Draft Report **BC Marine Conservation Analysis**

MARINE PLANTS EXPERT WORKSHOP REPORT

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1.0 Introduction

1.1 Objective of Report and Overview of Marine Plants Experts Workshop

The objective of this document is to summarize the recommendations from the Marine Plants Expert Workshop held in Vancouver on March 14, 2007. The Marine Plants Expert Workshop was the second of several expert workshops to be conducted as part of the British Columbia Marine Conservation Analysis (BCMCA) Project[1]. The first workshop covered Seabirds while the other workshops will cover Ecosystem Representation, Fish, Mammals, Invertebrates, Human Use, and the use of Marxan.

The intent of the Marine Plants Expert Workshop was to draw on the knowledge and expertise of scientists, resource managers and the conservation community to determine how best to represent marine plant species (including seaweeds, sea grasses and marine lichens[2]), plant structured communities, high quality marine plant habitat, or surrogates thereof in subsequent conservation utility / optimization analyses. Marine plants are an important component of the BCMCA because they are an integral part of the marine ecosystem, play a fundamental role in ecosystem integrity, and are commonly used as indicators for the health and condition of the marine environment. In the BCMCA marine plants are also an important focal species whose presence indicates other species or can be used to characterize a particular habitat or community.

Participants of the workshop were divided into 3 groups – 1) Canopy Forming Kelps, 2) Understory, Turf, and Encrusting Algae, 3) Vascular Marine Plants – 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 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.

[1] Formerly the Conservation Utility Analysis 2 (CUA2) Project.
[2] Phytoplankton will be considered in a subsequent workshop.

- 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 all the subgroups as well as subsequent workshops. This discussion is outlined below.

2.1 Atlas

- For the product "Atlas of important areas" – the inventory is not complete (not all important areas are known), therefore the atlas should be named "Atlas of known important areas
- For output maps it will be important to ID areas where data are missing or N/A; Ensure limitations due to missing data are documented.
- Place maps on a website to allow workshop participants to edit and review. See Brad Mason for tools and options to do this (www.cmnbc.ca).

2.2 Targets and Goals

- The idea that the feature layers are static came up and was seen as a limitation. Suggestion: we could create an index of static versus dynamic beds (*i.e.* in some locations beds are observed regularly, in other locations beds may or may not be there in any given year); When choosing targets will there be different weights for permanent vs variable habitat? This is a really difficult question to answer – a variable habitat may provide critical services when present or of a given extent.
- Will water quality be a feature? *i.e*. turbidity is important to eelgrass, and future changes in turbidity may signal a change in the affected habitat.
- What is meant by 'conserve'? *i.e.* features that provide conservation value. *Answer*: Prescriptive management recommendations are outside the scope of the BCMCA, thus conserve is used at the overarching conceptual level.
  During expert review of this report further explanation here was asked for. *Answer*: The BCMCA is not being prescriptive about management; meaning our goal is not to recommend how conservation of these features might be attained. However, the goal of the project is to identify areas of high conservation value – defined in terms of our stated 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.
- At the workshop participants recommended that *sargassum muticum* should not be given a conservation target because it is an introduced species. However, one post-workshop comment disagreed mildly: it is introduced, but the habitat it now provides is extensive in some areas (e.g. shallow marine and low intertidal areas with limited flow and high temperature in summer). Its possible importance is not well documented, although there is currently a Ph.D. ongoing study (Laura White at UBC) investigating aspects of this question.

2.3 Planning units and Shorelines

- What size of planning units? *Answer*: probably variable.
- In the context of setting targets, how would an ecological feature be quantified into planning units? Krista responded with drawing of eelgrass beds example.
- Which shoreline, what coastline? Issue of different resolutions, different data sets. Coast guard charts use low water line, these data are continuous but different charts are at different resolutions. A high water coastline is being mapped this fiscal year and will match to the low waterline. The TRIM shoreline used by the province has no standard as what is shoreline (mostly referenced to high water, but not always)
  - Krista said she would look at what was used and recommended in CUA

2.4 Data, Data Sharing and updating

- 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.
- What about updating layers? *Answer*: It's not easy, but not impossible. Suggestion that custodians of data might populate the planning units – (and make updates?)

- What about depth and substrate data? *Answer*: for some areas there are more detailed data; talk to Terry Curran, Jim Galloway. Also Joanne Lessard is starting a nearshore project mapping out to 30 – 50 m depth.
- What is biobanding? *Answer*: A term describing attributes in shorezone mapping. Biobands are coastal species assemblages observed in the ShoreZone mapping system. Shoreline is first segmented into linear 'shore units', average length of about 400m, which are determined from geomorphic, substrate and other physical attributes. The shore units provide the framework for the mapping of biological features for each unit. The relative abundance of the set of biobands observed in the unit is recorded in a spatial dataset, as: Continuous (observed in more than half of the unit), Patchy (in less than half of the unit). Based on the observations of the biobands and the geomorphic characteristics, each unit is also assigned to a 'Biological Wave Exposure' category, as well as a 'Habitat Type' category. Biota have specific life requisite conditions and the presence/absence of indicator species are used as a indicate shoreline habitats.
- Need to ensure look into including Traditional Ecological Knowledge, if available and can be shared.

2.5 Other workshops/General

- Question about the link to the land in this analysis, will we look at some watersheds? Have a nearshore workshop? To incorporate the effects on sponge reefs from silt created by logging near Prince Rupert, for example.
    - Parks Canada have done work in that area and should be contacted.
- Reconsider holding a nearshore workshop (in conjunction with Joanne's project).
- Subtidal zone needs to be represented as an ecosystem.
- Need to 'map' areas of high impact – these could be interpreted as lower priority areas if similar areas with less impact are available.
- National Topographic System (NTS) as a data source for substrate – not at appropriate resolution for specific analysis.

3.0 Canopy Forming Kelps

3.1 Introduction

The 'canopy forming kelp group' considered marine algae that mature at heights and in dense beds such that they form a canopy above the seafloor. The group considered the species *Nereocystis leutkeana*, and *Macrocystis integrifolia*. Canopy forming kelps provide significant primary productivity in shallow waters, habitat values (*e.g.* for some juvenile fish), and sources of food for herbivorous animals in areas where they occur (*e.g.* important for herring spawn). The group also considered sightings of *Macrocystis pyrifera*, a canopy forming kelp normally found in California and some areas of Alaska, Feather boa kelp (*Egregia menziesii*) is another species of interest and is an indicator of semi-exposed habitat.

Participants in the canopy forming kelp group were:

- Michael Coon, Province of BC (retired)
- Debbie Paltzat, Province of BC
- Joanne Lessard – Fisheries and Oceans Canada

- Kevin Conley (facilitator/note-taker) – Fisheries and Oceans Canada

3.2 Sources of Canopy Kelp Data

Canopy kelp data sources available in BC are summarised in Table 1. The majority of discussion about the data sources was around comments/questions about them. 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), and quality (precision and accuracy). For example, some datasets capture broad-scale inventories covering the entire province (e.g. BC kelp biobands), while others datasets provide in-depth surveys of very small geographic areas (*e.g.* Quatsino Sound Coastal Planning).

Datasets listed at the bottom of the table in red text do not currently exist in a GIS supported format but are included to document priorities for future research and data collection. For instance habitat models (using predictors such as substrate, depth, current and wave exposure, and freshwater exposure/salinity) can be surrogates to fill gaps in survey data. Other sources include work by Joanne Lessard on El Nino effect on *Macrocystis* kelp (to be published soon?); Mike Foreman's (IOS) tidal current model; and Ed Gregr's models for the DFO's nearshore habitat mapping efforts.

Pre-processing was not discussed as the participants in the group were not comfortable providing recommendations on that aspect of the data. Where possible, data from the same category will be combined and summarized in one dataset. For example, efforts will be made to compile the various sources of canopy kelp data in order to derive one dataset representing canopy kelp biobands and another representing eelgrass meadows.

3.3 Features and Targets

A total of 7 marine features were identified for canopy forming kelps during the workshop (Table 2). Of these, three (*Nereocystis leutkeana* beds, *Macrocystis integrifolia* beds, and *Egregia menziesii*) have at least some existing spatial information, and therefore are considered to be priorities for the BCMCA, the remaining features need to have spatial data generated with the aid of either expert knowledge and/or spatial modeling methods. The experts felt that the priority features are: *Nereocystis leutkeana/Macrocystis integrifolia* habitat, *Nereocystis leutkeana/Macrocystis integrifolia* beds, followed by the remaining features. If time permits, methods will be undertaken to identify priority habitats (*i.e.* predictive modelling). The predictive modelling will require further follow-up with the expert participants after the datasets are assembled.

Where possible, a range of targets spanning minimum to preferred amounts was recommended for each feature (Table 2). The targets define the amount of the marine feature required for meeting the BCMCA's four ecological objectives[3]. Targets were identified irrespective of current conservation policy/management measures.

[3] 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.

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. Experts voiced a desire to reconsider these ecological considerations when they are reviewing the spatial data.

3.4 Assumptions/Limitations

Information on canopy kelps in British Columbia is 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 of canopy kelps and the species they support. Fortunately, information on canopy kelp biobands is coast-wide, from to the systematic aerial surveys and mapping conducted for the BC biophysical shorezone mapping system.

Giant kelp (*Macrocystis integrifolia*):

- is non-existent in Strait of Georgia from Beecher Bay to Johnstone Straight, not in Broughton Strait east of Malcolm Island. Macrocystis is intolerant of warm and low salinity water, thus is not found in areas where warm and low salinity water occur together – areas such as Georgia Strait and the inner portions of the Strait of Juan de Fuca.
- Is perennial, habitat usually in semi-protected areas, beds are more regularly present although density can change. May also be found in semi-exposed areas, as the species appears to need some swell or surge on a regular basis.

Bull kelp (*Nereocystis leutkeana*):

- Is annual and has different exposure range, habitat is generally more exposed and in deeper water.

Temporal variation in kelp beds is an unresolved issue.

- Bull kelp and perennials kelps can be seral, urchins allow bull kelp forests to establish by providing a perturbation (ie grazed areas on the seabed where perennial species can not establish).
- Ocean climate also causes changes, *i.e*. El Niño (warm temperatures and low nutrients) causes die off.

3.5 Recommendations

The canopy kelp group suggested expanding group 2 (other algae) habitat types to include subtidal.

The canopy forming kelps working group recommends using 19 data sources and targeting 7 canopy kelp features in an effort to capture canopy kelps and the species they support in the BCMCA. Data from the recommended data sources will be compiled and maps will be generated for each of the high priority recommended marine features. These maps will be distributed to the canopy forming kelp working group and other workshop participants for comment.

Table 1: CANOPY KELP: Data Sources

Category	Dataset	Description	Geometry	Data Custodian	Extent	Key Fields	Comments	Pre-Processing
Nereocystis leutkeana and *Macrocystis integrifolia*	Provincial (LUCO / DSS). From Oil spill atlas	1:7200 mylar georeferenced to 1:40,000 nautical charts (Nicolson and Booth 1997)	polygon	DSS - Carol Ogborne	Central Coast - Bardwell Group, Goose Group, McMullin Group, Stirling Island-Hakai Pass, Cultus Sound	Macrocystis and Nereocystis. High and low abundance	Mylar source from Barron Carswell MAFF(mylars from all the KIM-1 surveys should still be available from archives, although I think all these maps from all the KIM-1 surveys have been digitized by LUCO – see Carol Ogbourne). Created from 1993 Aerial surveys and ground truthing. Digitized for Oil Spill Atlas	
	Provincial (LUCO / DSS). From Oil spill atlas	from surveys hand drawn to nautical charts and digitized. Based on aerial overflights	polygon	DSS - Carol Ogborne	NE Van Isle (1983, 1989) between Ledge Pt & Dillon Pt incl NW shore Malcolm Is. Northern VI (1976) from Cape Sutil to Scott Islands and N shore Hope, Negei & Balaklava Is	Macrocystis and Nereocystis. High and low abundance	Michael Coon's own maps (mid 70s to mid 80s – My hand drawn maps result from aerial reconnaissance flights in Georgia Strait, the east coast of QCI, the BC side of Juan de Fuca between Barkley Sound and Sidney,) See #6 in Ardron's kelp notes, is that data also included in this?	
	Provincial (LUCO / DSS). From Oil spill atlas	CHS chart data. Used in LRMP planning (Nicolson and Booth 1997)	polygon	DSS - Carol Ogborne	Coast-wide	Area - No species breakdown.	digitized from Nautical charts in 1990's (charts from 1994-1996 scale mostly 1:40,000 range 1:12,000 to 1:80,000. Digitized polygon based on kelp symbol and sailing guide.	
	Pac Rim Park	linked to Marbled Murrelet work		Mike Collyer/Heather Holmes	Broken Group, West Coast Trail		Don't know what kelps are included. Contact custodian.	
	Gwaii Hanaas	As used in CUA1		Pat Bartier/Norm Sloan	Gwaii Hanaas Park Reserve		Uncertain whether beds mapped and what species are represented.	

	Quatsino Sound Coastal Plan	Developed for the Coastal Management Plan		Steve Diggon (DFO) or Rob Paynter (Prov BC)		Presence/ absence	What species are represented. Does this include/expand on work done in 78?	
	DFO Herring	Herring spawn surveys.	polygon	Charles Fort (DFO) Kristen Daniels	Coast-wide		Includes all canopy kelp and understory, don't record to species level, presence/absence, less detailed, but detailed for macrocystis (e.g. include % cover by 1m square quadrat, therefore presence/absence more appropriate use of the data).	
	Invertebrate Dive Survey Data		point	Joanne Lessard (DFO) / Shellfish Data Unit	Coast-wide		Includes all canopy kelp and understory, presence/absence	
		See invert dive survey dataset above and possibly the herring spawn survey						
Egregia menziesii (feather boa)	shorezone biobanding	As in CUA1.					Egregia included in 'chocolate brown algae' group of bioband data. Can Egregia be teased out of the data?	
	Michael Coon sighting				*Northwest coast of Graham Island (QCI)*		*A rare sighting and probably not worthy of being used*	
Alaria fistulosa					Gray Bay, QCI		Michael Coon sighting (Dr. Louis Druehl of SFU published a note on his later sighting in the same area), may be included in invert dive survey dataset (Joanne Lessard did not see any on her surveys in May).	
Macrocystis pyrifera (type?)	depth							
Habitat Modelling	substrate							

for *Nereocystis leutkeana* and *Macrocystis integrifolia*	current modelling	include salinity, temperature		Mike Foreman			described in Nearshore Habitat Working Group report (Joanne Lessard)	
	relative exposure	Sum of fetch calculation.		Ed Gregr				
	salinity							
	shorezone biobanding	As in CUA1.					Biobanding data can be used to focus/verify modelling work.	

Post-workshop addition:

I don't think that you have captured all the quantitative kelp surveys using the KIM-1 standard method have been included. Here is a summary list of those surveys, with the years that surveys were conducted following the geographic descriptor.

NE Vancouver Island – 1974, 1978, 1980, 1983, 1989
Nootka Sound & Hesquiat Peninsula – 1975
Estevan Group & Campania Island – 1976
Dundas Group – 1976
N&W Graham Island, QCI – 1976
Goschen Island to the Treee Knob Group – 1976
N Vancouver Island to Balaklava Island – 1976
NW Vancouver Island – 1978
Juan de Fuca Strait – 1988
Hakai Passage to Bardswell Group – 1993

Reports have been published on each of these surveys (except for several of the NE Vancouver Island surveys). The mylar maps are probably still available in MAF archives. I think LUCO digitized all these maps – check with Carol Ogborne. This is the best and most comprehensive data set on Macrocystis and Nereocystis stands in BC.

Table 2: CANOPY KELP: Data Preparation and targets

Marine Feature	Rationale	Measure	Target	Comments/ Justification for targets	Ecological Considerations	Comment
Nereocystis leutkeana beds	'Annual' plant, more opportunistic, exposure range different. Not found too sheltered, nor too exposed (mid exposure). May occur at highly exposed areas, but deeper water. c.f. *Macrocystis*	proportion of beds	30-80	Similar to *Macrocystis*, but more opportunistic, relying on seabed perturbances to provide opportunity for colonisation. Upper target is the same as *Macrocystis* due to ecosystem values (nutrient cycling, structural habitat).		Maintain range. Conservation should be spread throughout the range. Refer to eelgrass group. All features
Macrocystis integrifolia beds	Perennial, less variable in bed area and consistency. Note: does not occur in Georgia Basin nor Johnstone Strait. Queen Charlotte Strait occurrence (Joanne Lessard has found it at one site only on islands in Port Hardy area) Others noted that Macrocystis occurs in large beds along the northern and west coast of Malcolm Island and off the coast of Vancouver Island from the Port McNeill- Malcolm Island area to the open coast off Cape Scott.) c.f. *Nereocystis*	proportion of beds	50-80	Resilient to smaller impacts (i.e. conservative harvesting), so very difficult to destroy a bed. Provide significant habitat values for marine fauna. One bed represented by one polygon in the provincial dataset. Seek consistency with the DFO Policy for Managing Fish Habitat.		Maintain range. Conservation should be spread throughout the range. Refer to eelgrass group. All features in this category. Spore dispersal (<10m according a study in California),
Nereocystis leutkeana habitat	Predictive models under development, but need substrate, depth, salinity, finer scale wave exposure and current data (e.g. Mike Foreman, IOS current modelling). Further surveys required, extrapolation exercise underway to expand on biobanding data, and population changes expected with sea otter recovery.	proportion of area	50-80	Should be based on unoccupied habitat/unconfirmed beds.		
Macrocystis integrifolia habitat	Similar to above, but different habitat requirements.	proportion of area	50-80	Should be based on unoccupied habitat/unconfirmed beds.		

Egregia menziesii (feather boa)	Provide habitat, in similar areas as surf grass. Indicator in shorezone semi-exposed habitat. However, maybe data limited, and is lumped in with 'chocolate brown' algae band. Data does exist from herring spawn and other dive surveys.	presence/absence (occurrence)	12-40			
Macrocystis pyrifera (type?) Gray Bay, QCI	Different species potentially in Southern QCI, localised to Gray Bay, QCI (Mike Coon observations and cited in a L Druehl paper). Conical holdfast specimens found in this area (more similar to California species. Rare within BC. South of Sandspit, Cumshewa Inlet.	number of occurrences	100	2 historical sightings, Joanne Lessard did not find these in her 2007 survey).		
Alaria fistulosa	Rare within BC, W of Naden harbour on NW Graham Island (Mike Coon observation). Likely range extension from Alaska. Forms kelp forests in Alaska. However, did it persist after regime shift in 70's? Need to go back and survey.	number of occurrences	100	Few historical observations. No documented collections in BC		Post workshop comments: Rarity at the extremes of a range is not a reason to consider it important in the context of this exercise.

4.0 Understory, Turf, and Encrusting Algae

4.1 Introduction

This category considers intertidal, subtidal and deep water non-canopy forming algae, including coralline red algae and *Porphyra* Like canopy-forming kelp and marine vascular plants, these algae provide significant primary productivity, habitat (including substrate for herring spawn), and sources of food for herbivorous animals. They are the major primary producers on most of the intertidal coast of British Columbia and dominate the intertidal and a significant proportion of the subtidal realm. They are an important source of biodiversity in the marine environment.

Participants in this group were:

- Dr. Robert DeWreede – Department of Botany, UBC (Retired)
- Dr. Sandra Lindstrom – Department of Botany, UBC, and private consultant
- Dr. Michael Hawkes – Department of Botany, UBC
- Penny White – Institute for Resources, Environment and Sustainability, UBC
- Dave Nicolson (facilitator/ note-taker) – Nature Conservancy of Canada

4.2 Sources of Algal Data

Sources of data identified by the group are summarized in Table 3. Sources range from collection data to habitat mapping. Some are coast-wide; most have limited geographic coverage.

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 expending effort to verify the data; however, this may be impractical given the timing of this project. Much of the data collection effort for Herbariums was in the 1960’s and 1970’s and climate regime changes (e.g. 1978 El Niño) have altered species distribution. However, most data about altered species distributions are non-quantitative observations, and are probably not enough to be concerned about.

4.3 Features and Targets

Experts identified 36 features to be targeted in our analysis. Two features have limited distribution in BC. Twenty-two features are considered rare in BC – most are at their northern or southern limit; only a few are endemic to BC. For many of the rare features there is only limited collection data, therefore seven ecological habitat features were identified. There was some discussion, but no consensus, about adding additional subtidal habitat types. Five of the features are special habitat types, for which there is little or no mapping available. These were identified mostly to highlight data gaps. Details of the algal features are contained in Table 4.

4.4 Assumptions/Limitations

Recommendations for the features and targets were constrained by data availability and limited knowledge of the species and their habitat requirements. In general, data are lacking on species distributions and habitat use, and thus this analysis will be limited to available collection data. Much of that collection data is dated and should be used with care. Specific sources of data which may be useful for data mining when time and resources allow are listed in the data sources.

4.5 Recommendations

For algae, the expert sub-group recommended 36 features at varying levels of targets. Maps for these features will be created by combining all the available data sources. Effort will be required to verify data for the rare species. These maps will be distributed to the understory, turf, and encrusting algae working group for comment.

Table 3: Understory, Turf, and Encrusting Algae: Data Sources

Category	Dataset	Description	Geometry	Data Custodian	Extent	Key Fields	Comments	Pre-Processing
Ecological habitat	shorezone mapping	BC ShoreZone Mapping system	line	Carol Ogborne	coast-wide		community based information - intertidal distr and range of distribution	
Estuary	Selected estuaries		quantitative work.	Gary Bradfield – UBC		Selected estuaries in SoG and WCVI		
	Pacific Estuary Conservation Program	Estuary mapping - tidal portions of estuary/rivers	polygon	DU/CWS	coast-wide			
	Will McKenzie	book - wetlands classification						
General	IOS or DFO	localized datasets					DFO dive surveys – same as kelp	
	UC Berkeley						unlikely but should check	
	Ron Foremans Bath Is / Strait of Georgia Data	intertidal 1970. Murray Manson sampled 1992. NaGISA (Census of Marine Life) resampled last year.	n/a (reports)	see Murray or Sandra	Strait of Georgia	Quantitative data on species abundances	reports, not GIS data (in Excel spreadsheet). Check with Murray. Debbie Paltzat might also have. Library could have report by Foreman	
	Thesis by students / published papers	site specific, species specific, quantitative data, some survey. Focus Barkley Sound				Density, phenology (growth rate etc), assoc species, ecological interactions, distrib to wave exposure	see sheets provided by Robert DeWreede. Detailed interactions - site specific data (what species are doing at site - eco interactions)	mine papers for data/information (summer student job)
	Library search						run species names though search. Also geographic names (e.g. Whiffin/Whiffen Spit)	
High current	Oil Spill atlas	Can Hydrographic charting						
kelp & some red algae	Permits for Harvest (provincial)			Debbie Paltzat				

Rare Rare & limited	CDC	rare names (10 years out of date) for 50 species short list. Developed EOs for those & applied provincial rankings	polygon	see CDC	Coast-wide	species etc		Some species names have changed since they were collected for UBC Herbarium. Check to see if more recent data added to UBC since CDC created this dataset
	Univ New Brunswick Herbarium	Some collections in BC. May or may not be online		Gary Saunders				
	UBC Herbarium		database	Mike Hawkes	BC Coast plus	species, Lat/longs (some/inconsistent), date, habitat, collector	38,000 BC records, each representing voucher specimen in UBC collection. Each record refers to a collection. Names are not up to date - not reflected in current taxonomy - need Key (purchase for 28 - See Sandra for copy). What we know of species range in province.	Ideally expert to review. Pull info out via search for target. Data is available on line via UBC HEB website - keyword search BC & species
Seamount	Bowie Seamount	data collect collection		Doug Swanston - Seacology. Report available on web or via DFO			Specimens deposited in UBC herbarium.	
	Bowie Seamount			AXYS studies - DFO website				
Upwelling/High current	Mike Foreman models							

Table 4: Understory, Turf, and Encrusting Algae: Data Preparation and targets

Marine Feature	Rationale	Measure	Target	Comments/ Justification for targets	Ecological Considerations	Comment
Limited/restricted distribution						
Pterygophora	Common but important (old growth equivalent) species; Keystone. Found on rocky, semi-exposed shore	occurrence	30-80%	Lack knowledge to be more specific (no less than 30, don't need 100)		
Postelsia	Patchy outer coast distribution - headlands. Harvested in other jurisdictions. Difficult to collect (headlands, exposed outer coast)	occurrence	20 replicate areas, scattered around coast. As many as possible.	Replicates through local distribution of spores, so if leaves from area, not easily re-established. Potentially vulnerable to harvesting		
Rare	First 18 from CDC list of 50 rare species, based on existing collection records (Mike Hawkes). 18 or so genuinely rare (list provided by Hawkes). Some questionable (not enough sampling & names changed - from 10 years ago, needs updating) - 43 on-line				capture sample from each geographic location	Target is most rare. Do not have enough info to map populations. Have records (verifiable observations).
Codium ritteri (Phylum Chlorophyta). Setchell et Gardner 1903.	At southern limit. (Alaska to northern BC.)	occurrence	100%	Rare. The loss of this and other northern species rare in BC could be a strong indicator of global warming.		known from 3 localities (5 collections, 4 of them in UBC). Campania I, Kitlakatla, Dolphin I. Reported (not collected) at Botanical Beach
Desmarestia tortuosa (Phylum Phaeophyta). Chapman 1970	BC Endemic	occurrence	100%	Endemic and rare.		known from 5 locations (6 collections in UBC). Barkley Sound, Orr I, Holberg Inlet
Dictyoneuropsis reticulata (Phylum Phaeophyta). (Saunders) Smith 1942	At northern limit. (Vancouver Is, Oregon, Channel Is California)	occurrence	100%	now synonym of Dictyoneurum		known from 5 locations (7 collections in UBC). Hope I, Cape Scott, Goose I, Quatsino, Sombrio

Dictyoneurum californicum (Phylum Phaeophyta). Ruprecht 1852	At northern limit. (Southern BC to Baja California, Mexico)	occurrence	100%	Rare.		known from 7 locations (20 collections in UBC). Restricted to SW coast Van Is (Botanical Beach to Sombrio River & West Coast Trail). Also recently collected on the central coast where it was locally abundant.
Laminaria farlowii (Phylum Phaeophyta). Setchell 1893	At northern limit. (Southern BC to Baja California, Mexico)	occurrence	100%	Rare.		known from 4 locations (7 collections in UBC). Comox, Gabriola I, Arab Cove, Vancouver I)
Laminaria longpipes (Phylum Phaeophyta). Bory 1826	Near southern limit. (Western North Pacific, Bering Sea, Aleutian Islands, Alaska to Southern SE Alaska; BC & northern Washington)	occurrence	100%	Rare.		known form 3 collections in UBC. Bunsby Is, Vancouver Is
Laminaria sinclairii (Phylum Phaeophyta). (Harvey ex Hooker F. et Harvey) Farlow, Anderson et Eaton 1879	At northern limit. (Hope Is BC to Santa Barbara California)	occurrence	100%	Rare.		Known from 8 locations (18 collections in UBC). May be more common than collections indicate. Hope I, Nasparti Inlet, Vancouver I, Grassy I, Commerell Pt, Lippy Pt, Long Beach, Carling R, Sombrio R,
Antithamnion kylinii (Phylum Rhodophyta). Gardner 1927	At northern limit. (Southern BC to Baja California, Mexico)	occurrence	100%	Rare.		known from 5 locations (6 collections in UBC). Small and cryptic. Seymour Narrows, Tribune Bay, Hornby I, Ladysmith Harbour, Bamfield
Arthrocardia silvae (Phylum Rhodophyta). Johansen 1971.	At northern limit. (Barkley Sd BC to Monterey County California.)	occurrence	100%	Rare.		Cape Beale, Vancouver Is.
*Cumathamnion sympodophyllum (*Phylum Rhodophyta). Wynne at Daniels 1966.	At northern limit. (Southern BC to Mendocino Bay, California)	occurrence	100%	Rare.		Botanical Beach, Vancouver Is.
*Hollenbergia nigricans (*Phylum Rhodophyta). Wollaston 1971.	At northern limit. (Southern BC to Mendocino Co., California)	occurrence	100%	Rare.		Known from 2 locations (3 collections in UBC). Hedley I and Botanical Beach
*Phycodrys riggii (*Phylum Rhodophyta). Gardner 1927	At southern limit. (Northern Japan Sea, bearing sea, Aleutian Is, Alaska to northern BC)	occurrence	100%	Rare.		known from 2 locations (13 collections in UBC). Rennell Sound, Haida Gwaii & Prince Rupert

						Area
*Tayloriella abyssalis (*Phylum Rhodophyta). Wynne 1985.	A northern species. Subtidal. (Aleutian Is & Cook Inlet Alaska; North and Central BC)	occurrence	100%	Rare.		known from 4 locations (4 collections in UBC). Gill I, Campania I; Kelp Head, Queen Charlotte Sound
*Tayloriella divaricata (*Phylum Rhodophyta). Wynne 1985	A northern species. (Aleutian Is & Cook Inlet Alaska; North and Central BC)	occurrence	100%	Rare.		known from 2 locations (3 collections in UBC). Princess Royal I; Broken Is, Barkley Sd. Post-workshop comment: Found on Ridley Island, near Prince Rupert this summer. Perhaps it is not as rare as previously thought although it is at its southern distribution limit in northern BC. *Tayloriella abyssalis* may be a synonym.
Thuretellopsis peggiana (Phylum Rhodophyta). Kylin 1925	Cryptic, small, seasonal and subtidal. BC center of range. (Prince William Sd, Alaska to northern Washington)	occurrence	100%	uncommon, rarely collected. Little new information		known from 3 locations (3 collections in UBC). Barkley Sd & Juan de Fuca. Also found at Bath Island in the Strait of Georgia during NaGISA sampling in May 2006.
Tokidademdron bullatum (Phylum Rhodophyta). (Gardner) Wynne 1983	At southern limit. (Western North Pacific (Japan, northern Japan Sea, Kuril I, Sakhalin I; Aleutian I; Alaska to Northern BC)	occurrence	100%	Rare.		known form 4 locations (12 collections in UBC). Langara I; Triple I; Prince Rupert; Kitkatla, Dolphin I.
Tokidaea chilkatensis (Phylum Rhodophyta). (Gardner) Wynne 1983	At southern limit. (Prince William Sd, Alaska to northern BC)	occurrence	100%	Rare.		known from single collection in UBC. Kitkatla, Dolphin I.
Whidbeyella cartilaginea (Phylum Rhodophyta). Setchell et Gardner 1903	**Endemic**. Subtidal. Also occurs in Washington.	occurrence	100%	Rare.		known from 2 collections in UBC. Chatchannel Pt, Union I; Wizard Islet, Barkley Sd
Rhodolith Bed	Do not know distribution in BC - only specimen is from Rose Harbour, Haida Gwaii. Thought to be in Bath Island, (specimens not yet accessioned into UBC).	occurrence	100%	Rare.		
Lithothrix (red algae)	Spotty distribution. Important for herring spawn? (Debate among group)	occurrence	100%	widespread, few records		

Cystoseira geminata	Spotty distribution / rare? Canopy forming brown alga	occurrence	1 from each geog location	50 records, fewer than 12 diff geographies	capture sample from each geographic location. -want to capture everywhere it occurs - doesn't mean need to capture all observations	if use herbarium as data source, ensure target was attached when collected, not collected from drift
Eisenia arborea	Some collection data, limited quantitative. Not rare, but not common. Found in shallows. Charismatic megaflora	occurrence	1 from each geog location	50 records, fewer than 12 diff geographies	-want to capture everywhere it occurs - doesn't mean need to capture all observations	
Ecological habitats						
Rocky intertidal - sheltered	algae habitat	% of length of feature	30-60%	Highly productive, important habitat		
Rocky intertidal - semiwave exposed	algae habitat	% of length of feature	30-60%	Highly productive, important habitat		
Rocky intertidal - highly exposed (surge)	algae habitat	% of length of feature	30-60%			
Boulder/Cobble floor	algae habitat	% of length of feature	40-70%	Highly productive, important habitat, often very high diversity		
mudflats/estuarine	algae habitat	% of length of feature	40-70%	Highly productive, important habitat		
High current areas e.g. Gabriola Pass, Active Pass etc	algae habitat	area	40-60-100%	capture all intact or portion; highly productive		
eelgrass beds (substrate for algae)		area	40-60%	Highly productive, important habitat		
Special habitats	In most cases do not know enough about to map (data gap). Consider for marine plants					
Whiffen Spit. Cape Palmerston. Brooks.	refugium (glacial and post glacial)? Areas with unique genotype of species. Limited data. Data gap (needs further study)	area	100%	Rare. Unique species distributions and genotypes.		
Subtidal glacial moraine	If they exist. Special feature. Exist in San Juan group - data gap for BC.		100%	Rare. Unique species distributions and genotypes.		

Seamounts (Bowie etc)			100%	Unique habitat. Natural laboratory for colonization studies.		
Vertical granite walls (Fjords) e.g. Kynoch Inlet	Preliminary samples suggest unusual flora, but data gap (needs further study)			Unique habitat.		
Special upwelling with unique features (e.g. Cape St. James) - persistent	Question of how to map			Highly productive, important habitat		

Post-workshop comment: On reading the above list, I don't personally feel that species that are at the extremes of a range (in other words are common elsewhere but uncommon in BC due being at the natural limit of their range) constitute something that this group should be concerned about in terms of conservation.

5.0 Vascular Marine Plants

5.1 Introduction

The vascular marine plants group considered seagrasses (*Zostera marina*, *Phyllospadix scouleri, Phyllospadix torreyi, and Ruppia maritima), salt marsh species, and dune vegetation*. Vascular marine plants and their associated communities play a vital role in the integrity of nearshore ecosystems in British Columbia —they provide vital habitat for many adult species, act as nurseries for juveniles, supply valuable organic detritus into marine food webs, produce oxygen, and sequester carbon.

Participants in this group were:

- Mary Morris – Archipelago Marine Research
- Brad Mason – Fisheries and Oceans Canada
- Dr. Maycira Costa – University of Victoria, Department of Geography
- Cynthia Durance – Precision Identification
- Krista Royle (facilitator/note-taker) – Parks Canada

5.2 Sources of Vascular Plant Data

Table 5 summarizes the vascular plant datasets currently available in BC. 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), and quality (precision and accuracy). For example, some datasets capture broad-scale inventories covering the entire province (*e.g.* BC eelgrass biobands), while other datasets provide in depth surveys of very small geographic areas (*e.g.* Prince Rupert Harbour). Datasets listed at the bottom of the Table 5 in red text do not currently exist in a GIS supported format but are included to document priorities for future research and data collection.

Where possible, data from the same category will be combined and summarized in one dataset. For example, eelgrass bioband is linear spatial data and may not be directly comparable with mapping of polygon-based data for eelgrass meadows

5.3 Features and Targets

The vascular marine plants group identified 9 marine features during the workshop (Table 2). Of these nine features, five have existing spatial information and therefore are considered to be priorities for the BCMCA, two (priority eelgrass habitat and eelgrass potential) need to have spatial data generated with the aid of expert knowledge and/or spatial modeling methods, and two (*Ruppia* and dune vegetation) represent data gaps. The priority features are: eelgrass polygons, eelgrass biobands, surfgrass biobands, *S*alicornia biobands and salt marshes. If time permits, methods will be undertaken to identify priority eelgrass habitats (eelgrass beds that are of particular significance for herring, juvenile salmon, Dungeness crabs, etc.) and eelgrass potential.
We would appreciate your suggestions for how to identify priority eelgrass areas and map eelgrass potential.

Post workshop suggestions:

- I don't have much knowledge in this area, but the high use of some beds by juvenile fish (especially species of fish with declining populations) would be an indicator of high priority beds. Don't think we know much about this, however. One of my students, Sharon Jeffery, is just finishing an M.Sc. thesis on this topic, but her results are not very definitive or predictive. The work is sound, however, and the results may be a reflection of our lack of knowledge of what to look for as predictors of habitat use.
- Suggestions: Priority Eelgrass Habitats, based on the previous paragraph I would suggest overlaying species maps (eg. Herring spawn maps) with known eelgrass distribution. The weakness of this method is that most of the eelgrass in BC has not been mapped.
- Eelgrass potential could be determined based on the physical habitat requirements of the species for which data is available. These include depth, substrate, and exposure. A model could be developed that used existing data layers to develop a map of potential eelgrass habitat.
- Develop a habitat model, from known coastal substrate and wave exposure conditions, predicting likelihood of *Zostera* occurrence, then check the model against area with detailed, mapped observations.
- I think that some eelgrass beds are very important and some of these have been mapped such as Boundary Bay, Nanaimo estuary, Comox/ Denman Island. In addition the Haegle mapping shows where significant herring spawn occurred which coincided with seagrass mapping. So existing mapping will show some significant seagrass beds which would all be high priority to protect and are all important from an ecosystem perspective. Trying to say which bed is more important could be done on the basis of size, or some measure of production but we don't have production data. So all the beds are important and in my view, equally important. If the intent is to say that some beds are less important or significant than others, it would be difficult to support but this approach has been done in the past for planning purposes for other habitats and species. I think we are not in a position to do this at this time.

Due to regional differences in data sources, survey methods and data quality, participants stressed the importance of targeting the eelgrass polygon features and the three bioband features by ecoregion. Participants also emphasized the importance of considering land use practices and the effects they may have (*e.g.* water quality, turbidity, etc.) on the health of vascular marine plant features.

Where possible, a range of targets spanning minimum to preferred amounts was recommended for each vascular marine plant feature (Table 2). The targets define the amount of the marine feature required for meeting the BCMCA's four ecological objectives[4]. After some clarification by the BCMCA Project Team, targets were identified irrespective of current conservation policy/management measures. A number of participants voiced concern about the process of deciding on targets for a single species, without considering the overall interactions represented by each habitat, and in trying to compare quite different data sources. The "comments /

[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.

justification" column for the setting of targets was not filled in for all vascular marine plant features during the workshop due to time constraints. Some of these were filled in when experts reviewed the report.

Definitions of ecological targets (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. In the data preparation process, data compilers could possibly use international standards, already in use, for these definitions. Experts voiced a desire to reconsider these ecological considerations when they are reviewing the spatial data.

5.4 Assumptions/Limitations

Information on vascular marine plants 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 of vascular marine plants and the species they support. Fortunately, information on marine vascular plant biobands is available coast-wide, from the systematic aerial surveys and mapping conducted for the BC biophysical shorezone mapping system.

5.5 Recommendations

The vascular marine plants working group recommends using 19 data sources and targeting 7 vascular marine plant features in an effort to protect vascular marine plants and the species they support in the BCMCA. Data from the recommended data sources will be compiled and maps will be generated for each of the high priority recommended marine features. These maps will be distributed to the vascular marine plants working group for comment.

Table 5: VASCULAR MARINE PLANTS: Data Sources

Category	Dataset	Description	Geometry	Data Custodian	Extent	Key Fields	Comments	Pre-Processing
Eelgrass (Zostera) Polygons	Seagrass Conservation Working Group Polygons	Groups are mapping polygons, points and lines. Focus is on eelgrass.	Point, lines and polygons	Eelgrass Atlas, Community Mapping website, Brad Mason/Cynthia Durance.	All over BC, but patchy (24 communities are mapped)	5 level methodology.	Mapped by volunteers. Quality/detail of mapping varies based on group. Metadata is online on community mapping network.	Work closely with Brad on this dataset.
	CMN Eelgrass and Coastal Resource Atlas	Includes Haegle Dataset. This is the herring spawn data. All of the historical eelgrass data is on this site.	Polygons	DFO, Brad Mason.	Spotty, attempted to hit important herring spawn areas.	Presence/absence	Some of the datasets are in autodesk compatible format. Look at Jeff's data and look at community mapping network to see if this data has already been incorporated into existing datasets.	
	Kathy Dunster Report	Gives up information on sources of eelgrass data.	REPORT	www.cmn.ca / or contact Kathy directly. (Bowen Island, Kathy Dunster)				
	Living Oceans Eelgrass Data	Known distribution and relative abundance of eelgrass. Several overlapping sources of eelgrass data were merged together and a standardized ranking system was developed with relative importance values of .5 - low, 1 - moderate and 2-high.	Polygon	LOS	Province wide, patchy	Relative Importance (RI)		

	BC CRIMS Data	Distribution of eelgrasses in coastal British Columbia showing relative abundance (RA) and overall relative importance (RI). RI is based on project region and not on the province as a whole.	Polygon	Carol Ogborne. See metadata from CRIMS. Can be requested by BC Parks.	Province wide, patchy	Relative Abundance (RA), Relative Importance (RI)	LOS likely already has this datasets as well as many of the other ones listed here.	
	Parks Canada datasets	Eelgrass collected by Parks Canada for Gwaii Haanas, Pacific Rim, and Southern Strait of Georgia. Includes warden mapped eelgrass meadows and detailed eelgrass surveys.	Point, Line, Polygon	Cliff Robinson, Pat Bartier (Gwaii Haanas).	Gwaii Haanas, Pacific Rim, Strait of Georgia.			
	Quatsino Sound DFO	Eelgrass Polygons in Quatsino Sound.	Polygons	Steve Diggon, DFO Port Hardy	Quatsino Sound			
	Prince Rupert Harbour	Remote sensed eelgrass data	Polygons	DFO, Brad Mason	Prince Rupert Harbour			
	Goose Island	Nearshore habitat inventory for Goose Islands. Data was gathered by BC Parks.	Polygons	Mary Morris, Archipelago Marine Research.	Goose Island		Possibly not digitized.	

	Provincial (LUCO / DSS). From Oil spill atlas	Identified by DFO Fishery officer survey (1993). Drawn on to Nautical charts and digitized (Nicolson and Booth 1997)	polygon	DSS - Carol Ogborne	DFO Stat areas 13 &15			
	Transect data from DFO	Dive surveys; same as kelp		DFO - PBS, Joanne Lessard	Patchy, BC -wide			
	Town of Sidney	Subtidal eelgrass habitat inventory.	Polygons	Town of Sidney (backup Mary Morris)	Town of Sidney			
	Victoria Capital Region District Harbours Atlas	Habitat inventories that include eelgrass done for VCRDH. Final product is an intertidal habitat rating system. Based on intertidal and subtidal inventory and classification.	Polygons	Harbour atlas.com Victoria CRD website.	All of Victoria and Esquimalt Harbours.	Habitat rating.	Very detailed inventory.	
Eelgrass Biobands	Shorezone Bioband Data	BC Shorezone mapping program. Biomapping component.	Line	Carole Ogborne	All BC	Patchy or Continuous	Ecoregional differences in data quality, source, confidence. SoG and WCVI gave the poorest quality data (with exception of SGI data mapped for Parks Canada).	

Surfgrass Biobands	Shorezone Bioband Data	BC Shorezone mapping program, biobanding component. The Bioband class is based on observed coastal species assemblages with a characteristic colour and across-shore elevation. Biobands are mapped as continuous or patchy throughout an individual shore unit.	Line	Carole Ogborne	All BC	Patchy or Continuous	Ecoregional differences in data quality, source, confidence. SoG and WCVI have the poorest quality data (with exception of SGI data mapped for Parks Canada).	
Salicornia Bioband	Shorezone Bioband Data	BC Shorezone mapping program, biobanding component. The Bioband class is based on observed coastal species assemblages with a characteristic colour and across-shore elevation. Biobands are mapped as continuous or patchy throughout an individual shore unit.	Line	Carole Ogborne	All BC	Patchy or Continuous	Ecoregional differences in data quality, source, confidence. SoG and WCVI have the poorest quality data (with exception of SGI data mapped for PC).	Work closely with Mary on this dataset.
Salt Marsh	Province Dataset	Known estuaries of BC from provincial database.	Polygons	Carole Ogborne	All BC			
	Estuary Mapping	This dataset contains maps of 442 estuaries found in British Columbia, showing site-specific physiographic features of each estuary. This data was collected as part of the Pacific Estuary Conservation Program (PECP).	Polygons	Kathleen Moore, CWS.	All BC			
	DFO Estuary mapping	Check to see if there are historical records showing the distribution of estuaries.		Colin Levings				

	Sensitive Ecosystem Mapping	Check and see if Dune's and Salt marshes are mapped in these databases.						
Priority Eelgrass Habitat		The distribution of eelgrass habitat that is of particular significance to other species life requisites (e.g. herring, juvenile salmon, Dungeness crab).		Mary Morris, Archipelago Marine Research.				IF BCMCA was to pursue this work contact Mary Morris.
Eelgrass Potential		Modeling data to represent eelgrass habitat that is not currently mapped. Could use physical/oceanographic datasets to estimate eelgrass distribution (e.g. depth, substrate, wave exposure).		Mary Morris, Archipelago Marine Research/Brad Mason, DFO.				IF BCMCA was to pursue this work contact Mary Morris and Brad Mason.
Dune plant community		Data gap.						Should be included when data is available.

Table 6: VASCULAR MARINE PLANTS: Data Preparation and targets

Marine Feature	Rationale	Measure	Target	Comments/ Justification for targets	Ecological Considerations	Comment
Eelgrass (Zostera) Polygons (by Ecoregion)	Data sources/quality/completeness of polygon versus line data varies and therefore polygon and line data should be targeted separately. Want to ensure representation in different ecoregion.	Percent of know extent	50-100	In the literature, such beds are usually said to be of high importance due to their productivity, shelter, and habitat potential. As they are often endangered by human activities, a high target seems appropriate.	Minimum patch size: 25 m^2; replication: 5; separation distance: 5km Expert comment: These numbers will require further definition/explanation of rationale. Response: see comment next column.	All ecological considerations will be reconsidered when the experts consult the maps. Consult experts after maps are produced.
Eelgrass Biobands (by Ecoregion)	Data confidence varies by region for biobanding data. E.g.. SoG is highly variable with respect to data quality compared to the rest of the province. Higher quality data exists outside Strait of Georgia (except SGI). Data source also varies based on year of data collection.	Percent of know extent	50-100	Treat the same as eelgrass polygons.		Data are attached to linear shore unit and polygonal extent is not explicitly mapped.
Surfgrass Biobands (by Ecoregion)	Different habitat type than eelgrass, therefore important to treat separately. Different substrate and wave exposure. Most surfgrass is likely captured through shorezone mapping. Good confidence in this dataset.	Percent of know extent	50-100			Data are attached to linear shore unit and polygonal extent is not explicitly mapped.
Salicornia bioband (by Ecoregion)	Represents salt marsh vegetation and includes dunegrass. Habitat attribute from shorezone. Other estuary vegetation mapping surveys may also provide relevant information.	Percent of know extent	50-100	Rarer and highly valued		Data are attached to linear shore unit and polygonal extent is not explicitly mapped.
Salt Marsh		Percent of know extent	50-100			

Priority Eelgrass Habitat	Identify eelgrass habitat used by other species, e.g. salmon, herring, brant, and heron.	Percent of know extent				Lower Priority
Eelgrass Potential	Represent eelgrass habitat that is not currently mapped. Only as good as our confidence in the biophysical data that is used to build the model (e.g. depth, substrate, wave exposure).	Percent of know extent				Lower Priority
Ruppia	Should be included when data becomes available.					Data gap.
Dune vegetation	Should be included when data becomes available.					Data gap.

5.0 Conclusions

Overall, 52 marine plant features were identified by expert participants (7 related to canopy forming kelps, 36 related to algae, and 9 related to vascular plants) including features that *should* be included for which data are lacking. Pre-processing will be necessary to combine datasets for many of these features, although targets must be set by region to ensure representation of each feature in each ecoregion. It is equally 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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Day, J. C. 2002. Zoning--lessons from the Great Barrier Reef Marine Park. Ocean & Coastal Management 45:139-156.

Appendix 1: Detailed expert feedback

Out of 11 workshop participants, 10 responded to the request for feedback on the workshop report. Nine participants suggested edits to the workshop report, and one provided general comments only. 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. Names and other individual identifiers have been removed.

General expert feedback after the workshop:

- I also think that those participants with PhDs should have Dr. in front of their names - just to distinguish them appropriately. It [the workshop report] looks like what we talked about. I can't see anything that is missing. Although it does look like there's a lot of basic knowledge that we all could contribute to!
- I think that you have done a comprehensive job in summarizing the results of the workshop. I think that we should conclude that it is important that we view, analyse and give feed back on the mapped products on the CMN (Community Mapping Network).
- Possible additional target: Do not impede natural processes that allow the expansion of noninvasive species. I am thinking particularly about the colonization of areas by indigenous species after the last Ice Age, a process that is still occurring. Regarding canopy kelps, should Sargassum and Cystoseira be included in this category? Although technically not "kelp", they can form canopies in some circumstances (I don't know whether this occurs in BC; I've seen it in some areas in Alaska). Why is the UBC herbarium not listed as a Data Source in Table 3 since it is the main source of information on occurrence of species in BC? (*Note that UBC Herbarium is listed in Table 3.*) Can LOS or Parks or someone associated with this effort provide a home for orphaned data that might be useful to this project (e.g., a two-year intertidal sampling project on the Central Coast)?
- I'm still struggling with two fundamental stages of this process:
  1. how to meaningfully combine spatial datasets that may have very different sources/confidences/definitions/spatial extents? I remember we talked about this at the workshop; such as how one might combine linear shoreline data (i.e., the shorezone type data) to data mapped to a polygon.
  2. how to meaningfully compare individual species with broader habitat-based attributes? I think there has to be some kind of modelling to project 'likelihood' of species occurrence, (i.e., the eelgrass 'potential' habitat attribute) but then the Marxan is working from predicted, modelled data and not from real observations.

  hmmm. all very thought provoking. You've done a fine job pulling the workshop results together. Clearly the discussions took different routes in the three different groups, because each of the groups' plant types had different issues to consider. thx for including me in this process!
- Re: Table 4 (below) This table is a difficult mixture of point features (a few records of occurrence of rare species) and very broad habitats (e.g., 'boulder/cobble floor'). These attributes would be difficult to compare or to input as spatial coverages in Marxan