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TABLE OF CONTENTS

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FORWARD

Conservation of Canada's ocean ecosystems is an issue of critical importance. A key tool in this effort is marine protected areas (MPAs). Canada is currently developing a bioregional network approach to MPA establishment. There is great hope, that done well, this new approach will address some of the challenges that have been experienced with getting beyond 1% protection of Canada's ocean ecosystems.

The Canadian Parks and Wilderness Society (CPAWS) convened an independent scientific team from academic institutions across Canada to develop these guidelines. These scientists enthusiastically contributed their expertise in the natural and social sciences relevant to conservation and marine protected areas. The scientific team convened for two 2-day workshops in Vancouver in January and April, supported by a team of CPAWS staff from across Canada, and worked over a five-month period to develop these guidelines.

The purpose of this document is to provide guidelines for effective networks of MPAs throughout Canada's three oceans[1]. The approach is based on scientific understanding of marine ecosystems and of human communities and institutional arrangements, integrating knowledge from the biophysical and social sciences. The guidelines also reflect the prominent place of Canada's Aboriginal peoples in the stewardship of our oceans.

The guidelines are organized into four thematic categories: ecological criteria, social, cultural and economic considerations, MPAs in context, and governance. Within each category several guidelines are presented, typically with a definition, rationale, and references.

Our intended audiences for this document are MPA practitioners, managers, policy- and decision-makers, Aboriginal marine planners and managers, marine conservationists, fishers, and other stakeholders.

We extend our heartfelt appreciation for the time and energy that the scientific team dedicated over the past five months to this task: Kai Chan, Isabelle Cote, Philip Dearden, Elizabeth Di Santo, Marie-Josee Fortin, Frederic Guichard, Wolfgang Haider, Glen Jamieson, Donald Kramer, Ashley McCrea-Strub, William Montevecchi, Monica Mulrennan, John Roff and Anne Salomon.

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Sabine Jessen
Vancouver, BC
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1 While Canadian MPA network policy includes the Great Lakes, these guidelines only consider marine ecosystems. Nevertheless, many of the guidelines may be applicable to the freshwater ecosystems of the Great Lakes bioregion.

1 | INTRODUCTION

Global ocean health is in decline due to a variety of human activities such as fishing, shipping, and offshore oil and gas. The impacts of these activities such as declines in fish stocks, pollution, and invasive species are being compounded by the multiple manifestations of climate change and ocean acidification. These pressures on ocean ecosystems are especially evident in Canada. With the longest coastline in the world and a larger marine jurisdiction than any other country, Canada has strong maritime traditions in three oceans – the Atlantic, the Pacific and the Arctic. Canadians have a special responsibility to assume leadership in ocean science, stewardship, and conservation.

Sustaining ocean health requires ecosystem-based approaches to management. Marine protected areas (MPAs) are a central tool in an ecosystem-based approach. In 1999 the International Union for Conservation of Nature (IUCN) defined an MPA as, "*any area of intertidal or sub-tidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment.*" In 2008, to clarify that the purpose of protected areas needs to be conservation-focused, IUCN adopted a new general definition that applies to marine, terrestrial and freshwater environments:

> *A clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values.* (Dudley 2008)

Within this general definition, the strictness of protection can vary extensively from one MPA to another, and among zones of an individual MPA. MPAs or zones from which extractive activities are strictly prohibited are generally referred to as "no-take" reserves.

Canada has made many national and international commitments to complete a national network of MPAs, including the 2002 World Summit on Sustainable Development, and the 2004 United Nations Convention on Biological Diversity (CBD) Programme of Work on Protected Areas, and subsequent CBD decisions in 2006, 2008, and 2010. Recognizing the importance of healthy oceans, Canada has also made considerable effort to develop a policy framework to establish a comprehensive system of MPAs (DFO 2005, 2008, 2010a,b,c, DFO and WWF 2009). Nevertheless, MPA development in Canada, with protection of less than 1% of the country's Exclusive Economic Zone, is lagging far behind its urgent need and behind that of many other countries.

As scientists with expertise and experience in marine conservation, we are concerned that the planning and management of marine protected areas in Canada currently is not incorporating key lessons from conservation science. Effective progress in MPA development will depend on the incisive use of pertinent scientific information. Empirical research from Australia, the USA and elsewhere has demonstrated the myriad of benefits that accrue from well-designed MPAs, and especially from no-take reserves. Such benefits include the protection of biodiversity, enhancement of ecosystem resilience and support of ecosystems services that stem from healthy marine ecosystems. These services include coastal protection, provision of nursery areas for many marine species, nutrient cycling and filtration of wastes, and carbon storage for climate regulation. Direct economic benefits also accrue in and around MPAs through increased tourism and recreation opportunities and often fisheries enhancement. MPAs also provide key ecological benchmarks to assist the gauging of environmental change, by providing sites protected from some human influences.

This extensive international scientific research is highly relevant to Canadian marine policy and for shaping expectations of MPAs, ***but the way in which Canadian policy and legislation is currently being implemented is unlikely to realize these benefits***. As Canada develops and implements a policy framework for marine protected area networks, we hope these guidelines will help to support an effective path forward.

To increase the probability of long-term success, MPAs need to be embedded in a network of interconnected protected areas. In an effective network, protected critical habitats are connected by the movement of nutrients and organisms between areas, allowing the preservation of natural processes and allowing for spatial shifts

caused by climate change and other emerging environmental stressors. Networks can thus become much more than the sum of their individual components.

Our purpose in this document is to provide guidelines for effective networks of MPAs throughout Canada's three oceans[2]. We base our approach on scientific understanding of marine ecosystems and of human communities and institutional arrangements, integrating knowledge from the biophysical and social sciences. The guidelines also reflect the prominent place of Canada's Aboriginal peoples in the stewardship of our oceans.

These guidelines affirm that in order to achieve the full benefit of MPAs in Canada, the protection of healthy marine ecosystems must be the priority, and a number of specific requirements must be met, including:

- **no-take reserves spanning no less than 30% of each bioregion in Canadian waters;**
- **exclusion of industrial uses and developments, including exploration for and extraction of non-renewable resources, dredging, dumping, and destructive fishing practices, particularly bottom trawling;**
- **planning MPAs in effective networks and comprehensive oceans management;**
- **respecting the rights and interests of Aboriginal peoples.**

If the above requirements are met, marine protected areas can contribute to the protection of marine species, subspecies, biological communities and habitats, as well as ecological and evolutionary processes; and they can support sustainable relationships of people with oceans, including a sustained flow of benefits. Also relevant to the development of MPA networks is the need for just treatment of current and future people, and of non-human organisms and natural entities

A major threat to the long-term future of the oceans is climate change. Climate change is already exacerbating the negative effects of fishing in some areas. The manifestations of such change are numerous and include rising sea levels and temperatures, more frequent or intense storm events and changing ocean circulation patterns and ocean acidification. Some of these effects are already evident. The excessive anthropogenic carbon emissions behind climate change are also increasing ocean acidification. However, even if carbon emissions were halted tomorrow, the trends associated with global climate change, will continue for decades. Hence, in the short to medium term, marine ecosystem resilience needs to be bolstered by strategic management. Thus the guidelines in this document incorporate actions that are aimed at mitigating and adapting to the impacts of climate change.

Given that the necessary legislative tools are currently in place, **Canada has the opportunity and *the responsibility* to take a leadership role in marine stewardship and protection**. These guidelines have been prepared with the goal of helping to realize this responsibility.

2 While Canadian MPA network policy includes the Great Lakes, these guidelines only consider marine ecosystems. Nevertheless, many of the guidelines may be applicable to the freshwater ecosystems of the Great Lakes bioregion.

References:

Boyd, R. 2011. Blue Carbon: An Oceanic Opportunity to Fight Climate Change. *Scientific American.* http://www.scientificamerican.com/article.cfm?id=blue-carbon.

Butchart, S.H.M., Walpole, M., Collen, B., van Strien, A., Scharlemann, J.P.W., Almond R.E.A., Baillie, J.E.M., et al. 2010. Global biodiversity: Indicators of recent declines. *Science* 328, 1164-1168.

Chan, K.M.A., Shaw, M.R., Cameron, D.R. , Underwood, E.C., and Daily, G C. 2006. Conservation planning for ecosystem services. *PLoS Biology* 4, 2138-2152.

DFO. 2005. Canada's Federal Marine Protected Areas Strategy. DFO/2005-799. Cat. No. FS23-478/2005. ISBN 0-662-69076-1.

DFO. 2008. Further Guidance on the Formulation, Prioritization, and Use of Conservation Objectives in an Ecosystem Approach to Integrated Management of Human Activities in Aquatic Ecosystems. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2008/029.

DFO. 2010a. Science Guidance on the Development of Networks of Marine Protected Areas (MPAs). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/061.

DFO. 2010b. Marine Protected Areas and Networks: the benefits and costs. August 2010 Draft Report. Fisheries and Oceans Canada.

DFO. 2010c. National Framework for Canada's Network of Marine Protected Areas. November 2010 Draft Report. Fisheries and Oceans Canada.

DFO and WWF-Canada. 2009. Guidance and Lessons Learned for Canada's Marine Protected Areas Networks: Proceedings of a national workshop held in Ottawa in January 2008. http://www.dfo-mpo.gc.ca/index-eng.htm.

Dudley, N. (Ed) (2008). *Guidelines for Applying Protected Area Management Categories*. Gland, Switzerland: IUCN. X+86pp.

IUCN (International Union for Conservation of Nature). 2008. *World Heritage and Protected Areas*. http://cmsdata.iucn.org/downloads/world_heritage_and_protected_areas_2008.pdf.

Jessen, S. 2011. A Review of Canada's Implementation of the Oceans Act since 1997 – From Leader to Follower? *Coastal Management* 39, 20-56.

Kaluza, P., Kölzsch, A., Gastner, M. T., Blasius, B. 2010. The complex network of global cargo ship movements. *Journal of the Royal Society Interface* 7, 1093-1103.

Lewison, R. L., Crowder, L. B., Read, A. J., and Freeman, S. A. 2004. Understanding impacts of fisheries bycatch on marine megafauna. *Trends Ecology and Evolution* 19, 598-604.

Lubchenco, J., Palumbi, S. R., Gaines, S. D., and Andelman, S. 2003. Plugging a hole in the ocean: The emerging science of marine reserves. *Ecological Applications* 13, S3–S7.

Mulongoy, K.J. and Gidda, S.B. 2008. *The Value of nature: Ecological, economic, cultural and social Benefits of protected areas*. Secretariat of the Convention on Biological Diversity, Montreal. 30 pp.

Myers R.A., Hutchings, J.A., and Barrowman, N.J. 1996. Hypothesis for the decline of cod in the north Atlantic. *Marine Ecology Progress Series* 138, 293-308.

Nellemann, C., Corcoran, E., Duarte, C.M., Valdés, L., De Young, C., Fonseca, L., Grimsditch, G. (Eds). 2009. *Blue Carbon.* A rapid response assessment. United Nations Environment Programme, GRID-Arendal. www.grida.no

Pauly, D, Watson, R., and Alder, J. 2005. Global trends in world fisheries: Impacts on marine ecosystems and food security. Philosophical Transactions of the Royal Society: *Biological Sciences* 360, 5-12.

2 | ECOLOGICAL CRITERIA FOR MPA SITES AND NETWORKS

The design of functional networks of MPAs requires the initial identification of a broad set of sites of bioregional importance. Sites can be deemed important according to a number of ecological criteria, outlined below, or because they have cultural, historical and/or spiritual significance. A subset of sites are then assembled into a bioregional network, which will function as an interconnected, synergistic entity if site selection achieves or enhances certain properties, such are connectivity and representativity.

2.1 Site characterization

Much research has been aimed at identifying the characteristics of sites that, if protected, would result in effective protection of large amounts or particularly important components of biodiversity. While there is not equivalent evidence for all characteristics, the features explained below are those most likely to lead to success in ensuring the long-term functioning of marine ecosystems and their key components. All of these features have been, in some form, adopted as essential to the identification of ecologically or biologically significant areas (EBSAs) in marine environments by the Convention on Biological Diversity (Decision IX/20). The definitions used here are based on those of the CBD but have been expanded for added clarity.

Guideline: Characterize all areas of the seascape according to key ecological criteria to allow the identification of ecologically or biologically significant areas

Uniqueness, rarity or special character

Definitions:

Sites may be unique, rare or special at various spatial scales due to the habitat types, oceanographic or geological features, or specific organisms occurring there.. Thus, *uniqueness* can mean that there is a single example or population in a bioregion or, at larger scales, that there are a few examples or populations in Canada but none anywhere else. *Rarity* indicates that the characteristic of interest occurs only in a few locations in a bioregion or is endemic to Canadian waters (it does *not* mean having low abundance across a broad geographic range). Rarity and uniqueness may be natural or the result of human impact on similar ecosystems, processes, features or types of organisms in other locations. *Special character* relates to key roles in the lives of organisms (e.g. spawning grounds, migratory stopover locations).

Rationale:

Areas with unique, rare or special characters are valuable because they are not replaceable, and their loss would be permanent leading to a significant reduction in marine biological diversity. The larger the spatial scale at which a characteristic is unique, rare or special, the higher the priority for protection because the effect of their loss would be much greater. Higher priority for protection should be given for higher numbers of rare, unique and special characteristics. Uniqueness and rarity can be assessed at multiple levels:

(a) *Genes, populations, species*. Uniqueness and rarity at these levels of biological diversity and organization are important to protect because they represent genetic pools that reflect long evolutionary histories and/or future evolutionary potential.

(b) *Habitat types*. Some habitat types such as hydrothermal vents and seamounts are the sites of particular ecological processes and species assemblages.

(c) *Geological/oceanographic features/processes*. Certain geological or oceanographic features are essential to support associated biological communities. Examples include areas of upwelling, permanent polynyas, continental shelf edges, and deep sea trenches. Areas that offer thermal refugia (e.g. cold-water upwellings) may

be important in the context of warming sea temperatures.

(d) *Special biological function.* Some populations depend on specific areas to complete critical parts of their life cycle. Examples include breeding grounds, spawning and nursery areas, juvenile habitat and stopover sites along migratory routes.

(e) *Threatened, vulnerable species and habitats*. Areas that contain significant populations of species that are threatened, vulnerable or declining in Canada need protection to ensure the protection, recovery and restoration of such species.

References:
UNEP-CBD 2008, DFO 2004.

Productivity

Definition:

Productivity refers to the rate at which plants and animals and their populations grow. It depends on environmental conditions, especially nutrient availability, and factors that promote survival and reduce mortality.

Rationale:

Areas with comparatively high natural biological productivity, such as sites of permanent fronts and upwellings, hydrothermal vents, seamounts and polynyas, play important roles in maintaining populations and fuelling ecosystems. Such areas, which typically encompass viable populations that have a full array of size/age classes, may support productive fisheries in adjacent areas by serving as sources of nutrients and of new members to the population via juvenile and adult dispersal.

References:
Salomon et al. 2006, UNEP-CBD 2008.

Biological diversity

Definition:

Biological diversity refers to the variety of ecosystems, habitats, communities, species, or the genetic diversity in an area. For example, sea-mounts, fronts and convergence zones, cold-water coral communities and deep-water sponge communities all contain particularly large numbers of species. Because of the strong association between species and habitats, habitats often provide a useful proxy for species richness when detailed information is lacking.

Rationale:

High biodiversity is essential for the maintenance of evolutionary potential of species, the resilience of marine ecosystems in the face of environmental change and their ability to deliver ecosystem services. Sites with high diversity allow protection of more features with equivalent effort. At the network level, however, some sites with low diversity might be important to assure adequate representation of the full range of diversity.

References:
UNEP-CBD 2008, Worm et al. 2006.

Degree of naturalness/human impact

Definition:

Naturalness refers to the extent to which an area is undisturbed by human activity or introduced species. Some human activities, such as some subsistence harvests, light recreational use and ecotourism, can have low impact and areas allowing such activities can retain a high degree of naturalness. On the other hand, intensive harvesting, heavy marine traffic, dumping and pollutant discharge, dredging, oil and gas and mineral

exploration and development, and high densities of invasive species have a high impact and often result in habitat degradation.

Rationale:

More natural areas are characterized by population and community structures, ecosystem processes and functions that resemble those of pristine marine ecosystems (though it is unlikely that any pristine marine ecosystems remain). As such, more natural areas can act as reference sites or natural archives to assess habitat recovery and decline. Natural sites may be more resilient and can act as sources of organisms to rebuild populations in adjacent disturbed and degraded sites. In areas of high overall naturalness, it may be valuable to protect sites that are at high risk of human impact.

References:
Game et al. 2008, UNEP-CBD 2008.

Sensitivity/resistance to disturbance

Definition:

Ecological sensitivity refers to the extent to which a habitat type or an ecosystem changes following a disturbance. It is the opposite of ecological resistance. The likelihood, frequency and magnitude of both natural and human disturbances need to be considered.

Rationale:

Removing or lessening some human-made disturbances through protection is expected to reduce the cumulative impact of multiple disturbances and the risk of synergistic interactions among disturbances. This is particularly important for ecologically sensitive areas where the cumulative impact of disturbances will elicit a proportionally greater change (usually seen as a loss of species or function) than in more ecologically resistant areas. The identification of ecologically resistant areas with respect to the impacts of climate change is critical for comparative assessments of sensitive areas.

Functional redundancy, i.e. the presence of several species that perform similar functions in an area, can confer resistance because if one species is lost, its role can be fulfilled by another species. Thus, relatively simple marine communities, such as those found in polar areas, are predicted to be more ecologically sensitive. Similarly, deep-water coral and sponge reefs are likely to be sensitive to disturbance because of their heavy reliance of those communities on a few species that provide essential habitat structure.

References:
Halpern et al. 2007, 2008, UNEP-CBD 2008.

Potential for recovery from disturbance

Definition:

Recovery potential refers to the time taken by a disturbed area to return either naturally or following a management intervention to a state of high naturalness. For example, an area that has species with small body size and early age of maturity can recover more quickly than when such species are absent. Highly productive areas and those without chronic degradation (such as heavy metal deposits or oil damage) have greater recovery potential.

Rationale:

Population viability and ecosystem function can be maintained or enhanced only when ecosystems have time to recover between disturbance events. Protection removes many chronic disturbances that degrade ecosystems, which can lengthen the time window for recovery between acute disturbances. Populations, habitat types and

ecosystems with low recovery potential, and/or facing the effects of several disturbances, will need more time under protection to achieve noticeable effects.

References:
Palumbi et al. 2008.

2.2 Assembling sites into functional networks

It is well recognized that marine protection cannot be satisfactorily achieved by protecting individual sites alone because many processes require functional connections between sites to operate over large scales. Moreover, while individual sites are usually selected on the basis of one or a few features, sites should collectively be representative of Canadian marine ecosystems and processes.

A bioregional perspective is the appropriate scale in the development of a network. Twelve marine bioregions and one Great Lakes bioregion have been identified in Canadian waters on the basis of oceanographic and bathymetric similarities. Using site-level scores and decision tools (Section 4.2), a network of MPAs that meets to the greatest extent possible the guidelines outlined below should be implemented for each bioregion. Bioregional networks must recognize the changes to natural processes and human use that will result from rapid climate change.

Reference:
DFO 2009.

Guideline: Create no-take reserves

Definition:

No-take reserves are MPAs or zones in larger MPAs in which all forms of renewable and non-renewable resource extraction and industrial activity are excluded.[3]

Specific recommendation: At least 30% of each bioregion should be within no-take reserves

Within each MPA, the proportion of area under strict protection can vary according to specific conservation objectives, but a minimum of 30% of each bioregion should be within no-take reserves.

Rationale:

No-take reserves are more effective than MPAs that offer lesser levels of protection. Numerous studies of a variety of marine species in a variety of ecosystems suggest that the full realization of the benefits of protection in terms of conservation and fisheries requires that at least 30% of an area be strictly protected. As a result, this figure was adopted as one of the key recommendations for MPAs at the IUCN World Parks Congress in 2003.

References:
Ballantine 1997, Bohnsack et al. 2004, Gell and Roberts 2003, Fraschetti et al. 2009, Lester and Halpern 2008.

Guideline: Provide adequate representation of habitat types and sites with unique, rare and special character

Definition:

A network is representative when it consists of areas that reasonably reflect the full range of habitat types and of sites with unique, rare and special character sites found within a bioregion.

Specific recommendation:

Every broad-scale habitat type present in a bioregion must be represented in that bioregion's network. Habitat

3 Food, social and ceremonial use by Canada's Aboriginal peoples can be excluded only with the agreement of the relevant Aboriginal rights-holders.

types that are widespread and meet few, if any, of the key ecological criteria outlined earlier should be considered to be low priority for protection. At a minimum, 10% of the area of widespread habitat types that have few, if any, of the criteria listed in Section 2.1 should be placed in no-take reserves. At least 30% of the area of each habitat types that are less common or possess more of the characteristics listed in Section 2.1 should be placed in no-take reserves. For some particularly significant or particularly degraded habitat types, a larger proportion of the habitat area present may need to be protected to achieve conservation goals. All unique sites and most rare and special character sites must be protected.

Rationale:

Different habitat types harbour distinct assemblages of species. It follows that unless some proportion of each and every broad-scale habitat type is protected, there is a risk that significant elements of biodiversity will remain unprotected. Thus, every habitat type should be given protection. Protecting areas that contain transition zones will be particularly important to allow for shifts in species distribution as a result of climate change.

Increasing the area of each habitat type under protection will also increase, but at a declining pace, the proportion of species characteristic of that habitat type that are protected. For example, it has been estimated that protecting 10-40% of each type of marine habitat (for which data were available) in the UK would protect 70-80% of the species present in these habitat types. Protecting 30% of the area of each habitat type within a bioregion will therefore capture a substantial amount of habitat-specific diversity.

Sites with unique, rare or special character are, by definition, unlikely to be naturally replicated within a bioregion. All such sites should therefore be protected to preserve the biotic and abiotic features that give these sites their unique, rare or special status.

References:
Beger et al. 2003, Fraschetti et al. 2009, Gladstone 2007, Rondinini 2010, UNEP-CBD 2008

Guideline: Ensure connectivity among MPAs

Definition:

Connectivity refers to linkages between geographically separate areas, which occur as a result of the movement of individual larvae, juveniles and adults (e.g. through passive dispersal in currents, active dispersal and migration), and of organic and inorganic matter (e.g. nutrients). Within networks of MPAs, connectivity can refer to movement among protected areas or between protected and unprotected areas. Network design influences connectivity through spacing between individual MPAs, taking into account current speeds and directions and relevant features of local sites. The maintenance of connectivity in a network may require the protection of 'stepping stone' areas, i.e. areas that play key roles in dispersal or migration, for example by providing a resting or refuelling habitat (termed staging areas in bird migrations) or appropriate habitat patches amid areas of mostly unsuitable habitat for species with limited planktonic dispersal capacity. Stepping stone areas may meet few, if any, of the ecological criteria described above but are crucial to species persistence and the ecological integrity of a bioregion.

Specific recommendation:

The appropriate distance between MPAs in a network depends on the scale of dispersal of the species of concern in that network. All MPAs (including stepping stones) should generally be within » 20 km to » 200 km from the nearest MPA in the network.

Rationale:

In a functional network, individual sites can benefit one another because they are linked by a flow of dispersing or migrating organisms (eggs, juveniles or adults). At a population level, these connections mean that local populations that have declined or become extirpated might be restored by immigrants from elsewhere. At a genetic level, connectivity means a constant renewal of genetic diversity, which is important for evolutionary potential and population persistence. Connectivity has direct implications for fisheries: when animals move

from protected areas, the resulting spillover effects can benefit local fisheries. A distance of » 20 to » 200 km between MPAs encompasses the potential larval dispersal distance of a large number of coastal marine species with planktonic larvae.

References:
Cowen et al. 2007, Gaines et al. 2010, Halpern 2003, Hamilton et al. 2010, O'Connor et al. 2007, UNEP-CBD 2008.

Guideline: Create large MPAs

Definition:

Size refers to the spatial area given a particular level of protection. In some situations, shape is also relevant.

Specific recommendation:

The actual size and boundary locations of sites within a network should be determined by the size and location of the features and ecological processes they are meant to protect. This will vary among sites within a bioregion and from one region to another. An average MPA size of 10-20 km (in the smallest dimension) is recommended, in recognition of the fact that very small MPAs may be effective in some circumstances but that in general, MPA sites should be larger rather than smaller, with shapes that minimize the amount of edge.

Rationale:

Larger areas generally hold larger populations or larger fragments of habitats, which makes them less vulnerable to environmental variability, climate change and human influences. Larger areas may also accelerate some population recovery processes. Furthermore, larger areas have larger ratios of area to edge so that more of the protected area is distant from unprotected areas. This minimizes disturbances from outside and reduces the probability that mobile species will stay out of the protected area and be exposed to capture or disturbance. Given the mobility of most coastal species, reserves of several kms to tens of kms alongshore extending offshore to cover local migrations should be sufficient. For example, a minimum functional MPA size was estimated for BC lingcod to be about 74 km wide. Commercially important pelagic species will require even larger MPAs (recommended minimum diameters of 30 km – 60 km), because of their higher mobility. Small MPAs can be effective for species with restricted dispersal and movement.

References:
Carr et al. 2003, Gaines et al. 2010, Jamieson and Dixon 2001, Halpern et al. 2006, Lester et al. 2009, Roberts et al. 2010, UNEP-CBD 2008.

Guideline: Ensure multiple representation of protected habitat types and features

Definition:

Multiple representation refers to the inclusion of a given feature (species, habitat type and ecological processes) in several protected sites in each bioregional network.

Specific recommendation:

Networks should contain at least two, spatially well-separated examples of each habitat type and at least three to five examples of all rare or special character sites (when their natural abundance allows it). Some features may require more replication than others, depending on their inherent variability or vulnerability to disturbance (i.e., exposure and sensitivity to and potential to recover from impacts).

Rationale:

Multiple representation is needed to reduce the risk that a given habitat type or the species it contains could be lost, for example a single natural or human-generated disaster. Because many damaging events are spatially

localized, risk is spread more effectively when multiply represented sites are farther apart. Replication across environmental gradients will ensure the protection of at least some sites that are resistant to the impacts of climate change.

References:
Salm et al. 2006, UNEP-CBD 2008.

2.3 Planning for climate change

Networks of MPAs must be designed today while keeping in mind that the seascape of tomorrow will be vastly altered by climate change. Species distributions will shift in response to temperature increases, the area of various coastal ecosystems may increase or decrease in response to sea level rise, while ocean acidification is expected to affect many populations of marine organisms. In addition, changes in global circulation patterns, frequency and intensity of storms, and dissolved oxygen levels will affect the distribution of species and habitats, and change patterns of connectivity among populations.

Several of the guidelines outlined in this document will ensure some network resilience to future impacts of climate change. Foremost among these is the necessity for **large, strictly protected areas.** Within these areas, populations will exhibit extended age structures, with many large individuals that have high reproductive potential. The risk of synergies among the more limited number of disturbances will also be reduced within these MPAs.

How connectivity will change among MPAs may be difficult to predict. However, it is expected that warmer sea temperatures will speed up larval development time, resulting in shorter dispersal distance for organisms with planktonic larvae and a possible breakdown of connectivity among MPAs that are located at the current limit of dispersal distances. A climate-wise approach would therefore be to designate **more, closely spaced MPAs rather than fewer, widely separated MPAs** to preserve connections among MPAs in the face of changing temperatures and current patterns.

Finally, the oceans and coastal ecosystems are the largest sink of anthropogenically emitted carbon, and as such they play a crucial role in mitigating climate change. Estuarine ecosystems such as seagrass meadows and saltmarshes are particularly effective at sequestering "blue" carbon. The **protection of large areas (i.e. more than 30%) of ecosystems that are efficient carbon sinks** is essential in planning for a warmer future.

References:
Campbell 2011, Harley et al. 2006 , McLeod et al. 2009, O'Connor et al. 2007

References

Ballantine, W.J. 1997. *Design principles for systems of no-take marine reserves.* Design and Monitoring of Marine Reserves Workshop, February 18-20, 1997, Fisheries Centre, University of British Columbia, Canada.

Beger M., Jones, G.P., and Munday, P.L. 2003. Conservation of coral reef biodiversity: a comparison of reserve selection procedures for corals and fishes. *Biological Conservation* 111, 53-62.

Bohnsack, J.A., Ault, J.S., and Causey, B. 2004. *Why have no-take marine protected areas?* American Fisheries Society Symposium 42:195-193.

Brierley, A. S. and Kingsford, M.J. 2009. Impacts of Climate Change on Marine Organisms and Ecosystems. *Current Biology* 19:R602-R614.

Campbell, C.R. 2011. *Blue carbon – British Columbia: The case for the conservation and enhancement of estuarine processes and sediments in BC.* Sierra Club, 16 pp.

Carr, M.H., Neigel, J.E., Estes JA, *et al.* 2003. Comparing marine and terrestrial ecosystems: implications for the design of coastal marine reserves. *Ecological Applications* 13, S90–107.

Cowen R.K., Gawarkiewic G., Pineda J., Thorrold S.R., and Werner, F.E. 2007. Population connectivity in marine systems: an overview. *Oceanography* 20, 14–21.

DFO, 2004. *Identification of Ecologically and Biologically Significant Areas.* DFO Can. Sci. Advis. Sec. Ecosystem Status Report. 2004/006.

DFO. 2009. *Development of a Framework and Principles for the Biogeographic Classification of Canadian Marine Areas.* DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/056. 17 pp.

Fraschetti, S., D'Ambrosio, P., Micheli, F., Pizzolante, F., Bussotti, S. and Terlizzi, A. 2009. Design of marine protected areas in a human-dominated seascape. *Marine Ecology Progress Series* 375, 13-24.

Gaines, S.D., White, C., Carr, M.H., and Palumbi, S.R. 2010. Designing marine reserve networks for both conservation and fisheries management. *PNAS* 107, 18286-18293.

Game E.T., Mcdonald-Madden E., Puotinen M.L., and Possingham H.P. 2008. Should we protect the strong or the weak? Risk, resilience, and the selection of Marine Protected Areas. *Conservation Biology* 22, 1619-1629.

Gell, F.R., and Roberts, C.M. 2003. Benefits beyond boundaries: the fishery effects of marine reserves. *Trends in Ecology & Evolution* 18, 448-455.

Gladstone, E. 2007. Requirements for marine protected areas to conserve the biodiversity of rocky reeffishes. *Aquatic Conservation – Marine and Freshwater Ecosystems* 17, 71-87.

Halpern, B.S. 2003. The impact of marine reserves: do reserves work and does reserve size matter? *Ecological Applications* 13, S117-S137.

Halpern, B.S., Regan, H.M., Possingham, H.P., and McCarthy, M.A. 2006. Accounting for uncertainty in marine reserve design. *Ecology Letters* 9, 2-11.

Halpern B.S., Selkoe K.A., Micheli F., and Kappel C.V . 2007. Evaluating and ranking the vulnerability of global marine ecosystems to anthropogenic threats. *Conservation Biology* 21, 1301-1315.

Halpern, B. S., Walbridge, S., Selkoe, K.A. et al. 2008. A global map of human impact on marine ecosystems. *Science* 319, 948-952.

Hamilton S.L., Caselle, J.E., Malone, D.P., and Carr, M.H. 2010. Incorporating biogeography into evaluations of the Channel Islands marine reserve network. *PNAS* 107, 18272–18277.

Harley, C., Hughes, A., Hultgren, K., Miner, B., Sorte, C., Thornber, C., Rodriguez, L., Tomanek, L. and Williams, S. 2006. The impacts of climate change in coastal marine systems. *Ecology Letters* (2006) 9:228-241

Jamieson, G.S. and Dixon, S. 2001. *A proposed MPA boundary identification process for reproductive refugium establishment, using lingcod (Ophiodon elongatus) as an example focal species.* Canadian Stock Assessment Secretariat Res. Doc. 2001/106. 20 pp.

Lester, S.E., and Halpern B.S. 2008. Biological responses in marine no-take reserves versus partially protected areas. *Marine Ecology-Progress Series* 367, 49-56.

Lester, S.E., Halpern, B.S., Grorud-Colvert, K., Lubchenco, J., Ruttenberg, B.I., Gaines, S.D., Airame, S., and Warner, R.R. 2009. Biological effects within no-take marine reserves: a global synthesis. *Marine Ecology-Progress Series* 384, 33–46

McLeod, E., Salm, R., Green, A., and Almany, J. 2009. Designing marine protected area networks to address the impacts of climate change. *Front. Ecol. Environ.* 7(7):362-370.

O'Connor, M.I., J.F. Bruno, J.F., Gaines, S.D., Halpern, B.S., Lester, S.E., Kinlan, B.P., and Weiss, J.M. 2007. Temperature control of larval dispersal and the implications for marine ecology, evolution and conservation. *PNAS* 104, 1266-1271.

Rondinini, C. 2010. *Meeting the MPA network design principles of representation and adequacy: developing species-area curves for habitats.* Joint Nature Conservation Committee Report No. 439. Peterborough, U.K.

Roberts, C.M. et al. 2010. *Guidance on the size and spacing of marine protected areas in England.* Natural England Commissioned Report NECR037. http://naturalengland.etraderstores.com/NaturalEnglandShop/NECR037

Palumbi, S.R., Mcleod, K.L., and Grunbaum, D. 2008. Ecosystems in action: Lessons from marine ecology about recovery, resistance, and reversibility. *Bioscience* 58, 33-42.

Salm, R.V., Done, T., and Mcleod, E. 2006. *Marine protected area planning in a changing climate.* In: Phinney JT, Hoegh-Guldberg O, Kleypas J, *et al.* (Eds). Coral reefs and climate change: science and management. Washington, DC: American Geophysical Union.

Salomon, A.K., Ruesink, J.L., and DeWreede, R.E. 2006. Population viability, ecological processes and biodiversity: Valuing sites for reserve selection. *Biological Conservation* 128, 79-92.

UNEP-CBD (United Nations Environment Programme -Convention on Biological Diversity). 2008. Decision adopted by the conference of the parties to the convention of biological diversity at its ninth meeting. UNEP/CBD/COP/DEC/IX/20. www.cbd.int/doc/decisions/cop-09/cop-09-dec-20-en.pdf

Worm, B., Barbier, E.B., Beaumont, N., Duffy, J.E., Folke, C., Halpern, B.S., Jackson, J.B.C., Lotze, H.K., Micheli, F., Palumbi, S.R., Sala, E., Selkoe, K.A., Stachowicz, J.J., Watson, R. 2006. Impacts of biodiversity loss on ocean ecosystem services. *Science* 314, 787-790.

3 | SOCIAL, CULTURAL AND ECONOMIC CONSIDERATIONS FOR MPA SITES AND NETWORKS

While ecosystem protection needs to be prioritized in the design of MPA networks, social, cultural and economic concerns shape the performance of MPAs and are fundamental pillars for the conservation planning and implementation of MPA networks. MPAs are ultimately part of systems with both ecological and human dimensions. Viewing these dimensions as linked will help to inform the selection and design of MPAs. The involvement of local communities, fishermen, recreational users, and other stakeholders in the planning of MPAs will help to ensure that their concerns are considered, and that MPAs are effectively managed over the long term. The social, cultural and economic guidelines below identify considerations for the planning and management of MPAs that should be integrated and considered.

Reference:
Gleason et al. 2010, Pollnac et al. 2010, Scholz 2004.

3.1 Site characterization

The design of functional networks of MPAs requires the initial identification of all sites of bioregional importance, both for ecological reasons as noted in Section 2, or because they have cultural, historical and/or spiritual significance.

Guideline: Identify culturally, historically and spiritually significant areas

Many coastal and marine areas include culturally, historically and spiritually significant sites as well as environments and resources that underpin traditional and on-going use of these areas. Many of these sites are a reflection of the extensive, interconnected usage of land and sea that permeate the lives of coastal residents.

Aboriginal peoples may value sites and areas for their cultural and spiritual values, see themselves as responsible for their maintenance, and increasingly seek ways to enhance their protection. Sites may also include natural features such as rock bluffs, pictographs, petroglyphs, canoe blanks, middens, canoe runs, platforms of houses and fishing weirs.

References:
Chan et al. (in press), Gardner 2009, Hamilton and Wilson n.d, Mulrennan and Scott 2001, Mulrennan et al. 2009, Turner 1995.

Guideline: Identify community-based MPA initiatives and integrate local knowledge

Definition:

Community-based MPA initiatives often involve the establishment of MPAs to protect specific resources with a desired outcome of enhancing local opportunities in the form of increased fish catches and alternative economic activities, or to address specific community cultural and identity values.

Rationale:

Community-based initiatives can be incorporated into the MPA network as a way to address socioeconomic concerns and may be an important tool for managing specific marine resources. Local resource users have a unique understanding of the local environment and thus areas potentially important for conservation. There is value in integrating community-based initiatives and local knowledge with scientific knowledge when selecting sites during MPA planning.

Greater community acceptance may result from this integrative approach.

References:
Ban et al 2009, Christie et al 2002.

3.2 Assembling sites into functional networks

Once sites have been identified, the process of assembling sites into functional networks will also require consideration of existing uses and activities, identification of a range of values associated with specific marine environments, and measures to address impacts on social and economic values.

Guideline: Inventory current uses and activities

Definition:

Typical marine-based activities in Canada include commercial fishing, aquaculture, recreational and sport fishing, and many motorized and non-motorized recreation activities, such as cruising, kayaking, wildlife viewing, scuba diving and others. Industrial uses include shipping, oil and gas exploration and development, renewable energies such as wind and wave, and cable and pipeline laying.

Rationale:

Coastal and marine environments in Canada are under heavy pressure from a variety of human activities. For example, spatial information from British Columbia, including commercial and recreational fishing areas, transportation and infrastructure uses shows that at least 83% of the continental shelf and slope are being used by humans (Ban and Alder 2008:69).

Identifying the location and intensity of current recreational, commercial and industrial activities in a region is an important step in effective marine management and critical during the design of MPA networks. It will be important to obtain fine-resolution data and consider these activities and the use values associated with marine environments with respect to the overall ecological goals. For example, the incorporation of fine-resolution commercial fishing data (Section 5.3) in the MPA design process can lead to more efficient MPA designs and to reduce impact on industry, without compromising ecological objectives.

Marine-use information should be shared between sectors during the stakeholder engagement process (Section 5.6)

References:
Ban and Alder 2008, Klein et al. 2008, Pinfold 2009, Rees et al. 2010, Richardson et al. 2006

Guideline: Identify opportunities for alternative uses / compatible activities within networks of MPAs

Definition:

Certain activities such as tourism and recreation, non-invasive scientific research and education have potential to be compatible with the ecological objectives of an MPA network and may help to reduce human pressure on marine environments. For example, *ecotourism* is often defined as tourism that is nature-based, geared towards sustainable outcomes, involves education and interpretation, and is often community led. Coastal marine ecotourism is an economic sector that is dependent on a healthy marine environment, and may include whale watching, sightseeing, diving and kayaking, as well as sailing, cruising and visiting beaches and other marine locations. Coastal tourism can include recreational fishing, which should not be permitted in no-take MPAs, but could potentially be allowed in other zones of an MPA.

Rationale:

One of the primary purposes of MPAs is to ensure protection from unsustainable extractive activities. Restrictions on fisheries or other consumptive uses may initially impact the local economies. However, by working with stakeholders and communities the economic impacts can be offset with the introduction of less damaging, non-extractive activities within certain zones of an MPA. For example, MPA establishment can positively affect the local economy by enhancing tourism opportunities.

A recent global evaluation of the effectiveness of coral reef MPAs in meeting their conservation and socio-economic objectives found that the large majority of MPAs had experienced increases in tourism and local employment since establishment. Several proposed MPAs, such as Race Rocks and the Southern Strait of Georgia in BC, and the Bay of Fundy in Atlantic Canada, are in regions that include critical habitat for whales and other marine life and generate income and employment through tourism activities. Coastal marine tourism activities in Canada generated an expenditure of CAD$3,093 million by residents and non-residents in 2006 (Pinfold 2009:19).

The protection and preservation of a region often enhances the attractiveness of the area to tourists. Through well-managed ecotourism healthy ecosystems can provide benefits to local economies, and offset potential losses due to area closures. Furthermore, promoting low-impact tourism may provide long-term benefits and direct funds to help offset the management costs for maintaining the MPA. The provision of alternative employment opportunities in ecotourism can also improve stakeholder support for MPAs.

The extent to which commercial ecotourism and research activities are allowed in MPAs should be addressed in the MPAs management plan. MPA planners and managers should assess potential visitor impacts to MPAs in order to adopt management techniques that encourage the development of tourism activities that are compatible with the ecological objectives of the MPA network. For example, guidelines for marine wildlife interactions have been developed by Pacific Whale Watch Association and endorsed by DFO and Parks Canada.[4] In addition, the Saguenay-St. Lawrence Marine Park has also developed whale watching guidelines in collaboration with the local whale watching industry.

References:
Harriot VJ 2002, Hargreaves-Allen et al., 2011, Garrod and Wilson 2004, McCrone 2001, Sanchiricho et al. 2002, Scholz 2004, Wells et al. 2007

Guideline: Protect and enhance recreational sites and opportunities

Definition:

In addition to its value for biological productivity and fishery resources, the marine and coastal environment in Canada is highly valued for both passive and active recreation including cruising, sailing, kayaking, surfing, wildlife viewing, scuba diving and sport fishing. Recreation may rely on the same resources as coastal marine tourism, but is pursued by local and regional residents, or day visitors, who do not rely on the commercial tourism sector. It is difficult to separate tourism and recreation clearly, and appropriate distinctions may differ by region, and by specific activities.

Rationale:

Direct experiences with wildlife and natural environments can help foster environmental awareness and appreciation, and stimulate physical and mental health. MPAs provide a unique opportunity for visitors to experience and learn about marine heritage and enjoy the marine environment in its natural state. The notion of healthy ecosystems is inferred by the status of an MPA, and is attractive to recreational users of the marine environment. The mostly non-consumptive nature of recreational users often has few negative effects on MPAs and may be complementary with individual MPA objectives. Similar to regions ideal for ecotourism, the availability of recreational sites may provide economic benefits to local communities. Recreational uses that are consistent with the long-term protection of marine environments should be maintained and enabled within networks of MPAs.

References:
Maller et al. 2009, Parks Canada 1994, Parks Victoria 2003, Sanchiricho et al 2002.

Guideline: Protect spiritual sites and values in the marine environment

Definition:

Spiritual values of protected areas "…inspire humans to relate with reverence to the sacredness of nature" (Harmon 2004:10). Protected areas may include sites that have special spiritual significance to people and communities. They have non-material values that are often shared by groups and may be culturally defined. Individual spiritual values also exist and relate more to a connection to the natural environment and sense of inspiration and well-being. Specific sites of spiritual value exist as do spiritual values for the broader seascape.

Rationale:

Marine ecosystems are increasingly valued for more than direct human uses, and recognized for their value in contributing to human well-being. It is often through direct experiences in nature that people benefit from physical, emotional and spiritual well-being.

While spiritual values of sites are important to include in the decision making and design processes of MPA networks, accounting for non-material values can be challenging and requires the incorporation of local and traditional knowledge (Section 5.7).

References:
Harmon 2004, Mallararch (ed.) 2008, Verschuuren 2006, Wild and Mcleod (eds.)2008.

Guideline: Develop a displacement policy and measures

Definitions:

The *displacement* of people and specific users from MPAs has physical, economic and sociocultural implications. Another way to consider this issue is through the lens of the reallocation of rights within MPAs, which has both procedural and substantive aspects. Procedural aspects relate to the governance and decision making processes, while from a substantive perspective, "…MPAs reallocate pre-existing rights governing resource access and use." (Mascia and Claus 2009:17). Rights may be both formal and informal and occur on a variety of spatial scales. Mascia and Claus (2009) identify five types of rights (access, withdrawal, management, exclusion and alienation) that should be assessed through a five step process, in order to understand and address the social impacts of MPA establishment.

Once the displacement implications are understood, governments can develop approaches to assist with mitigating any adverse impacts. These can include the following:

- *Compensation,* which can be defined as "assistance aimed at making up for harm or loss" (Macintosh et al. 2010:581).
- *Structural Adjustment* or "assistance to help affected parties adjust to the new management arrangements" (Macintosh et al. 2010:581).

Rationale:

In designing MPAs and MPA networks, the process outlined in these guidelines seeks to reduce impacts on existing users. However, it will not always be possible to avoid such impacts completely, given the extent of human uses by a variety of different activities. Where MPA establishment affects existing users, it is important

4 http://www.pac.dfo-mpo.gc.ca/fm-gp/species-especes/mammals-mammiferes/view-observer-eng.htm

to ensure fairness and equity. This requires that a compensation and/or displacement policy be developed by government to indicate how social and economic impacts of MPA establishment will be addressed.

When establishing MPAs, in some situations uses will need to be reduced or eliminated. If such a situation arises, relocation of such uses to other areas may be considered. However, there are concerns that such measures will result in conflict between users and ecological harm, if use such as fishing is concentrated in a smaller area.

In order to address these concerns, compensation for discontinuation of these activities should be part of the decision process. Having a displacement policy and measures (for example, compensation) in place can also help to increase stakeholder support for MPAs and MPA networks, and compliance with restrictions.

In Australia, Commonwealth and state governments have developed various types of assistance regimes to address the impacts of MPA establishment. Perhaps most well-known, and also controversial, is the structural adjustment package for the re-zoning of the Great Barrier Reef Marine Park, which ballooned from AU$10.2 million to a final estimate of AU$250 million. There are many lessons to be learned from the experience with this program, especially in light of the stakeholder view that the program did not meet their needs. Key elements to consider are: a strict limit on funding, and well-defined principles, guidelines and criteria for assistance eligibility. However, as reviewers of the GBR experience have noted, regardless of the care taken in designing the program and its administration, "…there will always be a temptation for governments to use assistance programs to solve their own political problems and quell industry and community concerns." (Macintosh et al. 2010:587).

References:
Agardy et al. 2011, Gunn et al. 2010 Macintosh et al 2010, Mascia and Claus 2009, Sen 2010.

Guideline: Incorporate existence values into MPA decision making

Definition:

People may value ecosystems for their very existence, even if they will never visit them, and may derive satisfaction from knowing that an area is protected for future generations. MPAs in Canada are established for the benefit of all Canadian people [see *Canada Oceans Act*].

Rationale:

Existence values are challenging to determine, but should be considered in the design of MPAs. If they are ignored, activities and uses which are associated with a market value will inevitably be overemphasized. Local and regional populations are likely to have different existence values than those of the national population. Given the complexity of the marine and coastal environment, existence value will vary as a function of environmental quality. The value of unprotected oceans territory will differ from the value of an MPA, and within an MPA the value of a core area will exceed the value of non-core areas that permit various uses.

While these issues appear complex, separate studies on existence value for each MPA are not necessary. The economic concept of benefit transfer allows the values determined in a study in one location to be "borrowed" for another location by adhering to certain assumptions. While the uncertainties associated with such a transfer may be too large if they involve values from an Australian or even a US site, one national Canadian study of existence value of MPAs with some regional test sites should provide the appropriate or rudimentary information for Canadian MPA network planning. Such information is of particular importance if planning / management / decision tools are also to consider a wider suite of economic values.

References:
Bohnsack et al. 2004, Harmon 2004, Rollins and Lyke 1998, Wallmo and Edwards, 2008

References

Agardy, T., di Sciara, G.N., and Christie, P. 2011. Mind the gap: Addressing the shortcomings of marine protected areas through large scale marine spatial planning. *Marine Policy* 35:226-232.

Ban, N.C. and Alder, J. 2008. How wild is the ocean? Assessing the intensity of anthropogenic marine activities in British Columbia, Canada. *Aquatic Conserv: Mar. Freshw. Ecosyst*. 18, 55-85.

Ban, N. C., Picard, C. R., and Vincent, A. C. J. 2009. Comparing and integrating community-based and science-based approaches to prioritizing marine areas for protection. *Conservation Biology* 23, 899-910

Bohnsack, J.A., Ault, J.S., Causey, B. 2004. Why have no-take marine protected areas? American Fisheries Society Symposium 42:195-193.

Chan, K. M. A., J. Goldstein, T. Satterfield, N. Hannahs, K. Kikiloi, R. Naidoo, N. Vadeboncoeur and U. Woodside (in press). Cultural services and non-use values. The Theory & Practice of Ecosystem Service Valuation in Conservation. P. Kareiva, G. Daily, T. Ricketts, H. Tallis and S. Polasky. Oxford, UK, Oxford University Press.

Christie, P., White, A., Deguit, E. 2002. Starting point or solution? Community-based marine protected areas in the Philippines. *Journal of Environmental Management* 66, 441-454.

Gardner, Julie. 2009. *First Nations and Marine Protected Areas: An introduction to First Nations Rights, Concerns and Interests Related to MPAs on Canada's Pacific Coast*. Report for Canadian Parks and Wilderness Society, BC Chapter.

Garrod, B. and Wilson, J.C. 2004. Nature on the Edge? Marine Ecotourism in Peripheral Coastal Areas. *Journal of Sustainable Tourism* 12, 95-120.

Gleason, M., McCreary, S. Miller-Henson, M., Ugoretz, J., Fox, E., Merrifield, M., McClintock, W., Serpa, P., and Hoffman, K. 2010. Science-based and stakeholder-driven marine protected area network planning: A successful case study from north central California. *Ocean & Coastal Management* 53, 52-68.

Gunn, J., Fraser, G., and Kimball, B. 2010. Review of the Great Barrier Reef Structural Adjustment Package. Canberra: Department of Environment and Heritage. www.environment.gov.au/coasts/gbr/publications/gbrmp-sap-review.html

Hamilton, C. and R. Wilson. Undated. *Marine Protected Areas and Aboriginal People in British Columbia: From Conflict to Collaborative Management*. http://cec.org/files/PDF/BIODIVERSITY/Chris-Hamilton_en.pdf

Hargreaves-Allen, V., Mourato, S., and Milner Gulland, E.J. 2011. A global evaluation of coral reef management performance: Are MPAs producing conservation and socio-economic improvements? *Environmental Management* 47, 684–700.

Harmon, D. 2004. Intangible values of protected areas: what are they? Why do they matter? The George Wright Forum 21, 9-22.

Harriott, VJ. 2002. *Marine tourism impacts and their management on the Great Barrier Reef*. CRC Reef Research Centre Technical Report No 46. CRC Reef Research Centre, Townsville, Australia.

Klein, C.J., Chan, A., Kircher, L., Cundiff, A.J., Gardner, N., Hrovat, Y., Scholz, A., Kendall, B.E., and Airamé, S. 2008. Striking a Balance between Biodiversity Conservation and Socioeconomic Viability in the Design of Marine Protected Areas. *Conservation Biology* 22, 691-700.

Macintosh, A., Bonyhady, T., and Wilkinson, D. 2010. Dealing with interests displaced by marine protected areas: A case study on the Great Barrier Reef Marine Park structural adjustment package. *Ocean & Coastal Management* 53, 581-588.

Maller C., Townsed, M., St Leger, L., Henderson-Wilson, C., Pryor, A., Prosser, L., and Moore, M. 2009. Healthy Parks, Healthy People: The Health Benefits of Contact with Nature in a Park Context. The George Wright Forum 26, 51-83.

Mallarach, J. (Ed). 2008. Protected Landscapes and Cultural and Spiritual Values. Volume 2 in the series Values of Protected Landscapes and Seascapes. IUCN, GTZ and Obra Social de Caixa Catalunya. Kasparek Verlag, Heidelberg.

Mascia, M.B., and Claus, C.A. 2009. A property rights approach to understanding human displacement from protected areas: the case of marine protected areas. *Conservation Biology* 23, 16-23.

McCrone. 2001 *Visitor impacts on marine protected areas in New Zealand*. Science for Conservation. Department of Conservation, Wellington , N. Z. 68pp. http://www.doc.govt.nz/upload/documents/science-and-technical/SFC173.pdf

Mulrennan, M.E., Bussieres, V., and Scott, C.H. 2009. *Tawich (Marine) Conservation Area, Eastern James Bay*. Proposal to the National Marine Conservation Program, Parks Canada.

Mulrennan, M.E. and Scott, C.H. 2001. Aboriginal Rights and Interests in Canada's Northern Seas. In C.H. Scott (ed.), *Aboriginal Autonomy and Development in Northern Quebec and Labrador*. Vancouver: UBC Press, 78-97.

Parks Canada. 1994. Parks Canada Guiding Principles and Operational Policies. http://www.pc.gc.ca/docs/pc/poli/princip/sec2/part2b/part2b6.aspx

Parks Victoria. 2003. Victoria's System of Marine National Parks and Marine Sanctuaries. Melbourne: Parks Victoria. 144pp.

Pinfold, G. 2009. Economic Impact of Marine Activities in Large Ocean Management Areas. Statistical and Economic Analysis Series. No.1-2. Fisheries and Oceans Canada. 97 pp.

Pollnac, R. Christie, P., Cinner, J.E., Dalton, T., Daw, T.M., Forrester, G.E., Graham, N.A.J. and McClanahan., T.R. 2010. *PNAS*, 107, 18262–18265.

Rees, S., Rodwell, L.D., Attrill, M.J., Austen, M.C., and Mangi, S.C. 2010. The value of marine biodiversity to the leisure and recreation industry and its application to marine spatial planning. *Marine Policy* 34, 868-875.

Richardson, E.A., Kaiser, M.J., Edwards-Jones, G., and Possingham, H.P. 2006. Sensitivity of Marine-Reserve Design to the Spatial Resolution of Socioeconomic Data *Conservation Biology* 20, 1191–1202

Sanchirico, J.N., Cochran, K.A., and Emerson, P.M. 2002. Marine Protected Areas: Economic and Social Implications. Discussion Paper. Resources for the Future,Washington, D.C.

Scholz, A., Bonzon, K., Fujita, R., Benjamin, N., Woodling, N., Black,P., Steinback, C. 2004. Participatory socioeconomic analysis: drawing on fishermen's knowledge for marine protected area planning in California. *Marine Policy* 28, 335-349.

Sen, S. 2010. Developing a framework for displaced fishing effort programs in marine protected areas. *Marine Policy* 34, 1171-1177.

Turner, Nancy J. 1995. *Food Plants of Coastal First Peoples*. Royal British Columbia Museum Handbook series. UBC Press.

Verschuuren, B. 2006. An overview of cultural and spiritual values in ecosystem management and conservation strategies. Supported by IUCN Specialist Group on Cultural and Spiritual Values of Protected Areas.

Wallmo, K., and Edwards, S., 2008. Estimating non-market values of marine protected areas: a latent class modeling approach. Marine Resource Economics 23, 301–323.

Wells, S., Burgess, N., and Ngusaru, A. Towards the 2012 marine protected area targets in Eastern Africa. *Ocean & Coastal Management*. 50, 67-83

Wild, R. and McLeod, C. (Ed). 2008. Sacred Natural Sites: Guidelines for Protected Area Managers. Gland, Switzerland: IUCN.

4 | MPAS IN CONTEXT

MPAs are affected by what happens outside their boundaries. As a result, the achievement of MPA conservation goals may rely on sustaining habitats, or ecological or biophysical processes that extend outside the boundaries of MPAs (such as through recruitment or productivity dependencies), including in adjacent terrestrial ecosystems.

It also follows that successful MPA planning and management must be embedded in broader planning and management processes. A regional ecosystem based management approach is key to ensuring that MPAs and MPA networks achieve their conservation goals, and also that they in turn contribute to overall improvements in ecosystem health.

In addition, marine spatial planning, undertaken at a broader regional scale, will ensure that MPAs and MPA networks are planned in a way that they can protect the areas of most significance and importance from a conservation perspective, while at the same time, trying to avoid those areas of high-use.

4.1 Marine Spatial Planning and Ecosystem-Based Management

Guideline: Implement MPA networks through marine spatial planning (MSP) embedded in ocean-wide ecosystem-based management (EBM)

Definition:

Ecosystem based management (EBM) "is an attempt to integrate the full spectrum of goals, management entities, and constituents within that region to design a management strategy that explicitly considers the necessary tradeoffs among various activities and services" (Halpern et al. 2010:18312). As a system-wide approach, EBM considers interactions among ecosystem components and sectors, together with the cumulative impacts of oceans uses.

Marine spatial planning (MSP) refers to a process for analyzing and allocating ocean space for a variety of uses in order to achieve ecological, economic and social management objectives.

Rationale:

An opportunity exists in Canada through integrated oceans planning processes to plan for bioregional MPA networks. Currently five integrated oceans planning processes are underway (Pacific North Coast, Beaufort Sea, Placentia Bay/Grand Banks, Gulf of St. Lawrence and Eastern Scotian Shelf) and others are being considered in the future for the remaining large ocean areas in Canada. If marine spatial planning (MSP) is implemented as part of these processes, an important outcome should be MPA networks that would be planned in the context of human uses.

As bioregional planning takes place, it will need to work on multiple scales supported by appropriate nested levels of governance structures and processes. Explicit consideration should be given to how political jurisdictions align and overlap with bioregional boundaries/networks and appropriate arrangements established to ensure adequate cooperation in these areas. In addition, specific measures will be need to ensure that the boundaries between bioregions are considered.

Because MPAs are intimately connected to surrounding areas, the success of MPAs to achieve conservation outcomes and also human benefits will depend upon a seamless integration of MPA networks into broader planning and EBM, which inherently recognizes connections, cumulative impacts, the inevitability of change, and the necessity of learning and adaptation.

As part of the bioregional planning process there is an opportunity to ensure that the location of MPAs with

harvesting restrictions do not disproportionately impact particular communities or specific fisheries. For example, First Nation-driven coastal planning on the west coast is focusing on the scale of traditional territories in the consideration of protected area replication – which is consistent with larval dynamics of some important species.

References:
Christensen et al. 1996, Halpern et al. 2008, Levin et al. 2009, McLeod et al 2005, McLeod and Leslie 2009, POC 2003, USCOP 2004.

Guideline: Conduct a threats assessment that considers cumulative impacts

Definition:

Information gathered from the scientific literature, stakeholders and experts can help identify potential threats to marine ecosystems from human activities. This process relies on spatial and temporal data regarding current activities occurring on Canada's coasts (Section 3.2).

Rationale:

The marine environment is heavily impacted by a suite of human activities. In order to address threats outside of MPA boundaries the relationship between human activities and stressors on marine ecosystems should be quantified. A recent study (Ban et al. 2010) suggests that MPAs in BC currently do not fully address the overall impacts of human activities.

A detailed threats assessment, which considers multiple activities and cumulative impacts, can help address potential threats to MPAs and conservation objectives. Scientific advice is key to understanding the relationship between human activities and ecosystem stressors as well as the potential resilience of ecosystems to varying levels and types of impacts. Such an assessment can help guide MPA network design and also management strategies for protection and threat mitigation.

References:
Ban et al. 2010, Halpern et al. 2007, 2008, 2009.

Guideline: Evaluate threats in relation to Limits of Acceptable Change (LAC)

Definition:

The Limits of Acceptable Change (LAC) is an adaptive management process that refers to the amount of human-induced change that is acceptable in order to prevent significant adverse environmental effects during resource use. The objective of the LAC process is to manage change -not prevent it-by making decisions as to what management actions are needed to maintain or enhance desired conditions.

The LAC process consists of selecting key indicators of acceptable resource and social conditions, defining qualitative standards to measure indicators, applying different standards to resource and social conditions and implementing management actions to maintain desired conditions over time.

Rationale:

The LAC process attempts to answer how much impact is acceptable? for whom? and what measures should be implemented to avoid unacceptable impacts? This compromise must be developed through a collaborative process in which the resultant decisions reflect the input of numerous stakeholders.

A pilot project in British Columbia (Volt et al. 2008) tested the applicability of the LAC approach for tourism and recreation management in BC, resulting in a positive evaluation of the LAC as a sound and useful framework, which allowed active networking and communication among participants. Roman et al. (2007) arrived at acceptability values and a zoning scheme for snorkeling tourism at the Koh Chan National Marine Park in Thailand, based on social surveys that assessed visitor perceptions and satisfaction with conditions encountered on snorkeling tours. Another experience provided a valuable reference for the management of large-scale

aquaculture in New Zealand (Zeldis et al. 2006). The study found the LAC to be a transparent process to set trigger points and proposed management responses. Indicators for environmental conditions and associated trigger levels were agreed in advance of development. Management responses should these trigger levels be exceeded were clearly delineated, thus providing certainty for participating stakeholders.

References:
Cole and Stankey 1998, McCool and Cole 1997, Roman et al. 2007, Vold et al. 2008, Zeldis et al. 2006

4.2 Systematic Conservation Planning

The conservation literature continues to demonstrate the benefits of a systematic approach to conservation planning. This framework comprises many steps, ranging from scoping to maintenance and monitoring, several of which we detail elsewhere in this report, but here we focus on a systematic process for integrating the various ecological criteria and socioeconomic considerations to ensure that the resulting network satisfies the objectives of an MPA network. This stage is greatly enabled by decision-support tools and a process for involving stakeholders and constituents in the evaluation of alternative networks. This may require an iterative process whereby technical methods and participant processes are integrated.

References:
Ban et al. 2009, Craighead et al. (in press), Margules and Pressey 2000, Margules & Sarkar 2007, Pressey and Bottrill 2009.

Guideline: Employ a decision-support tools that enable the integration of the various ecological criteria and socio-economic considerations to achieve MPA objectives.

Choosing the most appropriate methodology depends on the underlying goals for establishing the set of MPAs. Clearly defining the purpose and the overall conservation goals is an important first step that must not be overlooked.

Systematic network design in conservation planning offers a great advance over previous unsystematic methods based on the simple selection of high scoring sites: it enables and depends upon the evaluation of alternative networks based on network-level considerations (e.g., connection between MPAs to ensure movement of animals), and the evaluation of each site's contribution to the broader network's overall representation and maintenance of key elements. Because of the complexity of this task—the importance of any potential MPA depends on other MPAs in a network—systematic network design generally relies upon algorithm-based decision support tools. One of the most commonly utilized tools is Marxan which is both well supported and regularly updated. Marine Map[5] has also been used in MPA network planning as a web-based tool designed to facilitate stakeholder involvement and collaboration in the design of MPA networks.

References:
Ball and Possingham 2000, Game et al. 2008, Gleason et al. 2010.

Guideline: Embed tools in processes to integrate socio-cultural and economic considerations.

Tools such as Marxan can incorporate some socio-cultural and economic considerations—such as social and economic costs and benefits associated with ecosystem services—in the optimization process. Other socio-cultural and economic considerations will require other tools and/or participatory processes to account for them effectively in network design. Accordingly, designing an effective MPA network will require an interplay between technical processes and stakeholder involvement.

References:
Ardron et al. 2010, Ban et al. 2009, Chan et al. (accepted), Evans et al. 2004, Game et al. 2008, Klein et al. 2008, Watts et al. 2009.

5 www.marinemap.org/marinemap

4.3 Ecological and Social Uncertainties, and the Limits of Analysis

Guideline: Characterize Uncertainties Comprehensively, and Proceed without Certainty

Data and analysis should be central to decision-making, but it's critical to note that uncertainties are pervasive and unavoidable, but not paralyzing. Ecological and social outcomes and associated values will remain uncertain because seascapes are complex systems with multiple interacting human and ecological components. Accordingly, attributing the causes of an observed pattern is complicated by the many possible factors operating at numerous interacting scales. Similarly, and connected to this, *prediction* of future outcomes—particularly in the long-term future—is currently impossible, and model outputs should be considered *projections*. Projections from modeling can provide some understanding of which outcomes are more likely than others—given a large number of assumptions—but the assumptions themselves are uncertain and subject to change over time. Since the purpose of MPAs is explicitly long-term, these uncertainties should not cripple design and implementation.

An associated issue is that uncertainties are rarely characterized fully: many significant uncertainties are implicitly built into analyses and models through structural assumptions. Such hidden uncertainties impede learning and decision-making by providing false senses of security and obscuring the nature and sources of uncertainty. Accordingly, MPA implementation and management should follow an adaptive approach (Section 4.4) beginning with a comprehensive assessment of uncertainty, such that structured learning can enable enhancement of MPA effectiveness.

References:
Cressie et al. 2009, Lee 1999, Levin 1992, Walters 1986

Guideline: Recognize Limitations of Economic Valuation and Cost-Benefit Analysis

Definition:

Economic valuation is the quantification, in monetary terms, of costs and benefits. Cost-benefit analysis is the weighing of total expected costs and benefits associated with one or more actions. Valuation and cost-benefit analysis have been granted a place of considerable authority within environmental law and policy in Canada and elsewhere. For example, The Treasury Board of Canada requires cost-benefit assessments as part of the Regulatory Impact Assessment Statement process, when considering the impacts of regulatory change at the national level.

Rationale:

Cost-benefit analysis can provide a convenient yet incomplete frame for integrating many types of data to evaluate the merits for alternative designs for MPAs or MPA networks. Because such analyses rely upon economic valuation, it is critical to recognize that valuation cannot comprehensively represent all values for at least three reasons.

1. Valuation of costs and benefits relies fundamentally upon an understanding of how the implementation of MPAs will result in ecological changes, and how those ecological changes will result in changes to benefits to people. As noted in the guideline above, our ability to project such changes is imperfect.

2. Economic valuation is limited in its ability to represent value where marketed goods and services do not already exist.

3. Many costs and benefits are of a non-material nature (e.g., cultural integrity) and so are not appropriately valued in economic terms. Whether to create an MPA is fundamentally an issue of what is morally right and what we want as a society, which is a moral question that cannot be solved by economic valuation.

Economic valuation is of great utility for particular questions—e.g., helping determine which configuration of a planned MPA is likely to yield the lowest economic costs and the greatest economic benefits—but it should not be used as the sole tool for determining whether the full suite of benefits of an MPA outweigh the full set of costs. For valuation purposes, economic methodologies should generally be used in conjunction with approaches from other social sciences.

References:
Chan et al. in press, EPA 2009, Gregory 1993, NRC 2005, Sagoff 1998, Rudd 2007.

4.4 Goals, Objectives, and Adaptive Management for MPAs

Guideline: Adopt an adaptive management framework with explicit and achievable objectives

Definition:

Each individual MPA and the MPA network should have explicitly stated and achievable conservation objectives and targets which structure all stages from design through to management. For individual MPAs, management plans will specify the desired objectives for a given protected area, the action steps necessary to achieve those objectives, clearly defined agency responsibilities, compliance regimes and performance measures, adequate funding sources, and measures that are capable of being implemented. These plans also act as an accountability mechanism and a learning tool: clearly defined goals and objectives, together with measurable criteria can be used to evaluate MPA effectiveness.

Adaptive management is a structured, iterative process of decision-making under uncertainty, where management actions and monitoring activities are designed to reduce key uncertainties, thereby enhancing future decision-making.

Rationale:

Protected areas are embedded within complex and changing ecological and socio-cultural contexts. MPA planners and managers face a high degree of uncertainty in planning and decision-making. An adaptive approach is needed to effectively manage MPAs, comprising an integrated, iterative cycle of planning, management, monitoring and reporting, all tied to clearly defined and measurable conservation objectives. An integrated adaptive approach should be intentionally designed to include clearly identified goals and objectives, strategies to achieve these, and on-going measurement of results that are publicly reported, and that inform future management through learning.

MPAs in Canada allow multiple use of a large proportion of the designated area. For desired conservation results to be achieved it is essential that ecologically sustainable management practices be implemented that are explicit, measurable and adaptive. For renewable resource extraction and other activities considerable research may be required to define the use levels that are sustainable under the mandate of the relevant legislation and prime direction for implementing the precautionary principle.

References:
Hockings et al. 2006, Lundquist and Granek 2005, Parks Canada 2008, Walters 2002.

Guideline: Shift the burden of proof

Definition:

Shifting the burden of proof is a risk averse or precautionary approach that requires ecosystems and resources to be protected from activities until it is demonstrated that the activities are unlikely to result in substantial harm.

Rationale:

This concept was proposed by Dayton (1998) in the context of fisheries management, and is applicable in the case of marine protected areas where some uses will continue to occur, for example through a zoning approach, and in determining the appropriate boundaries for MPAs. By shifting the burden of proof in favour

of conservation, the onus would be on users to conduct the studies and demonstrate that their activities will have either no impact or acceptable levels of impact prior to their activities being allowed. Given that fish and other ocean organisms and resources are publicly owned, those who profit from them should demonstrate that they will not pose harm to marine ecosystems. Costanza and others (1998) have suggested this as a principle of sustainable oceans governance. In order to be precautionary, Gerrodette and others (2002:658) have noted the need to determine the "metric on which a decision is based and the level (or standard) of proof that the metric must meet. Charles (2002) has documented the challenges in fisheries management in Canada when the burden of proof is either misunderstood or not placed in favour of conservation.

References:
Agardy 2000, Bohnsack et al. 2004, Charles 2002, Costanza et al. 1998, Dayton 1998, Gerrodette et al. 2002.

Guideline: Link MPA planning, establishment, management and monitoring processes

In order to ensure that objectives are targets are met, protected area managers should be brought into planning and establishment process to ensure continuity between phases. In addition, management needs should be considered during the process of establishing an MPA to ensure that decisions and understandings made during the establishment process are compatible with, and enable, effective MPA management.

MPA networks and individual units must be supported by a monitoring assessment and report system focused on achievement of biodiversity, socio-economic and cultural objectives, outcomes and management effectiveness from the outset. The emphasis in monitoring should be on feasibility, including affordability and logistical considerations as well as on scientific credibility, and it should complement any existing data collection programs. The key focus of monitoring programs must be the links to the stated objectives of the MPA. Involving local people in the design and implementation of monitoring programs brings many benefits.

References:
Crawford et al. 2004, Day 2008, Dearden and Topelko 2006.

4.5 Interim protection measures

Guideline: Provide interim protection for candidate MPAs

Additional protective measures should be applied as soon as a potential MPA site has been identified to ensure that ecological and cultural values are secured while planning and establishment processes are initiated and completed. Interim protection could be achieved through a number of mechanisms, including fishery regulations, shipping regulations, agreements with other governments and/or stakeholders.

Definition:

Interim protection is a mechanism to protect the values of a proposed protected area while it moves through the protected area establishment process to final designation.

Rationale:

While providing interim protection for proposed terrestrial protected areas early in the establishment process is widely accepted and applied in terrestrial protected area establishment processes in Canada (eg. national parks, NWT Protected Areas Strategy), it has been less widely applied in the establishment of marine protected areas. Internationally, the need for interim protection for proposed MPAs been noted in some cases such as for establishing MPAs on the High Seas. In Canada it generally takes many years – even decades – for proposed marine protected areas to move through the establishment process and be designated in law. Meanwhile, there is a significant risk that the values that are identified for protection could be compromised. A policy framework exists to enable interim protection for Oceans Act MPA areas of interest, including a commitment to monitor the ecological integrity of areas of interest.

However, in many cases, interim protection measures have not been applied, except in a few cases For example interim protection to protect cold water corals in the Gully, NS has been implemented through fisheries closures and to protect glass sponge reefs in the Hecate Strait, BC,. Providing interim protection is in accordance with the Canadian government's legislative mandate to manage according to the Precautionary Principle.

A suite of legislative and non-legislative tools exist in Canada that could be used to provide interim protection, including fisheries and vessel operation restrictions, voluntary agreements, and many others. A 2008 report prepared for WWF Canada and CPAWS described 28 different measures (17 legislative and 11 non-legislative) that could be used to provide interim protection for marine areas of high conservation value. In some cases, multiple tools will need to be applied to achieve effective interim protection.

The globally significant Hecate Strait Glass Sponge Reefs off the BC coast demonstrate the importance of interim protection. They were identified for protection over a decade ago, at which time they were being seriously damaged by bottom trawling. In 2001, fisheries closures were put in place to prevent further damage to the reefs. More than a decade later, the process of designating this area as an Oceans Act MPA is still not completed. Without this interim protection measure, the ecological values of the glass sponge reefs would have been seriously compromised while the process to protect them was underway.

Reference:
Breeze and Fenton 2007, 2008, DFO 2007, DFO 1999, Laffoley 2005, WWF Canada and CPAWS 2008.

References

Agardy, T. 2000. Effects of fisheries on marine ecosystems: a conservationist's perspective. *ICES Journal of Marine Science* 57, 761-765.

Ardron, J. A., Possingham, H. P., and Klein, C. J. (Eds). 2010. *Marxan Good Practices Handbook. Version 2.* Pacific Marine Analysis and Research Association, Victoria, BC, Canada. 165 pp. www.pacmara.org.

Ban, N.C., Alidina, H.M., and Ardron, J.A. 2010. Cumulative impact mapping: Advances, relevance and limitations to marine management and conservation, using Canada's Pacific waters as a case study. *Marine Policy* 34, 876-886.

Ban, N. C., Picard, C. R., and Vincent, A.C.J. 2009. Comparing and integrating community-based and science-based approaches to prioritizing marine areas for protection. *Conservation Biology* 23, 899-910.

Ball, I. R. and Possingham, H.P. 2000. *MARXAN (V1.8.2): Marine Reserve Design Using Spatially Explicit Annealing, a Manual.* http://www.ecology.uq.edu.au/index.html?page=27710

Breeze, H. and Fenton, D.G. 2007. Designing management measures to protect cold-water corals off Nova Scotia, Canada. *Bulletin of Marine Science* 81(1): 123-133.

Bohnsack, J.A., Ault, J.S., and Causey, B. 2004. Why have no-take marine protected areas? *American Fisheries Society Symposium* 42, 195-193.

Chan, K., Goldstein, J., Satterfield, T., Hannahs, N., Kikiloi, K., Naidoo, R., Vadeboncoeur, N., and Woodside, U. (in press). *Cultural services and non-use values*. The Theory & Practice of Ecosystem Service Valuation in Conservation. P. Kareiva, G. Daily, T. Ricketts, H. Tallis and S. Polasky. Oxford, UK, Oxford University Press.

Charles, A.T. 2002. The precautionary approach and 'burden of proof' challenges in fishery management. *Bulletin of Marine Science* 70, 683-694.

Christensen, N. L., Bartuska, A., Brown, J.H., Carpenter, S., D'Antonio, C., Francis, R., Franklin, J.F., MacMahon, A., Noss, R.F., Parsons, D.J., Peterson, C.H., Turner, M.G., and Moodmansee, R.G. 1996. The report of the Ecological Society of America Committee on the scientific basis for ecosystem management. *Ecological Applications*. 6, 665-691.

Cole, D.N. and Stankey, G.H. 1998. Historical development of Limits of Acceptable Change: conceptual clarifications and possible extensions. In: McCool, Stephen, F. and David N. Cole, comps. Proceedings - Limits of acceptable change and related planning processes: progress and future directions. USDA Forest Service Gen. Tech. Rep. INT-GTR-371, 5-9.

Costanza, R., Andrade, F., Antunes, P., van den Belt, J., Boersma, D., Boesch, D.F., Catarino, F., Hanna, S., Limburg, K., Low, B., Molitor, M., Pereira, J.G., Rayner, S., Santos, R., Wilson, J., Young, M. 1998. Principles of sustainable governance of the oceans. *Science* 281,198-199.

Crawford, B. R., Saihainenia, A., Rotinsulu, C., and Sukmara, A. 2004. Compliance and enforcement of community-based coastal resource management regulations in North Sulawesi, Indonesia. *Coastal Management*, 32, 39-50.

Craighead, L., C. Convis and F. Davis, Eds. (in press). Shaping the Future: Conservation Planning from the Bottom up - A Practical Guide for the 21st Century. Redlands, CA, ESRI Press.

Cressie, N., Calder, C.A., Clark, J.S., Hoef, J.M.V., and Wikle, C.K. 2009. Accounting for uncertainty in ecological analysis: the strengths and limitations of hierarchical statistical modeling. *Ecological Applications* 19, 553-570.

Day, J. 2008. The need and practice of monitoring, evaluating and adapting marine planning and management-lessons from the Great Barrier Reef. *Mar Policy* 32, 823–831.

Dayton, P. 1998. Reversal of the burden of proof in fisheries management. Science 279, 821-22.

Dearden P., and Topelko K.N. 2006. *A Review of Methods for Evaluating the Effectiveness of Marine Protected Areas with Consideration for Application and Use as an Adaptive Management Tool in Canada*. Report prepared for Fisheries and Oceans Canada. Ottawa. 48pp.

DFO, 2007. *Guidance Document on Identifying Conservation Priorities and Phrasing Conservation Objectives for Large Ocean Management Areas*. DFO Can. Sci. Advis. Sec. Science Advisory Rep. 2007/010.

DFO (Fisheries and Oceans Canada).1999. *National Framework for Establishing and Managing Marine Protected Areas*. http://www.dfo-mpo.gc.ca/oceans/publications/mpaframework-cadrezpm/page05-eng.asp

EPA (Environmental Protection Agency) Science Advisory Board. 2009. *Valuing the Protection of Ecological Systems and Services: A Report of the EPA Science Advisory Board*: 138. http://yosemite.epa.gov/sab/sabproduct.nsf/WebBOARD/ValProtEcolSys&Serv?Open Document

Evans, S.M.J., Jamieson, G.S., Ardron, J.A., Patterson, M., and Jessen, S. 2004. *Evaluation of site selection methodologies for use in marine protected area network design*. Can. Sci. Advis. Sec. Res Soc. 2004/082: 40 pp.

Game E.T., Mcdonald-Madden E., Puotinen M.L., and Possingham H.P. 2008b. Should we protect the strong or the weak? Risk, resilience, and the selection of Marine Protected Areas. *Conservation Biology* 22, 1619-1629.

Gerrodette, T., Dayton, P.K., Macinko, S. and Fogarty, M.J. 2002. Precautionary management of marine fisheries: moving beyond burden of proof. *Bulletin of Marine Science* 70, 657-668.

Gregory, R., Lichtenstein, S., and Slovic, P. 1993. Valuing environmental resources: A constructive approach. *Journal of Risk and Uncertainty* 7, 177-197.

Gleason, M., McCreary, S. Miller-Henson, M., Ugoretz, J., Fox, E., Merrifield, M., McClintock, W., Serpa, P., and Hoffman, K. 2010. Science-based and stakeholder-driven marine protected area network planning: A successful case study from north central California. *Ocean & Coastal Management* 53, 52-68.

Halpern B.S., Selkoe K.A., Micheli F., and Kappel C.V. 2007. Evaluating and ranking the vulnerability of global marine ecosystems to anthropogenic threats. *Conservation Biology* 21, 1301-1315.

Halpern, B. S., Walbridge, S., Selkoe, K.A. et al. 2008. A global map of human impact on marine ecosystems. *Science* 319, 948-952.

Halpern, B. S., Kappel, C. V., Selkoe, K.A., et al. 2009. Mapping cumulative human impacts to California Current marine ecosystems. *Conservation Letters* 2, 138-148.

Hockings M., Stolton, S., Leverington, F., Dudley, N., Courrau, J. 2006. *Evaluating effectiveness: A framework for assessing management effectiveness of protected areas*. (2nd ed). Gland and Cambridge: IUCN.

Klein, C.J., Chan, A., Kircher, L., Cundiff, A.J., Gardner, N., Hrovat, Y., Scholz, A., Kendall, B.E., and Airamé, S. 2008. Striking a Balance between Biodiversity Conservation and Socioeconomic Viability in the Design of Marine Protected Areas. *Conservation Biology* 22, 691-700.

Laffoley, D. 2005. *Protecting earth's last frontier: Why we need a global system of High Seas marine protected area networks*. Parks 15, 5-10.

Lee, K. 1999. Appraising adaptive management. *Conservation Ecology* 3, 3.

Levin, P.S., Fogarty, M.J., Murawski, S.A. and Fluharty, D. 2009. Integrated Ecosystem Assessments: Developing the scientific basis for ecosystem-based management of the ocean. *PLOS Biology* 7, 0023-0028.

Levin, S.A. 1992. The problem of pattern and scale in ecology: The Robert H. MacArthur Award Lecture. *Ecology* 73, 1943-1967.

Lundquist, C.J., and Granek, E.F. 2005. Strategies for successful marine conservation: integrating socioeconomic, political, and scientific factors. *Conservation Biology* 19, 1771-1778.

Margules, C. R., and Pressey, R.L. 2000. Systematic conservation planning. *Nature* 405, 243-253. http://www.nature.com/nature/journal/v405/n6783/full/405243a0.html

Margules, C. R., and Sarkar, S. 2007. *Systematic conservation planning*. Cambridge, UK, Cambridge University Press.

McLeod, K. L., and Leslie, H.M. (Eds). 2009. Ecosystem-Based Management for the Oceans. Island Press, Washington, DC.

McLeod, K. L., J. Lubchenco, S. R. Palumbi, and Rosenberg, A.A. 2005. *Scientific Consensus Statement on Marine Ecosystem-Based Management*. Signed by 221 academic scientists and policy experts with relevant expertise and published by the Communication Partnership for Science and the Sea.

McCool, S. F. and D. N. Cole, comps. 1997. *Proceedings - Limits of acceptable change and related planning processes: progress and future directions*. USDA Forest Service Gen. Tech. Rep. INT-GTR-371

NRC (National Research Council U.S.). 2005. *Valuing Ecosystem Services: Toward Better Environmental Decision-Making*. Committee on Assessing and Valuing the Services of Aquatic and Related Terrestrial Ecosystems. Washington, DC, National Research Council: 277. http://books.nap.edu/openbook/030909318X/html/index.html

Parks Canada. 2008. *Guidelines to Management Planning*. Ottawa: Parks Canada.

Pressey, R. L. and M. C. Bottrill. 2009. Approaches to landscape- and seascape-scale conservation planning: convergence, contrasts and challenges. *Oryx* 43, 464-475. http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=6221300&fulltextType=RA&fileId=S0030605309990500

POC (Pew Oceans Commission). 2003. *America's Living Oceans: Charting a Course for Sea Change*. Pew Oceans Commission, Arlington, Virginia.

Roman, G.S.J., Dearden P., and Rollins, R. 2007. *Application of Zoning and "Limits of Acceptable Change" to Manage Snorkeling Tourism*. Environmental Management 39, 819– 830

Rudd, M. A. 2007. Evaluating the economic benefits of marine protected areas (MPAs) in Canada. *SWGC Environmental Valuation and Policy Laboratory*: 34.

Sagoff, M. 1998. Aggregation and deliberation in valuing environmental public goods: A look beyond contingent pricing. *Ecological Economics* 24, 213-230.

USCOP. 2004. *An Ocean Blueprint for the 21st Century*. Final Report of the U.S. Commission on Ocean Policy (USCOP). Washington, DC.

Vold, T., Sranko, G., Johnsen, S. and Mitchell W. 2008. *Limits of Acceptable Change (LAC) Pilot Project: Final Report*. March 2008. Prepared for: Headquarters – Regional Client Services Integrated Land Management Bureau and LAC Steering Committee, BC Government and Tourism Industry Joint Steering Committee. http://ilmbwww.gov.bc.ca/lac/pilots/johnstone.html

Walters, C. J. 1986. *Adaptive Management of Renewable Resources*. New York, NY, MacMillan. http://books.google.com/books?id=rkEqPQAACAAJ&source=gbs_navlinks_s

Walters, C. J. 2002. *Adaptive Management of Renewable Resources*. Caldwell, NJ, Blackburn Press. http://books.google.com/books?id=rkEqPQAACAAJ&source=gbs_navlinks_s

Watts, M. E., Ball, I. R., Stewart, R. S., Klein, C. J., Wilson, K., Steinback, C., Lourival, R., Kircher, L., and Possingham, H. P. 2009. Marxan with Zones: Software for optimal conservation based land- and sea-use zoning. *Environmental Modelling & Software* 24, 1513-1521.

WWF-Canada and CPAWS. 2008. *Options for interim management of marine areas in British Columbia with high conservation value*. Draft report prepared by Daryl Brown and Associates.

Zeldis, J., Felsing, M., and Wilson J. 2006. Limits of acceptable change: a framework for managing marine farming. *Water & Atmosphere* 14. http://www.niwa.co.nz/__data/assets/pdf_file/0010/49375/lac.pdf

5 | MPA GOVERNANCE

Governance refers to the formal and informal arrangements, institutions and norms that determine how environments and resources are utilized. It includes laws and regulations, in addition to a variety of other decision-making processes, such as public consultations, stakeholder involvement, negotiation, mediation, and conflict resolution. As such, it is important to distinguish *Government* from *Governance*; "governance is not the sole purview of the state through government, but rather emerges from the interactions of many actors, including local communities, private actors, companies and not-for-profit organizations" (Lebel et al. 2006: 3).

A shift from Government (or 'top down' traditional approaches where the state relies on its formal political hierarchy and problem-solving structures to Governance "does not necessarily mean that the role of the state has diminished or even decreased" (Holmgren et al. 2010: 424). However, the role of government has changed in recent years towards being more of a collaborator and partner, facilitating the involvement of multiple societal players in developing and implementing solutions.

The implementation of environmental policy is carried out by a number of policy instruments, including institutional, regulatory, economic and informational methods. These include a range of different measures from the more traditional measures regularly undertaken by the state, to the more norm-building measures that are more accessible to other actors. To have a "beneficial impact", a policy instrument must have a strong "foundation in the values and opinions of the public". The legitimacy of a policy is linked to values such as flexibility, efficiency, cost-effectiveness, communication and equality. There is also, according to Nilsson (2003), "a positive correlation between the existence of effective democratic institutions and successful policy reforms." Finally, good governance has been associated with attributes such as "participation, representation, deliberation, accountability, empowerment, social justice and organizational features such as being multilayered and polycentric" (Lebel et al. 2006: 3).

There is increasing consensus that the cause of environmental degradation and resource depletion is institutional and that if "we get the right rules and governance structures, natural resources will be used wisely and conservation goals will be met" (Acheson 2006: 118). That is, individual and collective aims and interests in environmental management and protection will be affected by the extent to which various actors and stakeholders perceive that state and governance measures are supporting "good governance."

Several attributes of "good" governance relevant to the Canadian MPA Governance context have been identified and are presented below in terms of guidelines:

- Commitment
- Accountability
- Transparency
- Cooperation
- Aboriginal partnerships
- Stakeholder engagement
- Knowledge and social learning
- Public awareness and support

See Appendix 1 for details of Government (federal and provincial) policy relating to MPAs.

References:
Acheson 2006, Appelstrand 2002, Bellefontaine et al. 2010, Berge 2002, Bryant and Wilson 1998, Carlsson and Sandström 2008, Clausen and McAllister 2001, Holmgren et al. 2010, Juda 1999, Lebel et al. 2006, Lockwood et al. 2009, Lockwood 2010, Lockwood and Davidson 2010, Nilsson 2003, Young 2002.

5.1 Commitment

Definition:

Commitment is the act of meeting a promise or obligation to a particular course of action. In the context of the establishment and management of MPA sites and networks, commitment is required at a variety of levels within government and society– from elected officials to government managers to stakeholders and the public. This commitment must be sustained in the face of changing circumstances, including changing government regimes and political priorities, and over the long term.

Adequate funding is an essential component of this commitment and is required to support all phases of proposal, planning and preparation for the establishment, implementation and enforcement of MPA management objectives and regulations; this includes costs associated with project proposal, development of a legal framework for designation, development of a management plan, outreach to local community and stakeholder groups, community and stakeholder compensation schemes (including alternative-income generating activities and fisher buy-out), ecological and socio-economic research, management and enforcement training, and infrastructure (including buildings, equipment, and site delineation). Subsequent to the establishment of MPA sites, long-term funding must be available to support maintenance and management, including staff expenses, maintenance of buildings and equipment, fuel, education and outreach, and recurrent capital expenses. The amount of funding necessary for the initial establishment and long-term management of an MPA may be estimated using models developed by McCrea-Strub et al. (2011) and Balmford et al. (2004), respectively.

Rationale:

Strong political commitment can lead to a strong national or regional mandate for MPA implementation, which in turn can translate into adequate resources, consistent policy over time and compatible policy development by other agencies (e.g. in the California, Governor Schwarzenegger's executive mandate for MPAs, and the Great Barrier Reef rezoning experience). On-going commitment is also necessary to support: effective coordination and continuity among and within government agencies; a fair and inclusive process of strong stakeholder involvement; coordination of knowledge inputs; effective opportunities for public engagement; and the maintenance of momentum towards MPA establishment. It is essential for staying the course despite organized resistance from some sectors.

Guideline: Develop a national MPA network action plan that includes a commitment to precise timelines and milestones

Canada must live up to its international commitments to complete a national network of MPAs. Marine ecosystems are degrading in all of Canada's oceans and are subject to many stressors. It is critical that the Government of Canada follows through on commitments regarding the completion of a national network; this should be done in a timely manner, with a plan that includes milestones and timelines.

Guideline: Include provisions for strict protection and strong prohibitions in Canadian MPA legislation

A legislative commitment to strict protection in a minimum of 30% of all habitats in all marine bioregions in Canada would provide the greatest assurance that all bioregional MPA network planning processes achieve this target. At the next opportunity to update the Oceans Act, this guideline should be incorporated as the clear target for Canada's MPA network overall. In addition, this should be incorporated in the legislation of each type of MPA in Canada – Oceans Act MPAs, National Marine Conservation Areas, and National Wildlife Areas, as well as provincial and territorial statutes.

Human activities that could negatively affect ecosystem health and productivity are not compatible with the conservation and protection goals of MPAs. Industrial uses and developments, including exploration for and extraction of non-renewable resources, dredging, dumping, and destructive fishing practices, particularly bottom trawling, should be prohibited in all MPAs. The three Canadian federal MPA legislations (see Appendix 1) and relevant provincial and territorial legislation, should be amended to include these prohibitions. While legislative renewal is underway, these prohibitions should be incorporated into the MPA network framework and other policy instruments related to MPAs in Canada.

Guideline: Provide adequate funding to support MPA site and network development

Implementation of a national network of MPAs is fundamentally a government responsibility that should be funded through the federal budget, and where appropriate through the budgetary processes of the provinces and territories, recognizing their important roles in the MPA process and their protected area designations. In some cases, public/private partnerships may help to facilitate the timely completion of the network, as is currently the case for the Pacific North Coast Integrated Management Area (PNCIMA) region.

Funding commitments should be adequate for MPA site and network establishment and implementation as well as their long-term adaptive management. Budgets should be committed up-front, and include provisions for stakeholder participation in establishment and management processes as well as enforcement.

Greatest cost efficiency per unit area may be achieved for larger MPAs established in a relatively short period of time (provided the establishment phase is long enough to ensure future effectiveness). Research also indicates that management costs for single large no-take reserves are much less than for multiple-use designations of the same area, due to the costs associated with compliance.

References:
Balmford et al. 2004, Ban et al. 2011, Jessen 2011, McCrea-Strub et al. 2011.

5.2 Accountability

Definition:

Accountability refers to obligations imposed on authorities to provide information and explain decisions and actions or inactions as well as whether they can be sanctioned if those explanations are unsatisfactory. Accountability includes downward as well as upward accountability; that is, in addition to being accountable upward to central state authorities, authorities are also accountable downward to the resource users. In addition to vertical relationships (downward and upward), accountability applies to horizontal relationships; for example between federal government agencies responsible for marine conservation.

Rationale:

The institutional culture of government has been described as "risk averse and tied to accountability regimes that stifle innovation and discourage shared decision making". These regimes are linked to a legacy of "top-down" management (and associated upward accountability) which runs counter to, and has limited experience with, horizontal accountability. However, the role of government is changing with collaborative relationships providing opportunities for the government to take a more active and effective position in governance.

Guideline: Provide regular public reporting on progress in MPA network completion

In order to instil public and stakeholder confidence in the MPA process it will be important to monitor and publicly report on progress on the bioregional networks. This should include the implementation by the Government of Canada of an annual reporting mechanism on progress. The California Marine Life Protection Act Process provides a possible model for public reporting and information availability, as does the *Canada*

National Parks Act. The latter requires a number of regular reports to Parliament, including the tabling of park management plans, State of the Parks reports every two years, and a biannual Minister's Round Table.

Ensuring that stakeholders and the public are informed as to "what is at stake in decision-making, who is responsible for what, how their performance can be evaluated, and how the responsible actors can be made accountable" (as well as how and why certain decisions have been or are taken is to key to building confidence in public processes. Public opportunities to demand accountability should be accessible and effective, and accountability should link to a clearly defined and appropriate system of rewards and sanctions.

Guideline: Establish an independent scientific advisory process

An independent science advisory process and panel comprised of natural and social scientists should be established to incorporate scientific rigour into the planning and management of MPAs and MPA networks. MPA site and network proposals should be weighed against guidelines by this independent panel to determine whether and to what extent the guidelines are being met. All bioregional MPA network processes should be required to use guidelines in the design of these networks.

An example of such an advisory process exists in the UK, which established an independent Science Advisory Panel. The Panel provides "…an expert and impartial scientific view on whether proposals meet the criteria set out in the SNCB [Statutory Nature Conservation Body] Ecological Network guidance." (DEFRA 2010: 7). In addition, the process provides for other specialist advice on the assessment of socio-economic information and the Impact Assessment process.

References:
Agrawal and Ribot 1999, Bellefontaine et al. 2010, Borrini-Feyerabend et al. 2006, Cash et al. 2003, DEFRA 2010, Ellsworth and Jones-Walters 2005, Ribot 2002.

5.3 Transparency

Definition:

Transparency refers to the visibility of decision-making processes, the clarity of the communication of the rationale for decisions, the availability of information about the performance of the decision maker(s), and the openness of decision-making to public input and oversight. Transparency and openness are essential to ensuring that decisions are fair, equitable and in the interest of the common good.

Rationale:

Transparent participation processes that provide comprehensive, accurate and up-to-date information to communities and user groups, including communication through advisory councils and other mechanisms including websites and other electronic media, is crucial at all stages of MPA planning and management. Transparent decision making ensures that participants have access to an adequate amount and quality of information and knowledge and that open lines of communication with all parties are established. Greater transparency also makes government officials and policy makers more accountable (Section 5.2), while at the same time enhancing public participation and building trust/social capital between different actors. This in turn can lead to an 'upward spiral' "of cooperation and confidence that cooperation will be reciprocated amongst MPA users, whilst erosion of trust through lack of transparency, equity, enforcement, *etc.* can lead to a 'downward spiral'"

Guideline: Provide adequate, accurate and timely information to stakeholders

The Government of Canada should provide comprehensive, accurate and up-to-date information to stakeholders and Aboriginal communities and organizations, including details of the potential benefits and costs of MPAs as well as restrictions on certain uses. It should also support the dissemination of relevant scientific information,

local knowledge and spatial data, and make priority data available early in the process (e.g. habitat and socioeconomic data).

Guideline: Improve public access to fishing data in Canada

In order to plan for MPAs and MPA networks and to consider potential conflicts between proposed MPAs and important fishing areas, it is critical that both ecological and socioeconomic information is made publicly available to all stakeholders. Only in this way can potential conflicts between uses and conservation be addressed in an open and transparentCurrently, access to fishing data in Canada is limited due to confidentiality rules under the Access to Information Act, which leads to data being summarized into grids of either 4 by 4 km or 10 by 10km, depending on whether at least three boats have been fishing in an area. Where there are less than three boats, the data are summarized.

In a study conducted by Ecotrust Canada (2008), many problems were identified with access to socioeconomic and scientific data from DFO, including the lack of a coherent policy on data access, and consistent and fair application of privacy rules. They note that "…the stakes go beyond the health of the fish stocks themselves to fundamental issues of who controls and benefits from a public resource."

Guideline: Provide public access opportunities to information, meetings, and decisions

The federal government should ensure that information is widely available and that meetings to discuss and make decisions on MPAs and MPA networks are open and accessible to all parties. In order to ensure transparency of decisions, discussions should be available over the internet; time should be allotted on agendas for public comment on the process; public submission of ideas and concerns should be facilitated; and publicly-accessible websites with agendas, materials and reference documents should be created and regularly up-dated. The ideas and concerns of the public and stakeholders should also be documented and made available with explanations, where possible, for how these ideas and concerns have been considered in decisions.

References:
Ban and Vincent 2009, DEFRA 2010, Ecotrust Canada 2008, Gleason et al. 2010, Jones et al. 2011, Osmond et al. 2010, Ostrom 1999, University of Queensland Ecology Centre 2009, World Resources Institute 2003.

5.4 Cooperation

Definition:

Cooperation refers to the legal or other official basis for cooperation between federal, provincial and territorial, and local authorities and between agencies/enforcement units to address cross-jurisdictional and cross-sectoral issues and conflicts. Inter-governmental cooperation in the context of environmental protection and resource management in Canada increasingly involves shared authority with Aboriginal peoples. Given the significance of this dimension of Canadian governance, a separate section (Section 5.5) addressing Aboriginal Partnerships is provided below.

Rationale:

Jurisdictional complexity related to overlapping federal department mandates and provincial interests in marine environmental management makes jurisdictional responsibility difficult to pinpoint. As a result, establishing mechanisms to ensure effective cooperation (and enforcement) between different levels of government both within and between regions is paramount. However, there may arise issues/areas of marine management with unintended 'gaps', which can be addressed on a case-by-case basis. Such arrangements could include establishing advisory, supervisory, or oversight bodies, coordinating commissions, cooperation protocols, joint policy statements, or other special arrangements.

Guideline: Ensure effective internal and cross departmental collaboration

Ensure cross-department/agency collaboration that is supported by clear communication and sharing of information (including information relating to enforcement of MPAs in different regions). Prevent and address, as much as possible, unintended gaps in jurisdiction over marine management issues by setting up appropriate bodies or mechanisms.

More specifically, enhanced levels of cooperation between different branches of DFO and between DFO, Parks Canada, and Environment Canada for coordinating and enforcing the Federal Network of MPAs will be necessary. While lead responsibility has been given to DFO for both ocean health and fisheries, ensuring greater levels of communication and information sharing (1) between branches within DFO and (2) between DFO and other agencies is essential to a more effective and integrated management approach. This has been a key challenge to Canada's progress on MPAs to date.

References:
De Santo et al. 2007, De Santo 2010, DFO 2009, Gromack et al. 2010, Jessen 2011, UNEP-WCMC 2008.

5.5 Aboriginal Partnerships

Definition:

Aboriginal rights refer to a spectrum of rights that extend from non site specific Aboriginal rights (i.e. rights that are not tied to a particular place), to site-specific Aboriginal rights and, finally, to Aboriginal title – the highest form of Aboriginal rights (See Appendix 2). Aboriginal and treaty rights are "recognized and affirmed" by Section 35(1) of the *Constitution Act*, 1982. Several important legal decisions have helped define and clarify these rights in recent decades. More importantly because Aboriginal rights are constitutionally protected, any federal or provincial legislation that unjustifiably infringes those rights is of no force or effect. As a result, any decision or legislation that establishes an MPA may by struck down if the government establishing the MPA cannot meet the justification test. For this reason, it is important to include First Nations in a meaningful way in the process for establishing MPAs.

See Appendix 2 for a detailed description of Aboriginal Rights and Title.

Rationale:

According to Peepre and Dearden (2002:324) Aboriginal Peoples have been the "most dominant force influencing the establishment of national parks over the last decade", accounting for the protection of more than half of the land area in Canada's national park system.

Aboriginal peoples also have a profound cultural, economic and physical relationship with the marine environment that stems from time immemorial. Their traditional and ongoing connections to marine environments and resources are thus pivotal to future marine conservation management arrangements, including MPAs, for several reasons.

First, Aboriginal rights are protected by the Canadian Constitution and confirmed by Canada's Courts, and some Aboriginal communities are concerned with potential restrictions that MPAs might place on their rights concerning marine resources. The strength of these rights, the fiduciary obligations of the federal government to Aboriginal peoples, and the 'honour of the Crown' that applies even where a claim of Aboriginal title has not been confirmed through negotiation or court determination, mean that the creation and management of MPAs must involve collaborative relationships with Aboriginal communities.

Second, many Aboriginal communities possess detailed knowledge representing generations of observation and experimentation about the marine plants and animals, weather, snow and ice conditions, and so forth. This knowledge, together with the worldviews and customary institutions of management within which they are

embedded, contributes to understanding many aspects of marine ecosystems and to the identification of locally-appropriate management and protection regimes.

Third, First Nations are a level of government with influence over decisions on marine planning and management. Meaningful partnerships with Aboriginal people which respect and build upon local institutions and place-based knowledge are more responsive to local social and environmental contexts and offer more rational, cost-effective approaches to management by ensuring local legitimacy and cooperation.

Fourth, Aboriginal concerns about maintaining the quality of home marine environments may represent one of the few and possibly the strongest bases for limiting and controlling offshore development activities into the future. With their close connection to place, Aboriginal communities are particularly concerned about the status of and threats to marine resources.

MPA advocates can maximize the potential for earning support for MPAs from Aboriginal peoples and for effective collaboration with Aboriginal peoples by working authentically towards addressing interests related to Aboriginal rights and title.

Guideline: Clarify how MPA creation and management interacts with existing Aboriginal rights and title

Clarify from the outset how MPA creation and management interacts with existing Aboriginal rights and title. In particular, confirm that Aboriginal rights to food, social and ceremonial harvesting apply within all MPAs, unless a particular Aboriginal group or community chooses not to exercise these rights in support of full protected areas. In the case of existing land claims agreements that have provisions for the offshore, ensure that the design and implementation of the proposed MPA is consistent with specific provisions of these agreements (e.g. wildlife co-management boards). In the case of uncertainty regarding offshore title, ensure that interim agreements protect Aboriginal interests, state in the agreement for the MPA that Aboriginal rights are recognized, and where Aboriginal rights remain unresolved designate the MPA as a reserve, subject to ("without prejudice" to) treaty negotiation

Guideline: Respect Aboriginal institutions

Build upon and support continued and enhanced local management embedded within customary institutions for land and sea stewardship and community governance. Clarify how these existing institutions would interface with regulatory and management arrangements for the MPA.

Where land claims agreements exist, it is vital that the designated institutions be involved in the development of the MPA network, and specific provisions, like the Inuit Impact Benefit Agreements of the Nunavut Land Claim, be honoured.

Respect Aboriginal aspirations, existing institutions and local conditions in MPA establishment. The direct participation of Elders, hunters, trappers and fishermen and other community members and leaders in identifying priorities, concerns and needs should be enlisted in mapping, life histories, traditional resource use and similar projects (Section 5.7).

Guideline: Establish meaningful Aboriginal engagement

Establish meaningful engagements with individual Aboriginal communities at the earliest possible opportunity. This should involve open communication with the elected leadership and community members, including Elders, hunters, trappers and fishermen as well as women and youth. MPA projects should not proceed without the consent of affected aboriginal groups, including consent from and within local and regional levels. Ensure that timeframes, venues and decision-making processes are locally appropriate and legitimate. Engage with

Aboriginal nations and organizations at the policy and network design level – not just the site level. Involve the entire community – but especially those individuals and families whose traditional territories are directly involved – in the identification of areas of importance and the establishment of boundaries.

References:
Berkes et al. 2007, Daoust et al. 2010, Dearden and Langdon 2008, Gardner 2009, Gladu et al. 2003, Mulrennan et al. 2009, Peepre and Dearden 2002, Vierros et al. 2010.

5.6 Stakeholder Engagement

Definitions:

The term *stakeholders* refers to those individuals and groups who have an interest in or are affected by an existing or proposed governing planning process; stakeholders who are identified by the urgency of their concerns, the legitimacy of their interests or the power they hold will be clear candidates to become involved in the decision-making process. A wide range of stakeholders have an interest in marine resources for use or conservation, including commercial and recreational fisherman, non-consumptive users, conservation organizations, industry users (shipping, energy, etc.), and local communities.

Stakeholder engagement refers to the involvement of key individuals and groups in the governing planning process and the mechanisms used to facilitate their participation.

Rationale:

The development and implementation of MPAs can be a long and arduous process often hindered by resource conflicts among different user groups with divergent views and interests. Broad engagement of diverse stakeholder groups is required during the identification, selection, design and management stages to ensure that local knowledge is incorporated and that existing uses and potential threats are considered throughout the planning process. This engagement helps provide a framework for strong stakeholder participation, acceptance, support and consensus around conservation objectives of the MPA. Consequently, the involvement of stakeholders, from the early planning stages through to the design and implementation, encourages a sense of ownership and commitment that can foster acceptance from local communities, long-term support and assistance with implementation and enforcement.

Meaningful participation leads to improved information exchange, greater accountability of experts and authorities, confidence in the decision-making process and collaboration amongst different stakeholder groups that result in collectively acceptable and successful conservation outcomes.

Although the most suitable approach to stakeholder engagement will be context and/or site specific, several guidelines for best practices have been suggested in the literature. It is generally acknowledged that stakeholder participation should be institutionalized as part of the planning process through governance structures and processes that support collaborative planning and decision-making.

Guideline: Establish clear terms of reference, including the scope of stakeholder involvement and influence

Participation of stakeholders should be based on a thorough stakeholder analysis and a clear systematic selection process; selection criteria should emphasize clear expression of interest, knowledge of the region, commitment to completing the process and consideration of vulnerable or marginalized stakeholder groups.

Ensure clear, shared understanding of the potential impact of stakeholder input on MPA planning or decision outcomes. Manage participant expectations from the outset to match the actual level of influence on policy development, whether aiming for information sharing, consultation or full co-management.

At the beginning of the process, agree on steps, rules of procedure, timelines and accountability of the participants. Provide each stakeholder group involved in planning and implementation with a clearly

defined role. Adopt set of ground rules for constructive interaction, e.g. a code of conduct. Emphasize clear communication, trust building, respect, and collaborative problem solving.

Guideline: Use professional third party facilitation

Professional facilitation by a neutral third party should be used whenever possible to guide stakeholder process and when necessary to aid difficult or conflicting processes. Employ neutral and widely respected panels as an arbitration mechanism.

Guideline: Aim to achieve realistic levels of support and acceptance

Despite the strong support for meaningful participation processes described above, many practitioners acknowledge that the standard of full consensus or virtually unanimous support for an MPA is a target that is not realistic or achievable. Even the most collaborative approaches should not be expected to achieve full agreement. Political leadership is required to move the process forward despite some opposition, understanding that in the long term, everyone stands to gain from an effective network of MPAs (Section 3.1).

Recognize that full consensus is not always possible. Work towards achieving realistic levels of support and acceptance through a meaningful participation process that adheres to all of the above guidelines. Ensure that stakeholders feel they have been heard even if some disagreement remains. Accept as adequate a level of support that is reasonable relative to the diversity of opinion in the array of parties/interests consulted.

References:
Agardy et al. 2011, Chan, et al. 2011 In press, Charles and Wilson 2009, Dalton 2005, DEFRA 2010, Gardner et al. 2008, Gleason et al. 2010, Gray et al. 2010, Grimble and Wellard 1997, Heck et al. 2011a and b, Jentoft et al. 2007, Jones et al. 2011, Kessler 2004, Lundquist and Granek 2005, Osmond et al. 2010, Reed 2008, University of Queensland Ecology Centre 2009.

5.7 Knowledge and Social Learning

Definitions:

Knowledge can be defined as "socially mediated information" and cannot be separated from the application, use and development of the information (Weber and Khademian 2008:338). An essential ingredient of good governance is a process for citizens, experts and managers to co-produce and use knowledge to address complex problems (Lockwood et al. 2009; Lane et al 2004). The process of transferring, receiving and integrating knowledge recognizes that each participant in the process understands the problem and identifies potential solutions based on their own experience. The challenge is to use the various forms of knowledge to develop a common base for the process (Weber and Khademian 2008, a key aspect of developing adaptive capacity.

"*Local Ecological Knowledge* (LEK) refers to a body of knowledge held by a specific group of people about their local ecosystems. It is often site specific and can be a mixture of practical and scientific knowledge" (Scholz 2004; 336).

Aboriginal Knowledge (also referred to as indigenous knowledge or traditional ecological knowledge) is a cumulative body of knowledge, practice and belief handed down through generations by cultural transmission. It is based in the experience of people who have come to know an area by living in it, using and managing its resources for generations (Berkes et al. 2001).

Social learning refers to the processes of learning among individuals or groups of people who seek to improve a common situation and take action collectively (Bandura 1977). The concept assumes an iterative feedback between learners and their environment consistent with the idea of "managing to learn in order to learn how to manage" (Pahl-Wostl 2006). In this sense, social learning is a form of adaptive management, or 'learning-by-doing'.

Rationale:

To facilitate well-informed, cooperative planning and management, the best-available knowledge and information must be readily available to the institutions and stakeholders involved. It is increasingly recognized that drawing on Aboriginal knowledge and LEK as well as sound science can bring more informed decisions that serve local people and ecosystems better.

Aboriginal people have unique knowledge about ocean systems. Local observations can provide much information, and many aboriginal experts recognize and monitor various environmental signals over time in a way that enables detection of long-term trends and assessment of aspects of the ecosystem. MPA management can benefit greatly from insights based in traditional knowledge, values and practices, and there is a need for MPA scientists to spend time with local communities and learn to share knowledge. With care, indigenous knowledge can be blended with science towards MPA planning and management, as has been done in fisheries settings (e.g., the Haida have based sockeye fishery management on modern stock assessment data along with Haida knowledge of the sockeye run.

Uncertainties and ambiguities can present major barriers to effective environmental management. Uncertainties usually relate to gaps in the knowledge base and can generally be addressed by gathering new knowledge, including knowledge from alternative sources such as Aboriginal and local knowledge. Ambiguities, on the other hand, are due to multiple perspectives or frames of reference; despite receiving far less attention than uncertainties, ambiguities due to multiple perspectives or frames of reference are known to be critical in environmental management contexts, particularly when uncertainties in both the factual knowledge base and decision stakes are high. Processes of social learning are not focused on achieving a consensus but on recognizing differences in opinion in order to deal with them constructively by engaging in collective learning and decision processes.

Guideline: Provide up-to-date and comprehensive, accessible datMPA design, planning, and management should be informed by scientific studies, including from both the social and natural sciences, as well as from local sources and Aboriginal Knowledge. Publically-funded information should be made readily available by the appropriate governmental agencies, and data collected from privately-funded studies should be made available via the purchase of access rights or information-sharing agreements. The information should be up-to-date, provided early in the process and be as comprehensive as possible, ideally providing data regarding biophysical, ecological, and socioeconomic factors.

The availability of relevant social and economic information should be identified at the outset, and strategies developed to address gaps in this information. Processes elsewhere have shown that relevant information needs to be provided on several scales, i.e. local, regional, provincial, national, and different data creating and gathering strategies should be devised.

Stakeholders and local resource users can be valuable sources of information and knowledge on the ecology of marine and coastal ecosystems, as well as the spatial and temporal use patterns of marine resources. The incorporation of local knowledge can focus limited scientific resources and be useful during the decision-making and marine planning process to fill gaps in scientific data.

Guideline: Respect and build upon Aboriginal knowledge

Aboriginal Elders, as well as hunters, fishers and other resource users can provide valuable knowledge and insights on the status of marine wildlife populations and environmental conditions. Many have developed highly effective regimes of customary resource use and management, often involving elaborate systems of social coordination to ensure optimal harvests while maintaining the long-term stability of wildlife populations. Respect and build upon Aboriginal knowledge, values and practices for resource management and environmental protection, in dialogue and partnership with relevant federal and provincial mandates and responsibilities. Ensure that appropriate ethical considerations are taken and protocols followed in the accessing, use and communication of Aboriginal knowledge.

Guideline: Create opportunities for constructive dialogue and shared learning

Shared or social learning emphasizes the importance of dialogue and negotiation between groups to better understand different points of view, and to develop processes for collective action and reflection over time. As such, opportunities for groups to communicate different points of view and engage in constructive dialogue and shared learning should be created and maintained; this would include collective learning about mutual dependencies and interactions, possible scenarios for future MPAs, and the identification of barriers for change and possible solutions to overcome them. Provide a forum for exchanging information not only about resources but also about stakeholders themselves.

References:
Berkes et al. 2001, Berkes, et al. 2007, Crabbe et al. 2010, Christie and White 2006, FAO 2011, Funtowicz and Ravetz 1993, Gardner 2008, Gardner 2009, Gleason 2010, IUCN 2008, Jessen 2011, Jones and Burgess 2005, Jones 2006, Jones et al. 2010, Mallory et al. 2006, Mulrennan et al. 2009, Osmond et al. 2010, Pahl-Wostl 2006, Pretty and Smith 2004, Scholz et al. 2004, Smyth 2005, Soto 2006. University of Queensland Ecology Centre 2009.

5.8 Public Awareness and Support

Definition:

Gaining public acceptance is an all-encompassing process that includes learning more about the local community and determining the expectations of the people who will be involved in management or stewardship of the area, and the broader public which values conservation and the marine environment. In this case, building public awareness and acceptance ultimately translates to gaining support for the establishment and continued protection of the marine environment, including enhanced compliance with MPA regulations.

Rationale:

Involving the public helps to enhance stewardship and lend support to resource management decisions after investing time in the process.

Societal participation and education are important in achieving improved marine governance. However there is still little consideration of how to engage the general public in the support of marine conservation and management. The behavioral and lifestyle choices made by individuals contribute to the degradation of the marine environment, thus engaging individuals as policy actors could reduce negative impacts on marine ecosystems. It is important to recognize the public as players in the development and implementation of marine policy and 'marine citizenship' as a mechanism to promote successful management and protection. Volunteer programs, particularly in the areas of monitoring and surveillance, provide additional ways to engage the public, particularly local community members.

A number of polls in Canada have documented strong public support for fully protected "no-take" MPAs on both the east and west coasts. However, the public believes that governments have already protected about 20% of the marine environment, when in fact less than 1% currently has any form of protection. Furthermore, the majority of MPAs that fall into this 1% protected are still open in some way to commercial fishing (that is, they are not no-take areas). In addition, residents are prepared to live with the short-term costs that may come with restricting human activities in the ocean. A 2007 poll of 1009 British Columbians revealed that 90% support the need for more MPAs and on average people want 60-70 percent of the ocean protected, where protected was defined as areas where industrial activity is strictly prohibited.

Guideline: Foster stewardship of the marine environment

Stewardship of the marine environment can be fostered by providing educational opportunities which will increase awareness and encourage the responsible use of resources. Provide targeted marine education through

expanded informal learning opportunities (visitor centres, interpretation etc.); marine focused television programmes; and improve availability of information

By highlighting the importance of a marine region for recreation and livelihood and by making marine issues relevant and real for day to day life, and identifying the personal actions that people can take, and by educating and empowering people will increase their sense of responsibility for the ocean.

Guideline: Build public awareness and support to encourage compliance

A valuable spinoff of enhanced public stewardship of the marine environment can be increased levels of compliance of MPA regulations. Traditional 'top down' modes of protection, focused on externally designed and enforced systems of rules and regulations, tend to be costly, alienate local populations, and result in relatively few detections. By building awareness in local populations and visitors of the need for protection and assisting local communities in deriving benefits from the MPA, "soft" approaches to enforcement can be fostered whereby the public, alongside stakeholders and local communities act as a "fence" for the MPA in discouraging illegal activities.

References:
Acheson 2006, Bryant and Wilson 1998, Christie and White 2006, CPAWS-BC 2001, CPAWS-NS, 2002, Crabbe et al. 2010, Dalton 2005, FAO 2011, Gleason et al. 2010, IUCN 2003, Jessen 2011, Jones and Burgess 2005, McAllister Opinion Research 2007, McKinley and Fletcher 2010, Osmond et al. 2010, Robb et al. 2011.

References

Acheson, J.M. 2006. Institutional Failure in Resource management. *Annual Review of Anthropology* 35,117–34.

Agardy, T., Notarbartolo di Sciara, G., and Christie, P. 2011. Mind the gap: Addressing the shortcomings of marine protected areas through large scale marine spatial planning. *Marine Policy* 25, 226-232.

Agrawal, A., and Ribot, J. C. 1999. Accountability in decentralization: a framework with South Asian and African cases. *Journal of Developing Areas* 33, 473-502.

Appelstrand, M. 2002 Participation and societal values: the challenges for lawmakers and policy practitioners. *Forest Policy and Economics* 4, 281-290.

Balmford A., Gravestock P., Hockley N., McClean C.J., and Roberts C.M. 2004. The worldwide costs of marine protected areas. *PNAS* 101, 9694-9697.

Ban, N.C., Adams, V., Pressey, R.L., and Hicks, J. 2011. Promise and problems for estimating management costs of marine protected areas. *Conservation Letters* 00, 1-12.

Bandura, A. 1977. *Social learning theory*. Prentice-Hall, Englewood Cliffs, New Jersey, USA.

Bellefontaine, T., Haley, J. and Cantin, B. 2010. *Exploring the role of the Canadian Government in Integrated Land Management*. Policy Research Initiative on Sustainable Development, Research Paper, September 2010.

Berge, E. 2002. *Improving Biodiversity Policy : What do we need to know?* Paper presented to "Les Journées de l'Institut français de la biodiversité",Tours, 18-20 December 2002.

Berkes, F., Mahon, R., McConney, P., Pollnac, R., and Pomeroy, R. 2001. *Managing Small-scale Fisheries: Alternative Directions and Methods*. International Development Research Centre (IDRC), Ottawa.

Berkes, F., Kislalioglu, M., and Fast, H. 2007. Collaborative Integrated Management in Canada's North: The Role of Local and Traditional Knowledge and Community-Based Monitoring. *Coastal Management* 35, 143-162.

Borrini-Feyerabend, G., Johnston, J., and Pansky, D. 2006. *Governance of Protected Areas*. In M. Lockwood, G.L. Worboys, & A. Kothari (Eds.), Managing Protected Areas: A Global Guide. London: Earthscan. pp. 116-145.

Bryant, R.L. and Wilson, G.A. 1998. Rethinking environmental management. *Progress in Human Geography* 22, 321-343.

CPAWS-BC (Canadian Parks and Wilderness Society, BC Chapter). 19 November 2001. Press Release: British *Columbians want more protection in the ocean, says new poll*.

CPAWS-NS (Canadian Parks and Wilderness Society, NS Chapter). 16 February 2002. Press Release: Northwest Atlantic Ocean Needs More Protection: Poll show the public strongly favors more fully protected marine areas in New England and Atlantic Canada just as a new scientific study shows how urgently they are needed.

Carlsson, L., and Sandström, A. 2008. Network governance of the commons. *International Journal of the Commons* 2, 33–54.

Cash, D. W., Clark, W., Alcock, F., Dickson, N., Eckley, N., Guston, D., and Jager, J. 2003. Knowledge systems for sustainable development. *PNAS* 100, 8086-8091.

Chan, K.M.A., Ban, N.C., and Naidoo, R. 2011. Integrating Conservation Planning with Human Communities, Ecosystem Services, and Economics. (In press)

Charles, A., and Wilson, L. 2009. Human dimensions of Marine Protected Areas. *ICES Journal of Marine Science*, 66, 6-15.

Christie, P., and White, A. 2006. *Best practices in governance and enforcement of MPAs: an overview*. Background Paper 4, FAO Expert Workshop on MPAs and Fisheries Enforcement, 12-14 June 2006.

Clausen, S., and McAllister, M.L. 2001. An Integrated Approach to Mineral Policy. *Journal of Environmental Planning and Management* 44, 227-244.

Crabbe, M. J. C., Martinez, E., Garcia, C., Chub, J., Castro, L., & J. Guy. 2010. Is capacity building important in policy development for sustainability? A case study using action plans for sustainable Marine Protected Areas in Belize. *Society and Natural Resources* 23,181-190.

Dalton. 2005. Beyond Biogeography: a Framework for involving the public in planning of U.S. marine protected areas. *Conservation Biology* 19, 1392-1401.

Daoust, D.T., Haider, W., and Jessen, S. 2010. Institutional Arrangements Governing Marine Conservation Planning in the Canadian Arctic: The Case of Nunavut, Canada. *Environments: a Journal of Interdisciplinary Studies* 37, 73-93.

DEFRA (Department for Environment, Food and Rural Affairs). 2010. *Guidance on selection and designation of marine conservation zones (note 1)*. Nobel House, London.

Dearden, P., Bennett, M., and Johnstone, J. 2005. Trends in global protected area governance. *Environmental Management* 36, 89-100.

Dearden, P. and Langdon, S. 2008 Aboriginal peoples and national parks. In Dearden, P. and Rollins, R. (Eds.). *Parks and protected areas in Canada: Planning and management*. Toronto: Oxford University Press. 3rd Edition, 373-402.

De Santo, E.M. 2010. Whose Science? Precaution and power play in European marine environmental decision-making. *Marine Policy* 34, 414-420.

De Santo, E.M. and Jones, P.J.S. 2007. Offshore marine conservation policies in the North East Atlantic: emerging opportunities and challenges. *Marine Policy* 31, 336-347.

DFO. 2009. *Development of a Framework and Principles for the Biogeographic Classification of Canadian Marine Areas*. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2009/056.

Ecotrust Canada. 2008. *Accessing Federal Fisheries Data*. Briefing-Fisheries Data Policy. http://www.ecotrustcan.org/fisheries/accessing-federal-fisheries-data

Ellsworth, J.P., and Jones-Walters, L. 2005. *Journeys in Governance: The Role of the Public Sector in Addressing Tough Community Issues*. Unpublished.

FAO (Food and Agriculture Organization of the United Nations). 2011. Fisheries Management. 4. Marine protected areas and fisheries. *FAO Technical Guidelines for Responsible Fisheries* No.4, Suppl. 4, Rome, FAO, 199 pp.

Funtowicz S., and Ravetz, J.R. 1993. Science for the Post-Normal Age. *Futures* 25, 735-755.

Gardner, Julie. 2008. *Knowledge Integration in Salmon Conservation and Sustainability Planning: Towards Effective Implementation of Wild Salmon Policy Strategy Four*. Watershed Watch Salmon Society and David Suzuki Foundation

Gardner, Julie. 2009. *First Nations and Marine Protected Areas: An introduction to First Nations Rights, Concerns and Interests Related to MPAs on Canada's Pacific Coast*. Report for Canadian Parks and Wilderness Society, BC Chapter.

Gardner, J. Bicego, S., Jessen, S., and Baker, M. 2008. *Challenges and Opportunities in Progress towards Canada's Commitment to a National Network of MPAs by 2012*. Canadian Parks and Wilderness Society-BC Chapter.

Gladu, J.P., Brubacher, D., Cundiff, B. Baggio, A., Bell, A., and Gray, T. 2003. *Honouring the Promise: Aboriginal values in protected areas in Canada*. National Aboriginal Forestry Association and Wildlands League.

Gleason, M., McCreary, S. Miller-Henson, M., Ugoretz, J., Fox, E., Merrifield, M., McClintock, W., Serpa, P., and Hoffman, K. 2010. Science-based and stakeholder-driven marine protected area network planning: A successful case study from north central California. *Ocean & Coastal Management* 53, 52-68.

Gray, D.L., Canessa, R.R., Rollin, R.B., Dearden, P. and Keller, C.P. 2010. Understanding recreational boater attitudes to zoning in a proposed marine protected area. *Coastal Management*, 38, 575-597.

Grimble, R. and Wellard, K. 1997. Stakeholder methodologies in natural resource management: a review of principles, contexts, experiences and opportunities. *Agricultural Systems* 55, 173-193.

Gromack, A.G., Allard, K., Fenton, D., Johnston, S., and Ford, J. 2010. *Ecological and Human Use Information for Twenty Areas on the Atlantic Coast of Nova Scotia in Support of Conservation Planning*. Canadian Technical Report of Fisheries and Aquatic Sciences 288, xiv + 226 pp.

Hamilton, C. and Wilson, R. Undated. *Marine Protected Areas and Aboriginal People in British Columbia: From Conflict to Collaborative Management*. http://cec.org/files/PDF/BIODIVERSITY/Chris-Hamilton_en.pdf

Heck, N., Dearden, P., McDonald, A., and Carver, S. 2011. Developing MPA performance indicators with local stakeholders input in the Pacific Rim National Park Reserve, Canada. *Biodiversity and Conservation* 20, 895-911.

Heck, N., Dearden, P., McDonald, A., and Carver, S. 2011. Stakeholder opinions on the assessment of MPA effectiveness and their interests to participate at Pacific Rim National Park Reserve, Canada. *Environmental Management* 47, 603-616.

Holmgren E., Carina, E and Keskitalo, G. 2010 Swedish forest commons – A matter of governance? *Forest Policy and Economics* 12, 423-431

IUCN-WCPA (International Union for Conservation of Nature – World Commission on Protected Areas). *Establishing resilient marine protected area networks-making it happen*. Washington, D.C.: IUCN-WCPA, National Oceanic and Atmospheric Administration and The Nature Conservancy; 2008. 118 pp.

Jentoft, S., van Son, T.C., and Bjorkan, M. 2007. Marine protected areas: a governance system analysis. *Human Ecology* 35, 611-622.

Jessen, S. 2011. A Review of Canada's Implementation of the Oceans Act since 1997 – From Leader to Follower? *Coastal Management* 39, 20-56.

Jones, P. J. S., and Burgess, J. 2005. Building partnership capacity for the collaborative management of marine protected areas in the UK: A preliminary analysis. *Journal of Environmental Management* 77, 227–243.

Jones, P.J.S., Qiu W., and De Santo E.M. 2011. *Governing Marine Protected Areas - Getting the Balance Right*. Technical Report, United Nations Environment Programme.

Jones, R. 2006. Canada's seas and her First Nations: a colonial paradigm revisited. Pages 299-314 *in* D. R. Rothwell and D. L. VanderZwaag, editors. *Towards principled oceans governance.* Routledge, New York, New York, USA.

Jones, R., Rigg, C., and Lee, L. 2010. Haida marine planning: First Nations as a partner in marine conservation. *Ecology and Society* 15, 12.

Juda, L. 1999. Considerations in Developing a Functional Approach to the Governance of Large Marine Ecosystems. *Ocean Development & International Law* 30, 89-125.

Kessler, B. L. 2004. *Stakeholder Participation: a synthesis of current literature*. NOAA, Silver Spring, Maryland.

Lane, M.B., McDonald, G.T. and Morrison, T. 2004. Decentralisation and environmental management in Australia: A comment on the prescriptions of the Wentworth Group. *Australian Geographical Studies*, 42, 102-114.

Lebel, L., Anderies, J.M., Campbell, B., Folke, C., Hatfield-Dodds, S. Hughes, T.P., and Wilson, J. 2006. Governance and the Capacity to Manage Resilience in Regional Social-Ecological Systems. *Ecology and Society* 11, 19.

Lockwood, M., Davidson, J., Curtis, A., Stratford E., and Griffith, R. 2009. Multilevel Environmental Governance: lessons from Australia natural resource management. *Australian Geographer* 40, 169-186.

Lockwood, M. 2010. Good governance for terrestrial protected areas: A framework, principles and performance outcomes. *Journal of Environmental Management* 91, 754-766.

Lockwood, M. and Davidson, J. 2010. Environmental governance and the hybrid regime of Australian natural resource management. *Geoforum* 41, 388-398.

Lundquist, C.J. and Granek, E.F. 2005. Strategies for successful marine conservation: integrating socioeconomic, political, and scientific factors. *Conservation Biology* 19, 1771-1778.

Mallory, M., Fontaine, A., Akearok, J., and Johnston, V. 2006. Synergy of local ecological knowledge, community involvement and scientific study to develop marine wildlife areas in eastern Arctic Canada. *Polar Record* 42, 205-216.

McAllister Opinion Research. 2007. *Marine Communications Strategy and Messaging: A Telephone Survey of British Columbians.* Topline Report, April 2007.

McCrea-Strub, A., Sumaila, U.R., Zeller, D., Nelson, J., Balmford, A., and Pauly, D. 2011. Understanding the cost of establishing marine protected areas. *Marine Policy* 35, 1-9.

McKinley, E. and Fletcher, S. 2010. Individual responsibility for the oceans? An evaluation of marine citizenship by UK marine practitioners. *Ocean & Coastal Management* 53, 379-384.

Mulrennan, M.E., Bussieres, V., and Scott, C.H. 2009. *Tawich (Marine) Conservation Area, Eastern James Bay*. Proposal to the National Marine Conservation Program, Parks Canada,

Mulrennan, M.E. and Scott, C.H. 2001. Aboriginal Rights and Interests in Canada's Northern Seas. In C.H. Scott (Ed.), *Aboriginal Autonomy and Development in Northern Quebec and Labrador*. Vancouver: UBC Press, 78-97.

Hill, N.A.O., Michael, K.P., Frazer, A., Leslie, S. 2010. The utility and risk of local ecological knowledge in developing stakeholder driven fisheries management: The Foveaux Strait dredge oyster fishery, New Zealand. *Ocean & Coastal Management* 53, 659-668.

Nilsson, S., 2003. A Generic Framework for Policy Reforms in the Forest Sector. International Institute for Applied Systems Analysis (IIASA). Schlossplatz, Laxenburg, Austria. http://www.iiasa.ac.at/docs/HOTP/May03/forestry-writeup.pdf. Accessed online July 2009.

5

Osmond, M., Airame, S., Caldwell, M., Day, J. 2010. Lessons for marine conservation planning: A comparison of three marine protected area planning processes. *Ocean & Coastal Management* 53, 41-51.

Ostrom, E. 1999. Coping with tragedies of the commons. *Annual Review of Political Science* 2, 493-535.

Pahl-Wostl, C. 2006. The importance of social learning in restoring the multifunctionality of rivers and floodplains. *Ecology and Society* 11, 10.

Peepre, J. and Dearden, P. 2002. *The Role of Aboriginal Peoples*, in P. Dearden and R. Rollins (Eds.) Parks and Protected Areas in Canada: Planning and Management. Second Edition. Oxford University Press.

Pretty, J., and Smith, D. 2004. Social Capital in Biodiversity Conservation and Management. Conservation Biology, 18, 631-638.

Ribot, J. C. 2002. *African decentralization: local actors, powers and accountability.* Democracy, Governance and Human Rights Paper Number 8. United Nations Research Institute for Social Development, Geneva, Switzerland.

Reed, M. S. 2008. Stakeholder participation for environmental management: A literature review. *Biological Conservation* 141, 2417-2431.

Robb, C.K., Bodtker, K.M., Kim Wright, K., and Lash, J. 2011. Commercial fisheries closures in marine protected areas on Canada's Pacific coast: The exception, not the rule. *Marine Policy* 35, 309-316.

Scholz, A., Bonzon, K., Fujita, R., Benjamin, N., Woodling, N., Black,P., Steinback, C. 2004. Participatory socioeconomic analysis: drawing on fishermen's knowledge for marine protected area planning in California. *Marine Policy* 28, 335-349.

Smyth, Dermot. 2005. Report as Coordinator of Cross-cut Issues 1: Indigenous Peoples and Local Communities for the International Marine Protected Area Congress (IMPAC), Australia, October 23-28, 2005

Soto, C. 2006. *Socio-cultural Barriers to Applying Fishers' Knowledge in Fisheries Management: An Evaluation of the Literature Cases*. Ph.D. thesis. Burnaby: Simon Fraser University, School of Resource and Environmental Management.

UNEP-WCMC (United Nations Environmental Programme – World Conservation Monitoring Centre). 2008. *National and Regional Networks of Marine Protected Areas: A Review of Progress*. Cambridge: UNEP-WCMC.

University of Queensland Ecology Centre. 2009. *Scientific Principles for Design of Marine Protected Areas in Australia: A Guidance Statement*. www.ecology.uq.edu.au/docs/Scientific_Principles_MPAs_c6.pdf

Vierros, M., Tawake, A., Hickey, F., Tiraa, A., and Noa, R. 2010. *Traditional Marine Management Areas of the Pacific in the Context of National and International Law and Policy*. Darwin, Australia: United Nations University - Traditional Knowledge Initiative.

Weber, E.P. and Khademian, A.M. 2008. *Wicked Problems, Knowledge Challenges, and Collaborative Capacity Builders in Network Settings*. Public Administration Review March/April: 334-349.

World Resources Institute. 2003. *Principles of Good Environmental Governance*. World Resources 2002-2004: Decisions for the Earth: Balance, voice, and power. http://archive.wri.org/page.cfm?id=1698&z=?

Young, O., 2002. *The Institutional Dimensions of Environmental Change: Fit, Interplay and Scale*. MIT Press, Cambridge, MA.

APPENDIX 1: CANADIAN GOVERNANCE CONTEXT

International Commitments to MPAs

Canada has made many international commitments to complete a national network of MPAs at the 2002 World Summit on Sustainable Development, and in the 2004 United Nations Convention on Biological Diversity Program of Work on Protected Areas.

The 2010 CBD target is:

Target 11: By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascapes.

Also, the maintenance of respectful relations with Aboriginal peoples is consistent with Canada's international obligations, including the United Nations Declaration on the Rights of Indigenous Peoples, article 27 of the International Covenant on Civil and Political Rights, International Labour Organization Convention No. 169, and the International Conventions on Biological Diversity.

Federal and Provincial

Legislative authority for MPAs is shared on between the federal government and provincial and territorial governments. At the federal level Fisheries and Oceans Canada (DFO), Parks Canada, and Environment Canada, each has a mandate for a different kind of MPA. Various types of protected area designations exist at the provincial and territorial level for the establishment of MPAs. Canada's Oceans Act tasks the Minister of Fisheries and Oceans to lead and coordinate the development and implementation of a national network of MPAs on behalf of the Government of Canada.

Canada has approximately eight federal and 40 provincial/territorial legislative or regulatory tools for establishing protected areas with a marine component, including those located within the Great Lakes.

Policy Context

In 2010, the Fisheries and Oceans Canada released a Draft Framework for a National Network of Marine Protected Areas, that was developed in collaboration with other federal agencies and provincial and territorial governments. The framework is being finalized after a public comment period.

In order to facilitate cooperation between the Federal Government and the Province of British Columbia, a 2004 Memorandum of Understanding Respecting the Implementation of Canada's Oceans Strategy on the Pacific Coast of Canada was signed (http://www.dfo-mpo.gc.ca/oceans/publications/bc-cb/index-eng.asp) This instrument established cooperation between Canada and British Columbia and an agreement to develop subsidiary MOUs in several areas, including coordinating the establishment of MPAs on the Pacific coast. While the MOU was never signed by the governments and is no longer being used to framework cooperative relationships, a joint BC Canada MPA strategy has been developed, although not yet publicly available.

The provinces of Nova Scotia and Newfoundland & Labrador have embarked on the development of coastal and ocean management strategies with the objective of providing a long-term road map to managing coastal and marine resources. These initiatives include references to the state of coastal and marine resources, key threats and current provincial protected areas strategies, while making the linkages with existing federal coastal and ocean management processes. In NL the province aims to expand the current protected areas network to include representative portions of all natural regions, including coastal areas.

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Nova Scotia released its State of the Coast report as a precursor to a Sustainable Coastal Development Strategy, expected by Spring 2011, which will likely address the need for greater protection of coastal ecosystems and habitats in NS.

Additionally, the Province of Nova Scotia and the Federal Government signed a Memorandum of Understanding on March 23rd , 2011 with the purpose of advancing collaboration in coastal and ocean management priorities. The MOU is to be implemented through the Regional Committee for Coastal and Oceans Management, a senior executive forum for Federal and Provincial Governments. Subsidiary agreements, working groups and /or other instruments will be developed to address:

- The implementation of Nova Scotia's Sustainable Coastal Development Strategy
- Integrated coastal and ocean management and marine conservation tools development
- Collecting, managing and sharing of information, including access to information by non-government users
- Development of a coastal research network to advance natural and social science, policy and legal research

APPENDIX 2: ABORIGINAL RIGHTS AND TITLE

Aboriginal rights are recognized and affirmed by Section 35(1) of the Constitution Act 1982. Two categories of Aboriginal rights exist. When an Aboriginal group has exercised exclusive occupation and use of a territory from the moment European sovereignty was exerted to the present, their rights to that territory amount to outright title. Other Aboriginal rights may nevertheless exist apart from a demonstration of Aboriginal title, if these are anchored in distinctive and enduring practices, traditions and customs.

In 1990 the Supreme Court of Canada ruled in the landmark *Sparrow* decision that constitutionally protected Aboriginal rights to fish for food, social and ceremonial purposes may not be interfered with by legislation or regulation except where required to fulfill the responsibility of the state to conserve. Subsequent decisions (e.g. *Van der Peet* 1996, *NTC Smokehouse* 1996, *Gladstone* 1996) have further clarified the nature of these rights, particularly with respect to fisheries.

The 1997 *Delgamuukw* case provided the first comprehensive statement by the Supreme Court of Canada on the content of Aboriginal title, confirming that Aboriginal title is "right in the land itself, not just the right to hunt, fish and trap." It clarified that Aboriginal title is a collective right to the exclusive use and occupation of the land for purposes not restricted to traditional activities (e.g. aboriginal groups could undertake development of resources on lands to which they have title, provided it does not interrupt the fundamental character of their cultural relations to the land) (McNeil 2006). At the same time, the Crown has the right to undertake development on Aboriginal title lands, but any infringement by the Crown must be supported by "a compelling and substantive legislative objective" and must involve prior consultation with the Aboriginal group, may require compensation, and in some cases may require consent of the Aboriginal title holders (Christy, 2006; Slattery 2009).

According to Brown and Reynolds (2004) there is no apparent legal basis for thinking that Aboriginal title is inapplicable to the offshore (including the water column, seabed and subsoil). The principles established in *Delgamuukw* are recognised as relevant, as are legal precedents from foreign jurisdictions such as the United States, Australia and New Zealand (Pannell, 1998; Sharp 1998, 2002). It is an entrenched habit in European legal traditions to regard ownership of seas as a Crown prerogative, which may entail greater resistance to the notion of Aboriginal title at sea than on land (Mulrennan and Scott 2000). For this reason negotiations concerning the offshore have tended to focus on co-management arrangements for marine resources, together with a share of various benefits and revenues, rather than the kind of collective fee title ownership negotiable on terrestrial portions of Aboriginal territory (Scott and Mulrennan 2010).

The approach taken on the issue of sea space by the Federal Comprehensive Land Claims process has evolved over recent decades (White 2002). Earlier land settlement agreements such as the *Inuvialuit Final Agreement* (1984) required the extinguishment of Aboriginal claims to sea spaces. The *Labrador Inuit Land Claims Agreement* (2004) provides some limited recognition of sea rights. However, the *Nunavik Inuit Land Claims Agreement* (2006) and *Eeyou Marine Region Agreement* (2010) have gone substantially further in settling land and resource rights over the islands and marine waters of James Bay, Hudson Bay, Hudson Strait and Ungava Bay, as well as northern Labrador. Canada retains jurisdiction over the marine waters and ownership of the seabed while the Cree and Inuit gain ownership of 80% of the offshore islands, including rights to the surface and subsurface. The agreements also include annual royalties from the Government of Canada based on resource development in these marine areas as well as arrangements for co-management boards to manage and regulate wildlife in the offshore, and provisions for MPA development.

On the west coast, close to half of the Statements of Intent filed by First Nations with the BC Treaty Commission include descriptions of sea spaces as part of their traditional territories (Brown and Reynolds 2004). A number of First Nations, including the Haida, Lax Kw'allams[31] and Nuu-chah-nuulth, have initiated court proceedings concerning Aboriginal title to the sea and related fishing rights. These cases have included claims of infringement of rights and title, claims to fishing rights, title to fisheries resource harvesting sites, fishing territory and rights to harvest fish for commercial purposes (Gardner 2009).

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References:

Brown, C.R, and Reynolds, J.L. 2004 Aboriginal title to sea spaces: a comparative study. 37 U.B.C. L. Rev. 449

Christie, G. 2006. "Developing Case Law: the Future of Consultation and Accommodation." *University of British Columbia Law Review* 39: 139-184.

Eeyou Marine Region Land Claims Agreement between the Crees of Eeyou Istchee and Her Majesty the Queen in right of Canada, 7 July 2010.

Gardner, J. 2009. First Nations and Marine Protected Areas: An introduction to First Nations Rights, Concerns and Interests Related to MPAs on Canada's Pacific Coast. Canadian Parks and Wilderness Society

Labrador Inuit Land Claims Agreement between the Labrador Inuit and Her Majesty the Queen in the Right of Newfoundland and Her Majesty the Queen in the Right of Canada, ratified 29 August 2003.

McNeil, Kent. 2006. "Aboriginal Title and the Supreme Court: What's Happening?" *Saskatchewan. Law Review* 69:281-308.

Mulrennan M.E. and Scott C.H., 2000. Mare Nullius: Indigenous Rights in Saltwater Environments. *Development and Change*, 31(3), 681-708.

Mulrennan M.E. and Scott C.H., 2001. Aboriginal Rights and Interests in Canada's Northern Seas. In C.H. Scott (ed), *Aboriginal Autonomy and Development in Northern Quebec and Labrador*. Vancouver: UBC Press, 78-97.

Nunavik Inuit Land Claims Agreement between the Nunavik Inuit and Her Majesty the Queen in right of Canada, signed 1 December 2006.

Nunavut Land Claims Agreement between the Inuit of the Nunavut and the Government of Canada, signed 25 May 1993.

Pannell, S. 1998 The Promise of Native Title and the Predicament of Customary Marine Tenure. In N. Peterson and B. Rigsby, eds., *Customary Marine Tenure in Australia.* Sydney: University of Sydney, 1998).

Scott C.H. and Mulrennan M.E., 2010. Reconfiguring Mare Nullius: Torres Strait islanders, Indigenous Sea Rights and the Divergence of Domestic and International Norms. In M. Blaser, R. de Costa, D. McGregor and W.D. Coleman (eds) *Indigenous Peoples and Autonomy: Insights for a Global Age*. Vancouver: UBC Press. Chapter 7, 148-176.

Sharp, N. 1998. Reimagining Sea Space: From Grotius to Mabo. In N. Peterson and B. Rigsby, eds., *Customary Marine Tenure in Australia.* Sydney: University of Sydney.

Sharp, N. 2002 *Saltwater People: The Waves of Memory*, Allen and Unwin, Australia; University of Toronto Press, North America, Crows Nest, NSW; Toronto, Buffalo.

Slattery, Brian. 2009. "The Metamorphosis of Aboriginal Title" In Maria Morellato, ed. *Aboriginal Law Since Delgamuukw*. Canada Law Book. Pp. 145-173.

The Western Arctic (Inuvialuit) Claims Settlement Act. signed 5 June 1984 between the Inuvialuit and the Government of Canada.

White, G. 2002. "Treaty Federalism in Northern Canada: Aboriginal-Government Land Claims Boards." *Publius* 32(3):89-114.

APPENDIX 3: AUTHORS

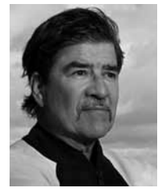
The following scientists contributed to the document and reached consensus on the guidelines as a whole:

Dr. Kai Chan

Kai Chan is an associate professor and Canada Research Chair (tier 2) at the Institute for Resources, Environment and Sustainability at the University of British Columbia. His training spans conservation biology, ecology, evolutionary biology, policy, and ethics. Kai combines these perspectives in a research program on social-ecological interactions (including human impacts on ecosystem components and processes, and ecosystem services to benefit people) to inform applied environmental ethics and ecosystem-based management. Kai leads the Conservation Collaboration in Interdisciplinary Study of Ecosystems (www.conciseresearch.net); he is a director on the board of the Canadian Parks and Wilderness Society's BC chapter (CPAWS-BC) and a senior fellow of the Environmental Leadership Program.

Dr. Isabelle Côté

Isabelle Côté is a professor in the Biology Department at Simon Fraser University and leads the Tropical Marine Ecology Research Group. Her applied marine ecology and conservation research comprises three focal areas: marine protected areas, reconstructing patterns of ecological change on coral reefs and the invasion of Caribbean reefs by Indo-Pacific lionfish. Isabelle is currently part of a Royal Society of Canada expert panel focused on issues related to climate change, overfishing and marine biodiversity.



Dr. Philip Dearden

Philip Dearden is leader of the MPA Research Group within the Geography Department at the University of Victoria. His research focuses on the establishment and management of protected areas with topics ranging from natural science (ex. seagrass ecology, whale shark monitoring, coral reef assessments) to social science (ex. economic impacts of diving, MPA governance, Indigenous perspectives) and the relationship between them. He is Chair of the Marine Protected Area Working Group of the Ocean Management Research Network and also served as the Co-Chair of Parks Canada's NMCA Science Advisory Network.

Dr. Elizabeth De Santo

Elizabeth De Santo is an Assistant Professor in the Marine Affairs Program at Dalhousie University. Her research interests encompass environmental politics, marine conservation and governance, environmental law, and improving the science/policy interface in environmental decision-making. She is particularly interested in spatial approaches to management, including MPAs and marine spatial planning. She is a co-author of the recently released UNEP-funded project on MPA Governance that examined case studies from over 20 countries.

Dr. Marie-Josee Fortin

Marie-Josee Fortin is a Professor of Ecology and Evolutionary Biology at the University of Toronto. She is an ecologist by training with four main research areas: spatial ecology, forest ecology, landscape ecology and spatial statistics. Her research program studies the effects of global changes (land use and climate) on species spatial dynamics at the landscape and the geographical range levels both in multiuse forested ecosystems and aquatic networks to maintain biodiversity and species conservation.

Dr. Frederic Guichard

Frederic Guichard is an Associate Professor in the Biology Department at McGill University. He is interested in studying how large scale patterns of biological diversity develop and are maintained from local interactions among individuals; how biological diversity is influenced by global changes; the role of biological diversity for community structure and dynamics; and how environmental complexity interact with biotic processes to maintain variability and diversity in communities. Much of his research is focused on understanding how diversity and other properties of marine communities emerge from local interactions among individuals.

Dr. Wolfgang Haider

Wolfgang Haider is a Professor in the School for Resource and Environmental Management at Simon Fraser University. He is interested in social science survey methods, quantitative analysis, and trade-off modelling, as they relate to decision making in resource management. Most of his work focuses on protected areas management, outdoor recreation and recreational fishing, resource-based tourism, land use planning, and landscape perception. Many of his research applications include discrete choice experiments, which permit the explicit modelling of trade-offs for a large number of land use or recreation alternatives, including currently non-existing options.

Dr. Glen Jamieson

Glen Jamieson is a retired research scientist from Fisheries and Oceans Canada, Pacific Biological Station. He is interested in conservation biology issues, specifically marine protected areas, research in support of ecosystem-based management, invasive species and critical habitat definition for Species at Risk. He was involved in identifying ecologically and biologically significant areas (EBSAs) in Pacific Canada, and expects that many of these may ultimately become regional MPAs. Other work has focused on marine biogeoclimatic zone classification and locating high-density coral and hexactinellid sponge locations.

Dr. Donald Kramer

Don Kramer is a Professor Emeritus and former Chair of Biology at McGill University. His research focuses on the behavioural ecology of space use and movement, including habitat selection, frequency- and density-dependent distributions, predation risk and predator avoidance, and resource defense. Among other topics, he and his students have studied the behaviour and ecology of marine fishes in the Caribbean and Atlantic, including factors influencing emigration from reserves into harvested areas.

Dr. William Montevecchi

Bill Montevecchi is a Professor of Biological and Ocean Sciences at Memorial University. He is engaged in a long-term interdisciplinary ecosystem research program focused on the behavioural ecology of marine and terrestrial birds. With a conservation focus, his research explores multi-species interactions in dynamic Low Arctic and Boreal ecosystems and assesses the use of animal responses as indicators of prey and ecosystem conditions. He collaborates with oceanographers, fisheries research scientists and seabird biologists from across Canada, the USA, Europe, Australia and Africa.

Dr. Monica Mulrennan

An Associate Professor in Geography at Concordia University, Monica Mulrennan's research interests focus on indigenous peoples and their use and management of coastal and marine environments. More specifically, she is interested in local ecological knowledge, community-based management, protected area development, human adaptations to environmental change, and small boat fisheries development. Monica is current Chair of the Indigenous Peoples Working Group (IPWG), a specialty group of the Canadian Association of Geographers.

Dr. John Roff

John Roff is the Canada Research Chair in Conservation and Environment and was a Professor of Environmental Science and Coastal Oceanography at Acadia University. He has had extensive research experience in aquatic environments, from the tropics to the Canadian Arctic and is an internationally recognized authority on marine conservation planning. John was also the past Editor of the Canadian Journal of Fisheries and Aquatic Sciences. His present research is primarily focused on developing practical frameworks for marine conservation based on ecological principles, and analyses of geophysical parameters, biological community structure, and habitat and ecosystem level processes.

Dr. Anne Salomon

Anne Salomon is an Assistant Professor in the School of Resource and Environmental Management at Simon Fraser University. Broadly, Anne is interested in the cascading effects of predator depletion on marine food webs, marine reserve design and evaluation, climate change impacts on coastal ocean ecosystems, alternative state dynamics, and the resilience of social-ecological systems. Ultimately, Anne strives to engage coastal communities and government agencies in collaborative research and encourage constructive dialogue among stakeholders to navigate the tradeoffs between coastal conservation and resource use.

Dr. Ashley McCrea-Strub

Ashley is a postdoctoral-fellow with the Sea Around Us Project at the University of British Columbia, and is working with Dr. Daniel Pauly and other project members. She earned her PhD in Marine Biology and Fisheries from the Rosenstiel School of Marine and Atmospheric Science at the University of Miami in Florida. Her dissertation research focused on the use of multispecies modeling frameworks to evaluate dynamic interactions between predator and prey populations, and to understand the influence of fisheries and environmental temperature change on predator-prey and food chain communities. Currently, her research focuses on quantification of the global financial cost of marine protected areas and evaluation of changes in mean trophic level following the establishment of no-take marine reserves.

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APPENDIX 4: CANADA'S MARINE ECOREGIONS