# Identifying Critical Habitat: Methods, Issues, and Solutions

October 18–19, 2005
Cranbrook, British Columbia
Canada

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# Acknowledgements

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- B.C. Ministry of Agriculture and Lands
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- Cortex Consulting
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- Fisheries and Oceans Canada
- Pandion Ecological Research
- Parks Canada
- Tantalus Ecological
- University of British Columbia.

Special thanks to our **volunteer assistants,** who took notes at the workshop, and helped with the many details that kept the event running smoothly on October 18 and 19. Their records of the questions and responses after each speaker added greatly to the quality of this document.

- Jennifer Karmona, Resource Management and Environmental Studies, University of British Columbia
- Angela Cunningham, Parks Canada, Calgary

Our **presenters** travelled from Ottawa, Edmonton, Banff, Kelowna, Vancouver, Victoria, and the Kootenays to share their expertise with us. We are grateful for their participation and for the support of their host agencies; many of them covered the time it took to prepare and present the talks and the costs for travelling to Cranbrook. We acknowledge the contributions of Kari Stuart-Smith, Rob Neil, Jim Beare, and Alan Dibb, who were resource people for the field trip on October 20.

The **Chair of the conference organizing committee** was Dave Poll, Species at Risk Specialist with Parks Canada in Calgary. Other members of the organizing committee were: Liz Williams (B.C. Ministry of Agriculture and Lands, Integrated Land Management Bureau), Kari Nelson (B.C. Ministry of Environment, Terrestrial Ecosystem Science Section), and Susan Hall (Parks Canada in Mount Revelstoke and Glacier National Parks). Chris Steeger of Pandion Ecological Research was on the organizing committee and was also our **Master of Ceremonies.** Our **Field trip coordinator** was Ian Adams of Corvus Communications.

And, of course, we'd like to thank the **workshop participants**, who travelled from various towns in British Columbia, Alberta, and the Northwest Territories to attend the conference.

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# Workshop Description

Identifying critical habitat for species at risk is one of the essential action items for recovery and action planning. While the importance of critical habitat for species recovery is well recognized among recovery planners, confusion and controversy remain regarding ecologically and legally defensible approaches to identifying critical habitat. This conference clarified policy surrounding critical habitat identification, and, through presentations from people working on identifying critical habitat, explored the issues, challenges, methods, and solutions related to critical habitat identification.

On October 18 and 19, presentations were held at the Prestige Inn in Cranbrook, B.C. On October 20, a field trip group went north of Cranbrook as far as Radium Hot Springs to look at habitat work in the Rocky Mountain Trench. Also on October 20, as an adjunct session to the main conference, FORREX offered a one-day event entitled "ABCs of Planning a Communication Strategy that Works!"

The workshop was attended by 125 people. Participants were: biologists, resource managers, government staff, academics, representatives of environmental non-government organizations, and others with an interest in critical habitat definition.

## Workshop Agenda

| | |
|---|---|
| 9:00 a.m. | **Welcome** by Chris Steeger, Master of Ceremonies and Director of the Columbia Mountains Institute |
| 9:10 a.m. | **Models for the Identification of Critical Habitat**: Peter Arcese and Janelle Curtis, UBC Centre for Applied Conservation Research |
| 9:45 a.m. | **Identifying Critical Habitat Under the *Species at Risk Act*: A Policy Overview**: Kent Prior, Parks Canada |
| 10:15 a.m. | *Coffee break* |
| 10:35 a.m. | **Tools for Addressing Critical Habitat Protection in British Columbia:** Jeff Hoyt, B.C. Ministry of Environment |
| 11:00 a.m. | **Resolving Critical Habitat Designation Failures under *ESA*: Reconciling Law, Policy, and Biology:** Karen Hodges, UBC Okanagan |
| 12:00 p.m. | *Lunch, provided* |
| 1:00 p.m. | **Building and Using a Model Framework to Inform Decisions on Critical Habitat in the Case of the Northern Spotted Owl:** Louise Waterhouse, B.C. Ministry of Forests and Range; Glenn Sutherland and Dan O'Brien, Cortex Consultants |
| 2:15 p.m. | **Critical Habitat for Plants: Contrasting the Examples of Lyall's Mariposa Lily in Okanagan Grasslands and Vernal Pool Habitats within Garry Oak Ecosystems:** Michael Miller, Consultant |
| 3:00 p.m. | *Coffee break* |
| 3:20 p.m. | **A Habitat Model for the Coastal Giant Salamander in British Columbia:** Jeff Lemieux, Tantalus Ecological |
| 4:00 p.m. | **A Functional Approach to Managing Mountain Caribou Habitat:** Steven Wilson, EcoLogic Research, and Dennis Hamilton, Nanuq Consulting |
| 5:00 p.m. | *End of Day One* |

9:00 a.m. **Welcome back,** by Chris Steeger

9:05 a.m. **Critical Habitats in a Settled Landscape: A Case Study of Two Freshwater Fishes in the Lower Fraser Valley:** Mike Pearson, Pearson Ecological

9:50 a.m. **The Challenges of Identifying Critical Habitat for a Large River Fish Species, the White Sturgeon:** Dan Sneep, Fisheries and Oceans Canada

10:35 a.m. *Coffee break*

10:50 a.m. **Modelling Habitat Use by Wood Bison at Multiple Spatial Scales: Tools and Techniques to Define Critical Habitat:** Olaf Jensen, Canadian Wildlife Service

11:40 a.m. Description of tomorrow's activities:

- **Field Trip:** Ian Adams
- **ABCs of Planning a Communications Strategy that Works:** Karyn Sutherland, FORREX
- **Upcoming CMI Events**: Jackie Morris, CMI Executive Director

12:00 p.m. *Lunch, provided*

1:00 p.m. **Letting Snails Show Us the Way: Delineating Critical Habitat for the Endangered Banff Springs Snail:** Dwayne Lepitzki, Wildlife Systems Research

✱ 1:40 p.m. **Delineating Critical Habitat for the Western Yellow-Breasted Chat and the Whooping Crane Under the New *Species at Risk Act* in Canada:** Kathryn Lindsay, Environment Canada

2:35 p.m. *Coffee break*

3:00 p.m. **Unencumbered by Data: Combining Science and Stewardship to Address Information Gaps:** Kari Nelson, B.C. Ministry of Environment, and Ian Adams, Corvus Communications

3:45 p.m. **Observations from the Conference, and the State of Identification of Critical Habitat:** Peter Arcese, Janelle Curtis

4:00 p.m. **Panel Discussion:** Questions from the audience addressed to speakers

4:45 p.m. **Closing Remarks:** Chris Steeger

✱ Unfortunately Dr. Lindsay was not able to attend the conference.

# Presentation Summaries

## About the Presentation Summaries

Conference presenters provided the following summaries. Notes on the question-and-answer periods after the talks were taken by Jennifer Karmola and Angela Cunningham. Contact information is provided for all presenters, along with an invitation to contact the presenters directly for more details about their work.

## *1. Models for the Identification of Critical Habitat*

Peter Arcese, Centre for Applied Conservation Research, University of British Columbia
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Janelle Curtis, Centre for Applied Conservation Research, University of British Columbia
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We reviewed conceptual models related to identifying "critical habitat," including the habitat concept, the problems related to the small size or spatial structure of populations, and the species differences. Critical habitat identification in the context of the Canadian *Species at Risk Act (SARA)* has few examples in practice, a range of possible approaches, and uncertain social and economic impacts. In addition to uncertainty around the biology of particular species, several challenges suggest that adaptive management and monitoring offer a useful framework for developing and refining recovery plans.

"Habitat" defined broadly, provides a species' life requirements. These include food, water or other physiological requirements, shelter, including nest or den sites (i.e., residences), anti-predator and thermal refuges, and space for reproduction, offspring development, dispersal, and migration. For many species, habitat quality, measured as the availability and abundance of resources or potential for population growth, will vary in space and time. For all species, variation in habitat quality in time and space will lead to variation in population size and, most probably, source and sink or metapopulation dynamics at the scale of the species range. Thus, the arrangement of habitat in space and variation in habitat quality through time will often be key concerns when identifying what parts of a species' current or historic range are critical to its future persistence and recovery.

Habitat loss and modification are leading causes of population decline in many rare and endangered species. As a consequence, most species at risk occupy a fraction of their historic range, often in degraded and/or isolated patches of habitat. Population isolation tends to further reduce the number and size of extant populations by reducing gene flow, the colonization rates of extinct patches and, at least occasionally, the survival and reproduction via inbreeding within patches. The persistence of very small populations will also be affected by random variation in demographic rates and the environment, and by accidents related to human influence. Therefore,

overall, critical habitat plans will often have to accommodate some minimum number of viable populations needed to ensure persistence at the landscape scale.

Much empirical evidence also suggests that where suitable habitat is severely degraded or novel enemies or competitors are introduced and abundant, reproduction may be insufficient to maintain population growth. In the worst cases, these "ecological traps" or "population sinks" can limit the overall rate of population growth by luring otherwise able breeders into situations in which they cannot contribute positively to population growth. Where the potential area of critical habitat has been severely reduced, managers will need to ameliorate key threats in sink habitats so that even the most degraded patches regain their potential to support population growth. In contrast, where the portfolio of potential habitat is relatively unconstrained, managers might be more efficient in creating reliable networks of critical habitat by considering designs that exclude the most severely degraded habitats, particularly where the chances of ameliorating threats is low.

The influence of each effect above on the most beneficial configuration of habitat is likely to vary with species life history. Habitat specialists, for example, may sometimes require more or less contiguous habitat arrangements to minimize isolation effects and promote dispersal. Habitat generalists may sometimes tolerate habitat fragmentation better, provided that core habitats produce a population surplus on average and barriers to dispersal are small or absent. Similarly, species vagility will be influenced if various physical barriers impede dispersal or not. Overall, managers are likely to enhance population persistence by reducing threats, restoring habitat, and maintaining multiple populations and dispersal paths (thus allowing for the potential re-colonization of extinct patches).

Identifying landscape-level variation in habitat quality represents a first step in designing potential networks of critical habitat. Doing so requires identifying the distribution of limiting resources and mapping threats and barriers to dispersal. Many spatial modelling frameworks support these exercises and the application of these models, when sufficient data are available, often reveals opportunities for enhancing population growth and viability while minimizing impacts on competing land uses.

Under *SARA*, the recommended steps for identifying networks of critical habitat generally follow the points above. First, teams synthesize all available information and identify biologically appropriate recovery targets. Ideally, these targets will be based on qualitative or quantitative estimates of likelihood of species persistence based on the number of individuals and populations extant, the rate of occupancy of habitat, or other criteria related to patterns in the distribution of individuals or key limiting resources. Next, managers define habitat-abundance relationships based on estimated rates of occupation, survival, and/or reproduction, as the best available data allow. Lastly, managers estimate the amount and configuration of habitat necessary to support the recovery targets using habitat-abundance relationships and some formal consideration of the influence of spatial and temporal arrangements of habitat.

The form and complexity of the analytical framework used to identify critical habitat will necessarily depend on the nature, quality, and quantity of the available data. Information about

the presence of a species at risk can be used to identify occupied habitat patches for protection. Knowledge of which habitat features are correlated with the presence or absence of a species at risk can help recovery teams predict where the species might currently or potentially persist. Relationships between habitat variables and population abundance are often useful for ranking habitat patches in terms of quality, for prioritizing patches for protection, and for setting targets for habitat restoration. Linking demographic data to habitat data in spatial models, for example by using a population and habitat viability analysis (PHVA) framework, may be especially helpful as recovery teams make key decisions about the size and configuration of habitat patches likely to promote species survival and recovery.

Even in the absence of detailed demographic and habitat data, however, there are considerable benefits to be gained by synthesizing all available information into a spatial framework. These benefits include conveying transparency in the decision-making process, documenting assumptions of recovery teams, highlighting data gaps and uncertainties, and facilitating the revision of plans as knowledge about species life history, demography, and distribution improves. Many flexible, internally validated, and user-friendly platforms exist to facilitate the construction of simple to highly complex single and meta-population models (e.g., VORTEX, RAMAS, PATCH). Even simple models based on a qualitative assessment of population and habitat dynamics can provide transparent and effective planning tools for workshops that include diverse stakeholders, and where social and economic factors are being considered.

It is also critical, however, that planners understand and accept that even the best parameterized models and plans are complexes of hypotheses about nature, and that are each of these hypotheses is likely to be false in some instance, under some conditions, or for some species. It is therefore essential that managers accommodate uncertainty in models and habitat plans by considering how the models might fail if one or more key assumptions are proved false in the future. Overall, the most reliable plans will be those that adjust "optimal" designs to anticipate these potential failures and then monitor with sufficient precision that failures are identified and designs or management policies revised.

It is inevitable that some managers will find themselves planning for several species within the same landscape. The Garry Oak Ecosystem and Freshwater Fishes Recovery Team are already facing this task. Given the need to accommodate social and economic costs in the designation of critical habitat, multi-species land-use planning models will also help find synergies in recovery planning, and will facilitate the coordination of recovery teams working in overlapping regions.

***Discussion after Presentation***

**Q:** If random variation in vital rates causes lower confidence intervals for survival as time increases, how confident can we really be about our predictions for e.g., wolf populations, in the future?

**A**: The predictions provide us with a best- and worst-case scenario. That way we can place uncertainty bounds on our outcomes; they provide us with a check on how certain we can be.

## 2. *Identifying Critical Habitat Under the* Species at Risk Act: *A Policy Overview*

Kent Prior, Species at Risk Program, Parks Canada, Gatineau, QC
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The *Species at Risk Act (SARA)* requires the identification of critical habitat, to the extent possible, for Schedule 1 extirpated, endangered, and threatened species—a brand new obligation for species at risk practitioners in Canada. My remarks in this presentation were intended to summarize current federal policy and technical guidance with respect to critical habitat, with the aim of promoting: i) common administrative and procedural standards; ii) a consistent methodological framework; and iii) the preparation of biologically and legally defensible critical habitat proposals.

*SARA* defines critical habitat as the habitat "necessary for the survival or recovery of a listed species" (section 2.1of Act). On the whole, this is interpreted to be the suite of habitat conditions (e.g., type, amount, spatial arrangement) believed to be necessary and sufficient to achieve conservation (i.e., viability or persistence at some level) of the species (See Figure 1).

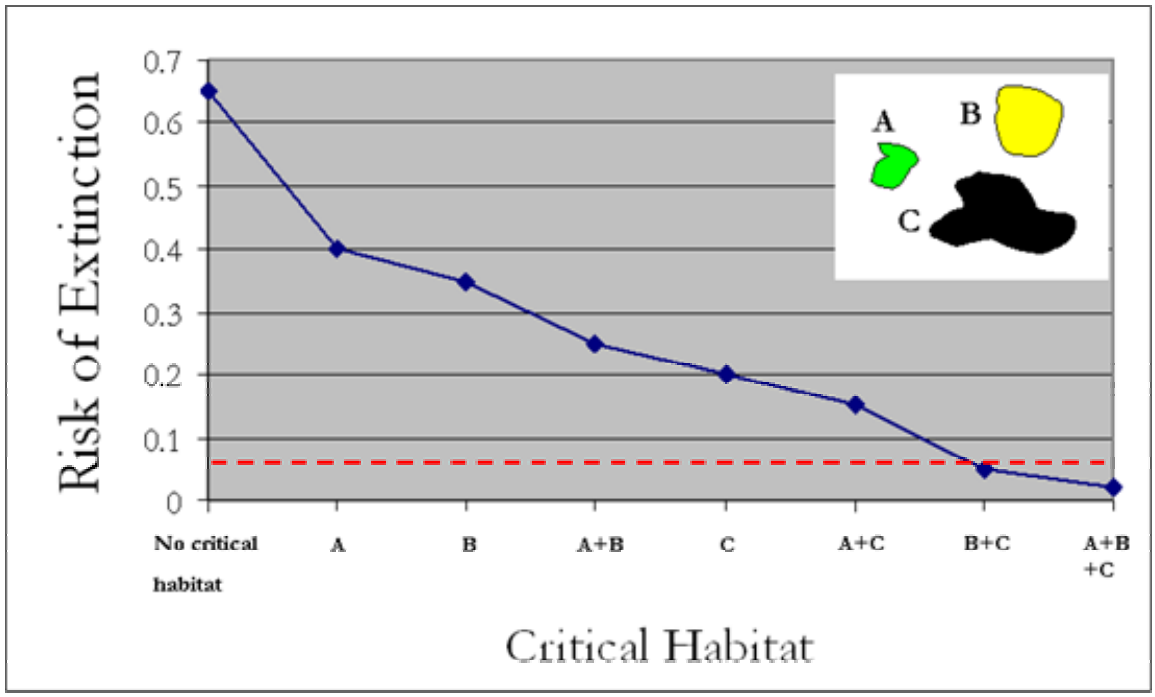
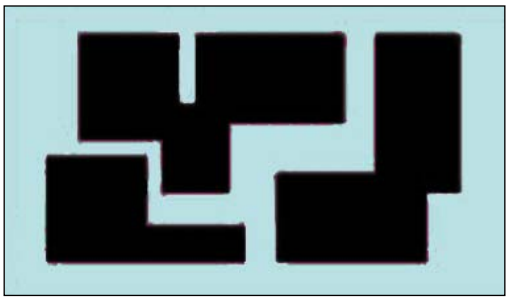



**Figure 1:** Critical habitat required to support species survival or recovery—as the amount of identified critical habitat increases, so declines the risk of extinction. The horizontal red line represents an "extinction threshold," below which the species cannot recover. Adapted from Akcakaya *et al.* 1999.

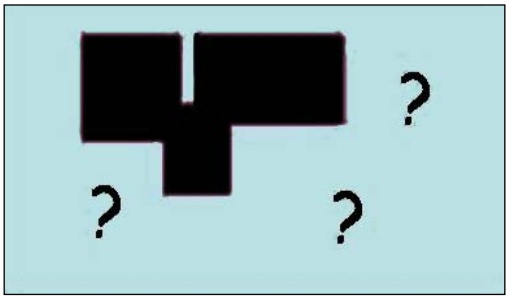
At a minimum, the concept of critical habitat applies to a population of the species.[1] As such, critical habitat should support predetermined population and distribution objectives. If it falls short of this, then any proposal for critical habitat should be considered a partial solution to the question, how much is enough?

Fortunately, *SARA* allows for partial solutions based on the requirement that critical habitat be identified *to the extent possible*—the assumption being that the specification (and protection) of any critical habitat will be of conservation interest to the species. Thus, three general solutions to the problem of critical habitat identification are acceptable:

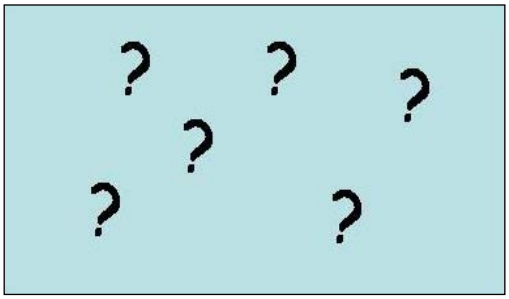
*a)* Comprehensive identification includes all the critical habitat (black polygons) that is believed necessary and sufficient to meet the recovery goal.



*b)* *Partial identification* represents an incomplete identification of critical habitat (black polygons) due to a lack of certain information (question marks). Other parcels of critical habitat will be located pending the availability of additional information. Knowledge gaps are outlined in a schedule of studies, completion of which should allow identification of additional critical habitat parcels.




*c)* *Justified deferral* supports the postponement of critical habitat identification due to a lack of information (question marks). Knowledge gaps are outlined in a schedule of studies, completion of which should allow identification of critical habitat.




[1]As an aside, critical habitat contrasts another habitat concept in *SARA*—that of the species *residence*. The idea of residence applies to individuals and *SARA* formally defines it as "a dwelling-place such as a den, nest or other similar area or place…" (section 2.1 of Act). In this respect, residences are distinct habitat features used by individuals for particular life history functions like incubation, hibernation, or feeding.

The critical habitat identification process may take many different forms depending on the species, the quality and extent of current knowledge, and jurisdictional context. For a few species, relationships between population persistence and habitat resources are relatively well understood and thus the critical habitat requirements for species survival or recovery can be estimated quantitatively and delineated "on the ground" with considerable certainty. For others, the relationship is far less clear, often amounting simply to documenting habitat associations during opportunistic encounters with the species. Under such conditions, it is less certain that recommendations for critical habitat will be sufficient for species survival or recovery. Nevertheless, recommendations for what constitutes critical habitat for a species should be based on the best available information. Ideally that means drawing on quantitative measurable data, but might also include experience-based information or qualitative descriptions. Further, to the extent possible, critical habitat should be identified in cooperation with appropriate authorities (e.g., governments, wildlife management boards, aboriginal organizations) and in consultation with landowners and others directly affected by the recovery strategy. Such "non-experts" can bring valuable insights to the process that may result in more effective recommendations for critical habitat than might otherwise be the case.

Recommendations for proposed critical habitat are expected to contain the following six basic elements:

1. *Description*—a text account of the critical habitat type, amount, and condition or state (e.g., seral stage).
2. *Range coordinates*—the geographic location in Canada (e.g., UTM zone, UTM easting, UTM northing, datum of coordinates or mapped area).
3. *Rationale*—justification for the type, amount, condition, etc., including methods and reference to sources of evidence.
4. *Determination of unprotected portions*—a description of sections that are not effectively protected by existing measures or mechanisms (e.g., regulations) at present, especially those believed to be in imminent jeopardy.
5. *Examples of activities likely to destroy critical habitat*—a short list of human actions that are expected to have a negative impact on critical habitat by changing some qualitative or quantitative aspect of the environment (e.g., percent cover, total area, micro-climate).
6. *Schedule of studies*—an outline of any anticipated research necessary to obtain information to identify critical habitat comprehensively.

***Key Web Sites:***

*Species at Risk Act* Public Registry
www.sararegistry.gc.ca/policies/default_e.cfm

Environment Canada—Species at Risk
www.speciesatrisk.gc.ca/default_e.cfm

***Discussion after Presentation***

**Q:** What is the extent to which critical habitat needs to be defined in recovery strategies as compared to action plans?

**A:** Technically, you can defer defining critical habitat until the action plan, so long as this is justified e.g., if the degree of uncertainty requires you to do more work down the road. Or you could do part of it in the recovery strategy and part in the action plan. There is a great deal of flexibility.

**Q:** Why should uncertainty in determining critical habitat mean that we should defer its definition as opposed to taking a precautionary approach and protecting what we think is important?

**A:** Precaution is mandated by *SARA*. However, whatever is defined needs to be thoroughly backed up because this may be fought out in court. If it's you defining your uncertain critical habitat against your "competitor" in court, you will fail.

**Q:** Is there space in the legislation to use more "carrots" instead of "sticks"? For example, if a piece of private land is identified as critical habitat we could give tax credits to landowners, or some other benefit in exchange for protection.

**A:** I don't think the federal government has been as proactive as it might have been in terms of calming fears over *SARA*, and critical habitat in particular. For example, it's important to realize that critical habitat will not necessarily represent "no-go zones"; in many instances existing land-use practices will be allowed to continue, perhaps in modified forms. In future, I think stewardship incentives will be used more creatively early on, which is one of the reasons why key stakeholders should be involved in the critical habitat identification process—so that their contributions to species recovery can be tabled before any lines are drawn on the map. Citizens and industry need to know that *SARA* is not "out to get them," its primary focus is species survival and recovery. While this is the goal of *SARA*, critical habitat solutions will often come about by balancing the equation; biological requirements held by species on the one side, and social and economic concerns held by human communities on the other.

## 3. *Tools for Addressing Critical Habitat Protection in British Columbia*

Jeff Hoyt, Ecosystem Planning Biologist, B.C. Ministry of Environment
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The purpose of the presentation was to provide a general overview of B.C.'s approach to addressing critical habitat, and specifically to discuss the legislative and policy tools available in the province for addressing critical habitat for species at risk.

Managing and conserving species at risk in British Columbia involves cooperation and partnerships with the federal government, several provincial agencies, local government, First Nations, industry, other stakeholders, and the general public. The efforts of these parties must be coordinated and carried out at provincial and local scales.

Legislative and policy tools available for addressing critical habitat in British Columbia:

- *Parks and Protected Areas Act*
- *Ecological Reserve Act*
- *Forest and Range Practices Act (FRPA)*
- *Land Act* and Land Use Planning
- *Wildlife Amendment Act*
- *Private Managed Forest Land Act*
- *Environmental Assessment Act*
- *Mines Act*
- Shared Stewardship

***Parks and Protected Areas Act***

B.C.'s parks and protected areas contain significant occurrences of species at risk. The Ministry of Environment has an obligation to protect these species. This is part of government's stewardship commitment and responsibility. These areas may contribute to the protection of critical habitat depending on other uses.

***Forest and Range Practices Act (FRPA)***

Whether talking about wildlife, fish, or biodiversity in *FRPA*, the focus is on managing and conserving habitat. There are a number of tools and provisions in *FRPA* that can be used to address critical habitat.

a) ***Category of Species at Risk***: May include vertebrates, invertebrates, plants and plant communities negatively affected by forest or range management on Crown land. Currently includes 39 elements (species, sub-species and populations) identified by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as Endangered, Threatened, or Special Concern. It is intended that the list will be updated annually. The

Category of Species at Risk under *FRPA* serves as the basis for the Identified Wildlife Management Strategy.

b) ***Identified Wildlife Management Strategy:*** The Identified Wildlife Management Strategy (IWMS) is the province's approach to managing habitat for species at risk affected by forest and range activities on Crown land under the *Forest and Range Practices Act (FRPA)*. Implementation of the IWMS is bound by government policy that limits impacts on provincial timber supply to 1% of the mature timber harvesting land base, applied at the level of each individual forest district. While the IWMS is one mechanism that can be used in species recovery planning and other conservation efforts, it is not intended to be the sole tool to address habitat requirements for wide-ranging, high-impact species. www.env.gov.bc.ca/wld/identified/index.html.

c) ***Wildlife Habitat Areas (WHAs) and General Wildlife Measures (GWMs)*:** WHAs are mapped areas that are necessary to meet the habitat requirements of a species included in the Category of Species at Risk. WHAs designate important habitats in which forest and range activities are managed to limit their impact on the species. Within WHAs forest and range activities are managed by GWMs. GWMs outline a practice requirement that a holder of an agreement under the *Forest Act* or *Range Act* must meet when carrying out activities on the land base. GWMs prescribe a level of management appropriate to the conservation status of the species at risk. Measures may partially limit or prohibit activities. The IWMS guides the establishment of WHAs and GWMs.

d) ***Ungulate Winter Ranges (UWRs)****:* UWRs are areas established for the winter survival of ungulate species. Ability to establish UWRs for species at risk, e.g., caribou. GWMS are applied within a UWR to direct management.

e) ***Notices provided under section 7 of the Forest Planning and Practices Regulation (FPPR) and section 9 of the Woodlot Planning and Practices Regulation (WLPPR)*:** In the absence of approved WHAs or UWRs, Notices require licensees to plan for habitat for species at risk and ungulate species. Notices provide indicators of the amount of area, distribution of area, and attributes of area required for the survival of species at risk. Notices require licensees to prepare results or strategies in their Forest Stewardship Plans and Woodlot License Plans consistent with the objective set by government for wildlife in the FPPR and WLPPR.

f) ***Other provisions*:** *FRPA* contains other provisions for riparian management, wildlife tree patches, and fisheries sensitive watersheds that may provide protection for critical habitat.

### *Land Use Planning*

a) ***Land and Resource Management Plans (LRMPs), Sustainable Resource Management Plans (SRMPs) and Land Use Plans****:* The Integrated Land Management Bureau, of the B.C. Ministry of Agriculture and Lands, leads both strategic and landscape level

planning. LRMPs and SRMPs are land use plans that may contribute to protecting a few key species. Plans often contain a mix of both legal objectives and non-legal management direction. Several of the recent strategic land use plans include recommendations for species at risk. Legally established land-use objectives, including objectives for species at risk, arising from these plans may be delivered through other legislation. For example, under *FRPA* and other regulations, land-use objectives trigger preparation of results and strategies in operational plans. Also available, are the tools e under *FRPA*, for example WHAs and UWRs, to capture the intent of plans and spatialize the objectives and management direction. There is a need, however, to show consistency with the Plan intent. There is an expectation to incorporate new species at risk information into review of established LRMPs.

b) ***Landscape level planning–Old Growth Management Areas (OGMAs)****:* Designed to maintain old seral and ecosystem representation across the landscape. Generally no harvest or road building can occur to maintain interior forest conditions. Habitat management for some species at risk can be addressed through establishing OGMAs. The conservation strategy to date for Marbled Murrelet is very reliant on the establishment of OGMAs.

***Wildlife Amendment Act***

The Minister of Environment may designate land in a wildlife management area as a critical wildlife area or as a wildlife sanctuary.

***Private Managed Forests Land Acts***

This Act enables the identification of critical wildlife for the survival of one or more species at risk because there is insufficient suitable habitat found on Crown lands within that eco-region. The identified area may be a maximum of 1% of the management area. The Act provides the ability to defer the identified area from harvest for a period of one year to allow government and the landowner to explore options for protecting the habitat.

***Environmental Assessment Act***

Currently there is consideration of species at risk in a large number of projects subject to review under the *Environmental Assessment Act.* A bilateral agreement reinforces the need to consider species at risk in the terms of reference for each environmental assessment application.

Mines Act *permitting*

*Mines Act* permitting can be used to address mines that are under the Environmental Assessment threshold, whereby the Chief Inspector of Mines may require the proponent to address species at risk, as well as impacts and mitigation, in the application.

### *Shared Stewardship*

The B.C. Ministry of Environment believes strongly in a model of shared stewardship with partners, stakeholders, and other ministries. Legislation is only one component. Achieving effective protection of critical habitat will require shared stewardship on both Crown and private land.

### *Summary*

- A large number of tools are available—there is a need for effective communication to ensure that Recovery Teams understand the tools and their applications.
- Need to address gaps in legislation and policy as they arise.
- A large number of the species in the province can be managed under existing tools.
- Other species clearly outside current policy limits will require government decision.
- The Species at Risk Coordination Office (SaRCO) was established in October 2004 to develop decision package for government around three species: Mountain Caribou, Spotted Owl, and Marbled Murrelet.
- Effective management of critical habitat will require a shared stewardship approach.

### *Discussion after Presentation*

**Q:** Given the variety of tools you mentioned what mechanisms do you have in understanding how they interact in the identification of critical habitats?

**A:** We have a number of knowledgeable people doing this type of work now, because in the past we did a poor job. I have to admit that it is a challenge and we need to foster more effective communication in this area.

**Q:** What is the ability to adapt LRMPs?

**A:** When we developed the list of species we had to cut things off at November 2002. We are now attempting to fill in the gaps between then and now. Therefore, a lot of things have slowed down, but we are attempting to complete the list.

## 4. *Resolving Critical Habitat Designation Failures under ESA: Reconciling Law, Policy, and Biology*

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Amy N. Hagen, University of Montana

*Conservation Biology*, in press.
Online Publication Date February 26, 2006.
http://www.blackwell-synergy.com/toc/cbi/0/0;jsessionid=e9U30DGocGFbTxJ6aN

The U.S. *Endangered Species Act (ESA)* requires designation of critical habitat to be concurrent with species listing. The Fish and Wildlife Service often has not designated critical habitat, based on the legal exceptions in the *ESA* of "not prudent" or "not determinable." This lack of habitat designation has led to numerous lawsuits and court orders to designate critical habitat for listed species. Court-mediated implementation of critical habitat is costly and delays listing for at-risk species. Legal, policy, judicial, and biological issues all contribute to the current inability of the law, as enforced, to effect timely and cost-effective critical habitat designation. Although increased appropriations and delaying critical habitat designation until recovery planning occurs have been proposed as solutions, we suggest changing the critical habitat guidelines to a decision-analysis framework will be essential in making critical habitat scientifically and legally workable as a conservation tool.

***Discussion after Presentation***

**Q:** What happened to de-listed species and did critical habitat play a role in their de-listing?

**A:** I would be shocked if critical habitat played a role. Too few species have had it, and most delisting has occurred when new populations are discovered.

**A:** Also some de-listing is due to taxonomic reassessment.

**Q:** Do you think that fixing the criteria is going to fix the problem? Aren't we taking away from doing proactive and preventable work on the ground?

**A:** The cases that have been brought to court represent a history of problems that are centered on the criteria problem. There are some additional problems, but the criteria issue is a major and substantial one.

**Q:** How do they identify fish designations in the U.S.?

**A:** I may be able to get you a contact for that information.

**Q:** Using a PVA is very data expensive and we are not sure if these methods are even worthwhile for ground preventions; do you have any comments?

**A:** It's a good question. I haven't seen a good analysis of how different the critical habitat designations are when different approaches are taken for designation; no one has taken a look at this issue. Dr. Arcese and Dr. Curtis are doing some research on this topic.

## 5. *Building and Using a Model Framework to Inform Decisions on Critical Habitat in the Case of the Northern Spotted Owl.*

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Since late 2003, analysts, topic experts, and the Canadian Spotted Owl Recovery Team (CSORT) have cooperated to develop a flexible and comprehensive model framework (implemented using SELES) for spatial landscape analyses of habitat supply, and for examining effects of habitat supply on population structure and possible trends for the British Columbia population of Northern Spotted Owls. The modelling framework (see Sutherland *et al*. in review for details) has been used to inform the CSORT as they developed both the Habitat Action Plan and Recovery Plan for this species.

Evaluation components specifically devised to inform the CSORT on questions related to recovery planning include: classification of habitat at the stand and territory scales; potential population responses; and effects of policy on timber supply (an important socio-economic output) (Figure 1). Classifying suitable and restorable habitat for consideration as "critical habitat" has been an evolving process in the model framework. We defined "restorable" habitats as those that are highly likely to become suitable within 20+ years of a given reference year. For example, for reference year 2005, habitat hectares that can become suitable any time before 2025 would be classed as "restorable" for 2005, etc.

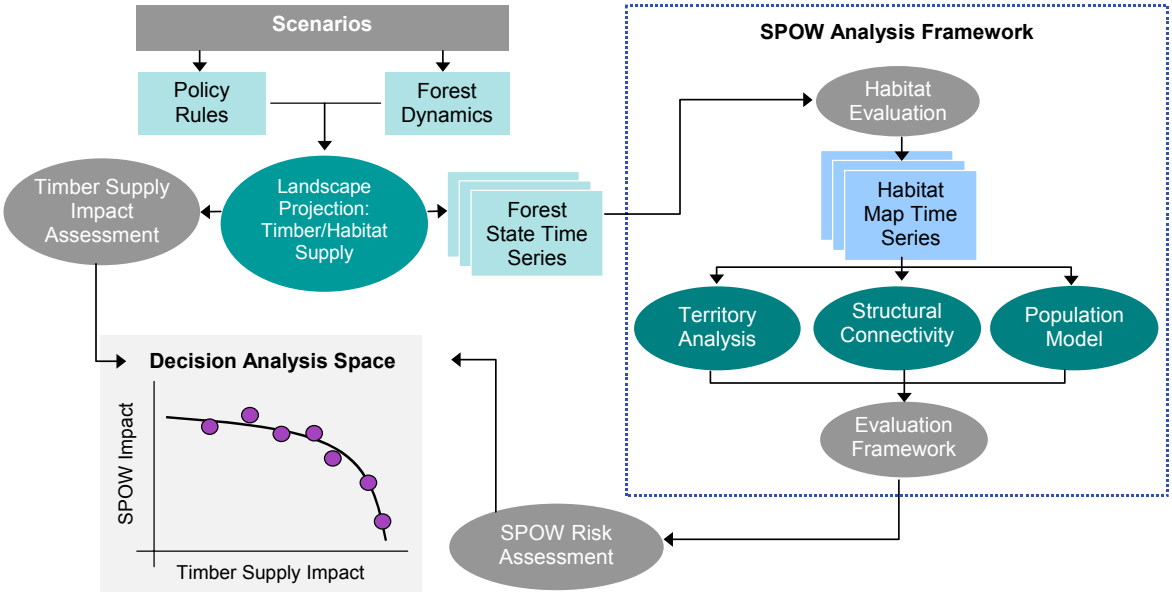


**Figure 1:** Overview of Northern Spotted Owl recovery planning modelling framework.

Building on a strategic, biophysical definition of suitability applied to each hectare of land within the owl range, we extended these definitions to include the ecological functioning of each hectare in territorial and population-level contexts. Within the "Evaluation Framework" portion of Figure 1, we used a Bayesian Belief Network (BBN) to describe the relative quality and availability of each hectare at each scale to infer and rank its capability to support recovery of owls over time (Figure 2).

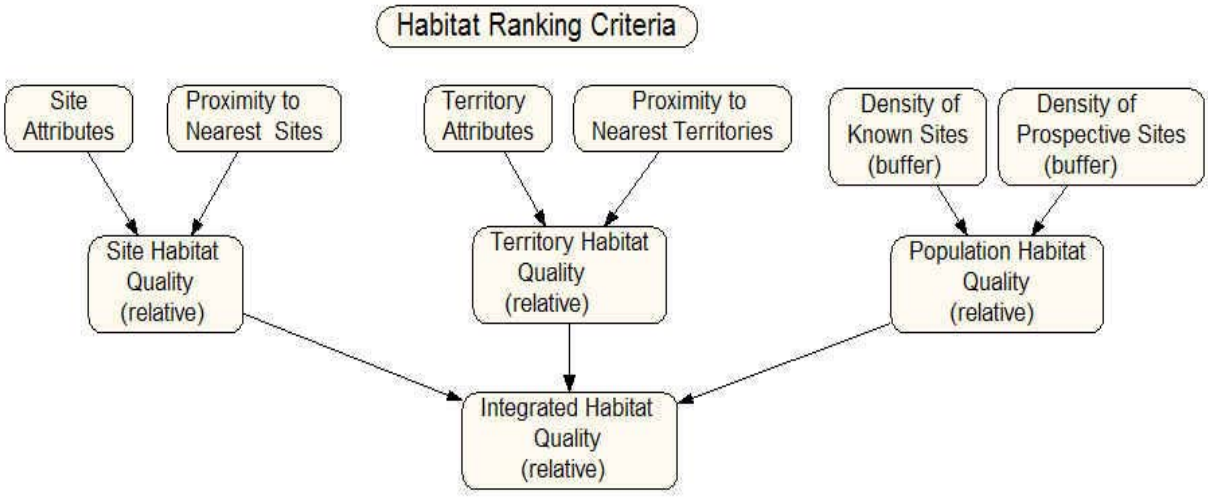


**Figure 2**: Conceptual diagram of factors considered in ranking critical habitat at multiple scales.

Innovative model components and approaches that we used to explore the definition of critical habitat include: a "packed territory" model (estimating the maximum number of potentially feasible territories) based on territory initiation and growth using a movement cost surface; a connectivity model to examine proximity to probable locations of owls where confirmed observations are limited; and a resource location model to identify priority areas for habitat management by integrating ranked results from three time periods (year 0, 20, 50) obtained by the BBN. Risk to potential critical habitat is not implicitly weighted in the biological rating of habitat quality and availability, but indicators of future risks of habitat losses are also produced by the framework. Accounting for such risks would require explicit weighting as part of decision making regarding "critical habitat" placement. So far, rules for weighting these risks have not yet been included in this modelling framework. The population model provides a means for relative comparisons of outcomes for owls from different possible decisions. Since information on sustainable vital rates is unavailable in British Columbia, the rates were derived from a long-term equilibrium landscape incorporating natural disturbance.

In summary, while recognizing uncertainty of data sources and assumptions if used to inform decisions on identification of critical habitat (even for a relatively well-studied species such as the Spotted Owl), the model framework has enabled CSORT to collate current information on

the owl and to predict habitat quality and risk. Yet, critical habitat designation cannot depend solely on models—expert opinion and consideration of the socio-economic trade-offs remain central to the designation of critical habitat, at least in this case study.

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### *Discussion after Presentation*

**Q:** Mike Demarchi: In the mid 1990s my brother conducted research on the Spotted Owl decline and concluded that there was no hope in owl recovery without drastic reduction in the Allowable Annual Cut (AAC) in the area.

**A**: This is a hard question to answer. One of the tasks we were challenged with was to look at all possible threats to Spotted Owls. We think habitat has been lost to a large extent, but we don't know the effects of habitat loss on basic survival. Barred Owls are also a contributing factor in the decline of Spotted Owl habitat loss, as much as habitat and maybe even more, but we don't know yet what the relative weights of these two threats are.

## 6. *Critical Habitat for Plants: Contrasting the Examples of Lyall's Mariposa Lily in Okanagan Grasslands and Vernal Pool Habitats within Garry Oak Ecosystems*

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### *Introduction*

"Recovery" is, at the most fundamental level, a demographic process: the restoring of a critical balance between birth rates, death rates, and dispersal rates to achieve a stable (or growing) population. Unfortunately, the detailed demographic data needed to make accurate population projections are lacking for most plant species at risk. Moreover, many aspects of plant life history can present special challenges when assessing population viability. These include the frequent occurrence of seed and bulb dormancy, periodic recruitment, and clonal growth. In the absence of good demographic data, recovery planners may be required to err on the side of caution when proposing critical habitat boundaries to ensure that sufficient habitat is secured.

In this presentation, I described some of the decision processes involved in identifying critical habitat for plants, relying on a pair of recently-drafted Recovery Strategies to serve as contrasting case studies. The first case (Plants at Risk RIG 2005) involves a single species for which several years of intensive demographic data (and associated population projections) were available to recovery planners. The second case (Southern Interior Rare Plants RIG 2005) involves a group of six unrelated plant species for which only sporadic census data were available, and which were treated under a single multi-species recovery strategy due to their co-occurrence within a similar habitat type (vernal pools and other ephemeral wet areas) on southeastern Vancouver Island.

### *Case Study One: Lyall's Mariposa Lily*

Lyall's mariposa lily (*Calochortus lyallii*) is a perennial, bulbiferous herb in the lily family. It is endemic to the Columbia Plateau region of western North America, where it inhabits grassland, sagebrush-steppe, and open-canopy coniferous forests from central Washington to south-central British Columbia. In B.C., it is restricted to about a dozen sites on the height of land (East Chopaka) separating the Okanagan and Similkameen Rivers, in what is now South Okanagan Grasslands Protected Area. The distribution here is highly patchy, with dense populations surrounded by wholly unoccupied areas. Due to potential threats from forestry and grazing activities (Miller and Douglas 1999), Lyall's mariposa lily was designated "Threatened" by COSEWIC in 2001.

From 1996–2000, the author monitored permanent demographic plots within three different populations of Lyall's mariposa lily (Miller 2004). Plots were censused three to four times each year to obtain information on stage-specific growth, survivorship, and fertility rates in various

habitat types. These life-table data were then transformed into population projection matrices (Caswell 2001), allowing calculation of both annual and stochastic rates of population growth ($\lambda$). Perturbation analyses (e.g., elasticity and Life-Table Response Experiment (LTRE) analyses) were then used to identify factors responsible for variation in population performance across sites and years.

These analyses indicated that Lyall's mariposa lily populations at East Chopaka are not only large (several hundred to 0.5 million individuals) but more or less stable, with little sign of population turnover; that there is little significant differentiation among sites in terms of population performance; that dispersal is not a major factor in the local population dynamics of the species; and that effective conservation can best be achieved by mitigating short- and long-term threats to currently occupied sites (Miller 2004).

Based on these findings, the recovery team identified the following recovery goals for Lyall's mariposa lily (Southern Interior Rare Plants RIG 2005):

- Maintain it at its approximate current extent of occurrence and area of occupancy.
- Ensure a fully viable Canadian population with a high probability of persistence[2].

To help achieve these goals, the following habitat was proposed as "critical habitat":

- Any occupied habitat patches within South Okanagan Grasslands Protected Area currently supporting more than 100 lily plants.
- Any habitat patch in the protected area supporting an independent population, regardless of population size.

In addition, it was recommended that the following be included as potential critical habitat:

- A 100 m ecological buffer zone around occupied sites.
- Any currently unoccupied, intact, or semi-intact grassland openings on East Chopaka above 1000 m elevation having the necessary ecological characteristics to support viable populations of Lyall's mariposa lily (Southern Interior Rare Plants RIG 2005).

***Case Study Two: Vernal Pool Habitats***

The second case involves the recovery of six endangered plant species inhabiting vernal pools and other ephemeral wet areas (e.g., swales and seeps): bog bird's-foot trefoil *(Lotus pinnatus*), tall woolly-heads (*Psilocarphus elatior*), *Juncus kelloggii,* water plantain-buttercup *(Ranunculus alismifolius* var. *alismifolius*), rosy-owl clover (*Orthocarpus bracteosus*), and dwarf sandwort (*Minuartia pusilla*). In Canada, these species occur (or occurred) primarily in Garry oak and

[2] Defined as < 5% probability that the total population size declines by ≥ 20% from its current size over the next 50 years, or ~ 3 generations. In addition, after 10 years, population size at four protected localities is stable or increasing, with the combined population exhibiting a projected stochastic population growth rate ($\lambda s$) ≥ 1.0.

associated ecosystems on Vancouver Island and nearby Gulf Islands where they are largely restricted to low elevation, coastal areas (Plants at Risk RIG 2005).

Vernal pools are spatially discrete, seasonally flooded depressions that form on top of impermeable layers such as hardpan, clay-pan, or bedrock. They occur under Mediterranean-type climatic conditions that provide for winter and early spring inundation, followed by complete or partial drying in summer (Holland and Jain 1977, Zedler 1987). These habitats are naturally highly fragmented. Urbanization has intensified their natural fragmentation, and species occurring within these habitats face a diverse array of threats including impacts from recreational activities, encroachment of invasive alien plants, secondary succession due to fire suppression, wetland draining, and stochastic environmental events (Witham *et al*. 1998, U.S. Fish and Wildlife Service 1998, Plants at Risk RIG 2005).

With some exceptions, little information is currently available on the demography and population dynamics of vernal pool species on southern Vancouver Island. However, the very small size of most populations, combined with the island-like nature of the habitat patches, suggest that metapopulation dynamics (i.e., dispersal and rescue effects) may be important to the long-term persistence of these species. Furthermore, it is evident from herbarium records that many of these species have undergone sharp contractions in range and abundance during the past century, likely as a result of anthropogenic activities. In keeping with the precautionary nature of *SARA*, it was therefore proposed (Plants at Risk RIG 2005) that critical habitat for this suite of species include *all occupied habitat patches found on federal and municipal lands as well as any other occupied habitat considered to be under imminent threat, together with the adjacent upland areas that contribute directly to sustaining hydrologic functions within the primary habitat*.

In addition, it was recommended that critical habitat also include the following:

- Any intact naturally-occurring vernal pool, seep, or other ephemeral wet area greater than 1 $m^2$ on southeastern Vancouver Island and the Gulf Islands having the necessary ecological characteristics to serve as future recovery habitat for species at risk, along with a 20 m buffer zone around said feature.
- The associated watershed and hydrologic features, including upland habitat, that contribute to the filling and drying of the above vernal pool or ephemeral wet area, and that maintain suitable periods of inundation, water quality, and soil moisture for germination, growth, reproduction, and dispersal.

Some of these sites already benefit from some functional protection by virtue of their location either on Department of National Defence (DND) lands or B.C. Ecological Reserves. Other sites, such as those occurring on municipal parkland or on private property, have no formal protection mechanisms in place. In these instances, achieving security for critical habitat will likely necessitate a range of approaches (e.g., conservation covenants and other stewardship agreements; direct land acquisition; listing under the *Wildlife Amendment Act*; regulation under the *Community Charter Act*).

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### *Discussion after Presentation*

There were no questions (ran out of time).

## *7. A Habitat Model for the Coastal Giant Salamander in British Columbia*

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We used a novel statistical technique (non-parametric multiplicative regression and data extracted from geo-referenced resource files) to evaluate habitat suitability for the coastal giant salamander (CGS) within British Columbia. Using data collected at four different scales, ranging from site level to averages taken over entire watersheds, we evaluated a suite of commonly available forest structure and physiographic features for their use as predictors of CGS occurrence. The application of our model has helped to reinforce and refine traditionally held beliefs about what is "critical" for habitat to this species, but it is hampered by the exclusive use of presence-absence data. The model can be used in its present form to identify riparian areas with a high likelihood of CGS occurrence, though it cannot inform predictions about population demography. Model results are used to form a set of working hypotheses about the requirements of this species, to be refined through further intensive sampling and adaptive management approaches. The model is being used to compose forest and riparian protection measures aimed at managing for the persistence of this species.

***Discussion after Presentation***

No discussion was recorded.

## 8. *A Functional Approach to Managing Mountain Caribou Habitat*

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Mountain caribou are an "ecotype" of woodland caribou restricted to southeastern British Columbia. They are distinguished from other ecotypes by their reliance on arboreal lichens for food in winter, and by their seasonal migration patterns between high-elevation parkland habitats and low-elevation old forests. The key life history strategy of mountain caribou is to remain as much as possible at high elevations and at low population densities over large expanses of sub-alpine forests, where predators infrequently encounter them.

Although now distributed in several relatively distinct subpopulations, mountain caribou were likely once distributed continuously throughout suitable habitat over a larger range, extending south into northern Idaho and northwestern Montana, and west through the Okanagan Highlands. Extensive habitat change by forestry, human settlement, and other activities has affected the availability of arboreal forage, has created barriers to movement and dispersal, and has also affected the distribution and abundance of other ungulates and their predators. As a result, mountain caribou have lost their spatial separation from ungulate predators in many parts of their range. Although no longer hunted, caribou are highly vulnerable and it is likely that populations were reduced sharply by over-hunting. Climate change is hypothesized to be affecting mountain caribou, although future effects remain uncertain. Biologists generally agree on the stressors that are likely causing the decline of mountain caribou; however, there is little consensus regarding the relative impact of different factors—impacts which also likely differ among different subpopulations.

Federally, the Southern Mountains Ecological Area population of woodland caribou (which includes all mountain caribou) is considered "Threatened," while the B.C. Conservation Data Centre has placed mountain caribou on the provincial "Red List."

Critical habitat for mountain caribou is difficult to define because mountain caribou exist over very large areas at low densities, sometimes not occupying highly suitable areas for many years. Also, the fate of mountain caribou is likely tied to management of habitats outside their range (e.g., populations that support high numbers of other ungulates and associated, far-ranging predators). Because of these issues, Recovery Implementation Groups have inconsistently addressed the issue of critical habitat. Biologists have largely ignored it, preferring to focus on setting objectives in currently suitable habitat.

Methods to define mountain caribou habitat fall into two broad categories: data based and expert based. Data-based methods include selection ratios, which are no longer widely used, and regression modelling methods, which have been applied throughout the range of mountain caribou, largely based on telemetry data collected during the 1990s. The most common method

involves testing a series of biologically plausible alternative models that contrast "used" (i.e., telemetry) and "available" (i.e., random) locations with logistic multiple regression and selecting the most parsimonious (i.e., explaining the most variation with fewest variables). This method has broad acceptance in the scientific literature and it is largely objective and data-driven. However, the method also has a number of disadvantages such as:

- it is prone to sampling errors (like all statistical methods);
- it does not test functional relationships;
- output is relativistic (use in relation to availability); and,
- output is relevant only to the period of time during which the telemetry data were collected.

The time-specific nature of the results tends to encourage the development of recovery options that emphasize maintaining current conditions rather than recovery of habitat which is no longer suitable. Considering broader recovery options requires habitat models that consider the functional relationships between habitat attributes and caribou life history requisites. Among those common in British Columbia are wildlife habitat ratings models, which simply rate different ecosystems according to their assumed value for caribou. Because all structural stages of all ecosystems are rated, the method can be used to forecast the value of past or future landscapes, making the method suitable for recovery planning. However, the system is not explicit regarding functional relationships and therefore output is not repeatable and difficult to test.

An alternative expert-based method is the use of Bayesian belief networks to explicitly represent functional relationships among important variables. This method has been used by the B.C. Species at Risk Coordination Office to model habitat for mountain caribou and also by the northern caribou recovery team. The method creates models that are independent of current conditions and therefore suitable for recovery planning; however, models can become very complex.

Clearly, no single method is superior and recovery efforts benefit from having multiple tools available. What is obvious is that whatever methods are used, critical habitat definitions need to consider more than current conditions. In addition, critical habitat is necessary, but not likely sufficient for mountain caribou recovery, and the need for additional management actions will differ among remaining subpopulations.

### *Discussion after Presentation*

No discussion was recorded.

## 9. *Critical Habitats in a Settled Landscape: A Case Study of Two Freshwater Fishes in the Lower Fraser Valley.*

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Salish sucker (*Catostomus* sp.) and Nooksack dace (*Rhinichthys cataractae* sp.) are limited to a few streams in the lower Fraser Valley, all of which have experienced extensive habitat loss and alteraation over the past 150 years. These species are at risk of further degradation from urban development, agricultural intensification, and resource extraction (McPhail 1987; McPhail 1997). In the draft Recovery Strategies for these species, the Recovery Team defines critical habitat and delineates it for the majority of the known range. Critical habitat is linked to population targets using field-based algorithms for density in different habitat types (Pearson *et al*. 2005a; Pearson *et al*. 2005b). It includes both instream and riparian habitats. The width of riparian area to be included is to be based on site-specific assessments based on an adaptation of the Provincial Riparian Areas Regulation methodology. These will be completed over the next year.

Habitat trade-offs between the two species are caused by beaver activity. Dams create the deep slow-moving habitats favoured by Salish suckers, but ponding eliminates the fast flowing riffles used by Nooksack dace (Pearson 2004a). One watershed (Pepin Brook) may require management intervention in the future and is being monitored.

Stewardship activities are key to recovery as virtually all occupied reaches flow through private lands. The Habitat Stewardship Fund has provided ongoing funding for recovery activities and the monitoring of populations, habitat conditions, and restoration projects. Three experimental habitat restoration projects for Salish sucker have been completed. Designs are based on extensive field research on habitat use including radio-telemetry (Pearson 2004b; Pearson and Healey 2003). Monitoring data indicate that Salish suckers have colonized two of these and that densities are very high relative to natural habitats in one of them. Construction of the third project has just been completed. Other activities include landowner contact programs and provision of native plants for riparian restoration on agricultural lands.

Efforts have been most successful when landowners and local governments are engaged and when habitat restoration is integrated with existing works such as agricultural drainage maintenance and gravel pit site restoration.

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***Discussion after Presentation***

**Q:** How much riparian habitat do you want to include?

**A**: This is the most contentious issue. Initially we put in 5 m. This is the minimum amount we need to maintain habitat. This went to review in the province but they're concerned about undercutting the riparian area regulation. In the recovery strategy we've put in that riparian areas will be defined on a reach specific basis.

**Q:** What is the link between beavers and Dace habitat? Are some of the near term negative impacts balanced by positive ones over time and space?

**A**: Beavers are not a problem in all situations. The impacts to Dace habitat are highly significant because beaver activity eliminates the riffle habitat. Additionally, because of the interaction with nutrient loading and lack of riparian, beaver dams aggravate hypoxia in sucker habitat.

**Q:** How much time and energy is spent with other recovery teams if you're doing stream-by-stream assessment and work? I'm asking because there's the concern that the first recovery team out the gates gets their critical habitat protected first.

**A**: In Mountain Slough, the Oregon Spotted Frog Recovery Team was on the job too. There are some streams with records of water shrews in them and we probably need to do more with this species.

## *10. The Challenges of Identifying Critical Habitat for a Large River Fish Species, the White Sturgeon*

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No abstract was provided.

Please refer to the Upper Columbia White Sturgeon Initiative web site:
www.uppercolumbiasturgeon.org/

Their recovery plan is at:
http://uppercolumbiasturgeon.org/RecoveryEfforts/Rec-RecPlan.html

***Discussion after Presentation***

**Q:** Is slag still being deposited?

**A**: It was cut back in 1995 by 95%, but it still exists to some degree.

**Q**: Does the *Fisheries Act* authorize that under a regulation?

**A**: I don't know, but I think it would be highly unlikely.

**Q:** How was the Nechako population recently discovered?

**A**: It's not that we just discovered them; it's just that we recently discovered that they were spawning there last year.

**Q:** Do you anticipate finding that for any other populations?

**A**: We have actually documented spawning for the other three populations.

**Q:** How will you being looking at residence vs. critical habitat?

**A:** The spawning site is not a residence, but incubation habitat could be. We haven't worked to define residence yet.

**Q:** Can you designate critical habitat if you don't get legal listing under *SARA*?

**A**: I don't think so. I think the species needs to be legally listed first.

**Q:** Are you considering restoration of spawning sites?

**A**: Yes, we are looking at the feasibility of doing that. We are designing a pilot substrate rehabilitation project for the Nechako.

**Q:** Could you explain why spawning would not be a residence?

**A:** I'm not sure how we could define an animal suspended in the water column as a residence.

**Q:** How do you do stream restoration?

**A:** We haven't done much restoration yet. We expect it to be very difficult to restore habitats in these large rivers. Initially we are conducting research into how we might do that. BC Hydro is proposing flow and turbidity experiments. There are a number of regulatory hoops we need to get through first.

## 11. *Modelling Habitat Use by Wood Bison at Multiple Spatial Scales: Tools and Techniques to Define Critical Habitat*

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We modelled resource selection by wood bison (*Bison bison athabascae*) using resource selection functions (RSF) at multiple scales. In this multi-scale project we considered ecological and foraging processes at finer spatial scales. We constrained our model selection by considering the limitations imposed on lower scales of selection by those at higher spatial and temporal scales. We assessed the predictive qualities of the RSF model using k-fold validation within the study area and out-of-sample validation. Resource variables were obtained from a land cover map developed from the classification of remote sensing data. Covariates in the analysis include metrics of landscape physiognomy measured within a circle with a radius of two kilometres, a scale equal to the average daily movement distance of a bison. We employed a used/available design to analyze telemetry and aerial survey data that had been previously obtained over a 10-year period. We created *a priori* models of habitat use using a conceptual framework developed through the incorporation of optimal foraging and hierarchy theory. We postulated that while forage abundance can be used as a partial predictor of use, measures of landscape physiognomy might additionally be employed to model energy loss through different matrices of non-forage habitat. When validated by applying the model in a new area, the model proved robust and a useful predictor of occurrence. While the distribution of wood bison depends on the presence of forage habitat, factors such as edge density and contagion proved to be important predictors of use. The incorporation of landscape metrics into resource selection modelling proved to be an effective means of linking spatial landscape attributes to biological functions. The resulting maps and analysis using Population Viability Analysis were used to create spatially explicit maps of critical habitat for wood bison.

### *Discussion after Presentation*

No discussion was recorded.

## 12. *Letting Snails Show Us the Way: Delineating Critical Habitat of the Endangered Banff Springs Snail*

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The endemic, aquatic, endangered Banff springs snail, *Physella johnsoni*, lives in a handful of thermal springs near the town of Banff in Banff National Park, Alberta. Between 1926, when the species was first described, and the beginning of the snail research and recovery program in 1996, nearly half of the historic populations were extirpated. The disappearance of four historic populations, annual population fluctuations of over two orders of magnitude, continuing threats, and having four of the five remaining populations in a high visitor-use area led the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) to designate the species as threatened in 1997. This was the first extant mollusc to be listed in Canada. When COSEWIC revised its listing criteria to more closely match those used by the World Conservation Union (IUCN), the species was up-listed to "Endangered" in 2000. With the passing of the *Species at Risk Act* (*SARA*) in 2002, the species was listed in *SARA* Schedule 1 and given additional legal protection beyond that offered by the *National Parks Act*.

Direction for the species' recovery has been given in the Resource Management Plan (RMP) for the Recovery of the Snail, a hybrid of Recovery of Nationally Endangered Wildlife (RENEW) and Parks Canada Resource Management guidelines, drafted in 1998 and approved by Parks Canada in 2002 (Lepitzki *et al*. 2002). An integral part of the RMP, Appendix III, delineated draft critical habitat for the species, as defined under *SARA*. It is expected the critical habitat so delineated will be published on the *SARA* Public Registry by June 2006 as part of the RENEW Recovery Strategy and Action Plan, essentially the updated and reformatted RMP.

Microdistributional data from 99 population surveys conducted once every three (up to summer 2000) or four weeks (thereafter) from January 1996 to January 2002 were used to define and delineate critical habitat. During population surveys, snails within clearly defined areas (depicted on maps constructed with compass and tape measure) called microsites, located in each thermal spring and along the outflow streams, are counted, resulting in minimum population estimates. Those microsites that contained ≥ 75% of the snail population for at least 60% of the population surveys—the critical habitat for the species—are indicated on maps, such as Figure 1. Because the number of snails occupying downstream microsites drops substantially, critical habitat encompasses those areas where the thermal spring bubbles out of the ground and areas immediately downstream of the origin pool

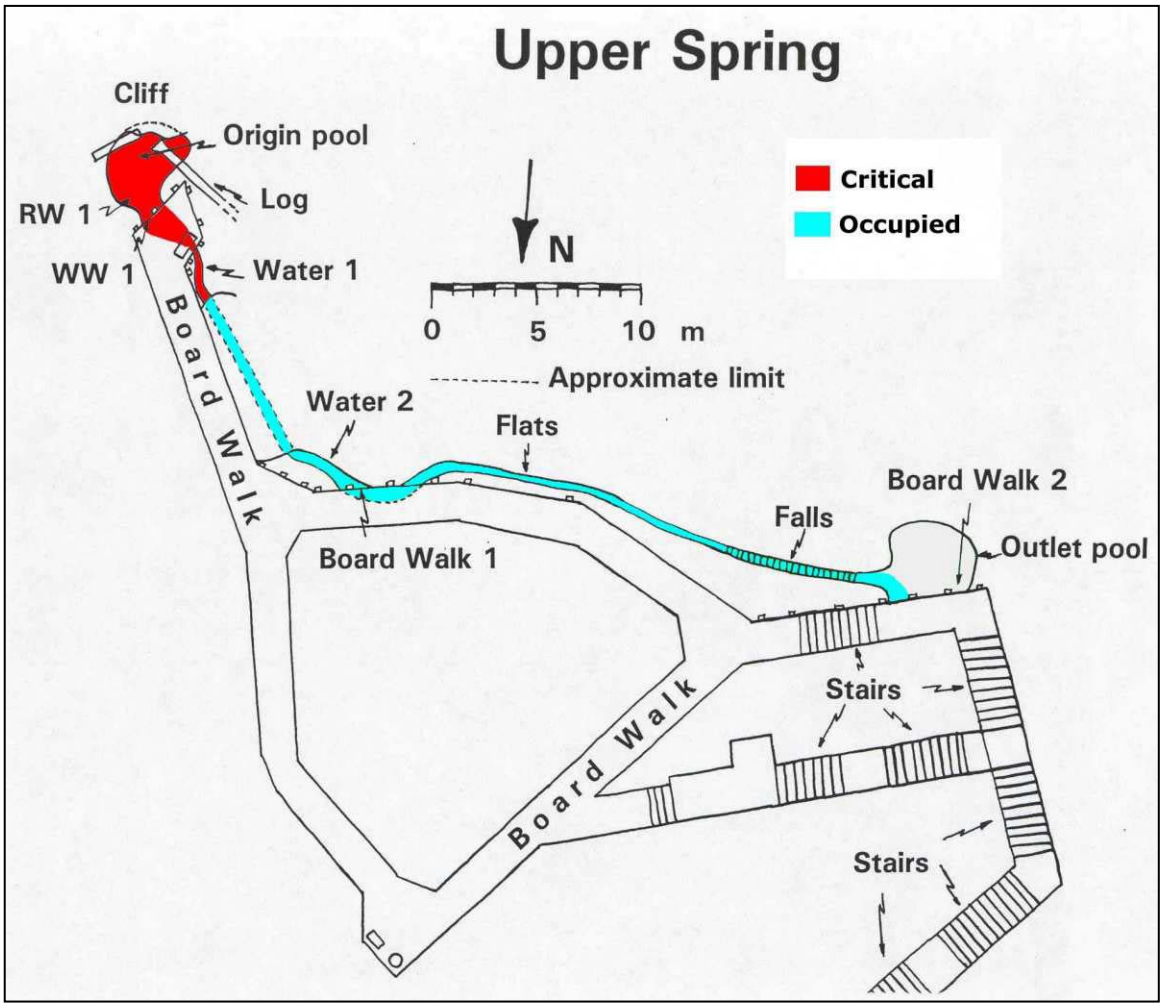


**Figure 1:** Critical habitat for the endangered Banff springs snail at the Upper Cave and Basin Spring, Banff National Park, Alberta. The map was drawn with the aid of compass and tape measure.

The validity of the delineated critical habitat was or will be tested in three ways:

1. In general, there was good agreement between the draft critical habitat delineated using data collected from 1996 through 2001 to those areas delineated using microdistributional data collected since then.

2. Based on observations of the five occupied springs, critical habitat predicted at thermal springs where snail populations were re-established was in close agreement with what was actually observed. While the critical habitat predicted at the Upper Middle Spring re-establishment site was too conservative by one microsite, critical habitat predicted at the Kidney Spring re-establishment site was too extensive by one microsite.

3. A third, and so far unexplored, method to test the validity of the critical habitat

delineations will be to use RAMAS-GIS population models derived from and during an IRF collaborative project with Dr. Kathryn Lindsay (Environment Canada). By eliminating various proportions of modelled snail populations and observing the corresponding change in the probability of extinction, it may be possible to test the validity of the "≥ 75% of the snail population" portion of the critical habitat definition.

Reasons for the snail's marked microdistributional pattern, the underlying principle of the critical habitat delineation, are unknown but are most likely related to abiotic and biotic gradients found in and along the thermal spring and outflow stream. As snail populations decline along the outflow streams, water temperature and levels of hydrogen sulphide also decline while pH and dissolved oxygen increase. An obvious visual change in the microbial community, the snail's food source, is also very evident even at the scale of metres.

An important critical habitat component is the thermal water itself. Recent flow anomalies, which may be a direct result of drought conditions and possibly global climatic changes, suggest that the narrowly defined and delineated critical habitat for the Banff spring snail could be expanded to include the actual source and flow route of the thermal spring water. Doing so would greatly expand the extent of critical habitat to include an entire mountainside.

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### *Discussion after Presentation*

**Q:** What is the cause of the extirpation in the Upper Middle Spring?

**A**: We don't know. At one point Parks Canada piped water from Middle Springs to the Cave and Basin bathing facility. It might have been a combination of low water levels plus the piping.

**Q:** What about the idea of water being diverted? Could people have been tapping into the springs as the water flowed back up to the earth's surface?

**A**: It's a good question because up until a while ago Banff took water from near the surface. Now they take it from deep wells by tapping into the Banff aquifer. The aquifer is declining now. Some of the water that normally flows into the thermal springs could be getting pumped for human use.

**Q:** Have you looked at what snails eat and correlated the distribution of different species of algae and bacteria with the distribution of the snails?

**A**: Yes, we've looked at this a couple of ways. We've looked at snail diet anecdotally by observing them in a petri dish where we have seen them consume white, filamentous bacteria. Visually we can see changes in the microbial community along the outflow streams. We're also looking at other components of the ecosystem: the autotrophic and heterotrophic microbial communities. Other researchers have used nitrogen isotopes to compare what the snails eat with what is available in the spring. One of the problems is that we don't want to have to collect and kill snails in order to do the isotope analysis.

**Q:** The regression might be better if you looked at food source.

**A**: Yes, using food source could give better results. Other researchers have suggested that it is the phototrophs that are driving the system. The phototrophs decline during the fall and reach their lowest levels in January, just before the snail's peak. There's then a lag period after which the snail populations also begin to decline.

**Q:** How did you define residence?

**A**: Using the earlier *SARA* draft we concentrated on the part that said "habitually occupied," and ignored "nest." Since then we've been concentrating on the reproduction part. Residence is now the spot where eggs are being laid—the oviposition sites. They are very discrete locations in space and time.

**Q:** Are their conflicts between commemorative integrity (CI) and ecological integrity (EI)?

**A**: Yes, at times major conflicts have occurred in the past. CI essentially addresses socio-economic impacts. Biologists agree on the residence and critical habitat definitions, but we're somewhat limited by what we can do because of CI. For example, we can't put up all the signs we might consider necessary because signs have been called a "contemporary intrusion." We also can't have snail messages overwhelm historic site messages.

**Q:** So you were able to do critical habitat mapping without assessing the socio-economic impacts?

**A**: Yes and no. Critical habitat was defined using biological criteria and then Parks Canada, through an IRF project, hired a firm to look at how we defined critical habitat. They addressed the potential impacts on visitors to the Cave and Basin site, and said the impact to visitors would be minor.

**Q:** If someone wants to put a hot tub on the stream lower down where it is not classified as critical habitat, would that be okay?

**A**: No. We're starting to look at the ecosystem level. Lower down is critical habitat for a damsel fly species. There are also S1, S2, and S3 bryophyte and mosses living along the outflow streams, downstream of snail critical habitat. We're trying to look at the thermal ecosystem as a whole.

**Q:** Can you correlate changes in snail numbers and microdistribution with water temperature?

**A**: We have thermometers in the thermal springs that are logging temperatures every hour. We have seen a lag in seasonal temperature drops between the highest and lowest elevation springs of up to 12–24 hours. When temperatures in the springs are dropping during late-winter early-spring, so too are snail numbers. There's also the correlation between snail microdistribution and water temperatures—as you go down the outflow streams, both snail numbers and water temperatures drop. We've recently discovered that too much water can be just as bad as not enough. Every year since 1998 the Upper Hot Spring has dried up (possibly due to global warming?). During the summer of 2005 we had record rainfalls, (more water entering the spring system) and unprecedented drops in water temperatures, both which change the water chemistry, which affects the microbial communities, which affect the snails. So we have some populations that are at the lowest we've seen in 10 years at this time of year.

**Q:** What is the nearest living relative? Is there a chance of exchange between populations?

**A**: There is *Physella gyrina*. Allozyme and mitochondrial DNA says that the Banff snail is a unique species. We think our snails have evolved *in situ* over the past 6,000 years. But there is some contention that we have an eco-phenotype caused by warm water—the age-old debate between lumpers and splitters. Downstream, after the point where we no longer find the Banff springs snail, is where we find *Physella gyrina* so there is no spatial overlap between the two species. The chances of a snail crawling out of one spring and going to another are pretty remote now. However, in the past when Parks Canada pumped water among springs they could have moved via the pipes—giving a whole new appreciation for the concept of a wildlife corridor**.**

## 13. *Unencumbered by Data: Combining Science and Stewardship in the Identification of Critical Habitat for the Sharp-tailed Snake*

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There are many challenges associated with studies of rare, small, and cryptic species. U.S. Secretary of Defence Donald Rumsfeld perhaps summed it up best at a news briefing in February 2002, when he stated: "There are known knowns. There are unknown knowns. There are things we know we know. We also know there are known unknowns. That is to say, we know there are some things we do not know. But there are also unknown unknowns, the ones we don't know we don't know." Mr. Rumsfeld was explaining the limitations of intelligence reports, but he could have just as accurately been describing limitations in our understanding of critical habitat for the sharp-tailed snake. The purpose of this presentation was to illustrate the importance of using both science and stewardship to identify and protect critical habitat for species such as the sharp-tailed snake.

The sharp-tailed snake was assessed as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 1999, and is on British Columbia's Conservation Data Center Red List. What we do know about the ecology of the sharp-tailed snake (the known knowns) is largely thanks to the efforts of Christian Engelstoft and Kristiina Ovaska, who have been conducting research on this species in British Columbia since 1996 (Engelstoft and Ovaska 1997, 1998, 1999). Artificial cover boards have proven to be a very effective technique for studying the sharp-tailed snake (Engelstoft and Ovaska 2000). Additional information on the life history, ecology, and distribution of the species is summarized in Leonard and Ovaska (1998), Ovaska and Engelstoft (2001) and Ovaska *et al.* (2005).

In British Columbia, the sharp-tailed snake has been found in areas with relatively open-canopy forests dominated by Douglas fir and arbutus, or Garry oak and associated ecosystems. These areas typically have abundant cover, such as talus, coarse woody debris, and/or fissures in rock (Ovaska and Engelstoft 2001, Engelstoft 2004, and unpublished data). These general habitat characteristics have been used to assess potentially suitable habitat for the sharp-tailed snake within the range of the species on federal lands, regional parks, and a provincial park (Engelstoft 2002, 2004; Engelstoft *et al.* 2002). Monitoring of artificial cover objects installed in potentially suitable habitat on federal lands (Engelstoft 2004; Engelstoft 2003) has resulted in the discovery of two new locations for the sharp-tailed snake (Engelstoft 2004).

Wilkinson and Gregory (2005) compared characteristics of habitats either occupied by sharp-tailed snakes or identified as potential habitat. Within each site, characteristics were sampled at the location of cover boards and locations chosen at random. Areas occupied by sharp-tailed snakes have either a south (81%) or west (19%) aspect, shallow soil and litter cover, and relatively high rock cover, and these habitat characteristics differed significantly from those of both random locations and areas identified as potential habitat for the species (Wilkinson and Gregory 2005).

Despite these studies, there are still many gaps in our understanding of sharp-tailed snake ecology and habitat requirements. These include: basic ecological parameters such as population sizes and demography; the extent and distribution of potentially suitable habitat throughout the range of the species; distribution of the species and area of occupancy at known locations; foraging, nesting, and hibernating requirements; and movement patterns (Ovaska *et al.* 2005).

Because most of the known locations of sharp-tailed snake are on private lands, stewardship plays a critical role in the recovery of this species. Working with landowners and land managers to provide them with the information and tools they need to effectively steward known populations and habitats has been the primary focus of recovery efforts to date. Efforts are also being made to identify potential habitat on public lands, and to determine whether additional populations exist in these areas. As this work proceeds, we are gathering new information to fill knowledge gaps and to provide us with a better understanding of sharp-tailed snake habitat requirements. It is only through a careful balance of science and stewardship that recovery of species such as the sharp-tailed snake can be ensured.

### *Acknowledgments*

Sharp-tailed snake recovery efforts have been generously supported by many funders and partners including: the Habitat Stewardship Program; the Interdepartmental Recovery Fund; the Endangered Species Recovery Fund; the Habitat Conservation Trust Fund (Species at Risk Account); Parks Canada; Capital Regional District Parks; the Department of National Defence; the Habitat Acquisition Trust; the Pender Islands Conservancy Association; the Salt Spring Island Conservancy; the University of Victoria; Alula Biological Consulting; Biolinx Environmental Research Ltd.; the Canadian Forest Service; and the B.C. Ministry of Environment.

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***Discussion after Presentation***

No discussion was recorded.

## *14. Unencumbered by Data: Combining Science and Stewardship in the Identification of Critical Habitat for the American Badger*

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No abstract provided.

Please refer to www.badgers.bc.ca .

- The "Publications" section includes reports produced by the Recovery Team.
- The draft Recovery Strategy can be found at: www.badgers.bc.ca/pubs/Badger_Strategy_May_05.pdf

## *15. Notes from Panel Discussion at the end of the Conference*

Before this question-and-answer period began, Dr. Peter Arcese, with assistance from Janelle Curtis, gave an overview of the conference and the future of critical habitat definition. No summary of this talk was available.

**Q:** Regarding the legal framework of the *Species at Risk Act* (*SARA),* how does it actually work? I thought the law only had a "stick" on federal lands, but across the 99% of the landscape that is not federal, there is only a stewardship "carrot."

**A**: The simple answer is that the obligation to protect critical habitat on non-federal land is up to those who have jurisdiction over that land. They need to use their tools. There does remain, as a final opportunity for critical habitat, the "safety net" to be invoked, but it's a very last option and nobody wants to get to that stage. So the opportunity is for stewardship and the need to use existing (or create new) legislation on provincial and territorial land.

**A**: The Department of Fisheries and Oceans is responsible for aquatic habitat and it is covered under *SARA*—so we're okay on the aquatic front.

**Q:** I work as both a scientist and have worked on a U.S. recovery plan and have done many GIS models. My question is: as we scientists make more complex models are we setting the bar higher for what's enough if we go to court? Also, I see the value of doing the "magic marker" version of critical habitat identification. How can we make sure we're not excluding the simpler approach? Lastly, are we creating potential synergies between academic culture that encourages complex models and those that want to stall the recovery process?

**A**: There's no easy way to answer this. There are some promising papers that show Bayesian techniques are defensible. We definitely need processes that are transparent and well documented. My sense is that both are defensible. From *SARA* you do the best that is available. I think it's a question for us as modellers to get confidence in our projects. Both approaches are fine.

**A**: People who bring lawsuits do them to cases they think they can win. Conservation groups scout cases they think are winnable in order to set precedent. The key question of due diligence is: do we use the data intelligibly? If we don't have data, we shouldn't make complicated models—that's part of due diligence.

**Q:** Are there any examples where expert opinion has been used in court successfully?

**A**: No

**A: Peter:** Even if use marker approach, it's only defensible if we test it afterwards. Models need to be tested. Defensible means we need criteria on which to reject a model on. There have been many cases in B.C. where a marker approach has been used and it doesn't always take into account all the important things. There are bad examples of both approaches. The only way we can make a distinction between the marker approach and the complicated way is if in one system we use both complex and simple models and see if they have the same output. We can build the most complicated model you can imagine and use a few species for which we have lots of data, and then simplify the model until it no longer has same result. This will be able to tell us in what situations we can use simpler models based on the information we have.

**Q: Ross Vennesland:** I'd like to offer the provincial perspective on *SARA*. *SARA* is clear that we need protection on federal lands. I think we have to be careful about where we put our funds to do this. For the amount of money we put into some of these critical habitat models we could probably de-list several species. What does the panel think about the biodiversity mapping that was done for B.C.? That would be a good way to allocate funds across the landscape because there's currently a bias. The question of balancing biological needs with socio-economic ones is difficult because we can't really measure the benefit of conservation. One of benefits of *SARA* is that it separates science and economics. We should establish critical habitat according to science and then alter it later. But the public should be able to see what a "scientific" definition of critical habitat is before it gets altered.

**A**: I agree that the overall cost of modelling is costly. However, much of the cost is related to data gathering and paying people. Once the database is in place the cost of modelling is not that much.

**Response:** There are some species taking a lot of time and money

**A: Peter:** As I mentioned yesterday, for all the species that I've seen that have "required" fancy, expensive modelling, there is a political subtext. There are times when we use models for purposes they were not intended to be used for: to lengthen non decisions. Many of our prioritizing decisions are political.

**A: Karen:** Very few decisions follow a strict rational plan. We're not very good at making individual and collective decisions where we don't benefit (e.g., if we receive money for modelling we'll take it even though we have doubts about its usefulness)

**Q:** Directed at Kari, Karen, and Ian: I felt there was a contradiction in your presentations. Karen, you said we need clear criteria because that was the only way we could defend ourselves, for example in court. Kari and Ian, you said stewardship is the key. Does this mean you don't think critical habitat is key?

**A: Karen:** My argument for revising and clarifying criteria is in the context of this law; we need clear criteria for *Endangered Species Act* (ESA) and *SARA*. This is quite separate from my opinions of usefulness of critical habitat. I agree with Peter that we need to develop "rules of thumb" of when we need what information. With *SARA* we risk it not working because we have a plethora of critical habitat methods.

**A: Kari:** Most of the sites we know about are on private land. It's critical that those sites get protection in the interim. The appropriate approach to ensure we have that protection is through stewardship, and not through something scary to landowners. I want to maintain enthusiasm and participation among landowners. We need to work to get that effective protection in place prior to even calling it critical habitat.

**Same Questioner**: I agree, this is why I'm wary of rules for establishing critical habitat

**A: Karen**: Under *ESA,* if you can demonstrate that designation would be damaging then you don't have to identify it.

**Same Questioner:** Does this create an incentive for landowners to be hostile to critical habitat?

**A: Karen:** *ESA* is perceived as a big stick. As species are promoted to candidate status this creates an incentive for landowners to try to remove them from their land before the species are officially designated.

**Same Questioner:** Canada doesn't have these sorts of tools.

**A: Karen:** True, our approach is very "thou shall not make extinct." We need to make it cool to be green.

**A: Olaf**: Critical habitat and stewardship should go hand and hand. In Alberta many industry people are scarred of the *SARA* stick. But I think if we can show them that it's not a lose-lose situation for them and improve the tools for incentives, we will quell their fears. In general I think when people realize what *SARA* is about: consensus, stakeholders, etc., they won't be so scared.

**Q:** I think that because of the fear of litigation we'll be too narrow with our definitions of critical habitat and *SARA* won't work. We need an ecosystem species approach for the future. I also think we need to develop plans that encompass the unknown. But we need flexibility, it's not just the absence of good habitat that's the problem, we must consider the matrix, climate change, etc. So we can't just deal with "critical habitat."

**Q: Newhouse:** I'd like to reiterate what Kari was saying, in regard to my experience with badgers. I'd rather see us continue to work with landowners who are very excited about the species. I've heard on one hand that *SARA* has no clout, but then we've spent all this conference worrying about "when we go to court." Perhaps the tool we would like to look at is an environmental assessment for everything in the range of the badger. With such a

wide ranging carnivore, I'm concerned about putting lines on a map, especially when their food source is so widespread. I don't want people to start shooting squirrels because they think their land is on badger habitat.

**A:** **Kari:** *SARA* was built on three legs, one of which is stewardship—let's not forget that. Once we determine what "effective protection" is, we can move forward.

**Q:** Power strategies are only part of the things that motivate people. There are also incentives and re-education. That stewardship piece plays a really big role. It seems to me that when we talk about stewardship we think about private landowners. Often, on crown land, tenure holders need help about how to protect species, too.

**A:** **Jeff Hoyt**: I agree. With *Forest and Range and Practices Act (FRPA)* there is an increased reliance on professionals. Many of these people don't know which option is best. It will be the responsibility of recovery teams and government agencies to put that information out there for these professionals.

**Q:** When you're in areas where there are multiple species at risk and you're defining critical habitat and the definition for your favourite animal conflicts with the definition for another species at risk, how do you resolve that and at what stage? At the stage of identification, or at the stage of conflict and management decisions?

**A:** **Karen:** There a few cases like this in the States, such as the black footed ferret and the prairie dog, which may be listed. I think what happens in the States is that the critical habitats get designated separately. When you plan for management you consider the combined effects. Several strategies for mitigation are thought up and the powers that be make the choice about how to move forward.

**Q:** Would that come up during the consultation phase?

**A:** **Kent:** Yes, as a last resort it could occur at that stage. Preferably, it would come up much earlier on. Whenever possible, recovery teams should do an initial scan of all species at risk in the area, in order to take advantage of existing knowledge across species, and tackle problems in an integrated manner. For example, in southern Ontario a recovery team has formed to remedy problems faced by multiple species associated with Lake Erie Sand Spit Savannas—the expectation being that by dealing with underlying threats and processes at the community scale, recovery is likely to be more fundamental and more durable.

**Q:** Should we be using the term critical habitat? It's very hard to prove. You can't remove one, two etc., hectares and see what happens. Do we really just mean a population goal for a recovery goal?

**A:** **Olaf:** It's definitely a recovery driven definition. In terms of the wording I don't think it matters that much.

**A: Peter:** All I know is that when I listen to things there are so many different species with such different habitat needs—e.g., Banff snail needs all the habitat that exists. It's very different for different species. We've been given one legislation and are trying to fit it to a whole lot of sizes. It's complicated. I'm not sure how we deal with this.

**A: Karen:** Many ecological terms have many definitions. To say we have one term and it means "this" is not the best way forward.

**A: Dwayne:** We should look at all the criteria used to list a species, such as area of occurrence and not just number of individuals, when addressing critical habitat and species recovery goals. Strictly looking at numbers can be dangerous, especially for a hermaphrodite, because we could arguably only need to conserve several snails. From those few snails we could still have a population if they reproduce well but we wouldn't necessarily be on the road to the species' recovery.

# Appendices

**Appendix One:** ABCs of Planning a Communication Strategy that Works!

**Appendix Two:** Field Trip Outline

**Appendix Three:** Highlights from Participants' Evaluation Forms

## *Appendix One: ABCs of Planning a Communication Strategy that Works!*

On the third day of the workshop, 18 participants took part in a session offered by Karen Sutherland and Susan Leech of FORREX. The materials from this session are not included in this conference summary. Readers may wish to refer to the document described below, which is available on the internet at:
www.speciesatrisk2004.ca/pdf/leech_edited_final_june_14.pdf

**Recovery Planning to Achieve Desired Results: Using Principles of Extension to Create Meaningful Behavioural Changes Linked to Overall Recovery Goals**

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**From:** T.D. Hooper, editor. Proceedings of the Species at Risk 2004 Pathways to Recovery Conference. 1 March 2–6, 2004, Victoria, B.C. Species at Risk 2004 Pathways to Recovery Conference Organizing Committee, Victoria, B.C.

**Abstract:** The Canadian *Species at Risk Act (SARA)* requires that recovery strategies be developed under specified time frames for all species and ecosystems that are listed as Threatened, Endangered, or Extirpated. In most cases, recovery teams have been established and charged with developing these recovery strategies. While these groups have tended to focus on the biological aspects of species and ecosystem recovery within their strategies, it is critically important that time and effort is also spent on the human aspects of recovery. The Recovery of Nationally Endangered Wildlife's (RENEW) guiding principle #1 states that "Species recovery ultimately depends on changing human behaviour to allow species to maintain self-sustaining populations." *Extension*, or the process of creating change within a specific audience group, is thus an integral part of species at risk recovery.

It is important for recovery teams to firmly integrate these desired changes in human behaviour with the biological goals of species and ecosystem recovery. In this paper, we provide recovery teams with an introduction to how they may achieve this integration. Specifically, we introduce the concept of using extension, or non-formal education, to change human behaviour. We emphasize that extension should be aimed at specific stakeholders, not the general public, to ensure that these groups have access to the best available information to change their behaviour. We then provide an overview of planning tools (Bennett's Hierarchy and the logic model) that are helpful for identifying the human component and connecting it with the biological component of recovery. Finally, we provide a brief explanation of how to write "SMART" outcome objectives—a critical step for allowing recovery teams to measure the success of their programs in the future. At the end of the paper, we include a list of resources that may be useful to assist recovery teams with this type of planning.

## *Appendix Two: Identifying Critical Habitat, Field Trip on October 20*

On October 20, 18 people took part in a field trip that went north from Cranbrook to Radium Hot Springs, B.C.

Our thanks go out to Ian Adams, who coordinated the field trip and even organized hot coffee on that windy, rainy day. We are also grateful to Kari Stuart-Smith, Rob Neil, Jim Beare, and Alan Dibb for sharing their expertise with the group at the field trip stops along the way.

### Field Trip Outline

| | |
|---|---|
| 8:15 a.m. | Meet at Prestige Inn Lobby/Main doors |
| 8:30 a.m. | Depart for first site |
| 9:00 a.m. | Arrive–**Tembec High Conservation Value Forest** |
| | Leader: Kari Stuart-Smith |
| 10:00 a.m. | Depart north |
| 11:00 a.m. | Arrive at **The Nature Trust** Hoodoos property (Westside Rd northwest off Hwy 93/95 between Fairmont and Columere)<br>Leader: Rob Neil |
| 12:00 p.m. | Lunch, provided |
| 12:30 p.m. | Depart north |
| 1:00 p.m. | Arrive at **Akisqnuk First Nation** (Lakeside Campground west off Hwy 93/95 north of Fairmont)<br>Leader: Jim Beare |
| 2:00 p.m. | Depart north |
| 2:30 p.m. | Arrive at **Kootenay National Park** (Redstreak Campground east of Radium) |
| | Leader: Alan Dibb |
| 3:30 p.m. | Depart south |
| 5:30 p.m. | Arrive in Cranbrook at Prestige Inn |

## *Appendix Three: Summary of Participants' Evaluation Forms*

Evaluation forms were summarized by Angela Cunningham, Parks Canada Western Canada Service Centre, Calgary, Alberta.


Additional information was added by Jackie Morris, Executive Director, Columbia Mountains Institute of Applied Ecology.

### *Introduction*

The workshop on Critical Habitat held in Cranbrook on October 18–19, 2005 sought to not only clarify policy surrounding critical habitat identification, but also to explore issues, challenges, methods, and solutions. While the conference identified the importance of critical habitat for species recovery, the aim was to abate some of the confusion and controversy regarding ecologically and legally defensible approaches to identifying critical habitat. An evaluation form was distributed at the end of this two-day conference to elicit feedback from participants on how well the workshop met their expectations. The Columbia Mountains Institute of Applied Ecology (CMI) also wanted feedback on potential topics for future conferences on this subject, suggestions for future events, as well as which presentations participants found most useful and which ones they found least useful. The evaluation form asked a series of open-ended questions, which respondents were expected to answer and return to organizers.

### *Method*

The Sonar Professional TM text retrieval system is a powerful document-searching tool typically used by government agencies for archiving, researching, and annotating bodies of text. Sonar Professional can process many types of text and word-processing files, so information already contained in computer files can be easily integrated.

After performing a search, Sonar displays the full text of each found document.Occurrences of key words and phrases are highlighted. Continually refining search criteria can narrow the number of documents examined. This becomes especially valuable when key words or phrases are very common in a large number of documents. Occurrences of key words or phrases are displayed in order and ranked by frequency. After a search, an instant index can be created which shows every document and page that contains a search phrase.

### *Results*

Of the 37 evaluation forms returned to conference organizers, 33 participants responded to question one regarding how well the workshop met their expectations, 28 participants responded to question two which asked what topics they would like to receive more information on, 30

participants responded to question three, which asked them to comment on what presentations they found useful, and a little less than half of all participants, 15 in total, responded to the final question which solicited suggestions for future events and courses that could be organized by CMI. In total, seven open-ended questions were asked on the evaluation forms, approximately 120 people attended the conference, and of those people 37 participated in the evaluation.

*Question One: How well did the workshop meet your expectations?*

Of the 33 responses to question one, just over half of the respondents thought the conference met their expectations well.
Examples:

- "Yes Well Done"
- "Quite Well"
- "Well selected speakers and audiovisual quality to support them"
- Well prepared logistics and facility"

About one-third of the respondents felt the conference did not meet their expectations.
Examples:

- "Only partially as I am still dismayed at the general lack or progress in actual critical habitat descriptions for species"
- "Presentations were a bit short on practical things that I can use, and some were far too long"
- "Generally I was disappointed and surprised that so few industry representatives were at the conference"

*Question Two: What topics would you like more information on?*

Of the 28 responses to question two, one-third of the respondents wanted more information on recovery planning.
Examples:

- "Recovery Planning. Techniques for estimating populations"
- "Invertebrate example projects would have assisted to round out this agenda"
- "Industry land managers—example incorporation of critical habitat and recovery planning into forest management plans/ activities"
- "Ground Squirrels, Burrowing Owls info also applies to grizzly bears and caribou. One species of concern directly impacting another. State of recovery planning"

Ten participants made the comment that they would have liked more information on identifying critical habitat.
Examples:

- "Direct applications of critical habitat descriptions for specific species. Actual methods in how to determine critical habitat for a species"
- "The process of identifying Critical Habitat"

- "I would like to see more coverage regarding the tools available for determining critical habitat. Some creatures do not fit the mould and require specific tools or consideration.
- "Discussions on the issue of isolated peripheral populations"

*Question Three: Which presentations were the most useful to you?*

Of the 30 participants that answered this question about one third of the respondents identified the following speakers as having the most useful presentations: Karen Hodges, Kent Prior, and Mike Pearson.
Examples:

- Most useful: Karen Hodges and mountain caribou presentation
- Most useful: Kent Prior SARA presentation
- Most useful: Mike Pearson showed results of actions taken to solve a problem

Some responses noted which speakers and topics participants enjoyed, but did not indicate preference.
Examples:

- All were useful. I liked the broad presentations at the beginning and specific case studies later on.
- All presentations were useful, interesting Wood Bison conclusion that questioned modelling experience.
- Presenters should understand their audience better— not as many graphs etc. are needed to illustrate a point.

*Question Four: How did you hear about this workshop?*

Participants heard about the workshop from a wide variety of sources, from web sites to word-of-mouth.

*Question Five: Please complete the sentence: As a result of this workshop I plan to….*

- Discuss experiences and methods of recovery planning with colleagues.(six comments)
- Apply some of this information to the recovery process I am working on. (five comments)
- Review the basics of population ecology and applications to recovery. (two comments)
- Try to integrate critical habitat into large resource development projects. (two comments)
- Continue to push the fact that we spend huge sums of money on a few priority species, based on politics not biological need.
- Inform further recovery work.
- Watch for how critical habitat is addressed by other recovery teams.
- Inform myself about approaches in U.S. and experiences in U.S.
- Consider hosting an aquatic and stewardship critical habitat workshops.

- Contact some of these experts for specific advice for my recovery team (three comments)
- Go to species at risk web site listed in the workshop agenda.
- Look into more info on a few topics, such as Bayesian Belief Networks, Aikake (spelling?) Information criteria.
- Propose establishment of critical habitat technical group within our organization, which could provide support on AIC stats, RSF, PVA etc,
- Explore business development opportunities related to species at risk
- Pursue recent literature on some of the new concepts introduced to me at this conference.
- Apply this information to two species of large ungulates as the pioneering group in this topic area—not yet described or applied for these species.
- Attempt to sway my supervisor to incorporate education of public works employees and others. Wants to be called on site more often to assess any lost critical habitat or notice opportunities for restoration.
- Read up on formal methods to get expert opinion input into decision making.
- Renew efforts to increase stewardship activities for Spotted Owl.
- Make sure our recovery strategy is *SARA* compliant; be sure it meets residence, critical habitat requirements.
- Try to define our criteria for critical habitat in our recovery plans.

*Question Six: Do you have additional comments?*

- More time for questions and discussion
- Lack of talks on marine species
- Might have tried working groups focused on critical habitat problems
- There does not seem to be one solution
- Highlight times/opportunities when biologists and foresters can work together, what stages?
- Forest Practices Board does a good job, but how about creating a parallel Environmental Practices Board, one with less controversy than Sierra Club?
- Fewer talks and more discussion

*Question Seven: Do you have suggestions for future CMI conferences or courses?*

Of the 15 people that responded to this question, over half of the responses asked for more courses or workshops dealing with the following: environmental assessment processes, field courses on sampling, advanced statistics and modelling, and technical writing.
Examples:

- A follow up critical habitat workshop
- A course/workshop dealing with environmental assessment processes under the Canadian *Environmental Act* and the B.C. *Environmental Assessment Act*.
- Courses/workshops on modelling and an advanced statistics course related to critical habitat.

### *Conclusion*

From the responses given on the evaluation forms, this conference did a good job at identifying the importance of critical habitat for species recovery. Most people were pleased with how well the workshop met their expectations, and generally participants were satisfied with the chosen speakers. Confusion and controversy regarding ecologically and legally defensible approaches to identifying critical habitat necessary for species recovery was not completely resolved. General opinions on this suggested it is on-going problem within this field of study and not the fault of the workshop itself.