Recommended guidelines for applying Canada-BC Marine Protected Area Network Principles in Canada's Northern Shelf Bioregion:

Principles 1,2,3,5,6,7,8,9,11,14 and 15

Produced by PacMARA for the British Columbia
Marine Protected Areas Technical Team (MPATT)

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1 Executive Summary

1.1 Background and aims

This is the third report by the Pacific Marine Analysis and Research Association (PacMARA) produced for the Federal-Provincial-First Nations Marine Protected Area Technical Team (MPATT). In combination, these three reports have looked at most of the 16 Principles[1] contained in the Canada-British Columbia Marine Protected Area Network Strategy, with specific consideration to their application to the Northern Shelf Bioregion in BC. The current report has relied on the previous two for their literature reviews, as well as building upon their recommended guidance. As with the previous reports, the intended audience is those who have the responsibility to design and establish a network of marine protected areas (MPAs) in northern BC; however, much of the content is applicable more broadly as well.

The central purpose of writing this third report has been to develop short, specific and pragmatic *guidelines* for the implementation of the selected Principles. Derived from more general *guidance* in the previous PacMARA reports as well as other sources,[2] combined with the experiences of the authors, each *guideline* sums up how a specific aspect of a Principle can be implemented in practical terms. The guidelines aim to be short and pithy, but in writing these guidelines we found that they often lend themselves to further explanation, which in turn can look rather a lot like more generic guidance. Thus, the more specific guidelines act as a short-cut that leads back to broader guidance in the end. While there is a certain circularity to this, there is also iterative progression –analogous to marine planning more generally.

The guidelines are sub-divided into *primary* and *secondary* guidelines, whereby a secondary guideline largely flows out of a primary one. This is not to say that one is more important than the other. Primary guidelines, however, represent good starting points for the various aspects of MPA network design.

The primary guidelines are listed below. However, to suggest that these alone are sufficient for MPA network design, would be similar to saying that reading this Executive Summary is as good as reading the whole report! We hope you find this report useful, and are happy to clarify or discuss issues further, as they may arise.

[1] Of the 16 Principles only 10 (*Work with People*) and 13 (*Apply Adaptive Management*) have not been covered at all; though 4 (*Maintain Long-Term Protection*) and 12 (*Foster ecosystem-based management*) were only briefly discussed. The first PacMARA report on this topic was Ardron et al. (2015), which considered Principles 1, 2, 3, 5, 6, 16, with discussion on 4, 7, 8, 12. The Second PacMARA report was Patterson et al. (2016) which considered Principles 6, 7, and 8. This current report considers Principles 1, 2, 3, 5, 6, 7, 8, 9, 11, 14 and 15.

[2] Sources of guidance have included the academic literature as well as grey literature. Particular attention has been given to two previous reports in the grey literature concerning MPAs in BC: Jessen et al. (2011), and Burt et al. (2014).

1.2 Primary Guidelines contained in this report

1.2.1 Primary guidelines for general operating Principles

1. Develop a standardized set of criteria to assess which existing MPAs and other effective area-based conservation measures meet the Canada-BC Strategy's MPA definition.
2. Where appropriate, enhance the protection levels of existing sites with supplementary management measures (e.g. adding federal fisheries closures to provincial and locally protected areas).
3. Pre-define a set of protection levels to use when planning the spatial configuration of the network, based on the IUCN marine interpreted categories.
4. Pre-defined protection levels should include strict no-take zones (IUCN Category Ia), as well as other highly protected areas that may provide for limited traditional extractive use (IUCN Categories Ib and II).

1.2.2 Primary guidelines for social, economic and cultural network design Principles

5. Develop a typology of uses and values of marine space and resources.
6. Identify the suite of user groups and rights holders, considering, *inter alia*, federal and provincial leaseholders, First Nations, fishers, conventional and non-conventional energy, shipping, economic tourism and non-economic recreation.
7. Characterize the spatial and temporal distribution of the array of uses, values, and rights across the NSB, inasmuch as available data allow.
8. Identify highly valued areas, including areas which will be compatible or incompatible with MPAs.
9. Trade-off issues should include, but not be limited to, maximizing positive and minimizing negative economic impacts (economic efficiency) and tending to distributional impacts (social equity). Positive and negative impacts on the environment, spiritual and cultural practices, should also be included, when salient.
10. Higher risk conflicts with user activities / values should be prioritized for data gathering and the creation of baseline scenarios. All relatively likely issues should ultimately be assessed.
11. Consideration of alternative regulatory and non-regulatory options should be guided by principles of good governance, including (but not limited to) effectiveness, efficiency, and accountability.
12. Assessing benefits and costs of MPA options should first be at the scale of a regional network and take into consideration:
    i. the range of (economic, social, and cultural) benefits they provide;
    ii. how the places in question are valued by the public and stakeholders;
    iii. an evaluation of the consequences of inaction or inertia;
    iv. direct and indirect (to the extent possible) impacts of the options;
    v. the equitable distribution of the costs and benefits of conservation between communities and users;
    vi. relative management costs and cost-effectiveness;
    vii. using all readily available data and information.
13. There should be clear and well-communicated lines of authority, responsibility and management between Government Departments and Delivery Agencies.
14. Ensure the implementation of common and accepted standards of transparency and accountability throughout the process, recording important decisions as they are made.

15. Areas of high protection (IUCN Category Ia) should be designed as 'core zones' within MPAs, surrounded by a buffer area falling into a lower protection level.
16. First Nations whose territories fall within the MPA planning region should, at a minimum, be consulted and accommodated. Further levels of engagement should be at the discretion of the affected First Nations.
17. Existing relevant treaties in the NSB should be identified and their influence on MPA planning made explicit.
18. Traditional [Aboriginal] ecological knowledge should be integrated in the MPA network selection process, and/or can be blended with science in planning, implementation, and management.
19. Where possible, integrate Canadian laws and First Nations laws and customs to manage MPAs, recognizing that aspirations will vary Nation by Nation (e.g., type of desired economic development and support for MPAs will vary).

1.2.3 Primary guidelines for ecological network design Principles

20. Representation and replication targets should be set for each class in at least one broad-scale comprehensive classification system. Targets should be set for each class to be represented in each geomorphological class in which it occurs.
21. Identify a list of priority features (species, habitats, geomorphological and/or oceanographic features) for which to set representation and replication targets, focussing on valuable and important features that can be geographically demarcated, and for which spatial distribution data exist within the NSB.
22. Replicate each biodiversity proxy and priority feature in every geomorphological class where it occurs.
23. Representation targets for biodiversity proxies and priority features should vary widely (<5% to 100%), based on rarity, vulnerability, importance, level of data uncertainty, and MPA protection levels applied.
24. The minimum overall spatial footprint of the MPA network should be 20% of the NSB.
25. As a general rule, apply representation and replication targets across all geomorphological classes.
26. During the initial gap analysis, the existing NSB EBSAs identified by DFO should be reviewed to decide whether they warrant inclusion (as a whole or in part) within the MPA network.
27. Large EBSAs that cannot practically be included in full should be added to the priority features list under Principle 1, with percentage representation targets set for each one.
28. Apply the guidelines on MPA size and spacing presented under Principle 5.
29. In general, MPAs should be well distributed alongshore and offshore.
30. In the NSB, highly protected sites should have a minimum size ranging from 5 km^2 to 150 km^2 minimum, depending on site location, protection level, and conservation objectives, with the majority of sites at least 50 km^2 in size.
31. MPA shape should minimize the edge-to-area ratio to maximize compactness, where practical.

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List of Abbreviations:

BC	British Columbia
CCEA	Canadian Council on Ecological Areas
DFO	Fisheries and Oceans Canada
EBM	ecosystem-based management
EBSAS	ecologically or biologically significant areas
EEZ	Exclusive Economic Zone
ENG	Ecological Network Guidance (developed for England's MCZ process)
GBRMP	Great Barrier Reef Marine Park
GIS	Geographic Information System
ICCAS	Indigenous and Community Conserved Areas
IUCN	International Union for the Conservation of Nature
MCZ	Marine Conservation Zone
MLPA	California Marine Life Protection Act
MPA	marine protected area
MPATT	Marine Protected Area Technical Team
NSB	Northern Shelf Bioregion
OEABCMs	other effective area-based conservation measures
OECD	Organisation for Economic Co-operation and Development
PNCIMA	Pacific North Coast Integrated Management Area
TEK	traditional [Aboriginal] ecological knowledge
UNDP	United Nations Development Program
WCPA	World Commission on Protected Areas

2 Introduction

2.1 Background and Aims

2.1.1 Background

2.1.1.1 The *Canada – British Columbia Marine Protected Area Network Strategy* (henceforth referred to as the Strategy) was developed to protect the rich biodiversity of BC's marine environment for present and future generations (Canada-BC 2014). The strategy contains six overarching goals as well as 16 broad Network Design Principles to apply in the development of a marine protected area (MPA) network, covering ecological, social, economic, and cultural aspects as well as general operating Principles.

2.1.1.2 The six Strategy Goals are:

1. To protect and maintain marine biodiversity, ecological representation and special natural features (Goal 1 is of primary importance).
2. To contribute to the conservation and protection of fishery resources and their habitats.
3. To maintain and facilitate opportunities for tourism and recreation.
4. To contribute to social, community and economic certainty and stability.
5. To conserve and protect traditional use, cultural heritage and archaeological resources.
6. To provide opportunities for scientific research, education and awareness.

2.1.1.3 The 16 Network Design Principles are:

- Ecological Network Design Principles
    1. Include the full range of biodiversity present in Pacific Canada (representation and replication).
    2. Ensure ecologically or biologically significant areas are incorporated (EBSAs).
    3. Ensure ecological linkages (connectivity).
    4. Maintain long-term protection
    5. Ensure maximum contribution of individual MPAs (size, spacing, shape).
- Social, economic and cultural Principles
    6. Recognize and consider the full range of uses, activities and values supported by marine environments (spatio-temporal intensity of human activities, cultures and values, ecosystem goods and services, costs of inaction).
    7. Maximize the positive (identify opportunities for sustainable socio-economic activities, cultural and spiritual values).
    8. Minimize the negative (network design cost, user conflict, balance conservation with social and economic opportunities, economic analyses).
    9. Enhance management effectiveness and compliance to maximize benefits and minimize costs.

10. Work with people (balanced, open, inclusive, transparent, providing opportunities for meaningful involvement, stakeholders, & partnerships with First Nations, local authorities, coastal communities, resource users).
11. Respect First Nations' treaties, title, rights, aspirations and world-view.

- General operating Principles

12. Foster ecosystem-based management.
13. Apply Adaptive Management.
14. Build on existing MPAs, other management tools and marine planning initiatives.
15. Include a full range of protection levels.
16. Take a precautionary approach.

2.1.2 Aims of this report

2.1.2.1 The above Principles are broad and could be interpreted and implemented in many different ways. This report presents guidelines developed by PacMARA to support the Marine Protected Area Technical Team (MPATT) in the interpretation and practical implementation of a subset of the Principles (1,2,3,5,6,7,8,9,11,14 and 15). The MPATT is the Federal-Provincial-First Nations technical working group responsible for coordinating MPA network planning and implementation within part of BC's maritime area, the Northern Shelf Bioregion (NSB).

2.1.2.2 PacMARA has previously carried out extensive literature reviews and developed general guidance for most of the ecological Principles (Ardron et al. 2015) and socio-economic Principles (Patterson et al. 2016). This earlier work remains valid and should continue to be referred to along with this new report, in which the focus has shifted towards the development more detailed and specific guidelines applicable in the NSB context. The guidelines developed in this current report represent a further step along the way from Principles and general guidance towards operational planning guidelines (such as specific metrics and benchmarks that will directly guide the network design).

2.2 Approach and Structure

2.2.1 Approach

2.2.1.1 While the guidelines presented here build on the previous PacMARA work referred to above, a new team of academics and practitioners was assembled to write this report, providing a fresh perspective on the Principles and their implementation[3]. This report is more practically focused, with little emphasis on further literature review except for those Principles that weren't covered in detail in the literature reviews of the earlier reports.

2.2.1.2 Existing practical design guidelines for MPA networks used in planning processes in other parts of the world were reviewed in order to provide a sound and practical underpinning to the guidelines developed for the NSB process. However, there are not many processes globally where MPA network design guidelines have been developed at this level of detail for a broad planning region. Where such guidelines do exist, they are tailored to the specific context of their planning processes and natural environment. Hence, existing guidelines cannot be directly applied in the British Columbia (BC) context. The guidelines developed in this report are therefore all, to some extent, based on a considered judgement call by PacMARA, informed by the expertise of the authors.

2.2.1.3 The successful implementation of many of the Principles (the social, economic and cultural ones, in particular) will require a thoughtfully designed planning and decision-making process, so the guidelines in this report touch upon process management considerations as well as more technical network design considerations. We have endeavoured to strike a balance between providing sufficient detail for the guidelines to be useful, whilst maintaining enough flexibility to allow the MPATT to explore options best suited to the developing planning process, including the stakeholder engagement process.

2.2.1.4 In drafting the guidance and guidelines, we noted the many ways in which the Principles interlink and impact on each other. In order to ensure the full implementation of all Principles, the guidelines in this report should be interpreted and applied in each other's context, rather than individual guidelines being reviewed or applied in isolation. Where there are clear links and interdependencies between guidelines for different Principles, these have been flagged throughout the report.

2.2.1.5 Guidelines for the same Principle are also often closely linked with each other. We have differentiated between *primary* and *secondary* guidelines for each Principle, with secondary guidelines often being ones that flow out of the primary ones, providing more detail. Secondary guidelines should not be seen as unimportant – as stated in the previous paragraph, each guideline should be reviewed in the context of the full suite in order to ensure that the Principles are met in full.

2.2.2 Structure

2.2.2.1 The Strategy groups the Network Design Principles into three groups, as reflected in section 2.1.1.3: ecological (Principles 1-5), social-economic-cultural (Principles 6-11), and general operating Principles (Principles 12-16). This grouping is reflected in the three main report sections that follow this introduction. Each main section covers one of the groups of

[3] One team member (Jeff Ardron) was an author on both previous reports, to ensure continuity between the projects.

Principles, beginning by introducing the group as a whole, and then focusing in detail on the subset of Principles for which PacMARA has been asked to develop detailed guidelines in this report. These are ecological Principles 1,2,3, and 5; social-economic-cultural Principles 6,7,8,9, and 11; and general operating Principles 14 and 15.

2.2.2.2 The general operating Principles are addressed first (in section 3), despite the fact that they appear on the bottom of the list as presented in the Strategy. The general operating Principles address cross-cutting issues which impact on the guidelines for the ecological and socio-economic-cultural Principles, so addressing them first reduces the amount of repetition within the report. The Strategy's numbering of the Principles has been maintained, however, which means that the Principles don't run in numerical order (Principle 14 is the first to be covered).

2.2.2.3 Section 4 covers the social, economic and cultural Principles. Guidelines for these Principles address process design as well as technical methods that can be used to support their implementation. The ecological network design Principles are addressed in section 5.

2.2.2.4 Each of the three main sections is subdivided into subsections focussing on single Principles, within which we have attempted to draw a distinction between background information and existing relevant guidance published elsewhere (including in PacMARA's two previous reports), new general *guidance* that is specific to the NSB, and detailed *guidelines* for the NSB. General guidance addresses the 'what', whereas detailed guidelines address the 'how' of implementation. The *guidelines* for each Principle are clearly marked as such in the text, and summarized in summary tables at the end of each subsection, using the format suggested by the MPATT in the Scope of Work for this report.

2.2.2.5 There are many instances in which the implementation of one Principle will impact on the implementation of others, with synergistic effects as well as potential conflicts that are characteristic of multi-criteria decision-making. Under many of the Principles, cross-references have been included in the text to highlight these linkages.

2.2.2.6 Appendix 3 contains a stand-alone document aimed at a wider, public audience, which explains the way in which the origin, context and creation of the recommended guidelines in this report, using a format and language designed for a general rather than a specialist audience. The guidelines themselves are not explained in detail in this document, instead, interested readers are referred to this full document.

3 Guidelines for general operating Principles

3.1 General operating Principles

3.1.1 Overview

3.1.1.1 The Strategy lists a series of general operating Principles at the end of its list of MPA Network Design Principles (Principles 12-16). These general operating Principles cover broad, cross-cutting concepts such as ecosystem-based management, adaptive management, protection levels, and the precautionary approach. The implementation of these Principles will affect the way in which the other (socio-economic-cultural and ecological) Principles are applied.

3.1.1.2 In this report, PacMARA was requested to focus in particular on Principles 14 (building on existing MPAs) and 15 (including a full range of protection levels) – guidelines for these Principles are presented in sections 3.2 and 3.3 below. In order to place them (and the other guidelines in this report) in context, the other three general operating Principles (12, 13 and 16) are briefly introduced here. They were not included in the Statement of Work for this report, therefore, no new design guidelines have been developed for them.

3.1.2 General operating Principle 12: Ecosystem-based management

3.1.2.1 Principle 12 in the Strategy is that the MPA network and planning process should "*Foster ecosystem-based management. Marine protected area network planning will take into account the broader movement towards ecosystem-based management (EBM) of marine areas. EBM is an adaptive approach to managing human activities in a manner that ensures the coexistence of healthy, fully functioning ecosystems and human communities. The intent of EBM has been described as "to maintain those spatial and temporal characteristics of ecosystems such that component species and ecological processes can be sustained and human well-being supported and improved*" (Strategy, p.19).

3.1.2.2 With respect to Principle 12, Ardron et al. (2015) encouraged the NSB process to make use of EBM work that has been already carried out in BC, with particular attention to the Pacific North Coast Integrated Management Area (PNCIMA) definition of EBM (PNCIMA, 2013), as well as the Sidney Consensus (Appendix 3 in Ardron et al. 2015).

3.1.3 General operating Principle 13: Adaptive management

3.1.3.1 Principle 13 in the Strategy states that the process should "*Apply adaptive management. Including adaptive strategies (i.e. learning by doing) in MPA network planning processes allows for adjustments in management approach and/or alterations to protected area boundaries as science evolves and the dynamics of the marine environment change. In addition, flexibility and adaptability will be required to effectively and efficiently consider the interests of marine resource users now and into the future*." (Strategy p. 19)

3.1.3.2 Adaptive management is a concept that is often referred to in relation to marine spatial planning and MPA management. Passive adaptive management[4] is centred on the idea of an on-going process in which the effects of management measures and planning decisions are continuously monitored and outcomes reviewed against the objectives of the process, with monitoring and evaluation results informing modifications to management measures and planning decisions in a continuous review cycle. Ardron et al. (2015) highlight the need to regularly monitor, review, re-evaluate, and adapt throughout the MPA process in BC and the NSB, as experience is developed and new information becomes available.

3.1.4 General operating Principle 16: Precautionary approach

3.1.4.1 Principle 16 of the Strategy is that the MPA process should "*Take a precautionary approach. A lack of scientific certainty will not be used as a reason for postponing establishment of MPA networks as a tool to help mitigate or prevent serious damage to the marine environment.*" (Strategy p. 19)

3.1.4.2 Ardron et al. (2015) developed a list of guidelines and potential pitfalls for this Principle, these are reproduced in appendix 1.

[4] Active adaptive management, on the other hand, views management options as akin to scientific experimental treatments, and suggests trying a variety of management approaches to determine which one(s) works best (e.g. McCarthy and Possingham 2007).

3.2 Principle 14: Existing MPAs

3.2.1 Wording of Principle

3.2.1.1 Principle 14:

"Build on existing MPAs, other management tools and marine planning initiatives.

Marine protected areas will be established and operated in the context of broader marine management that includes a range of conservation tools and management techniques applied in adjacent marine and terrestrial areas (e.g., fisheries closures, shipping regulations, etc.). Governments will seek opportunities to capitalize on existing federal and provincial MPAs and other spatially defined conservation measures to achieve network goals and objectives." (Strategy, p. 19)

3.2.2 Background

3.2.2.1 As a participant and signatory of the Strategic Plan for Biodiversity (2011-2020) and the 20 Aichi Biodiversity Targets (2010), Canada has committed to protected 10% of marine environments via MPAs and other effective area-based conservation measures (OEABCMs) by 2020 (MacKinnon et al. 2015, Environmental Canada 2009). Currently, federal and provincial governments in Canada have designated 750 marine areas, which represent only 1% of Canada's marine environments (Canadian Council on Ecological Areas 2014).

3.2.2.2 The Strategy highlights that there are over 185 MPAs already in place in the NSB, which collectively seek to protect 28 % of BC's coastline and 2.8 % of Pacific Canada's Exclusive Economic Zone (EEZ). These areas were designated piecemeal under federal and provincial legislation, providing varying levels of protection to a range of different values and locales. While the current process aims to take a more systematic approach to maximize benefits at the MPA network level, it isn't starting from a blank slate – it has to build on these existing sites.

3.2.3 What counts as an MPA?

3.2.3.1 As a first step, it has to be determined which of the existing designated sites within BC meet the Strategy definition of an MPA, and what category or protection level they fall into (so they can be integrated into the protection level framework under Principle 15, see section 3.3).

3.2.3.2 Page 7 of the Strategy states that "*the term 'marine protected area' will be used as a single, general umbrella term that is applied to the range of different marine habitat protection tools available under federal and provincial legislation. In addition, the International Union for the Conservation of Nature / World Commission on Protected Areas (IUCN/WCPA) 2008 definitions of a protected area and a protected area network have been adopted both nationally and regionally for developing networks of MPAs*."

3.2.3.3 The IUCN defines an MPA as "*A clearly defined geographical space recognized, 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, IUCN 1994). It should be noted that each of the terms in this statement has, in turn, been given a clear and specific definition by the IUCN, these definitions are reproduced in appendix 3 of the Strategy.

3.2.3.4 An MPA network is defined by the IUCN as "*A collection of individual marine protected areas that operates cooperatively and synergistically, at various spatial scales, and with a range of protection levels, in order to fulfill ecological aims more effectively and comprehensively than individual sites could alone*." (WCPA/IUCN, 2007).

3.2.3.5 The Strategy specifies that "*to be considered for inclusion in a network, it must be demonstrated that a given MPA:*

1. *Meets the network definition of a marine protected area, including each of the key terms as described by the IUCN* [this refers to the interpretation of the terms within the IUCN definition, as given in Dudley 2008 and reproduced in appendix 3 of the Strategy]*;*
2. *Contributes to the Canada-BC MPA Network Strategy Goal #1* [biodiversity conservation]*; and*
3. *Has a management plan or protection guidance explicitly specified in supporting legislation or regulations and is being effectively managed for achievement of the MPA network goal(s).*" (Strategy, p.7)

3.2.3.6 Table 1 lists the spatial conservation measures that currently exist in BC, indicating which ones are present in the NSB, and whether or not they meet the Strategy definition of an MPA.

3.2.4 Categorizing existing MPAs: IUCN Categories

3.2.4.1 The IUCN have developed strict guidelines for categorizing protected areas (Dudley 2008, IUCN 1994). Briefly, the IUCN categories are:

- Ia, Ib No-take (and nearly no-take) highly protected reserves with limited access
- II, III – Protected areas allowing no or very little resource extraction but with recreational access, managed with the intent to conserve entire ecosystems and/or local and significant cultural or geological landmarks
- IV, V, VI – Protected areas managed to conserve specific named species, landscapes, or the broader environment, allowing sustainable use of natural resource in line with the site objectives, with category VI including sites with little restriction of human use.

3.2.4.2 The IUCN categories defined by Dudley (2008) are based primarily on site objectives and natural characteristics described in largely terrestrial terms. In order to make the categories more easily applicable in the marine environment, Day et al. (2012) developed a marine interpretation of the IUCN categories to use for MPAs. The marine interpreted categories are based on the management measures (activity restrictions) that are in place within protected areas as much as they are based on site objectives and natural characteristics. The IUCN categories defined by both Dudley (2008) and Day et al. (2012) are covered in more detail under Principle 15 (section 3.3).

3.2.4.3 In order for a site to qualify for a given category under the IUCN guidelines, its primary objective (and related management measures) should apply to at least three quarters of the protected area. Known as the '75% rule' (Dudley 2008, p. 35), this means that the remaining 25% of land or water within a protected area can be managed for other essential and unavoidable purposes so long as these uses are compatible with the definition of a protected area and the management category it is being assigned to.

3.2.4.4 Most of Canada's protected areas (both marine and terrestrial) have already been assigned an IUCN classification by their governing body based on their management intent (IUCN and UNEP 2009, ILMB 2009). However, when applying the marine interpreted IUCN categories to existing MPAs, a mismatch can emerge between the site objectives (i.e. the intended outcome of management measures), and the management measures that are in place in practice. This is often due to a lack of fisheries closures in MPAs, as some bodies responsible for managing MPAs lack jurisdiction over fisheries measures (Ban et al. 2014). Several studies have shown that, without spatially and temporally corresponding fisheries closures and commercial exclusion zones in place, Canada's current MPAs fail to meet their conservation goals and remain largely ineffective (Robb et al. 2015, Ban et al. 2014).

3.2.4.5 In this report, current categories of municipally, provincially, and federally protected areas (MPAs and OEABCMs) have been analyzed for their correspondence with the definitions in both Dudley (2008) and Day et al. (2012). Table 1 lists the spatial conservation measures that currently exist in BC and the NSB. Those that meet the Strategy definition of an MPA are allocated to IUCN categories in two columns. The first indicates the IUCN category as assessed by their respective governing bodies, the second allocates them to a marine interpreted category based on PacMARA's interpretation of the realistic levels of protection these areas currently afford.

3.2.4.6 As they currently exist, OEABCMs and MPAs in BC were not established (nor have they been assessed) under any singular criteria or screening tool. While some federally-imposed restricted areas (RCAs, Sponge Reef Closures) contribute to ecosystem conservation, they do not meet the standards for a Strategy MPA or a CCEA (Canadian Council on Ecological Areas) OEABCM because they are not long-term (i.e., could be undone easily and at any time) and have stated goals to protect only one species or genus (MacKinnon et al. 2015). Most provincial MPAs or OEABCMs in BC do not restrict fishing activities (Robb et al. 2011).

Table 1 Existing categories of municipally, provincially, and federally protected areas (MPAs and OEABCMs) in BC.

Existing Designation Type	Legislation	Jurisdictional Body	Present in NSB? (Y/N)	Meets Strategy MPA Definition?	IUCN Category [a]	IUCN Marine-Interpreted Category [b]	Rationale/Comments
Federal Jurisdiction							
Marine Protected Areas (MPAs)	Oceans Act	Fisheries and Oceans Canada	Y	Y	I-VI	(same as IUCN category)	MPAs in BC meet the Strategy definition of an MPA (zoned for varying degrees of protection).
National Marine Conservation Areas (NMCAs)	Canada National Marine Conservation Areas Act	Parks Canada	Y	Y	I-VI	(same as IUCN category)	NMCAs combine zones of high protection with larger areas where ecologically sound activities such as sustainable fishing are permitted. Exploration and development of non-renewable resources and ocean dumping are prohibited throughout NMCAs.
National Park Reserve	Canada National Parks Act	Parks Canada	N	Y	II	(same as IUCN category)	National Parks seek to conserve ecological integrity with permanence; none that extend into marine systems currently exist in the NSB
National Wildlife Areas	Canada Wildlife Act	Environment Canada	NP	Y	IV	(same as IUCN category)	National Wildlife Areas seek to conserve nationally significant flora, fauna, and features, are selected under a set of biological criteria, and managed through an ecosystem-based approach.
National Migratory Bird Sanctuary	Canada Wildlife Act	Environment Canada	N	Y	IV	(same as IUCN category)	Though Migratory Bird Sanctuaries seek mainly to conserve one (or several) designated bird populations via habitat protection, their spatial-definition and permanence allow them to fall within the Strategy definition of an MPA.
Rockfish Conservation Areas (RCAs)	Fisheries Act	Fisheries and Oceans Canada	Y	N	Not applicable	Do not qualify for IUCN category	Rockfish Conservation Areas are designated through spatial Fisheries Closures and therefore do not qualify as MPAs as fisheries closures are not guaranteed to be long-term. The 164 RCAs in BC all allow some types of recreational and commercial fishing within their boundaries. RCAs could meet the strategy definition of MPAs if given long-term secure protection and if biodiversity protection became a primary objective.

Existing Designation Type	Legislation	Jurisdictional Body	Present in NSB? (Y/N)	Meets Strategy MPA Definition?	IUCN Category [a]	IUCN Marine-Interpreted Category [b]	Rationale/Comments
Sponge Reef Fisheries Closures	Fisheries Act	Fisheries and Oceans Canada	Y	N	Not applicable	Do not qualify for IUCN category	Sponge Reef Fisheries Closures are implemented and regulated by the DFO, but fail to meet the strategy definition of a MPA. Though they seek to protect special marine features through limiting destructive bottom-contact fishing activities, they do not have marine biodiversity conservation as a primary goal. They are also categorized as temporary protection. If designated as MPAs, as currently proposed, they would fit the MPA criteria. The IUCN category would depend on management measures.
Regional Fisheries Closures	Fisheries Act	Fisheries and Oceans Canada	Y	N	Not applicable	Do not qualify for IUCN category	Regional fisheries closures have spatial components but are temporary in nature (i.e., need to renewed each year as fishery closures, and can be opened for fishing at any time) and seek only to conserve one of many commercial fish species and/or life history stages. If closures are intended to be permanent, they could be made into MPAs to qualify as such, and to ensure permanency.
Provincial Jurisdiction							
Ecological Reserve	Ecological Reserve Act, Protected Areas of British Columbia Act	British Columbia Ministry of the Environment	Y	Y	Ia-Ib, None (depending on activity restrictions in place)	VI or none	Aim to preserve iconic, BC ecosystems and natural or rare flora, fauna, and geographical features. The BC Provincial government has no jurisdiction over marine fishing, but it can restrict other activities that might affect the marine life (e.g., underwater pipelines, log booms). Thus Ecological Reserves can afford some conservation benefit.
Provincial Park (Class A, B, and C)	Park Act	British Columbia Ministry of the Environment	Y	Y	Ia-III, None (depending on activity restrictions in place)	VI or none	Provincial Parks (including Marine Parks) include different zones and designations with varying levels of protection and management (some have none). All designations are permanent and have stated goals to preserve local ecosystems. The BC Provincial government has no jurisdiction over marine fishing, but it can restrict other activities that might affect the marine life (e.g., underwater pipelines, log booms). Thus Ecological Reserves can afford some conservation benefit.

Existing Designation Type	Legislation	Jurisdictional Body	Present in NSB? (Y/N)	Meets Strategy MPA Definition?	IUCN Category [a]	IUCN Marine-Interpreted Category [b]	Rationale/Comments
Wildlife Management Area	Wildlife Act	British Columbia Ministry of the Environment	Y	Y	IV	VI or none	Wildlife Management Areas are established to protect a locality of internationally significant species or that species' corresponding habitat. This protection may widely benefit local biodiversity, despite the fact that it is established with intentions to protect species-level populations. They are spatially-defined and permanent, and therefore Strategy MPA's. The BC Provincial government has no jurisdiction over marine fishing, but it can restrict other activities that might affect the marine life (e.g., underwater pipelines, log booms). Thus they can afford some conservation benefit.
Conservancy	Park Act, Protected Aras of British Columbia Act	British Columbia Ministry of the Environment	Y	Y	Ib, None (depending on activity restrictions in place)	VI or none	Conservancies are designated explicitly to recognize the cultural or spiritual value of Crown Land to First Nations. They restrict commercial activity within protected areas with permanency, and are therefore within the Strategy definition of an MPA. The BC Provincial government has no jurisdiction over marine fishing, but it can restrict other activities that might affect the marine life (e.g., underwater pipelines, log booms). Thus they can afford some conservation benefit.
Recreational Area	Environment and Land Use Act	British Columbia Ministry of the Environment	Y	N	II	None	Recreational Areas as designated, permanent parcels of Crown Land established for recreational use and not explicitly managed to preserve ecosystem function or local biodiversity, therefore outside of the Strategy definition of an MPA

Existing Designation Type	Legislation	Jurisdictional Body	Present in NSB? (Y/N)	Meets Strategy MPA Definition?	IUCN Category [a]	IUCN Marine-Interpreted Category [b]	Rationale/Comments
Local and Indigenous Government Jurisdiction							
First Nations Marine Use Plans		First Nations Governments	Y	N	Not applicable	Does not qualify for IUCN category until further defined	Some coastal First Nations have developed local, community-based Marine Use Plans that include spatial-protection components. If applied, some of these protection plans may be considered MPAs under the Strategy definition. Because these plans are currently not locally applied and because First Nations do not have jurisdiction to mandate fisheries closures, these plans are not currently considered MPAs.
Municipal Marine Park		Municipal Government	Y	N	Not applicable	Does not qualify for IUCN category	

[a] IUCN categories are described under Principle 15, in the next section (3.3). [b] This category was modelled after Ban et al. (2014). Some provincial management authorities assigned IUCN Categories for the land-based portions of designated protected areas, but these may not apply in the marine environment because jurisdictional power of the water column (i.e. fisheries closures) lies solely with the federal government. Fisheries closures and commercial spatial restriction cannot be enacted by Provincial, Municipal, or First Nations Governments.

3.2.5 Guidance and guidelines for categorizing existing sites in the NSB

Guidance: Determining protection levels of existing sites

3.2.5.1 The MPA process should assess individual existing protected areas in BC under standardized criteria to ensure their value and efficacy before integration into a broader network with multiple levels of protection. Any MPAs and OEABCMs that have (or are given) appropriate protection may 'count' towards an MPA network, thereby helping to jump-start the establishment of an MPA network in the current planning process.

3.2.5.2 A first step should be to assess existing MPAs and OEABCMs against the Strategy's MPA definition. The use of a standardized set of assessment criteria is recommended. These could be developed specifically for the BC MPA network planning process (in line with the Strategy MPA definition, Goals, Objectives and Principles), or existing criteria could be adopted / adapted[5]. The CCEA consensus criteria and decision tool for screening MPAs and OEABCMs (current and potential) suggested by MacKinnon et al. (2015) could serve as a starting point. In brief, they state that area-based conservation measures must:

1. have an expressed purpose to conserve nature or biodiversity
2. be managed for the long-term (continue indefinitely)
3. not be compromised in cases of conflict with other objectives
4. result in effective and significant conservation outcomes (retention or expansion of biodiversity) and
5. have a management regime that is developed and expected to succeed in conservation goals (and conservation efficacy gaps will be addressed when discovered)

3.2.5.3 The CCEA consensus criteria do not address non-ecological values. This is consistent with the Strategy MPA definition, and the priority of Goal 1: Sites must effectively protect ecological values in order for them to 'count' as part of the network. Sites that qualify against ecological criteria can subsequently undergo further analysis to assess other values they protect (cultural, social and economic values), and their contribution towards meeting the other Strategy Goals. This assessment might best be conducted as part of a gap analysis (see section 0).

3.2.5.4 When completing the assessment of which existing OEABCMs should 'count' as components of the overall network, and determining the value these sites contribute, planners should remain mindful of the fact that a decision to disregard a given OEABCM within the MPA planning process does not mean that the OEABCM has no value. In line with Principle 12 (ecosystem-based management), an MPA network should be embedded within a wider range of measures to ensure the ecologically, socially, and economically sustainable use of the marine environment.

3.2.5.5 Under Principle 15 (section 3.3), a categorisation of protection levels for the NSB network has been proposed, based on the IUCN marine interpreted categories (Day et al. 2012). This categorisation should be reviewed and refined at the same time as current sites are assessed against standardized criteria, and each site that meets the Strategy MPA

[5] PacMARA understands that national criteria are under consideration by DFO, but these draft criteria were not made available for this report. Therefore, we refer to the published literature.

definition should be allocated into a category. Table 2 and its source publication (Ban et al. 2014) can serve as a starting point.

3.2.5.6 The lack of fishing restrictions within many of the MPAs or OEABCMs currently designated in BC reduces their effectiveness in protecting ecosystem functioning or biodiversity (Robb et al. 2011, MacKinnon et al. 2015). These sites may still meet the Strategy's MPA definition, falling within IUCN marine interpreted categories V and VI, and as such, can form part of the overall network (cf. Principle 15, section 3.3). Nevertheless, there may be opportunities to enhance the ecological effectiveness of existing provincial and locally protected areas by implementing overlapping federal closures of commercial and recreational fishing activities. This could push existing sites into higher IUCN categories and maximize their contribution towards a wider network, thereby potentially reducing the combined spatial footprint of new MPAs needed to complete the network.

Guidelines

3.2.5.7 **Primary guideline: Develop a standardized set of criteria to assess which existing MPAs and OEACBMs meet the Strategy MPA definition.**

3.2.5.8 **Secondary guideline: Classify existing sites that meet the Strategy MPA definition into protection level categories (based on IUCN categories, as defined under Principle 15), taking into account site objectives and de-facto management, and applying the 75% rule.**

3.2.5.9 **Secondary guideline: The protection level classification suggested under Principle 15 should be reviewed and refined as appropriate at the time that existing sites are classified.**

3.2.5.10 **Primary guideline: Where appropriate, enhance the protection levels of existing sites with supplementary management measures (e.g. adding federal fisheries closures to provincial and local MPAs and OEACBMs).**

3.2.6 Gap analysis

3.2.6.1 Once the existing suite of sites are individually assessed in terms of their effectiveness, and categorised in terms of their IUCN Category and protection levels, an analysis should be carried out to assess and evaluate how much the existing suite of sites within the NSB already contributes towards meeting the guidelines established under each one of the planning Principles. Additional sites can then be planned to complement and build on the existing sites.

3.2.6.2 A gap analysis is a significant piece of work, which will require a thoughtful methodological approach and appropriate benchmarks against which to assess the existing suite of sites. Developing a detailed set of benchmarks and methodological guidelines for a gap analysis is beyond the scope of this report, but some initial guidance is provided here.

3.2.6.3 Given the primary importance of Strategy Goal 1, an evaluation of the contribution of existing sites towards the implementation of the ecological Principles (1-5) should be a priority. Additional work can be carried out to establish their contribution towards other Strategy Goals and social, economic and cultural Principles.

3.2.6.4 The gap analysis should establish:

- the extent to which operational guidelines under each of the ecological Principles are already met by the existing suite of MPAs, and
- where the biggest gaps in the current suite of sites are – when planning the network, filling these gaps should be a priority.

3.2.6.5 For the first bullet point, the variables, metrics and benchmarks used in the gap analysis should be the same as those in the operational guidelines used for designing the whole network. The gap analysis should be comprehensive, assessing the existing suite of sites against every operational guideline under Principles 1-5 (including representation and replication targets, size/spacing, EBSAs and connectivity guidelines – see section 5). De-facto levels of protection in place within the current sites should be taken into account (cf. Principle 15, section 3.3).

3.2.6.6 In order to achieve the second bullet point, the gap analysis may carry out tests based on additional variables, metrics and benchmarks. For example, in order to identify the biggest gaps in the network, a spatial analysis might be carried out using distance benchmarks greater than the maximum distance benchmarks established under Principle 5. Relevant approaches and methods can be found in Johnson et al. (2012), Ardron (2008, 2009), and Lieberknecht et al. (2014).

3.2.7 Summary Table: Principle 14

Table 2 Summary Table: Guidelines for Principle 14. The origin code indicates the degree to which a guideline is taken from existing literature or based on PacMARA's own expertise. Origin codes: 1 = guideline adopted from source literature without modification, 2 = guideline adapted and modified from literature source(s) to suit the BC planning context, 3 = guideline developed by PacMARA specifically for the BC planning context.

Guideline	Rationale	Applicable sources	Origin code
Primary guideline: Develop a standardized set of criteria to assess which existing MPAs and OEACBMs meet the Strategy MPA definition.	Current MPAs and OEACBMs in BC were not created under any single criteria or entity. Assessing their alignment with the network definition of a marine protected area is essential.	MacKinnon et al. 2015, Environmental Canada 2009, Canadian Council on Ecological Areas 2014, Dudley 2008, Day et al. 2012, IUCN and UNEP 2009, WCPA/IUCN 2007, ILMB 2009, Robb 2011, Ban et al. 2014	2
Secondary guideline: Classify existing sites that meet the Strategy MPA definition into protection level categories (based on IUCN categories, as defined under Principle 15), taking into account site objectives and de-facto management, and applying the 75% rule.	IUCN categorization standardizes the intended protection levels for each area; assigning categorization and applying the 75% rule ensure protected area objective and efficacy, and help define individual management.	MacKinnon 2015, Day et al. 2012, Dudley 2008, WCPA/IUCN 2007, Robb 2011, Ban et al. 2014	2
Secondary guideline: The protection level classification suggested under Principle 15 should be reviewed and refined as appropriate at the time that existing sites are classified.	It is invaluable that protection level classifications are timely, relevant, and BC-specific.	Dudley 2008	2
Primary guideline: Where appropriate, enhance the protection levels of existing sites with supplementary management measures (e.g. adding federal fisheries closures to provincial and local MPAs and OEACBMs).	In BC, some protected areas are limited in efficacy because they lack fisheries jurisdiction or the capacity to implement closures. Adding federal fisheries closures to local or provincial protected areas will bolster their ecological effectiveness.	Robb 2011	2

3.3 Principle 15: Protection levels

3.3.1 Wording of Principle

3.3.1.1 Principle 15:

"*Include a full range of protection levels.*

To balance protection of the full range of values that marine environments provide, MPA networks will include a range of protection standards that meet criteria described in the IUCN's protected area categories I through VI (Appendix 3). This may require the introduction of management measures that could range from permanent limitations on specific human activities or restrictions adapted to seasons or species lifecycles, to promoting and facilitating specific human uses." (Strategy, p. 19)

3.3.2 IUCN Protected Area Categories

3.3.2.1 The Strategy's MPA definition is based on the IUCN's definition of a 'protected area', which is: "*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, p. 8).

3.3.2.2 Under the IUCN definition, the primary purpose of a protected area is the conservation of nature (biodiversity at all levels of scale). Ecosystem services and cultural values (as well as any additional objectives) are to be protected only inasmuch as doing so does not interfere with nature conservation outcomes: "*For IUCN, only those areas where the main objective is conserving nature can be considered protected areas; this can include many areas with other goals as well, at the same level, but in the case of conflict, nature conservation will be the priority*" (Dudley, 2008, p.10). This is consistent with the Strategy, in which Goal 1 is of primary importance.

3.3.2.3 As outlined under Principle 14 (section 3.2), the IUCN have developed a protected area categorisation framework (Dudley 2008). A summary overview of the IUCN categories can be found on the IUCN website[6], and the IUCN definition and categorization framework (together with detailed notes) are reproduced in Appendix 3 of the Strategy.

3.3.2.4 The original IUCN protected area categorization (Dudley 2008) was drawn up largely on the basis of site objectives and natural characteristics, defined in terms focused primarily on the terrestrial environment. Day et al. (2012) subsequently developed 'marine interpreted' IUCN protected area categories, making the classification more easily applicable to MPAs. The marine interpreted IUCN categories are defined not just on the basis of site objectives and characteristics, but also on the kind and level of activity restrictions in place. As such, the IUCN marine interpreted categories provide a useful basis for developing a protection level framework for the NSB's MPA network.

3.3.2.5 The definition and objectives of the IUCN protected area categories (as per Dudley, 2008) are summarised in the table below, with additional MPA management guidelines taken from Day et al. (2012) (this table is adapted from Ban et al. 2014).

[6]http://www.iucn.org/about/work/programmes/gpap_home/gpap_quality/gpap_pacategories/gpap_cat1a/

Table 3 Ban et al. (2014) developed a summary table outlining the IUCN marine interpreted categories, drawing from Day et al. (2012) and Dudley (2008). This table is reproduced here with some additions, as it provides useful starting point for developing a definition and categorisation of protection levels to be applied within the NSB process.

Category	Description	Primary objective	Other relevant objectives or notes
Ia: Strict nature reserve	Strictly protected areas that protect biodiversity and geological/geomorphological features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values. Can serve as indispensable reference areas for scientific research and monitoring.	Conserve regionally, nationally or globally outstanding ecosystems, species (occurrences or aggregations) and/or geodiversity features, formed mostly or entirely by non-human forces and will be degraded or destroyed when subjected to all but very light human impact.	Conserve cultural and spiritual values associated with nature; Be managed for relatively low visitation by humans. Should usually be "cores" surrounded by other suitably protected zones or areas. Strict no-take zone (no extraction of living or non-living resources), except strictly limited collection for scientific research if it cannot be conducted elsewhere and is minimized to the absolutely necessary to achieve the scientific goals of the study.
Ib: Wilderness area	Usually large unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation; protected and managed so as to preserve their natural condition. (Size is less often a useful guide for categories in the marine environment; MPAs of all categories may be large; and Category Ib MPAs may be smaller than Category Ia MPAs.)	Protect the long-term ecological integrity of natural areas that are undisturbed by significant human activity, free of modern infrastructure and where natural forces and processes predominate, so that current and future generations have the opportunity to experience such areas.	The concept of 'wilderness' is more difficult to apply to the marine environment than to land, though Category Ib MPAs might offer strictly regulated, low-impact recreational opportunities and enable indigenous communities to maintain their traditional wilderness-based lifestyle and customs, living at low density and using the available resources in ways compatible with the conservation objectives. Category Ib MPAs should be sites of relatively undisturbed seascape, significantly free of human disturbance (e.g. direct or indirect impacts, underwater noise, light pollution etc.), works or facilities and capable of remaining so through effective management. Strictly no-take of living or non-living resources, except limited collection for scientific research (under the same conditions as for Category Ia), and sustainable resource use by indigenous people to conserve their traditional spiritual and cultural values, provided this is done in accordance with cultural tradition.

II: National park	Large natural or near natural areas that protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities	Protect natural biodiversity and underlying ecological structure and supporting environmental processes (ecosystem-level protection), and to promote education and recreation.	Take into account the needs of indigenous people and local communities, including subsistence resource use, insofar as these will not adversely affect the primary management objective; support compatible economic development, mostly through recreation and tourism, that can contribute to local communities. Provide for visitation, non- extractive recreational activities and nature tourism (e.g. snorkelling, diving, swimming, boating, etc.) and research (including managed extractive forms of research). Essentially no-take zones, extractive use (of living or dead material) is not considered consistent with ecosystem-level protection (fishing, even at low levels, can impact on the overall food web), though exceptions are (as for Category Ib) limited extraction for scientific research, and sustainable resource use by indigenous people to conserve their traditional spiritual and cultural values.
III: Natural monument or feature	Protect a specific natural monument, which can be a landform, sea mount, submarine cavern, geological feature such as a cave or even a living feature such as an ancient grove. They are generally quite small protected areas and often have high visitor value.	To protect specific outstanding natural features and their associated biodiversity and habitats.	To conserve traditional spiritual and cultural values of the site. Applies to MPAs designed to protect specific features such as sea mounts or shipwrecks which have become aggregation sites for biodiversity and have important conservation value; key aggregation areas for iconic species; or other marine features which may have cultural or recreational value to particular groups, including flooded historical/archaeological landscapes. Essentially no-take zones, extractive use (of living or dead material), though exceptions are (as for Category Ib) limited extraction for scientific research, and sustainable resource use by indigenous people to conserve their traditional spiritual and cultural values.

IV: Habitat/ species management area	Aim to protect particular species or habitats and management reflects this priority. May need regular, active interventions to address the requirements of particular species or to maintain habitats.	To maintain, conserve and restore species and habitats.	Not strictly protected from human use. Category IV is aimed at protection of particular stated species or habitats, often with active management intervention (e.g., protection of key benthic habitats from trawling or dredging). MPAs or zones aimed at particular species or groups can be classified as category IV, e.g., seabird, turtle or shark sanctuaries. Zones within an MPA that have seasonal protection, such as turtle nesting beaches that are protected during the breeding season, might also qualify as category IV.
V: Protected landscape/ seascape	Interaction of people and nature over time has produced an area of distinct character with significant ecological, biological, cultural and scenic value; safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values.	To protect and sustain important landscapes/ seascapes and the associated nature conservation and other values created by interactions with humans through traditional management practices.	To maintain a balanced interaction of nature and culture through the protection of landscape and/or seascape and associated traditional management approaches, societies, cultures and spiritual values. Category V would apply to MPAs where local communities live within and sustainably use the seascape, but the primary objectives are nevertheless nature conservation protection. On land, category V is aimed at protection of landscapes, a concept that is more difficult to apply in the marine environment although the idea of protecting seascapes is gaining currency.

VI: Protected area with sustainable use of natural resources	Conserve ecosystems and habitats, and associated cultural values and traditional natural resource management systems. Generally large, with most of the area in a natural condition, where a proportion is under sustainable natural resource management and where low-level nonindustrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area.	Protect natural ecosystems and use natural resources sustainably, when conservation and sustainable use can be mutually beneficial	Promote sustainable use of natural resources, considering ecological, economic and social dimensions; integrates other cultural approaches, belief systems and world-views within a range of social and economic approaches to nature conservation. MPAs aimed at maintaining predominantly natural habitats but allowing sustainable collection of some species (e.g. food species, ornamental coral or shells), can be assigned to category VI. The point at which a spatially managed marine area becomes a category VI MPA is when it has a stated primary conservation aim, meets the overall definition of a protected area and the 75% rule, and achieves ecological sustainability as measured by metrics appropriate to the objectives. Careful consideration needs to be given as to whether activities such as seabed mining and some types of commercial fishing (e.g. dredge trawling) should be permitted in regard to their inherent unsustainability, and their consistence with the objectives of this category.

3.3.3 Recommended guidance and guidelines for the NSB

3.3.3.1 Experience from the UK's ongoing Marine Conservation Zone (MCZ) process (see box 3.1) illustrates that it is advisable to consider protection levels at the same time as planning proposals for the spatial configuration of the network and the location of boundaries. The MCZ process has been addressing these tasks in sequence, planning the spatial location, size and boundaries of MCZs first, with planning for site management measures (protection levels) commencing after sites are legally designated. This has meant that discussions, stakeholder negotiations and impact assessments carried out during the spatial planning phase have had to be based on unclear and uncertain assumptions about how sites may be managed in future, resulting in a series of negative impacts on the process (Lieberknecht et al. 2013, Lieberknecht and Jones 2016 in press).

3.3.3.2 Irrespective of the level of stakeholder participation within the NSB planning process, and the role and influence stakeholders will have, it is to be expected that stakeholder representatives consulted on site proposals will wish to know how the proposed sites will be managed, and whether their activities will be restricted in any way within MPAs. A lack of a clear answer will make it harder for stakeholders to provide meaningful feedback, and may lead to their distrust of the process and rejection of proposals based on a fear of what might happen.

3.3.3.3 Stakeholder fatigue will be another factor to consider if a sequential process requires a number of steps requesting stakeholder input. In the past 15 years, BC has already seen protracted MPA-related processes that have engaged stakeholders (including the 10 month consultation period engaging First Nations, local Governments, communities, stakeholders, and the general public in the development of the Strategy).

3.3.3.4 PacMARA recommends avoiding the complications of the MCZ process (box 3.1) by integrating the planning of MPA protection levels into network planning scenarios from the start. This can be achieved by pre-defining a range of protection levels, including multiple-use zones (in which uses are compatible with conservation objectives) as well as highly protected sites. The guidelines below suggest a framework for a pre-defined set of protection levels, based on the IUCN categories above.

3.3.3.5 The network should include highly protected sites, including no-take zones, as they deliver greater conservation benefits than partially protected sites (Ban et al. 2014). Complete no-take zones are likely to generate some controversy, but Strategy Goal 1 is of primary importance, and Principle 15 calls a full range of protection levels, so they should form part of the network. Complete no-take zones should be established through co-management between federal, provincial and First Nations governments, and can be complemented within the network with highly protected sites that allow limited traditional resource extraction, as per the definitions of IUCN categories Ib and II (cf. Principles 9 and 11).

3.3.3.6 Pre-defining protection levels allows the fine-tuning of size, spacing, representation and replication targets for different protection levels within the network under the ecological Principles. For example, smaller but highly protected sites might have as much ecological benefit as larger but less protected sites, so depending on the protection level, slightly different guidelines for the size and spacing of sites might be warranted (as reflected in the guidelines under Principle 1).

3.3.3.7 Table 4 presents a protection level framework based on IUCN categories, some of which have been merged based on the types of activity restriction that tend to be applied within them. This framework may be modified and adapted, merging or splitting the IUCN categories in different ways, as appropriate, based on the interpretation and implementation of guidelines under Principles 6, 9 and 11. Within the lower protection levels there is flexibility in terms of defining precisely which activities will be allowed within sites and how they will be managed once they are designated.

3.3.3.8 An iterative planning approach is recommended, with a series of planning cycles in which the spatial configuration of the network, the definition of the broad protection levels (in terms of restrictions on specific, named activities), as well as specific management proposals for individual sites is refined following expert and/or stakeholder review and feedback.

3.3.3.9 Through this iterative approach, the planning process should aim to have clarified proposed activity restrictions for each site in the network in time for the regulatory economic impact assessments, required prior to decisions on site designation (ensuring that the impact assessments are clear and meaningful).

3.3.3.10 Post-designation, site management should be viewed as an on-going adaptive process (cf. Principle 13), where the benefits of sites are assessed through a regular process of monitoring and evaluation. Site management measures can and should be refined in future based on the results of monitoring.

Table 4 Proposed protection level framework

Protection level	IUCN marine interpreted category or categories	Comments
Core Zones	**IUCN Ia: Strict nature reserve**	Strict no-take zones with strictly limited access, highly protected with no human infrastructure permitted. This protection level should be implemented as 'core zones' within less strictly protected sites (with "up-current" influences assessed and appropriately managed).
Highly protected areas	**IUCN Ib: Wilderness area**	Sites that are significantly free of human disturbance (e.g. no direct or indirect impacts, underwater noise, light pollution etc.), works or facilities. No removal of species and modification, extraction or collection of resources (e.g., no form of fishing, harvesting, dredging, mining or drilling. **Exceptions**: collection for scientific research if that collection cannot be conducted elsewhere and limited sustainable resource use by indigenous people to conserve their traditional spiritual and cultural values.
Conservation areas with recreational access and limited sustainable use	**IUCN Categories II (National Park) and III (National Monument or Feature)**	Managed for ecosystem protection, or for protection of specific features of conservation value (e.g., biodiversity aggregation sites) or marine features of historical or cultural value. Provide for visitation, non- extractive recreational activities and nature tourism (e.g. snorkelling, diving, swimming, boating, etc.) and research (including managed extractive forms of research). No extractive use (of living or dead material). **Exceptions:** extraction for research, sustainable resource use by indigenous people to conserve their traditional spiritual and cultural values.
Conservation areas with multiple sustainable use	**IUCN Categories VI (Habitat/ species management area), VI (Protected area with sustainable use of natural resources) and V (Protected landscape/ seascape)**	Includes sites managed for protection of particular stated species or habitats, often with active management intervention (e.g., protection of key benthic habitats from trawling or dredging), or seasonal protection. May allow sustainable collection of some species (e.g. food or ornamental species), but meets the overall definition of a protected area and achieves verifiable ecological sustainability as measured by appropriate metrics (as well as the 75% rule) Careful consideration should be given to whether activities such as seabed mining and some commercial fishing practices (e.g. benthic trawling) should be permitted in regard to their inherent unsustainability and inconsistency with nature conservation objectives.

Box 3.1 England's MCZ Process: Impacts of delaying the definition of protection measures until after site designation (Lieberknecht et al. 2013, Lieberknecht and Jones 2016 in press).

England's Marine Conservation Zone (MCZ) process has been ongoing since 2008. In an initial phase, stakeholder groups were tasked with developing recommendations for the location and spatial boundaries of new sites. These recommendations were subsequently reviewed by Government agencies in order to decide which sites to designate. A first tranche of MCZs was designated in 2013, and a final tranche is due in 2018. The process of planning and deciding management measures only begins once sites have been legally designated.

- The first question asked by stakeholder representatives in the initial spatial planning process was: 'How will these MCZs impact on my interests?'. It was not possible to provide a clear answer, which led many to assume a worst-case scenario for their sector, fuelling conflicts and opposition to the establishment of sites. The uncertainty was perceived by many as a lack of transparency, leading to a sense of mistrust in the process, and fuelling frustration (one participant described his task as 'being asked to fly blind').
- Government agencies are required to carry out a regulatory impact assessment on each recommended site before taking decisions on designation. Because of the lack of clarity on which human activities would be impacted in the event of designation, these impact assessments have been based on several hypothetical 'management scenarios' for each site, making the analysis more complicated and the outcome of the impact assessments a lot less meaningful (due to greatly varying potential cost figures for each site) than would have been the case if protection levels had been settled upfront.
- The assessment of the potential future ecological benefit of sites as part of the impact assessment process has been rendered equally difficult, because benefits depend strongly on how well a site is protected from negative impacts.
- The attempt to separate spatial planning from planning of protection levels has led to a drawn-out process in which, in effect, management discussions with all their inherent conflicts have had to be held twice. In the initial spatial planning phase, stakeholders could not be expected to ignore management when discussing site location, so they spent a lot of time in difficult discussions to formulate management assumptions to underpin their recommendations (in the knowledge that these assumptions may subsequently not hold true, potentially undermining their support). Three years following the designation of the first tranche of sites, the official management discussion for these sites is still unfolding.

Guidelines

3.3.3.11 **Primary guideline: Pre-define a set of protection levels to use when planning the spatial configuration of the network, based on the IUCN marine interpreted categories.**

3.3.3.12 **Primary guideline: Pre-defined protection levels should include strict no-take zones (IUCN Category Ia), as well as other highly protected areas that may provide for limited traditional extractive use (IUCN Categories Ib and II).**

3.3.3.13 **Secondary guideline: Given their particularly high potential for causing controversy, it is advisable that no-take zones and other highly protected sites are established through co-management among federal, provincial and First Nations governments.**

3.3.3.14 **Secondary guideline: An iterative planning approach is recommended, with cyclical reviews of the spatial network configuration and proposed protection levels of constituent sites.**

3.3.3.15 **Secondary guideline: The planning process should have clarified planned activity restrictions for each site in advance of regulatory economic impact assessments being carried out.**

3.3.4 Summary Table: Principle 15

Table 5 Summary Table: Guidelines for Principle 15. The origin code indicates the degree to which a guideline is taken from existing literature or based on PacMARA's own expertise. Origin codes: 1 = guideline adopted from source literature without modification, 2 = guideline adapted and modified from literature source(s) to suit the BC planning context, 3 = guideline developed by PacMARA specifically for the BC planning context.

Guideline	Rationale	Applicable sources	Origin code
Primary guideline: Pre-define a set of protection levels to use when planning the spatial configuration of the network, based on the IUCN marine interpreted categories.	To provide clarity to stakeholders from the start, and to allow meaningful impact assessments	Dudley et al. 2008 Day et al. 2012	2
Primary guideline: Pre-defined protection levels should include strict no-take zones (IUCN Category Ia), as well as other highly protected areas that may provide for limited traditional extractive use (IUCN Categories Ib and II).	To ensure that Strategy Goal 1 is met	Ban et al. 2014	2
Secondary guideline: Given their particularly high potential for causing controversy, it is advisable that no-take zones and other highly protected sites are established through co-management among federal, provincial and First Nations governments.	Co-management may be of particular value in managing conflicts in sites most likely to cause controversy		3
Secondary guideline: An iterative planning approach is recommended, with cyclical reviews of the spatial network configuration and proposed protection levels of constituent sites.	This will allow expert and stakeholder reviews of proposals to be gathered and the network to be improved in response	Lieberknecht et al. 2013 California Department of Fish and Game 2008	2
Secondary guideline: The planning process should have clarified planned activity restrictions for each site in advance of regulatory economic impact assessments being carried out.	To ensure that the impact assessments are realistic and meaningful	Lieberknecht et al. 2013, Lieberknecht and Jones 2016 in press	2

4 Guidelines for social, economic and cultural network design Principles

4.1 Overview

4.1.1.1 PacMARA recently completed a literature review on the incorporation of social, economic and cultural objectives into MPA planning (Patterson et al. 2016), which found an absence of highly specific guidelines within the existing literature, but developed some broad guidance based on the emerging themes of the literature review. This guidance is reproduced in appendix 1, and is built upon and extended here.

4.1.1.2 Often, there is no single 'right' answer when addressing social-cultural-economic issues that emerge in MPA planning, and no single 'optimal' solution when working through conflicts between different interests, values and perspectives. In the NSB region, it will ultimately need to explore diverse (individual and collective) ecological, economic, social and cultural values. Trade-offs, compromise and conflict will be inevitable.

4.1.1.3 There are technical tools to help explore trade-offs between different values and objectives. However, the outputs of such tools cannot provide ultimate solutions - they can only serve to inform decision-making. A thoughtfully designed and adequately resourced decision-making process (including a well-designed stakeholder engagement process) will be needed through which trade-offs can be explored and acceptable compromises reached, and the outputs of technical analyses should serve to underpin and inform this process in a timely and constructive manner. Thus, guidelines on technical methods need to make reference to process design, and technical and process design aspects are both addressed in the guidelines presented here.

4.1.1.4 A well-designed planning and decision-making process will avoid fuelling conflicts and misunderstandings as impacts and trade-offs are explored. It is important to establish clear roles for different process participants, including who will take ultimate decisions on MPA location, designation and protection levels, and how such decisions will be reached. When stakeholders are asked for input, they should be given a clear understanding of the purpose of the process, the way it might impact upon their interests, their role, and their level of influence on the process outcomes.

4.1.1.5 Note that this reports includes no guidance or guidelines for Strategy Principle 10, as it was not included in the Scope of Work. The development of a stakeholder engagement strategy is underway in order to achieve this Principle, the wording of which is as follows:

"Principle 10 – Work with people. A consultative process that is balanced, open, inclusive, transparent and provides opportunities for meaningful involvement will be used to plan and implement bioregional networks. Federal and provincial governments will collaborate with First Nations and involve coastal communities, stakeholders and the public to identify, establish and manage MPA networks. Government agencies responsible for implementation will coordinate their efforts and ensure that the process and flow of information is transparent and accessible." (Strategy, p. 17)

4.2 Principle 6: Recognise full range of uses and values

4.2.1 Wording of Principle

4.2.1.1 Principle 6:

"Recognise and consider the full range of uses, activities and values supported by marine environments (spatio-temporal intensity of human activities, cultures and values, ecosystem goods and services, costs of inaction).

Functional networks of MPAs will recognize the fundamental relationship between the environment and human activities, cultures and values, requiring an understanding of the value of ecosystem goods and services as well as the intensity and pattern of human uses across time and space. Integration of economic and social considerations in MPA network design should also include an evaluation of the costs of inaction or inertia. The costs of sustaining biodiversity and ecosystem services through protected area planning can be significantly lower than the costs of inaction." (Strategy, p. 15).

4.2.2 The importance of multi-sector considerations in conservation planning

4.2.2.1 It is broadly recognized that it is a best practice to incorporate social, economic, and cultural considerations for all user groups into marine conservation planning (Ban et al. 2013, Kittinger et al. 2014, Flannery & Cinneide 2008). There are a number of important reasons for this.

4.2.2.2 First, it is important to understand the multiple economic and non-economic values that rely on a healthy marine environment, as this can provide an important rationale to prioritize ecological conservation for governments (Angulo-Valdes & Hatcher 2010).

4.2.2.3 Second, some human activities and their impacts constrain MPA planning (Fraschetti et al. 2009) while other activities can be complementary to conservation (Kittinger et al. 2014).

4.2.2.4 Third, documentation of human uses and values of the marine environment is the basis for understanding the positive and negative impacts of marine conservation on different stakeholders and identification of trade-offs between different network configurations (Bennett & Dearden 2014a, Ban et al. 2013, Kittinger et al. 2014). Socio-economic data can be used to help identify more economically efficient (net impact) and equitable (distribution of impacts) configurations for conservation networks and zoning schemes (Ruiz-Frau et al. 2015, DFO 2016 (unpublished), Principles 7 & 8, below).

4.2.2.5 Fourth, stakeholders are more likely to support marine conservation initiatives when their views and aspirations are incorporated, when processes are inclusive and when the outcomes of conservation are perceived to be beneficial or equitable (Christie et al. 2005, Bennett & Dearden 2014b). Equity is also a requirement of Aichi Target 11 which states that systems of protected areas need to be "effectively and equitably managed" (CBD 2010[7]). Socio-economic information can be used to help identify impacts and calculate fair compensation for inequitable impacts (e.g., through direct monetary compensation, or other means such as investment in alternative livelihoods).

[7] https://www.cbd.int/sp/targets/

4.2.3 Identifying and classifying uses and values

4.2.3.1 A necessary first step in planning for social, economic, and cultural considerations is the identification of the full range of users, uses and values (Kittinger et al. 2014, Richmond & Katowicz 2015, Evans 2009). The coastal and marine environment of British Columbia is important for coastal communities with different demographics and geographies, for Aboriginal peoples, for various sectors of the economy and for the general Canadian public. Different methods are available to document who these different stakeholder groups are and to help explore the differences between them (Flannery & Cinneide, 2008).

4.2.3.2 Christie et al. (2003) suggest that it is important to "*evaluate: a) the characteristics and behaviours of constituencies, b) what constituents want, and c) what constituents know*". Evans (2009) shows how stakeholder analysis might be used to identify and compare the social-cultural values, histories, social and political context of different user groups as part of marine planning. Understanding these factors can be helpful to understand how different groups will be impacted by and respond to conservation plans (Gurney et al. 2015).

4.2.3.3 The range of stakeholder groups in the region that use and value the marine environment for a variety of economic, social and cultural reasons will need to be accounted for in the planning process. Economic uses of the marine environment include extractive industries (oil, gas, mining), consumptive industries (fishing, harvesting, aquaculture) and non-consumptive sectors (tourism, marine shipping, ocean energy). The net and relative economic value of these different activities needs to be understood and incorporated into the planning process. In particular, Bodtker et al. (2015) recognize the need to document the economic benefits of non-consumptive marine-based activities (e.g., eco-tourism) that depend on a healthy marine environment.

4.2.3.4 In the past, marine conservation and spatial planning exercises have most often focused on a limited number of human uses, often larger scale economic or extractive uses. However, the marine environment is also used for smaller scale and non-economic activities such as recreation, education and research, and subsistence and cultural uses. These latter activities, while of limited economic value, are often highly valued by those involved.

4.2.3.5 These uses are associated with a suite of related values, which might be classified under various benefit categories or values classification systems, e.g., tangible and intangible benefits, assigned and held values, ecosystem services) (Mascia et al. 2010, Robinson et al. 2012, Chan et al. 2012, Millennium Ecosystem Assessment 2005). Drawing on the ecosystem services frameworks, for example, the uses listed above (i.e., education, research, recreation, subsistence and cultural) are mainly associated with provisioning (food production, raw materials, medicinal resources, etc.) and cultural (recreation, education and science, spiritual and historical) ecosystem services. Constituents, communities and users also benefit passively or indirectly from the regulating (e.g., shoreline protection, carbon sequestration, disease control) and supporting (e.g., nutrient cycling, primary production) services provided by the marine environment.

4.2.3.6 It is recommended to develop a typology of all economic and non-economic uses of the area to incorporate into the planning process (Kittinger et al. 2014, Ardron et al. 2015). For example, Richmond & Kotowicz (2015) and Khakzad et al. (2015) urge that ancestral and historic sites, areas of spiritual importance and current cultural uses be incorporated into marine conservation planning. It may be relevant to recognize past uses of the area that

might establish some form of historical tenure or rights and to forecast how current uses will change in the future. Whichever framework is used to classify benefits or values, it is recommended:

- to assign both monetary and non-monetary values to different economic and non-economic activities (Rees et al. 2010, Ardron et al. 2015), and
- to recognize both tangible and non-tangible benefits of the marine environment for current and future generations (Chan et al. 2012, Robinson et al. 2012, Burt et al. 2015).

4.2.3.7 Formal and informal governance mechanisms (laws, policies, rules, historical tenure, court decisions, indigenous traditions) structure the rights of different groups and users to own, access, harvest, sell or manage marine spaces and resources now and in the future (Mascia et al. 2010). It is therefore recommended to understand and characterize these governance arrangements across the seascape and how they apply to different users and groups. In addition, the rights of aboriginal groups are recognized under Canadian law and require specific attention (see Principle 11).

4.2.4 Mapping different uses, costs and values

4.2.4.1 After the scoping of different users, uses, values and rights has been completed, these factors need to be characterized spatially and temporally so that they can be used in marine planning processes (Kittinger et al. 2014). As Ardron et al. (2015) recognize, this will require the incorporation of various types of knowledge (Aboriginal, local, and stakeholder) concerning usage of the marine and nearshore environment to produce fine resolution spatial datasets. In addition to the location, the relative intensity and diversity of activities, the importance of different activities and values, and the individual and cumulative impacts of different activities will need to be calculated for different planning units (Kittinger et al. 2014, Patterson et al. 2016).

4.2.4.2 Combining the various uses and values into a single cost-layer is not recommended (Patterson et al. 2016). Rather a suite of different methods may be needed to document the different types of knowledge, uses and values (Ban et al. 2013, Kittinger et al. 2014, Bennett et al. 2015). Both quantitative (e.g., monetary valuation, choice experiments) and qualitative (e.g., perceptions-based studies) methods can be used to establish the importance of different uses – as well as to establish spatial boundaries of use and social boundaries of acceptable levels of change (Ban et al. 2013). The documentation of historical use of areas and Aboriginal knowledge may require a combination of qualitative, historical and archaeological approaches.

4.2.4.3 Some benefits of conservation are hard to evaluate in monetary terms (Angulo-Valdes & Hatcher 2010). Perceptions can be drawn on to help understand different values, their importance to different stakeholders, and perceived impacts of MPAs (Pita et al. 2011). Forecasting methods might be used to predict future use in the area. During this stage, areas of absolute importance or non-negotiable areas – e.g., highly important cultural areas, areas with pre-existing rights, pre-existing leases / contractual arrangements, areas with high values or multiple uses – might also be identified. It is also recommended to identify and spatially locate community-based conservation initiatives and integrate local knowledge for possible inclusion of these sites in the MPA network (Ardron et al. 2015).

4.2.5 Process considerations in documenting and mapping human uses and values

4.2.5.1 The process of documenting uses and values should be done with stakeholders in an inclusive, respectful and transparent manner, and the spatial assessments and valuations should be made accessible as part of ongoing decision-making and deliberations (see DRAFT Stakeholder Engagement Strategy[8], DeReynier et al. 2010, Patterson et al. 2016). This is, in part, because participation and process quality determines perceived legitimacy and support for marine conservation (Christie 2005, Bennett 2016).

4.2.5.2 In any multi-party negotiation, including the selection of MPAs, there are perceived (and sometimes real) advantages to withholding information from other parties. As several parties may withhold information from one another, determining the fairness and equity of negotiated outcomes can become very difficult. Furthermore, efficient outcomes are unlikely to be achieved. This was found to be the case for MPA planning in Central California, when one sector withheld its information (Klein et al. 2008). Thus, transparency should be encouraged. Indeed, timely access to information has become internationally recognised best practice in environmental planning and decision-making (Aarhus Convention 1998).

4.2.5.3 There may be instances where the benefits of transparency need to be weighed against respect for confidentiality of some groups and types of information. For example, many Aboriginal groups, industries, and governments have distinct protocols for information sharing and use of data / information / local and Aboriginal ecological knowledge.

4.2.5.4 Where there is trust in the process, it will be easier to achieve transparency and sharing of information through MOUs and data sharing agreements, helping to overcome silos and reduce perceived or real bargaining advantages associated with privileged information.

4.2.6 Recommended guidance and guidelines for the NSB

4.2.6.1 In order to establish the range of uses, activities and values in the NSB, we recommend:

- Conducting a stakeholder analysis that identifies and categorizes user groups, uses, values, governance mechanisms and rights, building on past assessments where they exist (e.g., from the Marine Planning Partnership process);
- Developing a typology of uses and values of marine space and resources, noting any known gaps (a simple compatibility matrix may be helpful here and for Principles 7 & 8 - the generic typology from Table 2 in Kittinger et al. (2014) may a starting point); and
- Identifying the formal and informal rights that structure who can access and use the marine environment.

4.2.6.2 Where possible, spatially map relative measures for the following: economic and non-economic uses and their value(s); rights to areas that are recognized or allocated for these uses; ecosystem services and their economic and non-economic value(s); intensity of activities or uses (e.g., number of visitors, users, fishing pressure, harvesting, shipping); and impacts of uses on the marine environment and ecosystem services (when known or readily estimated). The level of uncertainty and strength of information (i.e. how confident are we of the data / information) should be explicitly recognized.

[8] Extract provided by MPATT to PacMARA to support the preparation of this report

4.2.6.3 Estimate the relative impact (relatively positive or negative) on uses, values and rights of MPA creation – differentiating the impact by a) the designation of an MPA where it occurs, b) the designation of an MPA nearby where it occurs, and c) the designation of an MPA further away in the sub-region - and the benefits and costs of inaction (i.e. in the case that no MPAs are created in the sub-region).

4.2.6.4 Identify highly valued areas, including areas which may or may not be appropriate for MPAs. The former might include areas that are used for recreational purposes or by Aboriginal groups for harvesting. The latter might include areas where leases have been granted for activities incompatible with conservation objectives, as well as spiritual or cultural sites where conservation measures would be incompatible with their ongoing use and cultural values. It will be important to identify these areas that are incompatible early on, to avoid stalling the process further down the line.

4.2.6.5 The implementation of this Principle is linked closely with the implementation of Principles 7 & 8, as the data gathering, typology and mapping work carried out under Principle 6 will provide the necessary information base for Principles 7 & 8 to draw from. It will therefore be important to ensure particularly close collaboration between planners working on these three Principles.

Guidelines

4.2.6.6 Primary guideline: Develop a typology of uses and values of marine space and resources.

4.2.6.7 Primary guideline: Identify the suite of user groups and rights holders, considering, inter alia, federal and provincial leaseholders, First Nations, fishers, conventional and non-conventional energy, shipping, economic tourism and non-economic recreation.

4.2.6.8 Secondary guideline: Identify formal and informal governance mechanisms (laws, policies, leases, traditional tenures, etc.) that structure access and use rights (e.g., property rights, harvesting rights, Aboriginal rights, exploration rights, etc.) as well as associated responsibilities.

4.2.6.9 Secondary guideline: Identify the links between the different user groups and the suite of uses and values, as well as identifying the assigned or held rights and any associated responsibilities of each group, where appropriate.

4.2.6.10 Primary guideline: Characterize the spatial and temporal distribution of the array of uses, values, and rights across the NSB, inasmuch as available data allow.

4.2.6.11 Secondary guideline: Differentiate the importance of different uses, values and rights (i.e. avoid mapping all as one weight or "the same") using relative measures appropriate to each (e.g., assigning both monetary and non-monetary values).

4.2.6.12 Primary guideline: Identify highly valued areas, including areas which will be compatible or incompatible with MPAs.

4.2.6.13 Secondary guideline: Characterize the relative intensity and impact of uses on the marine environment and ecosystem services spatially.

4.2.6.14 Secondary guideline: Identify the relative impact of the creation of MPAs on uses, values or rights, as well as the costs of inaction for each.

4.2.7 Summary Table: Principle 6

Table 6 Summary Table: Guidelines for Principle 6. The origin code indicates the degree to which a guideline is taken from existing literature or based on PacMARA's own expertise. Origin codes: 1 = guideline adopted from source literature without modification, 2 = guideline adapted and modified from literature source(s) to suit the BC planning context, 3 = guideline developed by PacMARA specifically for the BC planning context.

Guideline	Rationale	Applicable sources	Origin code
Primary guideline: Develop a typology of uses and values of marine space and resources.	It is a best practice to incorporate social, economic and cultural considerations into marine planning. This can ensure both equity and efficiency in network design, as well as increasing legitimacy of the process and acceptability of outcomes.	Kittinger et al. 2014 Ban et al. 2013 Ardron et al. 2015 Richmond & Kotowicz 2015	1
Primary guideline: Identify the suite of user groups and rights holders, considering, inter alia, federal and provincial leaseholders, First Nations, fishers, conventional and non-conventional energy, shipping, economic tourism and non-economic recreation.	In the BC context, there are an array of different users and rights holders who use and value the marine environment. It is appropriate to consider all stakeholders in marine planning processes.	Kittinger et al. 2014 Ban et al. 2013 Ardron et al. 2015	1
Secondary guideline: Identify formal and informal governance mechanisms (laws, policies, leases, traditional tenures, etc.) that structure access and use rights (e.g., property rights, harvesting rights, Aboriginal rights, exploration rights, etc.) as well as associated responsibilities.	Rights structure who can use the marine environment and what they can use it for, both now and in the future. Rights can constrain marine planning and need to be taken into account. They might also be impacted by the creation of marine protected areas.	Mascia et al. 2010	2
Secondary guideline: Identify the links between the different user groups and the suite of uses and values, as well as identifying the assigned or held rights and any associated responsibilities of each group, where appropriate.	See comments above. It is important to specify to whom uses, values and rights are allocated as this forms the basis of identifying spatial use of the area by different groups and losses and gains to different groups.	Kittinger et al. 2014 Ban et al. 2013 Ardron et al. 2015	1

Primary guideline: Characterize the spatial and temporal distribution of the array of uses, values, and rights across the NSB, inasmuch as available data allow.	MPA network planning is a spatial endeavour. Understanding the spatial distribution of uses, values and rights (now and in the future) enables the identification of areas that are and are not suitable for conservation. This process enables optimization under Principle 7 & 8.	Kittinger et al. 2014 Ban et al. 2013	2
Secondary guideline: Differentiate the importance of different uses, values and rights (i.e. avoid mapping all as one weight or "the same") using relative measures appropriate to each (e.g., assigning both monetary and non-monetary values).	Assigning relative importance to different uses, values and rights allows for the calculation of net value as well as losses and gains to different users under different scenarios. This process enables optimization under Principle 7 & 8.	Kittinger et al. 2014 Patterson et al. 2016	2
Primary guideline: Identify highly valued areas, including areas which will be compatible or incompatible with MPAs.	Identifying areas that are non-negotiable will help to avoid conflicts and minimize the likelihood of unacceptable MPA proposals. Areas of high social, cultural or economic that would align well with or be supported by marine conservation can also be prioritized for protection.	Ban et al. 2013	1
Secondary guideline: Characterize the relative intensity and impact of uses on the marine environment and ecosystem services spatially.	Understanding the intensity of different activities and the environmental impacts of the different activities, individually and cumulatively, can help in the identification of areas that are or are not suitable for conservation. It might also show areas where activities should be managed or restricted due to their overlap of areas of high ecological importance or value.	Kittinger et al. 2014	2
Secondary guideline: Identify the relative impact of the creation of MPAs on uses, values or rights, as well as the costs of inaction for each.	Assigning relative values to the impacts of conservation action or inaction can form the basis of trade-off analysis or structured decision-making processes. This process enables optimization under Principle 7 & 8.	Ruiz Frau et al. 2015 Gurney et al. 2015	2

4.3 Principles 7 and 8: maximizing the positive while minimizing the negative

4.3.1 Wording of Principles 7 and 8

4.3.1.1 Principle 7:

"Maximize the positive (identify opportunities for sustainable socio-economic activities, cultural and spiritual values).

Marine protected area network planning will include identification of opportunities to contribute positively to protection of sustainable socioeconomic activities and cultural and spiritual values. Socioeconomic data is typically incorporated in network design as a cost to be minimized, however, if the inclusion of a social, cultural or economic feature is desired in an MPA network (e.g., a traditional harvesting area, priority areas for fishing, a ship wreck, kayak routes, etc.), then it can be targeted for protection in the same way as biodiversity features. Protection of the feature must also contribute to the primary goal for BC's network of marine protected areas (i.e., to protect and maintain marine biodiversity, ecological representation and special natural features)." (Strategy, p. 15).

4.3.1.2 Principle 8:

"Minimize the negative (network design cost, user conflict, balance conservation with social and economic opportunities, economic analyses).

MPA network design should strive to minimize user conflict and balance conservation objectives with social and economic opportunities. Where there is a choice of several sites which if protected would add a similar ecosystem or habitat to the MPA network, the site(s) chosen should minimize adverse impacts on existing users. Economic analyses can identify design measures that maximize conservation success while minimizing costs. For example, network design should take advantage of best available knowledge (e.g.: traditional, local and scientific), bio-economic models and decision support tools (e.g., MARXAN) to support MPA site selection in order to reduce potential conflicts and ensure more equitable distribution of the costs and benefits of conservation between communities and users. The availability of various designation options provides additional opportunity to customize the level of protection to achieve goals and objectives for an area while minimizing impact on human activities. The result should be a network that maximizes benefits and minimizes detrimental impacts, providing fair and equitable consideration of the effects on livelihoods while still achieving conservation goals." (Strategy, p. 16)

4.3.2 The relationship between Principles 7 and 8, and with Principle 6

4.3.2.1 We view Principles 7 and 8 as two sides of the same coin, which is about optimizing decisions. Indeed, Principle 8's explanatory wording acknowledges Principle 7 when it says, "*The result should be a network that <u>maximizes benefits</u> and minimizes detrimental impacts…*" (Underlining added.)

4.3.2.2 Principles 7 and 8 in turn rely upon Principle 6, which requires *"…an understanding of the value of ecosystem goods and services as well as the intensity and pattern of human uses across time and space*." The use and values typology and mapping described under Principle 6 (section 4.2) is a prerequisite for work on Principles 7 and 8 to be started.

4.3.3 Interpreting the meanings of 'the positive' (and 'the negative')

4.3.3.1 MPAs can have a wide variety of possible positive outcomes. The academic literature generally focusses on ecological benefits. Patterson et al. (2016) interpret "maximizing the positive" as the optimization of positive environmental outcomes as well as the safeguarding (or, where possible, enhancement of) social-economic-cultural values.

4.3.3.2 The Strategy emphasizes "*opportunities for sustainable socio-economic activities, cultural and spiritual values.*" The Memorandum of Understanding on PNCIMA Collaborative Oceans Governance between the Department of Fisheries and Oceans, the Province of BC, and First Nations of the Pacific North Coast, which pre-dates the current NSB process, uses similar wording in the context of "maximize":

> "*The CFN and NCSFNSS have a mandate on behalf of their member First Nations to coordinate and develop an integrated marine use planning process … (to) maximize benefits of marine resources and areas while preserving ecological integrity, economies and the wellbeing of coastal people*" (P1; quoted in Burt et al. 2014, underlining added here.)

4.3.3.3 If we were to interpret "positive" as meaning human "wellbeing", there could be a very broad interpretation of what this might entail. Several books have been written on this topic,[9] with websites[10] and national statistical agencies[11] devoted to its measurement. One well-known and well-regarded approach is that taken by the OECD (2015) in their "How's Life" analyses of countries globally, which use a composite index containing ten wellbeing "domains", followed by 22 "concepts," each with an indicator.

4.3.3.4 As Principle 7 falls in the Strategy's group of *Social, Economic, and Cultural Network Design Principles*, we will assume that these three aspects are the intended focus of the Principle, notwithstanding the primacy of protecting marine biodiversity (Goal 1), and the much more inclusive scope of human "wellbeing" as applied by the OECD and others.

4.3.3.5 Having established that the focus is social, economic, and cultural,[12] these terms need defining. As pointed out in the *interim guidance on incorporating economic use information* (DFO 2016), the Treasury Board of Canada Secretariat's cost-benefit analysis guide uses the term *economic* to refer to matters that "affect economic welfare and economic growth," and the term *social* to refer to "distributional impacts of policies;" i.e., how costs and benefits of a policy are distributed among stakeholders. As this definition was adopted by the DFO's interim guidance, it shall also be used here. Note, however, that *cultural* values are not covered by this interpretation.

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[9] E.g. Andrews FM & Withy SB. 1976. Social Indicators of Well-Being: Americans' perceptions of life quality. Google Books: https://books.google.co.uk/books?id=wiRHAAAAMAAJ&q=social+indicators+of+well-being&dq=social+indicators+of+well-being&hl=en&sa=X&ved=0ahUKEwjF2ZDhjqrMAhWHLMAKHQy-DVYQ6AEIJDAB

[10] E.g. Five Headline Indicators of National Success: http://www.neweconomics.org/publications/entry/five-headline-indicators-of-national-success

[11] E.g. the UK approach: http://webarchive.nationalarchives.gov.uk/20160105160709/http://www.ons.gov.uk/ons/dcp171766_387245.pdf

[12] Here we will assume that "spiritual" which is mentioned in the principles' explanatory text, is covered by "cultural" in the sub-heading.

4.3.3.6 For the purposes of this report, *cultural* benefits are interpreted as including non-monetary and intangible benefits derived from marine biodiversity, the ocean and its resources, such as, *inter alia*:[13]

- Education, learning, and knowledge sharing;
- Spiritual and religious values;
- Traditional and ceremonial practices;
- Recreational activities;
- Communal and community activities; and
- Archeological and heritage sites, structures, and objects.

4.3.3.7 We suggest that the intention of Principles 7 & 8 is that efforts will be made to ensure that economic, social, and cultural uses are compatible with the management objectives of affected sites, and vice versa. This will require iterative planning, monitoring, and regular review, in line with Principle 13 (adaptive management).

4.3.3.8 Many important economic, social, and cultural costs and values are difficult to quantify and measure, and many relevant impacts of planning decisions may not become apparent (or measureable) for several years. This makes it hard to carry out comprehensive quantitative analyses on the maximization of benefits and minimization of costs. If the planning process were to limit its focus to those aspects that are readily measureable, significant values and costs would be overlooked[14]. We therefore take the view that the implementation of Principles 7 & 8 should include costs and values that are not readily quantifiable, but which nonetheless can in some fashion be discussed, and ideally assessed using a relative ranking or scoring system, acknowledging that this will inevitably require some judgement calls.

4.3.4 Maximizing what is desired and minimizing what is not: trade-off analyses

4.3.4.1 Regardless of what indicators are selected for use in the NSB, in the context of MPA placement the focus will inevitably turn to potentially complementary and conflicting spatial uses, and how they can be best reconciled; i.e. considering spatial trade-offs.

4.3.4.2 The Treasury Board of Canada Secretariat's guidance (2007) puts forward a five-step approach to cost-benefit impact analysis, which can be adapted for use here. PacMARA is not suggesting that a cost-benefit analysis is necessary or appropriate in the early stages of MPA planning, but the structure of such an analysis offers a useful template for considering Principles 7 & 8, and trade-offs more generally:[15]

1. Identifying issues, risks, and the baseline scenario;
2. Setting objectives;

[13] C.f. the four "social goals" developed by Burt et al. (2014).

[14] "*Not everything that can be counted counts, and not everything that counts can be counted"* has been attributed to various people, including Einstein, but is more likely to be William Bruce Cameron, 1963. (http://quoteinvestigator.com/2010/05/26/everything-counts-einstein/)

[15] A full cost-benefit analysis is inappropriate in the early stages of project planning, but can come into play during later stages. However, as noted above, the Treasury Board's approach, elaborated upon by DFO's interim guidance, focusses on economic efficiency and distributional equity, which would need to be further expanded to include the breadth of principles 7 & 8 vis-à-vis cultural values.

3. Developing alternative regulatory and non-regulatory options;
4. Assessing benefits and costs;
5. Preparing an accounting statement.

4.3.4.3 DFO has recently provided *Interim guidance on incorporating economic use information into marine protected area network design*. The document suggests ways to identify relevant economic and human use information to be incorporated in MPA design, as well as some initial guidance on data treatment (DFO 2016). It recommends using the decision support tool Marxan (Ball et al., 2009) in accommodating socio-economic considerations into MPA design. Marxan requires spatial information, which will need to be collected and compiled as recommended under Principle 6 (section 4.2.6).

4.3.4.4 Several Marxan analyses have already been carried out in BC and the NSB, which should inform future NSB planning:

- A Central Coast Analysis by the NGO Living Oceans Society (Ardron et al. 2000);
- Two subsequent analyses by the Coast Information Team (CIT, 2004) assisted by NGOs as part of the North and Central Coast LRMP process (shoreline (The Nature Conservancy) and marine (Living Oceans Society, Ardron 2008);
- Separate analyses by Parks Canada for Haida Gwaii and the Southern Gulf Islands (not published);
- Various analyses by BC marine conservation scientists (e.g., Ban et al. 2009, Ban & Vincent 2009);
- The independent multi-stakeholder BC Marine Conservation Analysis (BCMCA 2012);
- Analyses as part of the Marine Planning Partnership for the North Pacific Coast and other parts of BC (MaPP Marine Plans, all sub-regions: MaPP 2015a-d).

4.3.4.5 These analyses did not have access to full suites of socio-economic baseline data, and therefore tended to focus on maximizing ecological values in the minimum footprint. While some social-economic issues were addressed in the latter analyses (i.e. BCMCA), more information would need to be added to meet the requirements of Principles 6, 7, and 8.

4.3.5 Relevant guidelines in literature

4.3.5.1 Patterson et al. (2016) found that there are few concrete guidelines internationally on the implementation of principles equivalent to Strategy Principles 7 & 8. The familiar regional-scale MPA processes, such as the California Marine Life Protection Act (MLPA), England's Marine Conservation Zones (MCZ), and the Great Barrier Reef rezoning processes focussed on ecological guidelines (see the case studies in Appendix 1 of Ardron et al. 2015).

4.3.5.2 Burt et al. (2014) point out that social and conservation goals are often compatible (p 38), but when not, they acknowledge that difficult trade-offs will be necessary. Trade-offs in the case studies in Ardron et al. (2015) were negotiated with stakeholders as issues arose. Marxan was used to varying degrees as a support tool in many, but not all of these processes. Ardron et al. (2015) note that:

"…in the five real-life processes we considered in greater detail […] none had outcomes that pleased all stakeholders, with some processes facing considerable, and at times acrimonious, opposition. No MPA process should thus expect to please everybody, and

evidence from other parts of the world indicates considerable political will is required to move forward with implementation." (p 5)

4.3.5.3 Social displacement is an issue in most places where MPAs are established (except perhaps on the high seas, where ironically very few MPAs have been established). Canada is no exception, and this issue is discussed from different angles in four key reports that originated in BC, summarised in appendices 1 and 2. Two of these are the previous PacMARA reports (Ardron et al. 2015, Patterson et al. 2016). The other two are: *Science-based Guidelines for Marine Protected Areas and MPA Networks in Canada* (Jessen et al. 2011) and *Marine Protected Area Design Features that Support Resilient Human-Ocean Systems* (Burt et al. 2014).

4.3.6 Identifying issues, risks, and the baseline scenario

4.3.6.1 There will be many possible trade-offs. To sort through these, some idea of what social, economic, and cultural values prevail is required. Stakeholder engagement will be a necessary part of exploring trade-offs, and in many instances this will be critical for success. The stakeholder engagement process considerations discussed under Principle 6 (section 4.2.5) apply equally to this Principle.

4.3.6.2 This section is structured using the Treasury Board of Canada Secretariat's five step approach as a starting point, summarizing general guidance as well as proposing specific guidelines on how to consider trade-offs for each step, the first step one of which is to *Identify issues, risks, and the baseline scenario.*

4.3.6.3 The social, economic, and cultural baseline scenario will be established by following the guidelines under Principle 6 (section 4.2.6), and the establishment of the ecological baseline will be a prerequisite for the ecological Principles (section 5). We note here that "*Traditional ecological knowledge can provide independent insight, or enrich other sources of data that can inform our understanding of species distributions, ecological dynamics, the effectiveness of management, as well as baseline conditions*." (Burt et al. 2014, p. 47)

4.3.6.4 The DFO's *Interim guidance on incorporating economic use information into marine protected area network design* discusses some criteria for identifying critical economic information and whether to collect it at the planning stage or later on (DFO 2106). It suggests using measures of *relative importance* as a proxy for potential opportunity costs of MPA implementation.

4.3.6.5 To assess the likelihood of conflict and explore trade-offs, the range of restrictions on human activities that will apply within MPAs will first need to be clarified. Under Principle 15 (section 3.3), we propose a framework for pre-defining a set of protection levels in the early planning stages, which will help to establish likely activity restrictions in MPAs, which, in turn will allow an assessment of the relative economic, social and cultural opportunities that could be gained or lost, as a pre-requisite for the trade-off analyses we see as central to implementing Principles 7 & 8.

Guidelines

4.3.6.6 **Primary guideline: Trade-off issues should include, but not be limited to, maximizing positive and minimizing negative economic impacts (economic efficiency) and tending to distributional impacts (social equity). Positive and negative impacts on the environment, spiritual and cultural practices, should also be included, when salient.**

- Conflict and compatibility matrices may be helpful here, indicating the estimated relative conflict of given activities (rows, applying the typology developed under Principle 6) versus protection levels (columns, applying the framework recommended under Principle 15).

4.3.6.7 **Secondary guideline: For economic, social, and cultural data/information, relative scales of importance (e.g. 0-5) should be developed –either qualitatively through interviews gathering local, traditional, and expert opinion (so-called "Delphic" approaches); and/or with quantitative data where they exist.**

- The DFO's interim guidance (2016) recommends relative scales as a first estimate of benefits of usage.
- If qualitative data are used, the pedigree of each rating should be traceable to its sources, and the rationale they provided.
- If quantitative data are used, they should be accompanied with metadata.
- There is more than one way to reduce the data to a simple relative scale, and the appropriate method will hinge upon the nature of the data and what is being sought from them (see next guideline).

4.3.6.8 **Secondary guideline: The representation of baseline economic, social, and cultural information in each planning unit[16] should follow good statistical practices. Classifications and relative ranking methods should take into account the mathematical properties of the data distribution.**

- Often it will be appropriate to compress the data using data transformation and/or classification methods to reduce "noise" (i.e. the stochastic variability that results from (non-biased) measurement error, general inaccuracies, and other random factors) to reduce the likelihood that irrelevant random factors will drive the trade-off analysis. A properly chosen method will also better represent the question for which the data are being queried. Compression can include:
    - Linear standardisation, the simplest approach[17] (dividing by the data range and multiplying by the range of the desired scale), is often inappropriate, unless the data are evenly distributed, or if all datasets in question follow the same general statistical distribution. It has been used, for example, when "dividing

[16] I.e. the unit at which planning is being evaluated. This is the term used in DFO's interim guidance (2016), which was borrowed from the Marxan literature.

[17] Strictly speaking, standardization is not compression, in that it does not alter the shape of the datas' histogram (distribution). It is, rather, a simplification, reducing a larger range (say, 0-millions) to a smaller one (say, 0-100). The simplification does still remove some noise, in that several values in the original dataset are assigned to the nearest whole number in the standardized one (i.e. rounded up or down). However, the effects of exceptionally large or small values (i.e. long tails in a distribution) is not addressed.

up the pie" of total landed value of a fishery according to where the fish was caught (or landed). It can be appropriate in situations there are just a few areas under consideration. However, for widely dispersed activities, with a range of values, a few areas of exceptional value will overshadow most of the others.

- For data that are statistically quasi-normally distributed, standard Z-scores are commonly used and better capture the range of values in the given population. Multimodal data should be split, if possible, and sub-classified for each mode, again using Z-scores.
- Non-normal data[18] may need to be first transformed to become quasi-normal (sometimes called *normalization*). Common transformations include log-normalization (e.g. for biological populations), square-root transformation (e.g. for two-dimensional areal measures); or cube-root transformation (e.g. for 3-dimensional measures, such as volume, as used in the BC herring spawn index).
- Irregular data will need to be classified according to quantiles, natural breaks or other clustering methods.

4.3.6.9 Secondary guideline: **Data for trade-offs (whether for Marxan or simply discussion) need not be in the same structure, scale, or format. For ease of communication, however, layers should be standardised to a percentage scale, such that 100% equals the total distribution across the whole study area.**

- This guideline flows from the one above, after it is determined how to represent data in each planning unit.
- Though not necessary for software tools like Marxan, standardised percentages will facilitate discussions concerning target-setting, and later, evaluation of the proposed network(s).
- It is also recommended in DFO's interim guidance (2016).

4.3.6.10 Secondary guideline: **The different datasets used in addressing Principles 7 & 8 should be briefly characterised, using language and descriptors relevant to a) decision-makers, b) stakeholders, and c) analysts.**

- This will highlight the nuances of each of the potentially conflicting activities, as well as the data representing them. Many of these characteristics are visually obvious once a map is created, but some are not. For example, one activity may employ many people, but with only moderate overall economic impact (e.g. a small boat fishery), whereas another activity my employ relatively few people, but be economically highly valuable (e.g. offshore petroleum production). A map of production platforms or fishing areas only captures part of the story.
- Descriptors should include, *inter alia*, the age of the dataset, the number of samples (landings, vessels, interviews, affected parties, etc.), total value (dollars, hectares,

[18] One quick test for non-normal skewedness if the mode (the mid-value point in the dataset) is considerably different than the arithmetic mean (average). There are also more sophisticated approaches to check normality, such as Q-Q plots.

population, etc.), range and variability of the data, and the shape of the spatial distribution ("concentrated", "widespread", "localized hotspots", etc.).

- The descriptors can be presented in simple or more complex ways, as appropriate to the intended audience. For example, while the co-efficient of variation is meaningful to analysts, it is unlikely to resonate with decision-makers, and phrases like "highly variable, "with some variation," and "consistently" are better for that audience.

4.3.6.11 Primary guideline: Higher risk conflicts with user activities / values should be prioritized for data gathering and the creation of baseline scenarios. All relatively likely issues should ultimately be assessed.

- Just as benefits of usage, risk of loss or harm should be estimated using relative scales (e.g. 0-5).
- Risk to users / industry / communities should consider the following (quasi-)independent dimensions: a) the relative likelihood of the loss occurring; b) the relative impact (extent x magnitude); c) the relative recovery time (for the user, industry, or community).
- While ecological benefits are dealt with under other Principles, the same dimensions characterizing risk of loss (including through inaction) can and should be applied.
- If it is desired to combine the above dimensions into a single score, they should not be added together. Rather, the square-root of the sum of squares should be used, as per standard practice when combining orthogonal measures (like sides of a right-angled triangle). The combined score should be standardised and rounded-off to fit into the desired relative scale.
- Higher risk issues should be priorities for data gathering, collation, and development of baselines.
- Data and information on other issues not captured in the above steps, but which have a reasonable or high likelihood of occurring should also be collected / collated, albeit after the high risk ones.

4.3.7 Setting objectives

4.3.7.1 Here, we follow the wording of the Treasury Board Secretariat, referring to "objectives" in a general sense. In practice they will include the NSB (draft) Objectives, and hence much of the work has already been done. Additional objectives may also be developed later, particularly at the site-selection stages.

4.3.7.2 Adaptive management (Principle 13) should be considered as a strategy for acknowledging current uncertainties and information deficiencies, whilst allowing decisions to be taken and implemented in a timely manner. Consideration should be given to how a series of adaptive management cycles might unfold over the long term (Patterson et al. 2016).

4.3.7.3 For each high- or likely- risk trade-off, management objectives should be developed (recommendation of this report).

Guidelines

4.3.7.4 **Primary guideline: Recalling that "*Specific, measurable, achievable, realistic and time-bounded (SMART) objectives will be identified at smaller spatial scales […] in an open, transparent and participatory manner, reflecting a balance in the needs of those involved in or affected by establishment and management of MPA networks*" (Strategy p19), the following guidelines are offered:**

- **Specific: management objectives should clearly identify the benefits and ill effects to be maximized / minimized.**
    - Examples: managing MPAs to increase value of seafood products through increased quality and size; reducing bycatch through placement of MPAs in areas of high biodiversity; reducing the distance travelled from home port to fishing grounds by spacing MPAs along the coast with fishing grounds in between; decreasing conflicts between specific user groups through clear spatial zoning including MPA.
    - MPA planning could specify percentages of commercial fishing grounds for each gear group that should remain open to fishing.
    - Objectives for MPA placement should focus on existing spatial knowledge, information, data and trends. In the context of Marxan, these become "features" and "costs;" or in the case of Marxan with Zones, many can be fit into zones.
- **Measurable: objectives should have indicators that suggest whether the objective is being met, or not, and the trend.**
    - Fisheries and other typically collected data will require some processing to be translated into indicators that reflect upon MPA design attributes. Ones to be considered include: value of landings (to measure economic benefits / impacts); distribution and values of landings (to measure equity of impacts / benefits), per community or port; distribution and weight of bycatch (to measure ecological impacts / benefits); catch per unit effort (to indicate availability of resource and its returns on labour); mean distance from port to fishing areas (social impact); number of visitors; number of complaints / charges / prosecutions (social and cultural impacts); etc.
    - More commonly, the footprint of an economic activity, or a conservation area/network, are used as rough indicators of meeting objectives, but size alone leaves a lot of questions unanswered. In the case of MPA planning assisted by Marxan, the base indicator is a feature's (or zone's) "target" and whether it has been met or not. Usually these are areal footprints, but they need not be. Multidimensional values can be assigned.
    - *Commentary*: The literatures on environmental, social, and economic indicators are massive, with journals dedicated to the topic.[19] Indicators that suggest causation are most valuable for directed management and science, but very

[19] E.g. Ecological Indicators, http://www.journals.elsevier.com/ecological-indicators/; the International Society of Environmental Indicators has its own journal: http://www.environmentalindicatorsjournal.net/; Social Indicators Research, http://www.springer.com/social+sciences/journal/11205

difficult to design. Simpler choices are often more affordable and practical, and while not fully explanatory can provide an initial indication whether more management attention, monitoring or research will be required.

- **Achievable and realistic (these aspects are typically considered together): Trade-off objectives at the network and site level should be vetted according to criteria that address both "do-ability" and the likelihood of implementation, regardless of their focus (social, economic, cultural, spiritual, or environmental).**
    - *Commentary*: The challenge is not in setting objectives, but in selecting a subset (from a multitude of possibilities) that can realistically be implemented. Most objectives considered by governments are, at least to some degree, achievable in theory, but many are simply unrealistic (economically, socially, and/or culturally). For example, it is entirely possible to carry out trade-off analyses to re-structure a fishery to better benefit local communities, or re-direct shipping traffic away from whale or bird use areas, or protect a given percentage of the ocean from bottom trawling. However, whether implementing such actions is *realistic* will depend on the economic, social, and cultural (including political) context. In some cases, action is relatively easily achieved, whereas in others it will not be.
    - Realism can be best determined through stakeholder consultations. Indeed, early engagement can help adjust objectives towards being realistic as well as help bring stakeholders "on board".
    - A matrix of trade-off objectives and how they could be addressed can guide discussions, keeping them grounded in known constraints and therefore realistic. Typical considerations include: cost, time required, institutional capacity, political support, public support, environmental conditions, and whether solutions are already known / at hand.
    - In the NSB, uncertainty about what is realistic can be reduced by learning lessons from previous marine planning processes, including previous Marxan analyses and their (often tacit) objectives and assumptions. For example, the BC Coast Information Team analysis aimed to identifying recurring areas of ecological importance with a minimum combined footprint, however, protecting these areas was not achieved, in part because the objectives were solely ecological[20].
- **Time-bounded: NSB MPA planning, trade-off options, implementation, and schedules for revision, should be under-pinned by clear timelines.**
    - Timelines for those objectives supported by (departmental, project, or private) funding should be sub-divided to fall within relevant budget frameworks, to allow for timely requests, reporting, and renewal. Timelines should also be developed according to the factors considered in the sub-section above on achievability and realism, and should be a row or column in the above-suggested trade-off matrix.

[20] As well, the North and Central Coast LRMP process ran out of time (i.e. cost and capacity issues), and in that situation of limited resources, terrestrial planning was deemed of greater priority (i.e. a lack of sufficient political and social support for marine planning at that time).

- *Commentary*: The importance of clear timelines for project planning, resourcing and budgeting cannot be stressed enough, and time-bounded objectives encourage cooperation and give all actors a sense of what the future may hold. At the same time, the importance of review and revision is equally critical (cf. Principle 13). Some objectives initially deemed achievable and realistic within a given timeline may turn out to be neither, and some may have to be abandoned. Even "successful" objectives are unlikely to be fully met and will therefore need regular review and revision. Time bounded objectives should be set in a way that allows for their wind-down if they outlive their usefulness, or their expansion if they prove more valuable than originally anticipated. Timelines should be seen as opportunities to end project phases and start new ones. Continuation of status-quo projects should be supported by results that indicate that positive values are being enhanced, whilst negative effects are being reduced. Marxan-assisted planning should allow for re-running the analyses at regular intervals, allowing for new information, data, techniques, and understanding to be incorporated.

4.3.8 Developing alternative regulatory and non-regulatory options

4.3.8.1 MPAs should be planned in the context of a wider suite of management approaches (Principles 6, 10, 11, 14).

4.3.8.2 The planning process should establish what range of restrictions on human activities will apply within MPAs / zones, and may include categories with different protection levels (Principle 15).

4.3.8.3 "*LEGAL OR OTHER EFFECTIVE MEANS: means that protected areas must either be gazetted (that is, recognised under statutory civil law), recognised through an international convention or agreement or else managed through other effective but non-gazetted means, such as through recognised traditional rules under which community conserved areas operate or the policies of established non-governmental organisations*." (Strategy, pp 31-32)

4.3.8.4 Develop a displacement policy (Jessen et al. 2011, Ardron et al. 2015).

4.3.8.5 For the purposes of MPA planning, alternative regulatory and non-regulatory options will often exist; for example, catch quotas, traditional user rights, marine trusts, and so on. However, after enquiring with MPATT regarding the scope of this report, it has been agreed to limit the discussion here to options regarding the MPA network.

Guidelines

4.3.8.6 Primary guideline: Consideration of alternative regulatory and non-regulatory options should be guided by principles of good governance, including (but not limited to) effectiveness, efficiency, and accountability.

- *Commentary:* When considering governance options, it is easy to get lost in the details. This guideline reminds the reader to judge such options on commonly accepted principles of good governance. While there are several principles of good governance (e.g. UN Development Program 1997; Kaufmann, Kraay, Mastruzzi 2008; Aguilera & Cuervo-Cazurra 2004; G20/OECD 2015). The three selected here are judged to be applicable to most circumstances in MPA design and management. See also principle 9.

- Effectiveness shall be seen as the ability of the governance options under consideration to meet management objectives. Generally, this requires the *acceptability* of the options from economic, social, and environmental perspectives (all three aspects of sustainability), as well as effective management (cf. Principle 9, section 4.4).
- Efficient governance shall be interpreted as the application of management measures using the minimum amount of institutional structure and cost (cf. Principle 9, section 4.4).
- *Commentary:* Efficiency in this instance is about the *governance* associated with the options under consideration. It should not be confused with economic efficiency of MPA placement vis-à-vis other activities and the trade-offs referred to above.
- Accountability shall be seen as the availability and responsiveness of the entities responsible for implementing the measures under consideration.
- *Commentary:* Accountability is strengthened through transparency measures, e.g. access to information, public participation, and access to justice (Aarhus Convention 1998). Accountability need not be limited to mandatory measures. Voluntary measures may have built-in accountability measures, such as mandatory reporting, control, and surveillance.

4.3.8.7 **Secondary guideline**: **Recalling that MPAs should be planned in the context of a wider suite of management approaches, regional MPA network planning should consider other relevant management measures already in place and how the addition of MPAs in the region can maximize the effectiveness of these existing measures, while minimizing operational redundancies or conflicts**.

- *Commentary:* Integrated management has in practice proven to be challenging, particularly across governments. MPA network planning should not only span all the relevant levels (as it does in the NSB), but also aim to streamline management within the MPAs themselves, as much "under one roof" as possible. Legally, this may require taking existing measures and shifting them into the given MPA's management plan under the competence of the MPA authority(ies).
- When integrating existing measures into an MPA network, stakeholders should be given the opportunity to "one-stop" consultations.

4.3.9 Assessing benefits and costs

4.3.9.1 Recognizing that PacMARA is not recommending a full cost-benefit analysis for MPA network planning, there are elements of good practices which should be taken into account when implementing a trade-off analysis. As guidance, the quotations in the following paragraphs provide an overview of some of these good practices likely to be relevant.

4.3.9.2 "*Marine protected areas are public investments. The importance of such investments are determined and maintained by the benefits they provide and how they are valued by the public*." (Strategy Goal 3 text)

4.3.9.3 "*Integration of economic and social considerations in MPA network design should also include an evaluation of the costs of inaction or inertia*." (Strategy Principle 6)

4.3.9.4 "*…network design should take advantage of best available knowledge (e.g., traditional,*

local and scientific), bio-economic models and decision support tools (e.g., Marxan) to support MPA site selection in order to reduce potential conflicts and ensure more equitable distribution of the costs and benefits of conservation between communities and users." (Strategy Principle 8)

4.3.9.5 "*Although one is likely to be more focussed on the direct impacts of the policy on the affected sectors and individuals that must comply with it, indirect impacts can also be significant and therefore should also be measured. One should then attempt to establish which other sectors of the economy the policy might affect*." (Treasury Board of Canada Secretariat 2007)

4.3.9.6 "*Marine protected areas network planning will be informed by information relating to ecological, environmental, social, cultural and economic aspects of the marine environment that is available without unreasonable cost, effort, or time. Standards should be developed to outline the quality requirements for the use of information in MPA planning*." (Canada-BC Strategy, p 26)

4.3.9.7 "*When benefits cannot be expressed in monetary values in a meaningful way, a cost-effectiveness analysis (CEA) should be carried out to assist in making effective decisions. A CEA calculates cost-effectiveness ratios of different alternative policy options and then compares the resulting ratios so that the most efficient option is chosen*." (Treasury Board of Canada Secretariat 2007, p29)

Guidelines

4.3.9.8 Primary guideline: Assessing benefits and costs of MPA options should first be at the scale of a regional network and take into consideration:

i. **the range of (economic, social, and cultural) benefits they provide;**
ii. **how the places in question are valued by the public and stakeholders;**
iii. **an evaluation of the consequences of inaction or inertia;**
iv. **direct and indirect (to the extent possible) impacts of the options;**
v. **the equitable distribution of the costs and benefits of conservation between communities and users;**
vi. **relative management costs and cost-effectiveness;**
vii. **using all readily available data and information.**

- *Commentary:* This guideline is the heart of trade-off analyses, and is our attempt to summarize existing guidance relevant to the NSB process, reflected in the quotations in the above section on guidance.
- Completing site-by-site assessments for multiple options would be very labour and time intensive. PacMARA suggests keeping MPA network planning at the scale of network level options. Use of tools like Marxan can explore multi-site trade-off options more quickly than manual methods. Also, a network level analysis can demonstrate that the role a particular site plays in the network overall may make it more or less attractive compared to a site-level assessment, depending on whether it is adding many new values to the overall network or not. Overall MPA conflicts can be minimized, and benefits maximized, only through analysis at the network level.

4.3.10 Preparing an accounting statement

4.3.10.1 "*It should also be kept in mind that the estimation of the benefits will often depend on the values for a number of variables that are known only with a considerable degree of uncertainty. The nature of this uncertainty and risk, in terms of likely ranges of the values of these variables or their distribution over time, should be documented and presented as an integral part of the cost-benefit analysis*." (Treasury Board of Canada Secretariat 2007, p13)

4.3.10.2 *"…analysts should identify the impacts on disadvantaged groups. Decision makers will almost certainly use this information in conjunction with the efficiency measure as captured by the cost-benefit analysis to evaluate trade-offs between equity and efficiency*." (Treasury Board of Canada Secretariat 2007, p 33)

4.3.10.3 "*In addition to the cost-benefit analysis, one should also present the distribution of the impacts of the policy on various stakeholders and the environment*." (Treasury Board of Canada Secretariat 2007, p. 40)

Guidelines

4.3.10.4 Secondary guideline: Selection of the appropriate trade-off among many possible scenarios should be documented noting the following:

i. **The rationale behind the decision.**

ii. **The "known unknowns"; i.e. the known data gaps and issues with existing information** (e.g. effects of water temperature increases on NSB human activities**);**

iii. **The suspected "unknown unknowns;" i.e. areas where it is postulated our knowledge is incomplete, in ways as yet unknown, but which will emerge over time** (e.g. unanticipated effects from climate change and CO2, outside of temperature changes, increased extreme weather events, and acidification, on human activities and valued places in the NSB)**;**

iv. **The relative certainty / confidence in the results of the analysis;**

v. **Disadvantaged and minority groups, and undocumented ecosystem components, that are likely to be affected, which are largely missed by the trade-off analysis;**

vi. **Suggestions on where to focus future data collection and adaptive management efforts.**

4.3.11 Summary Table: Principles 7 and 8

Table 7 Summary Table: Guidelines for Principles 7 and 8. The origin code indicates the degree to which a guideline is taken from existing literature or based on PacMARA's own expertise. Origin codes: 1 = guideline adopted from source literature without modification, 2 = guideline adapted and modified from literature source(s) to suit the BC planning context, 3 = guideline developed by PacMARA specifically for the BC planning context.

Guideline	Rationale	Applicable sources	Origin code
Primary guideline: Trade-off issues should include, but not be limited to, maximizing positive and minimizing negative economic impacts (economic efficiency) and tending to distributional impacts (social equity). Positive and negative impacts on the environment, spiritual and cultural practices, should also be included, when salient.	A summary of guidance already broadly accepted in BC.	Treasury Board of Canada Secretariat 2007 Jessen et al. 2011 Burt et al. 2014 Ardron et al. 2015 Patterson et al. 2016 DFO 2016	1
Secondary guideline: For economic, social, and cultural data/information, relative scales of importance (e.g. 0-5) should be developed –either qualitatively through interviews gathering local, traditional, and expert opinion (so-called "Delphic" approaches); and/or with quantitative data where they exist.	Although PacMARA has also made this recommendation before, the rationale is best summarised in DFO 2016.	DFO 2016, Ardron et al. 2015	1
Secondary guideline: The representation of baseline economic, social, and cultural information in each planning unit should follow good statistical practices. Relative scoring methods should take into account the mathematical properties of the data distribution.	This guideline highlights the importance of proper data manipulation. Early Marxan analyses were plagued by such issues, which led to the writing of the Marxan Good Practices Handbook.	Any reputable statistics text Ardron et al. 2010	1 (good statistical practices) 2 (examples in the text)
Secondary guideline: Data for trade-offs need not be in the same structure, scale, or format. For ease of communication, however, layers should be standardised to a percentage scale, such that 100% equals the total distribution across the whole study area.	A good communications tactic, as highlighted by DFO.	DFO 2016	1

Secondary guideline: The different datasets used in addressing Principles 7 & 8 should be briefly characterised, using language and descriptors relevant to a) decision-makers, b) stakeholders, and c) analysts.	A good practice, no matter what analysis, but particularly so for ones that involve discussions concerning common property resources.	Ardron et al. 2010	2
Primary guideline: Higher risk conflicts with user activities / values should be prioritized for data gathering and the creation of baseline scenarios. All relatively likely issues should ultimately be assessed.	Due to the sheer number of possible issues and conflicts, some sort of prioritization will be necessary.	Treasury Board of Canada Secretariat 2007 DFO 2016	2
Secondary guidelines: Recalling that "*Specific, measurable, achievable, realistic and time-bounded (SMART) objectives will be identified at smaller spatial scales […] in an open, transparent and participatory manner, reflecting a balance in the needs of those involved in or affected by establishment and management of MPA networks*" (Strategy p19), the following guidelines are offered: ***Specific*: management objectives should clearly identify the benefits and ill effects to be maximized / minimized**. ***Measurable*: objectives should have indicators that suggest whether the objective is being met, or not, and the trend.** ***Achievable and realistic*: Trade-off objectives at the network and site level should be vetted according to criteria that address both "do-ability" and the likelihood of implementation, regardless of their focus (social, economic, cultural, spiritual, or environmental).** ***Time-bounded*: NSB MPA planning, trade-off options, implementation, and schedules for revision, should be under-pinned by clear timelines.**	SMART is a widely recognized shorthand for the development of effective objectives, and is explicitly referred to in the Canada-BC Strategy.	Canada – BC MPA Network Strategy	2

Primary guideline: Consideration of alternative regulatory and non-regulatory options should be guided by principles of good governance, including (but not limited to) effectiveness, efficiency, and accountability.	In the consideration of governance options, it is easy to get lost in the details. This guideline reminds the practitioner to be guided by principles of good governance. C.f. also principle 9.	Several, e.g. UN Development Program 1997 Kaufmann, Kraay, Mastruzzi 2008 Aguilera & Cuervo-Cazurra 2004 G20/OECD 2015	3
Secondary guideline: Recalling that MPAs should be planned in the context of a wider suite of management approaches, regional MPA network planning should consider other relevant management measures already in place and how the addition of MPAs in the region can maximize the effectiveness of these existing measures, while minimizing operational redundancies or conflicts.	The trade-offs under Principles 7 & 8 will affect management under other mandates and jurisdictions in the region, and vice versa. Therefore, they should be considered together, when appropriate.	Canada – BC MPA Network Strategy	2
Primary guideline: Assessing benefits and costs of MPA options should first be at the scale of a regional network and take into consideration: **i. the range of (economic, social, and cultural) benefits they provide;** **ii. how the places in question are valued by the public and stakeholders;** **iii. an evaluation of the consequences of inaction or inertia;** **iv. direct and indirect (to the extent possible) impacts of the options;** **v. the equitable distribution of the costs and benefits of conservation between communities and users;** **vi. relative management costs and cost-effectiveness;** **vii. using all readily available data and information.**	This is a summary of existing national advice.	Treasury Board of Canada Secretariat 2007; Canada – BC MPA Network Strategy	1

Secondary guideline: Selection of the appropriate trade-off among many possible scenarios should be documented noting the following: **i. The rationale behind the decisions.** **ii. The "known unknowns"; i.e. the known data gaps and issues with existing information;** **iii. The suspected "unknown unknowns;" i.e. areas where it is postulated our knowledge is incomplete, in ways as yet unknown, but which will emerge over time;** **iv. The relative certainty / confidence in the results of the analysis;** **v. Disadvantaged and minority groups, and undocumented ecosystem components, that are likely to be affected, which are largely missed by the trade-off analysis;** **vi. Suggestions on where to focus future data collection and adaptive management efforts.**	Documentation of decision-making in general is best practice. This is a summary of existing national advice, modified for this specific situation; i.e. cost-benefit analysis guidelines reworked for MPA trade-offs.	Treasury Board of Canada Secretariat 2007	1 (basic ideas) 2 (summary wording and examples in text)

4.4 Principle 9: Management effectiveness

4.4.1 Wording of Principle

4.4.1.1 Principle 9:

"Enhance management effectiveness and compliance to maximise benefits and minimize costs.

Marine protected areas networks will incorporate design elements that help to ensure effective and cost efficient management, enforcement and compliance to achieve network goals and safeguard the public's investment. Partnerships with and among First Nations, local authorities, stakeholders, coastal communities and resource users will be key to success." (Strategy, p. 17)

4.4.2 Principles of good governance

4.4.2.1 Protected area governance refers to the formal and informal laws, structures, processes and traditions that determine how power and responsibilities are exercised and decisions taken (Graham et al. 2003, Lockwood 2009, McCay and Jones 2011). Lockwood (2009) highlights that governance concerns the powers and responsibilities exercised by organisation and individuals, whereas management concerns the processes, plans and actions that are applied as a component of governance.

4.4.2.2 OSPAR (2007) and Pomeroy et al. (2005) define management effectiveness as "*the degree to which management actions are achieving the goals and objectives agreed for a protected area*". Although governance is a much broader topic, principles of good governance are highly relevant to management effectiveness: "*Governance directly and indirectly influences the ecological outcome of MPAs: it affects management effectiveness by determining what inputs and processes are available for making and implementing good quality decisions; and good governance leads to increasing support for MPAs, resulting in greater buy-in and compliance with rules and regulations*" (Bennett & Dearden 2012).

4.4.2.3 If good governance and is not employed in the planning process, it will prove challenging to win over stakeholders and local communities during subsequent MPA management (Christie et al. 2003, Charles & Wilson 2009). The link between a well-run, inclusive, transparent and fair process and a high level of compliance for management measures is well established (e.g. Agardy et al. 2003, Christie et al. 2003, Andrade & Rhodes 2012).

4.4.2.4 There are many frameworks for governance effectiveness and/or principles of good governance in the literature. They all address similar themes and issues, but vary in the way they are structured and organised. Within the context of Principle 9, the relevant aspects of governance relate to whether the process, structures, institutions and management practices are able to support the achievement of effective outcomes with a high level of compliance (Bennett & Dearden 2012).

4.4.2.5 The design of the planning and decision making process cannot be separated from stakeholder engagement, because the latter forms part of the former. Therefore, although stakeholder engagement is not a required topic of focus for this report, and recognizing the work already undertaken by MPATT to develop a stakeholder engagement strategy, this section explores some good practices in stakeholder process design.

4.4.2.6 Jones et al. (2011) carried out empirical governance research into 20 MPA case studies around the world, and developed a governance analysis framework based on their findings. Within this framework, the authors categorized five types of governance incentives (defined as "*Institutions that are instrumentally designed to encourage people to choose to behave in a manner that provides for certain strategic policy outcomes, particularly biodiversity conservation objectives, to be fulfilled*") that are commonly in use in MPAs, arguing that the greater the diversity of incentives in place, the more resilient the management of the MPA:

- Economic incentives: Using economic and property rights approaches to promote the fulfilment of MPA objectives.
- Interpretative incentives: Promoting awareness of the conservation features of the MPA, the related objectives for conserving them, the policies for achieving these objectives and support for related measures.
- Knowledge incentives: Respecting and promoting the use of different sources of knowledge (local/traditional and expert/scientific) to better inform MPA decisions.
- Legal incentives: Establishment and enforcement of relevant laws, regulations, etc. as a source of 'state steer' to promote compliance with decisions and thereby the achievement of MPA obligations.
- Participative incentives: Providing for users, communities and other interest groups to participate in and influence MPA decision-making that may potentially affect them in order to promote their 'ownership' of the MPA and thereby their potential to cooperate in the implementation of decisions.

4.4.2.7 Graham et al. (2003) provide a table showing the United Nations Development Program's (UNDP) 'five principles of good governance' (UNDP 1997), which are: Legitimacy and voice; direction; performance; accountability; and fairness.

4.4.2.8 A number of authors have developed these principles further and provided a structure which is more relevant and applicable to protected areas:

- Lockwood (2009) defines six elements for governance effectiveness: Context (legal system); planning (policies, reserve design); inputs (human, financial); processes (administration, planning, delivery, engagement); and outputs and outcomes.
- Burt et al. (2014) summarize governance into six thematic principles and practices: Legitimacy; inclusion and fairness; capacity and performance; co-ordination and collaboration; knowledge integrity and adaptability; and transparency and accountability.
- IUCN principles for good governance of protected areas are defined in Dudley (2008) as: Legitimacy and voice; subsidiarity; fairness; do no harm; direction; performance; accountability; transparency; and human rights.

4.4.2.9 In order to maximize management effectiveness, the NSB's MPA planning process should apply the above principles of good governance. The spatial design of the network and its zonation into areas with different protection levels should also, where possible, reflect implementation of principles of good governance in site management and enforcement, e.g. equity, fairness, transparency and accountability.

4.4.2.10 We have synthesized a combined set of principles relevant to management effectiveness in the NSB process from the above frameworks. These are used in sub-headings to structure the next sections of this report, which provide more specific commentary and guidance on each principle:

- Legitimacy of decisions;
- Transparency and accountability of decisions;
- Inclusiveness, public awareness and support;
- Fairness/Equity in decision making;
- Proportionate and precautionary zonation;
- Designing for effective monitoring; and
- Designing for compliance and enforcement.

4.4.3 Legitimacy, transparency and accountability of decisions

4.4.3.1 Legitimacy refers to the validity of an organisation's authority to govern (whether conferred or earned), the extent to which decisions and actions are consistent with its mandate, and the integrity and commitment with which authority is exercised (Lockwood, 2009). The key test of legitimacy is from those stakeholders who will be affected by a potential MPA (Burt et al. 2014). Legitimacy therefore is both real and perceived, and can be both won and lost during a planning process. The principle of subsidiarity is important in relation to legitimacy of marine planning decisions, where the perception that decisions that will affect local communities are taken 'distantly' could have a negative influence on compliance and management effectiveness.

4.4.3.2 There should be clear roles and lines of authority and responsibility between different organisations and stakeholders within the process operating at the most appropriate geographical scale. This will help to ensure clarity and consistency on where power and responsibility lies.

4.4.3.3 Seeing how decisions are made is an important element of building stakeholder trust and support, building the foundation for management compliance and effectiveness. An effective process should ensure that decisions are transparent and that decision makers are accountable, particularly when multiple agencies are involved (Osmond et al. 2010). Decisions taken at various stages in the planning process should be recorded, and stakeholders should be able to see that actions and decisions by authorities are within clearly delineated responsibilities (Lockwood et al. 2012, Osmond et al. 2010).

4.4.3.4 The role and authority of each key person and organisation in the process should be clearly defined. Legislation plays a part in establishing this clarity, but usually, a more detailed roadmap will need to be developed in line with government policy. For example, the MCZ process in England mapped out governance and advisory roles and responsibilities of its participants (Davis & Vina-Herbon, 2010). Burt et al. (2014) argue that accountability should apply 'downwards' to stakeholders as well as 'upwards' to higher-level authorities.

4.4.3.5 The degree to which decisions are transparent and accountable has varied between different processes, as standards, expectations and legal requirements vary between

different countries, and limitations may also be set by technology, logistics and cost. The California MLPA process used a number of different tools and methods to make the process as transparent and widely accessible as possible, including webcasts of meetings, media broadcasts, public outreach workshops and online documents (Gleason et al. 2013).

4.4.3.6 The key is to ensure that there is a common and accepted standard for everyone in a given planning process, and that this standard of transparency and accountability is maintained throughout, including at the point of decisions on site designation and beyond (Osmond et al. 2010, Gleason et al. 2013, Lieberknecht et al. 2013).

Guidelines

4.4.3.7 **Primary guideline: There should be clear and well-communicated lines of authority, responsibility and management between Government Departments and Delivery Agencies.**

4.4.3.8 **Secondary guideline: Ensure a shared understanding of roles, responsibilities and influence across process participants, including clarity on who the decision-maker is at each stage.**

4.4.3.9 **Secondary guideline: Stakeholder roles and levels of influence should be defined and clear to all participants (including the stakeholders themselves).**

4.4.3.10 **Primary guideline: Ensure the implementation of common and accepted standards of transparency and accountability throughout the process, recording important decisions as they are made.**

4.4.3.11 **Secondary guideline: A transparent process should be set up to deal with any issues concerning perception that lines of authority have been crossed.**

4.4.4 Inclusiveness, public awareness and support

4.4.4.1 The need for meaningful participation in decision making and its link to effective management and compliance is well documented (e.g. Pomeroy et al. 2005; Rosendo et al. 2011; Bennett & Dearden 2012, Andrade & Rhodes 2012). Evidence for the converse has also been found, i.e. that if participation is weak, superficial, or limited to a small number of stakeholder groups, there can be negative outcomes (Shultz et al. 2011).

4.4.4.2 Good stakeholder process design should not be confused with a fully collaborative or bottom-up planning approach. Collaborative planning and decision-making is a resource-intensive, time-consuming undertaking that requires high levels of commitment from the participating stakeholder representatives, dedicated support from a planning team, and, crucially, the buy-in from decision-makers to devolve powers to design the network.

4.4.4.3 A badly designed collaborative approach with high levels of participation can lead to bad outcomes. In England's MCZ process, for example, stakeholders were initially asked to develop joint recommendations for an MPA network through a difficult and intense process of collaborative decision-making, only to find their recommendations subsequently assessed in a semi-transparent, drawn-out, top-down process that used a different set of benchmarks from the ones the stakeholder groups had been asked to comply with. This caused frustration and a significant loss of social capital (Lieberknecht et al. 2013). In this instance, it may have been better to follow a predominantly top-down consultative process with clearly defined and consistent roles from the beginning.

4.4.4.4 PacMARA does not advocate any particular level of stakeholder participation, as long as the process is fair, transparent, consistent and clear. The following paragraphs contain some basic guidance on good practices that will apply whether the stakeholder process is purely consultative or fully collaborative, but no detailed guidelines (beyond those above, relating to the importance of clear roles and remits) are recommended, because stakeholder engagement falls outside the Scope of Works for this report.

4.4.4.5 A stakeholder analysis (cf. Principle 6) will help ensure that all affected and potentially affected stakeholders are identified and their needs and priorities are understood. The planning process should ensure their knowledge and views are recognised and valued within the process, and that they have an opportunity to engage if they wish.

4.4.4.6 The stakeholder engagement strategy should ensure that vulnerable, remote and marginalised communities are reached. This should include (but not be limited to) a clear communication strategy that ensures they are aware of the process and of any opportunities engage with it.

4.4.4.7 The stakeholder engagement strategy should be mindful of stakeholder fatigue. Before asking stakeholders for input, the process should assess what other MPA-related processes the same stakeholder groups have already been involved with recently, and how those processes relate to the current NSB process. Care should be taken to avoid asking stakeholders questions which are (or might be perceived as) questions they have already been asked. Where relevant, opportunities should be taken to illustrate how previous stakeholder input into MPA-related processes is being built upon in the present process.

4.4.5 Fairness/Equity in decision making

4.4.5.1 The designation of MPAs will inevitably lead to gains for some stakeholders and losses for others (Holland 2000, cited in Sanchirico et al. 2007). As discussed under Principles 7 & 8 (section 4.3), trade-offs will need to be explored. The differential impacts from MPAs should be acknowledged, and the use of a 'win-win' discourse should not try and hide unequal and socially differentiated impacts (Fabinyi 2013, Chaigneau & Brown 2016).

4.4.5.2 Opportunity costs to fishermen are the most prominent costs from MPAs (Ban & Klein 2009), which can vary depending on target species, vessel type, fishing experience, skill, alternative sources of income and other socio-economic and cultural factors (Smith et al. 2010, Coulthard 2011). In the California MLPA process, the estimated maximum potential impact on fisheries (percentage loss in net economic revenue per year) varied widely – from 1% to 29% - between fishery and home port (Gleason et al. 2013). Inshore small-vessel fleets are deemed particularly vulnerable to the loss of local fishing grounds, and it has been argued that particular efforts should be made to positively involve inshore fishermen in MPA planning (Jones 2009).

4.4.5.3 The California MLPA and English MCZ process made concerted efforts to incorporate inshore fishermen's knowledge through participative mapping to identify important fishing grounds (Scholtz et al. 2004, Enever et al. in review). It is important to appreciate that not everyone can or should be 'won over' to the cause of MPAs. Stakeholders may remain unsupportive of MPAs in principle, but can nevertheless play a constructive role within a thoughtfully designed process, even if their objective is to minimize their own losses (Gleason et al. 2013, Jones 2012).

4.4.5.4 It is important to ensure that vulnerable sectors are identified through stakeholder analysis, and particular efforts are made to map information relating to their activities and values under Principle 6 (section 4.2.6). The draft guidance on incorporating economic use information (EAS 2016) recommends that, where sectors produce a relatively high value from a relatively small area, these sites should be locked out of the MPA network.

4.4.5.5 One way to address unequal impacts is through compensation for loss of earnings (Jones, 2009), or planning alternative livelihoods. If compensation is not an option for legal or political reasons, this should be made clear. Otherwise, the pros and cons of compensation should be carefully considered. Macintosh et al. (2010) note that the amount of compensation paid for displacement from the Great Barrier Reef spiralled from an initial expectation of $AU 10.2 million to a final bill of $AU 250 million.

Guidelines

4.4.5.6 Secondary guideline: Acknowledge and be open about the potential impacts of MPAs on different sectors (the establishment of a pre-defined protection level framework as recommended under Principle 15 will help achieve this).

4.4.5.7 Secondary guideline: When developing stakeholder engagement, communication, and data gathering strategies (cf. Principle 6), take particular care to engage with and map relevant information for those sectors and user groups most likely to be impacted by MPA management measures.

4.4.5.8 Secondary guideline: Provide clarity on whether compensation is going to be given for any losses incurred by any stakeholder as a result of site designation.

4.4.6 Proportionate and precautionary zonation

4.4.6.1 In addition to creating a network with individual sites that have different protection levels, the zonation of larger individual MPAs allows for management to be implemented proportionately, therefore reducing impacts to some resource users, and maintaining higher levels of support and compliance.

4.4.6.2 IUCN Guidelines (Dudley 2008, Day et al. 2012) state that when an MPA is divided into zones with different protection levels, the following three requirements should be met:

a) The zones are clearly mapped;

b) The zones are recognised by legal or other effective means; and

c) Each zone has distinct and unambiguous management aims that can be assigned to a particular protected area category.

4.4.6.3 The zoning plan for any MPA is inevitably a balance between biodiversity conservation and the sustainable use of environmental resources (Agardy 2002). Giving stakeholders the opportunity to provide feedback on multiple zoning options and their corresponding costs and benefits can help ensure sustained public support (Villa et al. 2002).

4.4.6.4 Vertical zoning, where different commercial fishing methods are permitted at different depths, is not considered good practice by the IUCN, since the interaction of benthic and pelagic systems is not fully understood, and surface or mid-water fisheries may in fact impact on the benthic communities below (Dudley 2008).

4.4.6.5 In terms of cost effectiveness, past work has shown that MPAs with single zones and clear rules (e.g., no-take areas) are less expensive to manage than multiple use MPAs. There is also evidence that size affects cost effectiveness – larger MPAs are generally cheaper to manage per unit area than smaller sites. Thus, a one-time compensation package for displaced fishermen to establish a large no fishing area may be cheaper than creating multiple-use MPAs that allow some fishing to continue, or several small no-take zones, if management costs are taken into account (Ban et al. 2011, Balmford et al. 2004).

Guidelines

4.4.6.6 Secondary guideline: Zoning should follow a precautionary and objective approach which ensures that each zone is proportionate to the ecological needs, whilst minimising unnecessary exclusion.

4.4.6.7 Primary guideline: Areas of high protection (IUCN Category Ia) should be designed as 'core zones' within MPAs, surrounded by a buffer area falling into a lower protection level.

4.4.7 Designing for effective monitoring

4.4.7.1 Principle 13 in the Strategy states that the process should 'apply adaptive management', recognising that there remains uncertainty in how MPAs could impact socially and environmentally over time. The impacts of the sites will need to be monitored, so that their effectiveness can be assessed, and the MPAs reviewed or adapted over time.

4.4.7.2 Klein et al. (2008) included proximity to research institutions and ease of access for survey work as parameters in a Marxan analysis for potential planning scenarios in California. The Ecological Network Guidance (ENG) developed for England's MCZ process highlighted that, where possible, sites should be placed in areas with a long history of research and monitoring, or areas close to research centres (Natural England and JNCC 2010 p61).

4.4.7.3 There are many case studies in the literature that demonstrate the value of incorporating local and traditional knowledge within the monitoring of individual MPAs. Actively involving people in this way creates social pressure to comply with the rules, support ecological objectives and supplement scientific monitoring programmes (Burt et al. 2014).

Guidelines

4.4.7.4 Secondary guideline: For coastal MPAs, a small weighting should be given favouring sites close to research institutions, within easy access of researchers, and/or with a long history of research.

4.4.8 Designing for compliance and enforcement

4.4.8.1 MPA design can enhance compliance and enforcement (Arias et al. 2015, Orstrom 2000, Pomeroy et al. 2006). Easily delineated boundaries provide clarity to users and enforcement agencies (Jones 2011) – for relevant guidelines, see Principle 5 (section 5.5).

4.4.8.2 The MCZ ENG (Natural England and JNCC, 2010) stated that MCZ boundaries should be drawn simply, using a minimum number of straight lines, ensuring as compact a shape as possible to minimize edge effects, and incorporating a margin (buffer zone) around sensitive features to protect them from accidental damage from fishing gear deployed beyond the boundary. Towed fishing gear warps and static gear ropes can extend up to 2000m in deep water fisheries (JNCC MNPG 2008, Natural England and JNCC 2010 p.122).

4.4.8.3 Coastal users tend to have much less flexibility and adaptability than offshore users in the areas they use, which means that large coastal MPAs are likely create friction and hardship (Ban et al. 2011). Larger MPAs may be more appropriate offshore, whereas smaller sites might be more appropriate inshore (this is also reflected under Principle 5, section 5.5).

Guidelines

4.4.8.4 Secondary guideline: MPA boundaries should be kept simple. In the nearshore area they should use prominent coastal or land features where possible. Further offshore, boundaries should be provided in geographic co-ordinates indicating their projection.

4.4.9 Summary Table: Principle 9

Table 8 Summary Table: Guidelines for Principle 9. The origin code indicates the degree to which a guideline is taken from existing literature or based on PacMARA's own expertise. Origin codes: 1 = guideline adopted from source literature without modification, 2 = guideline adapted and modified from literature source(s) to suit the BC planning context, 3 = guideline developed by PacMARA specifically for the BC planning context.

Guideline	Rationale	Applicable sources	Origin code
Primary guideline: There should be clear and well-communicated lines of authority, responsibility and management between Government Departments and Delivery Agencies.	Clear co-ordination and co-operation reduces risk of inefficient, incoherent or conflicting implementation.	Bennett and Dearden (2012) Burt et al. (2015)	2
Secondary guideline: Ensure a shared understanding of roles, responsibilities and influence across process participants, including clarity on who the decision-maker is at each stage.	Clarity on different roles and responsibilities gives certainty to those involved in the process and helps to manage their expectations.	Davis and Vina-Herbon 2010 Gleason et al. 2013 Lieberknecht et al. 2013	2
Secondary guideline: Stakeholder roles and levels of influence should be defined and clear to all participants (including the stakeholders themselves).	Managing stakeholder expectations from the beginning will help to ensure that their input and participation is productive and positive during the process.	Gleason et al. (2013) Osmond (2010)	2
Primary guideline: Ensure the implementation of common and accepted standards of transparency and accountability throughout the process, recording important decisions as they are made.	Some stakeholder sectors may challenge how a site was initiated, developed or changed. The use of an appropriate log will help stakeholders to trace the evolution of a site.	Osmond et al. 2010 Gleason et al. 2013 Lieberknecht et al. 2013	2
Secondary guideline: A transparent process should be set up to deal with any issues concerning perception that lines of authority have been crossed.	To avoid planning discussions being sidetracked by process issues, and to address any stakeholder concerns about fairness.	Lieberknecht et al. 2013	2
Secondary guideline: Acknowledge and be open about the potential impacts of MPAs on different sectors (the establishment of a pre-defined protection level framework as recommended under Principle 15 will help achieve this).	To ensure transparency, build trust, and to be able to identify, address and potentially prevent unequal impacts in trade-off analyses.	Fabinyi 2013 Chaigneau & Brown 2016	2

Secondary guideline: When developing stakeholder engagement, communication, and data gathering strategies (cf. Principle 6), take particular care to engage with and map relevant information for those sectors and user groups most likely to be impacted by MPA management measures.	To ensure that the most important impacts of the MPA network are well enough understood and mapped to be able to be considered in the exploration of trade-offs.	Jones 2009 Scholtz et al. 2004 Enever et al. in review Gleason et al. 2013	2
Secondary guideline: Provide clarity on whether compensation is going to be given for any losses incurred by any stakeholder as a result of site designation.	To ensure transparency and build trust.		3
Secondary guideline: Zoning should follow a precautionary and objective approach which ensures that each zone is proportionate to the ecological needs, whilst minimising unnecessary exclusion.	To ensure the achievement of Goal 1 whilst allowing greater flexibility when exploring trade-offs under Principles 7 & 8, and maintaining consistency with the guidelines under Principle 15.		3
Primary guideline: Areas of high protection (IUCN Category Ia) should be designed as 'core zones' within MPAs, surrounded by a buffer area falling into a lower protection level.	To prevent accidental impacts within highly protected core zones.	Day et al. 2012 Dudley 2008	2
Secondary guideline: For coastal MPAs, a small weighting should be given favouring sites close to research institutions, within easy access of researchers, and/or with a long history of research.	To enable easier monitoring of at least some of the sites in the network.	Natural England and JNCC 2010 Klein et al. 2008	1
Secondary guideline: MPA boundaries should be kept simple. In the nearshore area they should use prominent coastal or land features where possible. Further offshore, boundaries should be provided in geographic co-ordinates indicating their projection.	To make boundaries easy to identify and navigate by users without electronic navigation (in the nearshore) and with electronic navigation (in the offshore)	Natural England and JNCC 2010	2

4.5 Principle 11: First Nations

4.5.1 Wording of Principle

4.5.1.1 Principle 11

"Respect First Nations' treaties, title, rights, aspirations and world-view.

First Nations' support and participation is an essential part of creating an effective MPA network. The special relationship between the Crown and First Nations will be provided for; both governments will respect the continued use of MPAs by First Nations for food, social and ceremonial purposes and other traditional practices, provided that these uses are consistent with the objectives for the MPA. The establishment of any MPA will not affect ongoing or future treaty negotiations or agreements and will seek to address opportunities for First Nations to benefit from MPAs." (Strategy, p. 17)

4.5.2 Indigenous resource management approaches and MPA planning globally

4.5.2.1 Indigenous peoples have managed the oceans since time immemorial. Indigenous marine stewardship and management practices are ubiquitous where people rely on marine resources, and are varied in implementation and application to match the local ecosystems and customs. Common indigenous resource management approaches – those that are found in multiple, diverse cultures, including amongst First Nations in BC (Lepofsky & Caldwell 2013) include the following:

- Marine tenures or customary tenures - delimited areas of the ocean where rights of extraction, management, and access are attributed to specific entities or people (e.g., to a village, a chief, a family);
- Periodically harvested closures are marine areas that are off-limits to extractive activities most of the time, and are opened for fishing and harvesting for special occasions (e.g., village feasts, funerals, needs for cash for e.g. school fees);
- Other closed areas, such as marine areas that are permanently off limits to extraction or even to visits, commonly for cultural reasons;
- Selective harvesting, where only animals of certain sizes are harvested, or where only certain times are open for harvesting;
- Enhancement strategies, such as transplanting of eggs and improvement of spawning grounds.

4.5.2.2 All of these indigenous management practices are commonly underpinned by worldviews that embed respect for other living things and guide practices (e.g., don't take more than you need) (Lepofsky & Caldwell 2013, McClanahan et al. 2006). These worldviews in turn are embedded within stories, customs and traditions (Berkes 2012).

4.5.2.3 Recognition and respect for Indigenous peoples' treaties, title, rights, aspirations and worldview extends beyond the literature on marine management and protected areas. Indigenous peoples have suffered from historic injustices, including colonization and dispossession of land, water, territories, and resources. An international effort led to the recognition of the rights of indigenous peoples, culminating in the UN Declaration on the Rights of Indigenous Peoples (2008). Canada initially refused to sign the Declaration, but announced its support in 2010 and declared its full support without qualifications in May

2016. The Declaration lays out 46 articles that articulate the rights of indigenous peoples, including, for example, the right to self-determination, the right not to be subjected to forced assimilation, the right to practice and revitalize cultural traditions and customs.

4.5.2.4 Due to the past history of dispossession of indigenous peoples from protected areas, the IUCN developed an initiative to support conflict resolution on protected areas and indigenous peoples and local communities, called the Whakatane Mechanism (Freudenthal et al. 2012). The objectives of this Mechanism are to explore opportunities for conflict resolution involving indigenous peoples, local communities and protected areas, and support and promote multi-stakeholder dialogues and consensus-building. The approach is quite broad, and includes these key elements: "*doing evidence-based fieldwork in protected areas involving key stakeholders and right-holders, facilitating interactions, advancing consensus on objectives and strategies, creating good will, empowering stakeholders, promoting awareness and information sharing*" (Whakatane Mechanism 2012). The steering committee of the Mechanism considers requests by indigenous peoples and local communities for an intervention of IUCN to address their concerns. The fact that a global mechanism is needed to ensure that indigenous peoples are not negatively affected by the implementation and management of parks highlights the extent of the past history of wrong-doings.

4.5.2.5 Global marine conservation efforts have a mixed history of dispossession of indigenous peoples, and conversely as a tool for empowerment and revitalization of cultural practices. Negative examples are usually those where MPAs are forced upon indigenous peoples without proper consultations. For instance, the top-down designation of the Motu Motiro Hiva Marine Park, a 150000km^2 no-take MPA in Chile, was done without proper consultation of the Rapa Nui people (Gaymer et al. 2014). A commonly cited example of marine conservation as a tool for empowerment is Locally Managed Marine Areas in Oceania, which use traditional stewardship tools such as taboo areas to benefit marine conservation while enhancing cultural practices (Johannes 2002, Jupiter et al. 2014).

4.5.2.6 As yet, there are no exemplary cases with a similar context to Canada that provide specific guidance for MPA network planning that respect indigenous rights, title, aspirations and worldviews. The most relevant MPA network planning processes are the MLPA process in California, management and rezoning of the Great Barrier Reef Marine Park (GBRMP), and MPA network planning in New Zealand.

4.5.2.7 The MLPA process in the northern California region (the only region where there was active engagement by Tribes in the planning proces) was not equipped to address concerns or rights of California tribes. While planners made an attempt to integrate concerns, State laws do not recognize tribal fishing rights, and thus some tribal rights were violated and ecological design principles not met in the attempted compromise (Effron et al. 2011).

4.5.2.8 In the GBRMP in Australia, traditional owners need to apply for and develop Traditional Use of Marine Resources Agreements (TUMRAs). An agreement describes how Traditional Owner groups wish to manage their take of natural resources (including protected species), their role in compliance and their role in monitoring the condition of plants and animals, and human activities, in the GBRMP. An agreement operates for a set amount of time, and is the renegotiated (Nursey-Bray and Jacobson 201421).

4.5.2.9 In New Zealand, the Marine Reserves Act does not make specific reference to the Treaty of Waitangi, and hence the process of establishing marine reserves (as no-take MPAs are called in New Zealand) is seen to require improvements in consultation with Maori and local communities (Taylor & Buckenham 2003). New Zealand's attempts to settle fisheries claims against the Crown by the Maori have resulted in spatial conflicts between commercial fisheries, marine reserves, and customary fishing rights (Bess and Rallapudi 2007). Thus none of the countries with similar contexts to Canada provide exemplary guidance for the NSB.

4.5.2.10 A growing literature in marine conservation emphasizes the importance of integrating traditional indigenous stewardship and management practices to achieve ecological and social benefits (Cinner & Aswani 2007, Johannes 2002). The benefits of MPAs, especially no-take areas, are well-established (e.g., Halpern & Warner 2002, McCook et al. 2010), and in theory no-take areas should be the most effective protection mechanism for biodiversity. However, in some cultural contexts indigenous stewardship and management practices are more effective at achieving conservation outcomes than no-take areas (McClanahan et al. 2006). Indigenous resource management practices can be more ecologically effective because they are culturally appropriate, locally developed, and relevant to the ecosystems and species in those places. In such situations, other management measures, such as no-take areas, may not be culturally appropriate. That said, biodiversity conservation effectiveness of indigenous stewardship and management practices can vary (Bartlett et al. 2009, Cinner 2007). Yet there are many social and cultural benefits to indigenous stewardship, including cultural revitalization through recognition of traditional governance and decision-making structures (Berkes 2012, Johannes 2002, Nursey-Bray and Jacobson 2014).

4.5.2.11 A commonly recommended practice in the literature to recognize and empower indigenous peoples is to enable the culturally appropriate integration of traditional [Aboriginal] ecological knowledge (TEK) in conservation efforts. The report by Burt et al. (2014) provides an excellent overview of integration of TEK into MPA planning, including highlighting many of the challenges. In short, meaningful engagement of indigenous peoples and their knowledge can help to link multiple goals and objectives regarding broader ecological, governance, and social considerations in planning of protected areas. Challenges include the potential to take TEK out of its context, misconstrue or misinterpret meanings, and take control of their information away from indigenous peoples (Burt et al. 2014, Nadasdy 2005). Including TEK in marine conservation planning and management should not be considered as a separate endeavour, but rather should be integrated throughout planning and management.

[21] http://www.gbrmpa.gov.au/our-partners/traditional-owners/traditional-use-of-marine-resources-agreements

4.5.3 First Nations in BC and MPA planning in the NSB

4.5.3.1 The importance of addressing this Principle requires an understanding of the context and history of treatment of indigenous peoples in British Columbia and Canada. Colonization and associated policies deeply affect(ed) First Nations in BC. Smallpox and other epidemics decimated First Nations populations in the late 1700s and 1800s. Estimates of population declines are scarce, but coastal First Nations settlements (permanent and seasonal) were once much more populous in most of BC compared to today. After Canadian Confederation, the Indian Act and associated policies and actions banned First Nations cultural practices such as potlatches, prohibited traditional fishing methods such as weirs, established Indian Reserves, and forced removal of children to residential schools (where abuse occurred and children were not allowed to speak their First Nations languages). These actions were taken in an effort to assimilate First Nations into the colonial society (Harris 2002). These policies and actions led to severe consequences for First Nations wellbeing (e.g., impacts to languages, knowledge, practices) (Truth and Reconciliation Commission 2015). In coastal BC, First Nations reserves were given very limited land because they were considered fishing cultures (Harris 2002). Most of BC First Nations did not sign historical treaties. The modern treaty process started in 1992, but few modern treaties have been signed, and thus details of First Nations' rights and title remain unresolved in much of coastal BC.

4.5.3.2 In Canada, Aboriginal rights and title are recognized (not granted) by the Canadian governments. Many of the rights and titles of First Nations have been clarified and affirmed through the court system. Canada's Constitutional Act (1982) recognizes and affirms existing Aboriginal and treaty rights (Section 35), including the right to fish for food, social and ceremonial purposes. Some key court decisions about First Nations rights and title include clarification that "existing rights" in the Constitution is defined as any rights that remain un-extinguished (Sparrow 1990), that oral history of First Nations must receive equal weight to historical evidence (Delgamuukw 1997), and that the government has a legal duty to consult and accommodate concerns of First Nations (Haida and Taku 2004) (Dearden & Bennett 2015). Most recently, the Tsilhqot'in decision affirmed that Aboriginal title "*extends to all the territory that a First Nation regularly and exclusively used when the Crown asserted sovereignty*" (Tsilhqot'in Nation v. British Columbia 2014).

4.5.3.3 These court decisions that affirm Aboriginal rights and title, and the recognition of the wrongs that were done in the past, have prompted some government actions to work towards reconciliation. For instance, in 2005 the Province of BC entered into a "New Relationship" with Aboriginal people and communities. The New Relationship is based on three themes: "respect, recognition and accommodation of Aboriginal title and rights; respect for each other's laws and responsibilities; and the reconciliation of Aboriginal and Crown titles and jurisdictions[22].The federal government elected in 2015 included in its mandate letters to Ministries[23] an expectation to move towards reconciliation with First Nations, Inuit and Metis peoples as a top priority, starting with implementing the UN Declaration on the Rights of Indigenous Peoples (2008).

[22] http://www2.gov.bc.ca/gov/content/governments/aboriginal-people/new-relationship
[23] http://pm.gc.ca/eng/minister-indigenous-and-northern-affairs-mandate-letter

4.5.3.4 Current planning for a MPA network provides a timely opportunity to contribute towards reconciliation by recognizing First Nations as an equal partner at every stage of the planning, implementation, management and monitoring of MPAs, where their knowledge, beliefs and practices are respected. Instead of inadvertently becoming another colonizing tool, MPAs can instead empower First Nations to co-govern parts of the ocean. PacMARA suggests that BC could serve as a global example of how indigenous rights, title, aspirations and worldview can be respectfully and proactively applied in MPA network planning.

4.5.3.5 Below are some initial recommendations to respect First Nations' treaties, title, rights, aspirations and worldviews. These recommendations emerged from the literature, personal experiences and professional knowledge by the authors, and conversations with some First Nations organizations. They should not be considered legal advice. Each First Nation has its own unique culture, aspirations, worldviews, and hence a diversity of approaches are likely to be needed to address rights, title, aspirations and worldviews. It should be up to each First Nation to determine how to best address their aspirations and worldviews within the context of MPA planning in the NSB.

4.5.4 Recommended guidance and guidelines for the NSB

4.5.4.1 Principle 11 states that *"Establishment of any MPA will not affect ongoing or future treaty negotiations or agreements"*, and that "*Governments will respect the continued use of MPAs by First Nations for food, social and ceremonial purposes and other indigenous practices, provided that these uses are consistent with the objectives of the MPA.*" As such, establishment of MPAs must be consistent with existing treaties and international law.

4.5.4.2 First Nations should continue to be considered as governments, and engaged as equal partners in the MPA network planning process. The body that will make decisions about MPA site selection and implementation will need to be identified and include representation of First Nations in its terms of reference.

4.5.4.3 MPA decision-making rules and the role of First Nations in that decision-making process should be created. These could include options that First Nations may choose from, according to their desired level of engagement (e.g. consultation, coordination, cooperation, co-management).

4.5.4.4 Where conflicts (real or perceived) exist, efforts should be made to resolve the situation through informal and formal discussions, resulting in MOUs, notwithstanding clauses, or other appropriate solutions consistent with international good practices. Resolving potential conflicts early will result in a more effective MPA network design process (Freudenthal et al. 2012, Burt et al. 2014)

4.5.4.5 First Nations approaches and methodologies relevant to MPA network planning, implementation and management processes should be encouraged, supported, and given equal consideration to other approaches.

4.5.4.6 Traditional [Aboriginal] ecological knowledge should be integrated in the MPA network selection process, and/or can be blended with science in planning, implementation, and management. When TEK is used, have cultural advisors and/or indigenous knowledge holders guide the use and sharing of that knowledge to ensure that proper cultural protocols are followed and knowledge is safeguarded.

4.5.4.7 Spatial depictions of TEK (e.g., locations of culturally important species) should be included in site selection tools if used, and targeted for inclusion or exclusion in MPAs, as deemed appropriate by the knowledge holders. Such analyses can be carried out by First Nations organizations, if so desired, but should be subject to the same review and revision process as other spatial analyses conducted by non-First Nation governments.

4.5.4.8 Culturally important areas can be locked in / out when a decision-support tool such as Marxan is used, and built onto to select additional sites to meet objectives. As with all information and data, each culturally important area will need to be supported with metadata and attributed to source(s) where consistent with First Nations protocols and data sensitivity concerns.

4.5.4.9 Efforts of the Marine Planning Partnership, and the protection management zones proposed therein, and conservation areas identified in First Nations' marine use plans, should be used as a starting point for discussions about potential siting of MPAs. These areas can be locked in / out when using a decision-support tool such as Marxan, and built onto to select additional sites to meet objectives. These areas may or may not be the same as culturally important areas.

4.5.4.10 One approach to ensuring equity of costs and benefits of MPAs would be to encourage each First Nation to participate in the process and to have at least one MPA in their territory. Territories of First Nations who wish to have MPAs should be included as targets when using a decision-support tool such as Marxan.

4.5.4.11 Being able to make a living within their marine territories is an aspiration by many First Nations. Enabling this aspiration requires recovery of depleted species, support for non-extractive and sustainable economic development. Following the ecological Principles and guidelines is thus important for enabling a revitalization of community-based economies based on marine resources.

4.5.4.12 Integrate Canadian laws and First Nations laws and customs to manage MPAs. Integrating Indigenous laws and resource management principles into MPA regulation may include gear prohibitions, noise reduction measures, and cultural protocols (e.g., how to conduct oneself on the land/sea, be respectful, take only what you need, request permission to use an area). Indigenous resource management practices should be encouraged within MPAs, where consistent with the objective of the MPA. These might include clam gardens, selective fishing practices such as fish weirs and traps, habitat and species enhancement activities, rules and customs for access and management (e.g., involving hereditary chiefs, implementing tribal parks).

4.5.4.13 Recognize that aspirations will vary Nation by Nation (e.g., type of desired economic development and support for MPAs will vary).

Guidelines

4.5.4.14 Primary guideline: First Nations whose territories fall within the MPA planning region should, at a minimum, be consulted and accommodated. Further levels of engagement should be at the discretion of the affected First Nations.

4.5.4.15 Secondary guideline: Each First Nation should be asked by the body that will make decisions about MPA site selection how they wish to be consulted and what level of engagement in the process they wish to have. Both elected and hereditary leadership should be consulted.

4.5.4.16 **Primary guideline: Existing relevant treaties in the NSB should be identified and their influence on MPA planning made explicit.**

4.5.4.17 **Secondary guideline: Where they exist, First Nations protocols for working in their territories should be followed. This may necessitate new agreements concerning MPA consultations and decision-making.**

4.5.4.18 **Primary guideline: Traditional [Aboriginal] ecological knowledge should be integrated in the MPA network selection process, and/or can be blended with science in planning, implementation, and management.**

4.5.4.19 **Secondary guideline: First Nations should be asked whether they wish to share their methodologies for MPA planning, implementation and management with MPATT (and/or the relevant bodies). If so, then that should become part of the planning schedule.**

4.5.4.20 **Secondary guideline: Prioritize culturally important areas for inclusion in MPAs, where these are brought forward by First Nations (e.g., designate sacred sites as highly protected).**

4.5.4.21 **Secondary guideline: Prioritize conservation areas proposed through past and ongoing planning initiatives that First Nations have led or been involved with.**

4.5.4.22 **Primary guideline: Where possible, integrate Canadian laws and First Nations laws and customs to manage MPAs, recognizing that aspirations will vary Nation by Nation (e.g., type of desired economic development and support for MPAs will vary).**

4.5.4.23 **Secondary guideline: Provide First Nations with an option to designate and govern MPAs in their territory as Indigenous and Community Conserved Areas (ICCAs).**

- *Commentary:* The ICCA Consortium articulates the defining characteristics of ICCAs as follows:

  > "1. A people or community is closely connected to a well-defined territory, area or species (e.g., because of survival and dependence for livelihood, because of historical and cultural reasons);
  >
  > "2. The community is the major player in decision-making (governance) and implementation regarding the management of the territory, area or species, implying that a community institution has the capacity to develop and enforce regulations; (in many situations other stakeholders are involved, but primary decision-making rests de facto with the community);
  >
  > "3. The community management decisions and efforts lead to the conservation of the territory, area or species and associated cultural values (the conscious objective of management may be different than conservation per se, and be, for instance, related to material livelihood, water security, safeguarding of cultural and spiritual places, etc.)"[24].

[24] http://www.iccaconsortium.org/

4.5.5 Summary Table: Principle 11

Table 9 Summary Table: Guidelines for Principle 11. The origin code indicates the degree to which a guideline is taken from existing literature or based on PacMARA's own expertise. Origin codes: 1 = guideline adopted from source literature without modification, 2 = guideline adapted and modified from literature source(s) to suit the BC planning context, 3 = guideline developed by PacMARA specifically for the BC planning context.

Guideline	Rationale	Applicable sources	Origin code
Primary guideline: First Nations whose territories fall within the MPA planning region should, at a minimum, be consulted and accommodated. Further levels of engagement should be at the discretion of the affected First Nations.	This underpins the achievement of the wording of the Principle.	Burt et al. 2014	2
Secondary guideline: Each First Nation should be asked by the body that will make decisions about MPA site selection how they wish to be consulted and what level of engagement in the process they wish to have. Both elected and hereditary leadership should be consulted.	A transparent and fair process is important, and roles should be identified clearly so that the process is clear.	Burt et al. 2014	2
Primary guideline: Existing relevant treaties in the NSB should be identified and their influence on MPA planning made explicit.	Principle 11 states that establishment of any MPA will not affect ongoing or future treaty negotiations or agreements.	Canada-BC MPA Network Strategy	3
Secondary guideline: Where they exist, First Nations protocols for working in their territories should be followed. This may necessitate new agreements concerning MPA consultations and decision-making	Following First Nations protocols shows respect and cultural awareness.	Burt et al. 2014	2

Primary guideline: Traditional [Aboriginal] ecological knowledge should be integrated in the MPA network selection process, and/or can be blended with science in planning, implementation, and management.	TEK can provide information that can contribute to meeting ecological and socioeconomic Principles.	Burt et al. 2014	2
Secondary guideline: First Nations should be asked whether they wish to share their methodologies for MPA planning, implementation and management with MPATT (and/or the relevant bodies). If so, then that should become part of the planning schedule.	Using First Nations methodologies shows respect and cultural awareness, and affirms the importance of those approaches.		3
Secondary guideline: Prioritize culturally important areas for inclusion in MPAs, where these are brought forward by First Nations (e.g., designate sacred sites as highly protected).	Including culturally important areas in the process affirms the importance of that information.	Burt et al. 2014	2
Secondary guideline: Prioritize conservation areas proposed through past and ongoing planning initiatives that First Nations have led or been involved with.	A lot of time and effort went into developing the MaPP plans and First Nations marine use plans. Ignoring this work will result in frustration and process burn-out. Using the information as a starting point shows respect for work that has already been done, and will expedite site selection.	Mappocean.org	2
Primary guideline: Where possible, integrate Canadian laws and First Nations laws and customs to manage MPAs, recognizing that aspirations will vary Nation by Nation (e.g., type of desired economic development and support for MPAs will vary).	Integrating First Nations laws and customs affirms their importance, and may help achieve compliance and ease enforcement.		3
Secondary guideline: Provide First Nations with an option to designate and govern MPAs in their territory as Indigenous and Community Conserved Areas (ICCAs).	This option is consistent with evolving good practices in Canada nationally, as well as internationally.	http://www.iccaconsortium.org/	2

5 Guidelines for ecological network design Principles

5.1 Overview

5.1.1 Focus and linkages with other Principles

5.1.1.1 Strategy Principles 1-5 serve to underpin the development of an MPA network with ecological integrity, which will deliver environmental benefits. The ecological principles are of key importance in achieving Strategy Goal 1 and delivering benefits that will contribute to Principle 7 (maximise the positive). This report develops detailed guidelines for all of them except Principle 4, which was not included in the Scope of Works. The wording of Principle 4 is as follows:

"*Maintain long-term protection. The benefits of MPA networks may be realized in a few seasons or it may take several decades. Therefore, management measures should be implemented on a permanent basis to better realize the benefits of protection*."
(Strategy p.14)

5.1.1.2 The general operating Principles have a direct bearing on the most reasonable approaches to take in the implementation of the ecological Principles. For example, the way in which the ecological Principles are interpreted and implemented has to be in line with ecosystem-based management (general operating Principle 12) and the precautionary approach (Principle 16). Thus, although this report does not include detailed guidelines for most of the general operating Principles, they are to some extent reflected in the guidelines presented in this section.

5.1.1.3 There are particularly close links with general operating Principle 15 (protection levels), for which the guidelines in section 3.3 propose developing pre-defined protection levels. The guidelines in this section propose a framework to integrate pre-defined protection levels (based on the guidelines under Principle 15) with the definition of ecological targets for feature representation and replication, and MPA size and spacing, adjusting the target level depending on the protection level applied within individual sites.

5.1.2 Building on existing guidance

5.1.2.1 PacMARA has previously carried out an extensive literature review and developed guidance on the application of ecological Strategy Principles (Ardron et al. 2015). This previous guidance is reproduced in appendix 1, and should be referred to in conjunction with the guidelines presented here, which build upon this previous guidance, proposing approaches for operationalizing (the 'how').

5.1.2.2 For MPA planning processes where detailed operational network design guidelines have been developed in other parts of the world, relevant guidance has been reviewed again in an attempt to extract details that can be applied in the NSB. In doing so, it rapidly became clear that operational guidelines need to be tailored to:

- the specific environment of the planning (sub-)region they cover;
- the design of the planning and decision-making process; and
- to the type, level and detail of ecological data available.

5.1.2.3 Thus, it is generally not appropriate to apply operational guidelines from other parts of the world directly in the NSB without adapting them and, where necessary, developing entirely new guidelines tailored specifically to the NSB's environment and planning process. Thus, while the guidelines recommended here draw from guidelines developed elsewhere, they also reflect PacMARA's advice specifically in relation to the BC/NSB context.

5.1.3 Scales

5.1.3.1 As highlighted by Ardron et al. (2015), the NSB is a highly varied bioregion characterised by land- and seascapes ranging from narrow glacial-fed inlets and current-swept passages to broad shelf waters, gyres and upwellings, and depths ranging from the intertidal zone to the abyssal plain. The highly complex shape of the coastline with its many inlets and islands means that MPA planning will inevitably have to be carried out at different spatial scales – for example, appropriate MPA sizes within narrow inlets will differ from appropriate sizes in open shelf waters.

5.1.3.2 Scale is a cross-cutting issue affecting the ecological principles. Here, we suggest that within each (sub-)region, the ecological guidelines may need to be tailored according to the scale of where they are being applied. As a starting point, we suggest the following geomorphologically defined classes:

- Inlets/ fjords;
- Enclosed waters / passages;
- HaidaGwaii;
- Open shelf waters; and
- The shelf break.

5.1.4 Gap analysis

5.1.4.1 One of the first steps in the network planning process should be a gap analysis to assess the current suite of MPAs in place within the NSB. This gap analysis should assess what elements of biodiversity are already represented and protected within the existing suite of sites, and evaluate to what extent the operational guidelines and benchmarks to be developed under principles 1-5 are already being achieved, taking into account the levels of protection currently in place in the existing sites. In addition, the gap analysis should aim to identify the biggest gaps in the existing network. The gap analysis is not covered in any detail in this section, instead, please refer to section 3.2.6 (under Principle 14).

5.2 Principle 1: Include the full range of biodiversity

5.2.1 Wording of Principle

5.2.1.1 Principle 1:

"*Include the full range of biodiversity present in Pacific Canada (representation and replication).*

Representation & Replication: *Represent each habitat type in the overall MPA network. For example, rocky reef habitat, eelgrass meadow, intertidal mudflat, persistent gyres or eddies, or representation within a hierarchy of ecological scales (e.g., representation of rocky reefs within a broader biogeographic classification). The degree of replication should be assessed at a bioregional (or finer) scale(s) in an effort to safeguard against catastrophic events or disturbances and to build resilience in the overall MPA network*." (Strategy, p. 14).

5.2.2 Relevant guidelines developed for other MPA processes

5.2.2.1 General ecological MPA design principles (such Strategy Principles 1-5) are well-established in the literature (e.g. see the review in Ardron et al. 2015, and references cited by Ban et al. 2014), but there are few published examples of detailed guidelines operationalizing these principles that have been applied in specific real-world MPA network planning processes.

5.2.2.2 Detailed Ecological Network Guidance (ENG) was developed for England's MCZ process (Natural England and JNCC, 2010), and applied in four separate planning regions covering English and Welsh offshore waters. In relation to representing and replicating the full range of biodiversity within each planning region, the ENG included the following guidelines:

- Represent each one of 29 broad-scale benthic habitats (from a comprehensive classification mapped for the entire planning area), each one of a list of species and habitats of conservation importance (for some, only limited point sample data were available) and each one of a small number of mobile species;
- For each broad-scale habitat, a percentage target range was set, the lowest starting at 16%, and the highest ending at 42%. The target range for each broad-scale habitat was determined underpinned by species-area models, with the aim being to ensure full representation of the biodiversity within each class;
- Represent at least two examples of each broad-scale habitat (i.e. an occurrence in at least two separate MPAs), and at least three to five separate examples of each feature of conservation importance, where their distribution allows.

5.2.2.3 Fernandes et al. (2005) present ecological guidelines that were developed for the 2004 re-zoning of the Great Barrier Reef Marine Park (GBRMP). Unlike the ENG in the MCZ process, these guidelines centred on the expansion of no-take areas (NTAs). The Park was divided into a series of biologically distinct reef bioregions, and NTA design guidelines developed to be applied in each one:

- Establish 3–4 NTAs per bioregion (fewer for small bioregions, more for large ones) to spread the risk against negative human impacts affecting all NTAs within a bioregion (replication). Unlike the MCZ ENG, these replication targets were not tied to specific ecological features, as bioregions were already biologically defined.

- In each bioregion, protect at least 3 reefs with at least 20% of reef area and reef perimeter included in NTAs. In each non-reef bioregion, protect at least 20% of area.
- Represent cross-shelf and latitudinal diversity in the network of NTAs, as many processes create latitudinal and longitudinal (cross-shelf) differences in habitats and communities within the GBRMP.
- Represent a minimum proportion of each community type and physical environment type in the network, to ensure full representation of biodiversity in NTAs. Habitat specific objectives were:
    - 10% each of known *Halimeda* beds, shallow-water seagrass habitat, deepwater seagrass habitat, and algal habitat;
    - 5% each of different epibenthic faunal classes (echinodermata, sponges, bryozoans, solitary corals, soft corals, foraminifera, and brachyura);
    - 50% of all high-priority dugong habitat;
    - 5% of reef area in each of five reef size classes;
    - 5% of reef and of non-reef area in each of five wave-exposure classes;
    - at least two examples of cays in each bioregion where they occur;
    - at least one inter-reef channel in bioregions where they occur;
    - at least one island in each bioregion where they occur;
    - 5% of reef and of non-reef area in each of nine oceanographic bioregions as well as in each of four flood frequency classes to ensure representation of reefs across the natural diversity of water quality;
    - locate NTAs adjacent to mangroves, wetlands, and protected areas rather than adjacent to suburbs; and
    - include known major turtle nesting and foraging sites (100% of ~30 sites of the 115 identified).

5.2.2.4 The science advisory team advising the California Marine Life Protection Act (MLPA) process developed detailed ecological design guidelines for the development of an MPA network within the inshore waters (to 3 nautical miles) of California (California Department of Fish and Game, 2008). These guidelines stated that:

- Every 'key' habitat should be represented in the MPA network, i.e. rocky shores, sandy beaches, coastal marsh, tidal flats, estuarine waters, surfgrass, eelgrass, kelp, rocky reef, soft bottom, submarine canyons, pinnacles, upwelling centers and larval retention areas;
- In order to represent a range of depths, MPAs should extend from the intertidal zone to deep waters offshore (bearing in mind the MLPA only applied to the 3 nm limit);
- At least five (and an absolute minimum of three) replicate MPAs should be designed for each habitat type within each of the two biogeographic regions defined for the state of California:
    - (1) the Oregon – California border south to Point Conception

- (2) Point Conception south to the U.S. – Mexico border; and

- Both biogeographic regions were further subdivided into bioregions, defined by their unique ecological and physical characteristics, with the guideline to include at least one replicate MPA for each habitat type within a bioregion.

5.2.2.5 In any given planning region there will inevitably be gaps in ecological data. The above examples follow the common approach of using a broad-scale habitat classification as a biodiversity proxy (broad-scale habitats in the MCZ process, bioregions in the Great Barrier Reef and MLPA examples), representing each broad-scale class to achieve full representation of biodiversity. The use of broad-scale proxies or surrogates can result in a better broad-scale representation of biodiversity within protected area networks than selecting sites piecemeal (Beger et al. 2007, Sarkar et al. 2004, Ward et al. 1999).

5.2.2.6 In addition, in the above examples, habitat and/or species-specific representation and/or replication targets are set for specific features of conservation importance, prioritising features of conservation concern for which fine-scale distribution data are available. The combined use of broad-scale biodiversity proxies and specific targets for priority features where data permits, is in line with MPA network guidelines developed by OSPAR (Ardron 2008, 2009, OSPAR 2008), and has been used in assessing the ecological coherence of the UK's MPA network (Lieberknecht et al. 2014).

5.2.3 Recommended guidance and guidelines for the NSB

5.2.3.1 The guidelines for the processes cited above cannot be directly applied in the NSB, because they make reference to natural features present in other parts of the world, and the planning processes differ from the NSB in their focus (e.g. the GBRMP example focussing on NTAs), as well as the spatial extent of the planning region (e.g. the MLPA applying only to 3 nm). This is in addition to differences in the remit of the planning authorities in charge, the legal frameworks, and the institutional and stakeholder contexts. The NSB will need its own set of guidelines and rules of thumb, which to a large extent will need to be based on local biodiversity, pragmatism and region-specific expertise.

5.2.3.2 In Ardron et al. (2015), PacMARA already developed relatively detailed guidance points on Principle 1, which are reproduced in appendix 1. Some of the guidelines below are drawn directly from it. For brevity, this report does not replicate the comprehensive rationale and background information underpinning the guidance in Ardron et al. (2015), readers should instead refer to the original report.

5.2.3.3 The guidance and guidelines on Principle 1 are split into three sections, the first of which (section 5.2.4) deals with the decisions on what geographically defined features to 'capture' within the spatial network configuration, i.e. what species, habitats and other features to set representation and replication targets for in the planning process. This is what Ardron et al. (2015) referred to as a list of 'representative' (indicative) species, and which we have divided here into biodiversity proxies and priority features.

5.2.3.4 Section 5.2.5 presents guidelines on setting appropriate representation and replication targets for each of the biodiversity proxies and priority features, once these have been defined. The guidelines presented in this section are largely distilled from the guidance and commentary previously provided in Ardron et al. (2015) (Appendix 1).

5.2.3.5 Section 5.2.6 provides additional commentary and advice on target setting, taking into account aspects of process design. This section also presents a framework in form of a table, designed to help planners apply the guidelines in section 5.2.5.

5.2.4 Selecting features to set targets for: Biodiversity proxies and priority features

Broad-scale biodiversity proxies

5.2.4.1 Ardron et al. (2015) recommended the establishment of a list of 'representative' (indicative) species and habitats to represent within the NSB's MPA network. It remains beyond the scope of this contract to develop a definitive list of exactly *which* features should form part of this list, nevertheless, the guidelines presented here extend the previous guidance, drawing a distinction between biodiversity proxies (paragraphs 5.2.4.2ff.) and priority features (paragraphs 5.2.4.13ff.), in line with the OSPAR approach.

5.2.4.2 Even if traditional [Aboriginal] ecological knowledge is used in conjunction with scientific data, ecological data gaps will still be an issue in the NSB (as in any other regional-scale MPA planning process). We recommend using broad-scale habitat classifications as biodiversity proxies, setting targets to represent each class as a way of achieving representation of the potential full range of biodiversity present in the planning region.

5.2.4.3 The classification(s) used as biodiversity proxies should be spatially comprehensive, i.e. every part of the planning region should be mapped as a class. Classifications that cover only part of the planning region, or that only map specific features (e.g. kelp beds, eelgrass beds, and sponge reefs) are not suited as biodiversity proxies, because they cannot capture the region's full range of biodiversity (it may, of course, still be appropriate to set targets for some of these, but they would be 'priority features' as discussed in (paragraphs 5.2.4.13ff.).

5.2.4.4 In line with the precautionary approach (cf. Principle 16), planning should proceed based on best available evidence - the development of an 'ideal' classification should not delay planning. If nothing else was available, progress towards achieving a representative MPA network could be made simply by defining a broad set of depth ranges, and representing each depth band in every geomorphological class (paragraph 5.1.3.2) in which it occurs. (Subsequent planning cycles could improve the network as better information becomes available, in line with Principle 13.)

5.2.4.5 Comprehensive broad-scale classifications can be based on physiographic or species-based methods (Gregr et al. 2012). Physical datasets are more likely to cover large areas without gaps than species data, so physiographic methods are more likely to yield classifications with comprehensive coverage for large planning regions. However, physiographic classes need have biological relevance in order to serve as a biodiversity proxy. Conversely, species-based classifications are by definition biologically relevant, but their development is more time consuming and data intensive.

5.2.4.6 Ardron et al. (2015) advise that credible species-habitat classification systems should be used where they exist, and that classifications that have already been verified with independent data and/or local knowledge should be prioritized. They also highlight that every comprehensive broad-scale classification will have its own strengths and weaknesses, and that using several classifications at the same time can provide for a more complete representation of biodiversity within an MPA network.

5.2.4.7 In the NSB, the HMECs and BC ShoreZone classifications (CSAS 2016, Robinson et al. 2015) can serve as a source of physiographic biodiversity proxies, which can be complemented by a simple and biologically meaningful depth categorization. The developing nearshore classification by Gregr et al. (*in prep.*) will, once completed, provide a valuable complement to the HMECS, as it has been developed using an ecological, process-based approach to characterizing habitats rather than a traditional physiographic or zoogeographic approach.

5.2.4.8 Robinson and McBlane (2013) completed an analysis for the BCMCA that identified 10-11 major upper oceanographic regions within the NSB that could be used as a starting point for representing pelagic biodiversity (e.g., phytoplankton). The analysis was restricted to the upper ocean (20-30 m) and focused on identifying physical oceanographic processes linked to enhancing nutrient supply during the summer growing season. It was assumed that each ocean sub region had a suite of recurring and enduring physical oceanographic processes that distinguished itself from its neighbour, and that the oceanographic processes resulted in lower trophic level properties (e.g., primary production) that influenced the organization and production of higher trophic levels, such as fish, seabirds and marine mammals.

Guidelines on biodiversity proxies

5.2.4.9 Primary guideline: Representation and replication targets should be set for each class in at least one broad-scale comprehensive classification system. Targets should be set for each class to be represented in each geomorphological class in which it occurs.

5.2.4.10 Secondary guideline: Credible and validated species-habitat classifications should be used as biodiversity proxies.

5.2.4.11 Secondary guideline: If possible, use more than one comprehensive classification system at the same time.

5.2.4.12 Secondary guideline: Start with the following as biodiversity proxies in the NSB:

- **broad ecologically-relevant depth classes (e.g., 0-10m, 10-50m, 50-200m, 200-1000m, >1000m);**
- **the biophysical classes (level 4) in the Pacific Region HMECS (CSAS 2016, Robinson et al. 2015);**
- **each shore-type class within the BC ShoreZone classification;**
- **classes within the developing classification by Gregr et al. (*in prep.*), once finalized; and**
- **Use the major oceanographic sub regions identified in Robinson and McBlane (2013) as a starting point for representing pelagic biodiversity in the NSB.**

Priority features

5.2.4.13 In addition to the biodiversity proxies, replication and representation targets should also be set for specific priority features. These can include biological facies defined in HMECs (CSAS 2016, Robinson et al. 2015), other biotopes and communities, habitats, species, and geomorphological and oceanographic features.

5.2.4.14 The list of priority features should draw from on-going work to develop a list of Conservation Priorities (CPs), which includes Ecological Significant Species (ESS), Ecological Significant Species Communities (ESSC), and Marine Ecosystem Goods and Services (MEGS) within the region. However, the priority features list for which to set MPA planning targets should not be confused with a regional 'red list' of features of conservation concern, or a list of all environmental features that have value within the planning region. There are likely to be ESSs, ESSCs and MEGs for which it is not practical or beneficial to set targets in MPA planning. Conversely, there may be benefit in setting targets for geographically demarcated and mapped priority features that are not specifically listed as CPs.

5.2.4.15 Criteria to consider when defining a list of priority features to set targets for in MPA planning should include:

- their value / importance (ecological or other value);
- their conservation status, rarity, threat or vulnerability;
- whether the feature is likely to benefit from the spatial protection measures afforded in MPAs; and
- whether spatial data of sufficient quality and coverage exist that indicate where the feature occurs within the planning (sub-)region (as it will not be possible to implement targets for features for which little or no distributional data exist).

5.2.4.16 Setting targets for features with patchy spatial data coverage will bias the process towards the selection of data-rich areas over data-poor ones (a bias that is immediately evident in Marxan outputs, but which also occurs if no decision support tools are used). There may be good reasons to include features with patchy data distribution (e.g. to ensure that known examples of particularly valuable features are protected), but they need to be weighed up against the possibility that data-rich areas might not represent optimal areas for inclusion within a network representative of the broader range of biodiversity.

5.2.4.17 It may be tempting to delay planning decisions until data gaps are filled. However, in line with the precautionary approach (Principle 16), planning should proceed based on best available information, rather than delaying the implementation of protection measures until comprehensive distributional data on every identified CP becomes available.

5.2.4.18 Plans should allow that the distribution of species and habitats will not remain static over time, especially in view of climate change. As such, it will never be possible to develop 'definitive' species and habitat distribution maps for more than, say, a decade. Nonetheless, basing planning decisions on a snapshot in time is a pragmatic approach, especially within the context of on-going cycles of adaptive management (Principle 13).

5.2.4.19 Targets should only be set for those priority features that stand to benefit from spatial protection measures. Highly mobile species may be difficult to protect in MPAs, unless they aggregate in predictable geographic locations or utilise particular habitat types at key lifecycle stages or times of year. In such cases, the 'priority feature' to set targets for

wouldn't be the species itself, but the habitat or geographic locations in question, e.g. seasonal breeding, feeding and resting areas for birds, seal haul-outs, or key feeding and staging areas along a migration route of a migratory species.

5.2.4.20 In addition to species and habitats, targets can be set to represent benthic physiographic features such as rocky reefs, plateaus, canyons, and sills, and geographically located oceanographic features such as upwellings, temperature / salinity fronts, and gyres. These may overlap with EBSAs, in which case treating (portions of) EBSAs as 'priority features' and setting targets for protecting a given proportion of them within the MPA network may be a way of contributing towards the implementation of Principle 2 (section 5.3).

Guidelines on priority features

5.2.4.21 Primary guideline: Identify a list of priority features (species, habitats, geomorphological and/or oceanographic features) for which to set representation and replication targets, focussing on valuable and important features that can be geographically demarcated, and for which spatial distribution data exist within the NSB.

5.2.4.22 Secondary guideline: For highly mobile species, the priority features list should include important habitats or areas of importance for key lifecycle stages.

5.2.4.23 Secondary guideline: Cross-check the priority features list with EBSAs identified under Principle 2, and include (portions of) EBSAs on the priority features list where appropriate, beneficial and practical.

5.2.5 Guidance and guidelines on setting representation and replication targets

5.2.5.1 Ardron et al. (2015) advised against the use of 'flat' representation targets (the same percentage for every feature and/or broad-scale habitat class), as these fail to capture meaningful ecological differences in the species-specific spatial requirements of habitats and their ecological communities.

5.2.5.2 Building on the guidance in Ardron et al. (2015), we recommend that targets for both biodiversity proxies and priority features should vary according to their commonness or rarity as well as their vulnerability, with targets ranging from <5% to 100%. Rarer and more vulnerable features should be given higher percentage representation targets than less vulnerable and more widespread features.

5.2.5.3 Where relevant scientific data exist, the development of species-area curves for different broad-scale habitats can serve to underpin the setting of percentage targets, as was done in England's MCZ process (Natural England & JNCC 2010, Rondinini 2010).

5.2.5.4 Target setting can be made easier by exploring a range of different target levels, beginning by setting relative targets using relative wordings (e.g. low, medium, high), then different target values can be tested for each until a desired overall footprint for the network is achieved. This approach works well for setting targets in Marxan (see Ardron et al. 2010 for further guidance on target setting in Marxan).

5.2.5.5 Ardron et al. (2015) recommended a minimum footprint of the NSB MPA network of 20% of the planning region[25] (see the original report for background and justification). When setting targets for individual biodiversity proxies and priority features, planners need ensure that, when these feature-specific targets are applied in combination, the total area within the network needs to achieve (or exceed) this 20% overall minimum.

5.2.5.6 Species and habitat targets should, as a general rule, be applied across geomorphological classes (paragraph 5.1.3.2), i.e. features should be represented in each geomorphological class where they are normally present. This will help ensure that the network represents the full range of biogeographic variation across the planning region.

5.2.5.7 In line with Ardron et al. (2015), each biodiversity proxy and priority feature should be replicated in each sub-region and be replicated in every geomorphological class (paragraph 5.1.3.2) where it occurs. This means it should be represented in separate MPAs, not several times within an individual site. Ardron et al. (2015) provide further guidance points on defining replication targets, which are reflected in the guidelines presented below.

5.2.5.8 As discussed under Principle 15 (section 3.3), greater protection levels provide greater conservation benefit, which means that the lower the protection level, the higher representation and replication targets are needed to achieve the same conservation benefit.

Guidelines on setting replication and representation targets

5.2.5.9 Primary guideline: Replicate each biodiversity proxy and priority feature in every geomorphological class where it occurs.

5.2.5.10 Primary guideline: Representation targets for biodiversity proxies and priority features should vary widely (<5% to 100%), based on rarity, vulnerability, importance, level of data uncertainty, and MPA protection levels applied.

5.2.5.11 Secondary guideline: Broad and widespread habitat classes should have lower percentage representation targets than less widespread and more narrowly defined ones.

5.2.5.12 Secondary guideline: Rare, threatened and endangered features should have higher representation targets and, where possible, a higher number of replicates than common features.

5.2.5.13 Secondary guideline: When assessing feature rarity, ensure that particularly small ('rare') classes in broad-scale classifications truly represent unique ecosystem components, as opposed to classification artefacts (GIS 'slivers'). Small classes deemed questionable should be merged into neighbouring classes.

5.2.5.14 Secondary guideline: Features for which there is greater uncertainty in classification systems and species distribution models should have higher representation and replication targets than features for which data are less uncertain.

5.2.5.15 Secondary guideline: Applying higher MPA protection levels can warrant the lowering of replication and representation targets, and vice versa.

[25]PacMARA recognizes that this recommendation was and remains controversial amongst some governments and stakeholders. While we continue to support it, its continuing controversy should not affect the many other guidelines proposed in this report.

5.2.5.16 **Secondary guideline: For replication targets, patch size matters: Very large patches (approx. two standard deviations above the mean size) may need only 1 or 2 replicates, while very small patches (approx. 2 SD below the mean) may require more than 5.**

5.2.5.17 **Primary guideline: The minimum overall spatial footprint of the MPA network should be 20% of the NSB.**

5.2.5.18 **Primary guideline: As a general rule, apply representation and replication targets across all geomorphological classes.**

5.2.6 A framework to support setting representation and replication targets

5.2.6.1 Table 10 sets out a framework to support planners in applying the above guidelines on defining representation and replication targets for biodiversity proxies and conservation priority features, taking into account MPA protection levels (cf. Principle 15). Some example target ranges are shown in the table for illustration of the framework. These can serve as a starting point when setting targets, but will need to be adjusted once the conservation proxies and priority feature list for the NSB has been drawn up.

5.2.6.2 Principle 15 requires the MPA network to include a full range of protection levels. Including each protection level within each geomorphological class (paragraph 5.1.3.2) may help achieve an equitable distribution of impacts and benefits across the NSB (cf. principles 7,8, and 9).

5.2.6.3 As discussed under Principle 15 (section 3.3), the network should include a full range of protection levels, including strict no-take areas (core zones / IUCN Category Ia), which are more effective at delivering conservation benefits than MPAs with lower levels of protection (Lester & Halpern 2008, Sciberras et al. 2015). Ban et al. (2014) carried out a meta-analysis of MPAs globally, finding a clear (albeit variable) relationship between IUCN category and conservation effectiveness (enhancement of fish biomass and density): MPAs in IUCN Category IV had about 60% the conservation effectiveness of Category Ia sites, and Category VI MPAs about 25% the effectiveness of Category Ia sites.

5.2.6.4 The differences in conservation effectiveness between protection levels mean there are two (interrelated) issues to consider when setting targets for biodiversity proxies and priority features:

- the level of the targets (higher protection levels may warrant lower targets for representation and replication, and vice versa), and
- how representation targets should be 'spread' across protection levels (which is essentially another way of phrasing 'what protection level(s) should be applied to each feature').

5.2.6.5 The first column in Table 10 defines relative target level categories for biodiversity proxies and priority features, the idea being to set targets for groups of features at a time in order to simplify the process (the table illustratively shows 'high', 'medium' and 'low' target level groupings, though these could be split further by adding rows). Each feature on the list of biodiversity proxies and priority features would need to be allocated into one of these relative target level groupings, based on rarity, vulnerability etc. (as indicated in the column heading). Where appropriate, specific features could be pulled out of the groupings and given their own rows, allowing for feature-specific target adjustment.

5.2.6.6 The second and third columns serve to show the overall representation and replication targets to be applied to each feature grouping (or individual feature, if separated) within each geomorphological class (paragraph 5.1.3.2). The final column serves to adjust the distribution of the representation (but not replication) target across protection levels.

5.2.6.7 In order to achieve the same conservation outcomes, lower representation and replication targets in columns 2 and 3 will require greater proportions of the representation target to be pushed into the higher protection categories in the final column, and vice versa. However, features or feature groups that are particularly rare, vulnerable, or valuable may warrant high target levels as well as high protection levels – a very rare and precious priority feature may even warrant a 100% representation target allocated in its entirety to high protection levels (in which case a replication target would become redundant).

5.2.6.8 Note that, as per the guidelines under Principle 15 (section 3.3), areas of high protection levels should form core zones within MPAs that also include a buffer zone with a lower protection level. As such, a single feature replicate may span two protection levels, which means that the four protection levels do not automatically mean that a minimum of four replicates are needed for each feature.

Table 10 A suggested framework to support representation and replication target setting.

Feature rarity / vulnerability / value / data uncertainty	Representation target (percentage of total area of feature)[1]	Replication target (number of occurrences)	Distribution of representation target across protection levels[2]
Broad-scale habitat classes (biodiversity proxies)			
High	e.g. 45-50%	4-5	Ia: x%
			Ib: y%
			II-III: z%
			IV-VI: etc.
Med	TBD	3-4	Ia:
			Ib:
			II-III:
			IV-VI:
Low	TBD	2-3	Ia:
			Ib:
			II-III:
			IV-VI: e.g. 50%
Priority features: species and habitats [3]			
High	e.g. 50-100%	4-5	Ia: e.g. 5%
			Ib:
			II-III:
			IV-VI: e.g. 0%
Med	TBD	3-4	Ia:
			Ib:
			II-III:
			IV-VI:
Priority features: physiographic, geomorphic or oceanographic features, EBSAs[4]			
High	e.g. 50-100%	4-5	Ia:
			Ib:
			II-III:
			IV-VI:
Med	e.g. 20-50%	3-4	Ia:
			Ib:
			II-III:
			IV-VI:

[1] Percentage figures in this column refer to the percentage of the total area covered by the feature(s) within each geomorphological class (<5% to 100%, based on the guidelines in section 5.2.5).

[2] Percentage figures in this column refer to the proportion of the target in column 2, indicating how representation targets should be distributed across protection levels.

[3] The high illustrative target figures would be warranted for relatively rare species and habitats. Much lower figures may be appropriate for priority species and habitats that are very widespread. Given that these are priority features, no 'low' category is included in the first column.

[4] Replication targets would be redundant in the case of *unique* features.

5.2.6.9 Target setting for a large number of individual features may seem like an overwhelmingly complex undertaking, and the more one focuses on details, the more (highly interrelated) complexities will emerge. The framework in Table 10 is designed to cut through some of that complexity and help structure the process of target setting, but it should not be seen as rigid or prescriptive. Planners should adjust and develop the framework to deal with issues as they emerge. Above all, pragmatism is recommended, to avoiding detail-induced paralysis (never let the perfect turn into the enemy of the perfectly good!).

5.2.6.10 Marxan / Marxan with Zones (Ball et al. 2009) may serve as a useful tool to support target setting and refinement. Running Marxan scenarios with different sets of targets will help planners gain an understanding of the overall footprint required to meet them, and of the flexibility within the spatial solution space of different scenarios. This will help set targets that are both underpinned with a strong ecological rationale, but which are also achievable and implementable in practice (see Ardron et al. 2010 for further advice on target setting in Marxan).

5.2.6.11 Depending on the design of the planning process, once relative targets have been established, it may not even be necessary to pre-define fixed numerical targets prior to network design. If, as currently envisaged, network proposals are drawn up internally by technical experts, with the wider stakeholder community asked for feedback only after potential network options have been mapped, (relative) targets can be kept flexible, allowing their iterative adjustment and refinement as proposals are developed (always based on a clear ecological rationale, and in line with the guidance and guidelines of this report, of course).

5.2.6.12 If, however, stakeholders were to be given a more active role in shaping the spatial network configuration (through a collaborative / participative process), then it may become necessary to fix at least some clear quantitative targets up-front in order to provide clear, simple ecological benchmarks and rules of thumb to guide stakeholders in their task. This may mean reducing the number of features to represent, and paring down the complexity of the design guidelines in this report. The ambition of the analysis, with regard to the number of features and their respective targets, would likely have to be reduced.

5.2.7 Summary Table: Principle 1

Table 11 Summary Table: Guidelines for Principle 1. The origin code indicates the degree to which a guideline is taken from existing literature or based on PacMARA's own expertise. Origin codes: 1 = guideline adopted from source literature without modification, 2 = guideline adapted and modified from literature source(s) to suit the BC planning context, 3 = guideline developed by PacMARA specifically for the BC planning context.

Guideline	Rationale	Applicable sources	Origin code
Selecting biodiversity proxies for which to set replication and representation targets			
Primary guideline: Representation and replication targets should be set for each class in at least one broad-scale comprehensive classification system. Targets should be set for each class to be represented in each geomorphological class in which it occurs.	To ensure full representation of biodiversity across the planning region, and to capture the biogeographic variation within widespread features. Classification(s) used as biodiversity should be comprehensive (covering the whole planning region) to ensure full regional-scale biodiversity representation.	Ardron et al. 2015[1] Robinson and McBlane 2013 Johnson et al. 2012 Natural England and JNCC 2010 Ardron 2008, 2009 OSPAR 2008 Beger et al. 2007 Sarkar et al. 2004 Ward et al. 1999	2
Secondary guideline: Credible and validated species-habitat classifications should be used as biodiversity proxies.	To ensure the biological relevance of biodiversity proxies used.	CSAS 2016 Robinson et al. 2015 Ardron et al. 2015[1]	2
Secondary guideline: If possible, use more than one comprehensive classification system at the same time.	Each classification will have its strengths and weaknesses, so using several classifications will help achieve a better representation of biodiversity.	CSAS 2016 Robinson et al. 2015 Ardron et al. 2015[1]	2

Secondary guideline: Start with the following as biodiversity proxies in the NSB: • **broad ecologically-relevant depth classes (e.g., 0-10m, 10-50m, 50-200m, 200-1000m, >1000m);** • **the biophysical classes (level 4) in the Pacific Region HMECS (CSAS 2016, Robinson et al. 2015);** • **each shore-type class within the BC ShoreZone classification;** • **classes within the developing classification by Gregr et al. (in prep.), once finalized; and** • **Use the major oceanographic sub regions identified in Robinson and McBlane (2013) as a starting point for representing pelagic biodiversity in the NSB.**	To represent the full range of biodiversity within the region in the MPA network.	CSAS 2016 Robinson et al. 2015 Ardron et al. 2015[1] Johnson et al. 2012 Gregr et al. 2012 Natural England and JNCC 2010 Ardron 2008, 2009 California Department of Fish and Game 2008 Beger et al., 2007 Fernandes et al. (2005) Sarkar et al. 2004 Ward et al. 1999 Gregr et al. (in prep.)	2
Develop a list of priority features for which to set representation and replication targets			
Primary guideline: Identify a list of priority features (species, habitats, geomorphological and/or oceanographic features) for which to set representation and replication targets, focussing on valuable and important features that can be geographically demarcated, and for which spatial distribution data exist within the NSB.	To ensure that known occurrences of rare, threatened, vulnerable, valuable or important features are protected within the MPA network, and to improve the overall representation of biodiversity within the network.	Ardron et al. 2015[1] Johnson et al. 2012 Ardron 2008, 2009 OSPAR 2008 Natural England and JNCC 2010	2
Secondary guideline: For highly mobile species, the priority features list should include important habitats or areas of importance for key lifecycle stages.	Representation and replication targets can only be set for features with a fixed geographic location. Mobile species can nevertheless benefit from spatial protection measures if they are targeted at geographical locations of particular importance to them.	Ardron et al. 2015[1] Lieberknecht et al. 2014 Natural England and JNCC 2010 Ardron 2008, 2009 OSPAR 2008	2

Secondary guideline: Cross-check the priority features list with EBSAs identified under Principle 2, and include (portions of) EBSAs on the priority features list where appropriate, beneficial and practical.	To ensure the achievement of Principle 2 as well as Principle 1.		3
Primary guideline: Replicate each biodiversity proxy and priority feature in every geomorphological class where it occurs.	To safeguard against catastrophic loss of the whole amount of a protected feature.	Ardron et al. 2015[1] Johnson et al. 2012 Natural England and JNCC 2010 Ardron 2008, 2009 OSPAR 2008 California Department of Fish and Game 2008 Fernandes et al. 2005	2
Primary guideline: Representation targets for biodiversity proxies and priority features should vary widely (<5% to 100%), based on rarity, vulnerability, importance, level of data uncertainty, and MPA protection levels applied.	To ensure that a high enough proportion of rare, vulnerable and important features are captured whilst avoiding targets for very widespread broad-scale habitat types greatly increasing the overall footprint of the MPA network for little conservation benefit.	Ardron et al. 2015[1] Natural England and JNCC 2010	2
Secondary guideline: Broad and widespread habitat classes should have lower percentage representation targets than less widespread and more narrowly defined ones.	To avoid targets for very widespread broad-scale habitat types greatly increasing the overall footprint of the MPA network for little conservation benefit.	Ardron et al. 2015[1] Natural England and JNCC 2010	2
Secondary guideline: Rare, threatened and endangered features should have higher representation targets and, where possible, a higher number of replicates than common features.	To ensure that a high enough proportion of rare, vulnerable and important features are captured	Ardron et al. 2015[1] Natural England and JNCC 2010	2
Secondary guideline: When assessing feature rarity, ensure that particularly small ('rare') classes in broad-scale classifications truly represent unique ecosystem components, as opposed to classification artefacts (GIS 'slivers'). Small classes deemed questionable should be merged into neighbouring classes.	To avoid biasing the selection of MPAs towards areas of no particular ecological value or significance.	Ardron et al. 2015[1]	2

Secondary guideline: Features for which there is greater uncertainty in classification systems and species distribution models should have higher representation and replication targets than features for which data are less uncertain.	To ensure that biodiversity is fully represented.	Ardron et al. 2015[1] Natural England and JNCC 2010	2
Secondary guideline: Applying higher MPA protection levels can warrant the lowering of replication and representation targets, and vice versa.	Higher MPA protection levels make MPAs achieve greater conservation benefit per unit of area.	Sciberras et al. 2015Ban et al. 2014 Lester &Halpern 2008	2
Secondary guideline: For replication targets, patch size matters: Very large patches (approx. two standard deviations above the mean size) may need only 1 or 2 replicates, while very small patches (approx. 2 SD below the mean) may require more than 5.	To ensure that tiny patches of a feature don't count as replicates without contributing any conservation benefit.	Ardron et al. 2015[1] Natural England and JNCC 2010	2
Primary guideline: The minimum overall spatial footprint of the MPA network should be 20% of the NSB.	To ensure the network protects a sufficient proportion of the region, ensuring that Strategy Goal 1 is met. To ensure that the network represents the full range of biogeographic variation across the planning region.	Ardron et al. 2015[1]	2
Primary guideline: As a general rule, apply representation and replication targets across all geomorphological classes.	To capture biogeographic variation.	Natural England and JNCC 2010 California Department of Fish and Game 2008 Fernandes et al. 2005	2

[1] The previous PacMARA guidance in Ardron et al. (2015) underpins many of the guidelines throughout this report. It was based on a literature review which has not been replicated in detail here.

5.3 Principle 2: EBSAs

5.3.1 Wording of the Principle

5.3.1.1 Principle 2:

"*Ensure ecologically or biologically significant areas are incorporated*

Protection of Unique or Vulnerable Habitats: *Design networks to include biophysically special and unique places.*

Protection of Foraging or Breeding Grounds: *Design networks to include important areas for breeding, feeding and high aggregation.*

Protection of Source Populations: *Design networks to include important sources of reproduction (e.g., nurseries, spawning areas, egg sources, etc.)*." (Strategy p.14)

5.3.2 Relevant guidelines in literature

5.3.2.1 Ardron et al. (2015) carried out a literature review on EBSAs, EBSA principles, the history of their development and application globally and in Canada, as well as practical challenges in the application of the concept. These details are not replicated here. Briefly, the CBD EBSA criteria include (Decision IX/20, Annex 1):

i. Uniqueness or rarity,
ii. Special importance for life history stages of species,
iii. Importance for threatened, endangered or declining species and habitats,
iv. Vulnerability, fragility, sensitivity, or slow recovery,
v. Biological Productivity,
vi. Biological diversity, and
vii. Naturalness.

5.3.2.2 Lieberknecht et al. (2014) and Ardron et al. (2015) highlight the conceptual distinction between EBSA criteria and systematic network planning principles: An area that qualifies as an EBSA may not be a suitable candidate for an MPA. Decisions on whether or not to include an EBSA in the network should carefully consider whether this will entail conservation benefits or not. If EBSA status is given to an area based on dynamic oceanographic processes of ecosystem importance, for example, spatial protection measures are unlikely to have any impact on those processes. Including such an EBSA in an MPA network would make sense, however, if these dynamic processes occur within predictable spatial boundaries that represent defined areas within which important species aggregate, and those species stand to benefit from spatial protection.

5.3.2.3 Elements of EBSA criteria have been integrated into practical MPA design guidelines in the UK (Natural England and JNCC 2012, Lieberknecht et al. 2014). While the MCZ ENG made no explicit reference to EBSAs, the guidelines did state that, when selecting areas with which to meet representation and replication targets, preference should be given to areas 'of additional ecological importance', such as important areas for key life cycle stages of species (spawning, nursery, and juvenile areas), areas of importance for behaviours such as foraging, breeding, moulting, loafing, rafting, wintering or resting, areas of high productivity, and areas of high benthic and/or pelagic biodiversity.

5.3.3 Recommended guidance and guidelines for the NSB

5.3.3.1 Comprehensive guidance for the application of this Principle was provided for the NSB process in Ardron et al. (2015). The guidelines presented here are largely distilled out from this previous guidance. The commentary in the 2015 report is not replicated here, but it remains valid and planners should make reference to it when implementing Principle 2.

5.3.3.2 As discussed under Principle 1, some EBSAs in the NSB may be suitable for inclusion on the list of priority features for which percentage representation targets are set (replication targets obviously will not apply for an unique area). Other EBSAs may warrant inclusion in full, in which case no percentage representation target needs to be set – these sites can be 'locked in' to the network from the beginning (their contribution to targets for other features, e.g. broad-scale habitats, should be assessed).

5.3.3.3 Within the NSB, work has already been undertaken to identify EBSAs (resulting in 20 EBSAs identified within the PNCIMA region), which can serve as a starting point within the NSB MPA planning process (DFO 2013, Jamieson and Levesque, 2014). These EBSAS should be reviewed during the gap analysis discussed in section 0 under Principle 14. Ardron et al. (2015) highlight a range of uncertainties and challenges associated with these EBSAs, however, which means that further work to review and potentially expand the existing list for use in the current process is warranted. In line with Principle 13, the EBSA list should also be kept open for review for future planning cycles, as the EBSAs identified at the time of this process are unlikely to be a comprehensive set.

5.3.3.4 Not every EBSA will necessarily derive conservation benefit from being included (fully or partially) within the network. Non-inclusion of such sites does not invalidate their EBSA status (in the same way that, for Principle 1, there will be Conservation Priorities within the region that aren't included on the list of priority features for which MPA planning targets are set, without this invalidating their Conservation Priority status).

Guidelines for EBSAs

5.3.3.5 Primary guideline: During the initial gap analysis, the existing NSB EBSAs identified by DFO should be reviewed to decide whether they warrant inclusion (as a whole or in part) within the MPA network.

5.3.3.6 Secondary guideline: Areas of significance for species and habitats not covered in the existing EBSAs should be reviewed and identified, potentially expanding the list of EBSAs (or EBSA-like features).

5.3.3.7 Secondary guideline: Other designations, such as *Valued Ecosystem Components* (DFO) and *Valued Marine Environments and Features* (Province of BC), should also be considered.

5.3.3.8 Secondary guideline: Use of local and traditional knowledge in the identification of additional EBSAs is recommended, building on the work of the DFO EBSA process, and others.

5.3.3.9 Primary guideline: Large EBSAs that cannot practically be included in full should be added to the priority features list under Principle 1, with percentage representation targets set for each one.

5.3.3.10 Secondary guideline: Decisions on whether or not to include an EBSA in the MPA network (either as a whole, or in part) should consider whether their important

ecological qualities will benefit from or be enhanced by spatial protection measures.

5.3.4 Summary Table: Principle 2

Table 12 Summary Table: Guidelines for Principle 2. The origin code indicates the degree to which a guideline is taken from existing literature or based on PacMARA's own expertise. Origin codes: 1 = guideline adopted from source literature without modification, 2 = guideline adapted and modified from literature source(s) to suit the BC planning context, 3 = guideline developed by PacMARA specifically for the BC planning context.

Guideline	Rationale	Applicable sources	Origin code
Primary guideline: The existing NSB EBSAs identified by DFO should be reviewed to decide whether they warrant inclusion (as a whole or in part) within the MPA network.	To ensure that EBSAs are represented within the MPA network where this will enhance the network's conservation benefits. EBSAs are already a recognized part of the DFO MPA process.	Ardron et al. 2015[1]	2
Secondary guideline: Areas of significance for species and habitats not covered in the existing EBSAs should be reviewed and identified, potentially expanding the list of EBSAs (or EBSA-like features).	To ensure the comprehensiveness of the EBSA list for the NSB, based on best available information.	Ardron et al. 2015[1] DFO 2013 Jamieson and Levesque 2014	2
Secondary guideline: Other designations, such as *Valued Ecosystem Components* (DFO) and *Valued Marine Environments and Features* (Province of BC), should also be considered.	To ensure the comprehensiveness of the EBSA list for the NSB, based on best available information.	Ardron et al. 2015[1] DFO 2014 Dale 1997	2
Secondary guideline: Use of local and traditional knowledge in the identification of additional EBSAs is recommended, building on the work of the DFO EBSA process, and others.	To ensure the comprehensiveness of the EBSA list for the NSB, based on best available information.	Ardron et al. 2015[1]	3
Primary guideline: Large EBSAs that cannot practically be included in full should be added to the priority features list under Principle 1, with percentage representation targets set for each one.	To ensure representation of EBSAs within the MPA network without locking in the entire NSB by including very large EBSAs in full.	Ardron et al. 2015[1]	3
Secondary guideline: Decisions on whether or not to include an EBSA in the MPA network (either as a whole, or in part) should consider whether their important ecological qualities will benefit from or be enhanced by spatial protection measures.	To ensure that EBSAs are represented within the MPA network where this will enhance the network's conservation benefits. This is also part of the approach adopted by Parties to the CBD.	CBD Decision IX/20 Annex 2.	1

[1] The previous PacMARA guidance in Ardron et al. (2015) underpins many of the guidelines throughout this report. It was based on a literature review which has not been replicated in detail here.

5.4 Principle 3: Connectivity

5.4.1 Wording of Principle

5.4.1.1 Principle 3:

"*Ensure ecological linkages (connectivity).*

Connectivity: *To the extent possible, consider the dispersal dynamics, the home range(s) of marine organisms, and the distribution of marine habitats, over space and time, especially when assessing replicates and when determining the spacing of individual MPA sites within the network*. " (Strategy, p.14)

5.4.2 Background

5.4.2.1 As for the other ecological Principles, the literature review and guidance in Ardron et al. (2015) should be referred to, as much of the commentary on Principle 3 remains valid, and underpins some of the guidelines presented below.

5.4.2.2 Maximising connectivity, whereby sites benefit from larval and/or species exchanges and functional linkages from other network sites is generally agreed as a key criterion in MPA network design. However, many aspects of connectivity are poorly understood, which means that proximity (spacing) between MPAs is often used as a coarse proxy for connectivity (Johnson et al., 2012).

5.4.2.3 In applied MPA network planning processes elsewhere, the principle of connectivity has primarily been implemented by establishing rules of thumb on MPA size and spacing, aiming to ensure MPAs are close enough together to allow larval transfer between sites for a large number of species, as well as large enough to encompass typical adult movement ranges of a large number of species. This was the approach taken in the MLPA (California Department of Fish and Game 2008), the MCZ process (Natural England and JNCC 2010) and the GBR rezoning (Fernandes et al. 2005).

5.4.2.4 Similarly, much of the guidance emerging from the literature review in Ardron et al. (2015) centres on spacing of sites as the primary way in which connectivity can be implemented in practice. A combination of appropriate size and spacing can serve to capture ranges of movement and dispersal for a large number of species without having to individually plan for the specific movement and dispersal patterns for hundreds of different individual species (a practical impossibility, even if the data were available, which they seldom are).

5.4.2.5 MPA size and spacing are explicitly mentioned in the wording of Principle 5, for which guidelines are presented in section 5.5.2. In order to avoid repetition, size and spacing guidelines are not included here, explaining the relative shortness of this section on Principle 3, which briefly discusses some additional ways of addressing connectivity in circumstances when data availability allows it. Thus, for full implementation of Principle 3, the guidelines in this section should be viewed as supplementary to those under Principle 5 (section 5.5.2).

5.4.3 Recommended guidance and guidelines for NSB

5.4.3.1 Supplementary to generic rules on size and spacing, connectivity can be addressed by recognizing and planning for specific, known ecological connections between particular spatial locations, based on an understanding of oceanographic linkages, adult migration patterns, and/or ontogenetic species movements. The GBR process built in linkages between coastal mangrove areas and offshore reefs, recognizing the former as important nursery areas for fish species inhabiting the latter as adults (Fernandes et al. 2005).

5.4.3.2 The spatial distribution of species' life history stages and adult movement patterns could, where known, be used to design ecologically connected MPA clusters (Ardron et al. 2015). Placing sites along onshore-offshore trajectories (perpendicular to the shoreline) might help capture the inshore-offshore ontogenetic shifts characteristic of many species (while helping to meet depth representation targets under Principle 1).

5.4.3.3 If clear directional movement axes emerge for specific species (e.g. migration routes), MPAs could be placed along these axes. However, the integration of species-specific directional movement trajectories should be weighed against the importance of achieving a network that protects the full range of biodiversity.

5.4.3.4 Where species-specific movement and dispersal patterns aren't directly known, an understanding of currents, tides, gyres can provide evidence of connectivity pathways between different areas, and sites can be oriented along those pathways (e.g. predominant currents that can serve as proxies for larval dispersal pathways).

5.4.3.5 Robinson et al. (2005) developed detailed oceanographic models for an area within the NSB, simulating the passive dispersal of particles at different depths between MPAs that existed or were planned at the time within the area of Haida Gwaii, Queen Charlotte Sound, and Hecate Strait. They identified potential source and sink areas for passively dispersed particles, as well as a potentially self-seeding area. This work can serve to inform the mapping of potential connectivity pathways within the planning region, and can serve to determine trajectories along which MPAs might be located.

5.4.3.6 Climate change may alter oceanographic connectivity patterns in future. This underlies the importance of viewing the above considerations as supplementary to the generic spacing guidelines presented under Principle 5. It is the latter that will ensure a good basic distribution of MPAs without major gaps in the planning region, making the network resilient against future changes in oceanographic connectivity patterns.

Guidelines

5.4.3.7 **Primary guideline: Apply the guidelines on MPA size and spacing presented under Principle 5.**

5.4.3.8 **Secondary guideline: When applying the spacing guidelines under Principle 5 in confined fjords and passages, distances between sites should be measured as the fish swims, not as the crow flies.**

5.4.3.9 **Secondary guideline: Place MPAs in patterns capturing inshore-offshore gradients by orienting series of sites extending offshore from the shoreline/nearshore.**

5.4.4 Summary Table: Principle 3

Table 13 Summary Table: Guidelines for Principle 3. The origin code indicates the degree to which a guideline is taken from existing literature or based on PacMARA's own expertise. Origin codes: 1 = guideline adopted from source literature without modification, 2 = guideline adapted and modified from literature source(s) to suit the BC planning context, 3 = guideline developed by PacMARA specifically for the BC planning context.

Guideline	Rationale	Applicable sources	Origin code
Primary guideline: Apply the guidelines on MPA size and spacing presented under Principle 5.	Size and spacing guidelines are the most important practical way of implementing connectivity in MPA networks.	See Principle 5 guidelines.	n/a
Secondary guideline: When applying the spacing guidelines under Principle 5 in confined fjords and passages, distances between sites should be measured as the fish swims, not as the crow flies.	Land is a movement barrier for marine species.		3
Secondary guideline: Place MPAs in patterns capturing inshore-offshore gradients by orienting series of sites extending offshore from the shoreline/nearshore	To create ecologically connected clusters along ontogenetic movement axes for many species. The California MLPA process followed this approach, albeit only to 3 nm offshore.	Ardron et al. 2015[1]	2

[1] The previous PacMARA guidance in Ardron et al. (2015) underpins many of the guidelines throughout this report. It was based on a literature review which has not been replicated in detail here.

5.5 Principle 5: Individual MPAs

5.5.1 Wording of Principle

5.5.1.1 Principle 5

"*Ensure maximum contribution of individual MPAs (size, spacing, shape).*

Size: *Design individual MPAs to include sufficient area to meet the related site objectives and effectively contribute to network goals and bioregional objectives over the long term.*

Spacing: *Design MPA networks to reflect the spacing of habitats, cover the geographic range of habitats and facilitate ecological connectivity between sites. Spacing should be assessed at multiple scales (i.e., bioregionally and coast wide) to best facilitate connectivity.*

Shape: *Design the shape of individual MPAs to the degree possible to follow ecological boundaries, avoid fragmenting cohesive habitats and to facilitate surveillance and enforcement*." (Strategy, p.14)

5.5.2 Size and Spacing: Background and existing guidance

5.5.2.1 As for the other ecological Principles, the commentary, literature review and guidance in Ardron et al. (2015) should be referred to, because it remains valid, and underpins some of the guidelines presented below.

5.5.2.2 MPA planning processes in other parts of the world have applied a range of minimum size and spacing guidelines. The GBR rezoning set a minimum size dimension of 20km across the narrowest part of an MPA, combined with a maximum spacing of 200km (Fernandes et al. 2005). The MLPA process set a minimum dimension of 5-40km across the longshore axis of the site (bearing in mind the planning region only extended to the 3nm limit, reducing the maximum possible shoreline-to-sea extension of MPAs to <6km), a minimum area range of 23-47 km^2 with a preferred size range of 47-93 km^2, and maximum alongshore spacing of 50-100 km (California Department of Fish and Game 2008). England's MCZ process set a minimum size dimension of 5km with a required average minimum dimension of 10-20km, and a maximum spacing of 40-80km between sites.

5.5.2.3 Ardron et al. (2015) highlighted that in practice, MPAs offshore tend to be larger and further apart, whereas MPAs inshore tend to be smaller and closer together, for a variety of ecological, practical, social and economic reasons. For the NSB, they advised a broad range of sizes for highly protected sites, ranging from 5 km^2 to 150 km^2 minimum, depending on site location, protection level, and conservation objectives. They also recommended that the majority of sites should be at least 50 km^2 in size. The most appropriate sizes for new sites are best determined following a gap analysis (section 3.2.6)

5.5.2.4 The large variation in the suggested size ranges reflects the varied scales of the landscape in different parts of the NSB, ranging waters along the highly complex and indented shoreline with its many narrow inlets, passages and fjords to wide expanses of open water offshore and on the shelf. MPAs within enclosed and spatially confined inlets should have much smaller minimum sizes that MPAs within open waters, which means that minimum size guidelines should be adjusted within each geomorphological class (paragraph 5.1.3.2).

5.5.2.5 Another consideration was protection level. As discussed under Principles 1 (section 5.2) and 14 (section 3.2), Ban et al. (2014) estimated the relative conservation effectiveness of

MPAs falling into different IUCN categories, findingthat IUCN Category IV sites are about 60% as effective as a no-take area, and IUCN Category VI sites have about 25% the effectiveness of a no-take area, though the results varied considerably from case to case. However, overall in order to achieve the same conservation gains, Category IV and VI sites need to be larger than a no-take zone to achieve the same conservation benefit. On this basis, Ardron et al. recommended that IUCN category IV sites, should have a minimum size range twice as high (10 km^2 to 300 km^2) as the 5-150 km^2 cited in paragraph 5.5.2.3, and IUCN category VI sites should have a minimum size range four times as high.

5.5.2.6 One aspect not touched upon in Ardron et al. (2015), but which was included in the MCZ ENG (Natural England and JNCC 2010), is the patch size of habitats within MPAs. The ENG set a minimum patch size threshold, below which areas of habitat within MPAs would not count towards the achievement of replication and percentage representation targets. A variation of this approach is suggested here in the guidelines for the NSB, taking into account the scale and resolution of the habitat classification.

5.5.3 Guidelines on MPA size and spacing

5.5.3.1 Primary guideline: In general, MPAs should be well distributed alongshore and offshore.

5.5.3.2 Primary guideline: In the NSB, highly protected sites should have a minimum size ranging from 5 km^2 to 150 km^2 minimum, depending on site location, protection level, and conservation objectives, with the majority of sites at least 50 km^2 in size.

5.5.3.3 Secondary guideline: Sites with lower protection levels should be larger than highly protected sites. IUCN category IV sites should have a minimum size range of 10 km^2 to 300 km^2, IUCN category VI sites of 20 km^2 to 600 km^2.

5.5.3.4 Secondary guideline: Size and spacing guidelines should be set at different levels in different geomorphological classes, reflecting differences in their predominant geography, oceanography, and landscape scale. Inshore sites should generally be smaller and closer together than offshore sites.

5.5.3.5 Secondary guideline: Habitats in fine scale and resolution classifications (median patch size <250 km^2) should only count towards the achievement of the Principle 1 representation and replication targets if the protected patch is > 25 ha (0.25km^2), and preferably larger.

5.5.3.6 Secondary guideline: Habitats in coarse scale and resolution classifications (median patch size > 250 km^2), should only count towards the achievement of the Principle 1 representation and replication targets if the protected patch is > 250 ha (2.5km^2), and preferably larger.

5.5.3.7 Secondary guideline: Where habitat classes form distinct features (e.g. rocky reefs) rather than covering extensive expanses of the sea, the whole feature should be protected.

5.5.4 A framework for developing size and spacing guidelines for the NSB

5.5.4.1 Table 14 and Table 15 below represent a framework for the definition of size and spacing guidelines within different geomorphological classes of the NSB, applying the protection level framework of Principle 15. As with Table 10 under Principle 1, some illustrative values are provided which can serve as a starting point.

5.5.4.2 'Minimum' size guidelines mean that larger sizes and closer distances may be warranted based on ecological considerations and the guidelines developed under the other Principles (e.g. to aim to capture whole features or processes within sites, cf. Principle 2, or to develop ecologically connected clusters of MPAs under Principle 3).

Table 14 Minimum MPA size guidelines for different geomorphological classs of the NSB, taking into account protection levels (Principle 15).

Protection level (as defined under Principle 15)	Minimum size
Inlets / fjords	
Core Zones& highly protected areas	5km^2
Conservation areas with recreational access and limited sustainable use	10km^2
Conservation areas with multiple sustainable use	20km^2
Haida Gwaii and enclosed waters / passages	
Core Zones & highly protected areas	x km^2
Conservation areas with recreational access and limited sustainable use	2x km^2
Conservation areas with multiple sustainable use	4x km^2
Open shelf waters and shelf break	
Core Zones& highly protected areas	y km^2
Conservation areas with recreational access and limited sustainable use	2y km^2
Conservation areas with multiple sustainable use	4y km^2

5.5.4.3 Ardron et al. (2015) identified a relationship between the rules for size and spacing implemented in the design guidelines used in England's MCZ process (Natural England and JNCC 2010), the GBR rezoning (Fernandes 2005) and the California MLPA (California Department of Fish and Game 2008). From these individual rules they formulated a generalized rule, such that MPA spacing should not exceed nine times the square-root of the average size of the neighbouring MPAs, i.e.:

$$\text{MPA Spacing} \leq 9 \times ((\text{Area}_1 + \text{Area}_2)/2)^{0.5}$$

5.5.4.4 As that this formula is a generalization of existing rules, it reflects existing practice, based on rules of thumb that were to an extent underpinned by scientific information; e.g., the known adult movement and larval dispersal ranges for large groups of species (e.g. Kinlan and Gaines 2003, Shanks et al. 2003, Carr et al. 2010), with practical and political considerations also taken into account. In generalizing the individual rules, it provides a flexible approach when defining guidelines for the NSB which is characterized by a variety of scales and geomorphic classes.

5.5.4.5 Table 15 suggests rules of thumb for maximum distances between sites of varying sizes, calculated using the formula above. In open water, where a site potentially has several neighbours of different sizes, applying the rule of thumb for the smallest pair of sites in the

group would be in line with the precautionary approach (Principle 16). However, this may not be practical or appropriate if sizes between neighbouring sites vary significantly – in this case, a rule of thumb based on average sizes within the group may be calculated using the above formula. Note that the distance guidelines apply to whole sites, not to zones within sites. If an MPA of 20km^2 total area contains a core zone of 5km^2, then the distance rule between 20km^2 sites applies.

5.5.4.6 Figure 3 in Burt et al. (2014), which is reproduced in Figure 1 below, shows general movement ranges and depth occurrences of fish and invertebrates in the NSB. This figure is a useful reference to support the definition of size and spacing guidelines.

Table 15 Suggested rules of thumb for spacing of MPAs within the NSB

Size of area 1 (km^2)	Size of area 2 (km^2)	Maximum distance (km)
5	5	7
5	10	8
5	20	11
5	40	14
5	80	20
5	150	26
10	10	10
10	20	12
10	40	15
10	80	20
10	150	27
20	20	13
20	40	16
20	80	21
20	150	28
40	40	19
40	80	23
40	150	29
80	80	27
80	150	32
150	150	38

Figure 1 This is a reproduction of Figure 3 in Burt et al. (2014). It will serve as a useful reference when refining the above size and spacing rules of thumb.

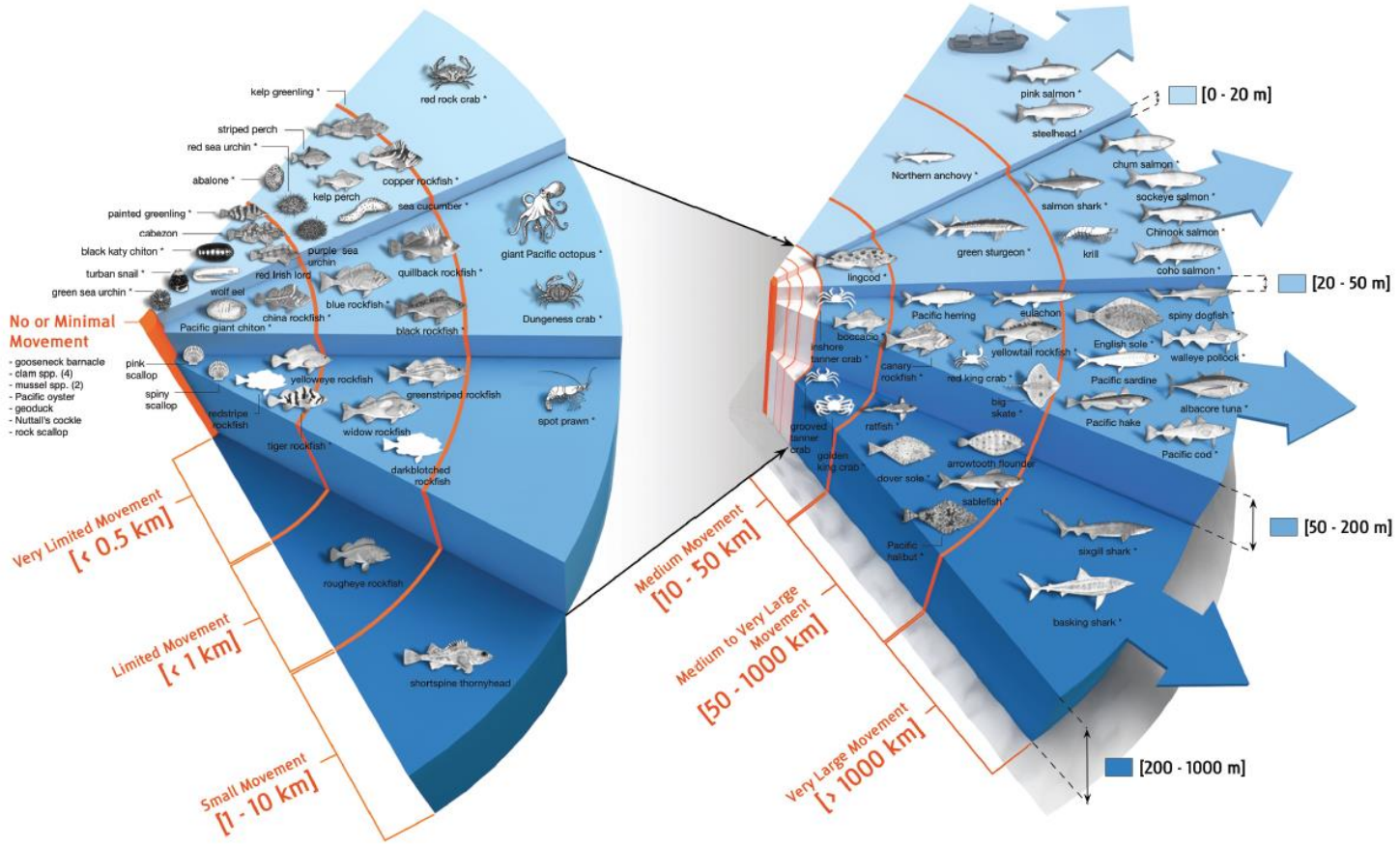

Figure 3. **General movement ranges and common depth occurrence for adult fish and invertebrate species of commercial, recreational, conservation, and cultural importance in British Columbia, Canada.** Species are placed in movement categories based on empirical data from tagging studies (marked by *) or based on observational information when specific movement data was not available (see Appendix C for species details). Depth class demarcations reflect the B.C. Marine Ecological Classification (0-20m = Shallow, 20-50m = Photic, 50-200 = Mid-depth, 200-1000 = Deep, BCMEC 2002). Species were placed in the depth class that best captured their commonly observed depth range (many species may be be found in shallower or greater depths). Fish illustrations are provided with permission from Andy Lamb (Lamb and Edgell 2010) and invertebrate illustrations provided with permission from Gloria Snively (Snively 1978). Four additional illustrations were obtained from open-licenced sources or are otherwise left blank. Illustrations are not to scale.

5.5.5 Recommended guidance and guidelines on Shape

5.5.5.1 Ardron et al. (2015) developed clear guidance for MPA shape, which is reproduced in appendix 1. Because this guidance is already relatively specific, the guidelines presented below simply distil key elements. Relevant guidelines are also included in section 4.4 in relation to designing MPA boundaries in a way that facilitates compliance and enforcement.

Guidelines for MPA Shape

5.5.5.2 Secondary guideline: MPA shape should seek to capture locally dominant ecological processes and features, which should (as far as practical) be protected in their entirety.

5.5.5.3 Secondary guideline: MPA shapes should reflect known species behaviours such as aggregating, feeding or breeding.

5.5.5.4 Primary guideline: MPA shape should minimize the edge-to-area ratio to maximize compactness, where practical.

5.5.6 Summary Table: Principle 5

Table 16 Summary Table: Guidelines for Principle 5. The origin code indicates the degree to which a guideline is taken from existing literature or based on PacMARA's own expertise. Origin codes: 1 = guideline adopted from source literature without modification, 2 = guideline adapted and modified from literature source(s) to suit the BC planning context, 3 = guideline developed by PacMARA specifically for the BC planning context.

Guideline	Rationale	Applicable sources	Origin code
MPA size and spacing			
Primary guideline: In general, MPAs should be well distributed alongshore and offshore.	To ensure there are no major gaps in the network, helping to achieve connectivity (Principle 3) and biodiversity representation.	Ardron et al. 2015[1] OSPAR 2008 Ardron 2008, 2009	1
Primary guideline: In the NSB, highly protected sites should have a minimum size ranging from 5 km^2 to 150 km^2 minimum, depending on site location, protection level, and conservation objectives, with the majority of sites at least 50 km^2 in size.	To ensure sites are large enough to capture movement ranges of adults and the protection of whole features where practical, whilst maintaining the flexibility to adjust to the characteristics of different parts of the NSB.	Ardron et al. 2015[1] Natural England and JNCC 2010 California Department of Fish and Game 2008 Fernades et al. 2005	2
Secondary guideline: Sites with lower protection levels should be larger than highly protected sites. IUCN category IV sites should have a minimum size range of 10 km^2 to 300 km^2, IUCN category VI sites of 20 km^2 to 600 km^2.	To reflect the differences in ecological effectiveness of MPAs with different protection levels.	Ardron et al. 2015[1] Ban et al. 2014	2
Secondary guideline: Size and spacing guidelines should be set at different levels in different geomorphological classes, reflecting differences in their predominant geography, oceanography, and landscape scale. Inshore sites should generally be smaller and closer together than offshore sites.	To reflect differences in predominant geography, oceanography, and landscape scale, as well as ecological, social and economic factors.	Ardron et al. 2015[1]	3

Secondary guideline: Habitats in fine scale and resolution classifications (median patch size <250 km^2) should only count towards the achievement of the Principle 1 representation and replication targets if the protected patch is > 25 ha (0.25km^2), and preferably larger.	To ensure that habitat patches too small to achieve conservation benefits don't count towards meeting targets.	Ardron et al. 2015[1] Natural England and JNCC 2010	2
Secondary guideline: Habitats in coarse scale and resolution classifications (median patch size > 250 km^2), should only count towards the achievement of the Principle 1 representation and replication targets if the protected patch is > 250 ha (2.5km^2), and preferably larger.	To ensure that habitat patches too small to achieve conservation benefits don't count towards meeting targets.	Ardron et al. 2015[1] Natural England and JNCC 2010	2
Secondary guideline: Where habitat classes form distinct features (e.g. rocky reefs) rather than covering extensive expanses of the sea, the whole feature should be protected.	To ensure holistic protection of features.	Ardron et al. 2015[1]	3
MPA shape			
Secondary guideline: MPA shape should seek to capture locally dominant ecological processes and features, which should (as far as practical) be protected in their entirety.	To ensure holistic protection of features.	Ardron et al. 2015[1]	3
Secondary guideline: MPA shapes should reflect known species behaviours such as aggregating, feeding, or breeding.	To ensure holistic protection of features.	Ardron et al. 2015[1]	3
Primary guideline: MPA shape should minimize the edge-to-area ratio to maximize compactness, where practical.	To minimize edge effects.	Ardron et al. 2015[1] Natural England and JNCC 2010	2

[1] The previous PacMARA guidance in Ardron et al. (2015) underpins many of the guidelines throughout this report. It was based on a literature review which has not been replicated in detail here

6 Summary of guidelines

6.1 Guidelines for general operating Principles

6.1.1 Guidelines for Principle 14 (existing MPAs)

1. Develop a standardized set of criteria to assess which existing MPAs and other effective area-based conservation measures meet the Canada-BC Strategy's MPA definition.
    a. Classify existing sites that meet the Strategy MPA definition into protection level categories (based on IUCN categories, as defined under Principle 15), taking into account site objectives and de-facto management, and applying the 75% rule.
    b. The protection level classification suggested under Principle 15 should be reviewed and refined as appropriate at the time that existing sites are classified.
2. Where appropriate, enhance the protection levels of existing sites with supplementary management measures (e.g. adding federal fisheries closures to provincial and locally protected areas).

6.1.2 Guidelines for Principle 15 (protection levels)

3. Pre-define a set of protection levels to use when planning the spatial configuration of the network, based on the IUCN marine interpreted categories.
4. Pre-defined protection levels should include strict no-take zones (IUCN Category Ia), as well as other highly protected areas that may provide for limited traditional extractive use (IUCN Categories Ib and II).
    a. Given their particularly high potential for causing controversy, it is advisable that no-take zones and other highly protected sites are established through co-management among federal, provincial and First Nations governments.
    b. An iterative planning approach is recommended, with cyclical reviews of the spatial network configuration and proposed protection levels of constituent sites.
    c. The planning process should have clarified planned activity restrictions for each site in advance of regulatory economic impact assessments being carried out

6.2 Guidelines for social, economic and cultural network design Principles

6.2.1 Guidelines for Principle 6 (taking account of the full range of uses and values)

5. Develop a typology of uses and values of marine space and resources.
6. Identify the suite of user groups and rights holders, considering, *inter alia*, federal and provincial leaseholders, First Nations, fishers, conventional and non-conventional energy, shipping, economic tourism and non-economic recreation.
    a. Identify formal and informal governance mechanisms (laws, policies, leases, traditional tenures, etc.) that structure access and use rights (e.g., property rights, harvesting rights, Aboriginal rights, exploration rights, etc.) as well as associated responsibilities.
    b. Identify the links between the different user groups and the suite of uses and values, as well as identifying the assigned or held rights and any associated responsibilities of each group, where appropriate.
7. Characterize the spatial and temporal distribution of the array of uses, values, and rights across the NSB, inasmuch as available data allow.
    a. Differentiate the importance of different uses, values and rights (i.e. avoid mapping all as one weight or "the same") using relative measures appropriate to each (e.g., assigning both monetary and non-monetary values).
8. Identify highly valued areas, including areas which will be compatible or incompatible with MPAs.
    a. Characterize the relative intensity and impact of uses on the marine environment and ecosystem services spatially.
    b. Identify the relative impact of the creation of MPAs on uses, values or rights, as well as the costs of inaction for each.

6.2.2 Guidelines for Principles 7 and 8 (Maximize the positive and minimize the negative)

9. Trade-off issues should include, but not be limited to, maximizing positive and minimizing negative economic impacts (economic efficiency) and tending to distributional impacts (social equity). Positive and negative impacts on the environment, spiritual and cultural practices, should also be included, when salient.
    a. For economic, social, and cultural data/information, relative scales of importance (e.g. 0-5) should be developed –either qualitatively through interviews gathering local, traditional, and expert opinion (so-called "Delphic" approaches); and/or with quantitative data where they exist.
    b. The representation of baseline economic, social, and cultural information in each planning unit should follow good statistical practices. Relative scoring methods should take into account the mathematical properties of the data distribution.
    c. Data for trade-offs need not be in the same structure, scale, or format. For ease of communication, however, layers should be standardised to a percentage scale, such that 100% equals the total distribution across the whole study area.
    d. The different datasets used in addressing Principles 7 & 8 should be briefly characterised, using language and descriptors relevant to a) decision-makers, b) stakeholders, and c) analysts.

10. Higher risk conflicts with user activities / values should be prioritized for data gathering and the creation of baseline scenarios. All relatively likely issues should ultimately be assessed.
    a. Recalling that "Specific, measurable, achievable, realistic and time-bounded (SMART) objectives will be identified at smaller spatial scales […] in an open, transparent and participatory manner, reflecting a balance in the needs of those involved in or affected by establishment and management of MPA networks" (Strategy p19), the following guidelines are offered:
        i. Specific: management objectives should clearly identify the benefits and ill effects to be maximized / minimized.
        ii. Measurable: objectives should have indicators that suggest whether the objective is being met, or not, and the trend.
        iii. Achievable and realistic: Trade-off objectives at the network and site level should be vetted according to criteria that address both "do-ability" and the likelihood of implementation, regardless of their focus (social, economic, cultural, spiritual, or environmental).
        iv. Time-bounded: NSB MPA planning, trade-off options, implementation, and schedules for revision, should be under-pinned by clear timelines.
11. Consideration of alternative regulatory and non-regulatory options should be guided by principles of good governance, including (but not limited to) effectiveness, efficiency, and accountability.
    a. Recalling that MPAs should be planned in the context of a wider suite of management approaches, regional MPA network planning should consider other relevant management measures already in place and how the addition of MPAs in the region can maximize the effectiveness of these existing measures, while minimizing operational redundancies or conflicts.
12. Assessing benefits and costs of MPA options should first be at the scale of a regional network and take into consideration:
    i. the range of (economic, social, and cultural) benefits they provide;
    ii. how the places in question are valued by the public and stakeholders;
    iii. an evaluation of the consequences of inaction or inertia;
    iv. direct and indirect (to the extent possible) impacts of the options;
    v. the equitable distribution of the costs and benefits of conservation between communities and users;
    vi. relative management costs and cost-effectiveness;
    vii. using all readily available data and information.
    a. Selection of the appropriate trade-off among many possible scenarios should be documented noting the following:
        i. The rationale behind the decisions.
        ii. The "known unknowns"; i.e. the known data gaps and issues with existing information;
        iii. The suspected "unknown unknowns;" i.e. areas where it is postulated our knowledge is incomplete, in ways as yet unknown, but which will emerge over time;
        iv. The relative certainty / confidence in the results of the analysis;
        v. Disadvantaged and minority groups, and undocumented ecosystem components, that are likely to be affected, which are largely missed by the trade-off analysis;
        vi. Suggestions on where to focus future data collection and adaptive management efforts.

6.2.3 Guidelines for Principle 9 (management effectiveness)

13. There should be clear and well-communicated lines of authority, responsibility and management between Government Departments and Delivery Agencies.
    a. Ensure a shared understanding of roles, responsibilities and influence across process participants, including clarity on who the decision-maker is at each stage.
    b. Stakeholder roles and levels of influence should be defined and clear to all participants (including the stakeholders themselves).
14. Ensure the implementation of common and accepted standards of transparency and accountability throughout the process, recording important decisions as they are made.
    a. A transparent process should be set up to deal with any issues concerning perception that lines of authority have been crossed.
    b. Acknowledge and be open about the potential impacts of MPAs on different sectors (the establishment of a pre-defined protection level framework as recommended under Principle 15 will help achieve this).
    c. When developing stakeholder engagement, communication, and data gathering strategies (cf. Principle 6), take particular care to engage with and map relevant information for those sectors and user groups most likely to be impacted by MPA management measures.
    d. Provide clarity on whether compensation is going to be given for any losses incurred by any stakeholder as a result of site designation.
    e. Zoning should follow a precautionary and objective approach which ensures that each zone is proportionate to the ecological needs, whilst minimising unnecessary exclusion.
15. Areas of high protection (IUCN Category Ia) should be designed as 'core zones' within MPAs, surrounded by a buffer area falling into a lower protection level.
    a. For coastal MPAs, a small weighting should be given favouring sites close to research institutions, within easy access of researchers, and/or with a long history of research.
    b. MPA boundaries should be kept simple. In the nearshore area they should use prominent coastal or land features where possible. Further offshore, boundaries should be provided in geographic co-ordinates indicating their projection.

6.2.4 Guidelines for Principle 11 (First Nations)

16. First Nations whose territories fall within the MPA planning region should, at a minimum, be consulted and accommodated. Further levels of engagement should be at the discretion of the affected First Nations.
    a. Each First Nation should be asked by the body that will make decisions about MPA site selection how they wish to be consulted and what level of engagement in the process they wish to have. Both elected and hereditary leadership should be consulted.
17. Existing relevant treaties in the NSB should be identified and their influence on MPA planning made explicit.
    a. Where they exist, First Nations protocols for working in their territories should be followed. This may necessitate new agreements concerning MPA consultations and decision-making.
18. Traditional [Aboriginal] ecological knowledge should be integrated in the MPA network selection process, and/or can be blended with science in planning, implementation, and management.
    a. First Nations should be asked whether they wish to share their methodologies for MPA planning, implementation and management with MPATT (and/or the relevant bodies). If so, then that should become part of the planning schedule.

b. Prioritize culturally important areas for inclusion in MPAs, where these are brought forward by First Nations (e.g., designate sacred sites as highly protected).
c. Prioritize conservation areas proposed through past and ongoing planning initiatives that First Nations have led or been involved with.

19. Where possible, integrate Canadian laws and First Nations laws and customs to manage MPAs, recognizing that aspirations will vary Nation by Nation (e.g., type of desired economic development and support for MPAs will vary).
    a. Provide First Nations with an option to designate and govern MPAs in their territory as Indigenous and Community Conserved Areas (ICCAs).

6.3 Guidelines for ecological network design Principles

6.3.1 Guidelines for Principle 1 (representation of biodiversity)

20. Representation and replication targets should be set for each class in at least one broad-scale comprehensive classification system. Targets should be set for each class to be represented in each geomorphological class in which it occurs.
    a. Credible and validated species-habitat classifications should be used as biodiversity proxies.
    b. If possible, use more than one comprehensive classification system at the same time.
    c. Start with the following as biodiversity proxies in the NSB:
        i. broad ecologically-relevant depth classes (e.g., 0-10m, 10-50m, 50-200m, 200-1000m, >1000m);
        ii. the biophysical classes (level 4) in the Pacific Region HMECS (CSAS 2016, Robinson et al. 2015);
        iii. each shore-type class within the BC ShoreZone classification;
        iv. classes within the developing classification by Gregr et al. (in prep.), once finalized; and
        v. Use the major oceanographic sub regions identified in Robinson and McBlane (2013) as a starting point for representing pelagic biodiversity in the NSB.
21. Identify a list of priority features (species, habitats, geomorphological and/or oceanographic features) for which to set representation and replication targets, focussing on valuable and important features that can be geographically demarcated, and for which spatial distribution data exist within the NSB.
    a. For highly mobile species, the priority features list should include important habitats or areas of importance for key lifecycle stages.
    b. Cross-check the priority features list with EBSAs identified under Principle 2, and include (portions of) EBSAs on the priority features list where appropriate, beneficial and practical.
22. Replicate each biodiversity proxy and priority feature in every geomorphological class where it occurs.
23. Representation targets for biodiversity proxies and priority features should vary widely (<5% to 100%), based on rarity, vulnerability, importance, level of data uncertainty, and MPA protection levels applied.
    a. Broad and widespread habitat classes should have lower percentage representation targets than less widespread and more narrowly defined ones.
    b. Rare, threatened and endangered features should have higher representation targets and, where possible, a higher number of replicates than common features.

c. When assessing feature rarity, ensure that particularly small ('rare') classes in broad-scale classifications truly represent unique ecosystem components, as opposed to classification artefacts (GIS 'slivers'). Small classes deemed questionable should be merged into neighbouring classes.
d. Features for which there is greater uncertainty in classification systems and species distribution models should have higher representation and replication targets than features for which data are less uncertain.
e. Applying higher MPA protection levels can warrant the lowering of replication and representation targets, and vice versa.
f. For replication targets, patch size matters: Very large patches (approx. two standard deviations above the mean size) may need only 1 or 2 replicates, while very small patches (approx. 2 SD below the mean) may require more than 5.

24. The minimum overall spatial footprint of the MPA network should be 20% of the NSB.
25. As a general rule, apply representation and replication targets across all geomorphological classes.

6.3.2 Guidelines for Principle 2 (EBSAs)

26. During the initial gap analysis, the existing NSB EBSAs identified by DFO should be reviewed to decide whether they warrant inclusion (as a whole or in part) within the MPA network.
    a. Areas of significance for species and habitats not covered in the existing EBSAs should be reviewed and identified, potentially expanding the list of EBSAs (or EBSA-like features).
    b. Other designations, such as *Valued Ecosystem Components* (DFO) and *Valued Marine Environments and Features* (Province of BC), should also be considered.
    c. Use of local and traditional knowledge in the identification of additional EBSAs is recommended, building on the work of the DFO EBSA process, and others.
27. Large EBSAs that cannot practically be included in full should be added to the priority features list under Principle 1, with percentage representation targets set for each one.
    a. Decisions on whether or not to include an EBSA in the MPA network (either as a whole, or in part) should consider whether their important ecological qualities will benefit from or be enhanced by spatial protection measures.

6.3.3 Guidelines for Principle 3 (connectivity)

28. Apply the guidelines on MPA size and spacing presented under Principle 5.
    a. When applying the spacing guidelines under Principle 5 in confined fjords and passages, distances between sites should be measured as the fish swims, not as the crow flies.
    b. Place MPAs in patterns capturing inshore-offshore gradients by orienting series of sites extending offshore from the shoreline/nearshore.

6.3.4 Guidelines for Principle 5 (size, spacing and shape of individual MPAs)

29. In general, MPAs should be well distributed alongshore and offshore.
30. In the NSB, highly protected sites should have a minimum size ranging from 5 km^2 to 150 km^2 minimum, depending on site location, protection level, and conservation objectives, with the majority of sites at least 50 km^2 in size.
    a. Sites with lower protection levels should be larger than highly protected sites. IUCN category IV sites should have a minimum size range of 10 km^2 to 300 km^2, IUCN category VI sites of 20 km^2 to 600 km^2.
    b. Size and spacing guidelines should be set at different levels in different geomorphological classes, reflecting differences in their predominant geography, oceanography, and landscape scale. Inshore sites should generally be smaller and closer together than offshore sites.
    c. Habitats in fine scale and resolution classifications (median patch size <250 km^2) should only count towards the achievement of the Principle 1 representation and replication targets if the protected patch is > 25 ha (0.25km^2), and preferably larger.
    d. Habitats in coarse scale and resolution classifications (median patch size > 250 km^2), should only count towards the achievement of the Principle 1 representation and replication targets if the protected patch is > 250 ha (2.5km^2), and preferably larger.
    e. Where habitat classes form distinct features (e.g. rocky reefs) rather than covering extensive expanses of the sea, the whole feature should be protected.
    f. MPA shape should seek to capture locally dominant ecological processes and features, which should (as far as practical) be protected in their entirety.
    g. MPA shapes should reflect known species behaviours such as aggregating, feeding or breeding.
31. MPA shape should minimize the edge-to-area ratio to maximize compactness, where practical.

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8 Appendix 1: Previous PacMARA guidance on the Principles

8.1 Previous PacMARA guidance

8.1.1.1 As highlighted in the introduction, the guidelines in this report build on guidance previously developed by PacMARA on the implementation of the ecological Strategy Principles (Ardron et al. 2015) and several of the socio-economic Principles (Patterson et al. 2016). The previous PacMARA reports reviewed literature and developed broad guidance, whereas in this report, the focus has been shifted from a literature review towards developing more detailed BC- and NSB-specific guidelines.

8.1.1.2 It is important to note that the previous PacMARA guidance remains valid – it has been built upon with, not superseded by, the detailed guidelines in this current report. Therefore, previous PacMARA guidance is referenced throughout this document. In order to have all PacMARA guidance and guidelines in one document, this appendix presents the complete set of summarized guidance points developed by Ardron et al. (2015) and Patterson et al. (2016), with wording and numbering maintained from the source documents. For a detailed commentary, readers should refer to the source documents.

8.2 Ecological Principles

8.2.1 Principle 1

8.2.1.1 For Principle 1, Ardron et al. (2015) developed the following points of guidance:

1. Divide the NSB into [smaller areas] that reflect the network's ecological objectives, while taking into account management and logistical realities.
2. In order to track progress in the protection of the full range of biodiversity, lists of "representative" (indicative) species and habitats for the NSB will need to be developed.
3. Use credible species-habitat classification systems where they exist. More than one can be applied in the same (sub-) region to highlight different aspects of biodiversity, but those that have been verified with biological data or local knowledge should be prioritized.
4. Replicate feature types and classification classes 3-5 times in each sub-region where they occur.
5. Targets for features should vary according to the rarity of the feature and the threats it faces, and could range from <5% to 100%.
6. The minimum recommended footprint of the NSB MPA network is 20% of the planning region. Footprints across sub-regions should be approximately the same.
7. Replication: rare, threatened and endangered species and habitats at risk may need more replicates than common features, as per the network objectives.
8. Very large patches (approx. two standard deviations above the mean size) may need only 1 or 2 examples, while very small patches (approx. 2 SD below the mean) may require more than 5.

9. Very broad habitat classes will need more replicates than narrowly defined ones (in order to capture the range of biodiversity within each broad class).
10. Classification systems and species distribution models based on weak or questionable data will also need more replicates (to better ensure that what is intended to be protected is actually so).
11. Biophysical classification systems should be validated using independent biological and physical data.
12. To ensure consistency with DFO (2009), the sub-biogeographic regional representation framework should consist of two major realms: pelagic and benthic. To that, we would recommend that an littoral / inter-tidal / shoreline zone be added.
13. In any classification system, small and unusual classes should be carefully scrutinized, especially in systems that have many classes. If found to be questionable, they can be merged into neighbouring classes.
14. If a multi-variate classification is not used, broad but ecologically meaningful depth classes (e.g., 0-10m, 10-50m, 50-200m, 200-1000m, >1000m), and broad geographic and geomorphic categories should still be applied (e.g., inlets / fjords, passages / mostly enclosed waters, continental shelf, and continental slope); as well as smaller readily identified geomorphic features such as rocky reefs, plateaus, canyons, and sills (for the benthic realm); and oceanographic upwellings, temperature / salinity fronts, and gyres (for the pelagic realm).

8.2.1.2 In addition to the above guidance, Ardron et al. (2015) also highlighted the following pitfalls to be avoided:

- classification systems are only a coarse approximation of ecological community distributions across a planning area, how well they capture biology is seldom tested, and they can go wrong (wrong assumptions made in model, abiotic data may be wrong or too coarse, overextended classification systems may leave fragments or GIS 'slivers', mapped ecological classes may differ depending on what classification systems or abiotic data were used).
- Good classification is not essential – don't delay implementation of MPA network
- Avoid flat targets – very common habitats are seldom in need of same level of protection as rarer habitats. Setting flat targets avoids the perception of favouritism or other political motivations, treating all species and habitats 'the same', but in doing so fails to capture meaningful differences in the species-specific spatial requirements of habitats and their ecological communities.

8.2.2 Principle 2

8.2.2.1 For the NSB process, Ardron et al. (2015) developed the following guidance for this Principle:

1. The existing NSB EBSAs identified by DFO should each be reviewed by scientific and local experts for inclusion in the MPA network based on the network objectives. Decisions (for or against) and rationale thereof should be documented and attributed.

2. Other designations, such as *Valued Ecosystem Components* (DFO) and *Valued Marine Environments and Features* (Province of BC), should also be used to inform the selection of MPA sites.
3. Identification (or estimation) of species and habitats not covered by existing designations is recommended, with particular consideration given to:
    a. Spawning, breeding, nursery, rearing, foraging migration, and seasonal refugia;
    b. Intertidal, shallow nearshore, and deep offshore habitats, and processes.
4. To facilitate management considerations, sub-divide large identified areas into smaller sub-units based on the network objectives.
5. Identified areas not included in the final MPA network should not be forgotten, but instead be listed as part of the description of the NSB's recognized ecologically valuable places.
6. Use of local and traditional knowledge in the identification of EBSAs and EBSA-like areas is recommended.

8.2.2.2 In addition, Ardron et al. (2015) highlighted the following pitfalls to avoid:

- Don't confuse EBSAs with MPAs, though some (parts) of them will become MPAs, not all MPAs will be EBSAs, and not all EBSAs will be MPAs
- The first EBSAs identified as part of the MPA process are unlikely to be comprehensive
- Attempting to capture dynamic behaviours and processes in static boundaries can, in some instances, lead to only partial protection

8.2.3 Principle 3

1. The spacing and configuration of an MPA network should reflect the ecological objectives of that network, such that sites for species' life history stages and habitat patches of particular interest are close enough to conceivably be ecologically connected.
2. In general, a representative MPA network should be well distributed, alongshore and offshore.
3. MPA size and spacing should reflect the predominant geography, oceanography, and scale of the local ecosystem into which sites are placed.
4. Generic MPA spacing should not exceed nine times the square-root of the average size of the neighbouring MPAs; i.e.

    $$\text{MPA Spacing} \leq 9 \times ((\text{Area}_1 + \text{Area}_2)/2)^{0.5}$$

5. Same or similar habitats in close proximity to one another (e.g., rocky reefs and islets <5 km apart) are likely to be a single ecological system, and if protected, should be treated as either a single larger MPA or as a cluster of ecologically connected MPAs.
6. When known, the spatial distribution of species' life history stages, including the movement of adults (foraging and feeding, breeding, migratory behaviours), should be considered to be protected as an ecologically connected MPA cluster.

7. MPAs in areas of restricted water flow or exchange should be considered to be ecologically further apart (for aquatic species) from other sites than simple distance measurements would suggest.

Ardron et al. (2015) also highlighted the following pitfalls to be avoided:

- Many species will not be affected by fisheries or other dominant human activities that would be constrained within MPAs – weighting all species equally when considering adult and larval movements can provide summary results that do not necessarily highlight the needs of those species most in need of protection.
- Some species may face localized pressures that have a much greater impact on their long-term viability than spacing per se.
- Seasonal adult movements should not be ignored – well-spaced but non-circumspect placement of MPAs may capture larvae of the vast majority of marine fish and invertebrates, but could fail at protecting key habitats of older life history stages, including areas of importance for 'bottlenecks' e.g. during migration.
- Sub-regions under intense human pressure may require more closely spaced MPAs than those under lighter pressure. Spacing and sizes of the NSB MPA network may need to be adjusted as more (or fewer) human activities are added to the NSB.

8.2.4 Principle 4

1. Long-term scientific and compliance monitoring is necessary to understand the value and success of implemented MPA's. A 10-year rule of thumb is suggested as a wait period to judge MPA efficacy.

8.2.5 Principle 5

1. MPA shape should attempt to capture the locally dominant ecological processes and features, in accordance with the MPA network objectives.
2. An uncertainty factor should be included as part of an MPA's overall shape and size calculation.
3. The NSB should contain MPAs across a broad range of sizes.
4. MPAs, at a minimum, should be 5 km^2 to 150 km^2 in size, depending on their location and conservation objectives.
5. The majority (more than half) of MPAs should be at least 50 km^2.
6. MPA and protected habitat patch size should take into account anticipated management measures, such that ecological function is preserved:
    a. Under management that will allow some limited extractive activities (IUCN category IV), or otherwise negatively affect species or habitats, affected areas should generally be at least two times as large as outlined above; and
    b. Under management that will allow sustainable use (IUCN category VI), affected areas should generally be at least four times as large as outlined above.

7. Generally, design of MPA shape should attempt to reduce the edge-to-area ratio to maximize compactness.
8. Fine scale biogeographic classification classes / habitat patches (defined as having a median patch size less than 250 km^2) should not be less than 25 hectares (0.25km^2), and preferable larger, to count towards representativity targets as per Principle 1.
9. Coarse scale biogeographic classification classes / habitat patches (defined as having a median patch size exceeding 250 km^2) should have a minimum patch size of 250 hectares (2.5km^2) to count towards representativity targets as per Principle 1.
10. For species with life history stages that move on-offshore, the MPA shape should attempt to capture this. If at too broad a scale, then an ecologically connected cluster should be considered – see Principle 3.
11. For species that have particular local feeding or breeding behaviours, the MPA should reflect this; e.g., seabird foraging grounds around a colony. If at too broad a scale, then an ecologically connected cluster should be considered – see Principle 3.
12. MPA boundaries, while remaining ecologically meaningful, should encourage compliance and ease of enforcement, and therefore should, when possible, follow obvious features (or depths), prefer straight lines, and not be unduly complex in shape.
13. Partially protected areas will need to be significantly larger than no-take reserves to achieve the same level of ecological benefit, and this will need to be taken into account when determining the size of the MPA and its impacted habitat patches.

8.2.5.1 Ardron et al. (2015) highlighted the following pitfalls to be avoided:

- Don't avoid protecting areas of high human use if this means only small areas protected
- Existing protected areas may not be ecologically ideal, but meet societal goals – their shape and size should reflect these values and uses. Political MPA targets (e.g. 10% protection) will miss such differences, unless different legal designations are applied.

8.3 Social, Economic and Cultural Principles

8.3.1 Principle 6

1. Before collecting data on the range of uses, activities, and valued areas in the NSB, first ensure there is a shared understanding of the planning process, its objectives, and management options.
2. Incorporate traditional, local, and stakeholder knowledge concerning usage of the marine and nearshore environment of the NSB to produce fine resolution spatial datasets (location, relative importance, and intensity) of:
    a. human commercial and recreational activities,
    b. culturally and historically significant areas, and
    c. spiritual sites.

3. Identify community-based conservation initiatives and integrate local knowledge for possible inclusion of these sites in the MPA network.
4. Incorporate non-market values into the MPA process, balancing these with conservation and economic concerns.
5. As that MPA implementation may initially impact some local economic opportunities, identify opportunities for future and alternative uses both within proposed MPA sites and the surrounding region, and develop a displacement policy for those that are impacted by development of MPAs.
6. Use optimization (e.g., Marxan) and decision support tools (e.g., InVEST) to integrate ecological, social and economic considerations into marine spatial planning processes for MPA design.
7. Incorporate cultural norms and traditional practices into management rules; do not supersede them.
8. Provide visible benefits to those whose behaviour the MPA's success is most contingent upon. These can be non-financial and include infrastructure or access to information, or incentive-based payments such as buy-backs and grants for re-training, as well as monetary compensation.
9. For larger MPAs (e.g. >70km^2), consider internal zoning to accommodate different objectives.
10. Plan on multi-generational time frames, both for desired socio-economic outcomes and for scientific monitoring.
11. Develop indicators to monitor progress in meeting this principle (coherent with principle 13, Adaptive Management).

8.3.1.1 Ardron et al. (2015) highlighted the following pitfalls to be avoided:

- Make sure enough attention is paid to this principle [principle 6]. Do not ignore patterns of human use that have evolved over decades and for First Nations, centuries or millennia.
- Do not sacrifice quality for quantity in MPA designations.
- Minimizing conflict while still reaching the ecological objectives of the MPA network will first require acceptance across sectors of the NSB process's mandate and legitimacy, second, a comprehensive spatial database mapping human valued areas, activities, and uses in the region, and third, a transparent and participative process.

8.3.2 Principles 6, 7 and 8: Guidance from Patterson et al. (2016)

Note that in the following list, section references refer to the original report, not this current report.

1. MPAs should be planned in the context of a wider suite of management approaches. In the NSB, First Nations management systems offer an opportunity for complementary marine protection strategies within the MPA network. (Section 3.6 7)
2. The planning process should establish what range of restrictions on human activities will apply within MPAs / zones, and may include categories with different protection levels. (Section 3.8.5)

3. Systematic MPA planning should be applied in the NSB, aligned with and building upon work that has already been completed in other relevant processes, and integrating pre-existing protected areas, where their objectives align with the Principles of the Canada-BC MPA Strategy. (Section 3.2.2)
4. Strategies should be considered for mitigating/compensating for social-economic impacts of MPAs and MPA networks on regional communities. (Section 3.9.1)
5. Ensure that regional analyses, discussions with stakeholders, and resultant decisions are not later undermined by site-by-site socio-economic impact assessments. (Section 3.8.3)
6. Analysts should work with process managers to ensure that participants have shared access to relevant information at each planning stage, including maps of environmental features and the distribution of human uses, as well as outputs of analyses that assess the potential impacts of MPA scenarios on human uses. (Section 3.8.4)
7. Adaptive management should be considered as a strategy for acknowledging current uncertainties and information deficiencies, whilst allowing decisions to be taken and implemented in a timely manner. Consideration should be given to how a series of adaptive management cycles might unfold over the long term. (Section 3.8.7)
8. The technical analyses supporting an MPA planning process need to be consistent with the legal and institutional mandates of the process. (Section 3.8.3)
9. Any existing laws or policies on evidence standards in public decision-making should be identified and followed (or if necessary, developed). (Section 3.8.3)
10. Before deciding what technical approach is the most appropriate, socio-economic analysts should consider the structure of the process their work is feeding into, and how it is expected their analyses will be used within that process. Ultimately, it is about ensuring that the analysis is answering the right question(s) at the right junctures in the planning process. (Section 3.8.1)
11. Data analysts should work in collaboration with process managers to develop a roadmap for the types of technical information and analytical outputs that will be needed to support each stage of the stakeholder engagement process. (Section 3.8.2)
12. Although a highly respected tool with a long track record of assisting planning processes, there is no one-size-fits-all recommendation that can be made as to whether Marxan (or Marxan with Zones) should be used within the NSB process. We do, however, recommend that both be considered. (Section 3.3.1)
13. Scoring that adds together multiple socio-economic costs or values should be avoided. Generally, a zoning approach is preferable, where specific targets are set against multiple objectives, and individual costs evaluated separately in each type of zone. (Section 3.4.1)
14. Where the human use and biological / environmental data exist in a GIS format, we recommend that spatial targets for both human uses and for conservation features be set. This could inform simple GIS mapping, or more sophisticated analyses using Marxan with Zones. (Section 4.2)

15. Continue to make a priority the collection of spatial information on human uses and their associated values and costs. This will in many cases require the aggregation of existing data sets, across years and statistical areas, into a continuous “surface” that covers the NSB (and ideally outside of it). (Section 3.7.2 45)
16. Data collected from stakeholders should not be used ‘against’ their interests, e.g. by using areas highlighted by fishermen as particularly valuable fishing grounds as a proxy for high biodiversity interest areas that need protecting from fisheries impacts. (Section 3.7.2)

8.3.2.1 Patterson et al. 2016 also included a literature review table, from which the following salient points have been extracted:

- Develop conflict and compatibility matrices;
- Identify the relative impact (benefits/costs, and distributions) of each type/category of MPA on the set of uses and values;
- Identify different plausible network configurations and calculate trade-offs;
- Use social impact assessment frameworks, establish methods to monitor, evaluate and adapt;
- Predict/forecast change in economic sectors and the impacts of marine conservation;
- Identify suite of social, economic, cultural and political indicators; e.g., well-being literatures, development, etc.;
- Importance of both perceived impacts as well as objectively measurable impacts;
- Pre-identification of steps to mitigate the negative impacts.

8.4 General operating Principles

8.4.1 Principle 12: Ecosystem-Based Management

8.4.1.1 Ardron et al. (2015) provided the following guidelines on the precautionary approach:

1. The EBM approach seeks to ensure ecological integrity. It seeks to sustain biological richness and services provided by natural ecosystems, at all scales through time. Within an EBM approach, human activities respect biological thresholds, historical levels of native biodiversity are met, and ecosystems are more resilient to stresses and change over the long term.
2. The EBM approach includes human well-being. It accounts for social and economic values and drivers, assesses risks and opportunities for communities, and enables and facilitates local involvement in sustainable community economic development. An EBM approach aims to stimulate the social and economic health of the communities that depend on and are part of marine ecosystems, and it aims to sustain cultures, communities and economies over the long term within the context of healthy ecosystems.
3. The EBM approach is precautionary. It errs on the side of caution in its approach to management of meeting designated objectives and targets. Uncertainty is recognized and accounted for in the EBM approach.
4. The EBM approach is adaptive and responsive in its approach to the management of human activities. It includes mechanisms for assessing the effectiveness of management measures and changing such measures as necessary to fit local conditions.
5. The EBM approach includes the assessment of cumulative effects of human activities on an entire ecosystem, not just components of the ecosystem or single sector activity.
6. The EBM approach is equitable, collaborative, inclusive and participatory. It seeks to be fair, flexible and transparent, and strives for meaningful inclusion of all groups in an integrated and participatory process. EBM is respectful of federal, provincial, First Nations and local government governance and authorities, and recognizes the value of shared responsibility and shared accountability. It acknowledges cultural and economic connections of local communities to marine ecosystems.
7. The EBM approach respects Aboriginal rights, Aboriginal titles and treaty rights, and supports working with First Nations to achieve mutually acceptable resource planning, stewardship and management.
8. The EBM approach is area-based. Management measures are amenable to the area in which they are applied; they are implemented at the temporal or spatial scales required to address the issue and according to ecological rather than political boundaries.
9. The EBM approach is integrated. Management decisions are informed by consideration of interrelationships, information, trends, plans, policies and programs, as well as local, regional, national or global objectives and drivers. The EBM approach recognizes that human activities occur within the context of nested and interconnected social and ecological systems. As such, EBM concurrently manages human activities based on their interactions with social-ecological systems. The approach helps to direct implementation of measures across sectors to integrate with existing and, where agreed, new management and regulatory processes.

10. The EBM approach is based on science and on wise counsel. It aims to integrate the best available scientific knowledge and information with traditional, intergenerational and local knowledge of ecological and social systems and adapt it as required.

8.4.2 Principle 16: Precautionary approach

8.4.2.1 Ardron et al. (2015) provided the following guidelines on the precautionary approach:

1. Avoid making irreversible decisions that could lead to substantive or irreversible harm to the environment (species and habitats).
2. Identify critical knowledge gaps so the appropriate decision-making strategies can be applied, and research can be applied in filling these gaps.
3. More precaution will be required in the face of more significant knowledge gaps. Build in safety factors (e.g., buffer zones) in calculations of MPA network design and management of human activities within, and outside of, the network.
4. While some MPAs should be seen to improve human well-being, not all of them need have this objective. Some should be established solely for reasons of ecological precaution.
5. Given that a key pitfall involves achieving an acceptable balance between using best available evidence and precaution, an attempt should be made to develop agreed minimum standards for acceptable risk at the start of the MPA process.
6. Treat the MPA Network Design Principles as a package, which as a whole contain several elements of the precautionary approach. Do not restrict implementation to a subset of Principles.
7. Incentivize data collection to clarify the likelihood and magnitude of poorly documented impacts and activities.
8. Recognizing that scientific budgets are greatly curtailed, other funding sources (including all levels of government[26], non-governmental organizations, and industry) for scientific research to fill knowledge gaps should be considered.
9. Avoid 'over-fitting' data and instead 'keep it simple' in calculations of MPA network design and the management of human activities within, and outside of, the network.
10. Continue to develop and use the methods underway by DFO regarding an ecological risk assessment framework (O et al., 2012) and the guidance provided in *A Framework for the Application of Precaution in Science-Based Decision making about Risk,* by the Government of Canada (2003).

8.4.2.2 In addition, Ardron et al. (2015) highlighted the following pitfalls to be avoided in the implementation of Principle 16:

- decision-making involves difficult trade-offs, often with cost-benefit analyses that cannot be fully quantified. The most likely pitfall concerns striking a balance between using best available evidence and precaution – tempting to decide that the best available evidence is insufficient to make a decision. This is contrary to the

[26] Wording as per the original report

precautionary approach. Clear rules for striking the balance need to be defined at the outset, including minimum standards for establishing unacceptable risk. This requires a clear statement of values and objectives.

- Precautionary approach should not be watered down to 'be careful' – emphasize consequence component of risk analysis, particular values may negate the need for more detailed study.
- Regarding the establishment of MPAs, the precautionary approach should not be misconstrued to mean that they cannot be designated without ample evidence of their utility.
- The evidence-based approach and the calculation of cumulative effects are seen as risk-based responses to the precautionary approach. Epistemologically, however, this is the obverse of the precautionary approach, both are required in good decision-making (risk-based approach when information is available, precautionary approach when there is uncertainty).

9 Appendix 2: Additional guidance from other sources

9.1 CPAWS related guidance on Principles 7 & 8

9.1.1.1 In 2010 and 2011, the BC chapter of the Canadian Parks and Wilderness Committee (CPAWS), an environmental non-governmental organization (NGO), organized two two-day workshops to convene an independent scientific team from academic institutions across Canada to develop a set of MPA recommendations. Although the Strategy had not yet been finalized or released, many of their recommendations speak to its Principles nonetheless. Those of relevance to Principles 7 & 8 are listed below. Where a Guideline's relationship to these Principles is not self-evident, some supporting text from their report is also provided (Jessen et al. 2011, excerpted):

- Identify culturally, historically and spiritually significant areas.
- 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. […] Greater community acceptance may result from this integrative approach.
- Identify opportunities for alternative uses / compatible activities within networks of MPAs
- Protect and enhance recreational sites and opportunities
- 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. These sites 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.
- 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 (Canada Oceans Act).

9.1.1.2 Jessen et al. also recommend developing a displacement policy. They point out:

"*Perhaps best known, and also controversial, is the structural adjustment package for the re-zoning of the Great Barrier Reef (GBR) 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)."*

9.2 Guidance in Burt et al. (2014) relevant to Principles 7 & 8

9.2.1.1 Table 17 is an excerpt from Table 7 in Burt et al. (2014). Commissioned by the Kitasoo/XaiXais First Nation and Coastal First Nations-Great Bear Initiative Society, the Burt et al. study ranges widely across several aspects of MPA network design. For the purposes of this report, most relevant is the section on Social Goals for MPAs: synergies and trade-offs in design and establishment. From that, we have excerpted most of their Table 7, below, as relevant to Strategy Principles 7 & 8 (as well as Principle 6 and others).

Table 17 Practices suggested by Burt et al. (2014), relevant to Principles 7 & 8. (Excerpted from Table 7, pp 39-40.)

Social Themes / Examples of Social Goals	Strategies and Practices (excerpted)
MARINE LIVELIHOODS AND FOOD SECURITY: Enhance capabilities and assets for income and subsistence activities	
Enhance or maintain contributions of sustainable fisheries to employment, income, and food security.	Consider the economic importance of fishing in MPA design and placement – costs of reduced access as well as benefits from spillover.
	Consider aspects of marine area access and adjacency by local marine users.
Support or enhance existing local 'non fisheries-based' livelihoods and possible alternative livelihood strategies.	Identify areas that are key sites/routes for current and prospective marine tourism and include them in the MPA network.
	Identify and develop alternate economic opportunities linked to marine resources within and outside of the MPA network.
Support employment opportunities related to cultural information and sharing.	Support local organizations and/or employment of local people in monitoring ecological conditions.
NON-MONETARY AND INTANGIBLE BENEFITS: Understand and incorporate non-monetary benefits of MPAs	
Enhance opportunities for recreational activities.	Collect information to identify areas that are key sites/routes for current recreational use, and areas of future prospective marine recreation.
	Create "buffer zones" within which recreational activities can be pursued with reduced impacts on sensitive ecological areas.
	Situate MPAs close to population centres in order to facilitate access for recreational users.
Protect cultural heritage and traditional practices.	Identify areas of cultural or historical importance and accommodate them within the boundaries of the protected areas.
	Use indigenous names for fauna, flora, and landscape features.
	Accommodate traditional practices that are compatible with conservation objectives.
Protect spiritual sites and values in the marine environment.	Identify and encompass spiritually significant areas or sacred natural sites within marine protected areas or networks.
	Where necessary, protect the confidentiality of site location and/or associated cultural/spiritual information by, for example, locating sacred natural sites within larger strictly protected zone so exact locations remain confidential.

EDUCATION AND KNOWLEDGE SHARING Foster education, research, and knowledge sharing opportunities within the MPA Network	
Foster knowledge sharing between interest groups.	Make use of local ecological knowledge (LEK) and/or fishers' ecological knowledge (FEK) in identifying critical habitat for protection within the MPA network.
Enhance marine research capacity.	Establish community-based participatory research programs.
	Consider designating or including sites specifically for monitoring and research.

10 Appendix 3: Non-technical summary

The following pages contain a stand-alone summary document which describes the guidelines in this report, their background, and PacMARA's approach in developing them, in non-technical language. As this is designed to be a stand-alone document, the page numbering re-starts at page 1.

Guidelines for creating a Marine Protected Area network in Canada's Northern Shelf Bioregion:

Non-technical summary

Produced by PacMARA for the British Columbia
Marine Protected Areas Technical Team (MPATT)

June 2016

Background: A marine protected area network for Pacific Canada

The governments of Canada and British Columbia, together with First Nations governments, are planning to establish a marine protected area (MPA) network in the coastal and offshore waters of BC. The Marine Protected Areas Technical Team (MPATT) is made up of representatives of relevant federal, provincial and First Nations authorities, and is responsible for overseeing the planning of this MPA network.

MPATT are starting the planning process in the Northern Shelf Bioregion, which extends from the sea around the northern tip of Vancouver Island to the Alaskan border, encompassing Haida Gwaii, Hecate Strait, Queen Charlotte Sound as well as northern and central coastal waters of BC.

The Canada – British Columbia Marine Protected Area Network Strategy[27] sets out the environmental, social and economic reasons why the MPA network is being established. It contains the following six Goals, with the first being of primary importance:

1. To protect and maintain marine biodiversity, ecological representation and special natural features.
2. To contribute to the conservation and protection of fishery resources and their habitats.
3. To maintain and facilitate opportunities for tourism and recreation.
4. To contribute to social, community, and economic certainty and stability.
5. To conserve and protect traditional use, cultural heritage and archaeological resources.
6. To provide opportunities for scientific research, education and awareness.

In addition to the above six Goals, the Canada-BC MPA Strategy also sets out 16 Ecological Network Design Principles. These include:

1. Ecological Principles (e.g. to represent the full range of regional marine species and habitats in the MPA network, to protect areas special ecological importance, and to ensure MPAs are ecologically connected);
2. Social, cultural and economic principles (e.g. to recognise the range and value of human activities in BC's waters, to maximize benefits while minimizing negative impacts from MPAs, and to respect First Nations' treaties, title, rights, aspirations, and world-view); and
3. General operating principles (e.g. to include a range of protection levels within the MPA network, to plan for the benefit of the ecosystem as a whole rather than focussing on individual species, to apply the precautionary principle, and to review and adapt the management of the MPA network over time).

[27] http://www.dfo-mpo.gc.ca/oceans/publications/bc-mpa/index-eng.html

What is this document?

This document is a non-technical summary of a much longer technical report[28] written by PacMARA for MPATT, containing a series of recommended guidelines on how to implement 11 of the 16 Principles mentioned above. MPATT commissioned this technical report in order to bring in external expertise and advice on how best to interpret and apply the Principles in practice. The guidelines are recommendations, and it will be up to MPATT to decide which ones to take on board, and how to interpret and apply them in detail.

What is PacMARA?

PacMARA is charitable organization based in BC, made up of science and planning professionals dedicated to building and increasing capacity in marine and coastal planning in Canada and internationally. Our goal is to help achieve sustainable prosperity through sound, collaborative decision making in ocean management, making the best possible use of current science.

In order to develop guidelines for the implementation of the Canada-BC MPA Strategy Principles, PacMARA assembled a team of experts from within and outside the organization. The authors of the technical report include international marine planning experts with experience of MPA planning in Europe and elsewhere, as well as BC scientists with a sound understanding of the natural, social and cultural environment of the region, as well as experience working with First Nation communities on the management of marine resources.

How were the guidelines developed?

The technical report on MPA guidelines is the third in a series of reports that PacMARA has written on the implementation of the Canada-BC MPA Strategy Principles. The first two reports (one of which focused on ecological aspects[29], the other on socio-economic aspects[30]) reviewed the international literature to establish current best practices, and developed general guidance for several of the Principles.

The current (third) report builds on the general guidance in the two earlier reports, developing more specific and detailed guidelines on how to go about implementing the Network Planning Principles in practical terms. Most of the guidelines have been drawn from advice in specialist literature and from MPA planning processes in other parts of the world, and modified to tailor them to the specific ecological, social, cultural and economic environment of BC's Northern Shelf Bioregion. Some of the guidelines are based directly on PacMARA's expertise (this is indicated in the main report).

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[28] Lieberknecht, L.M., Ardron, J.A., Ban, N.C., Bennet, N.J., Eckert, L., Hooper, T.E.J., and Robinson, C.L.K. (2016) *Recommended guidelines for applying Canada-BC Marine Protected Area Network Principles in Canada's Northern Shelf Bioregion: Principles 1,2,3,5,6,7,8,9,11,14 and 15.* Report produced by PacMARA for the British Columbia Marine Protected Areas Technical Team (MPATT).

[29] Ardron, J.A., Gregr, E.J., Robinson, C.L.K., Coleman, H.M., Dearden, P., Sumaila, U.R., Brandon, C., Kenk, E., Cisneros-Montemayor, A.M. (2015) *Recommendations on applying the Canada-BC Marine Protected Area Network Principles to Canada's Northern Shelf Bioregion: Principles 1, 2, 3, 5, 6, 16, with discussion on 4, 7, 8, 12*. Produced by PacMARA for the British Columbia Marine Protected Area Implementation Team. 110 pp.

[30] Patterson, M., Lieberknecht, L., Hooper, T., Ban, N., Ardron, J. (2016) *Recommendations on Applying Canada-BC Marine Protected Area Network Principles in Canada's Northern Shelf Bioregion: Principles 6, 7, and 8*. 80 pp. Report submitted by PacMARA to the British Columbia Marine Protected Areas Team.

What do the guidelines look like?

The guidelines are divided into primary and secondary guidelines. The secondary guidelines provide further detail on specific aspects of the primary ones. Examples of some of the primary guidelines are shown below, and explained in non-technical terms. Please refer to the full report for the complete set of all guidelines, their underpinning rationale and background, and additional guidance on their application.

Example guideline for defining different protection levels for MPAs within the network

"Pre-defined protection levels should include strict no-take zones (IUCN Category Ia), as well as other highly protected areas that may provide for limited traditional extractive use (IUCN Categories Ib and II)."

One of the Principles states that the network should include MPAs with a full range of protection levels. This guideline advises that protection levels should be based on the standardized categories for global terrestrial and marine protected areas which have been developed by the IUCN (the International Union for the Conservation of Nature).

Example guidelines for maximizing benefits and minimizing negative impacts

"*Trade-off issues should include, but not be limited to, maximizing positive and minimizing negative economic impacts (economic efficiency) and tending to distributional impacts (social equity). Positive and negative impacts on the environment, spiritual and cultural practices, should also be included, when salient*."

This guideline recognizes that trade-offs will be a necessary part of MPA planning, and that different sorts of potential impacts should be considered. It also highlights the importance of social equity (fairness) when assessing impacts.

Example guideline to help ensure respect for First Nations' treaties, rights and world views:

"Traditional [Aboriginal] ecological knowledge should be integrated in the MPA network selection process, and/or can be blended with science in planning, implementation, and management."

This guideline points out the value of knowledge about the natural and social environment held by Aboriginal communities, and that this knowledge should be integrated with scientific knowledge in MPA planning.

Example guideline to help ensure the full representation of biodiversity

"Representation and replication targets should be set for each class in at least one broad-scale comprehensive classification system. Targets should be set for each class to be represented in each geomorphological class in which it occurs."

This guideline recognizes that there are gaps in maps that show the distribution of individual species, but that there are broad classifications that are mapped for the whole planning region. Representing a proportion of each habitat type in a broad classification is one way of helping achieve a network that represents the full range of all species and habitats (biodiversity) present in the region.