SEABIRDS EXPERT WORKSHOP REPORT

Draft with expert feedback

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Table of Contents

1.0 Introduction

1.1 Objective of Report and Overview of Seabirds Experts Workshop

The objective of this document is to summarize the recommendations from the Seabirds Expert Workshop held in Vancouver on Dec. 8, 2006. The Seabirds Expert Workshop was the first of several expert workshops to be conducted as part of the British Columbia Marine Conservation Analysis (BCMCA) Project[1] (described below). The other workshops will cover Ecosystem Representation, Flora, Fish, Mammals, Invertebrates, Human Use, and the use of Marxan.

The intent of the Seabirds Expert Workshop was to draw on the knowledge and expertise of scientists, resource managers and the conservation community to determine how best to represent seabirds and their nesting and feeding habitat and other uses (e.g. moulting areas) in subsequent conservation utility / optimization analyses. Seabird data are commonly used by researchers as indicators for both the health and condition of the marine environment; for the BCMCA Project, seabirds will be used as a focal species whose presence often indicates the occurrence of other species. Seabirds will also be used to characterize a particular habitat or community.

Participants of the workshop were divided into 3 groups – pelagic birds, near-shore birds, and shore birds – 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 coast of BC. 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, 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 this purpose, the BCMCA Project will adhere to these principles:

- 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.

[1] Formerly the Conservation Utility Analysis 2 (CUA2) Project.

- 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 identify areas of high conservation utility that meet conservation objectives (see list below) 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. 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 data considerations

Several overarching data and technical issues arose out of the workshop, which affect all the subgroups as well as subsequent workshops. These issues are outlined below, and we invite your input.

2.1 Combining disparate datasets

Many participants identified the need to combine datasets. The near-shore and pelagic groups in particular recommended combining datasets so that each feature will have one corresponding layer. Because information was historically collected in different ways for different purposes, during the workshop we did not finalize the specifics of how all the disparate datasets should be combined. Ideally, we would be able to model habitat suitability for all features. However, we recognize the limitations of the datasets, our limited knowledge of many species' habitat requirements, potentially limited data availability at the scale necessary for modeling, and the limited resources available to undertake such an ambitious task. Therefore we acknowledge that it will not be realistic to do habitat suitability modeling for all the features in the time frame for this project.

Below is the BCMCA Project Team's suggested methodology for combining disparate datasets using a relative importance index. This methodology is based on workshop and post-workshop discussions. We acknowledge that the details of this methodology may vary based on the datasets being combined and the feature being modeled, however this example is intended to act as a general framework for pre-processing disparate datasets. Only datasets recommended by workshop participants would be used. Post-workshop feedback was received by the experts (see Appendix 2 and 3). Given the difficulty in combining disparate datasets, we will try the approach outlined below and get feedback on the resulting maps. Some datasets may need to be processed differently; this will be decided on a case-by-case basis.

1. For each feature, identify the relevant data sources.
2. Summarize each dataset by quartiles (or another statistically appropriate method) to create a relative importance index for that feature. Assign -1 to areas with confirmed absences, 0 for areas not surveyed
3. Assign a relative weight for the quality of each dataset for the feature (e.g., likely a ranking of 1 for low-quality data, 2 for medium, 3 for good).
4. For each dataset for the feature, multiply the relative importance by the quality weighting.
5. Add all the datasets for that feature.
6. Normalize each area by the number of surveys for the feature.
7. Refine the combined relative importance index (i.e., into the desired number of relative importance classes).
8. Repeat for each feature.

2.2 Workshop Discussion – Weighting Data

In a review of the Conservation Utility Analysis carried out by Living Oceans Society in November 2006, a key recommendation for the BCMCA project was to be more transparent about the assignment of penalty weightings[2]. In response to this recommendation, the entire group discussed a draft weighting criteria and the overall utility of using the weighting parameter. During the discussion, various Marxan users on the Project Team emphasized that Marxan, is very good at achieving its targets, and therefore the penalty weightings do not exert as significant an influence over Marxan's ability to achieve targets as was predicted. Further discussion of other Marxan applications highlighted the low priority placed on the weighting parameter. For example, some Marxan users do not use this option, others set the same penalty for all features, others use this parameter to reflect the quality and completeness of the data, and still others use this option on an as needed basis to help achieve conservation targets in scenarios where Marxan is having trouble achieving them. The group discussed the possibility of using one of these approaches in the BCMCA project.

The group also discussed the details of the proposed weighting criteria (see Appendix 1 for the criteria as discussed). The proposed weighting scheme included vulnerability or rarity, data quality, and data coverage. The group decided that vulnerability or rarity should be reflected in

[2] The penalty weighting is a user-defined weight, which controls how much emphasis Marxan places on fully representing a particular conservation feature.

the targets, not in the weightings. The fact that Marxan does not react much to the penalty weightings was worrisome to some participants, as this means that all features, no matter their quality, will be treated the same. The group decided that we should rate data quality, either for use in the penalty weighting, or to be incorporated in some other way (see Section 2.1 as the most likely mechanism for incorporating data quality).

2.3 Reality check – number of features

In this workshop 80 features were recommended to represent seabirds. If future expert workshops recommend a similar number of features, we will have some ~600 features to pre-process, prepare and document. Given resource and time limitations, we may have to limit the number of features. If this is the case, we will contact expert workshop participants for recommendations on how to prioritize features.

3.0 Pelagic Birds

3.1 Introduction

The Pelagic seabirds group considered those species that forage primarily in the offshore marine environment and are dependent on the offshore environment throughout various life history stages. In general, this diverse group of species comes to land only to breed. This group includes the following families: alcidae (murres, guillemots, murrelets, auklets, puffins), diomedeidae (albatross), procellariidae (petrels/ fulmars/shearwaters), and hdrobatidae (storm-petrels). Note that Glaucous-winged gull is included in the table for this group even though larids were to be covered by the near-shore group

Participants in this group were:

- Doug Bertram – Environment Canada
- Alan Burger – Consultant and University of Victoria
- Bob Hanson – Parks Canada
- Anne Harfenist – Consultant
- Mark Hipfner – Environment Canada
- Moira Lemon – Environment Canada
- Murray Manson (facilitator/note-taker) – Fisheries and Oceans Canada
- Ken Morgan – Environment Canada
- Krista Royle (facilitator/note-taker) – Living Oceans Society[3]
- Bernard Schroeder – Consultant

3.2 Sources of Pelagic Bird Data

Table 1 summarizes the pelagic seabird datasets currently available in BC. The data sources are grouped by colour to reflect the category of data — black text represents seabird colony data, blue text represents at sea surveys, green text represents marbled murrelet data and red text represents datasets that require significant processing time or have limited geographic distribution. The data sources vary with respect to the type of data, data provider, geometry,

[3] As of January 2007 Krista works for Parks Canada.

geographic extent, key attributes, and quality (precision and accuracy). For example, some datasets capture detailed inventories covering almost the entire province (e.g. CWS seabird colony dataset), while others datasets provide in depth surveys of very small geographic areas (e.g. Laskeek bay). Most, but not all data, are in a GIS supported format.

Where possible, data from the same category will be combined and summarized in one dataset in an effort to incorporate all recommended sources of data in the BCMCA. For example, efforts will be made to compile the various sources of at sea survey data in order to derive one dataset representing at sea density and another representing at sea diversity (see section 2.1).

3.3 Features and Targets

The pelagic seabird group identified 36 marine features to be targeted in the BCMCA analysis. Fifteen of the features target species-specific breeding seabird colonies, twelve target marbled murrelet populations by region, three target at-sea species with one specifically targeting globally listed at-sea species, and six target surrogates for pelagic seabirds (e.g. herring spawn, sea mounts, high current areas, etc.). Although participants stressed the importance of representing the different seasonal habitat requirements of species, they did not feel that current datasets adequately represented seasonal habitat variations and for this reason species were not split by season.

More consultation is needed to determine how best to process/prepare a number of the marine features for use in Marxan. Experts from the pelagic seabird group were identified to further advise on how best to pre-process each major category of data.

Where possible, targets were recommended for each marine feature. The targets define the amount of the marine feature required for meeting the BCMCA's four ecological objectives[4]. Surrogates were not discussed in detail at this time since they will likely be addressed in detail at future workshops. If not, further input from seabird experts will be solicited. Details of the marine features are contained in Table 2. Similar features are grouped by colour to reflect the category of the feature — black text represents seabird colony features, blue text represents at sea features, green text represents marbled murrelet features and pink text represents surrogates for pelagic bird species.

3.4 Assumptions/Limitations

Information on pelagic seabirds in British Columbia varies widely with respect to level of detail and geographic extent. Overall, survey effort has been extremely uneven. Fortunately, information on breeding seabird colonies is very detailed due to the in-depth systematic surveys conducted by the Canadian Wildlife Service (CWS) in the 1980's.

Surveys of marine birds at sea was gathered by CWS in the 1970's and 1980's as part of the environmental assessment associated with potential offshore oil and gas exploration as well as by NGOs and individuals. Despite these efforts, much of the at-sea survey data have been gathered

[4] The BCMCA's four ecological objectives are: (1) Represent the diversity of BC's marine ecosystems (2) maintain viable populations of native species; (3) sustain ecological and evolutionary processes; (4) build a conservation network that is resilient to environmental change.

on an opportunistic basis and existing at sea data cannot adequately be used to monitor the density of specific species populations or population trends. CWS at-sea data are still being collected - as many as 6 cruises/year. There are 2 lines that are routinely surveys - one to Ocean Station Papa (3 trips per year) and one that goes between Vancouver and Japan (also 3 times/year). Almost all of the CWS at-sea data have been collected on an opportunistic basis due to a dependence on gaining access to DFO/Coast Guard vessels conducting various oceanographic work. Although survey effort has not been evenly distributed in space and time, and consequently the at-sea database cannot be used to provide specific population values or trends; the data do provide information on seasonal distribution and relative abundance, for much of the west coast EEZ.

Fortunately, data on species that are federally listed (e.g. marbled murrelets) by COSEWIC (Committee on the Status of endangered Wildlife in Canada) have been growing with the initiation of the federal Species at Risk Act (SARA) in 2003 which mandates the identification and protected of critical habitat for threatened species.

3.5 Recommendations

The pelagic working group recommends using 19 data sources and targeting 36 pelagic bird features in an effort to protect pelagic seabirds in the BCMCA. Data from the recommended data sources will be compiled and maps will be generated for each of the recommended marine features. These maps will be distributed to the pelagic working group for comment.

Table 1: PELAGIC BIRDS: Data Sources[5]

Dataset/Layer	Description	Geometry	Provider, Custodian	Extent	Key Fields /Attributes	Comments	Category
Spatially georeferenced data that captures the location of important marine bird areas	*Brief description of dataset.*	*Geometry type*	*Data provider/reference*	*Geographic Extent of Database*	*Descriptive information stored with the spatial data.*	*Additional information that may be important to correctly interpret/process the data. Location of metadata.*	Category of Data
1. CWS seabird colony	Detailed inventory of known seabird colonies in BC. Includes location and population details of known seabird colonies as of 1989. Also now includes additional surveys. Metadata is being updated.	Point	CWS - Pacific and Yukon Region, Moira Lemon	Coast and coastal islands of BC	15 spp., # nesting pairs or individuals.	A few colonies on small remote islands were not visited. Seabird population estimates that are presented have been derived by various methods, over different years, and vary in quality, depending on species, habitat, size of colony and survey effort.	Seabird Colony Data
2. Haida Gwaii, 2003, Nesting Seabird Colonies.	Known nesting colonies of Petrels, Cormorants, Glaucous-winged Gulls, Murres, Pigeon Guillemots, Ancient Murrelets, Cassin's Auklets and Puffins.	Point	Parks Canada, Patrick Bartier	Haida Gwaii Archipelago.	Site, Name, # breeding pairs or individuals.	Includes data from #1 (CWS seabird colony) up to 2000 & comments above are relevant here as well. An absence of data does not indicate an absence of birds.	Seabird Colony Data
3. Haida Gwaii Important seabird areas	Marine waters and roost sites known to be important to sea birds, except Marbled Murrelets and Pigeon Guillemots in spring and summer.	Polygon	Parks Canada, Patrick Bartier	Haida Gwaii Archipelago	Site #, species, life requisite (e.g. gathering feeding, roosting, etc)	Not all areas of Haida Gwaii archipelago have been surveyed. An absence of data does not indicate an absence of birds.	At Sea Surveys
4. Laskeek Bay Conservation Society	Distribution of seabirds, late April – early July. Annually 1991-2006..	Spreadsheet	Tony Gaston, Alan Burger	Laskeek Bay, east coast South Moresby	Marbled Murrelet densities		At Sea Surveys
5. NaiKun Windfarm EA	Surveys done for EA, distribution at sea mostly strip transects	Line	Ken Summers	Northwestern Hecate Strait		May not be available yet, as EA has not been submitted. An absence of data does not indicate an absence of birds.	At Sea Surveys

[5] The data sources are grouped by colour to reflect the category of data — black text represents seabird colony data, blue text represents at sea surveys, green text represents marbled murrelet data and red text represents datasets that require significant processing time or have limited geographic distribution.

6. UNBC Northern Land use Institute	Appendix on the Waterbird Perspective written by Dr. Patricia Gallaugher	Text	Dr. Patricia Gallaugher	Queen Charlotte Basin		Text report.	At Sea Surveys
7. 1982-2005 At Sea Pelagic Seabird Data	ships of opportunity, density	Strip transects to polygon	Contact Kathleen Moore			Significant Data Gaps. Also contains marine mammal and sea turtle observations	At Sea Surveys
8. BC Ferry Swartz Bay to Tsawwassen	Strip transects done from ferry Aug. 1994 through Sept. 1995	excel spreadsheet	Ken Morgan	Southern Strait of Georgia		Referenced to landmarks	At Sea Surveys
9. At Sea surveys all species - Pacific Rim National Park Reserve	1991 to present, gap 95-99	Strip transects to polygon	Bob Hansen	Pacific Rim National Park Reserve area, WCVI		Georeferenced to survey leg	At Sea Surveys
10. At Sea surveys all species, Clayoquot Sound	96-2000	Strip transects to polygon	Trudy Chatwin	Clayoquot Sound		Georeferenced to survey leg	At Sea Surveys
11. At sea surveys, Pelagic seabirds offshore from Tofino	99-2003	Strip transects to polygon	Rod Palm, Strawberry Island Research Society	35km offshore surrounding Tofino, WCVI		Also contains marine mammal observations	At Sea Surveys
12. Southwest VI Shelf seabirds	strip transects, 93-95	Strip transects	Alan Burger	Southwest VI shelf waters	Bird densities, prey abundance, sea temperature & salinity	Available as Excel files – some are georeferenced, all have some location data	At Sea Surveys
13. Trevor Channel Transects	strip transects, 93-2000	Strip transects	Alan Burger	Trevor Channel, Barkley Sound, WCVI	Bird densities, prey abundance, sea temperature & salinity	Available as Excel files – most are georeferenced, all have location data	At Sea Surveys
14. Misc At sea numbers of seabirds	Accumulated data from various sources	Strip transects and counts	Alan Burger	Sites scattered around the BC coast	Bird densities and occurrence	Much of this is rather spotty data but might cover some areas with little coverage	At Sea Surveys
15. Phalarope surveys, 1991 (contained within Table 3, dataset 9)	GIS referenced		Moira Lemon	QC Strait, Northern SOG			At Sea Surveys
16. Marbled Murrelet population data	Radar counts at selected monitoring stations	Point	Doug Bertram	6 regions, coastwide			MAMU
17. Marbled Murrelet core area analysis	Documentation of concentrations of marbled murrelet at sea	Mostly strip transects and counts	Alan Burger, Trudy Chapman, Doug Bertram	Many scattered areas on the BC coast		Data being collated by Alan Burger for Min of Environment. Rough georeferencing only.	MAMU
18. Vermeer CWS data	summarized data in tech. reports					May be labour intensive to use, so therefore probably will have to leave out	Low Priority

19. Cassin's and Rhino marine foraging locations, CWS	Radio telemetry 40 birds per year		CWS, Doug B, Mark Hipfner	Triangle Island QC Sound		High quality data set must investigate how best to incorporate; could be useful for developing a buffer for the colony data, may be useful for groundtruthing the model, may be best as is.	Ground-truthing
20. At-Sea surveys for Marbled Murrelets on the Central Coast in 1998	Documented all species, but tabulated data only contain info on MAMU. Surveys consist of 1300 km of strip transects that were conducted along the sides of mainland islets	Line transects	Bernard Schroeder	Central Coast			At-Sea survey

Note – coastal waterbird data (see #11 data source for near-shore birds) should be included as a data source for pelagic species also.

Table 2: PELAGIC BIRDS: Data Preparation and targets

Marine Feature	Pre-Processing	Ecological Considerations	Target (range)	Comment/ justification for targets
List the unique species/ecological features from this dataset.	*How should this dataset (or combined data sets) be processed/prepared for use in Marxan.*		*The amount of the feature required for meeting the BCMCA's 4 ecological objectives.*	
1. Storm Petrels	Will involve buffering the colonies, more consultation is needed, Mark will provide some further input.	Note, this section was not addressed in detail. May wish to address this after data is pre-processed.	100% changed to 30-50 (see comments)	this low target bracket reflects the fact that although the area around the colonies should be buffered, storm-petrels generally feed long distances away from the colonies - usually beyond the continental shelf
2. Northern Fulmar			100% changed to 50-70 (see comments)	The lower target bracket (50-70%) means that the bird is pretty common (although there is a very small population prov. breeding pop. so maybe a higher target??)
3. Double-crested Cormorant			see near-shore spreadsheet	
4. Brandt's Cormorant			see near-shore spreadsheet	
5. Pelagic Cormorant			see near-shore spreadsheet	
6. Black Oystercatcher			60-90	vulnerable to disturbance and habitat alteration
7. Glaucous-winged Gull			50-70	The lower target bracket (50-70%) means that the bird is pretty common
8. Common Murre			100	very small population Higher target because it has been declining

9. Thick-billed Murre			100	very small population; south end of range Higher target because of low provincial breeding population
10. Pigeon Guillemot			50-80, changed to 50-70 (see comments)	The lower target bracket (50-70%) means that the bird is pretty common
11. Ancient Murrelet		Stage on the water around their breeding colonies during breeding season	100	BC supports ~ 50% world breeding population
12. Cassin's Auklet			100	BC supports ~70-80% world breeding population Higher target because the breeding pop. may be declining
13. Rhinoceros Auklet			100% changed to 50-70 (see comment)	BC supports ~ 50% world breeding population The lower target bracket (50-70%) means that the bird is pretty common
14. Tufted Puffin			100% changed to 50-70 (see comment)	very small population; south end of range The lower target bracket (50-70%) means that the bird is pretty common
15. Horned Puffin			100	very small population; south end of range Higher target because of low provincial breeding population
16. Haida Gwaii MAMU -at sea density	Talk to Doug Bertram. He will provide direction for working up the data. Alan Burger has preliminary report identifying some important marine concentrations across BC coast.		70-100	threatened species
17. North Coast MAMU -at sea			70-100	
18. Central Coast MAMU -at sea			70-100	
19. South Coast MAMU -at sea			85-100	
20. West Coast MAMU -at sea			70-100	
21. East Coast MAMU -at sea			90-100	

22. Haida Gwaii MAMU - population indices long term surveys (radar)			70-100	
23. North Coast MAMU population indices long term surveys (radar)			70-100	
24. Central Coast MAMU population indices long term surveys (radar)			70-100	
25. South Coast MAMU population indices long term surveys (radar)			85-100	
26. West Coast MAMU population indices long term surveys (radar)	Alan Burger has data from Clayoquot Sound and SW Vancouver Island		70-100	
27. East Coast MAMU population indices long term surveys (radar)	David Lindsay (TimberWest) has radar data from 8-10 stations on SE Vancouver Island		90-100	
28. At-sea density	Get in a consistent unit (e.g. Birds per sq. km.) Possible interpolate to within a 5 km buffer. Truncate at shore. Leave area outside as a gap. Patch radius of the aggregations can be measured and used to estimate the width. Contact Ken and Jamie (producing an atlas of at sea data). Geoff Scudder may have some ideas for how to treat this streaky data.		Determine after data is pre-processed.	After working up the data, the targets may become more obvious.
29. At-sea diversity or richness index	If possible identify subsets based on season. Most data is collected in summer.		Determine after data is pre-processed.	After working up the data, the targets may become more obvious.
30. At-sea nationally and globally listed species occurrences			Determine after data is pre-processed.	After working up the data, the targets may become more obvious.
31. Herring Spawn				Will likely be included as a feature in a future workshop.
32. Sand lance (2nd alternative would be sandy bottoms)	Scale is very important - birds respond at less than 1 km square. Near-shore 50meter depth is the important area for birds feeding on sand lance. Substrate data does not exist at this depth. Some relationship to sandy beaches has been found on West Coast trail. Shoreline substrate may also be surrogate (available from oil spill contingency maps).			May be included as a feature in a future workshop.
33. Sea Mounts, steep sided banks, canyons (shelf break and other)				May be included as a feature in a future workshop.

34. High Current, high tidal mixing				Will likely be included as a feature in a future workshop.
35. Eddies				May be included as a feature in a future workshop.
36. Salmon Escapement at estuary				May be included as a feature in a future workshop.

History of Target recommendations, revisions, and next steps:

At the workshop on Dec. 8, 2006, targets were discussed those recommend by the group were listed in the initial draft report. The draft report was reviewed by the same experts that participated in the workshop. Participants of the pelagic bird sub-group were asked to make recommendations about the targets. These suggestions were compiled and then reviewed again by the same group. Listed here are comments in response to the targets that may have been changed/suggested by one expert:

- There was a suggestion that all breeding colonies should be targeted at 100%, as discussed during the workshop.
- I can see the argument for lowering the storm-petrel target to 50-70% as was done for other abundant species. I'm not sure that I understand the argument offered in the rationale - I guess that the logic of this depends on how large a buffer around the colonies will be recommended as many other species feed far from their colonies.
- The rationale for lowering the target for RHAU to 50-70% while leaving it at 100% for ANMU seems inconsistent to me. B.C. supports approximately 50% of the global breeding population of each species. The population numbers are (very approximately) 250,000 breeding pairs of ANMU and 325,000 breeding pairs of RHAU; i.e., both species are "relatively common". If the targets differ, a better rationale needs to be offered. In my opinion, the fact that BC supports 50% of the breeding population is sufficient reason to set the targets at 100% for both species.
- The rationale for lowering the target for TUPU is given as very small population; south end of range. The lower target bracket (50-70%) means that the bird is pretty common. It seems to me that either the population is very small or the bird is pretty common, but not both. I suggest that the fact that the BC population represents the southern end of the species' range is a reason to maintain a relatively high target. I may be out-of-date on this subject - is there not still a school of conservation biology that argues that individuals at the edges of a species' range may contribute valuable genetic variability?

Next steps: After receiving and mapping available data, the BCMCA Project Team will ask the experts to review the data and come to some consensus on recommended target ranges.

4.0 Near-shore Birds

4.1 Introduction

This category considers those species that forage in the near-shore environment, and are dependent on these areas throughout various life history stages. These include the following families: Anatidaes (swans, geese, ducks and mergansers), Laridae (skuas, jaegers, gulls and terns), Phalacrocoracidae (cormorants), Ardeidae (herons and bitterns), Gaviidae (loons), PodicipediidsPodicipedidae (grebes), and marine raptors.

Participants in this group were:

- Natalie Ban (facilitator/ note-taker) – University of British Columbia Fisheries Centre
- Harry Carter – Consultant
- Trudy Chatwin – BC Ministry of Environment
- Ken Cripps (note-taker/ facilitator) – Coastal First Nations
- Pete Davidson – Bird Studies Canada
- Jamie Kenyon – Environment Canada

4.2 Sources of near-shore bird data

Sources of data identified by the group are summarized in Table 3. Sources range from one-time ship surveys that recorded all birds during that one transect, to province-wide data gathered by volunteers.

Summarizing these data presents a challenge to remain true to the original intent of the data collected. Yet this is the best available information, and much can be done to summarize and combine the datasets to make them useful for our analysis. The group recommended developing relative importance indices to combine datasets for each feature. See section 2.1 for a potential data processing approach.

4.3 Features and Targets

We identified 36 marine features to be targeted in our analysis. Mostly these are species-specific targets, although some combine species when habitat usage was considered to be similar. Likewise some species are split by season where seasonal habitat requirements differ substantially. Rather than keeping each dataset as a separate target for each feature, all the datasets should be combined to summarize our target features. Details of the marine features are contained in Table 4.

4.4 Assumptions/Limitations

Recommendations for the features and targets are constrained by data availability and our knowledge of the species and their habitat requirements. In general, we lack historical data on species distributions and habitat use, and thus our analysis will be limited to current data. Specific sources of data which may be useful for data mining when time and resources allow are

the documents and undigitized maps contained in the basement of the Biodiversity Centre for Wildlife Studies, and older CWS technical reports which contain data not yet digitized.

4.5 Recommendations

For near-shore birds, we recommend 36 features at varying levels of targets. Maps for the features will be combined from all the available data sources.

Table 3 - NEAR-SHORE BIRDS: Data Sources

Dataset/Layer	Description	Geometry	Provider, Custodian	Extent	Key Fields/Attributes	Comments
Spatially georeferenced data that captures the location of important marine bird areas (e.g., breeding colonies, nesting, feeding, staging areas, important habitat, etc.). Preference will be given to digital data. This list need not be inclusive but should represent the best available data for science-driven analyses.	*Brief description of dataset.*	*Geometry type (point line or polygon)*	*Data provider/reference*	*Geographic Extent of Database*	*Descriptive information stored with the spatial data.*	*Additional information that may be important to correctly interpret/process the data. Location of metadata.*
1. BC Coastal Water birds survey	Composite bird data set 1999-2007 (ongoing) - volunteer collected from shore	Poly	Bird studies Canada	coast wide-coverage a patch focus on Georgia basin	density data	meta data available
2. Triennial swan	Vancouver island lower mainland flight surveys every 3 to 5 years back to 70s both marine and terrestrial	Point	CWS - Jamie	Vancouver Island Lower mainland	count information	relative abundance
3. West Vancouver Island Water bird survey	aerial survey replicated spring and winter	line	CWS - André Breault	West Coast Vancouver Island	bird densities in relationship to marine eco-units	All species shoreline based inventory to get species habitat relationships to eco-units
4. North Island Strait	aerial survey spring 2004	line	CWS - André Breault	North Island Straits	Density in relation to eco-unit	
5. Seabird ship survey	boat based survey along NI and central coast 1998 May	point	CWS - Jamie	North Island Straits and Central Coast	Count data by species	One transect up the coast
6. Molting Sea ducks	July 1998 aerial survey - Port Hardy to Rupert	point	CWS - Jamie	Port Hardy to Prince Rupert	Count	One transect up the coast
7. Vancouver Island Marbled Murrelet study	1991 Summer)May to end of July) boat survey	line	CWS - Jamie	Vancouver Island and Mainland Inlets - sporadic	count	Covers all species
8. Pelagic seabird cruise	focus was on pelagics but does have near-shore species - boat survey	Strip transects to polygon	CWS - K. Morgan	coast wide	density	Focus on pelagics, but all birds encountered during these surveys are counted and recorded - so species such as cormorants, loons,

						waterfowl that are seen/identified are also entered in the database
9. Coastal Water bird Inventory	compilation of data from Ducks Unlimited and CWS from 1919 to 1991	line	CWS - Jamie	Coast wide	count or linear density	different data sets had different purposes and objectives (can't assume 0s) - variable coverage - includes ground and aerial survey
10. CWS seabird colony (Same as in Table 1)	colony locations 9-10 sp	point	CWS - M. Hipfner	Coast wide		last updated 1989
11. Bio diversity center for wildlife studies	Museum data set from 1972-78 Nesting colony	point	BD center - Mike Preston	coast wide	colony counts	Not digitized
12. Straight of Georgia Cormorant and Gull Survey	Cormorant Georgia Straits	Point	Trudy Chatwin, Min. of Environment	Georgia Straits	Colony counts	Only cormorant nest site surveys. Published in 2002 Northwestern Naturalist 83:109-117
13. West Coast Cormorant and Gull Survey		Point		WCVI	colony counts	
14. Great Blue Heron Nest Sites	Straits of Georgia	Point	Trudy Chatwin, Ministry of Environment Access database	Strait of Georgia	Nest sites marine foraging areas	Data covers Strait of Georgia for all years to 2006
15. WITS data base	bald eagle location	point	WITS - Karen Morrison		Nest sites	Volunteer inventory
16. Site specific surveys	CWS tech reports					bits and pieces here and there and needs to be pulled together
17. Peregrine falcon inventory	North American survey conducted every 5 years	point	Conservation data center	NA	Nest sites	
18. Herring Spawn DFO	herring - spawn index	Poly	DFO	Coast wide		Surrogate for Scoter distribution
19. PECP Estuaries	Selected estuaries	poly	CWS - Jamie	Coast Wide	Relative Importance	Surrogate

Note – various Reimchen and other data sources summarised in Parks Canada databases (eg. loon nesting sites; sea duck nesting sites) for Haida Gwaii. Patrick Bartier is contact.

Table 4 - NEAR-SHORE BIRDS: Data Preparation, ecological considerations, and targets

Marine Feature	Pre-Processing	Ecological considerations	Target (range)	Comment/ justification for targets
List the unique species/ecological features from this dataset (ex. species, families, groupings of species or of species habitats) that require individual consideration in the BCMCA. You may also wish to delineate features by season/ region or both.	*How should this dataset (or combined data sets) be processed/ prepared for use in Marxan?*		*The amount of the feature required for meeting the BCMCA's 4 ecological objectives.*	
1. Red throat and Common Loon Winter Habitat	**Note for all features**: The features should be pre-processed to compile all the available information by species or groups of species (some seasonal separation - see marine feature layers; features that contain more than one species are grouped because the species utilize similar habitats). Because different information was collected in different ways for different purposes, we did not finalize how exactly all the disparate information can be pulled together. Some kind of a relative importance index should be used to summarize each dataset, then merge the different datasets by marine feature. The rules for merging were not decided - e.g. if datasets cover the same area, should we use the highest relative importance, or an average? To arrive at the marine features, we flipped through the Bird Studies Canada booklet entitled "monitoring coastal bird populations in BC: the first five years of the Coastal Waterbird Survey (1999-2004)", deciding on groupings and seasonal importance. Groupings were made based on habitat utilization.	Note that we did not go through this section in detail. There was some concern that Marxan may pick only one area for some of these birds. When we get feedback, we may want to ask whether we need to ensure replication for any other features	25-50% of feature	**Note for all features**: we used percentage targets, and therefore the measure used is the percentage of whatever metric pertains to each dataset. These don't move around that much, and therefore higher targets are preferred. We have significant numbers of their populations in BC
2. Pacific Loon Winter			25-50	
3. Red necked and Horned Grebe			15-30	The lower target bracket (15-30%) means that the bird is pretty common
4. Western Grebe			40-60	Higher targets because it has been declining
5. Brandt's Cormorant Winter			15-30	The lower target bracket (15-30%) means that the bird is pretty common
6. Cormorant nesting (combine Brandt, double-crested, pelagic)			100	most nesting habitats (except for very common ones) were given a 100% target because these nesting sites are so crucial to the survival of birds. Brandt cormorant is nationally rare

7. Double Crested Winter			15-30	The lower target bracket (15-30%) means that the bird is pretty common
8. Pelagic Cormorant			15-30	The lower target bracket (15-30%) means that the bird is pretty common
9. Great Blue Heron Nesting	Because birds change nesting locations, only use more recent nesting sites - 2000 forward. Can use a minimum patch size of 10, or pre-process to exclude sites with less than 10 nests	Minimum patch size of colonies over 10. Many small heron colonies are not viable or move locations over time.	100	most nesting habitats (except for very common ones) were given a 100% target because these nesting sites are so crucial to the survival of birds
10. Great Blue Heron Winter			30-50	
11. Trumpeter and Tundra Swan Winter			25-50	
12. Canada Goose	Exclude the Strait of Georgia, because the Canada Geese there are introduced. Canada geese are important in Haida Gwaii		10-25	Exclude the Strait of Georgia, because the Canada Geese there are introduced. Canada geese are important in Haida Gwaii
13. Brant Goose			75-100	High target because it is really localized in its distribution
14. Anas sp. Winter		Replication of 5 to 10	20-50	
15. Greater and Lesser Scaup Winter			40-75	
16. Harlequin Winter			25-50	are vulnerable and easily disturbed
17. Harlequin Moulting			75-90	are vulnerable and easily disturbed, even more so while moulting
18. Long-tailed Duck Winter			15-30	The lower target bracket (15-30%) means that the bird is pretty common
19. Surf, black, and white-winged Scoter winter			25-50	surrogate for mussels and clams, because that's what they feed on
20. Surf, black, and WW Scoter pre migration staging			50-75	
21. Common and Barrow's goldeneye winter			25-50	very common, but we have a large portion of the global population
22. Bufflehead, hooded and common merganser			20-40	
23. Red breasted merganser			15-30	The lower target bracket (15-30%) means that the bird is pretty common
24. Bald eagle nesting	Buffer eagle nests by 1km		75-100	

25. bald eagle winter			15-30	The lower target bracket (15-30%) means that the bird is pretty common
26. Peregrine falcon nesting	Buffer nests by 1km		90-100	
27. Bonaparte's gull spring			40-60	potential surrogate for high current areas, because they concentrate in areas that are highly productive, especially in the Strait of Georgia
28. Bonaparte's gull autumn			40-60	potential surrogate for high current areas, because they concentrate in areas that are highly productive, especially in the Strait of Georgia
29. California gull, herring gull, Mew, and Thayer's gull winter			15-50	
30. Glaucous winged gull nesting			75 - 100	
31. Glaucous-winged gull winter			15-30	The lower target bracket (15-30%) means that the bird is pretty common
32. Common murre winter			25-50	
33. Ancient Murrelet winter			50-75	For alcids, we considered only the near-shore area. BC has 80% of global marbled murrelet
34. Marbled Murrelet winter				

5.0 Shorebirds

5.1 Introduction

Most Shorebirds (Order Charadriiformes) are migrants or winter visitors to the BC Coast. Other Shorebirds include Black Oystercatcher (BLOY), Plovers, surfbirds, Turnstones and Sandpipers, all of whom are found primarily along the shoreline. Although Phalaropes are from the Order Charadriiformes, they are mainly found in BC migrating in large flocks offshore, so are included with the pelagics. The Great Blue Heron (GBHE) has been documented with the shorebirds here because of its similar use of habitat.

Participants in this group were:

- Jackie Booth – Consultant
- Gary Kaiser – Consultant
- Dave Nicolson (facilitator/ note-taker) – Nature Conservancy of Canada
- Charles Short (note-taker/ facilitator) – ILMB, BC Ministry of Agriculture and Lands
- Pippa Shepherd – Parks Canada

5.2 Sources of shorebird data

Sources of data identified by the group are summarized in Table 5. Sources range from one-time localized surveys to province-wide data gathered by volunteers. There are few comprehensive, province wide datasets for shorebirds and some species have no known data sources. Black oystercatchers have the best data coverage. The same data challenges faced by the other subgroups apply here as well.

5.3 Features and Targets

For the shorebirds we identified 8 targets, broken into three groupings: Breeding (3 species-specific targets), staging areas (2 habitat targets based on observations and 2 habitat targets based on modeled habitat) and non-breeding/wintering grounds. It was suggested that the limited observation data (2 targets) could be used to verify the habitat models instead of being used as targets. Other than breeding and wintering, seasonality was not considered, primarily due to a lack of data.

Details of the shorebird marine features are contained in Table 6.

In general it was agreed that shorebirds are not keystone species, but can act as indicator species. No minimum patch sizes were suggested, but separation distances were suggested for breeding and wintering (see Table 6). Targets should be distributed throughout their natural range evenly. It was suggested to lock-in certain estuaries, specifically the Fraser Estuary and Tofino mudflats, and possibly also Stikine, Big Bay, Yakoon, and Naden, while excluding habitat in fjords.

5.4 Assumptions/Limitations

Of the breeding species of interest, the best records exist for black oystercatchers. Nobody has done province-wide study and available data consists primarily of cobbled together datasets. The

workshop attendees recommended using modeled habitat data where there is an absence of other reliable information. Local surveys could be used to verify the models.

5.4 Recommendations

We recommend 8 targets to represent shore birds.

Table 5 - SHOREBIRDS: Data Sources

Dataset/Layer	Description	Geometry	Provider, Custodian	Extent	Key Fields/Attributes	Comments
Spatially georeferenced data that captures the location of important marine bird areas (e.g., breeding colonies, nesting, feeding, staging areas, important habitat, etc.). Preference will be given to digital data. This list need not be inclusive but should represent the best available data for science-driven analyses.	*Brief description of dataset.*	*Geometry type (point line or polygon)*	*Data provider/reference*	*Geographic Extent of Database*	*Descriptive information stored with the spatial data.*	*Additional information that may be important to correctly interpret/process the data. Location of metadata.*
1. Coastal waterbird inventory file (CWIF)	mainly shorebirds - sometimes species specific. Booth pulled species out of this dataset to create BC CRI dataset (but that was 1998 - may be new records since)	georeferenced to polygons (zones/sub zones) - generalized	CWS - moved from Wayne Campbell (prov) to (Kathleen Moore (CWS))	Coast wide. (Little for central coast)	Numbers, species, year seasons. Can go to transect level	Card references from 1980s - made digital. Built on since that time. Not a lot of shorebird data. Some areas (Burnett bay etc) where no observations but are mudflats with suitable habitats. Dataset not corrected for effort. Booth and Berger did gap analysis (lack of info) 10 yrs ago
2. CRI Shorebirds	from 1995-8	polygon	BC Prov			RA assigned by flocks – recommend not to use - go to CWIF (above)
3. Oystercatcher nests	brought together. Incl user community & other datasets - likely most comprehensive dataset.	point	Stephanie Hazlitt SFU Masters thesis (see Pippa Shepherd for contact info) Works at MoE Victoria now			Need to ensure no duplication with other datasets. (e.g. 2 pts on same island are same nests for most part)
4. Oystercatcher nests	Nest locations	point	Mark Hipfner's data (See Moira Lemon for contact info)	coast-wide with gaps - Pac Rim, Central Coast, QCI	nest sites, location (all nests documented), # eggs, maybe hatch success, date	combined parks and CWS data
5. Community Observations (same as Dataset 1 in Table 3)	From work with communities - training & quality measure	DB (point) assigned to regions	Bird Studies Canada; CWS	spotty	observations (nests…)	diff communities do differently
6. Marine birds			CWS/Parks Canada			PC and CWS are not

						necessarily the same - need to merge the 2 datasets. Might be some overlap, their data should be considered better than BC Prov version (data poor - gaps, missing bits)
7. CWS, SFU, other universities (50+)	papers, raw data	Report, database	Nils Warnock; Point Rays Bird Observatory (see Pippa Shepherd for contact info)	tracking California to BC - key sites for those species	stop over time; location- western sandpiper; dunlin; sbdo	radio tracking
8. DU Estuary Project	mapped estuaries	polygon	Dawn Remington; Ducks Unlimited and CWS		includes heron data; shorebird where known	
9. COWEWIC & CDC status reports	If listed, status reports will have the most up to date data	report	Ross Vennesland		Coastal GBHE sub-sections	
10. Model habitat - mud flats etc		polygon	Province			Need a method/process to ensure where we don't have data, habitat is captured through input of other info like this
11. Fraser River shorebird counts to 1990 (Western sandpiper / Dunlin 1990 up to present with a few year gaps. These focused on the spring Western Sandpiper migration, and were done consistently for only one portion of the Fraser River foreshore (Roberts Bank between Brunswick Point and the Coal Port jetty).			Rob Butler			
12. Tofino mudflats (CWS also has a Tofino mudflat survey (just one year 1995). Focused on WESA but other species recorded as well.)		shapefiles & access DB	Parks Canada - Bob Hanson			has additional data too
13. Sandhill cranes			Raincoast	Bella Bella and surround	shoreline types	
14. Heron			Rob Butler	Strait of Georgia		
15. Kingfisher	No data					
16. QCI Combined Species Report	Report		Parks Canada	All QCI, not just		

				park		
17. CWS model of heron forage area		polygon	CWS - Jamie Kenyon & Barry Smith	lower mainland	built on CWS to test	

Table 6 - SHOREBIRDS: Data Preparation, ecological considerations, and targets

Marine Feature	Pre-Processing	Ecological considerations	Target (range)	Comment/ justification for targets
Breeding (3)	break out by species; remove duplicates	species specific nest data		
Black Oystercatcher (BLOY)	nests are on land - need to link to forage areas	breeding sites are critical habitat	60-70% of sites (nest + local feeding = 1 site). 20 km separation distance	good SOG & QCI; good in parks poor elsewhere
Great Blue Heron (GBHE)	Southwest SOG - forage areas and nest sites - use as basis for rest of coast (to model). For SOG use foraging area as core (nests are abandoned). Take foraging areas, buffer & include any wetland as foraging. Any tidal flat or estuary in colony becomes part of that site. Goals based on foraging areas. Use CWS modeled data. - model feeding areas. Some hard data on feeding and some will be modeled. Feeding area is estuary within 10 km of nest.	Feeding areas drive the location of colonies	Feeding area (habitat 10 km from nest) - want 6-8 in SOG. 15 km separation distance. Verify with Rob Butler. The critcal feeding areas are eelgrass bed which tend to occur in estuaries. Most heron nest sites and the most important nests are within 5km of marine foraging areas	SOG good - poor in N except parks. Some hard data on feeding and some will need to be modeled.
Semi-Palmated Plovers (SPPL)	Haida Gwaii - sites on beach - make sure all captured by analysis units. Breed on beach - forage on adjacent		all nests known (100%)	some guesswork based on habitat
Staging areas (observations)	take observations; brake out by species			
those that use flat			use observations to verify habitat model	Every polygon rated for quality. Patchy coverage
Those that use rocky			use observations to verify habitat model	aerial - if don't fly away do not see
Staging areas(migratory) (habitat model) (2)	Need habitat model (pre-processing step) to capture where we do not have observation data (e.g. central coast).(e.g rocky shoreline in exposed area - this is different than just coarse filter)	fall/spring - identified from bird data		
tidal flats (sandflats & mudflats on gradient)	Expert id important. rate tidal flats based on? Each rating has a goal (e.g. 100% very important, 50% important, 20% potential habitat.	WESA (Apr 5-Sept16); dunlin (winter observations)	% habitat - 100% High, 50% Low, 30% possible (bracket the percents). Even	

	Map using shoreline types.)		distribution.	
Rocky habitat with offshore rocks or piers or very complex shoreline	Data poor (for individual species) - need to model. Steps - species lists for flat and rocky. Take observation data and use to rank habitat: H, L and possible for each tidal and rocky. Then set targets (how much) for H, L & P (Where low or no data get experts together to rate potential). Seasonality: If habitat is important for even 1 day of year, it is important in Marxan input.	WHIM, RUTU, BLTU, SURF, ROSA, BLOY, WATA - seasonal/migrants.	% habitat - 80% High, 30% Low, 10% possible (bracket the percents). Even distribution.	
Non-breeding/wintering (1)				
Estuaries	Where low or no data get experts together to rate potential		% habitat - 100% High, 50% Low, 30% possible (bracket the percents) 100 km separation distance	not all estuary equal bird data

5.0 Conclusions

Overall, 80 features were recommended by expert participants (36 pelagic, 34 near-shore, and 8 shore birds). Note that some features and datasets overlap. We have left the features recommended by the pelagics, near-shore and shore bird breakout groups separate in this report, so that participants of those groups can verify the list generated during the workshop. We will then create a master list of datasets and features that eliminates the overlap. Pre-processing will be necessary to combine datasets for each feature as appropriate. While there are concerns about the quality of some datasets, the fact that we have enough information to recommend 80 features is certainly a good start to ensuring that seabirds are represented in the analysis. At the same time, it will be crucial to document data gaps and assumptions, so that future iterations of the analysis can be improved.

6.0 References

Ball, I. R. 2000. Mathematical applications for conservation ecology: the dynamics of tree hollows and the design of nature reserves. PhD Thesis. The University of Adelaide.

Ball, I. R., and H. Possingham. 2000. Marxan (V1.8.2): marine reserve design using spatially explicit annealing, a manual.

Day, J. C. 2002. Zoning--lessons from the Great Barrier Reef Marine Park. Ocean & Coastal Management 45:139-156.

Appendix 1: Weighting Criteria

Below are the weighting criteria that were discussed at the workshop. This will not be used as outlined below. Instead "data quality" and "coverage" are categories participants suggested should be incorporate into the analysis in through the weighting in combining datasets as outlined in section 2.1. "Keystone and indicator" and "vulnerability / rarity" will be considered when setting the targets.

Characteristics	Weighting
Data quality • Reliability, Accuracy and Precision of the data; Are spatial locations precise? Are attribute values accurate and complete? Is the information timely? Was data collection systematic and rigorous? Are models ground truthed and defensible? Are known features missing?	Excellent = 3 Very good = 2 Good = 1 Poor = 0
Coverage • Geographic extent and spatial completeness of the data; e.g., how much of the province is represented? Is it presence-absence data, or presence data only? Is the data patchy as a result of uneven or opportunistic data collection?	Excellent = 2 Very good = 1.5 Good = 1 Poor = 0
Keystone and Indicator	
• Presence is critical to maintaining ecosystem functioning, community organization and diversity	Yes = 1
• Indicator for habitat, prey species, or assemblage of species for which data are sparse or do not exist	Yes = 1
Vulnerable / rarity	
• Listed as endangered, threatened or of special concern by COSEWIC • Red, blue listed species from British Columbia • Listed as a species at risk by a National or international body (e.g., SARA, ESA, IUCN) • Globally or nationally rare	Endangered/globally rare = 3 Threatened/nationally rare = 2 Special concern = 1 (adapted from Root et al 2003)
Total: Maximum total score is 10, half data related (with data quality up to 3, coverage 2), and half ecology/status related (keystone/indicator 2, and vulnerable status 3).	

Appendix 2: Summarized Expert Feedback

Out of 15 workshop participants, 12 responded to the request for feedback on the workshop report. Three of these were unable to comment due to time constraints. All nine participants who provided feedback agreed that the document accurately reflects the workshop.

Feedback regarding Section 2.1: combining disparate datasets:

Comments about the suggested method for combining datasets have been extracted from the text and are inserted as bullet points below.

- I see 2 problems here. 1. You might be weighting too heavily. . I would suggest that the highest weighting be no more than 3x the lowest weighting to avoid skewing the analysis towards the very rare multi-year surveys. 2. You don't seem to take into account multiple surveys within a single year (which should get a higher weighting than 1 or 2. A single year with multiple surveys seems to have a very low weight but might be more informative than a multi-year survey which only has one survey per year. Some weighting is good.
- This system seems to overlap with the weighting of data quality which was put together in the workshop (Appendix 1 here). Do we need another weighting system or could these ideas be meshed with what was already decided?
- I would not be qualified to comment on this aspect of modeling. Perhaps Tara Martin or someone familiar with the Marxan model and how it works would be better able to comment on how this weighting would affect the model output. It seems OK to me, but as I mentioned I am not familiar with computer model function.
- If step 3 in Section 2.1 is the only place that data quality is incorporated, then the number of criteria that are considered in the relative weightings will need to increase significantly.
- Obviously, the weighting system chosen is critical to the utility of this approach. I would be uncomfortable with the one outlined here as an example for biological/ecological features that my group discussed at the workshop. I think that you will need to consult with some experts wrt a weighting system for each feature.

Data suggestions not captured in text changes

- Remove Christmas bird count dataset
- Remove Important Bird Areas dataset because it is the result of another prioritization exercise, and polygons contained therein are largely drawn from other datasets already included.

Appendix 3: Detailed expert feedback

Inserted below are the workshop report review messages received from experts who participated in the workshop. Suggestions and comments added directly to the document by experts have been incorporated into the workshop report. Comments about the suggested method for combining datasets have been extracted from the text and are summarized in Appendix 2. One person provided only specific comments, and therefore comments by only 8 experts appear below. Names and other individual identifiers have been removed.

Expert 1:

Well done on putting all this together. I've only found time to skim through it, but a couple of things popped out:

1. For shorebirds (a group which I didn't participate in), dataset 5 in Table 5 should presumably be the same as dataset 1 in Table 3 (for near-shore birds). The Coastal Waterbird Survey dataset contains a large number of shorebird records from standard monthly surveys, providing key information on a range of species, including Black Oystercatcher, Dunlin, Sanderling, Black-bellied Plover, Greater Yellowlegs, Black Turnstone and Surfbird.

You could clarify the "99-current" in the Description column of Table 3 for dataset 1, by inserting 1999-2007 (ongoing).

2. To reduce the number of features, I suggest removing Christmas bird counts dataset from table 3 (dataset 2) - on reflection, I think it is of limited use to this analysis.

3. The Important Bird Areas dataset is the result of another prioritisation exercise - the data associated with the polygons is largely drawn from other datasets already included, so you can probably remove this one too, although it would be interesting to overlay the final product of the seabirds features with the IBA polygons to assess congruence.

Expert 2:

I have gone through the report and using track changes - corrected typos, names misspelled, and made some suggestions about targets and added to the comment sections.
Re the questions you raised - I have inserted my comments below.

1. Does this report accurately reflect the workshop? Please provide specific changes you would like us to incorporate to clarify or correct the text. FROM WHAT I RECALL OF THE MEETING THE DRAFT REPORT SEEMS TO CAPTURE/REFLECT WHAT WE WORKED ON
2. Do you think our approach for combining disparate datasets (section 2.1) is appropriate? If not, can you suggest an alternate approach, or recommend changes or improvements? TO BE HONEST - I DON'T REALLY UNDERSTAND THE PROCESS NOR WHAT EXACTLY WHAT WAS BEING SUGGESTED. IT SEEMS TO MAKE SENSE - BUT..... SOME EXAMPLES MIGHT HELP TO EXPLAIN IT BETTER

Expert 3:

Your draft report looks like an appropriate description of the workshop and as far as I can tell, accurately captures the opinions of the experts present.

Two minor editing issues : "near-shore birds" is the correct form and "5.5" should follow 5.4.

I'm somewhat concerned by the arbitrary separation of so-called pelagic vs near-shore birds. The usage here would surprise seabird biologists in other jurisdictions. Some consideration should be given to separating the birds according to habitat use and prey type. Most of the pelagics (but not Long-tailed Duck or White-winged Scoter) take prey in the water column and are little affected by substrate type. They are affected by variations in substrate topography. Most of the "near-shore" species take food directly from the substrate within the intertidal region and are strongly affected by its character. In this sense, cormorants, loons, and grebes are pelagics even though Pelagic Cormorants and Horned Grebes are typically found close to shore. Mergansers are truly "near-shore" in spite of their foraging technique because they are so strongly associated with estuaries (an important substrate type).

Such a division would also be more consistent with the survey activities that record the distribution of those birds.

As for linking "near-shore" and "pelagic" surveys, there is a 4 or 5 km gap between the edges of the two about which we know nothing. In fairness it seems to be a zone with relatively few characteristic birds. Most "near-shore" surveys do not record data further than 800 m (<100 or 200 m deep) from the actual shoreline while pelagic surveys are usually carried out in vessels with other priorities and often do not approach within 5 km of shore (> 200 m depth).

Hope this is useful.

Expert 4:

I have made some comments directly on the report. I mainly focused on the sections where I was identified as a source of data. My professorial instincts came to the fore and I also did some minor editing (note that data are plural not singular)!

Good work. Contact me again if anything I added is not clear.

Expert 5:

Attached is a draft of the report with some comments (not meant to suggest exact wording) in red. As you no doubt have discovered, March is not the ideal time to ask for comments from consultants as it is the last month in the governments' fiscal year and deadlines loom.

The report accurately reflects those portions of the workshop in which I was involved.

The approach outlined in 2.1 is fine, however its usefulness in practice will depend heavily on the weighting used in step 3. Unfortunately, there was insufficient time at the workshop to fully discuss weighting criteria and I think that further discussion by e-mail or conference call should be considered.

Expert 6:

Great work on the workshop report! For the most part I think you have captured what we discussed. I only have a couple of comments. First, for the near-shore data, I think it would be possible to collapse the three cormorant nesting features into one since the target is 100 for all 3. Depending on how you conduct your pre-processing of data it may also be possible to add great blue heron nesting to this feature as well. Although not much can be done about it at this stage, I would not be surprised if many of the targets are too high and will need to be tweaked after the analysis process starts.
Its been a pleasure contributing to this interesting project. Best of luck!

Expert 7:

It seems to me that the report reflects what we spoke of in the workshop. I know there was a lot of uncertainty about how to treat different types of data, particularly in regards to the at-sea type surveys. Your approach for combining them, looks reasonable to me, but I am not experienced in designing ways to combine data, so am not the best person for advice on this.

In terms of the "comments / justification for targets" part in the Pelagic section, I would just re-iterate that all breeding colonies (100%) should be protected, as was suggested in the workshop, since there are not any alternate sites where these birds can nest.

The other comments I have are clarifications in the identified datasets, and they are as follows.

Table 1 – Data Sources for Pelagic Birds

Dataset 1 – now includes additional surveys done since the original compilation of data in 1989. Metadata is in process of being updated.

Dataset 1& 2 – for the majority of the records, dataset 1 (CWS Seabird Colony) is the original source of data on seabird colonies along all of the BC coast. Dataset 2 (Gwaii Haanas, 2003 Nesting Seabird colonies) contains just the data on the colonies in the Charlottes – there may be a few additions or small revisions in dataset 2, that aren't in Dataset 1.

Dataset 7 – Jamie Kenyon is just a temporary employee at CWS, so a permanent contact at CWS would be Kathleen Moore.

Dataset 15 – Phalaropes 1990 (should be 1991) this refers to observations that are within another dataset – dataset 9 (Van I. MAMU 1991) in Table 3 Near-shore.

Table 2 – Pelagic Birds –
Ecological considerations – ANMU stage on the water around their colonies during the breeding season.

Table 3 – Near-shore –

Dataset 9 – this is where there is some Phalarope data (southward migration), Surveys were not really spring – they were "summer" May to end July – coinciding with the MAMU breeding season.

Dataset 12 - this is the same as dataset 1 in Table 1

Dataset 14 and 15 – are these Trudy Chatwin's? Data from them may be incorporated into dataset 1 in Table 1 now, so need to crosscheck data, or be aware it might be duplicated.

Table 5 – Shorebirds

Dataset 3 and 4 – Black Oystercatcher nests (spelling of names for contacts for # 4 Mark Hipfner; Moira Lemon) It is possible that Dataset 4 contains some of dataset 3. There are also older records for other parts of the coast for BLOY nests in dataset 1 in Table 1 – Pelagics.

Dataset 11 – shorebird counts – Western Sandpiper/ Dunlin 1990 up to present with a few year gaps. These focused on the spring Western Sandpiper migration, and were done consistently in only one portion of the Fraser River foreshore (Roberts Bank – between Brunswick Point and the Coal Port jetty.)

Dataset 12 – CWS also has a Tofino Mudflat survey (just one year 1995). Spring migration of Western Sandpipers – focused on WESA but other species recorded as well.

I hope these comments are helpful, and thank you for the opportunity to participate in the workshop. I look forward to seeing the results of the project.

Expert 8:

I participated in the Pelagic Birds group during the Seabird Expert Workshop. On the list of participants, my last name is mis-spelled.

Also in table 1; I have a dataset to contribute that did not show up on the table. The data are: At-Sea Surveys for Marbled Murrelets on the Central Coast in 1998. The surveys documented all species, but my tabulated data only contains info on MAMU. The surveys consist of 1300 km of strip transects that were conducted along the sides of mainland inlets.

The report summarizes the workshop intent and proceedings well; my main concern is that the MARXAN generated product should stand beside a gap analysis of the assessed layers.