Draft Report | **BC Marine Conservation Analysis**

MARINE MAMMALS EXPERT WORKSHOP REPORT

Draft with expert feedback
May 7, 2008

Report prepared on behalf of the BCMCA Project Team:
Natalie Ban, University of British Columbia
Karin Bodtker, Living Oceans Society, BC ENGO Marine Planning Caucus
Ken Cripps*, Coastal First Nations
Steve Diggon*[1], West Coast Vancouver Island Aquatic Management Board
Christa Hrabok*, British Columbia Oceans and Marine Fisheries Division
Lynn Lee*, Haida Fisheries Program, Haida Tribal Society
Dave Nicolson, The Nature Conservancy of Canada
Glen Rasmussen, Fisheries and Oceans Canada
Krista Royle, Parks Canada
Charles Short, British Columbia Integrated Land Management Bureau

[1]Steve Diggon replaced Andrew Day on BCMCA Project Team, July 2007
*observers on the BCMCA Project Team

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1.0 Introduction

1.1 Objective of Report and Overview of Marine Mammals Experts Workshop

The objective of this document is to summarize the recommendations from the Marine Mammals Expert Workshop held in Victoria, May 31st 2007. The Marine Mammals Expert Workshop was the third of several expert workshops to be conducted as part of the British Columbia Marine Conservation Analysis (BCMCA) Project. The first workshop covered seabirds, the second covered marine plants and the others will cover ecosystem representation, fish, invertebrates, human use, and the use of Marxan.

The intent of the Marine Mammals Expert Workshop was to draw on the knowledge and expertise of scientists, resource managers and the conservation community to determine how to best represent marine mammal species and marine mammal habitat, or surrogates thereof, in a subsequent conservation utility / optimization analyses. Marine Mammals are an important component of the BCMCA because some species play an integral role in marine ecosystems as top predators, are sensitive to anthropogenic disturbance (i.e., many are endangered and/or threatened) and are commonly used as indicators for the health and condition of the marine environment. Marine mammals are also an important focal taxonomic group whose presence may be indicative of productive, functioning ecosystems.

Participants of the workshop were divided into two groups – 1) Cetaceans; and, 2) Pinnipeds and Mustelids - to identify available data and discuss features and targets. These groups are somewhat arbitrary, and were formed for the purpose of the workshop. The results of the subgroup discussions are reported in their respective sections.

1.2 Project Background

The overall purpose of the BCMCA is to collaboratively identify areas of high conservation utility/interest for the Pacific coast of Canada. The BCMCA Project will involve two main components/products: (1) An Atlas of Known Ecological and Human Use Values; and (2) the Marxan Spatial Analysis. The Atlas will map ecological data, human use data, areas where data are lacking, and a combination of areas of ecological value and human use hotspots. The Marxan Spatial Analysis component will iteratively identify: (1) areas of high conservation value using ecological data only; (2) areas of high conservation utility that minimize impacts to marine users and coastal communities; and (3) areas of high conservation value that incorporate reserve design principles.

To achieve these goals, the following are objectives of the BCMCA Project:

- Use the best available information, including the latest in marine conservation planning theory.
- Assemble and use the best available biological, ecological, oceanographic, and socio-economic data.
- Faithfully and transparently reflect the accuracy, scale and completeness of the data.

- Draw on the knowledge and expertise of governments (Federal, Provincial and First Nations), other resource managers, the conservation community, academics, and other scientists to develop sound, scientifically defensible methods and products.
- Utilize methods which are transparent in their application.
- Incorporate ecological, social and economic objectives in the analysis and balance these in a range of solutions.
- Work cooperatively to achieve project goals.
- Create products which are widely supported by partner organizations.

The BCMCA spatial analysis will be driven by six conservation objectives:

(1) represent the diversity of BC's marine ecosystems across their natural range of variation;
(2) maintain viable populations of native species;
(3) sustain ecological and evolutionary processes within an acceptable range of variability;
(4) build a conservation network that is resilient to environmental change;
(5) identify options that minimize impacts to marine users and coastal communities, while still meeting conservation objectives; and
(6) consider a variety of conservation scenarios and options.

Identifying areas of high conservation utility involves the consideration of multiple objectives and the use of large data sets that show the distribution of ecological, biological, and human use data. The BCMCA will use the decision-support tool Marxan to help achieve conservation objectives while minimizing impacts to marine users and coastal communities. Marxan was developed by researchers at the University of Queensland to help in the recent rezoning of the Great Barrier Reef (Ball 2000; Ball and Possingham 2000, Day 2002). The BCMCA Project will draw on the recommendations of the Marxan Best Practices Workshop, which was hosted by the Pacific Marine Analysis and Research Association (PacMARA) in April 2007.

The results of the BCMCA project are intended to help advance marine planning initiatives in BC by identifying priority areas for conservation.

2.0 General discussion

Several topics for discussion arose out of the workshop, which affect both groups in this workshop as well as subsequent workshops. This discussion and suggestions for improving the project are outlined below, and **we invite your input**.

2.1 Atlas

- There will be cases where data may not exist for particular taxa in particular spatial areas so it should be very clear that an absence of data does *not* infer an absence of ecological value. For output maps it will be important to identify areas where data are missing or N/A.
- A data gap analysis, perhaps run for each of the ecological components, should be part of the mapping study. *The BCMCA project team has discussed this suggestion and agreed to include this as a component of the Atlas product.*

- More sophisticated statistical techniques were suggested for use on the existing marine mammal datasets to elucidate distribution and abundance as well as habitat relationships (see Redfern et al. 2006).

2.2 Features and Targets

- There was some confusion around identifying features for this workshop, specifically related to identifying groups of species versus individual species. We could clarify this is future workshops.
- The idea that the feature layers are static came up and was seen as a limitation since many marine mammals are migratory and only occupy discrete spatial areas at specific times of the year. Suggestion: If we had seasonal data for marine mammal species we could produce seasonal layers.
- How do we account for seasonal and interannual variation? *Answer:* We can't at this point. We can identify and include in the analysis all areas that are documented as important for any species/ecological feature even if those areas are not continually important across all time. We can adjust relative importance 'scores' within any one feature data set and/or adjust the weight of one feature data set against others.
- For cetaceans, some experts felt that setting conservation targets at either the population or habitat level was seen as an inappropriate task for this workshop. The general feeling was that it was not the onus of the researcher/scientist to do this, but rather that of resource managers.
    - There were differing opinions from experts on this topic. Some felt that there is a need to set conservation targets for the species groups that are included in the analysis and that managers rely on scientists for this information. It was suggested that the group set whatever targets are needed, and simply include qualifiers that this is the best that can be done at this time.
    - This report includes all recommendations from workshop experts and acknowledges lack of consensus. The project will report separately on the application and implementation of workshop recommendations during data gathering and analysis portion of the project.

2.3 Planning units

- What size of planning units? *Answer*: Variable depending on resolution of the data.
- Can you assign confidence intervals for the data in each planning unit cell? *Answer:* We could attach information on confidence intervals as an attribute of the data, but it would not get used in the Marxan analysis.

2.4 Data and data sharing

- The concern was voiced that even the best available data are not good enough to meet the objectives of this project and analysis. There is a need to allocate more resources to completing surveys to fill data gaps. However, resource management cannot wait on complete information. It is recommended to use the best available information so that all species are included in the analysis, and then add the appropriate caveats and assumptions.

- Will compiled data be available when project is completed? *Answer*: depends on formal data sharing agreement. Data can be released with formal data sharing agreements.
- Will sharing of academic data affect individual publication prospects? *Answer:* no, can explicitly state in data sharing agreements that this data will *not* be available outside this exercise.

2.5 Other workshops/General

- Will areas that are not identified as having high ecological value be seen as locations where MPAs should not be placed and as areas undeserving of enhanced management activities? *Answer:* It depends on whether these areas were not identified as a result of insufficient data or absence of value. We will make it clear where data were lacking.
- Not sure how this will work – if this is supposed to be a coastwide analysis, how will No Data enter into the analysis? Will you require all data to exist in a location in order for it to enter into the Marxan analysis? or will different areas be analysed with different levels of data? *Answer:* Treatment of data gaps will be informed by a good practices handbook and possibly by the Marxan expert workshop. Our treatment of data and data gaps will be fully documented.
- The BCMCA report and output products needs to clearly spell out that MPAs may not be the best protection mechanism for all species considered in the analyses. There was a general feeling that the tool of choice may be inadequate, certainly for some species. This is true with regard specifically to large cetaceans which likely occupied habitat according to the availability of dense prey patches.
- The comment was made that the Conservation Utility Map, identifying areas of high conservation utility in a previous analysis, was backwards in terms of biodiversity, which should be greatest in flat sandy areas.
- The comment was made that the goals of this project are lofty (specifically our six conservation objectives, see pg. 4) and will not necessarily be met.

3.0 Cetaceans

3.1 Introduction

The cetacean discussion group considered species from the order *Cetacea* – the whales, dolphins and porpoises. All cetacean species were considered regardless of their rarity (or lack of reported sightings or survey effort). Because of the scale at which many cetaceans (especially the Balaenopterids) use the marine environment, it was difficult to conceptualize static marine boundaries that would encapsulate their range of movement. Some experts viewed cetaceans as unlikely candidates for protection via marine reserves; however there was no desire to exclude certain species from this project and analysis based on these observations. Spatial and temporal variability in cetacean distribution was also a point of contention in that Marxan can not account for dynamic environments. Marxan makes uses of information presented about the average distribution of features. However, it is recognized that for some highly dynamic components, this snapshot of average distribution is more limiting than for others.

Spatial and temporal variability are the hallmark of long-lived, marine predators. You may be able to make a case for MPAs and balaenpoterids, as the coast of BC represents a feeding ground, and thus, their habitat is represented by their prey species. Grey whales may be a possible exception, because of the migration route.

Comments were also made to separate the nearshore from the offshore in the analysis. This may help bound levels of confidence for species that exhibit high site fidelity or whose distribution may be explained by static habitat characteristics versus species whose distribution may be explained by more ephemeral prey or highly variable oceanographic conditions occurring over large spatial scales.

Participants in the cetacean group were:

- Larry Dill, Simon Fraser University
- Dave Duffus, University of Victoria
- Rob Williams, Marine Mammal Research Unit, University of British Columbia
- Bethany Lindsay, Vancouver Aquarium (BCCSN)
- Anna Hall, University of British Columbia – phone call follow-up
- Linda Nichol, Department of Fisheries and Oceans – phone call follow-up

Additional Comments:

- Ed Gregr, Consultant / Marine Mammal Research Unit, University of British Columbia
- Charlie Short & Krista Royle (facilitator/note-taker) – Province of BC & Parks Canada

3.2 Sources of Cetacean Data

Cetacean data sources available in BC are summarised in Table 1. The majority of discussion surrounding data sources had to do with systematic survey design and effort. The data sources vary with respect to the type of data (point, line, polygon), data provider, geometry, geographic extent, key attributes (presence, presence/absence, relative abundance / importance), and quality (precision and accuracy). For example, some datasets capture broad-scale systematic surveys (e.g., inside waters & central / north coast), while others datasets provide in-depth systematic distribution and habitat surveys of smaller geographic areas (e.g., Clayoquot Sound). Other datasets consisted of species' distribution and abundance via ships of opportunity and random opportunistic survey design. Very little survey effort for cetaceans was identified for the offshore waters (west of the shelf break) and waters south of Clayoquot Sound to Sooke on the west coast of Vancouver Island.

Marxan requires information on presence or absence of a feature in every grid cell in a study area. Most datasets that exist on marine mammal distribution in BC, in contrast, are collected as a series of points (for opportunistic sightings data), or points along transect lines (for systematic sightings surveys). One way that was proposed to get around this limitation was to use modeling approaches (reviewed and summarized in Redfern et al. 2006) to make predictions for marine mammal distribution throughout BC coastal waters. One solution might be to use existing effort and sightings data from line transect surveys (Williams & Thomas 2007) to interpolate densities between tracklines to produce smooth density surfaces (Williams, Hedley and Hammond 2006).

However, it was noted that this level of pre-processing may not be something researchers are likely to provide their data for. One view was that this type of 'sophisticated' model will likely be necessary for Critical Habitat designation, but is surely beyond the scope of BCMCA analysis. Instead features for a Marxan analysis could be based on some relative suitability on a species by species basis. You can make simple assumptions about habitat, and any necessary assumptions about proportion of the population. The point is your species representations do not need to satisfy the species biologists, since the analysis can always be qualified, and re-visited should better ecological maps become available (from those critical experts).

Again, the group did not reach consensus on how to best pre-process marine mammal data for inclusion into the BCMCA analyses as feature layers. The Project Team will consult experts as data are assembled and will request review of mapped features prior to analysis.

3.3 Features and Targets

A total of 19 cetacean species (including three killer whale ecotypes and four beaked whale species were identified. A total of 84 marine features were identified for cetaceans during the workshop (Table 2). Each cetacean species was given a feature for distribution, abundance and suitable / realized habitat. There was no desire by the group to set targets for any one of these features and, as a default; the group agreed that targets ought to be set at 100%. The rationale for this was the paucity of historical abundance / distribution data, the recovery of depleted cetacean species' stocks, the potential for range expansion into unoccupied habitat, and as discussed above, management objectives ought to be set by managers. Priority should be given to those species that are listed under SARA and that have "critical habitat" maps available. If this is the case, then 100% of that identified habitat should be targeted, the remainder of the "suitable" habitat was not discussed in terms of setting targets. Time and cost permitting, more sophisticated methods may be undertaken to identify priority habitats. **Additional modeling exercises will require further follow-up with the expert participants after the datasets are assembled.**

Other options to set targets could be the average difference between "suitable" habitat and "critical" habitat if it were known for each species. However, for many species these data may not be currently available.

Ecological considerations (including minimum patch size, replication and separation distance) were generally not specified during the workshop due to the complexity involved in estimating these considerations in a meaningful way.

3.4 Assumptions/Limitations

Information on cetaceans in British Columbia is highly variable with respect to level of detail, quality and consistency of survey methods and spatial coverage. Generally, we lack complete data on the presence/absence, distribution and abundance for many species.

3.5 Recommendations

For cetaceans in British Columbia, the expert sub-group recommended 84 features be used in the analysis and recommended that targets be set at 100 percent for each species. Maps for these features will be created by assembling and pre-processing all the available data. These maps will be distributed to the cetacean working group for review and comment.

While a modeling approach such as interpolation/density surface fitting, using GLMs or GAMs, was suggested as an approach to for pre-processing opportunistic observation and/or survey point data in order to provide Marxan with comprehensive features for these species, the BCMCA may not have the resources to undertake such modeling and statistical analysis. The BCMCA Project Team acknowledges that it is inappropriate to include point data to represent Marine Mammal features without appropriate pre-processing to create more comprehensive coverages. We also assure the experts that data gaps (areas where species data are lacking) will treated in the analyses according to Marxan 'Good Practices.' Experts will be given the opportunity to review our pre-processing methods and results. Further recommendations and comments will be taken into account whenever possible and fully documented.

Table 1: Cetacean: Data Sources

Dataset/Layer	Category	Description	Geometry	Data Custodian	Extent	Key Fields	Comments	Pre-Processing
1. Cetacean Research Program, DFO. Multispecies surveys (some fixed hydrophone data)	Cetacean distributions and abundance.	At sea boat based cetacean surveys. All species. Long term killer whale database and humpback catalogue	Point, line, poly.	DFO, Cetacean Research Program **Contact:** John Ford, PBS	Limited offshore and areas south of Estevean point on the west coast of Vancouver Island and Strait of Georgia, Haro and Juan de Fuca Strait.	Date, time, Location (lat, long) , species, effort, trackline	Opportunistic areas of BC marine waters. Non systematic surveys. Many ships of opportunity.	
2. British Columbia Cetacean Sightings Network (BCCSN)	Location data for all cetaceans	Opportunistic public sightings reporting network.	Point	Vancouver Aquarium **Contact:** Doug Sandilands.	All BC marine waters.	Date, time, location, species, behaviour, group size, confidence in identification.	Sightings are biased towards coastal areas of high population density. Not corrected for effort. Attempts have been made to correct this.	
3. Raincoast Research	Killer whales and small cetaceans	Distribution	Point, poly	Raincoast Research **Contact:** Alexandra Morton	Queen Charlotte Sound and Broughton Archipelago	Date, time, location…????	Mostly information for PWSD, Dalls' and killer whales. Abundance and survivorship estimates produced for Pacific white-sided dolphin by Erin Ashe	
4. Rob Williams and Raincoast	Multispecies	Distribution and Abundance, density	Point, line, ploy	Raincoast Misty MacDuffee **Contact: UBC** Rob Williams	Systematic survey of inshore coastal waters (BC-WA to BC-AK borders, plus mainland coast inlets	Date, time, location, group size, effort, density, behaviour.	Multi-year vessel surveys. Abundance est. for seven spp. Harbour Porpoise, Dall's, PWSD, Humpback, fin, minke, northern resident and transient KW's. Also has data on at-sea distribution of pinnipeds (Steller sea lions, harbour seals and elephant seals), sea otters, and some cetaceans seen too infrequently to estimate abundance (offshore kws, sei whale).	

5. Whale Research Lab – UVIC.	Grey whale ecology	Distribution, habitat, prey studies	Point, line	UVIC Whale Lab **Contact:** Dave Duffus	Clayoquot and Nootka Sound	Date, time, location, effort, prey, habitat	Systematic long term surveys. Real time oceanographic data – remote buoy. Detailed habitat studies for grey whales. Habitat association and fine scale movement patterns.	
6. Parks Canada	Grey whale and humpback whale distribution	distribution	Point, line	Pacific Rim, Wendy Szanislo and Brian Gisborne (Juan de Fuca Express) **Contact:** Parks – Heather Holmes Wendy Szanislo Brian Gisborne	Tofino south to Barkley sound and west cost trail to Port San Juan- coastal.	Date, time, location, spp., behaviour.	Opportunistic surveys.	
7. National Marine Mammal Lab (NMML)	Harbour Porpoises	Distribution, abundance	Point, line, ply	**Contact:** Jeff Laake	Southern Vancouver Island	Date, time, location, spp. ???	Vessel and aerial based surveys.	
8. South West Fisheries Science Centre - SWFSC	All Cetaceans	Distribution & Abundance	Point, line, poly	**Contact:** J. Barlow	WA - AK offshore	Date, time, location, spp., effort, trackline	Vessel & aerial based surveys.	
9. Cascadia Research Collective	Humpbacks, killer whales and grey whales	Distribution, abundance, ecology (tagging)	Point, line , poly	**Contact:** J. Calambokidas & R. Baird	WA - AK	Date, time, location, spp., *(effort, trackline?)	Vessel & aerial based surveys.	
10. UBC Fisheries Centre – Marine Mammal Research Unit.	Historical distribution of cetaceans	Distribution, catch statistics	Point, poly	**Contact:** Ed Gregr	All of BC	Location, catch rate	Modeling and logbook data	
	Harbour porpoise distribution and abundance	Distribution, abundance, oceanography	point data	**Contact:** Anna Hall	Juan de Fuca Strait, Haro Strait & Strait of Georgia	Date, time, location, effort, oceanography	Vessel based surveys. 1995 - 2007, excluding 1997. All are opportunistic sightings .	

	Dall's Porpoise, Pacific WSD			**Contact:** Kathy Heise? L. Nicol (DFO for historical distribution data)				
	Resident killer whales	Multi-year study of habitat use in Johnstone Strait	Point	**Contact:** Rob Williams	Johnstone Strait, Robson Bight Michael Bigg Ecological Reserve	Date, time, location, group size, matriline, activity	Land based monitoring	
	Dall's porpoise -	habitat use and behavioural.		**Contact:** Anna Hall				
11. Jim Darling	Humpback and grey whale photo ID	Local abundance; site fidelity		**Contact:** Jim Darling Wendy Szaniszlo (contracted to facilitate gathering of data from local whale watch guides, entering data, matching ID photos)	Clayoquot Sound	Date, location, group size, behaviour	Vessel –based opportunistic photo ID by Jim, Wendy and local whale watch guides	Jim Darling

Table 2: Cetaceans: Data Preparation and Targets

Marine Feature	Rationale	Measure	Target	Comments/ Justification for targets	Ecological Considerations	Comment
Southern Resident Killer Whales 1. Distribution 2. Abundance 3. Suitable Habitat 4. Realized Habitat	All cetaceans are deemed highly important to conserve due to their life histories. Historical and current population trends for many species have shown cetaceans to be sensitive to anthropogenic disturbance. Low fecundity rates, long life spans and seasonal variability in occurrence are common traits in many species.	Known distribution, known abundance, suitable habitat, realized habitat and, for SARA listed species - Identified critical habitat.??	100%	The wide ranging nature of many species, temporal and spatial variability in their prey base and the potential for range expansion due to individual species' population recovery is largely unknown. Therefore, target ranges for available species' habitat and distribution data is by default set to 100%.	Areas of high pacific salmon aggregation – narrow constricted channels at migration periods. RKWs are known to feed primarily on Chinook	Critical Habitat has been identified for this species.
Northern Resident Killer Whale 5. Distribution 6. Abundance 7. Suitable Habitat 8. Realized Habitat	All cetaceans are deemed highly important to conserve due to their life histories. Historical and current population trends for many species have shown cetaceans to be sensitive to anthropogenic disturbance. Low fecundity rates, long life spans and seasonal variability in occurrence are common traits in many species.	Known distribution, known abundance, suitable habitat, realized habitat and, for SARA listed species - Identified critical habitat.??	100%	The wide ranging nature of many species, temporal and spatial variability in their prey base and the potential for range expansion due to individual species' population recovery is largely unknown. Therefore, target ranges for available species' habitat and distribution data is by default set to 100%.	Areas of high pacific salmon aggregation – narrow constricted channels at migration periods.	Critical Habitat has been identified for this species.
Transient Killer Whale 9. Distribution 10. Abundance 11. Suitable Habitat 12. Realized Habitat	All cetaceans are deemed highly important to conserve due to their life histories. Historical and current population trends for many species have shown cetaceans to be sensitive to anthropogenic disturbance. Low fecundity rates, long life spans and seasonal variability in occurrence are common traits in many species.	Known distribution, known abundance, suitable habitat, realized habitat and, for SARA listed species - Identified critical habitat.	100%	The wide ranging nature of many species, temporal and spatial variability in their prey base and the potential for range expansion due to individual species' population recovery is largely unknown.	Phocid pupping and haul out sites. Otariiad haul out and rookery sites.	The appropriate feature associated with this species will be determined after data acquisition.

				Therefore, target ranges for available species' habitat and distribution data is by default set to 100%.		
Offshore Killer Whale 13. Distribution 14. Abundance 15. Suitable Habitat 16. Realized Habitat	All cetaceans are deemed highly important to conserve due to their life histories. Historical and current population trends for many species have shown cetaceans to be sensitive to anthropogenic disturbance. Low fecundity rates, long life spans and seasonal variability in occurrence are common traits in many species.	Known distribution, known abundance, suitable habitat, realized habitat and, for SARA listed species - Identified critical habitat.	100%	The wide ranging nature of many species, temporal and spatial variability in their prey base and the potential for range expansion due to individual species' population recovery is largely unknown. Therefore, target ranges for available species' habitat and distribution data is by default set to 100%.		The appropriate feature associated with this species will be determined after data acquisition.
False Killer Whale 17. Distribution 18. Abundance 19. Suitable Habitat 20. Realized Habitat	All cetaceans are deemed highly important to conserve due to their life histories. Historical and current population trends for many species have shown cetaceans to be sensitive to anthropogenic disturbance. Low fecundity rates, long life spans and seasonal variability in occurrence are common traits in many species.	Known distribution, known abundance, suitable habitat, realized habitat and, for SARA listed species - Identified critical habitat.	100%	The wide ranging nature of many species, temporal and spatial variability in their prey base and the potential for range expansion due to individual species' population recovery is largely unknown. Therefore, target ranges for available species' habitat and distribution data is by default set to 100%.		The appropriate feature associated with this species will be determined after data acquisition.
Sperm Whale 21. Distribution 22. Abundance 23. Suitable Habitat 24. Realized Habitat	All cetaceans are deemed highly important to conserve due to their life histories. Historical and current population trends for many species have shown cetaceans to be sensitive to anthropogenic disturbance. Low fecundity rates, long life spans and seasonal variability in occurrence are common traits in many species.	Known distribution, known abundance, suitable habitat, realized habitat and, for SARA listed species - Identified critical habitat.	100%	The wide ranging nature of many species, temporal and spatial variability in their prey base and the potential for range expansion due to individual species' population recovery is largely unknown. Therefore, target		The appropriate feature associated with this species will be determined after data acquisition.

				ranges for available species' habitat and distribution data is by default set to 100%.		
Humpback Whale 25. Distribution 26. Abundance 27. Suitable Habitat 28. Realized Habitat	All cetaceans are deemed highly important to conserve due to their life histories. Historical and current population trends for many species have shown cetaceans to be sensitive to anthropogenic disturbance. Low fecundity rates, long life spans and seasonal variability in occurrence are common traits in many species.	Known distribution, known abundance, suitable habitat, realized habitat and, for SARA listed species - Identified critical habitat.	100%	The wide ranging nature of many species, temporal and spatial variability in their prey base and the potential for range expansion due to individual species' population recovery is largely unknown. Therefore, target ranges for available species' habitat and distribution data is by default set to 100%.	Areas of high zooplankton density and abundance. Areas of high densities of forage fish (i.e. herring, pilchard)	The appropriate feature associated with this species will be determined after data acquisition.
Fin Whale 29. Distribution 30. Abundance 31. Suitable Habitat **32.** Realized Habitat	All cetaceans are deemed highly important to conserve due to their life histories. Historical and current population trends for many species have shown cetaceans to be sensitive to anthropogenic disturbance. Low fecundity rates, long life spans and seasonal variability in occurrence are common traits in many species.	Known distribution, known abundance, suitable habitat, realized habitat and, for SARA listed species - Identified critical habitat.	100%	The wide ranging nature of many species, temporal and spatial variability in their prey base and the potential for range expansion due to individual species' population recovery is largely unknown. Therefore, target ranges for available species' habitat and distribution data is by default set to 100%.	Areas of high zooplankton abundance.	The appropriate feature associated with this species will be determined after data acquisition.
Sei Whale 33. Distribution 34. Abundance 35. Suitable Habitat **36.** Realized Habitat	All cetaceans are deemed highly important to conserve due to their life histories. Historical and current population trends for many species have shown cetaceans to be sensitive to anthropogenic disturbance. Low fecundity rates, long life spans and seasonal variability in occurrence are common traits in many species.	Known distribution, known abundance, suitable habitat, realized habitat and, for SARA listed species - Identified critical habitat.	100%	The wide ranging nature of many species, temporal and spatial variability in their prey base and the potential for range expansion due to individual species' population recovery is largely unknown. Therefore, target ranges for available	Areas of high zooplankton density and abundance. Areas of high densities of forage fish (i.e. Sei whales are offshore, not nearshore like humpbacks which indeed feed on pilchards, herring)	The appropriate feature associated with this species will be determined after data acquisition.

				species' habitat and distribution data is by default set to 100%.		
Northern Right Whale 37. Distribution 38. Abundance 39. Suitable Habitat **40.** Realized Habitat	All cetaceans are deemed highly important to conserve due to their life histories. Historical and current population trends for many species have shown cetaceans to be sensitive to anthropogenic disturbance. Low fecundity rates, long life spans and seasonal variability in occurrence are common traits in many species.	Known distribution, known abundance, suitable habitat, realized habitat and, for SARA listed species - Identified critical habitat.	100%	The wide ranging nature of many species, temporal and spatial variability in their prey base and the potential for range expansion due to individual species' population recovery is largely unknown. Therefore, target ranges for available species' habitat and distribution data is by default set to 100%.	Areas of high zooplankton abundance.	The appropriate feature associated with this species will be determined after data acquisition.
Grey Whale 41. Distribution 42. Abundance 43. Suitable Habitat **44.** Realized Habitat	All cetaceans are deemed highly important to conserve due to their life histories. Historical and current population trends for many species have shown cetaceans to be sensitive to anthropogenic disturbance. Low fecundity rates, long life spans and seasonal variability in occurrence are common traits in many species.	Known distribution, known abundance, suitable habitat, realized habitat and, for SARA listed species - Identified critical habitat.	100%	The wide ranging nature of many species, temporal and spatial variability in their prey base and the potential for range expansion due to individual species' population recovery is largely unknown. Therefore, target ranges for available species' habitat and distribution data is by default set to 100%.	Areas of high zooplankton abundance.	The appropriate feature associated with this species will be determined after data acquisition.
Blue Whale 45. Distribution 46. Abundance 47. Suitable Habitat **48.** Realized Habitat	All cetaceans are deemed highly important to conserve due to their life histories. Historical and current population trends for many species have shown cetaceans to be sensitive to anthropogenic disturbance. Low fecundity rates, long life spans and seasonal variability in occurrence are common traits in many species.	Known distribution, known abundance, suitable habitat, realized habitat and, for SARA listed species - Identified critical habitat.	100%	The wide ranging nature of many species, temporal and spatial variability in their prey base and the potential for range expansion due to individual species' population recovery is largely unknown. Therefore, target ranges for available	Areas of high zooplankton abundance.	The appropriate feature associated with this species will be determined after data acquisition.

				species' habitat and distribution data is by default set to 100%.		
Minke Whale 49. Distribution 50. Abundance 51. Suitable Habitat **52.** Realized Habitat	All cetaceans are deemed highly important to conserve due to their life histories. Historical and current population trends for many species have shown cetaceans to be sensitive to anthropogenic disturbance. Low fecundity rates, long life spans and seasonal variability in occurrence are common traits in many species.	Known distribution, known abundance, suitable habitat, realized habitat and, for SARA listed species - Identified critical habitat.	100%	The wide ranging nature of many species, temporal and spatial variability in their prey base and the potential for range expansion due to individual species' population recovery is largely unknown. Therefore, target ranges for available species' habitat and distribution data is by default set to 100%.	Areas of high zooplankton density and abundance. Areas of high densities of forage fish (i.e. herring, pilchard)	The appropriate feature associated with this species will be determined after data acquisition.
Beaked Whales (Baird's, Cuvier's Stejnerger's, Hubb's) 53. Distribution 54. Abundance 55. Suitable Habitat **56.** Realized Habitat	All cetaceans are deemed highly important to conserve due to their life histories. Historical and current population trends for many species have shown cetaceans to be sensitive to anthropogenic disturbance. Low fecundity rates, long life spans and seasonal variability in occurrence are common traits in many species.	Known distribution, known abundance, suitable habitat, realized habitat and, for SARA listed species - Identified critical habitat.	100%	The wide ranging nature of many species, temporal and spatial variability in their prey base and the potential for range expansion due to individual species' population recovery is largely unknown. Therefore, target ranges for available species' habitat and distribution data is by default set to 100%.		The appropriate feature associated with this species will be determined after data acquisition.
Pacific White Sided Dolphin 57. Distribution 58. Abundance 59. Suitable Habitat **60.** Realized Habitat	All cetaceans are deemed highly important to conserve due to their life histories. Historical and current population trends for many species have shown cetaceans to be sensitive to anthropogenic disturbance. Low fecundity rates, long life spans and seasonal variability in occurrence are common traits in many species.	Known distribution, known abundance, suitable habitat, realized habitat and, for SARA listed species - Identified critical habitat.	100%	The wide ranging nature of many species, temporal and spatial variability in their prey base and the potential for range expansion due to individual species' population recovery is largely unknown. Therefore, target ranges for available		The appropriate feature associated with this species will be determined after data acquisition.

				species' habitat and distribution data is by default set to 100%.		
Dall's Porpoise 61. Distribution 62. Abundance 63. Suitable Habitat **64.** Realized Habitat	All cetaceans are deemed highly important to conserve due to their life histories. Historical and current population trends for many species have shown cetaceans to be sensitive to anthropogenic disturbance. Low fecundity rates, long life spans and seasonal variability in occurrence are common traits in many species.	Known distribution, known abundance, suitable habitat, realized habitat and, for SARA listed species - Identified critical habitat.	100%	The wide ranging nature of many species, temporal and spatial variability in their prey base and the potential for range expansion due to individual species' population recovery is largely unknown. Therefore, target ranges for available species' habitat and distribution data is by default set to 100%.		The appropriate feature associated with this species will be determined after data acquisition.
Harbour Porpoise 65. Distribution 66. Abundance 67. Suitable Habitat **68.** Realized Habitat	All cetaceans are deemed highly important to conserve due to their life histories. Historical and current population trends for many species have shown cetaceans to be sensitive to anthropogenic disturbance. Low fecundity rates, long life spans and seasonal variability in occurrence are common traits in many species. (Although, the Harbour Porpoise life span is not long relative to other cetaceans, it is long relative to marine species in general.)	Known distribution, known abundance, suitable habitat, realized habitat and, for SARA listed species - Identified critical habitat.	100%	The wide ranging nature of many species, temporal and spatial variability in their prey base and the potential for range expansion due to individual species' population recovery is largely unknown. Therefore, target ranges for available species' habitat and distribution data is by default set to 100%.		The appropriate feature associated with this species will be determined after data acquisition.
Risso's Dolphin 69. Distribution 70. Abundance 71. Suitable Habitat **72.** Realized Habitat	All cetaceans are deemed highly important to conserve due to their life histories. Historical and current population trends for many species have shown cetaceans to be sensitive to anthropogenic disturbance. Low fecundity rates, long life spans and seasonal variability in occurrence are common traits in many species.	Known distribution, known abundance, suitable habitat, realized habitat and, for SARA listed species - Identified critical habitat.	100%	The wide ranging nature of many species, temporal and spatial variability in their prey base and the potential for range expansion due to individual species' population recovery is largely unknown. Therefore, target ranges for available		The appropriate feature associated with this species will be determined after data acquisition.

				species' habitat and distribution data is by default set to 100%.		
Northern Right Whale Dolphin 73. Distribution 74. Abundance 75. Suitable Habitat **76.** Realized Habitat	All cetaceans are deemed highly important to conserve due to their life histories. Historical and current population trends for many species have shown cetaceans to be sensitive to anthropogenic disturbance. Low fecundity rates, long life spans and seasonal variability in occurrence are common traits in many species.	Known distribution, known abundance, suitable habitat, realized habitat and, for SARA listed species - Identified critical habitat.	100%	The wide ranging nature of many species, temporal and spatial variability in their prey base and the potential for range expansion due to individual species' population recovery is largely unknown. Therefore, target ranges for available species' habitat and distribution data is by default set to 100%.		The appropriate feature associated with this species will be determined after data acquisition.
Biological Variables						
77. Areas of upwelling or high productivity						May be included as a feature in a future workshop.
Physical Oceanographic Variables						May be included as a feature in a future workshop.
78. SST Fronts						May be included as a feature in a future workshop.
79. Eddies						May be included as a feature in a future workshop.
80. Slope						May be included as a feature in a future workshop.
81. Depth						May be included as a feature in a future workshop.
82. Sea Surface Height Gradients						May be included as a feature in a future workshop.

83. Rocky Reefs						May be included as a feature in a future workshop.
84. Seamounts, canyons						May be included as a feature in a future workshop.

4.0 Pinnipeds and Mustelids

4.1 Introduction

This discussion group considered sea otters, Steller sea lions, California sea lions, Harbour seals, Fur Seals, and Elephant seals.

Participants in this group were:

- Ed Gregr – Consultant / University of BC
- Linda Nichol – Department of Fisheries and Oceans
- Wendy Szaniszlo – Consultant
- Mark Zacharias – Province of BC
- Karin Bodtker (facilitator/ note-taker) – Living Oceans Society, BC ENGO Marine Planning Caucus
- Glen Rasmussen (facilitator/ note-taker) – Department of Fisheries and Oceans

4.2 Sources of Pinniped and Mustelid Data

Sources of data identified by the group are summarized in Table 3. Sources range from collection and count data to a habitat model. Most are coast-wide; but some have limited geographic coverage.

Observational data for some of the species is limited to counts at haulouts and rookeries and while assumptions can be made about distance traveled for the purpose of foraging, distances estimated from research at one site may not be applicable to different sites, especially in different regions. Despite this caveat, estimates of foraging habitat for most species will be based on this type of model. The sea otter potential habitat data set, which is based on a more robust model, is also recommended for use here. Current data are not available for some species.

Datasets shown in red text probably do not currently exist in a GIS supported format but are included to document data gaps, priorities for future research and data collection.

4.3 Features and Targets

Experts identified 12 features to be targeted in our analysis. For the central place foragers, each feature consists of a land feature (rookery or haulout) and a buffer around that site which is assumed to be the marine habitat that supports those animals. There was much discussion around setting targets and at least part of the difficulty was due to uncertainty as to what the available data might look like. Targets agreed upon were based on effective population size, in one case, and historical low population sizes from which recovery has been possible in the past. **Please provide input as to an appropriate target for the sea otter range based on the range map (Table 4).**

At least five identified features have little or no mapped data associated with them and were identified mostly to highlight data gaps. Details of the pinniped and mustelid features are contained in Table 4.

Ecological considerations (including minimum patch or population size, replication and separation distance) were discussed in this group and agreed upon recommendations are listed in Table 4.

4.4 Assumptions/Limitations

Recommendations for the features and targets were constrained by data availability and limited knowledge of where some of these very mobile species spend their foraging time and where they spend the winter months. One major assumption is that foraging takes place within a certain distance of a haulout or rookery and that it could be in any direction from any given rookery or haulout.

4.5 Recommendations

For pinnipeds and mustelids in British Columbia, the expert sub-group recommended 12 features be used in the analysis and recommended target ranges suitable for each species. Maps for these features will be created by assembling all the available data. These maps will be distributed to the pinniped and mustelid working group for review and comment.

It was also recommended that these targets should be further vetted, the pinniped ones in particular with Peter Olesiuk and/or Andrew Trites. The question is are they acceptable or too low, and is the rationale used reasonable.

Table 3: Pinnipeds and Mustelids: Data Sources

Category	Dataset	Description	Geometry	Data Custodian	Extent	Key Fields	Comments	Pre-Processing
Sea Otter	Range map	Shape file	polygon	Linda Nichol	BC coast-wide			Clip to 50 m depth profile
	Potential habitat	Based on a model, shows optimal habitat, summer and spring only	polygon	Linda Nichol	BC coast-wide except Georgia Strait to Race Rocks		To be published in Journal of Wildlife Management	
	Winter habitat	Data gap		Josie Osborne (consultant in Tofino) and Katie Beach (Nuu-chah-nulth Tribal Council biologist)	Clayoquot Sound (perhaps Nootka and Kyuquot as well)			
							Data on at-sea distribution of harbour and elephant seals, sea otters and Steller sea lions also found in Williams & Thomas 2007, and RW unpublished data from summers 2004, 2005, 2006 and spring 2007.	
Steller sea lions	Haul out and rookery locations	Shape file	points	Peter Olesiuk, get from Ed Gregr	BC coast-wide	Haul out rookery population counts		Need to add buffer around each haulout site
	Monthly counts for Barkley Sound	Counts done monthly with age and sex class, starting July 2006 (includes CA sea lions)	Lat./longs and counts in excel format	Wendy Szaniszlo	Barkley Sound Clayoquot done opportunistically May-Oct.			
							Data on at-sea distribution of harbour and elephant seals, sea otters and Steller sea lions also found in Williams & Thomas 2007, and RW unpublished data from summers 2004, 2005, 2006 and spring 2007.	
Harbour seals	Haulouts	Maps with point locations of haulouts and counts.	point	CSAS Report by Peter Olesiuk (2001)	BC coast-wide			

							Data on at-sea distribution of harbour and elephant seals, sea otters and Steller sea lions also found in Williams & Thomas 2007, and RW unpublished data from summers 2004, 2005, 2006 and spring 2007.	
	Foraging habitat	??					Someone in SE AK has forage range estimates from haulout data.	
California sea lions	Haulouts (seasonal)						Peter Olesiuk has surveys of these, may be published in CSAS reports.	
	Monthly counts for Barkley Sound	Counts done monthly starting July 2006 (includes Steller sea lions)	Lat./longs and counts in excel format	Wendy Szaniszlo	Barkley Sound Clayoquot done opportunistically May-Oct.			
	Foraging habitat						? May be accounted for by extending a buffer around haulout sites?	
Fur seals	Foraging areas from old data			Peter Olesiuk, possible COSEWIC report and CSAS reports			No recent data (talk to Mary Anne Lea)	
	Offshore habitat	possible data gap					Talk to Peter Olesiuk	
Elephant seals	Foraging habitat	data gap						
Possible other data sets/sources to research: 1. Oil spill research by Peter Olesiuk for presence of sea lions and other marine mammals 2. Sea lion migration routes from tagging studies 3. Foraging habitat based on diet; MMRU at UBC has diet data							Data on at-sea distribution of harbour and elephant seals, sea otters and Steller sea lions also found in Williams & Thomas 2007, and RW unpublished data from summers 2004, 2005, 2006 and spring 2007.	

Table 4: Pinnipeds and Mustelids: Data Preparation and Targets

Marine Feature	Rationale	Measure	Target	Comments/ Justification for targets	Ecological Considerations	Comments
Sea Otters: 1. range			???			
2. otter habitat (based on model)		use a habitat suitability model to predict the area.	enough of the occupied habitat to support 1500 animals(WCVI) (based on effective population size) And 100% of the central coast population.		Minimum patch: Habitat area to support 500 animals	
3. winter habitat		data gap				
Steller sea lions: 4. haulout locations		Measure: location with buffer. Each site weighted by? some kind of relative importance based on use by females and pups using Wendy's seasonal counts.	30-60%		Minimum population size: equal to the minimum number that was reached at the end of the cull in 1972 (i.e., 4880 non pups)	
5. rookeries		location of each rookery and the 15 km buffer	protect all known ones during months of use	only used in June, July and August. 15 km buffer around each rookery for forage needs.	Minimum patch size is site plus buffer of 15 km. Replication-n/a. Separation distance: n/a.	
Harbour Seals: 6. haulouts		the number of animals per haulout	10% of the existing animals in each region.	This value is approximately the level that the seals were at before protection.	Minimum patch size: one haulout with adjacent foraging area Replication: 2 haulouts per region Separation: Maximize distance between haulouts	
7. foraging habitat		May be a data gap		Data would have to be assessed before setting targets		
California sea lions: 8. haulouts (seasonal)		Location and buffer (size based on ?) Also relative importance	30-60%	Same as Steller sea lions		Could be dealt with the same way as

		based on population counts				Steller sea lions.
9. rookeries		Location and buffer (size based on ?)	protect all known ones during months of use	Same as Steller sea lions	Min. patch is one site plus buffer	
Fur seals: 10. foraging areas from old data (no recent data) ask Peter Olesiuk.				Data would have to be assessed before setting targets		
11. offshore habitat (ask Peter Olesiuk)				Data would have to be assessed before setting targets		
Elephant seals: 12. foraging habitat		Data gap		Data would have to be assessed before setting targets		

5.0 Conclusions

Overall, 96 marine mammal features were identified by expert participants (84 related to cetaceans and 12 related to pinnipeds and mustelids) including features that *should* be included for which data are lacking. Pre-processing will be necessary to combine datasets from different sources for many of these features, and while targets were recommended for the pinnipeds and mustelids, no minimum target below 100% could be agreed upon by the cetacean group. All participants agreed that it is crucial to document data gaps, relative quality and consistency of data, and any assumptions made, so that future iterations of the analysis can be improved.

6.0 References

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Appendix 1: Expert Feedback

All of the workshop participants responded to the requests for feedback on the workshop report. We integrated comments and questions into the report text as much as possible. We list additional comments here:

- Somewhere in this document, you need to spell out that the tool you've chosen makes a huge assumption: absence of dots means absence of whales. It sounds like it's too late to choose a different tool. So if you don't take the time to address that problem (by making rough guesses about animal density between dots), then you're going to make the wrong decisions and the wrong recommendations. This document underplays the seriousness of the limitations. We know, already, that Marxan is going to produce the wrong answer unless you throw some money at dealing with this essential flaw.