in the literature as late-seral (i.e., old-growth) coniferous forests with uneven aged trees that create a multilayered canopy and an average stem density of approximately 200 – 240 stems per hectare (Chutter et al. 2004, Blackburn et al. 2009). At a general level, habitat suitability includes consideration of (horizontal and vertical) structural complexity, tree species, canopy closure, stand (stem) density and stand height. The response to Question 12 provides additional detail regarding specific measurements of key forest habitat attributes used by CSORT to define and identify spotted owl habitat in BC.

As secondary cavity nesters, spotted owls are dependent on tree deformities that are most abundant in old-growth forests. Spotted owls’ nest in large natural cavities (broken limbs resulting in a cavity that creates access into the bole), broken topped trees with a hollow top into the core of the tree (referred to as chimney nests) or platforms created by mistletoe clusters and abandoned northern goshawk nest structures. As medium-sized owls, spotted owls require relatively large tree deformities for nesting and roosting, these typically occur in large diameter trees (>75 cm Diameter at Breast Height (DBH)) (Forsman et al. 1984, Thomas et al. 1990, Buchanan et al. 1993). In Washington and Oregon, mean

diameter of nest trees varied from 59-141 cm DBH with smaller trees used more frequently in drier ecosystems (Manley et al. 2003). In BC, spotted owl nests have been reported in two bio-geoclimatic (BGC) zones: the wetter ecosystem is referred to as the Coastal Western Hemlock (CWH) BEC zone and the drier ecosystems are referred to as the Interior Douglas-fir (IDF) BEC zone at elevations of 368-1,120 m above sea level.



Broken-top (or Chimney) nests occur in trees with a large bole; with an average age of 700 year. Once cut, these trees can't be quickly replaced.



In drier portions of the owl's range large diameter trees are scarce; abandoned platform nests may be used if available.

Forest structure is also critical to ensure that spotted owls have sufficient access to prey. Spotted owls need particular forest characteristics to locate and capture their prey, and as specialists (feeding predominantly on flying squirrel and bushy-tailed woodrat), they require a high abundance of prey species (see response to Question 11). Flying squirrel and bushy-tailed woodrat occur in higher densities in forested areas with diverse shrub cover, coarse woody debris, or nearby rocky talus (Gutierrez 1995) (see Question 11-3). As such, mature forested areas with these characteristics are required for persistence of spotted owls on the landscape.

Spotted owl persistence and survival requires breeding, foraging and dispersal habitats that are generally recognized to occur within large contiguous areas of old-growth forest in the CWH and IDF biogeoclimatic zone. Conservation of old-growth forested habitat within the known historic range of the species is essential to spotted owl recovery as these habitats provide nesting and roosting habitat and access to prey items with appropriate forage conditions. Spotted owl habitat has been described consistently in the BC Recovery Strategy (Chutter et al. 2004) and in the COSEWIC spotted owl species account (2008), as follows:

General Habitat:

The Canadian Spotted Owl Recovery Team (Chutter et al. 2007) identified three habitat types based on ecological subregions: maritime, sub-maritime and continental. High-quality habitat is characterized as mixed coniferous forests >200 years old, at elevations below 1,200 m with abundant large diameter and tall trees (Chutter et al. 2007). These forests feature uneven-aged, multi-layered canopies, and include numerous large trees with broken tops, deformed limbs, and large natural cavities in the bole of veteran trees. Snags are typically abundant, as is downed woody debris. These habitat characteristics are found naturally in old-growth forests in the maritime and sub-maritime areas. In interior areas spotted owls have been observed using younger forest stands where structural components typical of old-growth forests have been created by disturbances such as fire, wind or selective logging (COSEWIC 2008).

Breeding Habitat:

Old-growth trees are used for nesting, either in contiguous old-growth stands or in remnant old-growth patches (Thomas et al. 1990; Forsman and Giese 1997; Ripple et al. 1997 as cited in COSEWIC 2008). Nest sites are typically located in dense, multi-layered, older forests with 85-90% canopy closure (Gutiérrez et al. 1995). Spotted owl exhibit high philopatry (fidelity) to breeding areas (territory cores); re-using the same nest grove for their entire life, and often over successive generations.



Nest tree in breeding habitat at Sockeye Creek; nested in broken top tree for at least two years in 2004 and 2005.

Foraging Habitat:

Northern spotted owl foraging habitat occurs in forests with high canopy closure and complex structure (Gutierrez et al. 1995). Owls primarily forage in old-growth or mixed-aged stands (with mature and old-growth trees) and use a wider variety of habitat for foraging than for nesting or roosting (Thomas et al. 1990 as cited in COSEWIC 2008). Telemetry studies in BC, Oregon and Washington suggest that old-growth forests provide superior foraging habitat relative to maturing stands, young stands provided marginal habitat and clear-cuts were totally unsuitable for use as foraging habitat by spotted owl (Thomas et al. 1990; Forsman et al. 1984; Carey et al. 1990; Carey et al. 1992 as cited in COSEWIC 2008).

Dispersal Habitat:

Juvenile owls undergo natal dispersal in the fall. To be successful, dispersing owls require protection from predators and security habitat for shelter during inclement weather. They also need abundant and available prey to meet high thermo-energetic demands experienced during dispersal. Old-growth (and mature) forests are thought to provide ideal conditions for dispersal; however, dispersing owls may use a fragmented mosaic of various-aged forests, clear-cuts, roads, and non-forested areas (likely by necessity, and to their detriment, as these habitats are encountered) (Forsman et al. 2002, Hobbs 2004, Hobbs 2005).

Breeding-age owls also occasionally disperse, especially young unpaired females, to find new territories or to move between alternate territories (Forsman et al. 2002). The quality (stand structure, degree of fragmentation, topography) of dispersal habitat is likely an important factor in survival of dispersing birds (Forsman et al. 2004). Large non-forested valleys and large water bodies are known barriers to dispersal (Forsman et al. 2002a).

In BC, I used radio-telemetry to track seven dispersing juvenile spotted owls between 2003-2006. I confirmed use, by dispersing juvenile owls, of old-growth forested habitats (Hobbs 2004, 2005). I demonstrated that although dispersing juveniles were able to move through suboptimal habitats (including early seral forest, severely burned areas, and across large waterbodies (Hobbs 2005)) the effects on survivorship were negative. None of the owls I tracked, during dispersal, survived to reach adulthood. Starvation was the main cause of mortality (n=6) followed by predation (n=1). Similar studies in the US, with larger sample size, confirmed decreased survival with increased use of fragmented forest during dispersal (Forsman et al. 2004).

4. How should ecological requirements influence recovery actions?

Synopsis: As a species whose ecological requirements are determined by the availability and distribution of old-growth forest habitat, any measure of recovery action demands the protection of suitable habitat in sufficient quantity. Secondary actions such as captive breeding and control of barred owl populations should be undertaken once sufficient habitat conservation has been achieved.

Recovery actions, and associated effort and cost, should, ideally, be proportionately allocated in accordance with the sensitivity of the species to key threats (see Question 2). Compromising actions or effort allocated towards conservation or protection of habitat in favour of maintaining forest harvest targets (set by Annual Allowable Cut (AAC)) on the timber harvesting land base (THLB)) is counter-productive when attempting to recover a species whose persistence is directly linked to old-growth forest habitat availability and distribution on the landscape. This principle is stated and supported by a consensus in the scientific understanding in guidance provided to SARCO by the CSORT in 2004 (refer to Chutter et al. 2004-Appendix 1C (P.62))



Logging truck loaded with former owl habitat on route to the mill on the Harrison FSR.



Clear-cuts in former spotted owl habitat near Lillooet, BC.

It is also prudent to consider secondary threats (competition from barred owl) in addition to conservation of suitable habitat in sufficient quantity to ensure recovery. Augmenting natural populations of spotted owls (through captive breeding and release, or diet supplement), and controlling the effects of barred owls on spotted owls at occupied sites, are logical next-steps. Augmentation of spotted owl populations through captive breeding, and control of barred owls at occupied sites, is not sufficient to ensure recovery of spotted owls in BC in the absence of adequate habitat protection.

Triage management requires that recovery of any wild population of a species will be restricted by the most limiting factor. For spotted owl effective recovery requires sufficient attention is afforded to all key threats.

5. How has British Columbia managed for Spotted Owl survival and recovery? Please provide a chronology.

Synopsis: The following bullet points outline the chronology of Spotted Owl survival and recovery management in BC:

- 1990: Canadian Spotted Owl Recovery Team (CSORT) was established to develop a national recovery plan in response to 1986 COSEWIC designation. In 1991 the Province initiated surveys to assess population trend, and in 1995 accepted a management option with the lowest associated socio-economic impact.
- 1997: Initial implementation of Spotted Owl Management Plan (SOMP1), carried out between 1997-2007. In 1997 CSORT was replaced by the Spotted Owl Management Interagency Team (SOMIT) as a result of CSORT's refusal of SOMP1 based on its shortcomings (predicted 60% probability of halting decline).
- 2002: Review of SOMP1 (leading to SOMP2) begins with re-establishment of CSORT; primary challenge of SOMP1 recognized as the area based 'cap' to mitigate impact to forest sector at no greater than 4.5% to the THLB. This cap was carried forward and applied during development of SOMP2.
- 2006-2009: Development of SOMP2, with initial focus on captive breeding of spotted owl and barred owl control. In 2006 the Province released a Recovery Action Plan recommending revised habitat management guidance.
- 2009: SRMZ boundary revisions completed. Best Management Practices released by the Province. There was a net change in managed habitat under SOMP1 (363,000 ha) versus SOMP2 (396,247ha); however, of the 396,247 ha purportedly being *managed* for spotted owl 208,025 ha (52.5%) is co-located within Parks, conservancies, eco-reserves, protected areas and already protected watersheds within the Greater Vancouver Regional District (GVRD). The remaining 188,222 ha being managed by the Province is comprised of a large proportion of previously logged former spotted owl habitat – only 95,117 ha (51 %) is currently suitable – and within that commercial logging of suitable owl habitat is permitted in 28,198 ha as these habitats occur within MFHAs.
- 2011: WHAs designated in the Chilliwack NRD to provide legal management directive for forest management to support spotted owl recovery in BC.
- 2013: WHAs designated in the Sea-to-Sky NRD to provide legal management directive for forest management to support spotted owl recovery in BC.
- 2009-current: Under SOMP2 the BC population continues to decline to three remaining owls in 2018.

In 1990 the first Canadian Spotted Owl Recovery Team (CSORT) was established to develop a national recovery plan. Formal surveys were initiated, by government, in 1991 to better understand the population trend of spotted owls in BC. Concern for potential for socioeconomic impacts quickly arose and began to influence development of management options. The Province insisted on development of management options that ranged from maximum to minimum habitat protection for spotted owls in BC. A report entitled Management Options for the Northern Spotted Owl in British Columbia presented six

management options (each adjusted to varying degrees to cater to socio-economic considerations). In 1995, after a provincial cabinet level decision, the premier's office announced adoption of the least precautionary (i.e., lowest socio-economic impact) plan to manage spotted owls using existing and new protected areas and enhanced forest conservation measures to promote recovery. This initial attempt at spotted owl recovery and management was implemented by the Province in 1997 as the first iteration of the Spotted Owl Management Plan (referred to as SOMP1) and was implemented informally, by the Province, between 1997-2007. When released in 1997, SOMP1 afforded management to 363,000 ha of suitable and capable forested habitat within Parks and on Crown THLB lands. At the time, only about half of that total area was currently suitable, with recruitment and enhancement of second growth stands required to increase this amount in areas with only capable habitat (Chutter et al. 2004). When SOMP1 was released, SOMIT (1997a) suggested that the amount of suitable habitat would not begin to increase for several decades, after which it was hoped that numbers of spotted owls would also begin to recover. The transpiring reality did not follow these projections.

By 2002, it was clear that spotted owls were (still) declining precipitously in BC under SOMP1 management. In October 2002, in recognition of the dramatic spotted owl population decline under SOMP1, a new CSORT was initiated to review the existing SOMP1 and, in 2004, to develop a recovery plan to meet the requirements of the federal *Species at Risk Act*.

Chilliwack and Sea-to-Sky NRD:

In 2006, development of a revised Spotted Owl Management Plan (referred to as SOMP2) was instigated by the Province within the Chilliwack and Sea-to-Sky NRDs (but not in the Cascades NRD). Initial recovery efforts outlined by the Province focused on augmentation (captive breeding of spotted owls) and on barred owl control (through translocation and lethal removal). The habitat component of SOMP2 was not fully implemented until much later in 2009.

During the 2006 recovery planning process it was again raised that the fragmented condition of remaining spotted owl habitat, and sparse distribution of potential breeding owls, as well as other biological limitations and threats, resulted in continued dramatic population decline (Chutter et al. 2004, Chutter et al. 2007). The population continued to decline precipitously under SOMP2 and is now facing imminent extirpation. SOMP2 is still in place today (2019) and currently provides management, by the Province, to afford (partial) protection to spotted owl habitat in the interest of spotted owl recovery in BC. The specific management attributes of SOMP1 and SOMP2 are detailed below.

SOMP1: The first Spotted Owl Management Plan (SOMP1) was released in 1997. As noted, the SORT did not endorse SOMP1 as it predicted only a 60% probability of halting the decline of the spotted owl in BC (Chutter et al. 2004); as such, the SORT disbanded shortly after the release of SOMP1. Regardless of the lack of scientific support, SOMP1 was implemented by the Province to provide a 60% probability that BC's spotted owl population would stabilize, and then recover, predicated on the requirement that there must be no significant impacts to timber supply and forestry employment (Chutter et al. 2004). After disbanding in 1997, the SORT was replaced by the Spotted Owl Management Interagency Team (SOMIT) (comprised of representatives from BC's ministries of Environment and Forests) to develop and implement SOMP1 in May 1997. SOMP1 was predicated on an area-based 'cap' to mitigate impact to the forest sector and was set to not result in an impact greater than 4.5% to the THLB.

Within the Sea-to-Sky and Chilliwack NRD, 21 Special Resource Management Zones (SRMZs) were established (two were later rescinded) that included 159,000 ha of protected areas and 204,000 ha of Crown forest land to be legally established as Resource Management Zones under the *Forest Practices Code of British Columbia Act*. It was originally intended to legally establish SOMP1 as a Higher-Level Plan but this did not take place. Nonetheless, SOMP1 was voluntarily implemented by forest companies between 1997-2007 before prescriptive measures under SOMP1 were replaced by Best Management Practices under SOMP2 in 2009 (Blackburn et al. 2009). Under SOMP1, the objective, within each SRMZ, was to maintain 67% of the gross forested area as suitable spotted owl habitat. Unfortunately, many of the SRMZs had less than the targeted 67% suitable habitat at the time of their establishment; this posed a recognized challenge with SOMP1. The Cascades NRD (formerly the Lillooet FD) was not included in SOMP1; as such, there was no protection afforded to spotted owl in the Cascades NRD until 2006 as the Cascades NRD was considered to be extra-limital based on a restricted scope of inventory. In 2014, R.W. Campbell presented evidence that the range of spotted owls in BC also likely included the Sunshine Coast NRD on the west coast (Campbell 2014); to date there have been no formal surveys conducted and no management afforded to spotted owl in this portion of their former range in BC.

By 2002, a precipitous population decline (10.4% per year) was noted in trend monitoring data (Chutter et al. 2007). In 2002, I conducted a complete inventory within the Cascades NRD. My inventory results demonstrated that the population of spotted owls within the Cascades NRD was indeed extant and was, at the time, the most robust population of spotted owl remaining in the Province despite exclusion of management consideration under SOMP1⁵.

In a final attempt to halt the decline a renewed (second) Canadian Spotted Owl Recovery Team (CSORT) was re-established in 2002 with the intent of developing a recovery strategy to identify additional actions required to prevent extirpation. The second attempt was released as SOMP2 by the Province. The intent was to recover spotted owl in BC. Although SOMP2 was announced in 2006, habitat protection measures were not completed until much later.

SOMP2: In 2006, under direction from the BC MOE/MFLNRO and with oversight from the Species at Risk Coordination Office (SARCO) the Province released its Recovery Action Plan for spotted owl habitat management. These actions were implemented with the purported intent of preventing extirpation of spotted owls from BC. The SARCO spotted owl recovery action plan included considerations for captive breeding of spotted owls, barred owl control and partial inclusion (under SOMP2) of habitat management actions recommended by CSORT⁶.

SARCO released the BC spotted owl recovery action plan to provide guidance for spotted owl habitat management in BC within revised SOMP1 spatially designated areas called Special Resource Management Zones (SRMZs). The SRMZ boundary revisions and associated Best Management Practices

⁵ In 2006, additional consideration was afforded to spotted owl habitat conservation to accommodate new survey results in the Cascades NRD (J. Hobbs pers obs). This was achieved through designation of three new Wildlife Habitat Areas (WHAs) as enabled under the Government Actions Regulation (GAR).

⁶ CSORT recommendations were clearly presented and rationalized in the 2004 BC Spotted Owl Recovery Strategy document (Chutter et al 2004) and the 2007 Guidance and Action Planning document (Chutter et al 2007).

(BMPs) for forest harvest activities were not completed until three years later (2009). All SRMZs were subsequently legally designated in 2011 (Chilliwack NRD) and 2013 (Sea-to-Sky NRD) as Wildlife Habitat Areas (WHAs)⁷.

The habitat management guidance of the Provincial Recovery Action Plan is summarized by Blackburn et al. (2009) to include “*Evaluating and revising SOMP 1 (SRMZ boundaries) to ensure better protection for Spotted Owls and their habitat, within existing timber supply impacts*”. There was a net change in managed habitat under SOMP1 (363,000 ha) versus SOMP2 (396,247ha). Of the 396,247 ha purportedly being *managed* for spotted owl (within WHAs) 208,025 ha (52.5%) is located within Parks, conservancies, eco-reserves, protected areas and already protected watersheds within the Greater Vancouver Regional District (GVRD). The remaining 188,222 ha being *managed* for spotted owl is largely comprised of previously logged former spotted owl habitat – only 95,117 ha (51 %) is currently suitable – and within that logging is permitted in 28,198 ha of MFHA areas (a designation that permits intensive forest harvest).

This intricate and complicated management, including new prescriptive guidance for commercial forest harvest of spotted owl habitat within these areas, was authored by the Province (Blackburn et al. 2009) and is now referred to as SOMP2⁸. This initiative represents the Province’s Recovery Action Plan component, under SOMP2, to address conservation of spotted owl habitat in BC.

Cascades NRD:

In addition to revisions to SRMZ boundaries from SOMP1 to SOMP2 in the Chilliwack and Sea-to-Sky NRD the Provincial Recovery Action Plan for habitat conservation also included separate management, under the Identified Wildlife Management Strategy, for the Cascades NRD. This had an even more restrictive 1% ‘cap’ on impacts to the THLB. The Province stated an intention to Protect “*the known (2005) Spotted Owl locations by establishing nine Wildlife Habitat Areas (WHAs; approximately 23,000 ha) to protect 100% of the forests found within each WHA*” (as quoted from Blackburn et al. 2009) yet only 45% of the area within WHAs was actually suitable for spotted owl – the remaining area had been previously logged. In addition, and despite the Province’s stated intent, several extant sites documented between 2002 and 2005 were not afforded protection; they were disregarded from consideration for WHA designation by the Province (SARCO) without transparent criteria or justification. This point was contested internally by M. Chutter and myself, but our concerns were never addressed by SARCO or the Province. By the time the legal designations were accepted in 2009 (Cascades NRD) only six WHAs were established for spotted owl in the Cascades NRD, including three in 2006 (before SOMP2) was released (Copper, Bounder and Enterprise Creek); and three in 2012 (Mowhokam, Nesikep and Lost Valley). This falls short of the Province’s commitment to establish nine WHAs in the Cascades NRD when SARCO announced SOMP2.

⁷ WHAs were designated, by the Province, in 2006 (Cascades NRD), 2011 (Chilliwack NRD) and 2013 (Sea-to-Sky NRD).

⁸ Management guidance under SOMP2 was later formally legalized as General Wildlife Measures (GWMs) (prescriptive management requirements applied within WHAs as mandated under the *Forest and Range Practices Act*) for application within WHAs.

Sunshine Coast NRD:

The historic and current distribution of spotted owl in the Sunshine Coast NRD is unconfirmed as no formal surveys, for spotted owl, have ever been conducted despite verified and documented (published) accounts of spotted owl in this district (Campbell 2014). To date, no management consideration has been afforded to the Sunshine Coast NRD.

6. In reference to the BC Habitat Best Management Practices document (Blackburn et al. 2009) and any other relevant materials you are aware of, how has British Columbia managed and protected Spotted Owl habitat since the release of the Recovery Strategy (2006)?

Synopsis: SOMP2 was predicated on a principle of no-net loss to timber revenue relative to SOMP1 despite the obvious indication, as evidenced by the owl's decline, that the level of protection afforded to suitable habitat was insufficient to stabilize or reverse the declining population trend. SOMP1 was openly rejected by SORT; SOMP2 was also internally criticized at the time of its announcement in 2006. I (and others) openly raised concern when SOMP2 was announced but the Province was unwavering in their commitment to maintain timber harvest levels consistent with levels allowed under SOMP1.

The release of the 2006 Recovery Strategy resulted in a prolonged three-year process of revisions to SOMP1 SRMZ habitat management areas in the Chilliwack and Sea-to-Sky NRD. In 2009, the Province released a document recommending Best Management Practices (BMP) to provide voluntary compliance with prescriptive guidance for licensees harvesting within spotted owl management areas. The Province also approved three more WHAs in the Cascades NRD, in addition to three WHAs I submitted (approved in 2006) as part of an independent planning process.

Two years later (in 2011), within the Chilliwack NRD, the Province converted SOMP2 SRMZs to WHAs to afford legal management under the Forest and Range Practices Act. In 2013, this conversion was completed for SOMP2 SRMZs in the Sea-to-Sky NRD. Within managed areas, two management designations were recognized:

- 1) Managed Future Habitat Areas (MFHAs): the primary purpose of the MFHA is to provide timber harvesting opportunities by allowing Harvest with Retention (clear cuts with retention patches); and,
- 2) Long-term Owl Habitat Areas (LTOHAs): The primary purpose of the LTOHA is to recover and sustain the Spotted Owl population to prevent extirpation of the species. Harvest is permitted in these areas with the objective of enhancing habitat.

In describing the areas being managed for spotted owl habitat, under SOMP2, the Province is circumspect regarding the distinction between capable (i.e., disturbed (i.e., previously harvested) areas of immature forest that are not currently suitable for spotted owl but, with the passage of decades, have potential to mature into suitable habitat) and suitable habitat (old-growth forest currently suitable for use by spotted owl). An independent analysis of currently suitable habitat available within SOMP2 designations revealed that only 51% of the SOMP2 managed areas are considered currently suitable for use by spotted owl. In addition, these management areas represent only 31% of the available spotted owl Class A (breeding and nesting) habitat remaining on THLB today.

When SARCO announced the Province's Recovery Action Plan in 2006 the initial focus (until 2009) was limited to efforts afforded to spotted owl population augmentation and implementation of barred owl control measures. Barred owl control measures were purportedly focused on areas anticipated to be targeted for eventual release of captive-bred spotted owls (no captive bred spotted owls have been released to date). Barred owl control measures were also purportedly focused on extant spotted owl territories with intent to increase recruitment of breeding pairs and to improve nesting success of active breeding pairs. The habitat protection component of SOMP2 (as announced in 2006) was completed three years later.

In describing current management, the Province reports that *"As part of the Provincial Government's Spotted Owl Recovery Action Plan, the Province of British Columbia has protected 305,000 ha of forest for the spotted owl"* (Gillis 2016a) (**Figure 7**). The derivation of this estimate is uncertain as there was no supporting reference provided. As such, Wilderness Committee (WC) completed an independent GIS based analysis at my request. This analysis demonstrates that a total area of 396,247 ha is currently mapped within "managed areas" (under SOMP2 and under the Identified Wildlife Management Strategy⁹ (IWMS)) by the Province. At a glance this effort appears laudable; however, closer analysis shows that these designations include 208,025 ha (52.5%) of mapped areas that occur within already existing conservation designations (e.g., Provincial Parks and municipal watersheds). In terms of actual forested area, on the THLB, that was set-aside for management the conservation gain, for spotted owl, is significantly lower. Only 188,222 ha of harvestable forested area (i.e., crown land on the Timber Harvesting Land Base (THLB)) was designated for spotted owl habitat management under SOMP2. This figure is eroded even further when I considered management prescriptions within the 188,222 ha of designated management areas on the THLB, as 64,238 ha (34%) occurs within Managed Future Habitat Areas (MFHAs) whose *"primary purpose is to provide for timber harvesting opportunities"* (Blackburn et al 2009). In this context this is **very** misleading accounting – whilst the province claims 396,247 ha is being managed for spotted owl only the areas inside LTOHAs and WHAs, on the THLB, were actually protected for spotted owl habitat conservation and these areas only amount to 123,984 ha (or 31%) of the area purportedly afforded focused (special) management for spotted owl by the Province under SOMP2.

Taken further, the WC also analyzed the amount of habitat that is currently suitable for breeding use (Class A habitat) within the SOMP2 areas; this results in an even more disheartening statistic (**Table 1 and Figure 7**). There are two SOMP2 two management designations within SOMP2 spotted owl WHAs in the Chilliwack and Sea-to-Sky NRD; these are described and summarized below.

1. Managed Future Habitat Areas (MFHAs) (total area = 64,238 ha): Only 28,198 (44%) of the total area of MFHAs remains as suitable habitat for use by spotted owl. The remaining 56% has been

⁹ The IWMS is a component of the Forest and Range Practices Act (FRPA) that allows focused habitat management to species listed on the Category of Species at Risk through the designation of Wildlife Habitat Areas (WHAs). WHAs can be legally designated, as orders under FRPA, where recognized habitat features occur on Provincial Crown land.

previously harvested and affords no current benefit to the owl. Commercial forest harvest of remaining spotted owl habitat is encouraged within these (MFHA) areas.

2. Long-Term Owl Habitat Areas (LTOHAs) (total area = 103,823 ha): Only 57,851 ha (56%) of the total area of spotted owl WHAs remains as suitable habitat for use by spotted owl. The Province states that *“The primary purpose of the LTOHA is to recover and sustain the Spotted Owl population to prevent extirpation of the species”* (Blackburn et al. 2009) yet 44% of these areas have been previously disturbed and thus afford no current benefit to the owl.

Within the Cascades NRD there was an initial commitment to designate nine WHAs, in addition to the 31 SRMZs (converted to WHAs) under SOMP2 in the Chilliwack and Sea-to-Sky NRD. This commitment was never met – only six WHAs (total area = 20,161 ha) were designated within the Cascades NRD. Within these WHAs only 9,068 ha (45%) is currently comprised of suitable habitat for use by spotted owl (**Table 1 and Figure 8**).

In total, there were 31 SRMZs (later converted to WHAs in 2011 (Chilliwack NRD) and 2013 (Sea-to-Sky NRD) established under SOMP2 (**Table 1**) and six WHAs in the Cascades NRD. The Province’s inclusion of habitats that were already protected within existing conservation designations (e.g., Provincial Parks) or within lands managed by the Greater Vancouver Regional District (GVRD)¹⁰ provides a misleading measure of conservation commitment, by the Province, towards spotted owl recovery. Similarly, the Province’s quantification of habitat being managed for spotted owl is also misleading; the data in **Table 1** illustrates that in reality only 51% of the habitat being managed under SOMP2 (including the Cascades NRD) is actually currently suitable for use by spotted owls and only 66,919 ha (16.8%) of Class A habitat protected on the THLB by SOMP2 is actually suitable for use by spotted owl today.

Restrictive habitat conservation measures are a legacy that undermined both SOMP1 and SOMP2. Under SOMP1 the Province imposed an area-based ‘cap’ to ensure that the impact of habitat management measures did not to exceed 4.5% of the THLB harvest allocation in the Chilliwack and Sea-to-Sky NRD. The same limit used for SOMP1 was also applied during delineation of habitat management designations for SOMP2 and is referred to as the ‘no net loss’ policy. This was recognized by SORT (for SOMP1) and by CSORT (for SOMP2) as a fundamental challenge to recovery. Regardless of this recognition, implementation of SOMP2 proceeded and these restrictions are reflected in current habitat management by the Province.

¹⁰ It is challenging to resolve the discrepancy in the Provinces reported estimate of forest managed for spotted owl (305,000 ha) with the actual area within mapped management units.

Table 1: Summary of SRMZs and WHAs including the area of each SRMZ or WHA designation and the percentage of currently suitable spotted owl habitat that remains within each designated area.

SRMZ Name	Designation	WHA ID	Prescription	Area (ha)	% Suitable
Liumchen Creek	LTOHA A	2-497	Harvest to Enhance	983	24%
Elk Creek	LTOHA A	2-501	Harvest to Enhance	2,590	45%
Stokke Creek	LTOHA A	2-505	Harvest to Enhance	3,261	56%
Speyum Creek	LTOHA A	2-507	Harvest to Enhance	3,240	52%
Mowhokam Creek	LTOHA A	2-508	Harvest to Enhance	1,725	64%
Tantalus	LTOHA A	2-517	Harvest to Enhance	198	9%
Manning/Sumallo	LTOHA B	2-494	Harvest to Enhance	4,355	57%
Hornet/Clear	LTOHA B	2-503	Harvest to Enhance	3,150	54%
Spuzzum/Urquhart	LTOHA B	2-506	Harvest to Enhance	3,672	60%
Douglas	LTOHA B	2-518	Harvest to Enhance	3,878	68%
Chilliwack Lake/Depot Creek	LTOHA C	2-495	Harvest to Enhance	3,031	40%
Coquihalla/Sowaqua	LTOHA C	2-498	Harvest to Enhance	9,608	60%
Ure Creek	LTOHA C	2-520	Harvest to Enhance	1,959	58%
Birkenhead	LTOHA C	2-523	Harvest to Enhance	9,124	46%
Nahatlatch River	LTOHA D	2-509	Harvest to Enhance	8,349	53%
Glacier/Tuwasus	LTOHA D	2-519	Harvest to Enhance	5,247	78%
Twin One/Twin Two	LTOHA D	2-521	Harvest to Enhance	4,543	55%
Silverhope Creek	LTOHA E	2-496	Harvest to Enhance	7,064	56%
Tincup Creek	LTOHA E	2-510	Harvest to Enhance	3,254	64%
Anderson/Utzlius	LTOHA G	2-502	Harvest to Enhance	21,379	55%
Lillooet River	LTOHA A	2-522	Harvest to Enhance	3,215	50%
	TOTAL LTOHA			103,823	56%
Sasquatch	MFHA A	2-499	Harvest with Retention	2,465	8%
Hornet/Clear	MFHA A	2-503	Harvest with Retention	3,255	38%
Ure Creek	MFHA A	2-520	Harvest with Retention	3,926	50%
Liumchen Creek	MFHA B	2-497	Harvest with Retention	512	0%
Trethewey Creek	MFHA B	2-504	Harvest with Retention	10,971	52%
Douglas	MFHA B	2-518	Harvest with Retention	672	74%
Birkenhead	MFHA B	2-523	Harvest with Retention	4,822	38%
Chehalis	MFHA C	2-500	Harvest with Retention	11,949	42%
Tantalus	MFHA C	2-517	Harvest with Retention	4,899	31%
Twin One/Twin Two	MFHA D	2-521	Harvest with Retention	1,816	39%
Glacier/Tuwasus	MFHA F	2-519	Harvest with Retention	5,934	58%
Cheakamus	MFHA X	2-524	Harvest with Retention	6,338	51%
Wedgemount/Green	MFHA X	2-525	Harvest with Retention	6,679	42%
	TOTAL MFHA			64,238	44%
Boulder West	WHA	3-034	No future harvest	3,955	44%
Copper Creek	WHA	3-035	No future harvest	3,239	48%
Enterprise Creek	WHA	3-036	No future harvest	3,398	42%
Mowhokam	WHA	3-158	No future harvest	2,614	42%
Nesikep	WHA	3-159	No future harvest	2,997	54%
Lost Valley - Anderson	WHA	3-160	No future harvest	3,958	41%
	TOTAL WHA			20,161	45%

In summary, in the Province's estimate of area of habitat being *managed* for spotted owl there is no distinction between **capable** (i.e., previously harvested areas that, with time, may acquire suitable habitat attributes) and currently **suitable** habitat. This distinction is critical to recovery as areas comprised of early seral forest that are merely *capable* of becoming suitable habitat with the passage of time does not favour spotted owl recovery in the short-term. This issue is exemplified in **Figure 7**. It is readily apparent that the WHA boundary (red and blue shaded areas) depicting the managed area for spotted owl) contains little currently suitable Class A forested habitat for spotted owls (as indicated in green).

The WC GIS analysis of currently suitable Class A habitat within all THLB areas managed for spotted owl under SOMP2 (188,222 ha) demonstrates that only 95,117 hectares (51 %) represents currently suitable Class A habitat (**Table 2**).

This GIS analysis was next extended to determine the area of Class A suitable habitat for spotted owl that currently occurs on the THLB within the defined range of the species. In total there is 314,959 ha of suitable spotted owl habitat remaining on the THLB in BC. Less than 31% of available spotted owl Class A habitat on the THLB (within the defined range) is currently being managed¹¹ for spotted owl recovery within Provincially designated spotted owl habitat management afforded to only three (of four) NRDs that historically supported spotted owl in BC.

¹¹ Even within managed areas under SOMP2 WHA designation harvest is still permitted, with 64,328 ha of the total 188,222 occurring with MFHAs whose stated primary purpose is to provide timber harvesting opportunities to commercial operators for economic gain.

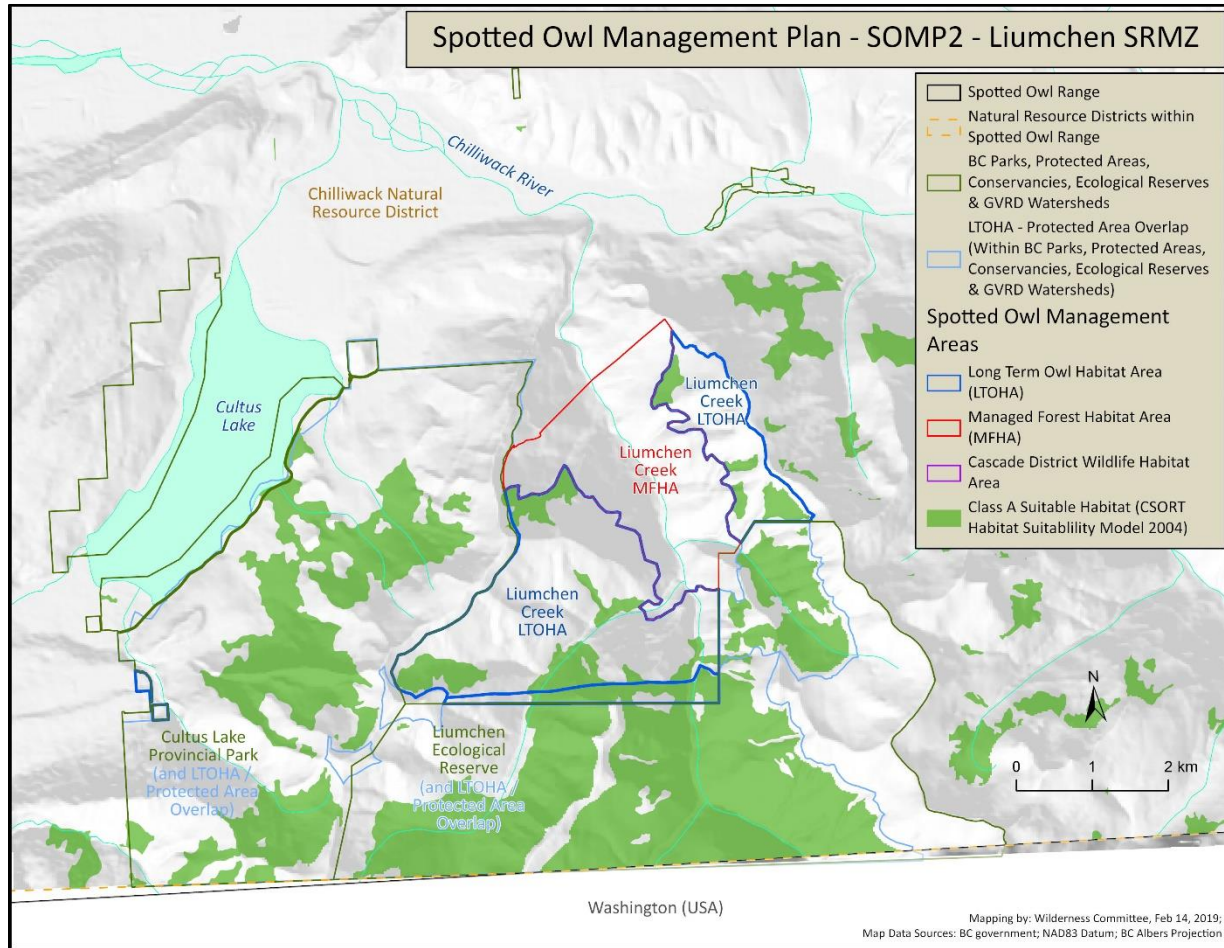


Figure 7: An example of misleading accounting is evident in the map depicting current remaining Class A suitable spotted owl habitat (239 ha) within the Liumchen Creek WHA (total area: 1,485 ha). Less than 16 percent of the area reported by the Province as “managed for spotted owl” contains currently suitable spotted owl habitat¹². This habitat condition is characteristic within all spotted owl WHAs (to varying degrees) and is consistent under SOMP1, and now under SOMP2.

¹² Each LTOHA is purported to achieve (in the distant future) suitable spotted owl habitat within the entire SRMZ area (i.e., 100% of the SRMZ area). Achievement of the management goal is purportedly to occur through conservation of existing spotted owl habitats and creation of additional spotted owl habitats using Habitat Enhancement Practices (HEPs). In my opinion (and as iterated by D’Anjou et al. 2015) this practice is unlikely to result in benefit to existing spotted owl habitat when applied to old growth or suitable forested habitat).

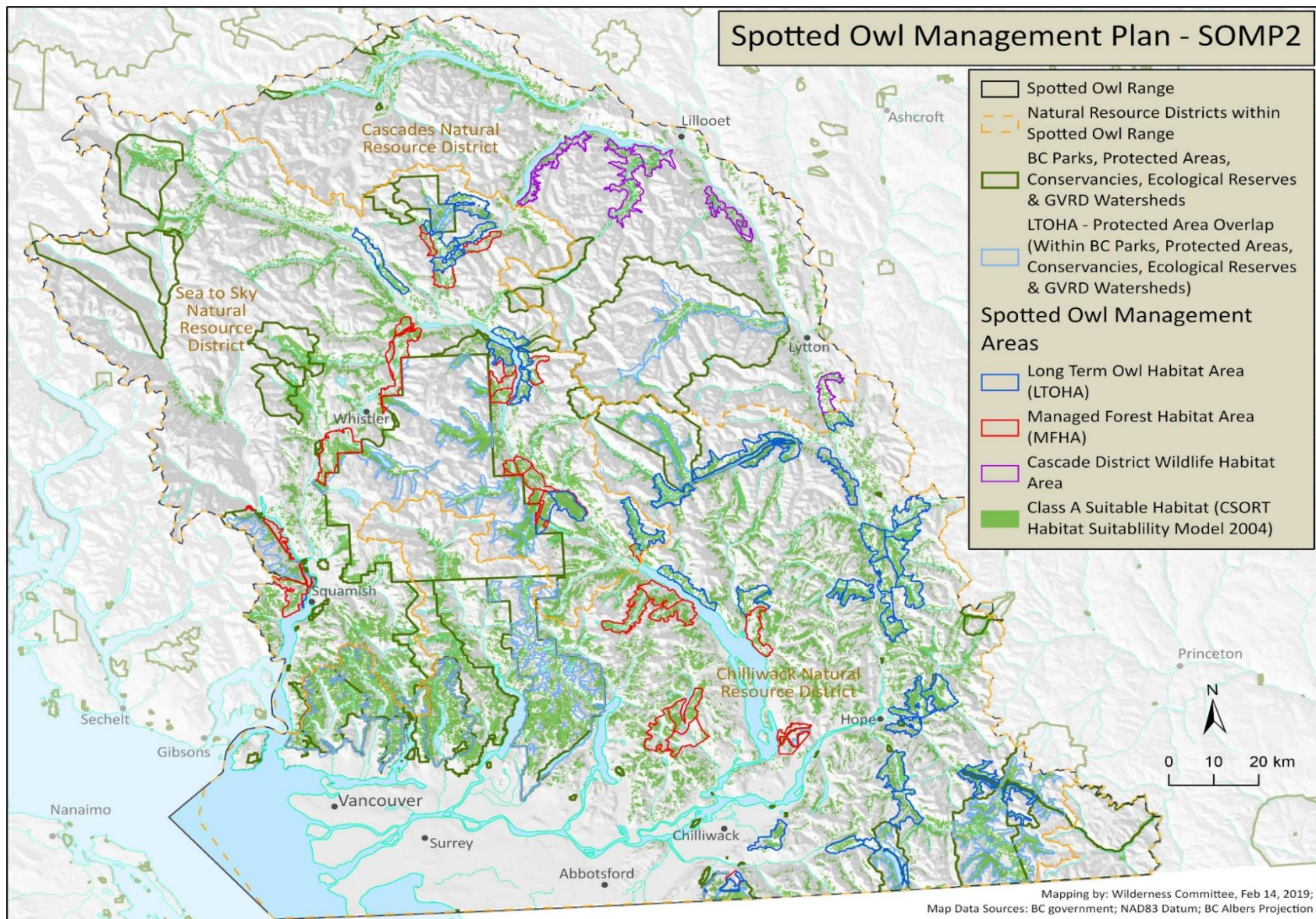


Figure 8: Spotted owl management in BC, under SOMP2 and IWMS.

7. How has British Columbia's management and protection of habitat affected the survival or recovery of the Spotted Owl?

Synopsis: Precise quantification of direct effects of habitat loss, from timber harvest, are unattainable as there are no requirements, in BC, to survey for spotted owls prior to commercial harvest of suitable habitat. Instead, effects must be inferred based on logical assessment of direct effects from habitat loss in accordance with literature-based consensus documenting the effects of commercial forestry on spotted owl from the US.

Forest resource management continues to impose a deleterious competing interest (i.e., revenue generation from forest harvest) upon available remaining suitable spotted owl habitat. Previous and continued harvest of old growth forest has resulted in dramatically diminished availability of suitable habitat on the landscape, with remaining suitable habitat becoming increasingly rare and fragmented rendering remaining small 'patches' of habitat un-usable. This has a concomitant and directly proportionate negative effect on recovery and survival of spotted owl.

SOMP2 was predicated on a principle of no-net loss to timber revenue relative to SOMP1 despite the obvious indication, as evidenced by the owl's decline, that the level of protection afforded to suitable habitat was insufficient to stabilize or reverse the declining population trend. SOMP1 was openly rejected by SORT; SOMP2 was also internally criticized at the time of its announcement in 2006. I (and others) openly raised concern when SOMP2 was announced but the Province was unwavering in their commitment to maintain timber harvest levels consistent with levels allowed under SOMP1.

By failing to distinguish between capable and suitable habitat the Province's estimates, when describing the area of managed forest, convey a misleading characterization of habitat conservation. The continued loss of suitable old growth forested habitat continues to jeopardize the ability of the species to persist, or recover, in BC.


Spotted owl recovery is directly affected by loss of habitat. The Provincial Recovery Strategy (Chutter et al. 2004) identified ongoing habitat loss as a primary threat to continued spotted owl population persistence. This position is repeatedly re-iterated in published literature. The effect of habitat loss upon recovery is both immediate (measured area of mature forested habitat harvested) and long-term (effects on natal dispersal, recruitment, competition as a result of edge-effect, and availability and abundance of prey). As such, areas in the Cascades NRD were only relatively recently surveyed in 2002-2004 despite suspected occurrence in the Cascades NRD dating back to 1997. Although management was extended to the Cascades NRD in 2006 in response to my survey results, management (and survey) has never been afforded to the Sunshine Coast NRD. In that context it is inappropriate to provide a quantitative estimate of 'loss' or 'impact' to the resident BC spotted owl population throughout the entire historic range as there is simply no information available.

For the Cascades, Sea-to-Sky and Chilliwack NRD this question was addressed (by Sutherland et al. 2007) using desktop GIS-based predictive (assumption based) multivariate analysis using a Spatially Explicit

Landscape Event Simulation ((SELES) GIS model. The SELES model was last run in 2007; re-analysis with the SELES model using current habitat conditions could be conducted to further examine this question.

For reasons stated above a quantitative analysis of the effects of BC's forest management is not feasible with existing data. I therefore requested that the Wilderness Committee (WC) analyzed the rate of depletion of mature forested habitat (as an acceptable proxy for suitable spotted owl habitat) that has resulted from commercial forest harvest from 2002 to 2018. This analysis was completed for both NRDs included in SOMP2 (Sea-to-Sky and Chilliwack), and in the Cascades NRD (managed under the Identified Wildlife Management Strategy (IWMS)). These results are summarized on an annual basis, since 2002, and presented in **Table 2**.

Table 2: Rate of potential spotted owl habitat loss, under pre-SOMP2 and post-SOMP2 management regimes, as a result of commercial harvest of old-growth forest within the Chilliwack and Sea-to-Sky NRD.

Year	Hectares of old-growth forest harvested	
2000	3,215	
2001	2,218	
2002	2,536	
2003	2,023	
2004	3,011	
2005	1,783	
2006	2,148	
2007	2,131	
2008	946	
2009	1,008	
2010	1,001	
2011	1,501	
2012	1,410	
2013	1,561	
2014	1,403	
2015	1,144	
2016	870	
Total	29,909	<p>This image was taken near Anderson Creek, inside an SRMZ within a formerly occupied spotted owl activity center (breeding and roosting location).</p>

This analysis, and insights from US literature and the SELES model in BC (Sutherland et al. 2007) afford insight into the Province's management of spotted owl habitat in the Chilliwack and Sea-to-Sky NRD. This approach allows quantitative assessment of the effects of the Province's approach to habitat management practices on the BC population of spotted owl. In total, the Province has approved harvest of 29,909 ha of mature forest habitat since 2000. This may seem insignificant but it represents 31% of the total area of Type A nesting habitat (95,117 ha) that the province is currently managing for spotted owl. In more tangible terms, this represents about 10 spotted owl territories that have been logged since 2000 despite elevated concern for the plight of the species and full awareness of the

interdependence of spotted owl persistence (and recovery) and the amount and distribution of suitable habitat on the landscape.

In that context it is logical to conclude that habitat loss has had, and continues to have, a negative effect on spotted owl recovery potential in BC. Habitat loss, as a result of government proposed and approved commercial forest harvest, continues today.

8. How has British Columbia managed key threats to Spotted Owl habitat?

Synopsis: In summary, the history of spotted owl habitat management, by the Province, is convoluted and undermined by its own complexity. In practical terms, habitat loss, the key threat to spotted owl population viability and recovery, has resulted in substantial reduction in available owl habitat. Pre-European contact, there was an estimated 939,800 ha of spotted owl habitat (Chutter et al. 2004) within the Chilliwack and Sea-to-Sky NRD's. Of this, 477,300 ha (51%) is considered as "contributing" to the Timber Harvesting Land Base (THLB) (upon which timber resource extractions may occur). Today the amount of currently suitable spotted owl habitat is further reduced, mostly existing as isolated patches within Provincial Parks and within GVRD lands. Commercial forest harvest practices, as managed by the Province, have resulted in a patchily distributed mosaic of forest age classes on the landscape; these conditions favor barred owls (competitors) and great horned owls (predators), disfavour spotted owl survival and recruitment and have contributed to the species practical extirpation from BC by 2018.

The following text provides clarification of spotted owl habitat management afforded by the Province under both SOMP1 and SOMP2.

- **SOMP1:** habitat was managed within Special Resource Management Zones (SRMZs) that encompassed 363,000 ha of suitable and capable habitat. Two forest management regimes were prescribed under SOMP1:
 1. Light Volume Removal (LVR) was applied within Long-term Owl Activity Centres (LTACs).
 2. Heavy Volume Removal (i.e., clear-cutting) (HVR) was applied within Forest Management Areas (FMAs) that were designated as Matrix areas.
- **SOMP2:** Habitat management provided under SOMP1 and SOMP2 is applicable within only the Chilliwack and Sea-to-Sky NRD. Habitat in the Cascades NRD is managed under IWMS and there is no management afforded to spotted owl habitat within the Sunshine Coast NRD. A total of 396,247 ha is purportedly being managed within WHA boundaries (under SOMP2 and IWMS) although this includes 208,025 ha that was already afforded protection within existing conservation designations. As such, only 188,222 ha of THLB area is afforded management under SOMP2 and IWMS and only 51% of that represents currently suitable Class A habitat for spotted owl.

After 2011, SRMZs were legally designated as WHAs and are now managed under the IWMS; the same forest management practices developed for SRMZs were applied, through GWMs within WHAs. Within WHAs in the Sea-to-Sky and Chilliwack NRD there are two spatial designations with

different prescriptive guidance for each designation as described in response to Question 6. The WHAs under SOMP2 (in the Chilliwack and Sea-to-Sky NRDs) include Long-term Owl Habitat Areas (LTOHAs) and Managed Future Habitat Areas (MFHAs). MFHA's are intended to provide replacement habitat in the event of catastrophic loss (i.e., fire) within a LTOHA, yet the explicitly stated primary purpose of the MFHA is *"to provide for timber harvesting opportunities while maintaining future options for all or portions of the MFHA to become Spotted Owl habitat, if necessary."* (Blackburn et al. 2009). It is not clear how the Province will achieve these competing objectives, nor how it will determine when it might be necessary to protect the small areas of remaining spotted owl habitat within MFHAs. Regardless of these issues the overarching intent of SOMP2 was to create a more 'natural' canopy gap and forest structure relative to SOMP1 following two prescriptive forestry methods:

1. Habitat Enhancement Practices (HEPs) are to be applied within LTOHAs (replaced Light Volume Removal (LVR) applied under SOMP1 within SRMZs). HEP prescriptions are now set within LTOHAs to promote recruitment of spotted owl habitat until 100%¹³ of the forested area can mature to become suitable for use by spotted owls. These prescriptions are intended to *"retain stand integrity and enhance stand structure through accelerated development of stand attributes associated with owl habitat."* (D'Anjou et al. 2015).
2. Harvest with Retention (HWR): This harvest method replaced the HVR (i.e., clear-cutting) prescription under SOMP1 by prescribing retention of 'seed tree' patches within clear-cut harvest areas. HWR is permitted within Managed Future Habitat Areas (MFHAs) and theoretically allows for retention of 'green (live)' trees, Course Woody Debris (CWD) and wildlife (veteran) trees to create structural diversity for spotted owl and their prey.

A GIS analysis was also completed to calculate the area of currently suitable (Class A) habitat within the spotted owl's defined range in BC within the Chilliwack, Sea-to-Sky and Cascades NRD (**Table 3**).

Table 3: Area of currently suitable Class A habitat with the defined range of the species in BC.

Total area of suitable Class A habitat in the defined range of the species.	533,306 ha (100%)
Total area of protected suitable Class A habitat within all Parks and GVRD lands	151,428 ha (28.5%)
Total area of protected suitable Class A habitat under SOMP2 (i.e., including WHAs within the Cascades, Chilliwack and the Sea-to-Sky NRD but excluding MFHAs as that habitat is not protected from harvest).	66,919 ha (12.5%)
Total area of unprotected suitable Class A habitat on THLB. Commercial forest harvest is permitted without survey, or without regard, for spotted owl recovery.	314,959 ha (59%)

This quantitative GIS analysis show that there is currently 314,959 ha of Class A suitable spotted owl habitat located on crown land within the THLB in BC. This habitat is not afforded any conservation or

¹³ Note: Many of the SRMZs were well below this designation target when they were mapped under SOMP1 and SOMP2.

management for spotted owl and is treated as productive forest land within the Timber Harvesting Land Base (THLB). As such, 314,959 ha of Class A spotted owl habitat can be clear-cut without any requirement to survey to determine current use by spotted owl or to offset habitat loss that may impact spotted owl recovery potential. This is a fundamental challenge to spotted owl recovery in BC. For context SOMP2 only afforded protection to 66,919 ha of spotted owl Class A habitat on the THLB; this represents only 12.5% of the total available Class A spotted owl habitat within the defined range of the species in BC.

Table 4: Clarification of Terms:

SOMP1 (SRMZs and Matrix areas)	SOMP2 (WHAs)
SRMZ (67% habitat retention in LTACs with adjacent matrix areas where harvest was permitted)	LTOHA (100% habitat retention) (managed primarily for conservation and creation of owl habitat)
FMA (Forest Management Areas) were designated within Matrix Areas	MFHA (Managed Future Habitat Area) (managed primarily for timber harvesting)
LVR (Light Volume Removal) (thinning in SRMZ LTAC) was allowed as long as 67% of the SRMZ remained as owl habitat) (under SOMP1 habitat model which was overly optimistic).	HEP (Habitat Enhancement Practices) are permitted within LTOHAs and replace the HWR rules from SOMP1 (intended for 60-140 year-old stands).
HVR (Heavy Volume Removal) (clear-cutting) allowed within matrix areas and SRMZs where >67% was deemed suitable (under old HSI model).	HWR (Harvest with Retention) (only allowed in MFHA).

D’Anjou et al. (2015) provided a simple comparative analysis of forest management under SOMP 1 (from 1997-2009) and SOMP2. Under SOMP1 *“Spotted Owl habitat was managed on a stand-level basis within Spotted Owl Resource Management Zones, where operational guidelines for two forest-management approaches (light volume removal and heavy volume removal) were used. Under SOMP2, Spotted Owl habitat is managed as Long-Term Owl Habitat Areas or as Managed Future Habitat Areas”* within SRMZs (now designated as WHAs). Under SOMP2, Habitat enhancement practices are prescribed within the Long-Term Owl Habitat Areas; these replaced light volume removal as prescribed under SOMP1. Harvest with retention (clear-cuts with seed tree patches) replaced SOMP1 heavy volume removal (i.e., clear-cuts) and is applied within the Managed Future Habitat Area (D’Anjou et al. 2015).

D’Anjou et al. (2015) concluded that the changes under SOMP2, relative to SOMP1, are effectively insubstantial – I agree. In more practical terms management activities that will be permitted under SOMP2 are very subtle and may be critically viewed as assigning new names to the same detrimental forestry practices. For example, “Harvest with Retention” (HWR) is essentially clear-cut harvest with retention of a seed patch – this prescription was already in place under SOMP1 (it was called HVR). The resulting effect of HVR or HWR is identical from a biological perspective; both practices result in loss of spotted owl habitat.

In practice these prescriptions have disconcerting implications for spotted owls. To illustrate this concern; the Province’s BC Timber Sales (BCTS) program has applied for HEP in a LTOHA in the Spuzzum

SRMZ; at the outset this application is in violation of the terms of SOMP2 as the harvest will occur within habitat reasonably identified as a “critical roost zone or nest area” yet the proposed (Category I) cut-blocks are still under consideration and review by the Province.

Based on analysis of harvest changes between 1997 and 2011 D’Anjou et al. (2015) concluded:

“Overall, this comparative review indicated that the transition from SOMP1 to SOMP2 has produced (subtle) changes and refinements to...habitat management objectives, forest management approaches, and operational practices and targets.... Of interest is whether these differences in management and eventual outcomes will create significant differences in enhancement and recruitment of stand attributes associated with superior owl habitat, and whether SOMP2 will result in more and better-quality (spotted owl) habitat.” The conclusion reached by D’Anjou et al. (2015) is that the difference between SOMP1 and SOMP2 is subtle; the authors have also questioned eventual outcomes to spotted owl recovery under SOMP2. I share the author’s concerns.



This juvenile spotted owl was fledged by the nesting pair I found at Sockeye Creek in 2003. It died near Lillooet in 2004, after dispersing a cumulative total distance of 133.9 km. This large dispersal distance, and fate, was shared by all of the spotted owls I tracked (over several years) and is indicative of fragmented forest condition on the landscape.

9. How has British Columbia's management of (other) key threats to the habitat affected the survival or recovery of Spotted Owl?

Synopsis: Management of key threats to habitat, other than commercial forest harvest, is considered to have a relatively minimal effect on spotted owl recovery.

Relative to commercial forest harvest each of these effects are suspected to be minimal. With specific reference to key threats to spotted owl habitat other than commercial forest harvest, these threats include:

- fire and post-fire management (i.e., salvage logging),
- management for mountain pine beetle (*Dendroctonus ponderosae*) (i.e., salvage harvest in response to beetle-kill); and,
- long-term effects of climate change.

Salvage harvesting is typically permitted within the mapped 'boundary' of the fire. The Province (BC MFLNRORD) predictively maps wildfire boundaries in a remote desktop-based GIS mapping process that extrapolates the extent of the burnt area as the fire is advancing on the landscape. In many cases boundaries are mapped well beyond the final or actual 'footprint' of the fire which creates an incentive to harvest within unburnt suitable spotted owl habitat, under the guise of salvage logging, as commercial harvest within these areas is not subject to stumpage fees that are charged by the Government during non-Salvage logging operations.

I'm aware of at least one instance where salvage harvest was conducted in response to fire within unburnt suitable occupied spotted owl nesting habitat (e.g., Enterprise Creek "salvage harvest" by Ainsworth Lumber).



Commercial harvest within areas mapped as beetle-killed or burnt is often conducted beyond the actual impacted area.

10. How has British Columbia managed key threats, other than to habitat, of the Spotted Owl?

Synopsis: Beyond the primary threat resulting from habitat loss there are several ecological attributes that threaten spotted owl survival and recovery. The next most pronounced deleterious effect is decreasing population density (typically as a direct result of habitat loss). Population density adversely affects juvenile survivorship and recruitment into the adult breeding population. The Allee effect (a biological theory) posits that the probability of encountering a mate diminishes as a population declines. For spotted owl settlement behaviour is promoted by the presence of conspecifics (i.e., another spotted owl). Juvenile spotted owls continue to disperse on the landscape until they encounter another spotted owl, or until they die of starvation (exacerbated by competition for prey from barred owls) or from depredation (exacerbated by increasing density of great horned owl as a positive response to increased forest fragmentation). BC is attempting to manage this threat by attempting to breed spotted owls in captivity with the eventual intent (if successful) to release spotted owls back into the wild.

Competition with barred owl and depredation from great horned owl are secondary threats. Initial recovery efforts under SOMP2 from 2006-2009 emphasized captive breeding of spotted owls, and barred owl control, with priority and urgency afforded to these threats instead of habitat conservation and management. After an unsuccessful spotted owl translocation effort in 2002, and attempted supplemental feeding programs from 2003-2004, a 12-year long effort to manage juvenile recruitment via captive breeding resulted in a net-negative impact to BC's wild spotted owl population. The captive breeding program is ongoing despite no net benefit and very limited success. The barred owl control program is also ongoing and has been purported to have resulted in some (potential/unmeasurable) benefit to spotted owls at previously known occupied sites but moral and logistical considerations warrant attention. To date there have been no known attempts at control of great horned owl by the Province.

Threats external to considerations regarding habitat include, primarily, the Allee effect (1) and secondarily competition from barred owl (2) and depredation from great horned owl (3).

1. **Allee Effect:** BC is currently attempting to address the Allee effect (negative effects on juvenile recruitment) by breeding spotted owls in captivity (see response to Question 11, point 6, for a definition of the Allee Effect). The forecasted commitment (in 2006) was to release 20 captive bred spotted owls back into the wild (annually) to promote settlement and recruitment. To date, 12 years later, eight captive owls have been bred. To achieve this at least ten owls have been removed from BC's wild population resulting in a net-negative impact to BC's wild spotted owl population after 12 years of focused captive breeding efforts. Actions preceding current captive breeding efforts included translocation (following overwintering of a captured wild-bred spotted owl) and supplemental feeding of dispersing juvenile spotted owls between 2003 and 2004. This effort is summarized below:

- I. In 2002, the BC government attempted translocation of a single juvenile spotted owl captured near Enterprise Creek, overwintered and released at Sumallo Grove (Skagit Park) near Hope, BC. Unfortunately, this attempt was poorly researched and implementation of the release strategy was compromised by an inaccurate interpretation of field survey results conducted for the Province by Keystone Consulting. The translocated juvenile owl was released into an active paired site in late winter (a particularly inhospitable period for raptors in BC). I surveyed the site after the release occurred and determined it was already occupied by a pair of breeding spotted owls. I had also raised concern, prior to release, that the habitat at Sumallo Grove (CWH BEC Zone) differed from the habitat at the capture site near Lillooet (IDF BEC Zone). The wetter/colder climate at the release site (at the time of release) created challenging conditions for a wild-born owl that had just spent six months penned in a very small enclosure. On that point, I had requested that the owl be fed, whilst in captivity, a natural diet to include bushy-tailed woodrat and northern flying squirrel; my request was not followed – the captive owl was instead fed domesticated mice. Finally, I also advocated that the owl be “hacked” (soft-release from an in-situ enclosure with food) but this recommendation was also not implemented. Instead the Province (I. Blackburn) proposed that the field crew (led by Keystone) would monitor the owl daily, post-release, using telemetry to ensure adequate supplemental feeding immediately post-release. This approach was also not successful as the technician was unable to track and follow the owl as he judged that the owl had moved too far from the road (~2km) and deemed the effort required unwarranted. The owl was found ~11 days post-release in a severely emaciated condition. It was found and delivered (by a road-work crew) to the South Okanagan Rehabilitation Centre for Owls (run by Sherri Klein) where it was used to pose for several media publicity ‘shoots’ for fundraising purposes (for the rehabilitation centre). This was contrary to explicitly stated permit stipulations. No charges were laid by the Province for this permit violation - the owl died after a few days in the rehabilitation facility.
- II. In 2003, after the Province’s failed attempt at over-wintering and translocating a captured wild owl the government ceased, at my insistence, a second and third attempt at translocation in 2003 and 2004. Instead I successfully implemented an experimental supplemental feeding program. In the post-fledging period, continuing through the winter and spring of the year following natal dispersal, I monitored and tracked juvenile spotted owls and provided food, on a 6-10 day rotation, to seven dispersing juvenile spotted owls I had found in 2004 and 2005 (n=7 (Hobbs 2004, Hobbs 2005)). I believe supplemental feeding positively influenced juvenile survival, but efforts were insufficient to ensure survival to recruitment into the adult resident breeding population. This program did however garner insight into dispersal movements, including documentation of natural survival rates and natural movement/connectivity corridors. This information was used to inform reserve design in subsequent habitat protections. This effort led to the eventual successful legal designation of six WHAs in

the Cascades NRD. These legal designations are today the only protective habitat measures afforded to spotted owl in the Cascades NRD¹⁴.

- III. In 2006, SARCO released the BC Recovery Action Plan. The release announcement claimed consistency with, and adherence to, the 2006 CSORT management strategy (released as guidance to government to inform development of the SARCO led action plan). The 2006 Action Plan detailed a commitment to implement a captive breeding program with a much-delayed implementation of habitat conservation measures.

2) Barred owl: Secondary threats include competition, by barred owls, for resources (food/habitat). The main predation risk to spotted owls is from great-horned owls and, to a lesser degree, northern goshawk. To address this secondary threat the Province initiated a barred owl control program in 2006. The barred owl control program has, to date, removed 189 barred owls (138 captured and relocated; 51 shot). There has been purported benefit to resident spotted owls at removal sites (Gillis 2016a); however, the sustainability of these efforts is questionable in the context of effort, moral values, and counter-effects from natural recruitment rates of barred owls within the range of spotted owl in BC. Based on productivity and sympatric population estimates, anticipated recruitment rates for barred owl are approximated at 5,400 new barred owls fledged within the spotted owl's range in BC annually.

3) Great horned owl: The third order key threat (other than threats to habitat) is depredation by great horned owl. To date there have been no (publicly disclosed) attempts at control of great horned owl by the Province.



A barred owl perches, vigilant, waiting for prey. Their generalist ecology gives them a competitive edge over spotted owls where they co-occur



Great horned owls are much larger than spotted owls, and are a formidable predator.

¹⁴ During the consultation process an MOU was signed by government and Ainsworth Logging (Lillooet) with a commitment to not harvest owl habitat within the nest grove or core activity center at any active spotted owl sites. Despite the MOU (November 25, 2003) Ainsworth Lumber harvested within the nest grove / activity centre at two proposed WHAs (Enterprise and Nesikep). WC protested, and a media article (Vancouver Sun: Larry Pynn) was released to bring attention to this contravention. The WHAs were eventually designated but the territory cores were, by then, already compromised at both sites.

11. How has British Columbia's management of these key threats affected the survival or recovery of the Spotted Owl?

Synopsis: Understanding the effect of BC's management upon all key threats affecting spotted owl recovery requires consideration of six key life-history attributes that influence spotted owl survival. These key ecological attributes, exacerbated by the species' 'specialist behavior, include: habitat dilution (loss of suitable forested habitat (primarily from commercial forest harvest), reduced prey accessibility (due to an increase in stem density during post-harvest forest succession), reduced prey abundance (due to reduction in prey abundance in post-harvest landscapes), increased competition for diminishing prey resources (as a result of an increasing barred owl population), increased predation risk (particularly upon dispersing juvenile spotted owls), and the Allee effect (decline of population below a critical population persistence threshold). The Province's management of these threats has been outlined in response to Questions 7 to 11. Continued loss of suitable old growth forested habitat continues to compromise survival and recovery of spotted owls in BC as it negatively influences productivity and survivorship via each of these ecological stressors.

In responding to this question, I have assumed inclusive consideration of all previously discussed threats and responded by assessing the Province's management of all the described threats to survival and recovery of spotted owl in BC. The preceding questions are re-presented below for clarity:

- Question 7: *"How has British Columbia's management and protection of habitat affected the survival or recovery of the Spotted Owl?"*
- Question 8 *"How has British Columbia managed key threats to spotted owl habitat?"*
- Question 9: *"How has British Columbia's management of (other) key threats to the habitat affected the survival or recovery of Spotted Owl?"*; and,
- Question 10: *"How has British Columbia managed key threats, other than to habitat, of the spotted owl?"*

As explained in my response to Question 7 this question cannot be answered quantitatively when assessing impact of forest harvest, using existing data, as the Province does not require survey prior to harvest of spotted owl habitat. Without a "Before/After-Control/Impact" (BACI) experimental design it is impossible to accurately quantify effects from realized threats. Instead, I have responded based on consideration of peer-reviewed published articles to afford an in-depth and thorough understanding of spotted owl ecology, and thus spotted owl population response. My response evaluates the effect of the Province's management (of *all* key threats) upon spotted owl recovery. I posit a qualitative assessment of the influence of habitat loss (post-European contact) by discussing six key life-history attributes that influence spotted owl survival in a modern landscape.

- 1) **Habitat Dilution:** Spotted owls are a 'resident' species – they occupy (and defend) a large (2,800-3,400 ha) territory year-round. The quality of forested habitat within their territory dictates their survival, or persistence, on the landscape as this directly influences their ability to secure (catch) their prey. Spotted owls are interior forest hunters (i.e., they hunt under the closed canopy of mature forest). As such, they depend on open, evenly spaced forests with low "stem-densities"

(see Question 3 or refer to Chutter et al. (2004): (37-185 stems/ha for coastal (wetter) ecosystems, 173-247 stems/ha for interior (drier) ecosystems)). These stem densities are characteristic of late succession old growth forested ecosystems in the Pacific Northwest. When mature forest is harvested it is converted to clear-cut areas (often with variable retention of small stands of seed-trees). These young age-class forests have to develop over 100-200 years through age classes 1-7 before attaining characteristics that create suitable foraging habitat for spotted owls. As suitable habitats disappear on the landscape, spotted owls are increasingly challenged to find sufficient habitat to maintain and occupy a viable territory year-round. In ecology this is termed 'habitat dilution effect'. When any organism is forced to expand its home range (area) in search of prey, economic theory dictates that the thermo-energetic cost of moving further must not exceed the reward (improved food supply); if it does the organism cannot persist. Under these conditions spotted owls must either abandon their territory (and disperse on landscape to settle elsewhere, with an associated risk and cost) or face starvation. BC's forest management practices have resulted in a highly fragmented mosaic of younger age-class forest in areas once dominated by old-growth coniferous forest throughout the species' range in BC. Loss of spotted owl habitat, range-wide, is repeatedly cited in the literature as the most dominant influential (causal) factor in spotted owl population declines; BC is no exception (Chutter et al. 2004). The current population and noted declines from trend monitoring (Blackburn et al. 2002) are most reasonably attributed to habitat loss (and thus habitat dilution) at the landscape scale (Chutter et al. 2004).



A pair of spotted owls once occupied this territory at Billygoat Creek – this illustrates ideal non-fragmented Class A habitat that is today only available within Provincial Park boundaries.

- 2) Prey accessibility: During forest succession from disturbance (clear-cut or natural loss) there is a dramatic increase in stem density (up to or exceeding 2,000 stems/ha); in maturing early seral forests spotted owls are unable to catch their prey as they can't forage (or fly) efficiently in dense forests. Their prey, even when present, is no longer 'available' to them. This has an obvious effect on survivorship. In response a resident owl may either abandon the territory or expand their movements to compensate for reduction in the area of mature (old-growth) forest in which they can more effectively forage.
- 3) Prey abundance: The literature also presents a second prevailing effect of forest harvest on spotted owl survival – prey abundance. The spotted owl is an upper trophic level carnivore that evolved along the west coast of North America (and Mexico). Before European contact their ecosystem was relatively stable and dominated by old-growth forested habitat. Evolutionary theory dictates that stable environments favor natural selection of specialist species (species with narrow niches and a specialized ecology). Specialist species evolved successfully by outcompeting other generalist species (i.e., species with a broad and adaptive niche ecology). Over millennia spotted owl and barred owl diverged from a common ancestor (likely the fulvous owl (*Strix fulvescens*), from Guatemala and Mexico). Barred owls occupied the east coast of North America (within patchy forested ecosystems with high edge-interior ratios) while spotted owls occupied mature contiguous areas of coniferous forests along the west coast of North America. In these stable mature forested habitats, with low edge-to-interior ratios 64.6% of the diet of the Northern spotted owl is comprised of tree squirrels (of this northern flying squirrel contributed 41.2% (Horoupian et al. 2004)). Bushy tailed woodrat contributed 27.8% of the diet (Horoupian et al. 2004). By converse, barred owls occupied forests along the east coast that featured a patchier age class with a mosaic of successional stages. In this environment of higher edge-to-interior ratios the barred owl learnt to be a generalist, preying on a greater diversity of prey items including: small mammals (e.g., mice, voles, flying squirrel and bushy-tailed woodrat), amphibians, birds, bats and large insects (e.g., noctuid moths) (Livezey et al. 2007). The advent of commercial forestry in coniferous forests along the west coast of North America rapidly altered the conditions spotted owls had evolved in and put them at a disadvantage due to their specialized ecology.
- 4) Competition: The effect of competition for limited resources (i.e., prey) by a generalist species (i.e., barred owl) upon a specialist species (i.e., spotted owl) is self-evident when demographic parameters (survivorship and fecundity) are examined. Both species weigh approximately 600-800 grams, and both species require ~56 grams of prey/day to persist yet barred owl populations have flourished while spotted owl populations crashed (Forsman et al. 2004). In a post-European landscape, commercial forest harvest of old growth forested areas results in a reduction in abundance of the spotted owl's primary prey items as both flying squirrel and bushy-tailed woodrat also depend on mature forest conditions. When the abundance of spotted owl prey diminishes survival is negatively affected as spotted owls lack the ecological plasticity to switch to prey items that fare better in a mosaic of successional stages (Livezey et al. 2007). Barred owls, by converse, flourish by capitalizing on a far more diverse prey base. A study by Diller et al. (2016) demonstrated that the continued decline in spotted owl abundance may be at least partially attributed to the presence of the congeneric invasive barred owl. Commercial

forest harvest has likely improved conditions for barred owl. Regardless of the cause barred owls have recently colonized the entire range of spotted owls in BC.

- 5) **Predation:** Since 2006 the Province has focused considerable efforts on removing barred owls from active spotted owl territories. No attention has been afforded to controlling the influence of the most common avian predators (including great horned owls and northern goshawk).
- 6) **Allee Effect:** For many species low population density (numbers) appears to strongly limit population growth. The Allee effect is pronounced, to varying degrees, in species with positive density dependence and is evidenced by a positive correlation between absolute average individual fitness (survivorship and productivity) and population density. This positive correlation may (but does not necessarily) give rise to a critical population size below which the population cannot persist (i.e., a minimum viable population size). In a long-term study (1987-1998) Lahaye et al. (2001) studied natal dispersal patterns in an insular population of spotted owl in Southern California; with a particular focus on territory acquisition rate in juvenile spotted owls. The authors concluded that the presence of conspecifics plays a key role in the settlement process for spotted owl; 78% of dispersing owls settled in occupied territories, 16% settled adjacent to occupied sites and only 6% settled at sites of unknown occupancy. No owls settled at sites that were unoccupied or not adjacent to occupied sites (Lahaye 2001). This finding demonstrates that spotted owl settlement, and ultimately recruitment in the breeding population, is strongly influenced by density dependence (the Allee Effect). At some point post-European contact commercial forestry activities (through habitat dilution) very plausibly diminished spotted owl population densities (within the species' range in BC) below a critical threshold resulting in sharp range-wide population decline. Spotted owl persistence (survival and recovery) in BC will continue to be challenged by the Allee effect.



A spotted owl swoops down on its prey – note the large wingspan. Prey is not as accessible to spotted owls in densely forested habitat.



Bushy-tailed woodrat are an important key prey item in BC.

12. In reference to the BC Habitat Model, how has British Columbia defined and described Spotted Owl habitat?

Synopsis: The Province has used Geographic Information Systems (GIS) desk-top based habitat modelling to define and describe spotted owl habitat quality. GIS based Habitat Suitability Index (HSI) models were used to delineate habitat reserves during development of both SOMP1 and SOMP2. HSI modelling methods consider attributes generally accepted to efficiently characterize habitat for the focal taxa. For spotted owl these attributes include BEC variant, stand age, stand height and elevation.

Input values to identify suitable habitat during development of SOMP1 grossly overestimated suitable spotted owl habitat within SRMZs as the elevational inputs were inaccurate for use in BC. This error allowed a subsequent reduction, through over-harvest of lower elevation suitable habitats, in the amount of actual available spotted owl habitat within SOMP1 reserve areas. As a result of this error remaining spotted owl habitat, inside SOMP1 conservation areas, was reduced well below threshold targets set by area-based SOMP1 planning objectives.

This oversight revealed the importance of accuracy, confirmed by field-verification, when using HSI models to define, describe and spatially map spotted owl habitat. I redeveloped the model used for SOMP1, creating a new more accurate model to delineate habitat reserves to inform the SOMP2 habitat reserve design process. My model was accepted by the Province, and by COSEWIC, as an accurate method to map available suitable habitat and was used, by Coretex Consulting, to evaluate population response to various habitat management scenarios during the CSORT led recovery planning process.

In defining and mapping suitable habitat, for many species, Habitat Suitability Index (HSI) modelling is commonly used in wildlife conservation planning. HSI modelling provides an accurate spatial depiction of the amount and distribution of suitable habitat based on input of attributes known to be used by the focal taxa. HSI models are developed in a desktop environment using Geographic Information Systems (GIS) software. GIS-based HSI modeling was used to map the distribution and abundance of spotted owl foraging and breeding habitat throughout the species range in BC, both by SOMIT (for SOMP1) and by the Province (for SOMP2). Habitat attributes used to model spotted owl habitat include: BEC variant, stand age, stand height; and, elevation. These input attributes are queried against Vegetation Resource Inventory (VRI) mapping data to generate maps depicting Type A (nesting) and Type B (foraging) habitat for spotted owl.

SOMP1: The first (early) HSI model used by SOMIT to map spatial boundaries of the SRMZs for SOMP1 was overly optimistic in its characterization of suitable spotted owl habitat. This (early) model was based on characteristics derived from literature and studies from the United States (I. Blackburn pers. com.). In consequence, this (early) model over-predicted suitable habitat to occur at elevations up to 1,370 – 1,500 m ASL (depending on BEC zone) (D’Anjou et al. 2006). This is well above the documented elevation breeding limit of spotted owl in BC (1,194 m ASL) and resulted in a gross overestimate of suitable

spotted owl habitat within SRMZs designated and managed under SOMP1 guidelines. This overestimate had a pronounced effect on habitat conservation (resulting primarily from habitat loss as a result of commercial forest activities). Lower elevation habitats continued to be harvested (under SOMP1 management) while upper elevation habitats (thought to be suitable based on this early model) were not harvested to maintain or meet the 67% retention target. When this inaccuracy was addressed and corrected in 2004, with a new model I developed (based on actual data collected from trend-analysis surveys, and telemetric monitoring collected 1991-2002) it was apparent that previous logging within lower elevation areas of each SRMZ, under SOMP1, had reduced the amount of actual spotted owl habitat, range wide, even further below SOMP1 habitat retention objectives. This was identified and recommended for correction by myself in 2004, and supported again by D'Anjou et al. (2006), but by then the loss of spotted owl habitat had already occurred.

SOMP2: In 2004, I developed a new (revised) BC habitat suitability model that was quickly adopted by CSORT and Coretex Consulting (for the purpose of SELES modelling¹⁵). My model was applied for recovery planning in the delineation of revised SRMZ boundaries for SOMP2. This (2004) model has been used consistently, since 2004, to define and describe spotted owl habitat in BC. The attributes used in this model were field verified, accepted and used by CSORT (Chutter et al. 2004), by Coretex (Sutherland et al. (2007)) and by COSEWIC (COSEWIC 2008). The parameters used to develop the 2004 model (used to inform development of SOMP2 SRMZ boundaries) are summarized consistently in Sutherland et al. (2007) and in Chutter et al. (2004) and presented in **Table 5**. These attributes are also described more fully in **Table 6**.

A third model is being developed currently (2019), by I. Blackburn for future planning but the necessity of additional model development should be rationalized and the attributes used should be examined to ensure accuracy and relevance if this model is proposed as a replacement to the model used by CSORT, COSEWIC and Coretex to delineate owl habitat in BC since 2004. Preliminary investigation of a draft version of the model showed poor alignment with actual owl habitat used based on reconciliation against field data (~1,463 survey observations, 33 nest records and 94 telemetry observations).

¹⁵ Used by Coretex Consulting to inform analysis of potential (predicted) spotted owl territories on the landscape, to assess landscape connectivity and to project spotted owl population response to various predicted habitat management scenarios during recovery planning.

Table 5. Description of habitat parameters for maritime, sub-maritime and continental ecosystems.

Parameter	Maritime		Sub- Maritime		Continental	
	Type A (Nesting)	Type B (Forage)	Type A (Nesting)	Type B (Forage)	Type A (Nesting)	Type B (Forage)
BEC variant	CWHvm1 CWHvm2 CWHdm CWHxm1 CDFmm*	CWHvm1 CWHvm2 CWHdm CWHxm1 CDFmm*	CWHds1 CWHms1 IDFww	CWHds1 CWHms1 IDFww	IDFun IDFdk IDFdk1-4 IDFhx1 IDFhx2 IDFxm IDFwx	IDFun IDFdk IDFdk1-4 IDFhx1 IDFhx2 IDFxm IDFwx MSdm2 MSxk PPxh2
Maximum Elevation	< =900	< =1000 m	< =1000 m	< =1100 m	< =1100m	< =1200m
Slope	all	all	all	all	all	all
Aspect	all	all	all	all	all	all
Minimum Stand Age	>=140 years	>=80 years	>=110 years	>=80 years	> =110 years	> =80 years
Minimum Stand Height	>= 28 m	>= 28 m	>= 28 m	>=26 m	> =26 m	>=23 m

*Although CDF listed little area actually falls in the owl range, and it all occurs in developed regions of Vancouver.

**Forest cover height classes: 3 = 19.5-28.4; 4 = 28.5 - 36.4, 5+ ≥36.5

Table 6: Descriptive summary of spotted owl habitat characteristics in wet and dry habitat types as taken from Chutter et al. 2007.**Table 5: Spotted owl habitat attributes (taken from Chutter et al. 2009. P. 7)**

Habitat Type	Superior Habitat (nest, roost, forage, and dispersal)	Moderate Habitat (roost, forage, and dispersal)
Wetter ecosystems: Maritime Coastal Western Hemlock and Mountain Hemlock Biogeoclimatic Zones		
Natural Disturbances: Rare to infrequent stand-initiating events.		
Suitable habitat characteristics	<ul style="list-style-type: none"> Three or more canopy layers, multi-species canopy dominated by large (>75 cm dbh) overstorey trees (typically 37–185 stems/ha) Moderate to high (60–80%) canopy closure. Five or more large (>50 cm dbh) trees/ha with various deformities (e.g., large cavities, broken tops, dwarf mistletoe infections). Five or more large (>75 cm dbh) snags/ha. Accumulations ($\geq 268 \text{ m}^3/\text{ha}$) of fallen trees and other coarse woody debris on the ground. 	<ul style="list-style-type: none"> Two or more canopy layers, multi-species canopy dominated by large (>50 cm dbh) overstorey trees (typically 247–457 stems/ha, although densities as low as 86 stems/ha are possible where large diameter trees are present). Moderate to high (60–80%) canopy closure. Five or more large trees/ha (>50 cm dbh) with various deformities (e.g., large cavities, broken tops, dwarf mistletoe infections). Five or more large (>50 cm dbh) snags/ha. Accumulations ($\geq 100 \text{ m}^3/\text{ha}$) of fallen trees and other coarse woody debris on the ground.
Dryer ecosystems: Sub-maritime Coastal Western Hemlock and Mountain Hemlock, and Interior Douglas-fir and Engelmann Spruce–Sub-Alpine Fir Biogeoclimatic Zone		
Natural Disturbances: Infrequent stand-initiating events to frequent stand-maintaining fires; however, fire suppression has increased the frequency of stand-initiating events.		
Suitable habitat characteristics	<ul style="list-style-type: none"> Three or more canopy layers, multi-species canopy dominated by large (>50 cm dbh) overstorey trees (typically 173–247 stems/ha, although densities as low as 86 stems/ha are possible where large diameter trees are present). Moderate to high (60–85%) canopy closure. Five or more large trees/ha (>30 cm dbh) with various deformities (e.g., large cavities, broken tops, dwarf mistletoe infections). Seven or more large (>50 cm dbh) snags/ha. Accumulations ($\geq 268 \text{ m}^3/\text{ha}$) of fallen trees and other coarse woody debris on the ground. 	<ul style="list-style-type: none"> Two or more canopy layers, multi-species canopy dominated by large (>30 cm dbh) overstorey trees (typically >247 stems/ha). Stands must contain 20% Fd and/or Hw in the overstorey. Greater than 50% canopy closure. Five or more large trees/ha (>30 cm dbh) with various deformities (e.g., large cavities, broken tops, dwarf mistletoe infections). Five or more large (>30 cm dbh) snags/ha. Accumulations ($\geq 100 \text{ m}^3/\text{ha}$) of fallen trees and other coarse woody debris on the ground.

13. Does the BC Habitat Model identify and define Spotted Owl critical habitat as required by the SARA (that is, “habitat that is necessary for the survival or recovery of [the Spotted Owl]” identified “to the extent possible, based on the best available information”) (“Critical Habitat”)?

Synopsis: No; the BC Habitat Model (i.e. the habitat modeling used in SOMP2) does not identify critical habitat as required by the SARA. Habitat conservation measures as defined by SOMP2 were constrained by socio-economic considerations. The SARCO imposed a constraint on the impact allowed during recovery planning to accommodate competing interests from revenue generation from commercial forestry activities.

Under the SARA, ecological considerations should not be influenced by socio-economic consideration when designating CH. An appropriate process for mapping CH requires a more fulsome suite of considerations that accommodates all ecological needs of the species and recognizes and protects breeding, foraging and dispersal habitats required for effective species recovery throughout the species’ entire (former) range.

Habitat Suitability Index modelling (i.e., the BC habitat model) is not an equivalent proxy for identification of Critical Habitat (CH) in isolation of consideration of patch size, connectivity, edge-effect and reserve design. The BC Habitat model simply identifies where suitable spotted owl habitats occur on the BC landscape (i.e., spatially depicts the amount and distribution based on selection of desired habitat attributes (as described in the response to Question 12)). The BC habitat model (circa 2004) does not identify and define CH; it is instead an informational tool that was intended to support mapping of CH. For clarity, I will assume that the wording “BC Habitat Model” as used in the question is analogous to the BC Habitat (Management) Model, or framework, referred to by the Province and in this document as SOMP2.

On that assumption, literature regarding effective reserve design suggests design must allow for management of habitat to provide ‘clusters’ of occupied territories spaced evenly on the landscape to facilitate natal and adult dispersal (Lamberson et al. 2003). In assessing the habitat protection component of SOMP2 in response to Question 13 the answer is “No” for the following reasons:

1. Design of SOMP2 was influenced by socio-economic considerations: The BC Habitat model (circa 2004) was used to inform reserve design for revisions made to SOMP1 SRMZ boundaries for the purpose of spatial mapping of SOMP2 boundaries. Although reserve design principles outlined by Lamberson (2002) were followed during this process (i.e., territory clusters, with spacing consideration afforded to ensure maintenance of connectivity habitat for dispersing owls), SOMP2 habitat management (as defined and announced in 2009) was constrained, in its design, by imposition of socio-economic considerations. The SARCO imposed a ‘cap’ on habitat protection afforded to spotted owls under SOMP2 by carrying forward the same 4.5% limit on impact to timber revenue within the Sea-to-Sky and Chilliwack NRD as used for SOMP1. The effect of this constraint warrants consideration as SOMP1 had already been demonstrated as

ineffective at halting or reversing the rapid spotted owl population decline in BC. Under the SARA, socio-economic concerns are not supposed to fetter designation of CH as CH designation is strictly a biological process¹⁶. On these grounds alone SOMP2 provisions do not meet the intent and requirement of CH designation under the SARA.

2. Critical Habitat identification not yet in place: SARA (S.2(1)) defines "CH" as *"the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species"*. The Province is required to post a proposed strategy to the SARA public registry within 1 year¹⁷ of listing for an endangered species. Furthermore, section 41(1)(c) SARA states that *"a recovery strategy must include an identification of the species' CH, to the extent possible, based on the best available information..."* Spotted owl was listed under SARA in 2004; as of the time of writing of this report (2019) CH for spotted owl has still not been defined and identified by the Province in a Recovery Strategy or in an Action Plan. Identification of CH for spotted owl is now 15 years overdue.
3. Delayed effective legal protection: Management of spotted owl habitat, as constrained by SOMP2, was not defined until 2009. In 2009, it was defined only informally by non-legal recommendations outlined by Provincial BMPs (Blackburn et al. 2009). This concern was partially addressed when SRMZ boundaries were finally converted to WHAs in 2011 and 2013 for the Chilliwack and Sea-to-Sky NRD. GWMs now afford legal guidance to habitat management within WHA boundaries; however, point 1 still presides and there is still no intent to afford protection to 314,959 ha of suitable Class A unprotected spotted owl habitat that currently occurs on the THLB within the owl's defined range.
4. Protection afforded to spotted owl habitat does not adhere to current scientific understanding of habitat management for spotted owl: Management outlined in Blackburn et al. (2009) is not in the best interest of spotted owl conservation. The BMPs promote harvest with retention (HWR) (within MFHAs) and logging to enhance owl habitat (HEPs) (within LTOHAs). Available literature and previous application of these methods in BC provide compelling evidence that neither of these prescriptions effectively benefit preservation of required attributes for spotted owl habitat (see response to Question 8).
5. Demonstrated non-compliance with habitat management practices: The Province's BCTS program continues to promote harvest within several WHAs (including one of the last three extant spotted owl territories near Spuzzum Creek) in a manner contrary to the guidance afforded by SOMP2. Category-Information (Cat-I) blocks is the term used to denote areas of forested habitat that have been advanced for approval to harvest. There are currently several Cat-I blocks within occupied spotted owl critical roosting and nesting habitat.

¹⁶ From Critical habitat identification toolbox: *Species at Risk Act* guidance: *"...socio-economic considerations are excluded from this stage of recovery planning. CH boundaries should be identified based on the best available information (ecological and biological relevance), not socio-economic orientation (for example, deliberately truncated to align with particular land parcel boundaries or land designations), such that activities likely to destroy CH and identified CH boundaries are mutually relevant."*

¹⁷ SARA (2002): the competent minister must include a proposed recovery strategy in the public registry within one year after the wildlife species is listed

In summary, an appropriate process for mapping CH requires a more fulsome consideration of ecological value and recognizes and protects breeding, foraging and dispersal habitats required for effective species recovery throughout the species' entire (former) range. This work has already been completed for spotted owl recovery by Sutherland et al. (2007) (i.e., the Coretex SELES model). The SELES model could have been used over a decade ago to identify CH throughout the owl's defined range in BC. It is very likely that a more fulsome consideration of recovery habitat requirements (i.e., for the purpose of mapping CH necessary for the survival and recovery of the spotted owl in BC) would differ markedly from the reserve design and habitat management afforded by SOMP2 as it would likely include much, or all, of the remaining 314,959 ha of unprotected Class A spotted owl habitat (on the THLB) within the owl's defined range in BC. This is self-evident as SOMP2 resulted in a net *reduction* in total area of habitat managed for spotted owl in BC relative to an already failed SOMP1. SOMP2 also failed to protect all active sites, all previously known active sites and all available currently suitable spotted owl habitat on the THLB by instead allowing continued harvest of suitable spotted owl habitat despite scientific guidance, in 2004, that suggested more habitat protection should be the primary recovery action (Chutter et al. 2004 – Appendix 1 – request for interim measures).

14. If you answered “no” to question 13, what is the Critical Habitat for the Spotted Owl as required by the SARA?

Synopsis: SARA suggests that CH must effectively and legally protect sufficient suitable (and if required, capable) habitat, within the known range of the species to accommodate recovery. Critical Habitat should define nesting, roosting, foraging, and dispersal habitat to accommodate future species recovery. Effective habitat conservation for spotted owl must also ensure maintenance of connectivity (at the landscape scale) and work towards reducing habitat fragmentation by preventing further loss of suitable habitat by preventing further loss of old growth forests range-wide.

Reserves should include aggregates of clustered potential spotted owl territories (34,000 – 68,000 ha) connected by corridors of low elevation dispersal habitat comprised of mature forests. Where these conditions are not met CH designation should ensure no further attrition (as a result of commercial forest harvest) within CH reserves. Within areas maintained for connectivity recruitment of suitable forest attributes could be accelerated by forests prescriptions that prioritize spotted owl management over revenue generation from extracted timber.

Spotted owl CH should be comprised of an adequate amount of survival and recovery habitats throughout the species' (former) natural range in support of scientifically defensible recovery goals (Chutter et al. 2004). The 2004 CSORT stated recovery goal was to provide sufficient “*suitable habitat, spatially distributed in a way that it can support and sustain a minimum of 250 mature owls*” in BC. Recovery habitat was identified by CSORT, in 2004, to include both existing occupied habitats, and all suitable habitat into which the species could recolonize. CSORT also identified inclusion of dispersal habitat as necessary to enable successful dispersal and establishment of new territories. These are valid biological principles that should be applied in defining CH.

Identification of the total amount and distribution of CH needed to meet the recovery goal was identified as one of the highest priorities by the CSORT in 2007. Theoretically, assuming 3,200 ha per

breeding territory, and assuming that 250 mature owls equated to 125 breeding pairs, about 400,000 ha of currently suitable habitat would be required (Chutter et al. 2004). SOMIT (1997) claimed that SOMP1 afforded management to 363,000 ha of **capable** (but not suitable) spotted owl habitat and yet the species declined precipitously. The Province's presentation of SOMP1 was a misleading oversimplification as capable habitat includes a spectrum of immature young seral forested habitat that is inhospitable to spotted owls. This should not have been attributed as beneficial towards spotted owl recovery. The same misleading oversimplification was again perpetuated by the Province when describing current management in a 2016 report. In the report the Province reported that "*As part of the Provincial Government's Spotted Owl Recovery Action Plan, the Province of British Columbia has protected 305,000 ha of forest for the spotted owl*" (Gillis 2016a). This is not equivalent to protection of 305,000 ha of suitable spotted owl habitat - this distinction may be lost on an uninformed audience – in reality only 66,919 ha (12.5 % of total available currently suitable spotted owl habitat) was afforded protection under SOMP2.

In addition, the amount of habitat required for recovery cannot be simply summarized as a total number of hectares of currently suitable spotted owl habitat protected, but must address the issues of connectivity, fragmentation, and elevational constraints across species' range. Spotted owl population health may be influenced by habitat composition and quality as available in the landscape. Fortunately, as described in the spotted owl Action Plan Guidance document (Chutter et al. 2007) much of the work required to define CH for spotted owl has already been completed. Chutter et al. (2007) list the following actions as Completed (in 2004) – this provides a framework to appropriately designate CH: Steps already completed towards appropriate identification of CH (taken from Chutter et al. 2007):

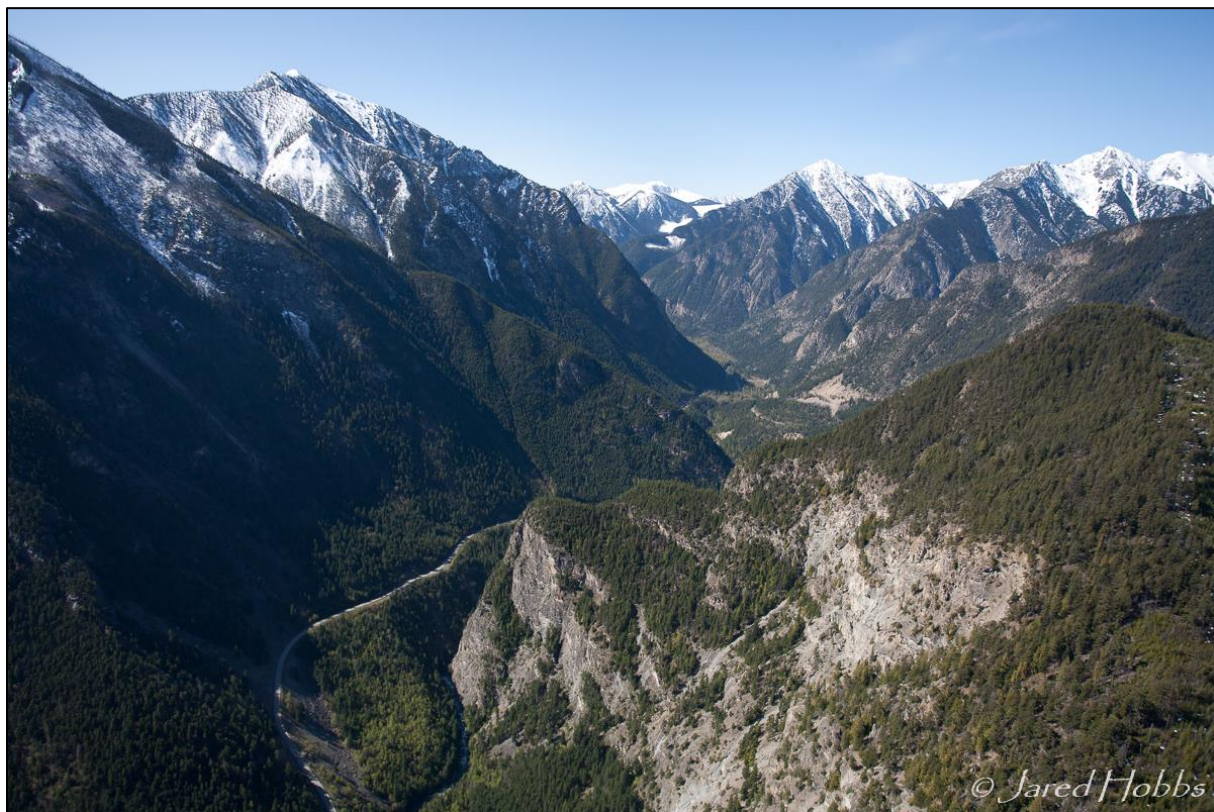
- ✓ Based on surveys and GIS work, create a base map of known sites and potential new sites.
- ✓ Define nesting, roosting, foraging and dispersal habitat.
- ✓ Develop a spatially explicit habitat supply model for the spotted owl based on the best science available.
- ✓ Refine the model and test its assumptions.
- ✓ Use the model to test assumptions about the effects of different habitat, territory and population characteristics, as well as threats on a potential stand-alone provincial population versus the need for connectivity to the United States populations.
- ✓ Apply the model to help create a map of all potentially suitable habitat.
- ✓ Apply the model to help define attributes necessary to define and delineate Critical Habitat in BC. This should incorporate survival habitat, and individual, population and landscape level requirements.
- ✓ Use the model to assess the existing spotted owl management plan (SOMP1).
- ✓ Establish spotted owl objectives under the Forest and Range Practices Act.
- ✓ Develop comprehensive guidelines to create, enhance and maintain critical habitat and reduce threats (author's note: this was noted as ongoing in 2004 and subsequently completed by Blackburn et al. in the 2009 BMP document; however, suggested management prescriptions that should be examined for scientific merit in the context of available published literature. This retro-active examination was anticipated by CSORT as adaptive management principles were recommended (in 2004) to evaluate the effectiveness of created or enhanced habitat to provide for the life requisites of the Spotted Owl or its prey populations).
- ✓ Implement a map-based spotted owl habitat management plan that conserves critical habitat and meets recovery goals and objectives (author's note: SOMP2 was completed in 2009)

however it failed to identify and protect CH for reasons outlined in the response to Question 13).

- ✓ Assess and monitor the effectiveness of the habitat management plan and revise and adapt the habitat management plan as necessary (author's note: *there is currently no effectiveness monitoring in place to evaluate SOMP2 habitat protection*).

The final step noted in the 2007 Action Plan Guidance document (Chutter et al. 2007) was adopted by SARCO, on behalf of the Province, and was described as the next required step (in 2007): “Provide a map of potentially suitable habitat along with a description of critical habitat in the recovery action plan” (Chutter et al. 2007). This final step has still not been completed by the Province in 2019 although the means to do so was completed by Coretex Consulting in 2007 using a comprehensive SELES model (Sutherland et al. 2007). The information required to map CH in a scientifically defensible manner has been available to the Province for over a decade.

The 2016 ECCC CH Identification “Toolbox” was provided by ECCC recovery practitioners to inform development of recovery documents where CH identification is required (ECCC 2016). The Toolbox could be used immediately, by the Province, to identify CH using the results from the 2007 SELES modelling already completed by Coretex Consulting (Sutherland et al. 2007). This action should be completed in a timely fashion - it is more than a decade overdue.



This spotted owl territory at Enterprise Creek was the most productive territory ever recorded in BC. I confirmed breeding at this site for five consecutive years before the female was taken from the wild to support the breeding program. All remaining suitable habitat could readily be mapped as CH.

15. How is the Critical Habitat you define and describe different and similar to the BC Habitat Model?

Synopsis: While the current BC Habitat Model under SOMP2 identifies suitable spotted owl habitats, it does not define or manage Critical Habitat reserves as required by the SARA. The fundamental difference between an appropriate spatial definition of CH, and the reserves mapped by SOMP2, is that SARA demands a process unfettered by socio-economic considerations.

In accordance with the SARA all habitat that is essential to the species' recovery should be afforded effective legal protection. In principle, SOMP2 is aligned with conventional wisdom for spotted owl reserve design (i.e., delineate large reserves spaced evenly on the landscape) but the size of the reserves are smaller than that recommended in the literature, and the omission of protection afforded to 59% of available remaining suitable habitat, suggests that CH defined in compliance with the SARA would be markedly different.

A Spatially Explicit Landscape Event Simulator (SELES) model was developed prior to development of SOMP2; this model should be used to allow more effective reserve design to better accommodate spotted owl recovery in BC.

As clarified in Question 13, the BC Habitat model simply identifies where suitable spotted owl habitats occur on the BC landscape (i.e., spatially depicts the amount and distribution based on selection of desired habitat attributes (as described in the response to Question 12)). The BC habitat (suitability) model (circa 2004) does not identify and define CH; it is instead an informational tool that was intended to support mapping of CH. For clarity, I will again assume that the wording "BC Habitat Model" (as used in question 15) is analogous to the BC Habitat (Management) Model, or framework, referred to by the Province and in this document as SOMP2.

On that assumption, literature regarding effective reserve design suggests successful reserve design must allow for management of habitat to provide 'clusters' of occupied territories spaced evenly on the landscape to facilitate natal and adult dispersal (Lamberson et al. 2003). The habitat protection component of SOMP2 applied this principle but did not define reserves as Critical Habitat; it simply refers to the reserves as WHAs with LTOHA and MFHA designations within each of 31 WHAs in the Sea-to-Sky and Chilliwack NRDs. The province has made no pretense of defining CH for spotted owl. The reserves, or WHAs, presented by the Province as SOMP2 (referred to as the "BC Habitat Model" in this question) would not meet the expectations, under SARA, of CH for reasons outlined in Question 13.

I recommend an unfettered process for CH designation that considers the species' needs and utilizes a reserve design that promotes large aggregations of suitable owl habitat and considers the likelihood of persistence and survivorship (during all requisite life history stages) and attempts to maximize fecundity by creating conditions favorable for survival and recruitment of adult and juvenile spotted owls. An early study by Lamberson et al. (1994) examined reserve design; the primary conclusion was that the level of occupancy (i.e., spotted owl persistence) is positively correlated with reserve size and that this relationship is less pronounced once reserve size is sufficient to accommodate at least 20 pairs (i.e.,

51,000 - 68,000 ha (allowing between 25 – 0 % overlap, respectively)). An analysis of reserve size under SOMP2 illustrates reserve size varies from 983 to 21,379 ha (with an average size of 4,944 ha) for LTOHAs and from 512 to 11,949 ha (with an average size of 4,941 ha) for MFHAs.

In the US two reserve designs were examined, using demographic models, by Anderson and Mahato (1995) and are summarized as follows:

- 1) The first design (Spotted Owl Habitat Area (SOHA)) uses smaller aggregates of one to three functional spotted owl territories (3400-10,200 ha). Reserve size closely follows that employed under SOMP1 and SOMP2.
- 2) The second design (Habitat Conservation Areas (HCA)) uses larger aggregates of 10-20 functional spotted owl territories (34,000 (10 territories) up to 68,000 ha (20 territories)).

The authors concluded that the HCA strategy always led to longer persistence times than the SOHA strategy (Anderson and Mahato 1995). The difference was attributed to the probability of colonization of an empty or vacated territory by a new owl. The authors recommended the HCA strategy for reserve design in proposed (at the time) conservation and management for the California spotted owl (Anderson and Mahato 1995). This approach was followed in the US management for northern spotted owl under the NWFMP throughout the species range in Washington, Oregon and California.

Designations for CH should be incorporated into future revision of spotted owl management in BC. Development of a revised SOMP (i.e., SOMP3) was beyond the scope of the contract but designation of CH by the Province is long overdue. When designating CH, a preliminary recommendation includes closer consideration of patch size consistent with recommendations from Lamberson et al. (2003), as larger patches (reserves) appear to more effectively support spotted owl survival, reproduction and recruitment relative to the smaller reserves implemented under SOMP1 and SOMP2. Any revised future management (SOMP3) should include a spatial definition of CH using the wealth of pre-existing HSI and SELES based models developed by CSORT (2004-2007) to identify existing suitable spotted owl habitat. CH designation should also identify capable spotted owl habitat for long-term habitat recruitment as this will be necessary for recovery. The CH objectives should stipulate retention and recruitment of attributes (discussed in response to Question 12) favourable for spotted owl persistence and recovery. CH designation processes should follow guidance from ECCC (ECCC 2016) and should, as stipulated under the SARA, *not* be fettered by continued consideration for socio-economic considerations. A GIS based analysis of remaining suitable Class A habitat within the defined range of the spotted owl in BC suggest there is currently 533,306 ha of suitable habitat currently remaining. Only 66,919 ha (12.5 %) is protected in areas designated by SOMP2; 151,428 ha (28 %) is afforded protection within Provincial Parks, Protected Areas, ecological reserves, conservancies and municipal watersheds. The remaining 314,959 ha (59 %) is located on the THLB and is currently available for commercial forest harvest.

Finally, future spotted owl management in BC may also consider broader application to areas of former spotted owl occurrence within the Sunshine Coast NRD, as supported by reliable observations presented by Campbell (2014). These areas have not ever been formally surveyed by the Province so occupancy status is unknown but, given the trend within the surveyed population, the probability of discovery of any currently extant spotted owl territories in these areas at the periphery of the species' range in BC is low.

16. How should the threats to Critical Habitat be managed to maximize the likelihood the Spotted Owl will survive and recover?

Synopsis: Management prescriptions within WHAs, LTOHAs and MFHAs continue to detriment spotted owl survival and recovery through commercial harvest of old-growth forest habitat. Critical Habitat needs first to be explicitly spatially defined and protected from future harvesting to maximize the likelihood of future spotted owl recovery.

In general, suitable habitat will continue to be lost or degraded through human activities such as logging, mining, other resource development, urban and rural development, and development of transportation and utility transmission corridors. Habitat loss, or conversion to early seral stands, is also caused by natural disturbances including major forest fires and insect outbreaks with each of these stochastic events exacerbated by climate change. However, in more practical terms, I believe commercial forest harvest continues to be the main stressor, and the predominant cause, of continued depletion of spotted owl habitat in BC. Many areas of old-growth forested habitats occur outside any management reserve boundary - continued harvest of these habitats is currently permitted by the Province's BCTS Program.

Viewed pragmatically the disproportionate threat from a single regulated activity should theoretically facilitate efficient threat management as improved conservation of spotted owl habitat can be efficiently addressed by focus on a single issue. At this over-simplified level further habitat loss could be prevented by a complete cessation of any further commercial harvest of old-growth forest habitat within the (former) range of spotted owl in BC.

The Province's current approach affords management to 31 spatially mapped areas with each area containing varying degrees of remaining unharvested suitable spotted owl habitat; however, as outlined in the response to Question 6, there are large areas of immature forest (unsuitable for use by spotted owl) also included within reserve areas that do nothing to contribute to recovery of spotted owl at the current time. Furthermore, harvest of old-growth forested habitat is also permitted within Provincial spotted owl management areas under two prescriptions:

1. Within LTOHAs commercial harvest of forested habitat is permitted if the intention is purported to improve habitat conditions (euphemistically phrased "Harvest to Enhance (HEP)" in the SOMP2 management guidance (Blackburn et al. 2007)). The intent of HEP prescriptions is sound but only if HEP is permitted within maturing forests – HEP applications within late seral mature or old-growth forest is contrary to scientific understanding (see response to Question 17).
2. Within MFHAs harvest of suitable habitat is permitted using variable (partial) retention of a subset of required habitat attributes deemed to be favourable to be retained as patches of suitable habitat. The Province states that "*the primary purpose of the MFHA is to provide for timber harvesting opportunities.*"

Both management prescriptions would be detrimental if applied to areas of suitable spotted owl habitat. Management guidance prescribed by Blackburn et al. (2009) is not in the best interest of spotted owl conservation when applied to existing suitable spotted owl habitat.

17. Can Critical Habitat be logged so as to enhance or not jeopardize the Spotted Owl's survival and recovery?

Synopsis: Available information suggests that commercial forest practices cannot be reasonably or prudently applied to mature or old-growth forest, in a practicable manner, to improve spotted owl habitat suitability. If Critical Habitat is defined to include old-growth or mature forested habitats then commercial thinning (i.e. HEP procedures under SOMP2) should not be permitted in old-growth forested habitats.

This question has been afforded thorough treatment in D'Anjou et al. (2006); four points of consideration were presented (and logically supported by scientific understanding) and is summarized as follows:

- 1) It is challenging to isolate, during forest manipulation, those attributes that are essential to spotted owl use from the suite of characteristic attributes of old-growth forests. To effectively identify habitat attributes the harvest prescription should be completed by an expert with extensive experience recognizing spotted owl habitat values.
- 2) There is a paucity of information regarding the temporal requirements, post-treatment, for recruiting and enhancing habitat. Extensive work on maturing second growth stands in Oregon (>150 years of age) by Franklin and Spies (1991, as cited in D'Anjou et al. 2006) suggest that even 200 years post-harvest these managed stands still lack the habitat attributes fundamental for use by spotted owl (e.g., large trees with broken tops, or Douglas-fir with spreading crowns). Wilk et al. (2018) described 1,717 nest trees in 16 tree species in Washington and Oregon; many of the nest trees in their study were estimated to be at least 700 years old. They concluded that managing for the retention of such trees, and for their replacement, is a significant challenge for land managers.
- 3) Available data is insufficient to allow accurate or reliable prediction of prey response by key prey items (including bushy-tailed woodrat and flying squirrel) to both short and long-term treatments. D'Anjou et al. (2006) cited telemetry data in Oregon that indicated spotted owls avoided partially cut mature conifer stands with 40-59% canopy closure. Another study demonstrated that commercial thinning (i.e., logging to enhance owl habitat) within the nest area may have caused a resident male owl to move from its breeding range and appeared to result in an overall increase in the home range size. Finally, D'Anjou et al. (2006) also cited Carey (2000) – Carey reported flying squirrels moved further and were found at lower densities in managed thinned stands. This data suggests any manipulation of mature and old-growth forested habitats (such as thinning as prescribed by SOMP2 HEP procedures) are likely detrimental to spotted owl survival on both the short and long term.
- 4) The final consideration in D'Anjou et al. (2006) raised concern over the operational feasibility of HEP procedures. Stand-level management is costly to implement; those costs, in most cases, will quickly exceed the value of the extracted resource (timber) making HEP procedures (if completed in compliance with their stated intent) cost prohibitive. This sentiment was

repeatedly raised during discussions with forestry proponents during the recovery planning process and cited by M. Chutter and myself in preparation of a draft report for Ministry review in April 2002 (*“since the release of SOMP, increased stumpage rates caused harvest costs to exceed profit margins, thereby preventing forest companies from improving habitat conditions for Spotted Owls by performing these treatments”*).

Speaking specifically to partial harvesting (i.e., HEP procedures) in older forests, management prescriptions are *“untested hypothetical constructs”* until validated by scientifically valid observations (D’Anjou et al. (2006) quoting Franklin (2005)). There are few well documented experiments to analyze. Results of future experimentation would be uncertain at best and are deemed unlikely to succeed. Negative effects from HEP will likely include (based on partial harvest practices already completed) residual tree damage, windthrow, mortality and conversion of the stand from desired tree type (Douglas-fir) to more shade-tolerant (less desirable) tree species.

Available information suggests that commercial forest practices cannot be reasonably or prudently applied to mature or old-growth forest, in a practicable manner, to improve spotted owl habitat suitability. If Critical Habitat is defined to include old-growth or mature forested habitats then commercial thinning (i.e. HEP procedures under SOMP2) should not be permitted in old-growth forested habitats. More research is required to determine if HEP procedures should or could be applied effectively within maturing (early to mid-seral) forested stands but conclusions from existing published literature on effects upon old-growth forested habitats caution this approach.

18. What are the key activities (such as habitat enhancement, predator control, prey augmentation, etc.) which should and should not accompany management and protection of Critical Habitat to maximize the likelihood the Spotted Owl will survive and recover?

Synopsis: Any activities to manage other key threats should be undertaken in conjunction with efforts to effectively address the primary threat of habitat loss. These activities include population augmentation (i.e., captive breeding), barred owl control (within active spotted owl territories and by experienced personnel), prey augmentation (for wild breeding owls and juvenile owls during natal dispersal), and inventory of unsurveyed habitats. Habitat enhancement prescriptions should not be permitted in any remaining mature and old-growth forest within the owl’s range.

Anthropogenic changes to spotted owl habitat has created favourable ecological conditions (increased edge effect) and, to an undefinable degree, promoted invasion of the more aggressive, prolific and adaptable barred owl. Similarly, these changes have also likely promoted an increase in population abundance and density of great horned owl with a concomitant increased predation effect on spotted owls.

To promote recovery the Provincial Government has largely focused its attention, effort and resources on controlling negative effects of the more aggressive barred owl, including call suppression (in spotted

owl) and competition for resources (prey) resulting in territory abandonment and reduced recruitment of juvenile spotted owls. Attention to these aspects of spotted owl recovery is not misguided as without spotted owl population augmentation (release of captive bred owls), and with no attempt to ameliorate secondary (barred owl) and tertiary (great horned owl) order threats (see Question 2 for discussion of threats) recovery will be hindered. The challenge is with the magnitude and sequence of effort applied to all threats. Prevention of further habitat loss should have been afforded the highest order of attention for recovery, followed by recruitment of habitat in younger forested habitats to advance succession towards late seral stand characteristics. When the primary threat (habitat loss and connectivity within remaining habitats) has been fully addressed efforts should logically shift towards control of secondary threats (barred owl competition) with focused efforts afforded to active spotted owl territories (note: this has been the approach followed for addressing barred owl but these efforts have been applied before the primary threat (habitat loss) has been fully addressed).

Captive Breeding Program: At this point the owls placed in captivity would likely be dis-advantaged if released into the wild; survival and recruitment would be heavily compromised. The captive-breeding program should continue in hopes that it will one day result in a net positive benefit.

Barred Owl Control Program: Control measures to ameliorate the effects of barred owl should only continue within active spotted owl territories. To enable this, continued inventory for spotted owl is required to locate new spotted owls that may immigrate from the Washington population. If lethal control methods are continued only experienced personnel should be tasked with removal of barred owls. In the U.S. there have been at least two reported incidents where a spotted owl was inadvertently shot due to mistaken identification.

Prey Augmentation: During my tenure as the field lead for spotted owl inventory and telemetric monitoring I had attempted to augment the diet of adults (during the nesting/brood rearing phase) and juveniles (during natal dispersal) phase. I believe these efforts resulted in a positive benefit. As evidence the resident pair of spotted owls at Enterprise Creek bred for five consecutive years. This level of productivity was unheard of in the literature, or in any field programs in the U.S. (Eric Forsman, pers. comm. 2005). Insufficient sample size (too few owls remaining in BC) prevented a controlled experiment to assess efficacy, but available evidence suggests that prey augmentation may be an effective means to improve productivity for wild breeding owls and recruitment/survivorship of juvenile owls during natal dispersal.

Inventory: The merit of inventory within the Sunshine Coast NRD, and within unsurveyed habitats at Lightning Lake, should be investigated in light of more recent disclosure of reliable reports of spotted owl detections in these areas. In the context of the current trend future inventory is unlikely to reveal any additional new (i.e., undetected) territories but if extensive areas of unprotected suitable habitat remain, particularly in the Sunshine Coast NRD, additional inventory may be warranted.

Habitat Enhancement: HEP and HWR prescriptions would likely be detrimental if conducted within mature and old-growth forest habitats. These procedures should be restricted to early seral forests only when attempting to promote recruitment of spotted owl habitat.

19. The authors of the Recovery Strategy determined that the survival and recovery of the Spotted Owl was at the time technically and biologically feasible. Is the survival and recovery of the Spotted Owl in British Columbia still technically and biologically feasible?

Synopsis: To determine feasibility I assessed available information from 2018 against Environment Canada's set of criteria from 2005, with revisions made to consideration of SOMP2 habitat management limitations as well as actual captive breeding outcomes. Given the amount and distribution of available suitable habitat (Sutherland et al. 2007) recovery is still technically and biologically feasible. This assessment suggests spotted owl recovery in BC, while logistically challenging, remains ecologically and technically feasible. The presence and connectivity of Spotted Owl populations on both sides of the international border also allows increased recovery potential in BC.

In the 2004 spotted owl recovery strategy CSORT concluded that recovery was ecologically and technically feasible. In 2005 Environment Canada (EC) provided policy guidance to offer a structured set of criteria to inform the re-assessment of recovery feasibility. Recovery was still suggested as feasible under the new criteria. The same criteria are applied below using current information available in 2019; however, one additional criterion (see #2: immigration from the US) has been integrated into the 2019 assessment. I have also divided CSORT bullet point #3 (considerations pertinent to habitat protection and barred owl control) into criteria 3, 4 and 5 to allow separate discussion of:

- revised habitat management under SOMP2 regulations (point 3),
- improved (potential) future habitat management from 2019 forward (to better protect existing spotted owl habitat in BC by recognizing limitations of SOMP2) (point 4); and,
- barred owl control (point 5).

In addition, the 2019 assessment (below), includes more detail on population enhancement measures (point 6), including captive breeding and barred owl control, as these actions have been underway for over a decade. The results of these efforts are also considered in the 2019 assessment whereas in 2005 they were simply identified as feasible recovery actions for implementation.

As per guidance set by Environment Canada (2005) determination of recovery feasibility must not consider human-centric values including aesthetic, economic, or other social values when assessing recovery feasibility as these considerations are accommodated separately in the recovery process. This assessment of recovery feasibility suggests that spotted owl recovery in BC continues to be ecologically and technically feasible based on the following rationale:

1. Extant population (updated with 2018 results): Breeding pairs were still present in Canada in 2017 (two sites with pairs and one single owl). Unfortunately, by 2018 all three known remaining sites were occupied by only single owls; however, there is some possibility that pairs remain undetected. Regardless, breeding in the wild population was most recently confirmed in 2017 at both the Spuzzum and Utzlius territories near Boston Bar.
2. Immigration (not considered in 2005): Breeding pairs are still present immediately south of the international Canada-US border and immigration from the US resident population of spotted owls is still occurring. For example, Greendrop Lake territory (near Chilliwack) was found active in 2015 after three years of inactivity (Gillis 2016a) and a new female (unknown origin, possibly

from the US) was detected at Spuzzum Creek (paired with the resident male at that site) in 2015. In an independent demographic review in Washington State J. Buchanan (2016) spoke to recovery potential in Canada and concluded, given the amount and distribution of habitat in British Columbia, it remains possible to restore a population of several hundred spotted owls in the BC. I agree with Joe Buchanan's position: "the presence and connectivity of spotted owl populations on both sides of the international border should allow for more stability in that part of the owl's range" (Buchanan 2016).

3. Potential to better conserve existing SOMP2 managed habitat (note: managed habitat is considered in the context of SOMP2 as implemented in 2009): Sufficient suitable habitat to support a sustainable population of spotted owls is not currently conserved in BC. Protection of habitat in isolation of other direct management measures will not be sufficient to promote recovery. Of concern, and contrary to stated CSORT recovery goals, conservation of existing old-growth spotted owl habitat (and recruitment of new habitat) is currently not being achieved effectively under SOMP2 as only 12.5% of available suitable Class A spotted owl habitat is protected by SOMP2 designations. In addition, even in managed areas harvest of suitable spotted owl habitats continues today¹⁸.
4. Potential to better conserve existing unprotected habitat: Recovery is further challenged as 87.5% of available Class A habitat exists outside SOMP2 reserve boundaries and is currently unprotected. Forest harvest is currently permitted in these areas despite the value of these habitats for spotted owl recovery. Unfortunately, the distribution and amount on the landscape is likely not sufficient to allow recovery through additional habitat protection alone. Since 2000 there has been 29,909 ha of suitable spotted owl habitat (i.e., approximately 10 viable territories) commercially harvested in BC. The continuing harvest of suitable spotted owl habitat is largely promoted by the Province under the BCTS Program. It is laudable that two major commercial forestry licensees (Interfor and Canfor) both voluntarily elected to cease harvest in managed spotted owl habitat (in 2006) to support recovery but this positive step was negated as BCTS re-instigated harvest of spotted owl habitat within both tenures despite increased understanding of the owls decline, and contrary to recommendations for more conservative management in BC (Chutter et al. 2004; Appendix 1 (request for interim measures)).
5. Barred owl control (treated speculatively in 2005): Removal, including translocation and lethal removal of 189 barred owls from active spotted owl breeding areas has been suggested to be effective in reducing pressure on resident spotted owls (Diller 2016, Gillis 2016a). Research on the effects of barred owl removal confirmed barred owl control (i.e., removal) had a positive effect on spotted owl survivorship and fecundity rates with a concomitant reduction on spotted owl extirpation rates (Diller et al. 2016). The effect of barred owl removal was unknown in the 2005 assessment as this action hadn't yet been applied. Since 2005 barred owl control measures were applied by J. Gillis; these actions have had a suggested positive effect on spotted owl persistence and productivity in BC (Gillis 2016a).
6. Population augmentation (treated speculatively in 2005): The captive breeding program has now been in operation for over 12 years; efficacy of program success is included in this assessment. The previous (2005) assessment was based on an optimistic projection of program effectiveness. Release rates were anticipated as 20 owls to be released each year (I. Blackburn pers. com.). Since 2006/7 the Canadian spotted owl captive breeding program has bred eight

¹⁸ As an illustrative example the Province has recently proposed additional commercial forest harvest under the Province's BCTS program; harvest is proposed within one of two last remaining active spotted owl conservation areas (Spuzzum Creek). These actions are proposed despite spotted owl management objectives set forth by the Province (SARCO) in SOMP2.

spotted owls in captivity (predicted release rates suggested 240 owls would be released by 2018 (Ian Blackburn pers. comm.). No captive bred spotted owls have been released yet. In addition to the discrepancy between anticipated and actual success the negative impact to the wild population should not be ignored. At least ten spotted owls have been removed from the wild to provide stock for the captive breeding program, which is likely to have adversely affected production and recruitment in the remaining wild population¹⁹. These results are far less optimistic relative to anticipated breeding rates which speculatively predicated a rate of production of approximately 20 juvenile owls produced per year (I. Blackburn pers. comm.). However, valuable lessons have been learned since the program's inception, providing potential for future success.

This current assessment of the feasibility of recovery recognizes additional challenges than those outlined in previous assessments. Ecologically, recovery is further complicated in 2019 by ongoing habitat loss, as protection measures under SOMP2 did not faithfully implement the recommendations provided to the Province by CSORT in the 2007 Action Plan Guidance document (see Chutter et al. 2007). Furthermore, in the 2005 CSORT feasibility assessment, consideration of population augmentation as a recovery action component was based on optimistic predicted or anticipated results whereas the current (2019) assessment of recovery feasibility is informed by actual results from the spotted owl captive breeding program initiated in 2007.

Over a decade has passed since SOMP2 was implemented in 2006 and it is clear that the certainty of recovery is more tenuous today relative to the previous 2005 CSORT assessment. The current (2018) known population of only three remaining single owls in the BC wild population is a stark contrast with the 2004 known population of 25 individuals (including eight breeding pairs and nine single adults) when recovery feasibility was assessed by CSORT in 2004, and 22 individuals (including six pairs) when recovery feasibility was re-assessed by CSORT 2005. The current 2018 status of spotted owl in BC allows retrospective consideration of the effectiveness of spotted owl management (including habitat and population management) since the last assessment by CSORT in 2005; SOMP2 is clearly not achieving the desired recovery outcome.

Although actions required to allow recovery, given current conditions and current management by the Province, seem daunting under the SARA the province is obligated to try as recovery is technically and biologically feasible. The ECCC toolbox, and the SARA, specify use of a precautionary approach, where *"...species for which recovery feasibility is unknown would be considered recoverable until proven otherwise"*. In this assessment recovery is still deemed technically and biologically feasible but it is clear that the Province will face several significant logistical, societal and economic challenges. Recovery actions need to be implemented more conservatively (with regards to timber harvest in spotted owl habitat), with strict adherence to scientific principle and without delay for improved habitat protection if the Province faithfully intends to successfully recover spotted owls in BC.

¹⁹ In favor of the captive breeding program survivorship of captive owls is higher – in the wild longevity is estimated at ~15-17 years whereas in captivity one individual owl, kept by E. Forsman, survived for 32 years.

20. Attached is a document prepared by the Canadian Spotted Owl Recovery Team (“CSORT”) that we refer to as the Action Plan Guidance. What is your understanding of the nature of this document?

Synopsis: The 2007 Action Plan Guidance document was prepared by CSORT to supplement the 2004 Recovery Strategy and to provide further guidance to the Province during the development of SOMP2. Being based on the best available science at the time, it was meant to encourage and facilitate compliance with SARA requirements in identification of Critical Habitat for spotted owl.

The document titled “Guidance and Some Components of Action Planning for the Northern spotted owl in British Columbia” (Chutter et al. 2007) is more concisely referred to by WC (and herein) as the “Action Plan Guidance” document. This document was prepared by CSORT to identify actions, considered reasonable in 2007, recommended to protect and recover spotted owls in Canada. The 2007 document was intended as a companion document to the previously submitted CSORT spotted owl recovery strategy²⁰ (Chutter et al. 2004) as the 2004 Recovery Strategy was not considered compliant with SARA requirements in identification of Critical Habitat for spotted owl. The 2007 Action Plan Guidance document was presented with the caveat that it “*did not necessarily represent the individual perspectives of the people involved in its formulation, nor the official positions of the organizations represented by CSORT members; rather it represented consensus of the team member’s views on what is required to recover the Spotted Owl in British Columbia*” (Chutter et al. 2007). The information and recommendations identified in the Action Plan Guidance document were based on the best available science at the time of submission to the Province in 2007.

The two combined documents (i.e., the 2004 Recovery Strategy and the 2007 Action Plan Guidance document) were proposed to constitute a single recovery plan for submission to Environment Canada to meet the Province’s requirements under the federal *Species at Risk Act* (SARA). The 2007 Action Plan Guidance document consistently referenced the results of the spotted owl habitat model I developed and provided “*recommendations for actions that should be implemented to reach the recovery goals and objectives set out in the recovery strategy; and provide(d) advice on considerations for Critical Habitat (designation)*” (Chutter et al. 2007). It was hoped that the Ministry of Environment would use the document as guidance in their recovery planning efforts (while developing SOMP2) and that the Province would consider the recommendations and advice provided by the document during their independent development of SOMP2.

After its submission to the Province, by CSORT, the Province assigned responsibility for spotted owl management in BC to the Species at Risk Coordination Office (SARCO). The SARCO then developed its own independent action plan for federal submission with the CSORT recovery strategy. This SARCO developed action plan was subsequently accepted by the Provincial Government and submitted with the CSORT recovery strategy to comply with SARA requirements. It is now referred to as SOMP2 and sets governance for spotted owl recovery in Canada.

²⁰ The 2004 CSORT Recovery Strategy provided a summary of scientific knowledge, current to April 2004, and represented advice to the Province to set recovery goals, including recommended approaches and objectives to protect and recover spotted owls in BC.

21. The CSORT states in the Action Plan Guidance that it was drafted to “identify reasonable actions required to protect and recover the Northern Spotted Owl in Canada” (at page v). How does BC’s current approach to protecting and recovering the Spotted Owl exceed, meet, or fall short of these actions?

Synopsis: The CSORT Action Plan Guidance requested and recommended habitat protection that was not met by the Province under the habitat conservation and management measures afforded by SOMP2, including recommendations to identify CH. SOMP2 instead placed far greater emphasis on captive breeding and barred owl control, whose success and shortcomings have been discussed. Overall, based on the lack of protection of suitable habitat and outcomes of additional management efforts, the Province’s current approach under SOMP2 falls short of the Province’s explicitly stated goal to protect and recover spotted owls in Canada.

When SOMP2 was released and endorsed by the Province SARCO claimed it was consistent with guidance provided in the CSORT Recovery Strategy (2004); however, in consideration of the differences in protection afforded to spotted owl habitat (versus recommendations outlined in the Action Plan Guidance document (2007)) SOMP2 did not afford an equivalent degree of protection relative to the CSORT Action Plan Guidance document. Most notably, SOMP2 did not afford protection to all available spotted owl habitat in BC, nor to all recently active spotted owl territories (as requested in Appendix 1 (interim measures)). Furthermore, SOMP2 did not allow any additional protection (relative to the impact already allowed under SOMP1) to spotted owl habitat with the species range. Under SOMP2 there were no adjustments made to AAC targets, for spotted owl, within the three NRD’s in which spotted owl was known to have occurred and no protection for spotted owl habitat in the Sunshine Coast NRD. This effectively meant that, relative to SOMP1, there would be no additional protection of existing habitat under SOMP2. Under SOMP2, management efforts were instead focused more heavily on population augmentation, supported by optimistic speculation of successes for captive breeding efforts (1) and barred owl control (2). These programs are summarized as follows:

- 1) After more than ten years in operation the captive breeding program has only bred eight spotted owls (one of which is not viable for release), which falls short of early projections for the program (predicated release of 200 owls in ten years). It is notable that the same program has removed at least ten owls from the BC wild population to augment the breeding ‘stock’ of 21 owls in captivity today. At least one, if not two, spotted owls have died during, or shortly after, capture. A spotted owl was diagnosed to have died from blunt-force trauma (in 2006) after capture was completed using noosing techniques (J. Gillis pers com 2006 and Dr. H. Schwantje (Provincial veterinarian)). There are rumors that a second owl was also lost during or shortly after capture, but this information is not publicly available. The current captive breeding stock includes three owls from the U.S., eight individuals successfully brought in from the wild, one owl hit by a car, and eight young produced by the program (I. Blackburn pers. com.).
- 2) The barred owl control program has effectively removed 189 barred owls (138 were captured and relocated; 51 were shot (Cox 2018)) with some noted benefit to resident spotted owls at removal sites (Gillis 2016a). The sustainability of these efforts is questionable in the context of effort, moral values, and counter-effects from natural recruitment rates of barred owls within the range of spotted owl in BC. Based on productivity and sympatric population estimates,

anticipated recruitment rates for barred owl are approximated at 5,400 new barred owls fledged within the spotted owl's range of in BC annually.

Together, and coupled with the fact that CH has still not been formally or appropriately identified under SOMP2 (as recommended on Page v of the 2007 Action Plan Guidance document) these statistics demonstrate that the Province's current approach under SOMP2 falls short of the Province's explicitly stated goal, and of obligations, as stated as a requirement under the federal *SARA*, to protect and recover spotted owls in BC.



*"For the animal shall not be measured
by man.
In a world older and more complete
than ours, they move finished and
complete,
gifted with extensions of the senses we
have lost or never attained,
living by voices we shall never hear."*

Henry Beston
Author (1888-1968)
"The Outermost House"

**The spotted owl conveys a message,
through its own decline, regarding the
management of old-growth forest
resources in BC. Will we be wise enough to
listen?**

Jared Hobbs M. Sc., R.P. Bio. (#1324)
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Date: February 24, 2019

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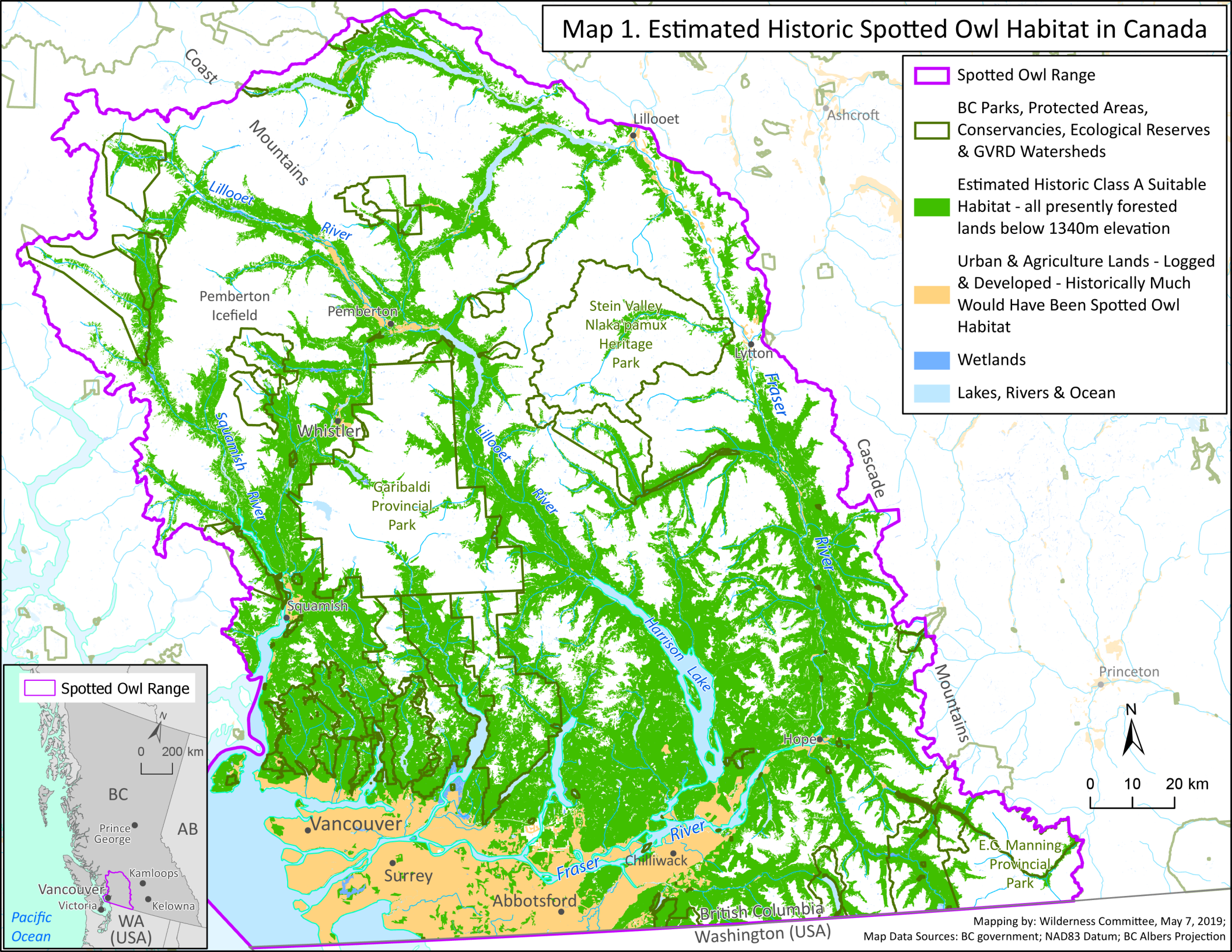
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Appendix 1: Image Catalogue

Image Description	Page/Figure Number	Location	Date
Spotted Owl (male)	Cover Page	Boulder Creek	June, 2004
Northern Spotted Owl	P.8	East Anderson Creek	June 10, 2010
California Spotted Owl	P.8	Oregon Caves NM	April, 2002
Mexican Spotted Owl	P.8	Scheelite Creek, Arizona	May 29, 2006
Stein Provincial Park	P. 12 / Figure 3	Scudamore Creek, BC	May 28, 2007
Upper Pitt	P. 12 / Figure 4	Upper Pitt River, BC	June 2002
Barred Owl	P. 14 / Figure 5	Logan Park, Victoria, BC	March 28, 2006
Spotted Owl (dead)	P. 14 / Figure 6	Stein Valley, BC	March 2004
Spotted owl adult and nestling in cavity nest	P. 17	Boulder Creek, BC	June, 2003
Spotted owl adult and nestlings in platform nest	P. 17	Boulder Creek, BC	June, 2002
Sockeye Creek nest	P 18	Sockeye Creek, BC	May, 2006
Logging truck	P. 20	Harrison, BC	June, 2004
Clear-cut near Texas Creek	P. 20	Texas Creek, near Lillooet, BC	September 14, 2011
Clear-cut near Anderson Creek	P. 34	Anderson Creek, near Boston Bar, BC	2001
Sub-adult Spotted Owl	P. 38	Anderson Lake, BC	January 2005
Anderson clear-cut	P. 39	East Anderson SRMZ	2000
Barred Owl (adult)	P. 42	Logan Park, Victoria, BC	March 27, 2006
Great Horned Owl	P. 42	Oak Bay, Victoria, BC	August 28, 2015
Billygoat Creek	P. 44	Baptiste, BC	September 18, 2009
Spotted Owl in flight	P. 46	Mowhokum Creek	June 10, 2010
Bushy-tailed Woodrat	P. 46	Lillooet, BC	August 21, 2014
Enterprise Creek	P. 55	Cayoosh Creek, BC	May 3, 2006
Mexican Spotted Owl	P. 68	Scheelite Creek, BC	May 29, 2006

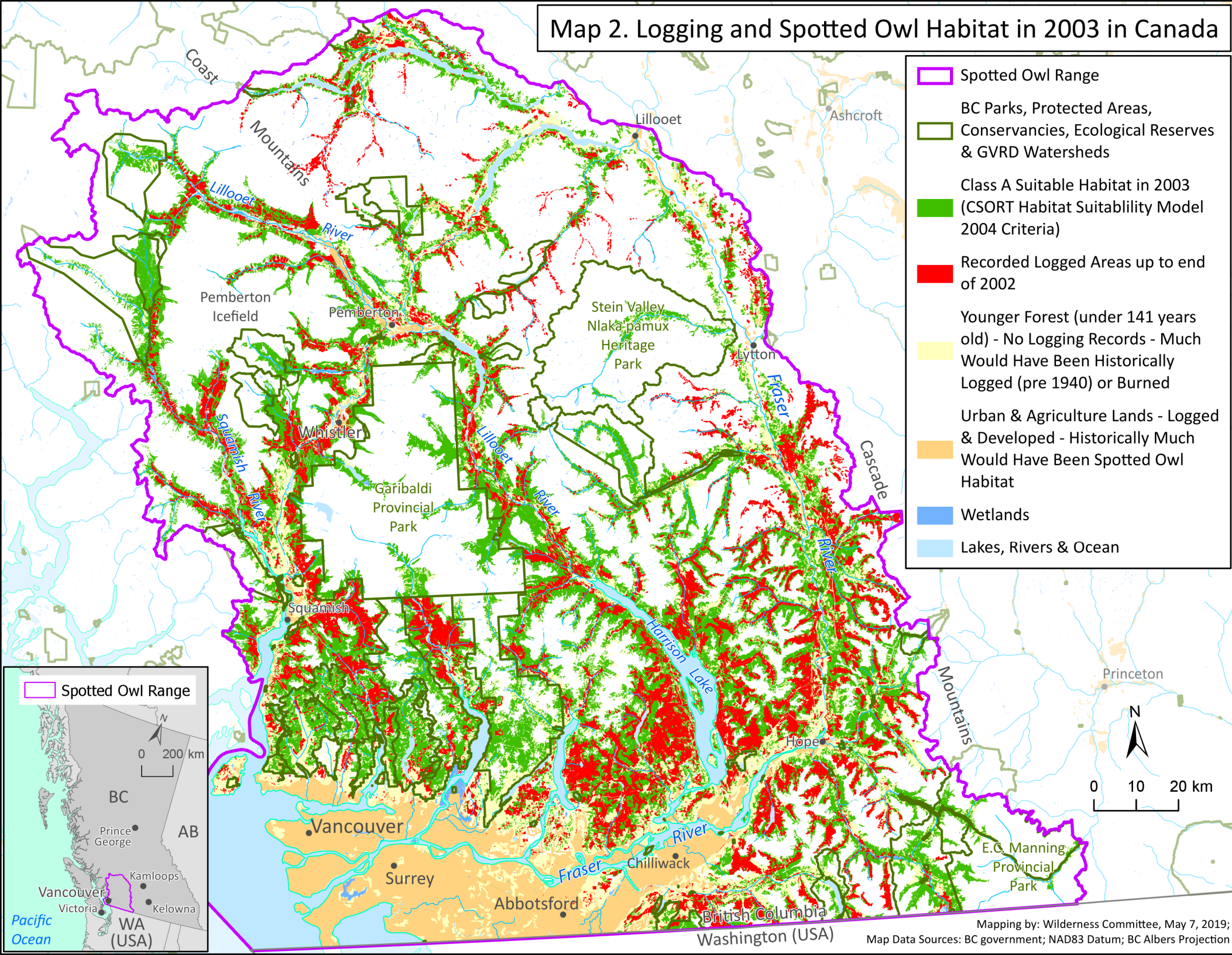
TAB 4(a)

Map 1. Estimated Historic Spotted Owl Habitat in Canada



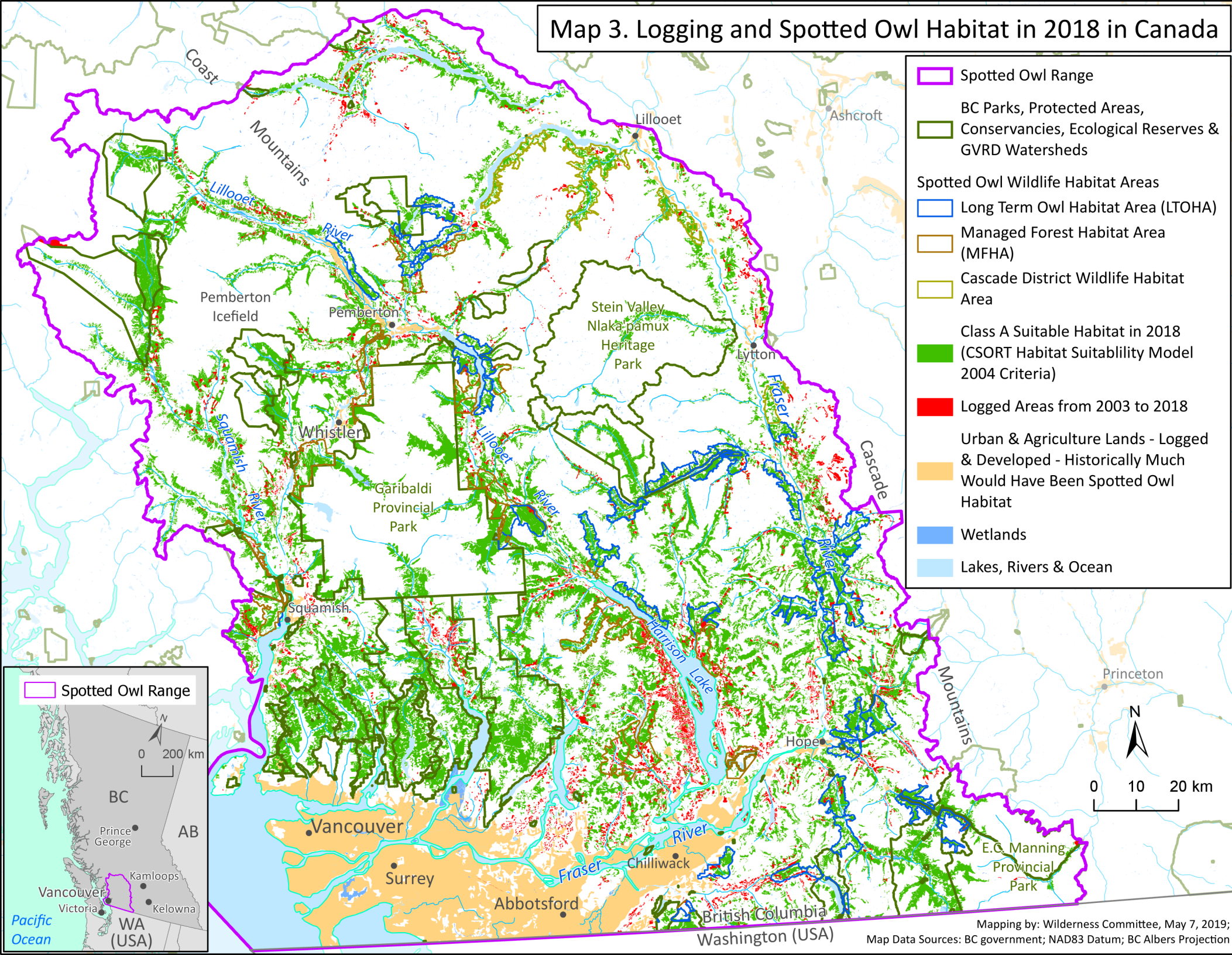
TAB 4(b)

Map 2. Logging and Spotted Owl Habitat in 2003 in Canada



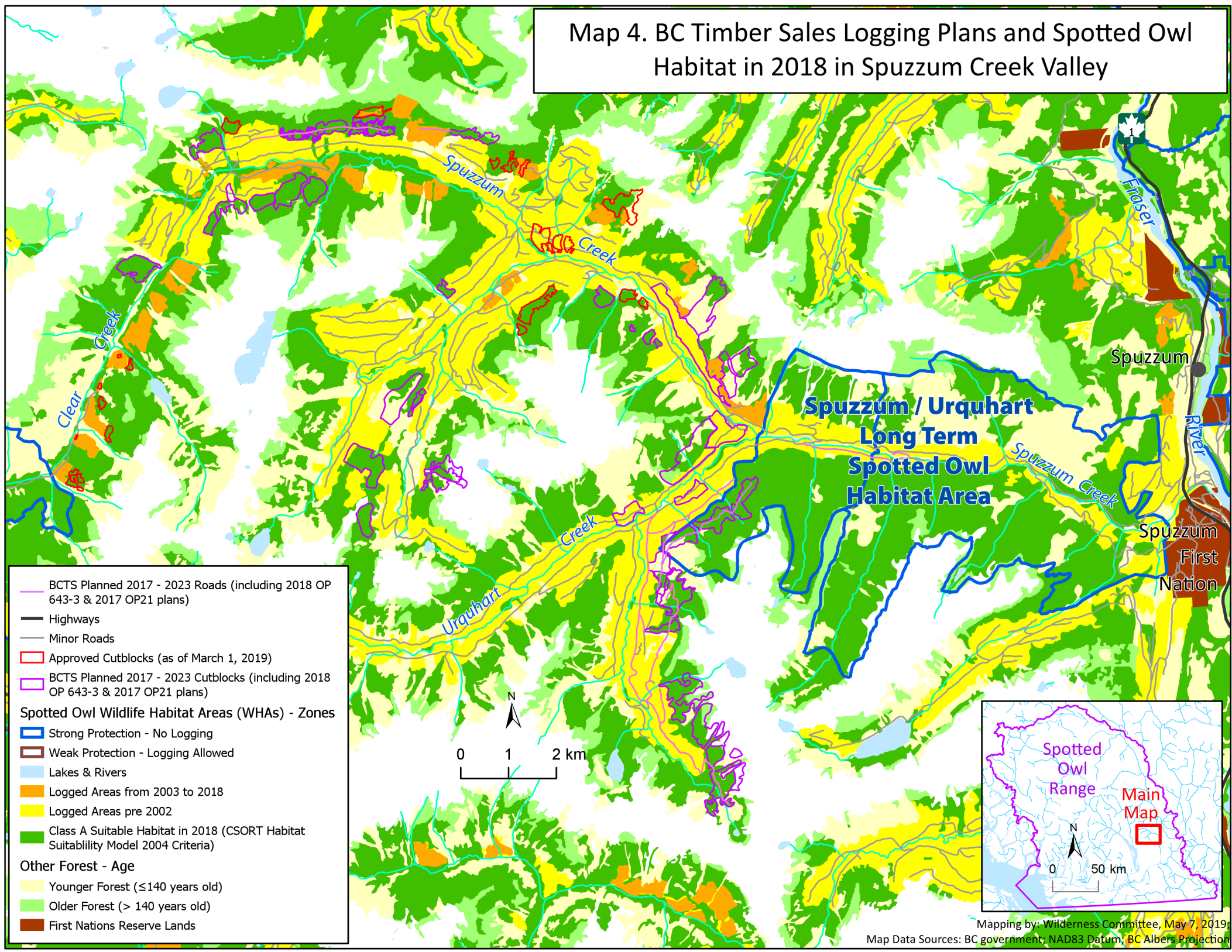
TAB 4(c)

Map 3. Logging and Spotted Owl Habitat in 2018 in Canada



TAB 4(d)

Map 4. BC Timber Sales Logging Plans and Spotted Owl Habitat in 2018 in Spuzzum Creek Valley



TAB 5



Jared Hobbs, M.Sc., R.P.Bio.

Director: Senior Wildlife Biologist / Technical Expert

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PROFFESIONAL PROFILE

I'm a registered professional biologist (RPBio#1324) with 25 years of applied experience designing and leading species assessment and conservation projects at both the local and provincial scale. My diverse experience enables me to efficiently recognize and communicate wildlife and habitat values, across multiple industry sectors, during all phases of project design and implementation. Throughout my career I've worked collaboratively with various stakeholders to achieve efficient, effective science-based solutions whilst maintaining transparency in reporting. As the director of J Hobbs Ecological Consulting I strive to ensure a strong focus on conservation and research by integrating these values and principles into Project results.

I have extensive experience in both interior and coastal ecosystems in BC, Yukon and Alaska, and am able to associate species-specific ecological requirements with habitat values for a diverse array of species. For over two decades I have focused on species at risk in British Columbia and maintained a leadership role, at a provincial level, in the design, implementation and reporting phase of numerous projects. Since 2014 I have also played a lead role, working with Dr. C. Helbing (Univ. of Victoria), in development and implementation of eDNA (Environmental DNA) methods in Canada. My efforts, on many projects in a diversity of ecologies, have informed and guided conservation assessments and species-specific management throughout BC for over two decades

RELEVANT EXPERIENCE

2018 (ongoing) J Hobbs Ecological Consulting, Director - Senior Biologist / Technical Expert

I operate an incorporated small business providing support, under contract, to many clients including Provincial and Municipal Government agencies, the Canadian Standards Association, Non-government organizations (NCC, Ecojustice, Wilderness Committee) and Conservation-oriented funding programs (FWCP, HCTF, AFSAR). My primary interest is to support application science and research to inform conservation and management of species-at-risk values in BC, Alberta, Yukon and Alaska.

2018 (ongoing) Natural Resources Training Group (NRTG), Instructor – eDNA Methods

Under request from Darren Hebert (Principal and founder: NRTG) I developed a course curriculum to convey instruction on field implementation of eDNA methods. I regularly provide focused two-day courses to support qualified professionals to implement eDNA methods. This two-day course has been well received across BC, Yukon and Alberta.

2013-2018 Hemmera Envirochem Ltd., Senior Technical Expert

At Hemmera, I functioned within the Ecology Planning and Management group as a senior technical expert / senior biologist as an identified leader in Hemmera's biological services. I regularly provided technical advice during project design and implementation, working directly with clients and a team of biologists.

2013-1997

BC Provincial Government, Senior Biologist / IWMS Program Lead

Served as the program lead for this core government initiative. Responsible for setting program priorities across all regions of the province and ensuring regional activities were aligned with program priorities. Also responsible for the design of numerous multi-year field programs and for policy development and communication related to program delivery. Directly led and/or assisted in the legal designation of over 1,785 Wildlife Habitat Areas in BC.

EDUCATION

- **2007 Masters of Science (Environmental Management):** Simon Fraser University / Royal Roads University
- **2004 Bachelor of Science (Ecology):** University of British Columbia

PUBLICATIONS

- Nagorsen, D., Lausen, C., Brigham, M., and Hobbs, J. 2019. Field Guide to Bats of BC. Manuscript in prep.
- Hobbs, J., C.C. Helbing, C. Goldberg, I. Adams. 20018. Ecology and Distribution of Rocky Mountain tailed frog using eDNA methods in Eastern BC. PlosOne. Manuscript in Prep.
- Hobbs, J., J. M. Round, C.C. Helbing. 2018. Expansion of the known distribution of the coastal tailed frog, *Ascaphus truei*, in British Columbia, Canada using robust eDNA detection methods. PlosOne. Manuscript in Prep.
- Veldhoen, N., Hobbs, J., Ikononou, G., Hii, M., Lesperance, M., and Helbing, C.C. 2016. Implementation of novel design features for qPCR-based eDNA assessment.
- Hobbs, J. and C. Goldberg. 2016. Standard Operating Procedure. Environmental DNA Protocol for Freshwater Aquatic Ecosystems. V2.0. Prepared for B.C. Ministry of Environment. 1-25.
- Livezey, K.B, M.F. Elderkin, P. A Cott, J. Hobbs and J. P. Hudson. 2008. Barred owls eating worms and slugs: the advantage in not being picky eaters. *Northwestern Naturalist*. 89: 185-190.
- Smith, J., G.D. Sutherland, D.T. O'Brien, F.L. Waterhouse, J.B. Buchanan; J. Hobbs and A.S. Harestad. 2008. Relationships between Elevation and Slope at Barred Owl Sites in Southwestern British Columbia. Research Section, Coast Forest Region, BC Ministry of Forests and Range. Nanaimo, BC. Technical Report TR-040.
- Hobbs, J., 2007, "Thermal Ecology of the Northern Pacific Rattlesnake." Masters of Science Thesis: Simon Fraser and Royal Roads University
- Hobbs, J. & Cannings, 2007, "The Spotted Owl – Shadows in an Old Growth Forest" (Book), Douglas and McIntyre. ISBN: ISBN 978-1-55365241-0. I
- Hobbs, J., 2007, "Thermal Ecology of the Northern Pacific Rattlesnake." Masters of Science Thesis: Simon Fraser and Royal Roads University

ADDITIONAL TRAINING

- First Aid Level One, St. John Ambulance - Current
- Wilderness First Aid and Survival Training, Slipstream Adventures
- WHMIS – Current
- Bear Aware – Current
- Motorcycle Operation & Safety – Current
- ATV and Snowmobile Operation & Safety - Current

ACTIVITIES / OTHER INTERESTS

2019 (ongoing) Aurora Expeditions, Wilderness Guide (Photography and Biology)

Recently retained, under contract, as a guide to provide photography instruction and act as an on-board naturalist for multiple destinations (annually) in both Arctic and Antarctic polar regions.

1998 (ongoing) Hobbs Photos Images, Director - Photographer

This sole proprietorship involves capture and marketing stock images of wildlife for publication. Previously retained by several magazines, including Canadian Geographic and British Columbia Magazine, for several assignments. My images are widely published in calendars, books, magazines, brochures and websites.