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Proceedings of the DFO Pacific Region Critical Habitat Workshop.

Compte rendu de l'atelier de travail sur les habitats essentiels de la région du Pacifique du MPO.

26-28 March 2003, Nanaimo, BC

G. S. Jamieson (Editor)

Fisheries and Oceans Canada,
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Abstract

A DFO Pacific Region Critical Habitat Workshop was held on March 26-28, 2003, in Nanaimo, BC, to 1) identify quantitative, science-based methods for measuring critical habitat for Pacific aquatic species-at-risk; 2) prioritize approaches and to develop performance criteria to guide the development of procedures to determine critical habitat for recovery plans, 3) determine the biological and habitat data needed to measure critical habitat, 4) recommend to regional DFO line management the research activities required to more fully understand habitat nature and scale in the quantification of critical habitat, and 5) bring both scientists and resource managers together to allow development of a common understanding of critical habitat issues relevant to both science and regulatory management perspectives. This workshop built upon the deliberations of the DFO National Critical Habitat Workshop held in December, 2002, and while this recent workshop primarily addressed Pacific issues, the need for case study examples as soon as possible of at least “representative” species types was identified. With designation of critical habitat a specified requirement within species recovery plans in specified time frames, elements of both designation and the protection of critical habitat are likely to be controversial, and so there is an immediate need to develop a process to consider science-based critical habitat identifications that is rigorous, transparent and publicly available.

Résumé

Du 26 au 28 mars 2003, à Nanaimo (C.-B.), le MPO - Région du Pacifique a tenu un atelier sur les habitats essentiels dont les objectifs étaient : 1) cerner des méthodes scientifiques quantitatives pour mesurer des habitats essentiels pour des espèces aquatiques en péril du Pacifique; 2) classer les approches par ordre de priorité et établir des critères de performance afin d’orienter la mise au point de procédures pour déterminer les habitats essentiels aux fins des plans de rétablissement; 3) déterminer les données biologiques et environnementales requises pour mesurer les habitats essentiels; 4) recommander aux cadres hiérarchiques du MPO les activités de recherche requises afin de mieux comprendre la nature et l'échelle des habitats pour la quantification des habitats essentiels; 5) réunir les scientifiques et les gestionnaires des ressources afin qu’ils s’entendent sur les enjeux liés aux habitats essentiels selon les points de vue de la science et de la gestion de la réglementation. Cet atelier fait suite aux délibérations tenues au cours de l’atelier national sur les habitats essentiels du MPO qui a eu lieu en décembre 2002. Bien que les principales questions abordées au cours du dernier atelier concernaient la région du Pacifique, on y a cerné le besoin pressant de disposer d’exemples d’études de cas pour des types d’espèces au moins « représentatives ». Étant donné que la désignation des habitats essentiels constitue une exigence soumise à des échéanciers précis dans les plans de rétablissement des espèces, des éléments de la désignation et de la protection des habitats essentiels risquent d’être controversés. Il importe

donc d'élaborer rapidement un processus fondé sur la science, rigoureux, transparent et public pour la détermination des habitats essentiels.

Summary

As stated in the National DFO Critical Habitat Workshop summary (Randall et al. 2003), DFO Science will be required to provide the tools and methodologies for identifying and mapping critical habitat. The critical habitat provisions of the proposed *Species at Risk Act* (SARA) are only one of several legislative options for protecting habitat, and they are expected to have only limited actual application. Other habitat protection legislation involving other Acts are expected to be preferentially used to protect important habitat whenever possible. Nevertheless, because designation of critical habitat is a specified requirement within species recovery plans in specified time frames, and elements of both this designation and the protection of critical habitat may be controversial, methods for its identification must be science-based, rigorous, transparent and publicly available.

At the National Workshop, salient points were grouped under the following headings: methods for measuring critical habitat, guidelines/criteria for selecting methods, information needs, research priorities, and next steps. The proceedings of the national workshop were still incomplete and hence unavailable to participants on the date this workshop was held, but five participants at the national workshop also attended this workshop. This allowed some perspectives of national workshop deliberations to be incorporated into our discussions. In particular, Howard Powles' summary of the national workshop was a substantial component of the first presentation given. In some respects, then, the deliberations presented here have built on the national workshop's conclusions and recommendations.

In general, deliberations of this workshop produced similar conclusions to those of the national workshop, and so rather than repeat those all here, the two documents should be considered as building on each other.

Measurement Methodologies: The adequacy of the information available for study species is the main determinate of the methodology that is most suited for usage. To categorise data quality and quantity, we adopted the guidelines developed in the USA for essential fish habitat, an approach that was also adopted at the national workshop (Table 1).

Habitat Selection Issues: It was also evident from our discussions that there will be a number of ways to identify critical habitat, depending on how much biology is known and the nature of the threats affecting a species. Considerations in identifying critical habitat include the:

1) designation of critical habitat in areas that are currently being impacted by a threat, but where if the threat is being removed, the habitat is believed to be best, or
2) to designate critical habitat in areas that are not being presently impacted by threats, and where the current viability of the species is assured, even if the habitat there is not perhaps optimal.

There may often be a number of scenario options that are combinations of the above that have “equal science merit”, and the scenario ultimately chosen for the identification of critical habitat may to a large part be determined by the social and economic costs associated with these “equal science” options. However, often options may not really be equal if different perspectives, or optics, are considered. For example, we must also consider other species, and the potential synergies of effort and “umbrella-type” habitat protection. When there are species-at-risk that utilize similar habitats (e.g., sea otters and abalone, white sturgeon and salmon), a joint review of proposed critical habitat designations in relevant recovery plans may be desirable. This is often likely to be an issue, as many listed species are at risk because their ecosystems or habitats are severely threatened.

In comparison of freshwater and marine species’ habitat threats, and interpreting habitat to also include water quality parameters, the concern was repeatedly brought up as to the importance of upland activities and threats, such as runoff, sedimentation, changes in vegetative cover, etc., in determining the suitability of freshwater habitats. The influence that SARA might have on the management of upslope activities that would affect designated critical habitat needs to be clarified. Ephemeral habitats, such as seasonally flooded habitat, are also increasingly being recognised as important habitat for some species-at-risk, and so there are likely to be temporal components to some critical habitat designations. This is different from habitat that functionally exists all the time, but which may only be used on a seasonal or short-term basis. It was also felt that species in freshwater habitats were generally more vulnerable to extinction than most of those in the marine environment because of the linear nature of freshwater systems, and thus have greater susceptibility to fragmentation; an often smaller scale (less buffering); and possibly greater species isolation (analogous to island biogeography). The extensive ranges, pelagic distribution and high mobility in either the larval or adult stages of many marine and anadromous species, such as cetaceans, leatherback turtles and salmon, pose other unique challenges to critical habitat definition.

Separating critical habitat from essential habitat was also actively discussed, with the recognition that for most species, there is a lot of mediocre habitat and a lesser amount of higher quality habitat. Conceptually, assuming that habitat quality can be linked to the viability of a species, there is likely a quality/quantity habitat trade-off (more poorer habitat may be equal to a lesser amount of higher quality habitat), thus indicating that there may be multiple spatial configurations that a recovery team can consider that achieve the same population viability.

This approach may provide the opportunity to identify a number of options in a recovery strategy.

Information Needs and Research Priorities: A basic understanding of a species' habitat requirements should be the foundation of defining critical habitat in every recovery plan. However, understanding of species' life histories and habitat requirements at different life history stages is often limited, even for some heavily exploited species. Definition of critical habitat of critical habitat will not be possible for such species without further study. . Recovery plans should include recommendations for research within acceptable time frames to gain an adequate understanding of a species' habitat needs. In particular, the quality of habitat, or its functionality for specific life stages, needs to be assessed in the context of the threats that are, or might be, impacting it.

Threats are also not also easily defined, and the cumulative effects from a variety of threats may often be the situation. Determining linkages between threats, habitat functionality, and the viability of populations will not be trivial scientific issues for many species-at-risk.

Next Steps: As with the national Workshop, the need to initiate case study trials as soon as possible was identified as a high priority. Only by trying to identify critical habitat for a number of "representative" species can many of the challenges be identified, and methodologies to address them be evaluated. There was much discussion about the merits of establishing a common marine habitat database, as many critical habitat evaluations will rely on the same data sets. A common database could minimise research duplication, but would require that someone accept responsibility to maintain it. Also, there was no clear recommendation as to whether if established, it should only contain physical parameter data, or biological data (spatial occurrences of species abundances) as well, recognising that both factors determine a species' spatial distribution and habitat suitability.

Finally, there was interest in having a follow-up workshop when the case studies were completed so that a broader understanding of the lessons learnt could be promulgated.

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1. Introduction

With the recent passage of the *Species at Risk Act* (SARA) in late 2002, and its expected enactment in mid 2003, there will be specific requirements to both identify and protect habitat in a timely manner that is critical to the continued survival of species listed in the *Act's* Schedules. It is thus imperative that those Canadian government agencies mandated to conserve species anticipate this forthcoming legislative requirement and initiate actions to begin this process as soon as possible. Critical Habitat, as defined by SARA, is:

> "that habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species" (Sec. 2)

A National Fisheries and Canada (DFO) Science Workshop in December, 2002 initiated the process of developing a collective DFO understanding of what critical habitat means in the context of marine and aquatic species, and how to begin addressing this issue. The proceedings of this workshop are in the final stages of completion, and will soon be published in the Canadian Science Advisory Secretariat Proceeding Series (Randall et al. 2003). This Pacific Region Critical Habitat Workshop is a follow-up to that workshop, and brings the discussion to Canada's Pacific Region so that:1) regional staff will have a better understanding of what "critical habitat" in the sense of SARA means, 2) more specific relevant applications are considered, as the focus in Nanaimo was solely on Pacific Region SARA Schedule 1 species, and 3) a broader sector group could participate in the discussions, in that in addition to science staff, operational resource managers (habitat and fisheries managers, and enforcement staff) were also present. The Breakout Group discussions listed in this report thus represent this diversity of interest and expertise, and so produced a broader perspective of the challenges that DFO staff will have to address once SARA becomes law.

1.1. Pacific Region Critical Habitat Workshop Objectives

1.1.1. To identify quantitative, science-based methods for measuring critical habitat for Pacific aquatic species-at-risk.

1.1.2. To prioritize approaches and to develop performance criteria to guide the development of procedures to determine critical habitat for recovery plans.

1.1.3. To determine the biological and habitat data needed to measure critical habitat.

1.1.4. To recommend to regional DFO line management the research activities required to more fully understand habitat nature and scale in the quantification of critical habitat.

1.1.5. To bring both scientists and resource managers together to allow development of a common understanding of critical habitat issues relevant to both science and regulatory management perspectives.

2. Presentations

2.1. Legislation and science for management of aquatic species.

Glen Jamieson[1] and Howard Powles[2], [1]Habitat Science, Fisheries and Oceans Canada (DFO), Nanaimo, BC; [2] Fisheries and Biodiversity, DFO, Ottawa, ON.

This presentation incorporates Howard Powles' summaries from the National Science Critical Habitat Workshop, Montreal, QC, in December, 2002.

Critical versus important habitat

- "Critical" habitat is a term that to date has often been used synonymously with "important" habitat, but in the context of the forth-coming *Species at Risk Act* (SARA), it has a very specific meaning.

- Critical habitat (CH) in SARA means "that habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species" (Sec. 2)

Interesting / useful / needed information

- There is broad species coverage among Committee on the Status of Endangered Wildlife in Canada (COSEWIC) - listed species: whales (large and small), salmon, sturgeon, freshwater spp, sea turtles, abalone, etc.
- Relationships between abundance and habitat use vary: species mobilities, shrinkage of distribution ranges, source-sink populations
- There is a need to evaluate how to assess habitat requirements under fluctuating population conditions (e.g., is more or better habitat needed under poor population conditions?)
- Community and multispecies issues:
  - Tradeoffs?: salmon vs sturgeon, sea otters vs abalone
  - can CH protection for one species help many?

SARA habitat – definition

- For some marine species, important habitat may be relatively well defined (e.g. bottlenecks, estuarine species), but for many widely-distributed nearshore listed species (e.g. northern abalone, sea otters, etc.) that

occur now, or have occurred in the past, at countless places over much of the coastal region, a challenge will be to define whether some spatial areas are more important than others.

- "Habitat" for aquatic species is defined consistent with the Fisheries Act (Sec. 2)
  - Sec. 34: ""fish habitat" means spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes"

SARA critical habitat – identification

- "recovery strategy must… include… (Sec. 41)
  - "an identification of the species' critical habitat, to the extent possible, based on the best available information…"
  - "a schedule of studies to identify critical habitat, where available information is inadequate"
- "action plan must include (Sec. 49)
  - "an identification of the species' critical habitat, to the extent possible, based on the best available information…"
  - "a statement of the measures that are proposed to be taken to protect the species' critical habitat"
  - "an identification of any portions of the species' critical habitat that have not been protected"

SARA critical habitat – timelines

- The Competent Minister must include a proposed recovery strategy in the public registry within one year of legal listing for ENDANGERED, two years for THREATENED or EXTIRPATED.
- The recovery strategy must include a statement on when one or more action plans will be developed.
- There are no mandated timelines for action plans except as above.

SARA critical habitat – protection (see Figure 1)

- General objective: to ensure that critical habitat in federal jurisdiction is protected within 180 days after being identified in a recovery strategy or action plan (Sec. 57).
- "No person shall destroy" is the operative clause (Sec. 58).
- Mandatory protection for critical habitat under federal jurisdiction (Sec. 58):
  - federal protected areas: the Competent Minister must publish a description of critical habitat within 90 days, and protect it within another 90 days
  - aquatic species: the Competent Minister must formally report on how protection is being achieved, or make an order to protect this habitat
  - protection can be achieved via agreement, or under another Act

SARA critical habitat – compensation

The Competent Minister may provide compensation for losses suffered as a result of extraordinary impact of application of critical habitat protection provisions (Sec. 64)

- Intent is for government to gain experience on this topic before developing detailed guidelines on compensation procedures
- Has potentially large financial implications
- Somewhat complicated for aquatic species and situations, given pre-existing Fisheries Act provisions
- Reinforces the need for rigour in identifying critical habitat

Habitat terminology: Fisheries Act VS SARA

Fisheries Act	SARA
• "Works and undertakings"	• "Activities"
• "Harmful alteration, degradation, and destruction"	• "Destroy"

Critical habitat identification process: considerations

- Critical Habitat identifications may be controversial
  - pressure to identify more/less
- "extent possible" provides some flexibility
- although this is essentially a science issue, appropriate standards might ultimately be defined in the courts
- Deliberations will have to be rigorous, documented (i.e., transparent), and peer-reviewed

SARA – other habitat references

- Destruction of residences of EXTIRPATED, ENDANGERED, and THREATENED species is prohibited (Sec. 33)
  - Residence means "a dwelling-place, such as a nest, den or other similar area or place, that is occupied or habitually occupied….." (long description)
  - Essentially an adjunct to species protection
- Recovery strategies must identify threats to survival of species, including loss of habitat, and strategies to address them (Sec. 41)

Realities

- Critical Habitat is a key part of SARA, and its implementation will be highly visible
- Critical Habitat is legally defined in the context of recovery strategies or action plans
- The Competent Minister is accountable, but a high level of consultation will occur

- High scientific standards will be required: rigorous peer-review processes and clear explanations of deliberations

Activities to date

- National committees:
  - Interdepartmental (federal) Critical Habitat Working Group (Kent Prior, EC, Chair)
    - Meets every 3-4 weeks
  - DFO Critical Habitat Working Group (Anne Phelps, Chair)
    - One national workshop (April 2002), mostly HEB-focused

- Critical Habitat Science Workshops (to date)
  - National Workshop, Montreal, December, 2002
  - Pacific Regional Workshop – this one

Table 1: Hierarchy of Information Level and the corresponding gradient in detail for population targets and critical habitat targets for at-risk species. (T. Bigford, modified by K. Minns)

Information Level	**Life History Stage**			**Habitat or ecosystem features**			**Model(s)**	**Population Target**	**Critical Habitat Target**
	a	b	c	d	e	f			
0 - Know nothing							TEK, surrogate species, inference	Qualitative	Broad in scope & area
1 - Presence/ absence data							Hansk; cursory mapping		
2 - Population density data							API, stock assessment techniques		
3 – Life stage process rates (survival, growth, fecundity)							PVA, Meta-population; others (as applicable to species, available information)		
4 -Productivity							Population – habitat capacity models	Quantitative	Narrow, well-defined

Status of National Critical Habitat Science Workshop, December, 2002, Montreal, QC, proceedings

- Being currently edited by Bob Randall and Ken Minns, DFO, Burlington
- Proceedings will be shortly published as a CSAS Proceedings Document

Discussion:

In legal terms is the Fisheries Act deemed to equivalent to SARA?

Under the Fisheries Act habitat protection applies to works or undertakings. However, in SARA habitat protection applies to activities.

Is SARA legally binding?

Recovery plans don't have a legal status per say. For example: a Recovery Strategy is written with stakeholder involvement and is put on the public registry. The recovery strategy itself is not legally binding; however, the portion that identifies critical habitat is legally binding.

2.1.1. A Habitat Management Perspective on SARA (Bill C-5)

Anne Phelps, Habitat Policy and Regulatory Affairs, DFO, Ottawa, ON

Purpose of SARA Bill C-5

- The purposes of this Act are to prevent wildlife species from being extirpated or becoming extinct, to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity and to manage species of special concern to prevent them from becoming endangered or threatened.
- The Act covers <u>all</u> wildlife species listed as being at risk <u>and</u> their critical habitats.
- "Wildlife species" includes aquatic species.
- "Aquatic species" means a wildlife species that is a fish, as defined in section 2 of the *Fisheries Act*, or a marine plant as defined in section 47 of that Act.

Status of Bill C-5 Species at Risk Act

- Bill C-5 introduced February 2001.
- Bill was passed by the House of Commons June 2002.
- Bill was passed by the Senate and obtained Royal Assent December 2002.
- A series of regulations are currently under development and must be completed prior to coming into force.
- Date coming into force unknown; June 2003 at the earliest.

SARA roles and responsibilities

<u>Three Competent Ministers:</u>

a. Minister of Fisheries and Oceans
   - Competent Minister for aquatic species (fish and marine plants as defined in the *Fisheries Act*) except individuals located in Parks.

b. Minister of Canadian Heritage
   - Competent Minister for species in national parks or historic sites.

c. Minister of Environment
   - Overall coordination, migratory birds and all other non-aquatic species.
   -

Species at Risk Act components (see Figure 1)

A. Species Assessment
   - COSEWIC reviews status reports and determines status

B. Response Statements
   - Minister's first response to COSEWIC designation
   - Ministerial communications tool

C. Legal Listing
   - COSEWIC list submitted for possible adoption by the Governor in Council

Approximately 30 non-Schedule 1 aquatic species will go through the Legal Listing process 9 months after proclamation.

- Staff may be required to provide any relevant information on aquatic SAR to COSEWIC.
- Staff may be asked to sign-off on response statements.
- Staff may be requested to participate in drafting or consultations associated with development of Regulatory Impact Analysis Statements (RIAS).
-

D. Protection

a. Automatic Prohibitions:

i. Prohibitions against harming extirpated, endangered or threatened species and their residences.

Sec. 32. (1): No person shall kill, harm, harass, capture or take an individual of a wildlife species that is listed as an extirpated, endangered species or a threatened species.

(2): No person shall possess, collect, buy, sell or trade an individual of a wildlife species that is listed as an extirpated, endangered species or a threatened species...

Sec. 33: No person shall damage or destroy the residence of one or more individuals of a wildlife species that is listed as an extirpated, endangered or threatened species...

ii. Implications of .Automatic Prohibitions

- Consider SARA prohibitions for aquatic SAR when reviewing referrals
- Harm to extirpated, endangered or threatened aquatic SAR should not be authorized
- The criteria in sections 73 and 74 of SARA must be met if considering the issuance of an approval or authorization affecting aquatic SAR
- Staff may support SARA enforcement activities and investigations as expertise warrants

Sec. 73 (2): (*a*) the activity is scientific research relating to the conservation of the species and conducted by qualified persons;

(*b*) the activity benefits the species or is required to enhance its chance of survival in the wild; or

(*c*) affecting the species is incidental to the carrying out of the activity.

Sec 73 (3): The agreement may be entered into, or the permit issued, only if the competent minister is of the opinion that:

(*a*) all reasonable alternatives to the activity that would reduce the impact on the species have been considered and the best solution has been adopted;

(*b*) all feasible measures will be taken to minimize the impact of the activity on the species or its critical habitat or the residences of its individuals; and

(*c*) the activity will not jeopardize the survival or recovery of the species.

b. Linkages with Existing Legislation

- SARA is complementary to the *Fisheries Act*, the *Canadian Environmental Assessment Act* (CEAA), the *Oceans Act* and other environmental laws. SARA does not replace these.
- Many measures in the proposed SARA are already within the Minister of Fisheries and Oceans authority under the *Fisheries Act* (e.g. closing fisheries to protect species, preventing destruction of fish habitat).
- Difference: SARA protection and recovery measures are mandatory once species are listed.
- *Sec. 57* provides for the use of other Acts of Parliament to protect critical habitat.

E. Recovery

a. Mandatory Recovery Planning:

i. Mandatory preparation of a recovery strategy for extirpated, endangered and threatened species. *(Sec. 37)*

- Include information about the species, threats and identify critical habitat, if possible
- Short and long term recovery goals and objectives

ii. Mandatory preparation of an action plan for extirpated, endangered and threatened species. *(Sec .47)*

- Describe specific measures needed and timelines
- Identify critical habitat, if possible
- Consider socio-economic impacts

iii. Mandatory preparation of management plans for species of special concern and its habitat. *(Sec .65)*

- The plan must include measures for the conservation of the species that the Competent Minister considers to be appropriate
- Existing plans may be adopted as SARA management plans.

b. Implications of Recovery Strategy, Action Plan and Management Plan development

- Approximately 70 recovery strategies for aquatic Schedule 1 and non-Schedule 1 species must be completed within 3-4 years of proclamation.

Next Steps

- Development of Fish Habitat Management Program SARA manual
- Regional training workshops
- Public information sessions
- TB submission
- Development of regulations

2.1.2. Critical Habitat Protection - Progress to Date and the Road Ahead

Presented by Anne Phelps for Kent Prior, EC, Ottawa, ON

Critical Habitat Working Group – Composition and Mandate

- EC/CWS, Parks, DFO
- Reports through L. Maltby to CWS Executive
- Objective: To recommend a consistent and coordinated process and technical guidance for implementation of components of SARA that relate to critical habitat (identification, protection, consultation, communication, governance)

Progress to Date

- Literature review – Biological Foundation for Critical Habitat
- Critical Habitat Under SARA – A Discussion Paper
- Critical Habitat Identification – Scoping Workshop (October 2001)
- Critical Habitat Protection – Scoping Workshop (January 2002)

- Consultation with USFWS Field Office (June 2002)
- Critical Habitat Identification – Technical Workshop (December 2002)
- Guidelines and Illustrative Descriptions of "Residence"
- Frequently Asked Questions (& Answers)
- Critical Habitat Protection Under SARA – A Discussion Paper

Work in Progress

- Critical Habitat Protection – Technical Workshop (February 2003)
- Critical Habitat Identification – Technical Guidance (March 2003)
  - Environment Canada's approach is to put together a series of technical guidance documents (protection, identification, enforcement, permitting, communication)
- D/IM for Critical Habitat (KMWC – March 2003)
- Federal Lands Working Group (March 2003)
- Critical Habitat Protection – Technical Guidance (April 2003)
- Interdepartmental Recovery Fund (IRF) Critical Habitat Case Studies & Workshop (May 2003)
  - Environment Canada received a grant to undertake some critical habitat case studies, the results will be presented at a workshop in May 2003
- Critical Habitat Procedures Manual (TBD)
- Critical Habitat Technical Training (TBD)

2.1.3. Challenges of Designating "Essential Fish Habitat" in the U.S. What Have We Learned?

Jon Kurland, National Marine Fisheries Service, National Oceanographic and Atmospheric Adminiatration, P.O. Box 21668, 709 West 9th Street, Juneau, AK 99802

Chronology for Designating EFH

- 1994/1995: Discussion to ammend the Magnuson Act to add habitat protection provisions
- July 1996: National Marine Fisheries Service formed an Essential Fish Habitat (EFH) working group
- October 1996: Magnuson-Stevens Act amended to require identification of EFH
  - Timeline associated with ammendment such that EFH had to be identified for all federally managed species of fish within two years after that the ammendment was enacted
- April 1997: Proposed rule published
  - Ammendments to act required that the agency publish regulations which would be the guidelines on how to go about identifying and describing EFH

- December 1997: Interim final rule published
  - Regulations were in effect, but not yet finalized
- October 1998: Statutory deadline for designating EFH
  - Original two-year deadline after enactment on when the EFH designations were supposed to go into effect. However, deadline wasn't quite made.
- January 1999: First EFH designations took effect
- January 2002: Final rule published
  - Regulatory guidelines were finalized

The Magnuson-Stevens Act §3(10) defines 'Essential Fish Habitat' (EFH) as *"those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity.*"

Key Terms in the Definition of EFH
"Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate.
"Substrate" includes sediment, hard bottom, structures underlying the waters, and associates biological communities.
"Necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem.
"Spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle.

Definitions of Habitat
EFH (Magnuson-Stevens Act): "…waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity"
Critical Habitat (SARA): "…habitat that is necessary for the survival or recovery of a listed wildlife species…"
Habitat (SARA): "…spawning grounds and nursery, rearing, food supply, migration, and any other areas on which aquatic species depend directly or indirectly in order to carry out their life processes…"
Critical Habitat (U.S. Endangered Species Act): "…areas…on which are found those physical or biological features (i) essential to the conservation of the species and (ii) which may require special management considerations or protection…"

The EFH Working Group fromed subgroups to develop 'White Papers' on what was meant by EFH and conceptually how does it fit in relative to all available habitat. Above is a schematic view of this, where

Critical Habitat (as outlined in the U.S. Endangered Species Act) is defined as: habitat necessary to avoid extinction, the bare minimum or core habitat.

Essential Habitat is defined as: somewhere in between the bare minimum habitat and all of the available habitat.

Habitat is defined as: all available habitat for a species.

Tiered Approach for Organizing Information

Because data are so limited for a lot of these species a data driven heirarchial scheme was developed to outline how to organize habitat information. The purpose of the scheme was to assist in the identification of specific areas or types of habitat as EFH.

Level 1: Distribution data are available for some or all portions of the geographic range of the species
- systematic presence/absence data
- a lot of the federally managed species fall into level one

Level 2: Habitat-related densities of the species are available
- relative abundance data

Level 3: Growth, reproduction, or survival rates within habitats are available
- linkage of habitat where species are found to activities that occur within the habitat

Level 4: Production rates by habitat are available
- quantitative realationship between habitat and a species

Majority of federally managed species are found in level one and two. Species found in level three were primarily some of the salmon species, and no species were found in level four.

Standards for Designating EFH

If only Level 1 information is available:

Evaluate distribution data (e.g., using frequency of occurrence analysis) to identify EFH as the habitat areas most commonly used by the species.

- use analysis (e.g., occurrence analysis) to weed out statistical outliers so that you aren't identifying EFH as everywhere the species is found, but focussing on areas that are most commonly used.

If Level 2 through 4 information is available:

Identify EFH as the habitats supporting the highest relative abundance; growth, reproduction, or survival rates; and/or production rates for the species.

Other Considerations for Designating EFH

- Habitat use may be inferred based on biological requirements, similar species, or other life stages

- e.g., if sampling hasn't occurred in a portion of a species range, but we have good information on the biological requirements of a species we could infer that the habitat that hasn't been sampled might also be EFH

- If a species is overfished, and habitat degradation or loss may be a contributing factor, EFH may include all current habitats and certain historic habitats
    - stock status or species status are relavent considerations in identifying imporant habitat
- EFH will normally be greater than or equal to "critical habitat" for threatened/endangered federally managed fish species
- EFH may be designated for assemblages of species rather than on a species by species basis
    - If there is good scientific reason to do so
- EFH may include degraded or inaccessible habitats in certain circumstances

Process for how EFH is identified

- Under the Magnuson-Stevens Act there are eight Regional Fishery Management Councils (North Pacific, Pacific, Western Pacific, Gulf of Mexico, Carribean, South Atlantic, Mid-Atlantic, New England). Each council focuses on fisheries within their geographic areas. The councils are the entities that are responsible for developing Fishery Management Plans. Once complete the councils hand them over the Fishery Management Plans to the NMFS for implementation. Similarily for EFH designations it is the councils that are charged with identifying and describing the EFH and then they turn it over to NMFS.

EFH Designations

- 43 fishery management plans covering ~900 managed species
- 2-4 major life stages per species (e.g., eggs, juveniles, adults)
    - EFH designations are largely done by life stage
- EFH for most species and life stages is a portion of the animal's full geographic range (in many cases about 60% of the observed range)
- EFH may be designated in federal or state waters
- Habitat Areas of Particular Concern are subsets of EFH that have extremely important ecological functions and/or that are especially vulnerable to degradation
    - Councils have the option of identifying Habitat Areas of Particular Concern

Examples of how EFH was designated

<u>Example 1:</u> EFH designation of Juvenile cod

The observed range for juvenile cod was based on trawl-survey data over a 30-35 year dataset for stock assessment purposes. Data is grouped in squares of latitude and longnitude.

Less than 60% of the observed range for juvenile cod was designated as EFH.

Habitat Area of Particular Concern (HAPC) was designated for a small area where there was really good habitat information (e.g., substrate and fauna information). The extra information that was available for a small portion of a species range allowed for a HAPC to be designated.

Example 2: Pacific groundfish and coastal pelagics EFH mosaic (see figure below)

Pacific Council looked at different types of habitats and then identified EFH for the species or complex of species that are found within each of these zones. For example, the EFH for rockfish found along the rocky shelf is outlined as the band labelled rocky shelf. This is an example where there has been criticism that the EFH designations are too broad.

Example 3: Juvenile and adult Pacific Ocean perch in the Gulf of Alaska (see figure below)

This shows the relationship for the designation of one species to the socio-economic zone. This is referred to as a general distribution approach, in this case the North Pacific Council looked at the general distribution meant to represent about 95% of the species range which is broader than the known concentration (~75% of the species range). They ofen went with the general distribution approach.

Challenges of Designating EFH

- We know surprisingly little about the habitat requirements of commercially important fish species.
- We know surprisingly little about the distribution and characteristics of sea floor habitats.
- For some species (e.g., pelagics) habitat features are ephemeral and not easily characterized or mapped.
  - Fisheries Management Plans cover species as diverse as giant tunas, flatfish, and razor clams
- Habitat conditions change over time.
- Different entities are responsible for the designations in different regions.
  - From an administrative point this was difficult because different approaches were taken by different councils.

EFH: Lessons Learned

- Resist the temptation to designate essential habitats broadly because of scientific uncertainty.
- Communicate clearly the implications of designating essential habitats, and be prepared to dispel myths.
- Exercise strong national and regional guidance and extensive coordination at all levels to ensure consistency in policy interpretation and scientific approaches.
- When you deviate from a standard approach document the methods used and have good reasons as to why you used them
- Map all essential habitat designations upfront using consistent protocols and GIS based, internet accessible tools.
- Document success stories and share them widely.

Future Directions for EFH

- New environmental impact statements and revised EFH designations
- Periodic review and revision, at least every 5 years
  - ensures the designations don't remain static
- Continued effort to distinguish EFH from all habitats
- Continued effort to include new information, be more explicit geographically, and improve GIS portrayals
- Additional research to fill data gaps
- Potential statutory changes

For more information about EFH, visit http://www.nmfs.noaa.gov/habitat/.

Discussion:
How did you determine the cut-off point wheter the CPUE was within the EFH or outside of it?

It was rather a subjective call. A ranked idex was developed for each of the 10 minute squares, then we picked the squares with the top 75-90% with the highest CPUE.

2.1.4. DFO Pacific Region Recovery Planning: Roles of teams and linkages between agencies

Don Lawseth, Policy, DFO, Nanaimo, BC

Overview

1. DFO Pacific - what's on our plate
2. Recovery Teams - role & structure
3. Recovery Strategy/Action Plan - content
4. How we work together

The Species List - Pacific Aquatic (see Appendix 1)

- Marine Species
  - 7 endangered
  - 6 threatened
  - 5 special concern
- Freshwater Species
  - 10 endangered
  - 3 threatened
  - 7 special concern
- More coming…some changing

The Timing

- Newly Listed Species
  - 7 Endangered - 1 year for recovery strategy
  - 1 Threatened - 2 years for recovery strategy
- Schedule 1
  - 9 Endangered - 3 years for recovery strategy
  - 7 Threatened - 4 years for recovery strategy
  - 3 Special Concern - 5 years for management plan
- Re-assessments and New Reports
  - estimate 25-28 species

Recovery Strategies – DFO

Completed (2001/02)	Underway (2002/03)	Next in Priority
Northern abalone	Northern Pacific right whale	Interior Fraser coho
Pacific leatherback turtle	Sea otter	Sakinaw Lake sockeye
	Sticklebacks	Cultus Lake Sockeye
		Killer whales (S & N resident)
		Blue whale
		Salish sucker
		Nooksack dace

Recovery Teams

- Role
  - develop recovery strategies/action plans
  - advise on funding priorities
  - monitor recovery of the species
- Structure
  - many different structures available
  - DFO lead by DFO - possible co-chair

– Include: other jurisdictions, experts/academics, First Nations, those affected by or may affect recovery

Recovery Strategy – Objectives

- Advice to Minister
- Broad recommendations will follow action plans
- Describes recovery goal, objectives and approaches to be undertaken by jurisdictions, stakeholders and individuals and groups

Recovery Strategy – Content

a) A description of the species and its needs;
b) an identification of the threats to the survival of the species and a description of the broad strategy to be taken to address those threats;
c) an identification of the species' critical habitat, to the extent possible, and if critical habitat is identified, examples of activities that are likely to result in its destruction;
d) population and distribution objectives that will assist the survival and recovery of the species;
e) any other matters prescribed by regulations;
f) a statement about whether additional information is required about the species;
g) a statement of when one or more action plans in relation to the recovery strategy will be completed;
h) identification and description of actions needed to promote recovery and of Action Plans which could serve to promote recovery;
i) a description of research and monitoring required to fill information gaps and to monitor whether recovery objectives are being met; and
j) a description of any regulations required to promote recovery

Action Plan - Content

In addition to other things...

- Identification of species' critical habitat
- Measures proposed to protect the critical habitat
- Identification of portions of critical habitat not protected
- Evaluation of socio-economic costs and benefits

Coordination - Federal Participation

1. *Dept of Environment* → migratory birds, overall leadership on wildlife
2. *Dept of Fisheries & Oceans* → aquatic species
3. *Dept of Heritage* → species in National Parks & National Marine Conservation Areas

SARA Coordination - Federal/Provincial/Territorial

- Overall direction and coordination through the Canadian Endangered Species Conservation Council (CESCC) > CWD > NRWG
- Accord for the Protection of Species at Risk (1996)
  - Bi-lateral discussions in B.C. underway to coordinate and cooperate
- Joint coordination of Habitat Stewardship Program - EC, DFO, Parks & BC
- Co-proponents for IRF projects (DFO/Parks - abalone, sea otters)
- Cross-participation on recovery teams
- DFO-BC cooperative approach to freshwater species & co-leads on freshwater recovery team

Fed/Prov Coordination of Habitat Protection

- Agreement on Interjurisdictional Cooperation with Respect to Fisheries and Aquaculture (1999)
- Canada - BC Agreement on Management of Pacific Salmon Issues (1997)
  - Canada - BC Fish Habitat Management Agreement

Discussion:

Could you comment on the formal mechanism on keeping science and socio-economic values separate in the development of the Action Plans?

That is indeed a potential point of conflict. One end of the spectrum is the part of the recovery strategy which is strictly science based. However, consultation on these recovery strategies, will often raise socio-economic issues. The Sea Otter Recovery Team resolved that recovery strategy is science/biology based and that of socio-economic concerns must be identified for further consideration during the next phase – the action plan.

Is the recovery strategy for advice for the Minister or Canadian Endangered Species Conservation Council (Wildlife Ministers)?

Recovery Strategies are delivered to the competent Minister (DFO in our case)., The Minister then posts it on the public registry for 60 days for public comment, then has 30 days to consider comments and make appropriate changes.

Which version of the Recovery Strategy gets posted on the public registry?

Both the version approved by the Minister for posting and the finalized version. The public can track changes, as all versions are posed on the public registry.

How does the Recovery Strategy get finalized?

The Minister finalizes the Recovery Strategy by posting on the public registry.

2.1.5. Using Viability as a Criterion to Determine Critical Habitat

Chris Wood* and H. Resit Akçakaya
*Stock Assessment Science, DFO, Nanaimo, BC

Minimum Viable Population approach

(1) Ask population biologists to specify minimum size of population necessary for survival and recovery (*i.e*., delisting) = Minimum Viable Population (MVP)
(2) Determine habitat required to support MVP (*e.g., area-per-individual models*) and designate it as critical habitat

MVP approach is not very helpful

- Population size is not the only factor (*or even the most important*) in determining viability of a population
- Habitat required to support a viable population depends on quality and spatial distribution
- Generalization is difficult because both quality and distribution are specific to species and landscapes
- Better to start with habitat in approaching the question of population viability

Using Viability as a Criterion to determine Critical Habitat

- Viability can be defined as the probability of persistence or recovery.
- Thus, under *SARA*, critical habitat can be interpreted as habitat necessary for viability.

Only an overall measure such as viability can integrate all the factors (population size, habitat, demography) that determine long-term persistence

What is a Viable Population?

A population that has a high likelihood of long-term persistence

- *High likelihood:* 90% probability? 99% probability?

Probabilities close to 0 or 1 are difficult to estimate

- *Long-term:* 100 years? 10 generations?

Long-term projections using these calculations are uncertain; short-term projections are not relevant

- *Persistence:* ≥1 individual? >50 mature individuals?

Dynamics at small population sizes are difficult to predict

What Determines Viability?

- Population size and structure: number of individuals, distribution to stages and subpopulations, density, trends
- Demography: survival, fecundity, dispersal rates; trends and fluctuations in these rates; breeding system, sex ratio

- Habitat: quality, amount, configuration
- Relationships between: demographic rates and habitat, demographic rates and population size

Critical habitat vs. other measures
If population is not viable within a given habitat:

- Add more critical habitat
- Change the spatial configuration
- Implement other measures:
  - Habitat improvement, especially for sink populations (*increase habitat quality, e.g., by reducing pollution*)
  - Re-introductions, translocations
  - Regulation of harvest in adjoining areas (*which may act as sink populations because of high exploitation rates*)
  - Removal of exotic species
  - Increasing connectivity (*e.g., habitat corridors*)
  - Precautions against catastrophic events (e.g. epidemics)

How can we determine if a population is viable?

- Population Viability Analysis (PVA)
- PVA uses species-specific data in an analytical or simulation model to calculate extinction risk, risk of decline, or other measure of viability
- Quantitative, rigorous methodology; Integrates different types of information
- Quality depends on availability of data and how good the assumptions are

1. Creating the habitat map
Regression of occurrence data on habitat variables such as:

Physical
- Stream width
- Gradient
- Water depth
- Channel slope
- Reach length
- Streambed elevation
- Lateral slope
- Light level periods
- Water velocity
- Water temperature
- Barriers to movement

Chemical
- Dissolved oxygen Concentrations
- pH
- Substrate type or particle size
- Conductivity

Biological
- Sediment organic content
- Cover type
- Riparian vegetation
- Woody debris

Landscape-level
- Percent forest cover in a drainage basin
- Presence and type of public boat launch
- Bedrock type
- Elevation
- Vegetation cover of the catchment
- Geomorphology
- Bank erosion index

Statistical methods for estimating the habitat suitability function (also called the resource selection function):

- Logistic regression and other GLMs
- Generalized additive models (GAMs)
- Discriminant analysis
- Classification trees
- Artificial neural networks

2. Estimating parameters: spatial structure

- Subpopulations based on habitat distribution
- Habitat patches identified (delineated) according to species-habitat relationships

3. Estimating parameters: demography

Estimating population-level and metapopulation-level parameters based on habitat-related variables:

Model parameters:	**Based on habitat variables:**
• initial population abundance (N0) • carrying capacity of the patch (K) • stage-specific survival (S) • stage-specific fecundity (F) • population growth rate (Rmax) • dispersal among patches • correlation among patches	• total habitat suitability • average habitat suitability • edge length (perimeter) • patch area (or core area) • habitat variables (vegetation, elevation, flow, temperature) • inter-patch distances

For example:

- *K* or *N*0 as a function of total habitat suitability
- *S* or *F* as functions of average habitat suitability or average values of specific habitat variables

Data requirements

Depend on the ecology of the species.

Models can be developed at many levels of complexity:

- Spatial structure: Single population; metapopulation; spatially explicit (habitat-based)
- Demographic structure: None (scalar), stage, age, stage+sex, age+sex
- Density dependence: None, ceiling, R as a function of total N, any survival or fecundity as a function of any abundance
- Variation: Demographic stochasticity, environmental fluctuations, catastrophes

As few as 2 parameters, to as many as thousands

RAMAS GIS in the context of other methods

- Ecosystem models
- Multi-species (food web) models
- Individual-based spatially explicit models
  - Structured, habitat-based metapopulation models
  - Unstructured metapopulation models
  - Stage-, age-, sex-structured single-population models
  - Unstructured (scalar) single-population models
- Occupancy models
- Rules of thumb
- Expert opinion

Dealing with Uncertainty

- Estimate parameters as ranges *(minimum, best, maximum estimates)*
- Develop alternative models for non-numerical parameters *(type of density dependence, etc.)*
- Combine results from all models
- Express results as ranges *(e.g., decline risk is 0%-12%)*

Uncertainty and CH Designation

- Ranges on estimates of viability and critical habitat will become wider with less data
- A precautionary approach *(to minimize type II error)* would require that more habitat be designated as critical when estimates are less reliable
- How precautionary should DFO be in designating critical habitat?
- Who bears the burden of proof for designating critical habitat?

Given that:

- Designation of critical habitat carries high social cost *(very limited flexibility for other use)*
- Other more flexible legislative instruments are available *(such as the Fisheries Act)*

DFO's position seems to be that proponent of critical habitat must accept burden of proof.

… this suggests that critical habitat will seldom be defined for aquatic species

→ still need to specify standard for test or decision analysis

<u>Summary</u>

- Viability is a unifying concept for determining critical habitat
- Viability is a unifying measure (end point) that integrates effects of population, habitat, and demography
- Viability analysis with habitat-based models is an objective method for determining critical habitat
- A wide range of models ranging from scalar, single-population models to habitat-based, age and sex-structured demographic models can be used

Discussion:
You mention that critical habitat will seldom be defined for aquatic species, however the SARA requires critical habitat to be defined to the best extent possible. We still have to come up with some designation of critical habitat.

What I'm saying is that it is difficult to define given the burden of proof.

Clarification of the RAMAS model – it appears to be a canned statistical package. So, if I had for example a GIS representation of a stream, say 50 km of stream with different habitat types designated, I could just import that into the package and I could give certain habitats certain carrying capacities capacities, and this model will determine viability using this data.

The RAMAS model is a very flexible, very well documented package for doing those type of calculations. The biggest limitation appear to be that it requires point estimates for vital rate parameters and it propagates process error uncertainty using those parameters. The result is a distribution of outcomes based on the assumed point estimates. To embrace parameter estimation uncertainty, one still needs to make multiple runs with different point estimates, or as a "precautionary" short cut, you could use the mean parameter estimate minus one standard error as the point estimate used in RAMAS. The RAMAS model has a very nice export function that prints a list of all the assumptions. This documentation feature improves transparency by allowing other users to determine quickly what assumptions were made.

I'm wondering how you are finding the model deals with the more dynamic marine landscape?

So far I haven't explored the GIS-habitat linkage capabilities of RAMAS, just represented meta-populations schematically by assigning them different characteristics and specifiying their relative size and relative productivity. RAMAS does allow you to model scenarios with trends or catastrophic changes in vital rates that could be caused by changes in habitat, so likely there is flexibility for allowing a variety of scenarios involving dynamic habitat.
That kind-of carries with it the issue of the minimum amount of habitat required to maintain the smallest population to be persistent over a timeframe. Is that what the Act is looking for?

In fact, I had hoped to steer people away from using the minimum viable population approach. The *Act* doesn't say anything about how much critical habitat to designate. Presumably these targets will be recommended by the Recovery Team within the Recovery Plan, and needn't specify a a minimum viable population. Critical habitat in SARA refers to survival and recovery, not just survival as a minimum viable population.

We might want to use thresholds to distinguish between survival and recovery. The output of the PVA scenarios associated with various configurations of the habitat and decision options would be probabilities of persistence or recovery at certain levels within certain timeframes. Outcomes could be ranked after considering the cost associated with each and the "best" option could be selected.

2.1.6. Species Presentations

2.1.6.1.1. Northern Abalone (*Haliotis kamtschatkana*)

Joanne Lessard (Presented by Jim Boutillier), Stock Assessment Science, DFO, Nanaimo, BC

Geographic distribution

- Northern Ablaone are distributed from Yakutat, Alaska, to Turtle Bay, Baja California, Mexico.

Habitat

- Typically found from the intertidal to 20 m deep.
- Most adults are in water less than 10 m deep.
- Juvenile and some adults are cryptic.
- Patchy distribution throughout coastal BC
- Preferred habitat is
  - on rocky substrate
  - on exposed and semi-exposed coasts
- May aggregate in shallow waters during spawning season
  - Spawning aggregation depends on the immmediate area density

Life history/Life cycle

- Broadcast spawners
  - require a certain density to be reproductively successful
- Larvae are planktonic for 8-14 days prior to settling
- Mature adults are 3-7 years old
- Maximum age is estimated to be between 30-40 years old
- Average age is between 15-20 years old

Genetic sample locations

- Short planktonic life-cyle would suggest that there is a variety of isolated populations
- Genetic work has been done on samples gathered from a number of locations along the coast

Population genetics

Genetic testing found there was high genetic variation throughout the region, which showed that there was a certain amount of gene flow over large areas

- Some genetic distinction on the Queen Charlottes compared to the rest of the coast
    - only 2% of variation explained by geographic location

Diet

- Trochophore larvae is non-feeding
- Newly-settled and small juveniles feed on the diatom film associated with encrusting algae
- Adults feed on drift macroalgae

Effect of habitat type

- Study conducted in Hoskins Inlet looked at the size-distribution of ablone with depth
    - found juveniles in deeper areas and adults in shallower areas

- Another study found better growth in *Macrocystis* kelp beds (usually more sheltered) than in *Nereocystis* beds (usually high current and/or moderate surge areas) than in *Pterygophora* beds (usually high surge areas)
- more exposed areas tend to have a higher density of abalone

Index site surveys

- Surveys have been conducted along the coast of central BC and Queen Charlotte Islands
    - survey sites have been monitored since the late 1970's, while the abalone fishery was still active, and continue to be monitored after the closure of the fishery in 1990
    - survey findings lead to the close of the abalone fishery

Decline and closure of the northern abalone fishery

- A large decline in the "legal" abalone density wass found within the Index Sites along the Central Coast and Queen Charlotte Islands
- Decline lead to the province-wide closure in 1990
- Index sites are continually monitored
    - There has been no signs of recovery in the last 10-13 years
- Percentage of index sites with no abalone and less than 0.25 abalone m^{-2} is increasing over time
- Broodstock survey data collected between 1999-2001 shows that there is no sign of recovery, the densities are very low
    - only 3 sites have a density of > 0.1 abalone m^{-2}
- In 1978, the mean densitiy of abalone was 2.7 m^{-2}
- In 1998, the mean density of abalone was 0.5 m^{-2}

Threats

1) Illegal harvest
2) Low recruitment: small numbers sparsely distributed

    - problem with broadcast spawners is low density
3) Habitat concerns: developments in, on and under water
4) Competing with other species at risk
    - e.g., sea otters which prey on abalone

Critical habitat
Good abalone habitat is not limiting, but...
we need to know where to rebuild stocks

- where the little ones grow into adults
- sources and sinks of abalone larvae
- how anthropogenic development will impact abalone and their habitat

Discussion:
How are the Asian abalone stocks able to support a fishery over a much longer timeframe than those in B.C.? Can we learn from their management?

No, there are indications from all over the world that abalone stocks are being exploited. Very few abalone populations can support a fishery. We know that poaching is still occurring in BC because enforcement staff are still catching perpetrators.

References
Campbell, A. 2000. Review of northern abalone, *Haliotis kamtschatkana*, stock status in British Columbia. Can. Spec. Public. Fish. Aquat. Sci. 130: 41-50.

Sloan, N.A., and P.A. Breen. 1988. Northern abalone, *Haliotis kamchatkana* in British Columbia: fisheries and synopsis of life history information. Can. Spec. Public. Fish. Aquat. Sci. 103: 46 p.

2.1.6.1.2. Boccacio (*Sebastes paucispinis*)

Rick Stanley, Stock Assessment Science, DFO, Nanaimo, BC

Geographic distribution

- Found along the edge of the continental shelf
    - or at least the trawl fishery exploits them in this area
- Also found in inlets

Life history/Life cycle

- Short-lived (maximum age ~40 years old) for rockfish species
- Fast growing

History of bocaccio bycatch in the trawl fishery

- In the 1970's, bocaccio bycatch coastwide was between 400-500 metric tones

- The bocaccio bycatch values in the early 1990's, where coastwide values were around 1000 metric tones, are likely overstated
    - during this time there was an incentive for trawlers to misreport other rockfish bycatch as bocaccio
- Since full observer coverage, the reported coastwide catch of bocaccio bycatch of approximately 200 tones is likely accurate
- The incidental catch in hook and line and recreational fisheries is unknown

Habitat

- Habitat range is in the order of 10's of 1000's of kms

History of bocaccio distribution between 1996 and 2001

- No obvious changes in distribution during this timeframe
- U.S. landings have decreased to virtually zero
- The U.S. triennial survey is an index that shows trends in the CPUE of bocaccio

Biology

Based on California research

- livebearing – mate in the fall with parturition in late winter
- 4-5 years for age at 50% maturity
- hard to age
- maybe a maximum age of 40 or 50 y, and mortality of 0.15-0.25 (natural mortality is ~20% die per year)
- larval settlement in the shallows, juveniles move deeper as they grow bigger/older
- pelagic piscivores when adults
- use to be a big item in the recreational fishery in California
- up to 91 cm in length, and 6.8 kg in weight
- move (up to 148 km) as juveniles, maybe not as much as adults
- two US stocks? (California and Washington – newer data says no)

According to COSEWIC…..

- Initially proposed by PSARC to be listed as "Special Concern", but COSEWIC , after review, listed it as "Threatened"
- Data deficient- little known re enclosed waters

For Outer Coast B. C. Groundfish commercial fishery…..

- Only demonstrated issue is decline are in Areas 3C and southern 3D
- Presumably linked to the US decline
- Probably not B.C. fishery generated?
- 1995- 2001 triennial biomass estimate shows trends similar to our trawl fishery data
- US fishery now very reduced

- Canadian landings now constrained by 6.8 t (15,000 lb) limit for non-quota trawl rockfish

After COSEWIC

- Special Concern => Threatened
    - document suggests all of the fish along the coast of B.C. belong to one stock, which shows a rate of decline of 95%

Recovery Plan to be developed by recovery team.

Remove "threat"

- Poor recruitment and overfishing as proximal cause
- COSEWIC concern over decline in U.S. waters, now virtually no fishery ("reduced threat)
- Canadian catches already "low" (25 t in 3C)

Management action

- Canadian catches are reasonably well known
- Catches already constrained (6.8 t trawl trip limit)

Science/assessment

- CPUE probably useful over short term for tracking
- Will be "Coastwide" starting in 2003
- What is the absolute biomass relative to 25 t harvest in 3C
    - If survey => 150 t in 3C and catchability = 0.25, then > 600 t in 3C?
    - Mortality= 0.2, therefore 120 t dying naturally per year, and 25 tones y^{-1} from fishing
        - Is 25 tones y^{-1} a threat?

Summary

- Species life histories, habitat and range summarized
- Information on habitat needs – little information on what juveniles require for survival
- Uncertainty regarding stressors
    - Poor period for groundfish = yes
    - Commercial fishing = yes
    - Habitat threatened = ?
- Need for anticipatory and precautionary management…
- Need for collaboration between environmental and fisheries science
- Need for collaboration between science and fisheries and habitat management = yes, but bocaccio is not an obvious example

Reference

Stanley, R.D., K. Rutherford, and N. Olsen. 2001. Preliminary status report on bocaccio (Sebastes paucispinis). Canadian Science Advisory Secretariat research document 2001/148: 55p.

2.1.6.1.3. Sakinaw Lake Sockeye Salmon (Oncorhynchus nerka)

Clyde Murray, Stock Assessment Science, DFO, Nanaimo, BC

Geographic distribution

- Important areas for Sakinaw salmon are the inside waters of Vancouver Island
- Sakinaw Lake is located in Statistical Area 16.
- Sakinaw or “Sauchenauch” Lake is located on the Sechelt Peninsula and is within the traditional territory of the Sechelt Indian Band

Important habitat:

- In 1979, a survey in Sakinaw Lake located five sockeye salmon spawning beaches, all occur within vicinity of creek mouths at depths of 3-10 m
- In 1999, a survey identified only one of the previous five spawning beaches being used

Trend in escapement

- Populations stable from 1945 to 1985 with an average of approximately 5000 and a peak escapement of 16,000 in 1975
- Escapements have decreased rapidly in the last 12 years
- 5 year average annual escapement for 1997 to 2002 is about 80 sockeye

Assessment of threat

- Regression analysis with the 90% CI for a 4-yr smoothed trend for Saginaw sockeye escapements over time shows a 98% decline in 12 years
- Sakinaw sockeye have been considered as a "species" by COSEWIC and have been emergency-listed as Endangered.

Evidence for uniqueness

- substantially reproductively isolated from other populations
- distinctive life history characteristics (early river-entry timing, protracted adult run timing, extended lake residence prior to spawning, beach spawning, small body size, low fecundity and large smolts)
- very restricted gene flow between Sakinaw and other sockeye populations and the distance to the nearest extant sockeye population both confirm that there is virtually no possibility of natural rescue from neighbouring sockeye populations.
- all previous attempts to transplant sockeye to Sakinaw Lake have almost certainly failed.

- cannot be optimistic about prospects for re-establishing a sockeye run to Sakinaw Lake if the native population were to become extinct.
- With the emergency listing COSEWIC concluded that Sakianw Lake sockeye are a “species” and a ecologically significant unit.

Threats

- Climate
- Dam
- Loss of spawning habitat
- Logging
- Urbanization
- Fisheries
- Enhancement
- Competitors and predators

Next steps

- Opportunities exist for enhancement and restoration of Sakinaw Lake sockeye, which include increasing escapements, hatchery incubation and fry outplants, captive brood, improvement of spawning grounds, and control of competitors or predators.
- A comprehensive recovery plan is being developed for Sakinaw Lake sockeye to explore all the options, to ensure that the proposed measures address the recovery of Sakinaw sockeye, address local and regional concerns, and do not contribute to further harm.

Reference

Murray, C., and C. Wood. 2002. Status of Sakinaw Lake sockeye salmon (Oncorhynchus nerka). Canadian Science Advisory Secretariat research document 2002/088: 100 p.

2.1.6.1.4. Cultus Lake Sockeye Salmon (Oncorhynchus nerka)

Neil Schubert, Stock Assessment Science, DFO, Delta, BC

Geographic distribution

- Southwestern B.C. in the upper part of the Lower Fraser Valley

Life history/Life cycle

- An anadromous fish species, utilizing:
  - rivers or lakes for breeding and egg incubation;
  - lakes for juvenile rearing;
  - rivers and estuaries to migrate to and from the ocean; and
  - near coastal areas and the Gulf of Alaska for growth and maturation.

- Spawner population:
  - protracted migration into Cultus Lake; long lake residency period before spawning
  - exclusively use lakeshore for spawning
  - latest spawners among Fraser sockeye
- Juvenile population:
  - school, move offshore (predator response)
  - rear for 1-2 summers, compete with shiner, stickleback for food (insects, zooplankton) and serve as prey to resident species
  - extensive limnological record for Cultus Lake
- Ocean residency:
  - smolt migration from late March to June
  - juveniles migrate through Johnstone Strait by July, offshore into Gulf of Alaska by first winter
  - maturing adults return to coastal waters with Summer Run in August of their 4th year
  - late Run delays in estuary for 6-8 wks
- Early migration into the Fraser River:
  - abnormally short estuarine delay since 1996
  - longer freshwater residency associated with *P. minibicornis* infestations, high PSM

Population status

- Nationally significant Population COSEWIC emergency listing status is *Endangered.* COSEWIC choose the rarely used emergency listing process because:

  - Very low abundances that leave population vulnerable to depensatory mortality and environmental stochasticity;
  - There is a significant risk of extinction if harvest pressure continues and prespawn mortality remains high;
  - They consider the preservation of the dominant cycle to be key to the conservation of the population

Contributors to the decline

- Fishery exploitation
- Low marine survival
- Early migration

Threats to the population

- Environmental stochasticity
- Parasites and predators
- Exotic species
- Habitat alteration

Uncertainty, precaution and collaboration

- Uncertainty: Two of the three primary causes of the decline are uncontrollable:
  - Early migration: cause unknown; severity unpredictable;
  - Variable marine survival: quasi-predictable, uncontrollable.
- Precautionary management: Exploitation is the only primary cause that is controllable.
- Collaboration: Low abundances leave population vulnerable to poorly understood depensatory population dynamics. Better understanding of the ecosystem and its linkages is required.

Reference

Schubert, N., A. Cass, T. Cone, B. Fanos, M. Foy, J. Gable, J. Grout, J. Hume, M. Johnson, M. Morton, K. Shortreed, M. Staley. 2002. Status of Cultus Lake sockeye salmon *(Oncorhynchus nerka).* DFO Canadian Science Advisory Secretariat Research Document 2002/064: 118 p.

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2.1.6.1.5. Interior Fraser Coho (*Oncorhynchus kisutch)*

Jim Irvine, Stock Assessment Science, DFO, PBS, Nanaimo, BC

Freshwater Geographic distribution

- Found in the Fraser River watershed upstream of Hell's Gate, including the Thompson River, as far upstream as the Nechako drainage

Life history

- Most spend 1 yr in freshwater, 18 months at sea
- Normally don't undergo extensive marine migrations
  - frequently found off West coast of Vancouver Island and in the Strait of Georgia

Evidence for uniqueness

- Genetic work
  - dendrogram showing significant genetic differences between Interior Fraser and Lower Fraser Coho
  - Interior Fraser coho originate from populations that survived glaciation in Columbia River refugia. Other coho that may have been similar genetically are now extinct.
  - Coho salmon coast-wide baseline consists of 22,000 fish from 141 stocks ranging from Alaska to the Columbia River
  - Are a designatable unit under COSEWIC and a "species" under SARA.

Population status

- Interior Fraser Coho

- Population declined by 60% over a 10 year period between 1990 and 2000

  - primary cause of decline was excessive fishing that was not reduced quickly in response to climate-driven declines in marine survival

- Listed in May 2001 by COSEWIC as endangered

What is the role of habitat in their decline?

- Rates of decline were positively correlated with changes in the quality of habitat

  - Although habitat degradation played a role in their decline, overfishing was still the primary cause

Threats

- Overfishing
- Habitat degradation

Critical Habitat

- Extremely difficult to identify critical habitat for a migratory species like interior Fraser coho salmon - how to accommodate concerns for habitat in the Fraser estuary and the North Pacific?
- Salmon require a variety of habitat at different life stages. Habitat diversity is critical.

References

Irvine, J.R., 2002. COSEWIC Status Report on Coho Salmon, *Oncorhynchus kisutch,* from the Interior Fraser River Watershed, BC. http://www.cosewic.gc.ca/

Irvine, J.R., C.K. Parken, D.G. Chen, J. Candy, T. Ming, J. Supernault, W. Shaw, and R.E. Bailey. 2001. 2001 stock status assessment of coho salmon from the interior Fraser River. Canadian Science Advisory Secretariat research document 2001/083. 67 p. http://www.dfo-mpo.gc.ca/csas/

Discussion:

Given the same history, and same threats, rather than going through as listing process, could we not develop a Recovery Plan for the Interior Fraser coho and the Interior Fraser steelhead simultaneously?

Certainly a possibility. However, steelhead have very different habitat requirements than coho. The critical habitats would be different for the two species.

Could you expand on the use of hatcheries and how they would increase the threat or impede the recovery?

This was one of the potential concerns identified by COSEWIC. Primary reason for decline was overexploitation and habitat degradation has played a less significant role in the decline.

2.1.6.1.6. Recovery Planning for Freshwater Fish Species at Risk in B.C.

Jordan Rosenfeld, Aquatic Ecosystem Science Section,
B.C. Min. of Water Land and Air Protection, Vancouver, BC

A National Recovery Team for Freshwater Species at Risk in B.C.
Formed to oversee the development of recovery plans for all COSEWIC listed species. Membership currently consists of:

Todd Hatfield – Co-ordinator, Solander Ecological Research
Clyde Murray – Co-Chair, DFO Nanaimo
Jordan Rosenfeld – Co-Chair, WLAP UBC
Chris Foote – Malaspina College
Duane Jesson – WLAP, Lower Mainland Region
Don McPhail – UBC Zoology
John Richardson – UBC Forest Sciences
Eric Taylor – UBC Zoology
Paul Wood – UBC Forest Resource Management

Recovery Plans will be developed for those species most immediately at risk from identifiable threats. The first species targeted for recovery plan development are Stickleback Species Pairs (red-listed), followed by Nooksack Dace and Salish Sucker (red-listed).

A. Stickleback pairs (*Gasterosteus* sp.)

Geographic distribution

- A small number of freshwater lakes on Texada, Lasquiti and Vancouver Islands (Paxton, Balkwill, Emily, Priest, Hadley, and Enos Lakes, and Vanada Creek)

Population status

- Hadley Lake: Extirpated by introduced catfish (brown bullhead)
- Enos Lake: - Benthic and Limnetic appear to be collapsing into hybrid swarm
- Paxton Lake: - seem OK, but some concerns re: development
- Vandana Creek: - seem OK, some concerns re: forestry

Threats

1) Exotics – predators; possible habitat change/bioturbation (e.g. crayfish)

2) Habitat impacts – water quality issues (e.g. Enos Lake – increased turbidity)
    - Specific critical habitat issues do not appear to be the problem
    - Water quality or habitat degradation that leads to loss of reproductive isolating mechanisms appear to be the problem

Activities to date

1) Contribution agreement to Dolph Schluter to collect *benthic* and *limnetic* brood stock from Enos Lake for possible future reintroduction, and assess causes of species collapse (e.g. source of turbidity)
2) Assessment of land use surrounding Vandana Lakes to determine real and potential land use impacts

B. Nooksack dace (*Rhinicthhys* sp.*)* and Salish sucker (Catostomus sp.)

Geographic distributions

- British Columbia's Fraser Valley and parts of northwestern Washington in the United States.

Population status

- Province of B.C. has red-listed these species

Critical habitat

Nooksack dace

- require riffles for spawning as well as adult rearing
- slow marginal habitat for juvenile rearing

Salish sucker

- require riffles for spawning
- Adults rear in slow marshy habitat
- juvenile habitat is poorly documented

Threats

Problems are typical for streams in a highly urbanized/agricultural landscape:

- Loss of spawning habitat (riffles) through dredging
- Loss of critical adult sucker marsh habitat through draining of wetlands
- same for off-channel habitat
- Low flow problems (high runoff from urban/aggie; removal of aquifer – gravel extraction)
- water quality problems (low dissolved oxygen)

Activities to date

- Population census and assessment of habitat need (Mike Pearson, Tyese Patton)
- Construction of 900m of stream habitat with Columbia Bitulithic Inc. in Langley (Mike Pearson, Tyese Patton)

- Construction of extensive off-channel habitat (GVRD, township of Langley)

Discussion:
The Thames River in SW Ontario, which has a number of threatened freshwater mussels, has similar watershed quality issues as mentioned in your presentation. To what extent are you learning from what they have found in the Thames River?

We have their Recovery Strategy documents. We have had no direct contact to date.

Is your assumption of critical habitat restricted to spatial areas? It seems that water quality is an aspect of habitat that could fit into the definition of Critical Habitat.

Yes. If we can define the water as critical habitat then activities conducted within the watershed that degrade the water quality are affecting critical habitat. In a previous critical habitat workshop it was assumed that water is a part of habitat.

2.1.6.1.7 White Sturgeon (*Acipenser transmontanus*)

Ted Down, Aquatic Ecosystem Science, B.C. Min. of Water Land and Air Protection, Victoria,

Geographic distribution
Fraser and Nechako watersheds and Kootenay and Columbia Rivers

Important habitat
- Side channels important for spawning habitat

Population status
- Considered vulnerable or a species of special Concern by COSEWIC
- Red-listed by the province of B.C.

Stocks

a. Fraser River
Four stock groups:
- Lower Fraser (~50,000 individuals)
- Mid Fraser (~3700 individuals)
- Upper Fraser (~400 individuals)
- Nechako (~570 individuals)
  Nechako currently has single digit female spawners

b. Kootenay River
Approximately 1500 individuals

c. Columbia River
Approximately 1100-1200 individuals

Life history/Life cycle

- Can be anadromous
  - small proportion use salt-water
- Largest freshwater fish in North America
- Females mature between 20-30 years old

Threats

Gravel mining and other habitat modifications to sloughs, side-channel and main channel habitats;
Flow regulation and the installation of dams
Contaminants

Recovery planning

- Initiated for Columbia & Nechako sturgeon in 2000 (Kootenay Plan completed earlier by USFWS)
- Will take an adaptive management approach
- Long-term goal is restoration of self-sustaining population in the watershed.

Next steps (at the provincial scale)

- Complete recovery plans for Nechako and Columbia - equivalence to RENEW process
- Recovery plan implementation issues (including conservation fish culture)
- Status update by COSEWIC- review at stock level (decision in May or November, 2003)
- Management (or Recovery) Plan for mainstream Fraser stocks
- Policy work: provincial SAR strategy and legislation, aquaculture policy

What is critical habitat for sturgeon?

- Uncertainty with regard to full range of habitat requirements for sturgeon (especially for spawning and early rearing)
- Dealing with river regulation is a key issue
- Are water quantity and quality part of 'habitat'?
- Can features of the hydrograph be captured as critical habitat?
- Can provision of a suitable thermal regime and turbidity be part of critical habitat?

2.1.6.8 Leatherback Turtle

Carole Eros, Fisheries Management Branch, DFO,
Vancouver, BC

Geographic distribution

- Broadly distributed

- Most migratory of all the sea turtles
    - Found in the tropical and temperate waters of the Pacific, Atlantic and Indian Oceans
    - migratory routes are unknown
- Fifty-eight sightings to date within BC
    - From Victoria to Langara Island

Life history

- Solitary
- Pelagic
- Life span and sexual maturity is unknown
    - Sexual maturity estimates range from 2-14 years old
- Feed at the surface and also dive up to 1200 m while foraging
    - diet is primarily jellyfish, but also eat other soft-bodied invertebrates

Habitat

Very little information is known about the habitat requirements for this species

- Nesting habitat
    - in tropical waters on sandy beach with deep ocean approaches to the nesting sites
- Mating location unknown
- Migration routes unknown
- Juvenile habitat requirement
    - exclusively tropical until they reach a carapace size of 100 cm, then they move out to the temperate waters
- Adults are pelagic
    - frequent cool waters along continental shelves
    - dynamic habitat

Potential threats in BC

- Accidental capture & entanglement
- Ingestion of debris
- Boat collisions
- Oil exploration and development
- Disease & parasites
- Environmental contamination

Habitat information gaps

- Distribution, abundance & behavioural patterns (temporal and spatial)
- Stock structure
- Distribution and behaviour of prey
- Vulnerability to specific threats (e.g., fishery interactions)

Actions in recovery

- First steps to understanding habitat requirements in BC is by maximizing information on encounters
  - Setting up a sightings network with a phone number to call with sightings
- Recovery Strategy and Recovery Team is highlighting the importance of taking an international approach and collaboration

Discussion:

It would be interesting to know what the gender of the animals in our waters are, could they all be just males?

Genders of animals in our waters is unknown.

How did it become listed in COSEWIC? Is it because it's rare in BC or is there data from elsewhere that is showing a decline?

It is a nationally listed species both along the Pacific and Atlantic. COSEWIC views Pacific subspecies of Leatherback turtle on the extreme decline. There has been a 95% decline in the Western Pacific Population, based on nesting female data.

How much have you been able to collaborate with the Recovery Team on the East Coast?

There is substantial collaboration with the East Coast Recovery Team, and a member of the Atlantic Team is also on the Pacific Team

2.1.6.1.9 Sea Otters (*Enhydra lutris*) in British Columbia

Linda Nichol, Stock Assessment Science, DFO, Nanaimo, BC

Geographic distribution

Global

- Prior to the maritime fur trade Historic: Range from Baja, CA to Northern Japan (150,000-300,000 individuals)

British Columbia

- Currently from Estevan Point to Hope Island, and on from Goose Islands to Cape Mark on the Central coast

Population status

- Currently listed as threatened by COSEWIC
  - COSEWIC listing due to small population size and limited distribution

- Historic: By 1911, about 2000 animals left mostly in western Alaska, and Russia (13 colonies)
- Present: Less than 100,000 individuals
- British Columbia
    - Eighty-nine sea otters were reintroduced to BC from transplant operations between 1969 and 1972
    - As of 1998, population estimated to include 2500 individuals in BC
    - 500 are along the central coast of BC
    - remaining 2000 are along the western side of Vancouver Island

Habitat

- Exposed, rocky shoreline with islets and reefs
- To depths of 40 m
- Usually within 2 km of shore

Life history

- Rafting aggregations range in size from a few to more than 100 individuals
- Rafts are segregated by gender and female and male rafts occupy spatially distinct areas
- Range expansion occurs as male rafts move into new areas. Female rafts subsequently occupy the areas vacated by male rafts.
- Breeding season peaks in the fall
- Peak pupping occurs in the spring
- Home range and movements of sea otter is based on information from California and Alaska and indicates:
    - Male home ranges are ~40 km
    - Females have larger home ranges, but on an annual basis adult males use a much larger area. For example during the breeding season, adult males may leave the rafting area and set up territories within female areas.
- Diet includes a wide variety of benthic invertebrates, such as sea urchins (preferential food), abalone, clams, snails, geoducks, crabs, sea stars. In parts of western Alaska and Russia, the sea otter diet also includes slow moving fish.

Limiting Factors

- Prey abundance thought to be the main natural limiting factor in population growth.
- Eagle predation of pups may be significant in BC, in the Aleutian Islands, sea otter pups have been found to make up to 20% of eagle prey

Threats

- Historically, the maritime fur trade posed the most significant threat, reducing the number of sea otters throughout the North Pacific to little

more than 1% of pre-exploitation abundance. In BC, the species was hunted to extirpation.
- Today, oil represents a significant threat, particularly because the BC population remains relatively small and limited in distribution and because of the species inherent vulnerability to oil spills.

Additional threats that have had significant population impacts in other areas and should therefore be clarified include:
- Entanglement in fishing gear
- Illegal kills
- Disease
- Contaminants

Actions taken for recovery/ how is this issue being addressed
- Currently writing sea otter recovery strategy

Discussion:
Is Paralytic shell poisoning (PSP) a big problem in sea otters?

There is one study suggesting sea otters can detect PSP in shellfish, however a large die- off of otters in the Aleutian Islands in the mid-1980's was attributed in part to PSP poisoning.

Are there conflicts between interactions with sea otter recovery and abalone recovery work?

The recovery team approach is to allow continued recovery of the population through reduction of threats that could impede or reverse the current trend. In addition to the challenge of reducing threats the recovery team recognized the need to identify a population size and a distribution that would be targets for recovery. The recovered population size and distribution should be sufficient so that even in the event of an incident catastrophic to the species, a sufficient numbers of animals would still survive.

How does Recovery team view sea otter re-establishment?

Sea otters along the west coast of Vancouver Island were re-introduced. However, we are unsure of where the sea otters on central coast of BC came from. There are two hypotheses
- Animals from the original re-introduction site dispersed northward and established on the central coast.
- The central coast sea otters are a remnant population that escaped notice.

Genetic work is needed to determine the origin of the central coast sea otters.

2.1.6.1.10 Natural History and Conservation Status of Cetacean Species-at-Risk in British Columbia

John Ford, Stock Assessment Science, DFO, Nanaimo, BC

A. North Pacific right whale (Eubalaena glacialis)

Geographic distribution

- Geographic distribution is based on historic whaling information (prior to 1875)
- Historically, north Pacific right whales were taken, via whaling activities, in BC primarily in May to July, north of Queen Charlotte Sound

Habitat

- Migratory
- Breeding location is unknown

Diet

- Primary prey are copepods

Population size

- Critically endangered
- Historical population was approximately 11,000 individuals
- Current population is approximately 200 individuals

Threats to the species

- Extremely low abundance - reduced mating opportunities and as a result there may be inbreeding problems
- Ship strikes
- Entanglement in fishing gear
- Ingestion of debris and pollutants

Actions taken for recovery/ how is this issue being addressed

- Will be undertaking a multi-species line-transect vessel surveys to estimate abundance
- Mark/recapture approaches using natural markings
    - taking photographs
- Developing a network of remote acoustic monitoring stations
    - with towed hydrophones

B. Blue whale (Balaenoptera musculus)

Geographic distribution

- widely distributed
- however, it is rare due to whaling activities in the early 1900's

- Known distribution based on whaling activities
- Blue whale kill locations – primarily off the edge of continental shelf
- Modelling program was used to create a map of current potential locations of blue whales in BC waters

Habitat
- Strongly migratory
- Deep water
- Utilize BC waters primarily for foraging

Diet
- Feed primarily on euphausiids

Population status
- Endangered
- Probably two or more populations in the North Pacific
- Commercial whalers took at least 9500 whales in the North Pacific between 1910-1965
- Over 1300 whales were taken by whalers in BC, mostly prior to 1930
- Current population size in BC is unknown

Threats
- Underwater noise
    - shipping noise
    - seismic exploration, blasting
    - naval exercises
- Pollutants
- Ship strikes

Actions taken for recovery/ how is this issue being addressed
- Will continue to conduct pilot surveys to practice techniques of finding whales based on GIS map created by the modelling program

C. Humpback whale (Megaptera novaeangliae)

Geographic distribution
- Widely distributed throughout the World
- Strongly migratory
    - migrate between Hawaiii and BC

Habitat
- Found in inlets and over the Continental Shelf
- Found close to shore
- Breed in Hawaii during winter (January to April)
- Forage in BC waters

Population status

- Listed as threatened by COSEWIC
- Historically, 15,000 individuals
- Whaling reduced the population in the early 1900's
- Current population is unknown

Diet

- Forage primarily on euphausiids and other crustaceans
- Schooling fish (herring, sardines and sandlance)

Threats

- Ship strikes
- Food supply
- Pollutants
- Underwater sound
- entanglement

Actions taken for recovery/ how is this issue being addressed

- Studied primarily through photo identification – collected in BC and shared with colleagues in other areas
- Using catalogue of BC sightings to determine population abundance through mark and recapture techniques and using site fidelity to determine which areas are important to which sectors of the population

C. Killer whale (Orcinus orca)

Geographic distribution

- Globally distributed
- common in BC, but rare in most other areas of the world

Habitat

- Important to identifying critical habitat is to determine their diet
- Movement seems to be dictated by food
- To determine the diet they look at observations of harassment and predation
- Winter appears to be the critical season
    - Most mortalities take place in the winter

Diet

Based on observations of predation and harassment the

- Resident population primarily feed on fish and harass the odd mammal
    - feed primarily on salmon (chinook preferred), with other fish and squid being taken
    - movements tied closely to salmon

- Transient population primarily feed on mammals and sea birds
  - feed on harbour seals, porpoises, sea lions, minke whales, sea birds, and rarely land mammals when they are swimming
  - don't show any seasonal movements
- Offshore population diet is unknown
  - speculating that they may be feeding on sharks, due to the wearing down of their teeth

Population status
Three populations of killer whales exist and all populations are genetically distinct:

- Resident population
  - northern resident population listed as threatened by COSEWIC
  - approximately 200 individuals in BC
  - southern resident population listed as endangered by COSEWIC
  - approximately 75 individuals in BC
- Transient population listed as threatened by COSEWIC
  - approximately 225 individuals in British Columbia
- Offshore population listed as special concern by COSEWIC

Potential threats

- Vessel disturbance
- Underwater noise
- Declining prey base
- Contaminants
- Interaction of these above factors

Actions taken for recovery/ how is this issue being addressed

- Work on finding where whales go in the winter months
- Use passive acoustic monitoring devices that are powered by solar panels
- Timing of arrival into key prey locations (primarily salmon migration locations)

Discussion:
Could you get access to the U.S. navy's acoustic data?

The Navy has arrays off the north end of Vancouver Island. However, a problem is that the Navy uses narrow low frequency acoustic bandwidths, that are not good for killer whales which use a higher frequency.

Interested in relative proportion of fish in the resident population's diet.

Trying to get an idea of what salmon stocks are important to the whales at certain times of year. For example, the Bella Coola River Chinook salmon run appears to be important, as we find a large number of residents in this area during a short period of time.

2.1.7 Defining critical habitat for large cetaceans

Edward Gregr, Marine Mammal Research Unit, Fisheries Centre, University of British Columbia, Hut, Vancouver BC

Modelling work was done on historic records based on coastal whaling locations in British Columbia from 1905-1967

Study objective

- Identify "preferred" habitat in terms of physical oceanography
- Use logistic regression with GLMs
  - Presence-absence whale data regressed against oceanographic predictor data

Oceanographic predictor data

- Continuous:
  - Bathymetry (5' lat-long grid)
  - Temperature & Salinity
  - Composite from 18 years of point data

- Categorical:
  - Slope
  - Depth class (3 levels) – shelf (<200m), slope (<1800 m), abyss
  - Month

Results

- Annual correlations had R^2s between 0.25 and 0.48
- Monthly correlations had R^2s between 0.22 and 0.39
- Sei, fin & male sperm whale models best
- Humpback whale & female sperm whale models performed the worst

Θ Shelf break & offshore of N. Vancouver Island appear to be important areas.

Critical vs. vulnerable habitat

- Critical habitat is an ecological assessment (science based)
- Protected areas balance "triple bottom line" of environmental, economic and social values
- Effective protection or designation will require a quantitative method of balancing the triple bottom line not just for 1 species, but across species
- Designation will require an ecosystem-based, multi-species approach
- Effort level will require that we focus on vulnerable portions of critical habitat

A marine feature (i.e. critical habitat) is vulnerable to the extent that it is may be exposed to a threat to which it is sensitive.

Valued Feature	Chemical	Oil spills	Non-point source – terrestrial	Prey removal	Vessel strikes	Noise pollution	Vessel congestion
Baleen migration							
HW migration							
HW feeding areas							

Vulnerability matrix based on Tyler-Walters and Jackson (1999), Idea of Valued Features based on Dale (1997)

Features in the marine environment

Representative (structural)		***Distinctive (Process-based)***	
Physical	Biological	Physical	Biological
Abiotic. Structural, permanent	*Biotic. Sessile organisms*	*Abiotic. Ephemeral*	*Biotic. Nectonic*
Geothermal vents, seamounts, tidal rapids, archipelagos	Shellfish beds, sponge reefs, coral reefs, marshes	Meso-scale eddies and gyres, fronts, upwelling zones	Animal habitats (spawning, rearing; feeding, migration)

after Roff and Evans 2002

Pros and cons (from Zacharias and Gregr 2003)

- Must be done for every relevant cell in a very large stress-value matrix
- Lends itself well to identifying data gaps, Wild-ass Guesses (WAGs), and the necessary studies to address them
- Requires significant investment in tough studies
- Part of a complete management system *(habitat modeling, vulnerability assessment, stakeholder value-based modeling, reserve sighting)*

Ask the right question

Why define “critical habitat”?

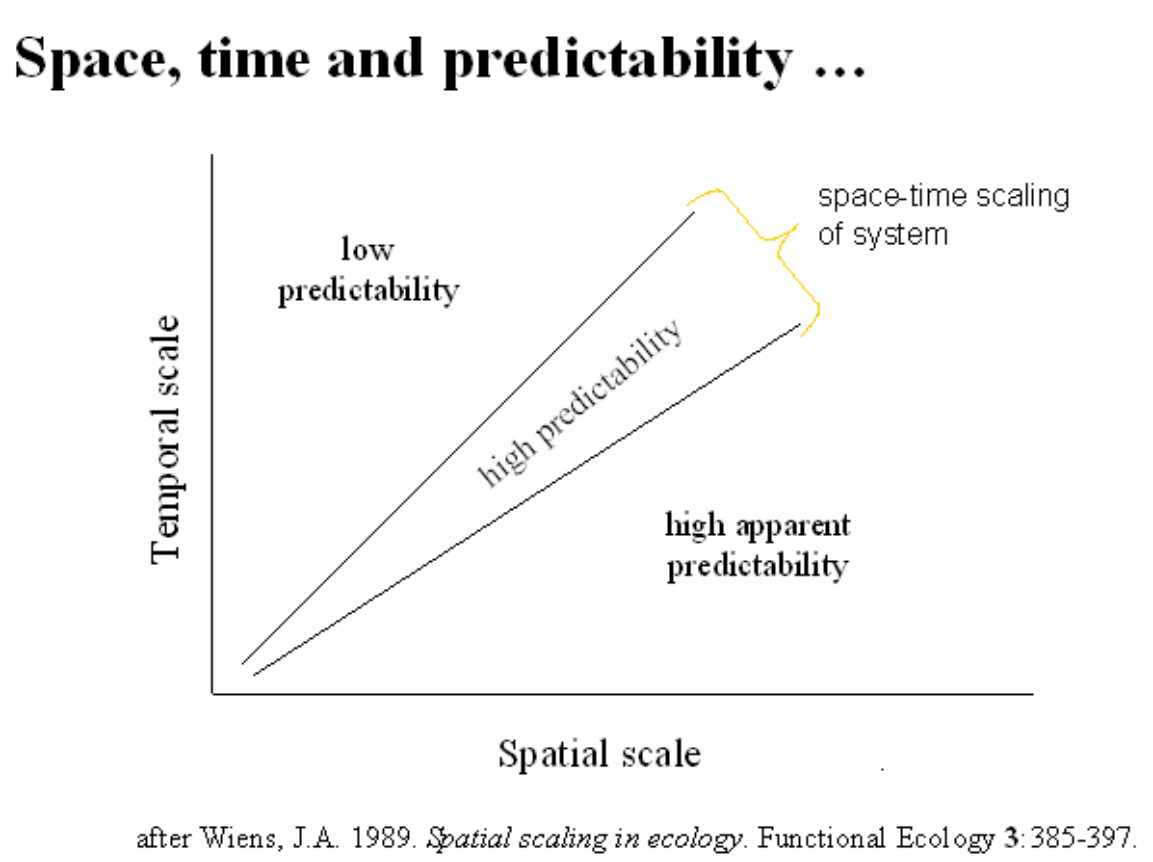
- Management (fisheries)
  - EFH objective is sustainable fisheries
  - MPAs often about increasing production of commercial species
- Conservation (ecological values)

Exploratory modeling

- Predictive models will be needed
- Pattern matching won’t be good enough - need to get at processes *(model process hypotheses and test against observation data)*
- Parameterization will be required
  At a minimum, need the models to facilitate an exploratory approach; at best, conduct a sensitivity analyses of parameters and a Bayesian analysis of assumptions
- Judiciously ignore data

Marine vs. terrestrial

- The temporal and spatial scales of primary production are reversed
- Spatial and temporal permanence of “landscape” features
- Processes that create landscape features differ by orders of magnitude (marine = ephemeral (exist for a matter of weeks); terrestrial = more permanent (exist for a matter of years)



Relevant literature
Zacharias, M. and E. J. Gregr 2003. *Sensitivity and vulnerability in marine environments: A value-stress approach to identifying Vulnerable Marine Areas.* Conservation Biology (submitted).

Discussion:
You used critical habitat to capture the environmental bottom line, but critical habitat by the definition of Sara is actually the bottom line, isn't it?

Terminology needs to be very clear. Critical habitat ought to be an ecologically based definition in order to keep a separation between the science and policy.

Comments: Under SARA, critical habitat can still be an ecologically-based entity but the overall plan must also include social and economic values. Need to look at vulnerability, as it will be key to deciding and protecting CH. Identifying CH is critical; for example, CH could be spawning habitat, but when you overlay development impacts over CH – this identifies vulnerable locations and highlights priority sites. Identifying critical habitat should be an objective science based process and prioritizing action is based on vulnerability.

2.1.8 Sea otter habitat in British Columbia

Linda Nichol, Stock Assessment Science, DFO, Nanaimo, BC

Sea otter recovery strategy

- In the current sea otter recovery strategy it is recognized that there is a need to develop a method to identify critical habitat for sea otters

Sea otter carrying capacity model

- Primary goal is to estimate carrying capacity - maximum population size that could exist in BC.
- Approach builds on method used to estimate carrying capacity in California and Washington.
    - Both methods characterizes habitat using physical habitat information and known densities of sea otters

Washington's and California's approach

- Characterized coastal habitat using substrate data – for example, Rock, Sand, Mixed.
- Resulting coast line divided into along shore segments with an offshore cut off by depth or distance from shore.
- Using sea otter survey data from representative areas of these different habitat types (rock, sand, Mixed) where sea otter population is at equilibrium, they calculated sea otter density for each of these habitat types.

British Columbia's approach

In BC, sea otters are found in areas of complex shorelines with numerous islets and offshore reefs

- Characterized sea otter habitat using shoreline complexity and Depth contour complexity
- British Columbia's model doesn't use substrate because:
    - no substrate data
    - and substrate isn't the best was to characterize BC's habitat
- Classified coastal habitat as sea otter habitat versus everything else
- Model started looking at Checleset Bay and Kyuquot Sound where sea otter numbers are at equilibrium.

Is this identified habitat actually critical habitat?

- Shoreline and depth complexities capture a variety of habitat detail that we don't fully understand.
- Model describes where we find sea otters during spring and summer in good weather conditions.

Seasonal changes in habitat use

We need to determine

- Seasonal movements? Sea otters in inlets in winter?
- Most mortality is in the winter, so is winter critical?
- Move inshore for protection during storms
- What is the winter diet?

Habitat use by age and sex
Females with pups are restricted to shallower more protected habitats while their pups are young.

Model summary
- The current sea otter model is looking at one aspect of the habitat
  - purpose of the model was to determine carrying capacity
- This model tells us something about the habitat of sea otters
  - it is not necessarily identifying the critical habitat

Identifying threats
- A need has been identified to model oil spill trajectories and use sea otter distribution data to identify areas of the coast where sea otters are particularly susceptible to spills.

Discussion:
Like abalone, sea otters can occur along the majority of the coast. In terms of critical habitat, the goal isn't to have otters along the entire coast. Therefore, how would you identify critical habitat where you want populations to persist?

One of the objectives of the recovery strategy is to identify a suitable distribution to allow the population to persist in the event of a threat, such as an oil spill.

2.1.9 Critical Habitat for Thompson River Coho Salmon

Mike Bradford, CRMI Resource and Environmental Mgmt, SFU, Burnaby, BC

Current work focuses on the Thompson River, which is only a fraction of the Interior Fraser complex.

Population trend
- Decline in total abundance in the early 1990's
- Fishing closures occurred in the late 1990's
- Increases in abundance in the last few years

Some critical habitat approaches
- Habitat-based: identification of well-used, unique or perceived important habitat types

- Life stage-based: habitats used during critical life-stages
- Minimum population analyses: habitats to support a viable population

Habitat

Freshwater coho habitat

- Small streams- spawning and rearing
- Off-channel areas- spawning and rearing, overwintering
- Large rivers- rearing, migration
- Lakes- rearing, migration

Common feature for all Interior Fraser coho

- All use the Fraser River
- Estuaries

The issue of scale for critical habitat and recovery planning

- All habitats are affected by landscape-scale processes
- Landscape is the "canvas" for all other activities
- For example:
    - Rate of cut and riparian regulations
    - Water withdrawals
    - Agricultural practices
    - Water quality and effluent treatment

If individual basins are identified:

- Special land and water use regulations?
- Aggressive restoration actions?
- Watershed-based management
- Meso- and micro-scale recovery activities require an acceptable 'canvas'.
- With adequate knowledge biological hotspots could be identified, protected, or created
- Examples for the Thompson coho include:
    - Groundwater springs and thermal refugia
    - Overwintering area
    - Sidechannels
    - Lakeshore marshes

Using life-cycle information to aid critical habitat

- Are there critical life stages (in terms of growth, mortality, etc.) that are associated with specific habitats?
    - spawning habitat doesn't appear to be a limiting factor
    - stream rearing habitat is a population limiting factor
    - trends in Ocean survival is also important

Can critical habitats be identified by critical life stages?

- These are best approximations of mortality in each life stanza.
- But good detailed data are lacking

- Mortality (M) = -*ln*(Survival)
- Each of the major freshwater stages contributes equally to overall egg-smolt survival.
- But each stanza makes use of similar habitats.
- Freshwater and marine stages contribute equally to overall mortality.

Minimum viable population approach

- How much habitat is needed to sustain the minimum viable population?
- How should that habitat be configured?
- What can be learned from recent experience?

Critical habitat and metapopulation dynamics

- When times are good, fish are distributed throughout the basin
- When times are tough, distribution is restricted
- From 1990-1998 the population collapsed to larger streams.

Two alternatives:

- Larger streams are "sources" and are the most productive sites. Larger streams are probably less sensitive to land-use impacts.
- Larger streams have similar productivity, but can survive periods of adversity because of greater numbers. Re-colonization is not assured as abundance increases.

Conclusions: Thompson coho critical habitat

- Anadromous fish use a suite of habitats-- all must be functional to complete the life cycle.
- More knowledge is needed for the identification of critical meso- or microhabitats. In freshwater their protection requires landscape-level considerations.
- Life-stanza approach does not appear useful.
- Metapopulation analysis might be useful, but needs work.

Discussion:

Why do you suggest that the life stanza approach wouldn't be useful, given that the importance of habitat at different stages in the life-cycle?

There isn't a certain life-stage that has a higher amount of mortality. Because sp doesn't render itself to this analysis

Is there work to address the meta-population within genetic work?

Genetics suggest there is a distinction between north and south Thompson coho.

Industrial use and decline: Industrial uses would have a large impact on side channels. Could CH be more the smaller systems because populations are no longer using these?

Yes, there is a link between heavily impacted streams and reduced use of streams. There was a certain spatial distribution of spawners during the previous period of high abundance and then that has contracted and now as we move back into a period of higher abundance there is a random pattern of the use of streams.

Summary prior to moving into breakout groups

The first step of this workshop was to recognize that there is no clear answer of what critical habitat is. We have now heard lots of ideas definitions, suggestions, and factors to consider. We are now going to separate into small groups to determine the path we are going to follow in the future.

3. Breakouts

3.1 Breakout #1: *What items need to be specified for a species-at-risk (SAR) before we can proceed to defined and map its critical habitat (CH), and how do life stage habitat ontogenies and/or metapopulation factors affect the identification and measurement of CH?*

Group 1
It is important to keep the identification of critical habitat in context of the recovery plan.

Mapping habitat may not be that valuable in some aquatic systems because of the temporal nature of the habitat. We should focus more on habitat elements, define elements such as flow regime, occurrence in ocean seasonally, and not so much depend on physical features.

Terms to be specified before we can identify critical habitat include a good understanding of the:

1) habitat requirements of the species of concern by life history stage. We should be able to characterize the type of habitat the species requires
2) range of the species
    i. both spatially and temporally
    ii. current and historical extents
3) measure of the quality of the habitat or the relative functionality of the habitat. Need to understand what types of habitat make greater relative contributions. Need:
    - some estimate of habitat capacity
    - understanding differential survival rates in different types of habitats
    - relative abundance indices as proxies for understanding where high quality habitats exist

4) greater understanding of threats and whether they are current or future threats

A basic understanding of a species' habitat requirements should be the foundation of defining critical habitat in a Recovery Plan.

Group 2

First thing the group did was pose the question: Is critical habitat a logical trap for the Minister? COSEWIC lists a species, and as of listing, with the act proclaimed, there will be a nine month period that allows the Governor in Council to make the decision of whether or not to put the species on the legal list. During the nine month period, the Minister will be looking for advice to determine if the assessment is valid, whether to ask for a reassessment, or accepting that the assessment is valid, are there socio-economic issues of affordability that would preclude the legal listing? In that nine month period, the discussions on incidental harm permitting occur, so that once the species is legally listed, there are automatic prohibitions about killing the organism. Discussions would focus on what a legal listing of this species would mean to fisheries and other activities. It is these discussions that contribute to the advice as to whether or not the species is legally listed.

However, critical habitat, once defined, has the same prohibitions, but it is not defined until the recovery team is in place and the recovery plan is approved. There is no opportunity to discuss the affordability of critical habitat protections prior to legal listings of the species. Is there a way the Minister can take the species off the list if it is determined that the protection of critical habitat is too expensive? Likely the only way to deal with this is not to finalize any recovery plan that is perceived to require unaffordable protection of critical habitat. This implies that we must be very careful on how critical habitat is defined.

If critical habitat is too broadly or too narrowly defined, there is opportunity to be sued by interest groups, etc.. Therefore, the identification of critical habitat must be scientifically based, with the best advice available to the extent possible.

There is no obvious "out-clause" except to limit identified critical habitat to that which is affordable. There appears to be no exemption allowed for critical habitat, if critical habitat is defined as being necessary for the viability, survival and recovery of the species. There is only limited scope for not protecting critical habitat once it's defined, so we have to very careful on how it's defined.

We need to determine how designation of critical habitat can be defended. Critical habitat needs to be conceptually based on viability. There must be compelling evidence that habitat is critical for the species viability. One approach is to rely on empirical or historical evidence that some threat has caused the decline. Another approach is to project threats that haven't been experienced

yet, e.g., oil spill effects on sea otters. When the historical threat was overexploitation or hunting, e.g., whales, it will probably be more difficult to establish that particular habitat is critical.

The second question the group posed was: *Is there anything that the Fisheries Act wouldn't do, that specifying critical habitat would do?* For example are there species whose habitat couldn't be protected by the Fisheries Act, but that could be protected by SARA? Also, are there activities that can't be stopped under the Fisheries Act, but could be stopped under SARA?

How do we demonstrate the link between viability and critical habitat? Does the precautionary approach utilized by the U.S. in designating EFH, using the hierarchical tiered approach, work for SARA as well?

For many species there are likely different configurations of habitat that are equally critical, that is, provide equal viability. Two very different options to improve viability by designating critical habitat might be:

- to designate critical habitat in those areas that are most likely to be impacted by a threat, thereby eliminating the most recognized threats , or
- to designate critical habitat more extensively in other areas that are not yet threatened, thereby preserving these areas. This configuration may be more affordable socially and economically than option #1.

For example, there are very few habitat configurations for Sakinaw sockeye salmon which utilize only one creek to get into only one lake, and while there are five spawning beaches, there is only one beach being used now. There are limited options that would allow for viability. However, there are likely a number of configurations of habitat areas for Interior Fraser Coho that, if designated as critical and protected, would ensure viability.

All things being equal, it would be best to choose the configuration that is most affordable, rather than trying to stop the threat where a threat is perceived to exist. However, often things are not equal and we must also consider other species, and we must consider synergies of effort and umbrella type protection. When there are species that utilize similar habitats, we need to ensure there is a joint review of the recovery plans.

What would be the scheme for updating the designation of critical habitat once new information became available? Recovery Plans are updated every five years. What if there is a change in status designation in the interim? As a species recovers and is downlisted, more options for configuring and designating critical habitat may become available.

Finally, before we get too far along making recommendations on how to define critical habitat, it would be useful to determine how other countries with endangered species legislation provide for habitat protection.

Discussion:
Do you think that critical habitat is irrelevant for species such as whales that have been hunted down close to extinction?

It is difficult to demonstrate that habitat is critical when there is no demonstrated link between habitat and the population's viability. We were trying to determine the situations where designation of critical habitat is possible, and when it should be used.

- Based on what is described in the legislation, once a species is listed on Schedule 1, there are automatic prohibitions on the destruction of its critical habitat.

- A list of permitted activities can be included in the Recovery Strategy, and this may allow activities that would destroy critical habitat to be permitted. Because Section 83(4) of SARA states: "*prohibitions against individuals do not apply to a person who is engaging in activities that are permitted by a recovery strategy, an action plan or a management plan and who is also authorized under an Act of Parliament to engage in that activity."*

- We shouldn't look at the Fisheries Act and Fisheries Policy as the saviour of protecting critical habitat, we are still losing habitat. SARA and Fisheries Act and Fisheries policy can work together to protect critical habitat.

Group 3
Issues/Factors of Concern (brainstorming)
- Once something is listed, it needs to be determined if habitat is limiting the population and what would be the purpose of identifying the critical habitat.
- If critical habitat is not a concern, it needs to be determined what resources should be allocated to the research to define and map critical habitat
- When developing recovery plans, we first need to decide if critical habitat is the concern. It is beneficial to identify the habitats and identify potential (future) risks.
- Important to define the goals of "recovery". What habitat is necessary to reach that level of recovery – we'll perhaps need to define carrying capacity.

Key Elements to define Critical Habitats (what prior info is needed to identify CH)
- Need to identify threats – what are potential impacts, will the habitat be easily replaced?
- Habitat requirements differ at different life stages

- Ideally you want to determine if there is a life stage that is limiting the population size, and why
- What is the quality of the habitat at different life stages
- How does life history tie into habitat needs (i.e., breed every year vs every 5 years; short lived vs long lived). How long will that CH be used in a life cycle? (sturgeon example – habitat has been impacted but adults persist with little/no recruitment)
- Seasonal changes in use of habitats
- What are mortality rates for different life stages
- What are the environmental variables within these habitats (tolerance ranges)
- What is the Limiting Habitat for a population (e.g., spawning habitat is limited)
- Areas of occurrence versus occupancy (where do they live within their range)
- Could divide information needs into habitat versus organism information requirements for modeling exercises
    - presence/absence (basic information); abundance/ growth (next level up), survival and reproduction by habitat versus physical parameters (next level up)– substrate, depth, velocity; water quality; scale; predator/prey productivity; host species
- Can habitat be compensated for? If habitat is lost can it be rebuilt? This is a very comprehensive list, and limits around information requirements may likely be necessary, or narrow the focus on describing the limiting habitats of that species
- Overall approach depends on the organism and the spatial range of that species
- Suggested model to identify critical habitat for all species - a Two- tiered approach: Is the species widely or discretely dispersed and what is the vulnerability of populations at different life stages (seasonal habitat use), and then consider habitat limitations for each life cycle stage (the approach will be species dependent). For example:
    - if a species is limited in distribution, the critical habitat can be identified for different life stages, e.g., spawning habitat and overwintering habitat
    - at a larger scale, e.g., sea otters or Thompson River coho, populations or sub-areas within the overall population may functionally comprise critical habitat.

Case Study - Salish Sucker

- Habitat usage & research questions for different life stages:
- First step would be to develop a life cycle model and determine 'bottlenecks'
    - Eggs – riffle spawners (gravel to small cobble substrate)
        - Is Spawning Habitat Limiting (larval recruitment)? [If so, need details for restoration.]

- Substrate size requirements?
- Water flow requirements?
- Spawning timing? (extensive season: May - July)
- Egg survival? (factors impacting survival: environmental/predators/development)

Would continue this approach with all life cycle stages and habitat requirements for Salish Sucker. Is the habitat for that life cycle limiting? Also need to consider how replaceable that habitat is – how vulnerable is the overall habitat and how is that species distributed: discrete populations or wide-ranging (salish sucker vs sea otter have different risks associated with micro-habitats)

Case Study - Sea Otter

- Need to first determine habitat use at different life stages and seasons. Then look at potential "bottlenecks"
- Winter Habitats may be the critical habitat for sea otter (juvenile mortality during the winter may be the key issue
- Temperature concerns? Exposure? Available food? Predation?
- Look at tagging individuals to movement patters, survival
- Foraging migrations?
- Will need to use professional judgment when info is limiting to determine if that habitat is limiting
- Will need environmental data on a small spatial scale, overlay abundance (suitability) – then make inferences on habitat

Other concerns

Don't discard professional judgment in the absence of hard information.

Discussion:

There is not always a need to get focused on the spatial distribution of critical habitat, as SARA doesn't explicitly tell you what critical habitat is. You may want to focus more on Habitat type. However, in some instances the spatial distribution is important when it is a rare habitat type found in only one location.

Even though habitat is not limiting for sea otters, population units should be defined so that a catastrophic event doesn't wipe out the whole population. The habitat may play a role in determining these population units. Must have a description of what habitat is.

We may need two types of critical habitat:

1) the necessary type of habitat to ensure viability
2) the habitat that a species may actually utilize

3.2 Breakout #2: What methods/ideas are available for the identification and measurement of critical habitats in freshwater environments?

Group 1
Coupling life stages of a species with specific habitat types, and the strengths of those couplings would help identify critical habitat.

Comparing the sockeye salmon situation where there is one lake, one population, to the coho situation where there is a broad landscape scale distribution of the species, one of the issues would be how many replicates of critical habitats are there and what would you do when there is only one spawning area, one rearing area, and one migration corridor. Does that mean that all of these habitats become designated as critical because there are no other options.

There is opportunity in a recovery plan to come up with a population size that would be preferred, and then the kinds of calculations that would be feasible to calculate the size of the habitat needed to support this population of size "X".

In freshwater, the watercourse is influenced heavily by upland/upslope activities and its unsure whether in a critical habitat designation, habitat would just be the water course in the case of a stream, or would it include some elements of the riparian often included in Fishery Act determinations? What influence would SARA have on upslope activities that would affect designated critical habitat? Would deleterious substances introduced into the stream be considered threats and would the critical habitat designation influence a manager's ability to influence upslope activities, beyond Section 36 of the Fisheries Act, for example. Presumably the designation of critical habitat on top of the Fisheries Act would be a larger instrument to influence land-use activities. Industrial activities along waterways could be identified as potential threats.

Ephemeral habitats
In streams, seasonally flooded ephemeral habitats can be extremely important habitats and should be designated when appropriate as critical habitats, but may not always be required habitats, depending on the time of the year.

Ephemeral habitats can be both temporal (e.g., seasonal flooding) and spatial (e.g., plankton blooms). The identification of temporal habitats may require surveys to be conducted at different times throughout the year. The identification of spatial habitats will be more difficult to identify.

- Guilds or multi-species approaches leading to ecosystem or watershed based management approaches are being invoked for recovery planning
- Index of biotic Integrity (IBI) – looks at habitat quality as indexed by the abundance, diversity, and attributes of the species of interest. Most often considers available prey invertebrates, but may also be used to look at fish communities used to measure stream quality.

Scale issues in critical habitat
Different methods needed for different sized areas (e.g., stream versus large lake)

Discussion:
Re the SARA Residence consideration:

- It is not required to identify residences in the recovery strategy; however, SARA immediately protects residences.
- Legal interpretation of residence is rather narrow.
- It is a policy interpretation of what residence is.
- Elements of SARA may be challenged in court, and residence definition may be one of those elements.
- Den, nest or other similar place: therefore, residence might be associated with reproductive activity.

Group 2
Discussion included the complexities of moving targets and the idea that critical habitat is broad versus specific.

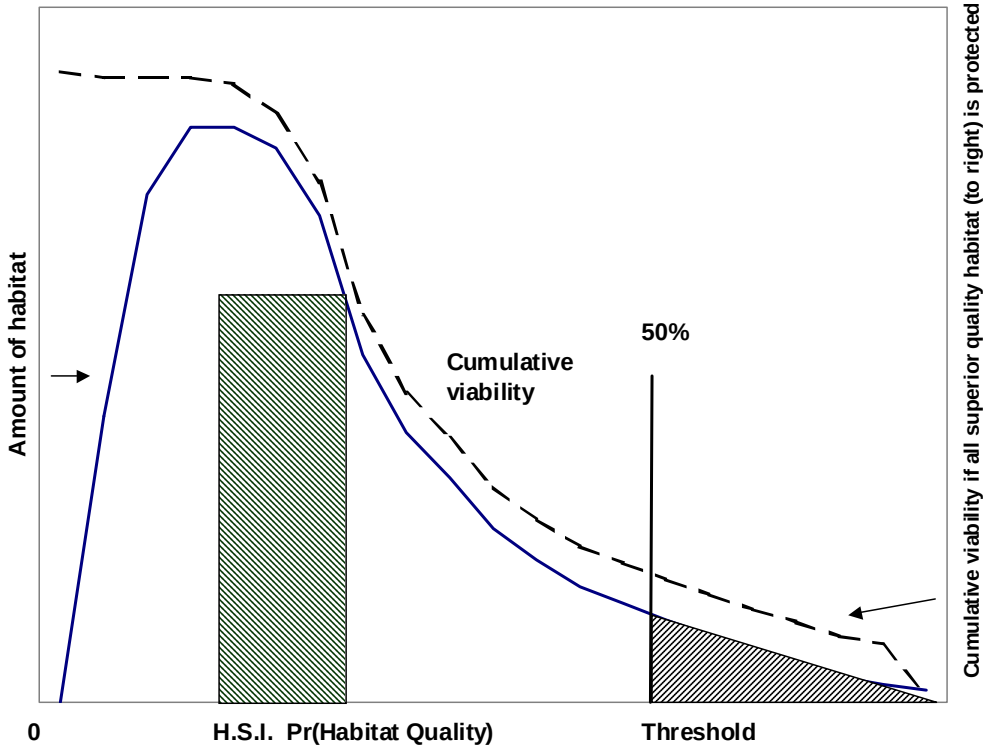
Data gathering needs:
1) mapping
2) inventory
3) models:
   - Habitat suitability indexes
   - Population dynamics
   - viability vs habitat quality
   - essential vs CH
   - or combinations of the above
4) adaptive management
   - flow issues

Adaptive management is essential where population dynamics are continually changing.

Conceptual model – how do you deal with a species that has a lot of habitat that may not all be critical but it is all "essential", i.e., important for production as defined by the US Magnusson-Stevens Act. We came up with the idea of working with residences as the most critical subset of critical habitat, then expand out to broader habitat concepts, such as essential habitat.

The Group was struggling with the idea of how to designate some subset of essential habitat as critical habitat. Most of the methods for describing habitat, whether they are habitat suitability index (HSI) or other measure of habitat quality, if you turn those into proportions, there is a lot of unsuitable habitat and less high quality habitat. This may be a continuous distribution that describes the quality of the habitat. We were interested in identifying a threshold using some

measure of population viability that links the concepts of habitat quality to the viability of a species. Assuming n the HSI can be linked to the life history parameters that determine viability, there is likely a trade-off between the quality and quantity of habitat such that the viability conferred by protecting more poorer habitat may be equal to that from protecting a lesser amount of higher quality habitat. Thus, there may be multiple spatial configurations of habitat that achieve population viability.



An example: This figure is a conceptual model of the description above. The probability of stream habitat quality ranges from 0 (poor quality) to 1 (high quality). The figure depicts that there is a lot of poor quality habitat and little high quality habitat. This scenario illustrates a quality/quantity habitat trade-off where protecting a large amount of poor quality habitat (thatched rectangle) is likely equivalent to a small amount of high quality habitat (thatched triangle).

This model provides an opportunity for different habitat configurations or options to be identified. Therefore, by using a model like this, the Recovery Team may have a number of different options. The team can then look at these options in relation to the socio-economics associated with the options and suggest which configuration would best reduce the impacts of threats by protecting critical habitat for that species.

5) Residences and protection of residences

There may be aquatic species that have readily identified residences (e.g. lingcod, where males guard egg masses for months). The concept of residence in SARA will likely be most directed at terrestrial species.

Potential aquatic species whose residences could be determined, include sessile species (mussels), species whose survival is largely in cryptic sites (e.g. abalone), and octopuses, sticklebacks and lingcod, species that lays eggs and then subsequently guard them.

Looking at the definition of residence, it can be interpreted to be perhaps relevant for many species.

HSI could allow specification of EFH, not all which is critical, although it is important for production and should be protected more generally under the Fisheries Act, without being identified as critical.

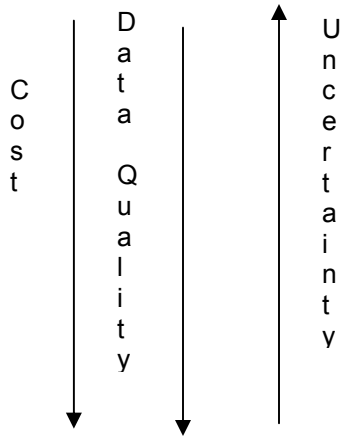
Discussion:
How would this model be used for each species?

You would likely have to look at different life history stages for this model and weight this for each stage against the viability criteria to determine the amount of habitat needed. This model may not work well with multi-species, but likely best for single species.

Group 3
We assume that habitat is a critical issue that needs to be clarified for a particular species.

Levels of information for identifying critical habitat (after EFH designations):

1) Presence/absence
2) Abundance
3) Growth, survival, fecundity (by habitat type)
4) Productivity (by habitat types)
5) Life-stage specific habitat population model



As one progresses from 1 to 5, data quality improves and uncertainty is reduced, but cost increases

.
Although it can be argued that ideally one should develop a population model that estimates the capacity of habitat available for each life-stage in order to assess whether habitat for anyone life stage is limiting, the questions are:

- What level of information is really necessary?
- How much can we afford or should we be willing to pay?

We find that often it is not necessary to go beyond level 3 in the above.

Levels

1) Presence/absence data (poorest data)

Method: POINT CAPTURE
Cost: relatively cheap

- basic starting point for habitat requirement evaluations
- look at correlations between occurrence and basic environmental data
- good first step in assessing critical habitat at a larger scale
- for species with limited spatial distributions, this may be all that you need for identifying critical habitat – i.e., you need all the habitat where the species occurs
- e.g. Liard Hot Springs snail

2) Abundance data (density, population size)
Method: area-based estimate (density)
Cost: more intensive, more effort

- Necessary when presence/absence data gives insufficient information about critical habitat, i.e., for widespread species that occupy many habitats

3) Growth, survival or fecundity
Method: requires estimate of growth, survival or fecundity by habitat type
Cost: very intensive, requires a lot of work and even perhaps experimentation

May be necessary when abundance data give insufficient information about critical habitat

- E.g., sturgeon in the upper Fraser. It has been shown that the age frequency distribution has changed over time. There is virtually no new recruitment to the population. If we did not have this time series, we would not understand the critical status of the population. Is habitat for juveniles a problem – this is an unknown?

Some Features of the Freshwater Environment That Can Make it Particularly Vulnerable to Threats

- Linear
- Moving water
- Possibility of fragmentation if habitat connectivity is interrupted

- Less buffering than marine environment, usually smaller scale
- Species specialisations (analogous to theory of island biogeography)

When is a (freshwater) species especially vulnerable to habitat concerns?
When it is:
- rare
- "unique" (may be extremely common)
- at the top of the food chain

Comments
- The snail example is a good example of what is critical habitat and what is residence. Critical habitat could be defined as habitat necessary for survival of a population of a species. Residence can be defined as habitat needed for survival or successful reproduction of individuals.
- Critical habitat may be implemented for habitat where the species is no longer present whereas residence would be restricted to sites still used by individuals of the species.
- The Michael Bigg Ecological Reserve might be an example of a killer whale residence as it is used annually.
- A residence is habitat that is used consistently but not necessarily continuously.
- Whether or not something can be protected by SARA as a residence comes down to the regulations that are developed and the policies the government uses to implement these regulations.

3.3 Breakout #3: What methods/ideas are available for the identification and measurement of critical habitats in marine environments?

Group 1
Define and map critical habitats
- Existing examples of defined critical habitats and important habitat for marine species.
    - sponge reefs, associated with particular types of glacial gullies
    - the Gully (Nova Scotia) – multi-species habitat

- Assumption of greater variability in marine environment. There are many examples of species that have close associations with habitat types, for example grey whales are associated with particular habitat types for feeding
- Sessile organisms are more vulnerable to disturbance or habitat destruction because they are immobile
- Conceptually, associating habitat with physical descriptions is easier than trying to describe and protect ephemeral habitats (e.g., gyres)

Marine versus freshwater habitats

- Fresh water habitat associations are often much tighter than those in the marine environment. Or are they, is this more a question of greater effort expended in freshwater systems? Maybe we haven't looked hard enough in the marine environment to find these habitat associations.
- Temporal scaling (timing) is an issue. Annual processes in a stream are important. Variability in marine environment may occur over a larger time scale (e.g., El Niňo).
- Mobile marine animals have a greater opportunity to get out of the way of a threat versus a freshwater organism. For example, a stream dweller can't choose to move to a different watershed.

The roles of temperature and currents

- Temperature and currents are important for structuring marine habitats, but they cannot be controlled or managed.
- Currents are very important for broadcast spawners
- Currents have uncontrollable aspects (like transport destination), they can cause a wide range of recruitment for a particular year
- Species' habitat specializations, specific tolerances to conditions
  - e.g., at Hot vents
  - What about sardines that disappear in abundance for decades?

Marine dynamics

- There is a diversity of distributions and strategies for dealing with variability that are important to long-term population viability
- Because of the dynamic nature of the marine environment, species strategies need to incorporate variability
- Different habitat aspects are important to different species; some species may depend on a specific area while others may depend on specific features, or other habitat aspects
- Species specific issues – grey whale feeding grounds can be identified and protected, but what about right or blue whales that rely on plankton?
- Quantity threshold may be needed to prevent the incremental loss of critical habitat. Loss of some essential habitat increases the critical nature of other habitats.

Approaches / recommendations

- Determine which life history stages are or aren't habitat dependent
- Determine the degree of species associations with physical features vs. those aspects that are determined by more stochastic events
- Compartmentalize species into different categories based on their complexity with respect to habitat use
- Associations with physical features are important to the development of an understanding of habitat

- Proxies for habitat may be necessary (i.e. prey distributions) because of the dynamic nature of the marine environment. Might want to use features such as prey.
- Where species actually are is often less important in determining their needs than understanding the processes that they depend on

Group 2

- In many instances a large amount of data has been collected and is available for analysis
  - e.g., harvest data, oceanographic data, remote sensing data, etc.
  - the challenge is how to relate this data back to the importance of that habitat
    - For example: we have the ability to track acoustics and link this with species' use patterns in the marine environment
    - With indexes we could get a direct link between ocean use and ocean survival, through the use of acoustic array data
  - it is also important to determine when the amount of data is sufficient to allow critical habitat to be identified

- Using site fidelity data for those species that return to sites consistently and evaluate whether this could be used to define critical habitat
- Overlaying threats onto a distribution map is a powerful tool for identifying critical habitat for many species. However, just because an animal is present and a threat is also present doesn't mean that the intersection point is critical habitat, but it gives the researcher an indication on where to focus their efforts.
- Critical habitat could be defined on a proportional basis versus an actual spatial basis. For example, if the researcher wants to maintain a population, and they know they need a certain number of populations distributed across the coast, maybe they don't have to spatially define units but they need to identify that a minimum number of those units must be maintained.

Challenges

1) Gaps in data – Is data adequate?
2) High uncertainty
3) Scale issues – applicability of data gathered on spatial scales
4) Temporal habitat
5) Expense or research
6) Expense of enforcement

Group 3

- What sort of habitats might be of concern in marine environment?

- May think of rare and unique habitats, such as hot water vents, and sponge or coral reefs.

- Trawling has physical impacts on the benthic environment; however, the impacts that trawling has on the densities and abundance of aquatic species is largely unknown.

- In the marine environmental processes happen over a broad scale, and this is important to consider when identifying critical habitat in the marine environment.

- Examples of how we think of habitat in terms of species?
  - e.g., abalone, sea otters, killer whales

  Abalone:
  - address threats or identify activities that would increase recruitment or survival of these species
  - habitat is not limiting; however, what habitat would best increase survival or recruitment of the species needs to be identified
  - Likely, want to identify habitats where there is the potential to have successful recruitment. So, is this critical habitat or is this critical to achieving the recovery strategy?

  Sea otters:
  - lots of habitat, and they are also not limited by habitat
  - concern with threats, such as oil spills and where the oil might go in the event of a spill
  - concerned with the location of otters in current and potential habitat and their vulnerability to an oil spill

  Killer whales:
  - southern residents: endangered because their numbers are declining. Potential threats include contaminants, possibly food supply and noise.
  - elements to focus on when identifying habitat important to killer whales include: ephemeral prey (e.g., salmon), the impacts contaminants are having on their diet, and that noise may limit the location where whales will feed
  - what physical threats can be related to a physical area in an ocean?
  - on the east coast, there was a successful effort to shift shipping lanes to avoid collisions with large whales

Methods to identify critical habitat

e.g., marine mammals

1) Map the distribution/occurrence and migration routes of these animals
2) Overlay the threats onto the map
3) Identify the vulnerable areas where animals intersect with a threat

When identifying critical habitat in the marine environment, the focus should be on specifics rather than broad aspects.

3.4 Breakout #4:

Group 1: Draft interim science-based guidelines/criteria for selecting methods/approaches to defining and mapping critical habitat.

Interpretation
Interpretation is important when defining and mapping critical habitat; factors that should be considered include:

- The critical habitat for a species should be less than the habitat for a species (in most cases) and may include "residence". Exceptions may occur when a species has a very limited range, in which case all of the habitat may be considered critical.
- Does critical habitat mean "biologically essential" or does it mean "vulnerable habitat"?
- It is the portion (biologically based) of habitat chosen as necessary for the purposes of the recovery plan.
    - Note that there may be a push to use legislation other than SARA that protects habitat (e.g., Oceans or National Parks Acts)

Priority
The priority of the recovery strategy must be determined by:

1. Reviewing the goals and objectives of the recovery strategy
2. Determining whether identifying and protecting critical habitat is a priority in light of the identified threats to the species?
    - Is the species tied to a unique/vulnerable/rare geographically limited area (an exceptional case)?
    - These considerations help to determine how much effort to put into identifying critical habitat with precision at this time.

Approach guided by species characteristics
Species characteristics that should guide the approach to identifying and mapping critical habitat include:

- Limitation of distribution
- Freshwater/ marine/ anadromous
- Wide ranging species with specific habitat needs
- Mobile vs. sessile species
- Migratory vs. resident
- Differences in above for each life stage

Biological considerations
Any interpretation of critical habitat must have a transparent (i.e. referenced and described) biological basis:

- Determine the species distribution
  - range (broad or narrow?)
  - inventory or anecdotal data
  - difference between historic and existing ranges
- Develop a life-cycle model and link it to habitat characteristics
  - Reproduction characteristics and recruitment rates (e.g. broadcast spawning, longevity, etc.)
  - Particular species may vary in how explicit or inclusive habitat usage is
  - Do we need to discriminate between critical habitat and overall habitat?
- Determine parameters limiting life stage-habitat needs (ecological bottlenecks): is habitat a limiting factor or associated with a threat?
- Describe the function of habitat at limited life-history stages
  - habitat range, abundance information, and habitat preferences
  - organize data along the "four levels" approach: presence/absence, etc. (see Table ?)
  - go as far as you can with the best available information

List vulnerabilities

Vulnerabilities need to be considered, such as

- Threats and potential threats to habitat may guide the identification of "critical habitat"
- Specific threat examples: e.g., sea otters and oil spills
- General threat examples, e.g., upland lakeshore developments
- Sensitivity of organisms/habitat to stressors
- Assess severity, frequency, and likelihood of existing and potential threats in specific areas
- Ability to mitigate or reduce identified threats
- Ability to recover, reproduce, or replace habitat

Other Considerations

Other factors to be considered when defining and mapping critical habitat include:

- Incorporation of expert opinion (professional judgment) on habitat suitability and data gaps
- Consideration of habitat function (not just habitat structure, location, etc.)
- Incorporation of Traditional Ecological Knowledge (TEK) and Local ecological Knowledge (LEK)
- Inclusion of other historic information sources (e.g., relating to the re-introduction of extirpated species)
- Harmonization with other possible complementary recovery strategies, e.g. multi-species, competing species
- Remember that critical habitat can be refined in the future

Group 2: *Key info and conceptual gaps and some prioritization for improving the toolbox and improving the guidelines/criteria?*

Point 1

- Identify key biological information and information gaps
- Determine research needs and operational approaches, linkages and challenges in defining terms
- Action – review "biological information needs" suggested during previous discussions
- Other information gaps
  - Legal gaps
  - Research gaps
  - Operational gaps
  - Policy gaps

Point 2

- How would cumulative effects be interpreted?
  - Cumulative effects equals general degradation
- Determine linkages between activities and habitat destruction
- Integrate via multiple species planning when possible
- Determine when should SARA be used versus the Fisheries Act? Fisheries Act is a very reactive piece of legislation as opposed to the proactive approach taken by SARA.
  - Need for stewardship activities to create a proactive approach
  - Need a methodology for managing cumulative effects – development of scenarios, evaluation and determination of priority areas
- How much destruction, if any, is tolerable? How much destruction actually constitutes habitat destruction (e.g., 1, 5 10, etc. %)?

Point 3

- Define functional habitat? When does habitat stop being functional habitat?
- Degree of habitat degradation need to be linked to population viability.
- Conceptually, re the problem of diffuse effects and cumulative impacts, the issues, impacts and management tools to address the problem can be thought of as the points of a triangle linked together
  - This Triangle of issues-impacts-tools is along the lines of reduce-reuse-recycle – it requires adaptive management feedback. Where you have an issue such as diffuse effects or a non-point source pollution leading to impacts that are not always well defined, we often need more information on the tools available to deal with such impacts in a timely manner– we need more effective ways of stewardship for the big issues!
  - Evaluate appropriateness of stewardship activities.

- When you have a point source habitat problem, it is easier to get public support to address it compared to when there is a non-point source. How do get broader buy in on non-point source issues is an on-going challenge? The public's awareness of general ecosystem degradation (particularly in a functional sense) is often poor.
- Work to get people to feel less indifferent about SAR, and to increase community involvement in enforcement. For example, with abalone, if there is a remote community that monitors local boat traffic in the area, work to get them to report poachers. Local people need to feel comfortable that their reportings are being followed up on.

Point 4

- Develop guidelines re the kind of resolution or scale that is needed in designating critical habitat? Relate scale to levels of complexity of biology; often the more complicated an organism's life history, the more data that may be required (e.g., with anadromous species).
  - higher level resolution is probably not necessary for very many species.
- Issues:
  - Evaluate whether the more basic parts of the food/reproductive webs might be being missed by SARA, species that might be important to the survival of higher trophic level organisms? Currently, a lot of species listed are charismatic species, not lower food-web components. There may be a problem in how SAR are being identified.
  - How global warming might affect critical habitat designations needs to be considered, including how such deliberations can be incorporated and potential consequences evaluated? How will this likely environmental change be dealt with?
  - How to deal with ephemeral habitats also need to be considered. Leads to issues about predicting critical habitat - perhaps describing versus mapping is sometimes most appropriate.

Point 5

- Evaluate the pros and cons of utilizing existing protection mechanisms, i.e., an area in association with an existing park may be easier to protect than an area not near a park.
- How to protect critical habitat for wide ranging/dynamic mobile species?
  - E.g., designating specific salmon runs for killer whales may be necessary.
- Some species carry their functional habitat with them, e.g., migratory birds, killer whales. Perhaps a specified "buffer zone" (e.g. 400 m around killer whales) around individuals of these species when they are present in an area is appropriate. However, this may not always offer protection from all threats, e.g. killer whales with such a a buffer would not be protected from seismic activities or oil spills.

- Research on identifying optimal habitat and protect is required, e.g.., some species may now be present only in marginal habitat which is not the area we wish to protect

Point 6

- Operational gaps:
  - Need for information on how ephemeral habitats can be protected?
  - There will never be enough government conservation and protection resources, so we need to develop and evaluate community stewardship tools
  - How to evaluate uncertainties?

- The current cetaceans sightings survey approach might be a useful model for other groups to consider to increase public engagement and connection science and stewardship activities
  - Some science mechanisms are in place to give feedback re monitoring; if government does not provide effective feedback, this may quickly erode this type of public participation

- Operational gaps: a better educated public could put increased pressure on the judiciary to increase penalties for SARA discretions, and hence encourage better compliance

- Guidance – there seems to be need for a core group to do critical habitat case studies re the development of guidelines for recovery strategy and action planning.

4. Workshop summary and where do we to go from here?

Discussion:

With respect to the proceedings from this workshop, the plan is to get them written up within the next couple of months. Glen Jamieson, Ted Down, Don Lawseth, Mike Bradford and Chris Wood have agreed to be on a steering committee to go over the proceedings and ensure the opinions presented at the workshop are reflected in the proceedings.

In the group discussions, the need for guidelines on how to address critical habitat in SARA was brought up. In January a national level proposal was submitted by Ken Minns (C&A) to look at a case study on a 4-5 species, including abalone. At of March 2003, funding for this proposal has not been approved.

It was suggested that it would be nice to evaluate how such guidelines might be applied at a regional/provincial level as well. It was felt that prior to the implementation of these guidelines, when they are developed, there needs to be a certain regional level of knowledge about SARA. One of the objectives of this workshop was to bring both scientists and resource managers together to begin the development of a common regional understanding of critical habitat issues relevant to both science and regulatory management perspectives. So, once the proceedings from this workshop are out, we will be in a position to e-evaluate how to work towards developing an adequate understanding of critical habitat issues guidelines, and how they might be applied, perhaps by undertaking more regionally-relevant case studies. It is important for us to remember that national guidelines are expected to be developed, and that case studies, if funded nationally, may demonstrate how to approach this subject – what we do in the region should not duplicate what is being planned nationally.

General agreement among participants was expressed that this workshop was very constructive, and that it increased the regional awareness of a broad range of individuals on what is meant by the term “critical habitat” in the context of SARA.

Going back to the toolbox issue discussed in the breakout groups – this whole exercise of identifying critical habitat would benefit with the development of consistent, standardized datasets of physical data (e.g., stream flow measurements, watershed characteristics, or bathymetric coverage) contained within a central repository. Consistent databases will help people do the work more efficiently, there won’t be duplication of effort, and any analysis will come from a consistent perspective. The Province of BC has done a lot of work on nearshore/intertidal/coastline classification, but at present it is unfortunately not very accessible.

This raised two issues:
1) This workshop came about because of a proposal submitted regionally to bring coastal data together into a standardized database. The proposal wasn’t funded last fall, as it was felt that a workshop like this one was needed first to understand what critical habitat was about.
2) DFO has yet to evaluate or critically reviewed any of the existing classification schemes for marine habitat, yet staff are been asked to make comments on these schemes without having any policy with respect to them to refer to. There is a need to have these classification schemes critically reviewed, such as through the PSARC process.

It was suggested that a database of marine physical parameters would be useful, but that the merits of incorporating biological data was not yet clear. The mapping of biological communities might be left to species’ specialists who are able to focus on the specific needs of species’ recovery, rather than initiate a

broad mapping exercise that may not be of much use to others at the end of the day.

However, it was suggested that might lead to both redundancy across species, and perhaps incompleteness in understanding a species' optimal spatial distribution. The main argument for inclusion of a biological database is that species are linked by both physical data and biological components, i.e., physical habitat and food resources respectively are both important. Such a database might also help address conflict issues arising from the spatial locations of existing fisheries. To look at the costs of different habitat protection options, we have to know where potential associated costs and benefits are spatially. The negative perspective of establishing such a database, though, is that it might be too big a job, and would need to be maintained to be useful over the long term.

It was then pointed out that the existence of a centralized, standardized database can provide a structure for people to hook biology too. The point is that a lot of required physical data exists, and it just needs to be pulled together, and in some cases, people may even need to be made aware that this type of information exists so that they can put it into their analyses. The complexity issue is a good example: the development of complex maps isn't needed, as these aren't often very useful, but a base dataset and a description of the algorithms required would be useful so that people could develop their own maps.

It was then stated that some other DFO Regions have also submitted proposals to access SARA funds for this type of project, and this may be appropriate for Pacific region as well. A lot of gathering of data has been done already. For example, invertebrate databases are largely referenced to spatial data, and mapping can show, for example, where clam beds are. In many of the IM initiatives, spatial data is already being used, so establishing a comprehensive database would not be starting from scratch. Research surveys don't just show commercial concentrations, but also areas of species absence or low density. This may be relevant, as species can survive on lower abundances and density of prey than a commercial fishery requires for viability, so mapped commercial data won't always provide all relevant information.

For many species, their locations often are related to the physical structure of the environment (e.g., where eelgrass and kelp beds are) and to some extent, the physical parameters of their environment (exposure, depth range, water quality characteristics). It should be possible to develop species-specific decision rules that when applied to a data set, should be able to predict where appropriate habitat characteristics for a specific species are. Biological structure often determines where competitor and predator species are too, and all relevant data layers need to be looked at together.

From a habitat management perspective, we need some way to "herd squirrels, i.e., bring challenging issues together" in terms of these various integrated

database management efforts. A problem is that there are numerous requests for the same data; there needs to be at least a listing of available data and where to get information, if it already exists. For example, we get many requests for advice or comments as to whether a fish farm should go at a specific location or not, and whether or not abalone are known to be there. If we had the type of database being discussed, we could query this database and then determine the probability of a feature or species as likely being in a certain spot.

Next Steps

There seem to be two possibilities:
1) we could form a small multidisciplinary working group and look at some regional case studies to get an idea of critical habitats might be identified. To some extent recovery teams are already doing this, but this may allow us to look at a broader range of species and give independent direction.

2) Another option is now that we have a diverse group that has begun to think about critical habitat issues in the Pacific Region, we could perhaps bring this group together again sometime within the next six months or so and try to work with the national guidelines, when they are made available, for the setting of critical habitat. Again it is important to have someone at the national level participate to give feedback as to what is going on there, as we don't want to develop regional approaches out-of-line with what is supported nationally. The Pacific region is near the forefront of the different regions trying to address this issue. Because we are both marine and freshwater, our perspectives will be different than other regions that are mostly freshwater.

We need to clarify the goal for determining critical habitat. In Montreal, the precautionary approach was supported, where we need to designate almost everything. Here we have just the opposite, in that it has been suggested that the habitat that supports the minimal viable populations may be the critical habitat. Concern was then expressed that there is not a lot of information being fed down into the regions from national deliberations, and it was pointed out that this was in part because there isn't a lot of information to share as of yet, with the exception of interdepartmental documents. Within the DFO critical habitat working group, Habitat Management has dealt with this through the initiation of teleconferences. However, these should be initiated more regularly by Science, and Habitat Management will be encouraging Science to take an active role in disseminating information to the regions. Case studies and guidelines should be discussed in the National Science Interdepartmental meetings and representatives in the National Science meetings should be main players in the implementation of regional case studies and guidelines.

A national critical habitat approach that can support recovery teams in what's being identified as critical habitat for a particular species is needed in the regions.

Critical habitat discussions could assist recovery teams in addressing the problems and issues they are facing.

What gives the proposed national case study group significance is that while there are narrow spatial requirements associated with different life-history features, there should also be some strong general spatial considerations applicable across species. At the national level, the objective was to look at different "representative" species with a variety of life history features. This then comes back to the question "Is critical habitat the tool that you used to achieve recovery?" We should know from the recovery strategy and policy guidelines that will hopefully be provided as to how to use critical habitat under the act. We have to use our minimal resources effectively. Some case studies may be interesting from a biological perspective but from a practical perspective in terms of helping the teams, we should pick case studies that most help support recovery teams. We also need close involvement with the Province in terms of case studies, as some of the freshwater examples may be very instructive.

The collective feeling of the group in bringing together again the players that were involved at this workshop was that it really depends on the case studies we have to discuss or the guidelines to develop or consider. There is value in getting a diverse group such as this together again, to provide follow-up so as to be able to integrate and provide support where it is needed. The point was also made that it may be more productive to have a small group do some initial work, and then consider their results during a workshop.

While Science Branch is leading the identification of critical habitat, it is important to remember who has to implement the plan once it is identified. From a field enforcement perspective, we don't want to be caught short when the time comes to put these strategies into play; five or six years down the road, people in the field will have to deal with whatever methods the recovery strategy comes up with. Therefore, we need to ensure that people in the field know who will take responsibility for what, and that they have access to and are able to use the tools needed to implement the plans as outlined in the recovery strategies. We need to have something solid so that when you take it to court, it is defendable beyond a reasonable doubt. The knowledge gap between the "general environment" and critical habitat has to be bridged. The addition of stewards and stewardship tools should also be included in the development of the recovery plan.

5. Acknowledgements

I particularly thank Heather Davies for her work as the Main Rapporteur during the course of the Workshop, and for transcribing the presentations and taped plenary discussions held during the Workshop. The timely production of these Proceedings is due in large to her efficient note taking. I also thank Tom J. Brown and Shelee Hamilton, who assisted with logistics during the course of the

Workshop, and most, if not all, the participants at the Workshop who either chaired or were a rapporteur in one of the many breakout groups. Anne Phelps, Ted Down, Don Lawseth, Mike Bradford and Chris Wood assisted by reviewing these proceedings to ensure the views expressed have been correctly captured in this document.

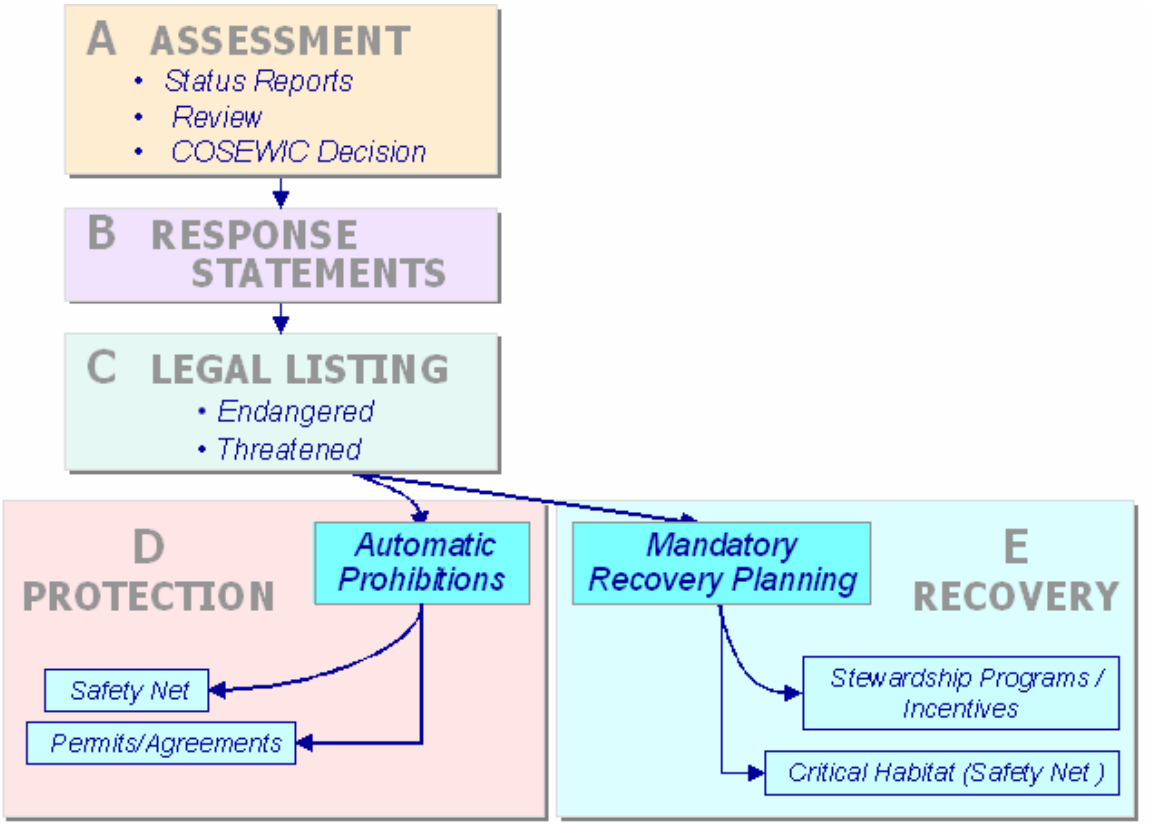
Mostly, though, I thank all the participants that attended the Workshop and contributed so much to its success, and in particular, those that gave presentations. Non-DFO participants came at their own expense, and all participants actively and positively contributed during all phases of the workshop.

Finally, I would like to thank Don Lawseth, Pacific Region Species at Risk Coordinator, for his assistance in obtaining the DFO SARA funding that allowed this workshop to be held.

6. References

Randall, R.G., 2003. National DFO Workshop on Quantifying Critical Habitat. 2-6 December 2002, Montréal, Québec. CSAS Proc. Ser. 2003: ?

Figure 1: How it works…The proposed *Species at Risk Act*



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Appendix 1: Workshop schedule.

DFO Critical Habitat Workshop Agenda

Wednesday, 26 March 2003, morning start at 10 AM:

10:00-10:20 **Glen Jamieson,** Fisheries and Oceans, Nanaimo: Workshop logistics and introductions.

1. Legislation and science

10:20-10:40 Glen Jamieson, DFO, Nanaimo: 'Legislation and science for management of aquatic species-at-risk'.

10:40-11:10 Anne Phelps, DFO, Ottawa: 'Critical Habitat and the Habitat Management Program'

11:10-11:20 Anne Phelps, DFO, Ottawa: 'An update on the interdepartmental CH working group'

11:20-11:40 Jon Kurland, NOAA, Juneau, AK: 'Describing and identifying essential fish habitat in U.S. waters'. (Keynote speaker).

11:40-12:00 Don Lawseth, DFO, Nanaimo. 'Species recovery planning in British Columbia: roles of teams, and linkages between agencies'

12:00-1300 Lunch

2. Viable population considerations

13:00-13:30 Chris Wood: 'Using viability as a criterion for critical habitat determination'

3. **Species Presentations**

13:30-13:45	Jim Boutillier	northern abalone
13:45-14:00	Rick Stanley	Boccacio
14:00-14:15	Clyde Murray	Sakinaw Lake salmon
14:15-14:30	Neil Shubert	Cultus Lake salmon
14:30-14:45	Blair Holtby	Interior Fraser coho
14:45:15:25	Jorden Rosenfeld, Ted Down	Nooksack dace, Salish sucker, stickleback pairs White Sturgeon

15:25-15:45 Break

15:45-16:00	Carol Eros	leatherback turtle
16:00-16:15	Linda Nichol	sea otter

16:15-17:00 John Ford Cetaceans: all killer whale populations (northern and southern residents, transients, offshores), right whales, blue whales, and humpback whales

Thursday, 27 March

Quantifying critical habitat

8:40-9:00 Ed Gregr, Vancouver: Identification and designation of important habitat for large cetaceans.

9:00–9:20 Linda Nichol: Sea Otter Habitat in BC, what do we know?

9:20-9:40 Mike Bradford, DFO, Burnaby: Critical habitat and interior Fraser coho salmon

9:40-11:30 **Breakout discussion:** What items need to be specified for a species-at-risk (SAR) before we can proceed to define and map its critical habitat (CH), and how do life stage habitat ontogenies and/or metapopulation factors affect the identification and measurement of CH?

11:30-12:00 Plenary Reporting from Breakout groups

12:00-13:00 Lunch

13:00-14:30 **Breakout discussion:** What methods/ideas are available for the identification and measurement of critical habitats in freshwater environments?

14:30-15:00 Plenary Reporting from Breakout groups

15:00-15:30 Break

15:30-17:00 **Breakout discussion:** What methods/ideas are available for the identification and measurement of critical habitats in marine environments?

17:00-17:30 Plenary Reporting from Breakout groups

Friday, 28 March

8:40-10:00 **Breakout discussion:**

Group 1: Draft interim science-based guidelines/criteria for selecting methods/approaches to defining and mapping CH

Group 2: Key information and conceptual gaps and some priorization for improving the toolbox and improving the guidelines/criteria

10:00-10:30 Plenary Reporting from Breakout groups

10:30-10:50	**Break**
10:50-12:00	Final Plenary: Workshop Summaries and Where To Go Next

Appendix 2: Workshop Participants

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Appendix 3. COSEWIC listed species at the time of the workshop, Please note that this table will change every time COSEWIC meets, and is subject to a June, 2003, proclamation date.

Pacific Region Aquatic Species

Listed by COSEWIC or Status Report Requested

File:/n/Sara/list of Pacific Region Aquatic Species.xls

*assumption is proclamation in June 2003

Common Name	*Scientific Name*	Current Status (date of last assesment)	Completion Date of Recovery Strategy	Year of Strategy (earliest start)
Abalone, Northern	*Haliotis kamtschatkana*	Threatened (1999)	June 2007	2006
Bocaccio	*Sebastes paucispinis*	Threatened (Nov 2002)	March 2006	2005
Dace, Nooksack	*Rhinichthys sp.*	Endangered (1996)	June 2006	2005
Dace, Speckled	*Rhinichthys osculus*	Endangered (Nov 2002)	March 2005	2004
Dace, Umatilla	*Rhinichthys umatilla*	Special Concern (1988)		*
Hotwater Physa	*Physella wrighti*	Endangered (1998)	June 2006	2005
KW, NE Pacific Northern Resident	*Orcinus orca*	Threatened (2001)	June 2007	2006
KW, NE Pacific Offshore	*Orcinus orca*	Special Concern (2001)	June 2008	2007
KW, NE Pacific Southern Resident	*Orcinus orca*	Endangered (2001)	June 2006	2005
KW, NE Pacific Transient	*Orcinus orca*	Threatened (2001)	June 2007	2006
Lamprey, Cowichan Lake	*Lampetra macrostoma*	Threatened (2000)	June 2007	2006
Lamprey, Morrison Creek	*Lampetra richardonsoni*	Endangered (1999)	June 2006	2005
Leatherback turtle	*Dermochelys coriacea*	Endangered (1981)	June 2006	2005
Olympia Oyster	*Ostrea conchaphila*	Special Concern (2000)	June 2008	2007
Pixie Poacher	*Ocella impi*	Data deficient (1991)		*
Salish Sucker	*Catostomus Species 4*	Endangered (1986)	March 2005	2004
Salmon, Cultus Lake	*Oncorhynchus nerka*	Endangered (2002 emergency)	March 2005	2004
Salmon, Sakinaw Lake	*Oncorhynchus nerka*	Endangered (2002 emergency)	March 2005	2004
Salmon, Thompson&Upper Fraser	*Oncorhynchus kisutch*	Endangered (2002)	March 2005	2004
Sculpin, Columbia Mottled	*Cottus bairdi hubbsi*	Special Concern (2000)	June 2008	2007

Sculpin, Cultus Pygmy/Lake	*Cottus sp.*	Threatened (2000)	June 2007	2006
Sculpin, Shorthead	*Cottus confusus*	Threatened (1984)	June 2007	2006
Sea Otter	*Enhydra lutris*	Threatened (1996)	June 2007	2006
Squanga Whitefish	*Coregonus sp.*	Special Concern (1987)		*
Stickleback, Charlotte Unarmoured	*Gasterosteus aculeatus*	Special Concern (1983)		*
Stickleback, Enos Lake Benthic	*Gasterosteus spp.*	Endangered (Nov 2002)	March 2005	2004
Stickleback, Enos Lake Limnetic	*Gasterosteus spp.*	Endangered (Nov 2002)	March 2005	2004
Stickleback, Giant	*Gasterosteus sp.*	Special Concern (April 1980)		*
Stickleback, Benthic Hadely Lake	*Gasterosteus*	Extinct (1999)		*
Stickleback, Limnetic Hadely Lake	*Gasterosteus*	Extinct (1999)		*
Stickleback, Paxton Lake Benthic	*Gasterosteus Species 5*	Endangered (1999)	June 2006	2005
Stickleback, Paxton Lake Limnetic	*Gasterosteus Species 4*	Endangered (1999)	June 2006	2005
Stickleback, Vanada Creek Benthic	*Gasterosteus Species 14*	Endangered (1999)	June 2006	2005
Stickleback, Vanada Creek Limnetic	*Gasterosteus Species 15*	Endangered (1999)	June 2006	2005
Sturgeon, Green	*Acipenser medirostris*	Special Concern (1987)		*
Sturgeon, White	*Acipenser transmontanus*	Special Concern (1990)		*
Whale, Blue	*Balaenoptera musculus*	Endangered (2002)	March 2005	2004
Whale, Fin	*Balaenoptera physalus*	Special Concern (1987)		*
Whale, Northern Right	*Eubalaena glacialis*	Endangered (1990)	March 2007	2006
Chiselmouth	*Acrochelius alutaceus*	Data Deficient (1997)	March 2005	2004
Whale, Humpback (North Pacific Pop)	*Megaptera novaeangliae*	Threatened (April 1985)	March 2006	2005
Harbour Porpoise (Pacific Ocean Pop)	*Phocoena phocoena*	Data Deficient (April 1991)	March 2005	2004
Lake Herring	*Coregonus artedii*	New Report	March 2005	2004
Lake Whitefish	*Coregonus clupeaformis*	New Report	March 2005	2004
Pearl Dace	*Margariscus margarita*	New Report	March 2005	2004
Sei Whale	*Balaenoptera borealis*	New Report	March 2005	2004

Skidegate Lamprey	*Lampetra sp*	New Report	March 2005	2004
Wolf-eel	*Anarrhichthys ocellatus*	New Report	March 2005	2004
Grey Whale (Northeast Pacific Pop)	*Eschrinschtius robustus*	Not at Risk (April 1987)		
Steller Sea Lion	*Eumetopias jubatus*	Not at Risk (April 1987)	March 2005	2004
Copper River Lamprey	*Lampetra sp*	New Report		
Dragon Lake Whitefish	*Coregonus sp.*	New Report		
Eulachons	*Thaleichthys pacificus*	New Report		
Harbour Seal	*Phoca vitulina richardsi*	Not at Risk (April 1999)		
Nass River Lamprey sp.1	*Lampetra sp*	New Report		
Nass River Lamprey sp.2	*Lampetra sp*	New Report		
Round Whitefish	*Prosopium cylindraceum*	New Report		
New Species				
Coastal cutthroat trout	*Onchorhynchus clarki clarki*	New Report (Draft Report in Preparation)		
Liard Hotsprings lake chub	*Couesius plumbeus ssp*	New Report (Draft Report in Preparation)		
Pygmy longin smelt	*Spirinchus sp*	New Report (Draft Report in Preparation)		
Westslope cutthroat trout				
Fourhorn sculpin freshwater form				
Fourhorn sculpin salt water form				
Rocky mountain ringed mussel				
Giant pygmy whitefish				
Minke whale				
Bowhead whale Western arctic				