Recommendations on Applying Canada-BC Marine Protected Area Network Principles In Canada's Northern Shelf Bioregion:

Principles 6, 7, and 8

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

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Executive Summary

This report distills good practices from the extensive literature on incorporating socio-economics into marine protected area (MPA) planning. While it was hoped that concrete 'best practices' would emerge, instead it was found that the literature is fragmented and anecdotal in nature, with many suggested good practices, but little consensus on what approach is best, and under what conditions. Trade-offs are a central theme, with solutions ranging from sophisticated desktop modelling to intensive stakeholder engagement. Marxan and Marxan with Zones appear regularly in the literature as a popular GIS-based solution to identify and explore trade-offs. These and similar tools are reliant on reasonable quality spatial data and should not be seen to subsume the necessity of stakeholder engagement. However, they can make such engagement more structured, and focus discussions. Stakeholder engagement is by far the largest component of the literature, indicating not only its importance, but also its difficulties.

In the body of the text, we have bolded what we view as recommendations and good practices that emerge from the topic under discussion. These are re-listed (grouped into sub-headings) in Section 5, at the end of the main report. The report's Appendix 1 contains case studies. Separate from the report is a table summarising the literature reviewed (Appendix 3).

This report, and the previous, more ecologically-focussed PacMARA report on Canada-BC MPA Design Principles (Ardron et al. 2015), are a foundation based on which operational guidance specific to the North Coast Bioregion can be formulated. If one thing can be said from all the literature, it is that every situation while facing similar challenges is nonetheless a unique mixture of governance style, financing, human resources available, data, geography, existing uses, precedent, and cultural expectations. BC's Northern Shelf Bioregion is no exception, and will require a "made in the North Coast" solution.

For an overview of this report's findings, please go to section 5, at the end of the main body.

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1. Introduction

1.1. Context

The 2014 *Canada-BC Marine Protected Area Network Strategy* lays out vision, goals and planning principles for development of a comprehensive, systematically developed MPA network on Canada's Pacific Coast. The Canada-BC Marine Protected Area Team (MPAT), formerly the Marine Protected Areas Implementation Team (MPAIT) is made up of Federal, Provincial and First Nations representatives working together to implement the BC MPA Strategy in BC's Northern Shelf Bioregion (NSB).

On March 23rd 2015, PacMARA submitted the following report to MPAIT: *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* (Ardron et al. 2015). The present report builds on the 2015 report, focussing in more detail on technical methods to support the practical application of three specific principles (6, 7 and 8) of the Strategy.

1.2. Objectives of this Report

Principles 6, 7 and 8 of the BC-Canada MPA Strategy are to: 6) recognize and consider the full range of uses, activities and values; 7) maximize the positive, and 8) minimize the negative. The objectives of this report are to provide guidance on the practical application of these principles, in particular, how social, economic and cultural characteristics and information should be used in: a) the design of a network of MPAs, b) the consultation process, and c) the management of the network.

As requested by MPAT, the main focus of this guidance is on the siting options part of the network design, i.e. the process of deciding where individual MPAs should be located, especially a) when biodiversity features targeted for protection and conservation interact with human use, and b) when cultural, social or economic features are targeted for protection. The guidance in this report is based on a review of peer reviewed and grey literature on MPAs and MPA planning, as well as insights based on the experience of our expert team.

In the project's Statement of Work and in discussions with MPAT, we were asked to identify best practices. For the purposes of this report, *best practices* are those that are widely recognized within the discipline as part of due diligence, consistently producing desirable results.[1] *Good practices,* on the other hand are those that in many circumstances are to be recommended, but which have not yet found widespread acceptance or application.

1.3. Background

In a previous contract for MPAIT (Ardron et al. 2015), PacMARA produced some initial guidance on Principles 6, 7 and 8 (Box 1), including that "*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*" (Ibid. p. 52).

[1] BusinessDictionary.com defines best practice as: "A method or technique that has consistently shown results superior to those achieved with other means, and that is used as a benchmark." http://www.businessdictionary.com/definition/best-practice.html#ixzz44IhsOjHO

In outlining “possible pitfalls”, the 2015 report warned of ignoring the patterns of human use that have evolved over more than a century, and for First Nations people, millennia. Such an approach often generates considerable backlash from local communities - the very communities that need to be relied upon to comply with conservation interventions. There are several examples where economic and social aspects (including, but not limited to patterns of use) have not been considered in MPA processes, leading to their failure (e.g. Christie 2004, Bunce et al. 2010, Bennett & Dearden 2012).

At the same time, however, PacMARA also advised that existing users should not exclusively dictate the location, size, and spacing of MPAs, at the expense of meeting ecological objectives. There are many examples throughout the world where minimizing conflict with existing uses has in practice ended up as seemingly the dominant design principle for MPA establishment (Devillers et al. 2014). While this approach can result in the rapid expansion of MPA systems, it can also seriously compromise the potential for those systems to protect against ongoing losses of marine biodiversity or productivity, often their main stated purpose. There may be cases where protecting areas with few human activities could have long-term benefits in preventing future expansion of human activities into previously unexploited areas of the marine ecosystem. However, the 2015 report (Ardron et al. 2015) suggested that if the Canada-BC MPA Network Design Principles are to be fully met, with biodiversity better protected than at present, then some conflict with existing human use will be inevitable - exclusively protecting areas with limited use value will not address current pressures on the NSB’s marine environment.

The implication of the guidance in Ardron et al. (2015) to avoid the above pitfalls is that the BC MPA planning process will need to analyse the potential social, economic, cultural and environmental costs and benefits of multiple MPA configurations in the NSB, in order to find a network that maximises the positive and minimises the negative across multiple user groups and values. This report reviews MPA-related literature to identify analytical methods that may help to underpin this process, and guidance is provided based on the findings of the literature review.

Although this report offers guidance that we hope will be helpful, we caution again that there will be no single “optimal” solution to address social-cultural-economic questions and issues. MPA network design, consultation and management in the NSB region will ultimately be an exploration and affirmation of diverse (individual and collective) ecological, economic, social and cultural values, and trade-offs, compromise and conflict are inevitable when dealing with people (Andrachuk & Armitage 2015, Bennett & Dearden 2012, Burt et al. 2014, Fabinyi 2008, Osmond et al. 2010, Ardron et al. 2015).

A thoughtfully designed and adequately resourced decision-making process (including a well-designed stakeholder engagement process) can help determine which of the above trade-offs can be made and how compromises can be reached. Outputs of technical analyses should underpin and inform this process in a timely and constructive manner, and should not be seen as the end result. When deciding on the most appropriate technical approach to use for a social-cultural-economic analysis in MPA planning, consideration of the design of the decision-making process is therefore as relevant as technical considerations (e.g. data quality and availability). Throughout this report, we have endeavoured to place the technical findings of the literature review within the context of relevant process design considerations.

Box 1 - Recommendations from PacMARA's 2015 report to MPAIT

The following are the overall recommendations for Principle 6 (Recognize and consider the full range of uses, activities and values supported by marine environments), which are further elaborated upon in the report.

Key Recommendations

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 NBS 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 planning 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.

Additional recommendations

7. Incorporate cultural norms and traditional practices into management rules; do not supersede them.
8. Provide visible benefits to those whose behaviour the MPAs 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.

2. Literature Review: Approach and Overview

2.1. Approach

This present report is narrower in intent than Ardron et al. (2015), specifically addressing the three Principles outlined above. For this new report, PacMARA assembled a new team[2] of academics and practitioners, reviewed new literature and looked in detail at relevant case studies in which members of our expert team were directly involved.

There is a now a voluminous academic and grey literature on MPAs. An initial set of approximately 100 papers (dated up to 2014) was provided by the DFO (Patrick Mahaux). We cross-referenced these with papers reviewed in Ardron et al. (2015), keeping those that contained information of specific relevance to the objectives of this report. We next sourced papers from the CVs of our expert team members, and also requested from them any others that they might recommend. We then used the *Open Channels* publication library (https://www.openchannels.org/literature) to identify other relevant literature, particularly from recent years (2014-2015), using combinations of the following key words: "socio-economic", "marine reserves", "Marine Protected Areas", "fisheries", "stakeholders", "conflicts", "Marine Spatial Planning", and "conservation". We continued to source and use relevant papers throughout the writing of the guidance document.

The finalised literature review covered 67 papers, as listed in Appendix 3 (33: Principle 6; 10: Principle 7; 24: Principle 8). Appendix 3 summarises the key points from each one, in a table with the following headings: sub-principle, site/network relevance, approach (summary/abstract), indicators/methods of measurement (from Pomeroy et al. 2004), lessons learned, and region/citation. Within each Principle heading, papers are listed in no specific order. Most of the literature we examined includes some content relevant to the objectives of this report, nevertheless we found that some of the key technical challenges in integrating socio-cultural-economic factors into MPA planning remain only partially addressed. We have highlighted gaps, and where possible have supplemented the literature review with relevant context and guidance based on the knowledge and experience of our expert team.

2.2. Structure of this report

This report has 5 main sections. This introductory section presents an overview of the main emerging themes of the literature review and highlights references of key relevance to the BC context. Section 3 discusses findings relevant to MPA planning when biodiversity features targeted for protection and conservation interact with human use, and section 4 focuses on situations when cultural, social or economic features are targeted for protection. Recommendations to MPAT are highlighted in bold throughout the text of each section, and are summarised in section 5. Appendix 1 presents summaries of real-world case studies, and Appendix 3 contains a table summarising the literature review. Appendix 2 lists author affiliations.

[2] We retained one team member who served on the previous contract (Jeff Ardron) to ensure continuity between the two projects.

2.3. Emerging themes from global MPA literature

A number of broad themes emerged from the literature reviewed for this report. Much of the MPA literature has traditionally focussed on conservation ecology, with the potential environmental benefits of MPAs and approaches for maximising those being central themes, but in recent years there has been a growing number of papers and examples regarding MPA-related social-cultural theory and practice around the world.

There is an emerging consensus that there is a need for integrated planning approaches that link environmental with social-cultural and economic factors in MPA planning from the earliest planning stages. Overwhelmingly, stakeholder participation is identified as a critical element across the site selection, consultation, implementation, and management phases of MPA development, as a mechanism through which social-economic-cultural factors can be identified and addressed. The literature is strongly slanted towards what *ought* to be done, however, and there is a lack of practical case studies and examples of fully integrated planning processes, both from a (stakeholder) process design and from a technical analysis perspective.

Recent research has started to focus on analysing stakeholder values, and stakeholder perceptions of MPAs and MPA processes. Despite this, lack of socio-economic spatial data is another emerging theme. Many studies highlight challenges associated with a lack of social science (including economic) data. In this literature review, few recent economic studies were found, and very few that looked at spatial patterns of use. Technical analyses to review or inform MPA network planning at a regional scale tend to focus primarily on the achievement of biodiversity objectives, and where trade-offs are analysed (or 'optimised' networks are aimed for), this is usually on the basis of a single or limited number of socio-economic cost types.

It seems that, in practice, few (if any) fully integrated MPA network planning processes have been implemented. Many of the reviewed papers describe theoretical frameworks and analyses that aren't necessarily tied directly in with a real-world decision-making process. Furthermore, where technical approaches have been suggested or tested, these tend to relate to a specific context or place, and at anything beyond a general level, lessons learnt may have limited applicability in other locations and contexts.

The literature review has broadly concluded that at a detailed technical level, clearly established and globally applicable 'best practices' relating to socio-economic trade-offs, analytical tools, or methods, do not currently exist. However, many *good practices* can be found in the literature, of which some key ones are highlighted throughout this report, using bold text. We have collated and re-arranged these good practices at the end of this report (section 5) under general themes.

Several literature sources with studies relevant to the BC context have also been identified and highlighted. Together with our own experience and expertise, this has enabled us to highlight a series of recommendations to MPAT which we hope will be useful and relevant to the implementation of Principles 6, 7 and 8 of the BC MPA Strategy.

2.4. Literature of specific relevance to BC

A couple of the papers reviewed are from researchers based in BC, providing guidance that is relevant and specific to the NSB; notably, Burt et al. (2014), *Marine protected area network design features that support resilient human-ocean systems - Applications for British Columbia, Canada*; and Jessen et al. (2011), *Science-based Guidelines for Marine Protected Areas and MPA Networks in Canada.* We would encourage the MPAT to review these and other relevant BC publications in detail to foster understanding of these issues through a variety of perspectives, and most importantly, to avoid duplication of effort.

As noted in Ardron et al. (2015), numerous attempts to maximize benefits, with a particular focus on ecological values, have already taken place in BC and the NSB, usually using the multi-objective optimization tool Marxan, and they should inform future NSB planning. These include (sequentially):

- 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 (Living Oceans Society, Ardron 2008);
- Separate analyses by Parks Canada for Haida Gwaii and the Southern Gulf Islands (unpublished in the peer-reviewed literature);
- 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 2011); and
- Analyses as part of the Marine Planning Partnership for the North Pacific Coast (MaPP Marine Plans, all sub-regions: MaPP 2015a-d).

However, while valuable contributions have been made to the current understanding of conservation options in the NSB, due to a lack of spatial data, none of the above analyses considered the full range of social, cultural, and economic costs and benefits. This is in part because of gaps in the available data, which will need to be addressed within the NSB MPA process (see section 3).

3. Considerations when biodiversity features targeted for protection interact with human use

3.1. Introduction to Section 3

In the scope of work for this literature review, MPAT requested that PacMARA review MPA-related literature on methods that have been used to find a good balance between social-economic-cultural costs and the achievement of conservation objectives in situations where biodiversity features targeted for protection interact with human use. In this case, we interpret 'maximising the positive' to refer to the optimisation of positive environmental outcomes as well as the safeguarding (or, where possible, enhancement of) social-economic-cultural values. 'Minimising the negative' would encompass minimising social-economic-cultural costs of MPA designation and implementation, as well as preventing unacceptable levels of compromise on environmental outcomes.

This section reviews a range of technical approaches and tools that have been suggested for or applied within the context of MPA planning in situations where there is a potential conflict between human uses and environmental protection measures. Issues around data availability and quality are also touched upon, as many of the reviewed papers refer to challenges associated with a lack of socio-economic spatial data.

This section begins with systematic conservation planning, then looks at tools and approaches in both systematic conservation planning and social sciences. It then briefly considers issues surrounding data quality and availability.

Because of the relevance of process design to decisions on the most suitable technical analysis approaches referred to in the introduction, the latter part of this section contains a subsection entitled 'process design considerations', which reviews some of the key process design and management issues, including the level of stakeholder engagement that technical analysts should bear in mind before embarking on their tasks. Following on from this, there is a final sub-section reviewing relevant issues around the social, economic and ecological context, which will have implications for the most appropriate analytical tools to use, and for the most relevant focus of socio-economic analyses in MPA planning.

3.2. Systematic Conservation Planning

3.2.1. The need for integrated data analysis

Coastal communities around the world are going through a period of tremendous 21st century change with new economic, social, political and ecological drivers present from the local to the global scale, in a new human driven geological epoch coined the *Anthropocene*. This, along with a shifting array of human values and perspectives has led to increasing polarization and position-based arguments about how to balance resource conservation and use, ensuring both ecological and human wellbeing. This results in increased challenges with ensuring social license (social acceptability), for ongoing and new resource development, and for conservation and protection initiatives, including MPAs (Bennett et al. 2015, Voyer et al. 2015b, Young & Matthews 2010). There can also be a difference between general public support for overall conservation aims that reflect broad ideas about the state of the marine environment; and the on-the ground detailed realities of MPAs which may have a more direct conflict with local economic, social and cultural values (Klain et al. 2015).

Once collected and compiled, data will need to be used in an integrated way. Although trade-offs can be explored through a collaborative decision-making process rather than through data analyses (as described below), it is likely that any process will benefit from relevant data analyses that integrate ecological, social and economic factors at least to some extent. As discussed below, a number of tools and approaches exist for carrying out integrated analyses; however, in the context of MPA planning, technical analyses have to date tended to focus on a single or a limited number of factors. In two case studies in Australia looking at what influenced stakeholder attitudes towards MPAs, the authors concluded that: "*A critical barrier to achieving a triple bottom line (ecological, social and economic) approach to MPA management lies in the tendency for assessments to be conducted for each component separately, with difficulties in integrating the final results. The importance of considering social, economic and ecological systems in an integrated way is underscored by the interdependence of these systems on each other. Social conditions are responsive to ecological and economic systems and ecological health is influenced by socio-economic conditions. These disciplines do not operate in isolation so it is of limited use to consider them separately*" (Voyer et al. 2015a, p. 265).

"*As MPA planning has become more sophisticated, managers have begun to realize that systematic approaches to MPA site selection and design are crucial to deriving maximum benefits*" (Villa et al. 2002, p. 516). Systematic MPA and MPA network planning often now involves the use of software tools, including ones like Marxan or InVEST that can look at trade-offs between conservation and use objectives. The use of such tools can produce more rigorous, defensible answers to social science questions, better integrate social and natural science data, and find good solutions for complex problems, while minimizing conflict by involving participants in building knowledge and scenarios. These tools, in addition to other tools and approaches, are discussed in turn in the subsections below.

3.2.2. Systematic conservation planning

Systematic approaches to network planning involve clearly articulated goals, objectives, and targets applied at a regional scale. With respect to the development of protected area networks, systematic conservation planning principles include ecological representativity, connectivity, replication and efficiency (achieving conservation targets at minimum cost, e.g. minimising the combined spatial footprint of a reserve configuration that represents a given proportion of a set of habitats). Thus, the main emphasis is on the achievement of environmental benefits, with environmental targets and objectives guiding the planning process, whilst minimising costs. Systematic planning is generally seen as a process with several stages, from data compilation, goal setting, reviewing existing protected areas to the addition of new protected areas under consideration of the social, economic and political context. Many of these stages may be iterative rather than linear, and stakeholder engagement is seen as a vital element throughout (e.g. Margules and Pressey 2000, Pressey and Bottrill 2008). Typically, a systematic approach will result in zoned, multiple-use marine protected area networks that integrate and build on pre-existing protected areas, ideally as part of a broader, regional, integrated approach to marine conservation.

Box 1: Systematic conservation planning. (Text modified from Coleman & Ardron 2015.)

Introduced to the scientific community over 15 years ago in a highly cited paper that appeared in Nature (Margules & Pressey 2000), there is still no agreed-upon definition for *systematic conservation planning*. Nevertheless, there is broad agreement on its constituent elements:

- a clear set of objectives;
- incorporation of the best available information;
- inclusion of stakeholders;

- transparent analysis and reporting; and
- iterative decision-making.

The full promise of systematic conservation planning has remained somewhat elusive because of emerging complexities such as proper accounting of the costs associated with proposed solutions and appropriate use of available decision support tools (McDonald 2009, Ardron et al. 2010).

Systematic planning relies on generic principles (noted above) being translated into more defined MPA network design guidelines that are specific to the planning region and process context (e.g. see OSPAR 2006, JNCC and Natural England 2010). There are a number of approaches that can be used to develop such guidelines, one of which is to develop a series of guidelines of increasing specificity and complexity, beginning with simple guidelines that can be applied in data-poor situations (OSPAR 2008, Ardron 2009). A detailed review of approaches is beyond the scope of this report, but a reminder is included here to develop a clear set of MPA design guidelines at the beginning of the NSB planning process, a task that we understand MPAT is already doing.

Such design guidelines should be underpinned by ecological principles of systematic planning, and specify different levels of protection (including no-take areas), as well as setting a minimum ecological standard for what counts as an MPA. The guidelines could also incorporate guidance for the creation of zones set aside for specific human uses or the safeguarding of cultural value, in order to meet socio-economic and cultural objectives at the same time as meeting ecological benchmarks. Whether or not this is appropriate will depend on the quality, quantity and coverage of relevant spatial datasets, and on the technical approaches used, which will in turn need to fit with the design of the planning process and the stakeholder engagement strategy.

The Canada-BC strategy states that, "*a systematic approach to network planning will enhance the capacity of existing and future MPAs to achieve multiple goals and objectives that no one single MPA could achieve*" (Canada-BC MPA Network Strategy, 2014, p. 2). The strategy also makes it clear that MPA networks in BC will have to meet multiple objectives. Additionally, there are already a suite of other potential sites in the NSB that should be considered as part of MPAT's network planning. These include the Province of BC's Marine Reserves, Fisheries and Oceans Canada's Rockfish Conservation Areas, Parks Canada's candidate National Marine Conservation Areas, Canadian Wildlife Service's National Wildlife Areas, and other conservation-based marine protection areas and measures. Systematic MPA networks zoned for multiple uses and pre-existing candidates from other processes that already have some support can better aim to meet collective policy outcomes that reflect a broader range of perspectives and ideas about both conservation and use (Agardy et al. 2003, Jessen et al. 2011, Lunn & Dearden 2006, McClannahan et al. 2006).

BC's Marine Area Planning Process (MaPP) used a multiple zoning approach to integrated marine planning resulting in: a) General Management Zones (GMZ), b) Special Management Zones (SM), and, c) Protection Management Zones (PMZ). The MaPP process used a regional and subregional framework to marine conservation and use planning in which nested goals, strategies and actions were generated for both conservation and sustainable use. While recognizing the MPA-specific mandate of the MPAT, the implementation of the Canada-BC MPA Strategy for the NSB with its collaborative Federal-Provincial and First Nations governance model offers a good opportunity to design MPA networks involving agencies and organizations with other complementary roles and mandates in a systematic way, including areas already agreed upon through the MaPP process, and looking at multiple use zones as a key strategy. In the NSB, this approach would also help align MaPP and MPA zoning.

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.

3.3. Tools for use in systematic conservation planning

3.3.1. Marxan and Marxan with Zones

The systematic planning approach incorporates the concept of efficiency, i.e. to develop MPA networks that meet ecological benchmarks at minimum social and economic cost. One way to do this is to develop network configurations that avoid high-cost areas where it is possible to meet ecological benchmarks in lower cost areas, thus ensuring biodiversity conservation benefits whilst minimising economic and other impacts. This approach requires the creation of a map of relative costs of different areas of a planning region. If multiple costs (e.g. to different economic sectors and user groups, or cultural and economic costs) are to be considered, a single cost map needs to be generated that integrates information across all factors considered relevant in the analysis (social, cultural, economic). Developing such an integrated 'cost layer' is fraught with challenges, which are outlined below.

Another approach is a zoning approach, which allows the integration of social and economic objectives (as well as costs) into a planning process. Instead of creating MPA network design guidelines focusing purely or primarily on the definition of ecological benchmarks, the design guidelines could include a series of MPA types with different types and levels of restriction on human activities, or areas beyond the MPA network designated as human use zones earmarked for different human uses, thereby safeguarding economic values of areas. In theory, the full range of human activities and socio-cultural-economic costs and values could be integrated with ecological targets in a fully integrated comprehensive approach. Fully integrated marine spatial planning (MSP) has spawned a literature of its own,[3] but is still rather unusual in practice, though there are many examples worldwide of some form of (less-integrated) MSP occurring.[4]

What is Marxan? (Some of the text is modified from Coleman & Ardron 2015.)

With more than nine thousand downloads from users in at least 140 countries over the past four years alone (M. Watts, personal communication, June 2014), Marxan (Ball & Possingham 2000, Possingham et al. 2000) has become the most popular tool of its kind. It was developed to address the "minimum-set problem" of protecting at least a set amount of conservation features for the minimum cost (McDonnell et al. 2002).

Marxan is best used in situations where spatial data have associated with them targets to be met, while count-balancing various costs of doing so. It is generally not suited for identifying areas with limited criteria (e.g. areas of high biodiversity or productivity), and hence has never been used in the selection of ecologically or biologically significant areas (EBSAs), where expert opinion and data overlays have been used instead. However, it is often used in situations where capturing representativity across a broad range of species and habitats is a goal.

[3] For example, see the special issue of Marine Policy on the topic, available here: http://www.unesco-ioc-marinesp.be/publications/marine_policy_special_issue

[4] MSP initiatives worldwide have been listed here: http://www.unesco-ioc-marinesp.be/msp_around_the_world?PHPSESSID=p85k1goqd23kcum6b2aahbhb41

Over the past 15 years, experience in implementing Marxan results has shown that part of its success comes from the ability to help practitioners adhere to the stages of systematic conservation planning (Box 1), which promotes a comprehensive, flexible, complementary, repeatable, and efficient process (Possingham et al. 2000). For example, using Marxan to plan a network of protected areas requires users to set explicit targets for species and habitat inclusion, a potentially politically charged consideration that too easily can be deferred or neglected in planning situations without tools that require this difficult, yet essential, discussion to occur (Lieberknecht et al. 2013).

On an analytical level, either approach is a complex task. As discussed in Ardron et al. (2015), conservation planning tools have been developed to support the development of efficient MPA networks and ocean zones. In the context of MPA planning, perhaps the most frequently referenced tools are Marxan and Marxan with Zones (MwZ) (Ball and Possingham 2000, Possingham et al. 2000, Watt et al. 2009, Ardron et al. 2010), which are spatial optimisation tools that can be used to bridge the gap between social and ecological elements in protected area network planning (Box 1). Marxan is a tool designed to optimise a protected area configurations based on ecological targets (targets for the amount and type of conservation feature to include in the network), which the tool aims to achieve based on minimising cost based on a single cost factor, represented in a spatial 'cost layer' that maps the cost of each planning unit. Marxan outputs are sensitive to cost weightings, so a sensitivity analysis of this process is recommended if Marxan is used within a planning process (Ardron et al. 2010).

Klein et al. (2008) found that Marxan yielded an MPA network configurations with fewer negative economic impacts that a network designed though collaborative stakeholder planning in California (with the caveat that the analysis was based on specific datasets, and could not consider all factors that stakeholders may have considered in their discussions). Fraschetti et al. (2009) describe a Marxan analysis aiming to meeting ecological objectives whilst avoiding areas of human use was carried out in the Mediterranean, although this was focused on minimising threats to biodiversity through lack of compliance with regulations than on minimising negative economic impacts.

Marxan with Zones (Watt et al. 2009) allows the development of a network consisting of different MPA types or zones, which could be MPAs with different levels of protection as well as human use zones. Separate costs and targets can be set for each zone, which precludes the necessity of creating a single integrated cost surface for the analysis. Ensuring an equitable distribution of costs across different user groups can be achieved if a zoning approach is used. Frau-Ruiz et al. (2015) describe a study using Marxan with Zones where, by incorporating cost layers reflecting the distribution of both extractive and non-extractive activities in the analysis, it was possible to design a network with a more equitable cost distribution compared to a conventional Marxan analysis considering only a single cost layer. The latter scenario, which did not consider non-extractive interests, generated network configurations that caused the loss of important areas of economic activity for the recreational industry, areas where almost 50% of their expenditure occurred. Conversely, the incorporation of both extractive and non-extractive interests in the reserve design process had positive outcomes for the two sectors under consideration, as both sectors were able to retain access to areas that generated almost 90% of their economic value.

Using Marxan with Zones also allows for a fine-tuning of the cost-zone type interaction that becomes difficult if all cost types are integrated into a single spatial layer (Watt et al. 2009). Different zone types (e.g. MPAs with different protection levels, or MPAs and human use zones) will impact differently on different activities – some cost types may therefore not be relevant for some zones. A no-take zone will preclude all extractive activity and will therefore have negative impacts on recreational fishermen. A map of the distribution of recreational fishing activity should therefore be considered a cost factor, if negative impacts on recreational fishermen are to be minimised. However, the same planning process

might include multi-use MPAs that allow recreational fishing but restrict commercial fishing. For these zones, the same map of recreational fishing activity should not be counted as a cost factor. Indeed, it may be appropriate to set a target for the inclusion of a proportion of particularly high-value recreational fishing areas to be represented within these zones, where recreational fishermen may benefit from having their high-value areas protected from commercial fishing pressure. Hence, the management measures under consideration affect not only the results, but also how the data will be used in the analysis.

Tools other than Marxan /MwZ exist that can help underpin analyses supporting systematic conservation planning. In work done for the West Coast Aquatic Management Board (outside of the NSB planning area), InVEST, a software tool to assess marine ecosystem services, was used to estimate changes in a suite of ecosystem services under different management scenarios and to investigate trade-offs among the scenarios (Guerry et al. 2012). However, the data and technical needs for a tool such as InVEST, doing a bespoke analysis on a particular region, can be very large.

Whether or not it is appropriate to use a planning tool such as Marxan / MwZ in a systematic planning process depends to a large extent on the type, quality and quantity of spatial data that are available. Each target and cost factor will need a spatial dataset to draw from, so if there is only a limited number of relevant spatial datasets available, it may not be worth investing the time it takes to carry out a Marxan analysis. Spatial data coverage is another important consideration. Uneven data distribution within a planning region will inevitably bias the outputs of the tools very heavily towards data-rich areas. While there are techniques for minimizing such a bias (e.g. dividing a study area up into sub-areas based on data collection intensity, and applying targets to each sub-area), none are perfect, and will require discussion with experts and stakeholders. Finally, the design of the stakeholder engagement strategy needs to be considered. Within the context of a collaborative process, tools such as Marxan can be perceived as 'black boxes' by stakeholders, and network design may be more constructively carried out by simpler methods that allow stakeholders more direct control. In this situation, where stakeholders are more active and put forward areas, a data analyst's time might be better spent on reviewing network configurations developed by stakeholders and providing feedback on how well these meet ecological targets or overlap with areas of importance to human users.

Within the context of a collaborative stakeholder process, Marxan outputs may serve as a useful starting point for stakeholder negotiations, as well as getting around impasses (e.g. Lieberknecht et al. 2013). Even within the context of a top-down process, Marxan will never be able to develop an optimal solution to be implemented without review and modification by decision-makers and their advisers, because there will always be gaps in spatial datasets and non-spatial factors that an algorithm cannot easily incorporate.

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.

Specifically, consideration should be given to what question is being asked, the datasets they would draw from, and the expected role that the analysis outputs would serve within decision making (including who will use them). Also, there is the question of capacity, and how an analyst's time, and the NSB's budget, is best spent. The Marxan Good Practices Handbook (Ardron et al. 2010) provides some excellent guidance that should be reviewed before decisions on the use of these tools are taken.

3.3.2. Tools for systematic planning in a collaborative stakeholder process

There are web-GIS based planning tools that have been developed specifically with a collaborative stakeholder process in mind. The south and north coast regions in the Californian process used MarineMap, an online MPA planning tool developed at the University of Santa Barbara. This tool could be used to draw potential MPA designs and provide analytical feedback on the extent to which the proposals met the guidelines for habitat representation. The tool has subsequently been developed into Seasketch,[5] is a more adaptable tool that can be used anywhere in the world to help stakeholders interact with MPA or marine spatial planning processes. Seasketch was also used in the Marine Area Planning Process (MaPP) in BC. If used, such tools need to be integrated into the process, so that users have clear understanding and expectations of how options are input and subsequently used in decision-making.

Open Ocean Map is another web-based GIS tool, which was developed by Ecotrust to aid the mapping of stakeholder knowledge on the distribution of human use and values of marine areas, usually in concert with on-the-ground practitioners working directly with fishermen (Scholz et al. 2011).

To summarize, selecting the right tool will be the result of three general considerations:

1. The question you are seeking to answer / address;
2. The quality and type of socio-economic data available; and,
3. The kind of process envisaged, particularly with regard to the type of stakeholder engagement.

With regard to the NSB and the first point, if the question is maximizing the positive whilst minimizing the negative, then Marxan / MwZ should be given serious consideration, as well as Zonation.[6] With regard to the second point, mapping tools like Seasketch can be invaluable in filling in gaps, provided that a fairly high level stakeholder engagement (the third point) is anticipated. If not, then only technical options, such as surrogates (mentioned above), cost surfaces, and other modelling can be considered. Beyond the discussion of MPA best practices, broader ecological and economic modelling are both massive literatures that may in some instances have relevance to aspects of MPA design,[7] but suffice to say that most approaches require highly specialized skills. While it is commonly pointed out that models are only as good as the data that feed them, models do vary considerably in their sensitivity to inaccuracies and uncertainties. Also, much will depend on the modeller herself and her level of experience and expertise. Unlike Marxan, ecological modelling (e.g. connectivity, species-habitat suitability, etc.) and economic modelling (e.g. commodity cycle forecasting, social choice theory, etc.) is not generally taught in two- or three-day courses; hence MPAT would probably need to contract a specialist. The strength of good modelling should be clear. However, if only a few people understand it, then there is a risk that senior decision-makers and stakeholders may not feel comfortable with the recommendations arising from the results. Again, this will be very context-specific, and in part is a reflection of trust –in the modeller, certainly, but more importantly, in the agency that contracted the work, and in the planning process itself.

[5] http://www.seasketch.org/

[6] http://www.helsinki.fi/bioscience/consplan/software/Zonation/References.html

[7] The literature review for this report focussed on the MPA literature. If desired, PacMARA would be pleased to do literature reviews for either (or both) of these wider disciplines and summarise the possible applications to MPA planning.

3.4. Integrated assessment of costs, values and benefits

3.4.1. Integrated cost mapping

Costs and benefits of MPAs are not distributed evenly in time and space, and do not affect everyone evenly. The positive impacts of a MPA tend to be spread out over a wide group of persons and can also be realized over a long time period, while the negative impacts are more likely to be held by a small group of people and affecting them immediately at the introduction of the area (Hilborn et al. 2004, Charles & Wilson 2009, Hattam et al. 2014, Schuitema & Jakobsson Bergstad 2012). Because of incompatible objectives between individuals and society at large, a central concern during the implementation of an environmental policy is often how to attend to this "*social dilemma"* (Schuitema & Jakobsson Bergstad, 2012, p.7). An approach to MPA planning that is systematic and network based can help mitigate the inevitable distributional impacts to communities that may be caused by discrete MPAs and single use MPA networks, because positive and negative impacts can be seen and considered across a broader geographic area, and at different scales.

Integrated cost assessments are fraught with difficulty, especially if the aim is to develop a single integrated map (or 'cost surface', in the context of a Marxan analysis) of socio-economic value for a planning region (the same is true for generating maps of ecological value). The Marxan Good Practices Handbook (Ardron et al. 2010) contains some useful and relevant guidance. If available socio-economic spatial datasets are all measured in the same units (e.g. dollar value) and are all given the same level of priority within the planning process, they can be added for each planning unit. Often, however, costs will need to be given different levels of priority, depending on the objectives of the process and the socio-economic priorities for the planning region. In that case, it will be necessary to assign weights to each cost before adding them, a process likely to require extensive stakeholder engagement. As outlined in our earlier report to MPATT (Ardron et al. 2015), the central conundrum is a) how costs are selected (e.g. national income generated vs. local income, vs. jobs?) and b) reconciling them, particularly with non-monetary values. There is no best practice in the literature that we could find, other than the use of multi-criteria decision software, such as Marxan discussed above. Another common, but not recommend approach, is the use of additive scoring, as discussed below.

Any multi-criteria analysis is complex, and reducing these complexities to a single measure carries much risk. Scoring is at first glance an attractive option; however, on closer examination, it brings with it several issues. If costs are not in the same units, they must first be standardised before weights can be appropriately applied. Implications of combining multiple costs should be carefully considered before aggregating them. Employing a scoring system (e.g. 1 - 5 for all costs) to combine costs is a quick, but not always very effective approach. Additive scoring systems have several limitations and can produce very misleading results. Klein et al. (2014) and Game et al. (2013) set out some of these limitations in the context of scoring the conservation value of different areas, and how different approaches can produce different results – a finding that is equally applicable to integrating costs or values. One key issue they raise (also highlighted by Wolman 2006) is that numerical scores are essentially arbitrary interpretations of complex multi-dimensional concepts – they may even be based on linguistic categories (e.g. high=3, medium=2, low=1).

Both Klein et al. (2014) and Game et al. (2013) point out that when scores are based on arbitrary scales to generate ordinal numbers for different variables, it is mathematically incorrect to add scores together across variables as if they were regular numbers. As Game et al. (2013) put it: "*What these constructed scales typically represent is a set of ordinal numbers that indicate, for example, a score of 2 is better than a score of 1 and worse than a score of 3. If one restricts interpretation of such scales to simple ordinal*

representations between alternatives (e.g., alternative X is better than alternative Y for variable Z), then the arbitrary nature of the numbers is not problematic. However, ordinal numbers do not convey how much better 2 is than 1; thus, constructed ordinal scales are a problem when one treats them as a set of regular numbers to be used in prioritization arithmetic (e.g., adding 2 or more variables together)."

Additionally, once scores have been added together, it is impossible to tell whether, say, a score of 5 on a scale from 1-5 indicates an area that is of especially high value (5) to one particular sector or human use, and of zero value to all other sectors, or whether it is of relatively low value to multiple sectors (i.e. 1x5 or 5x1). Two areas that each have the same cumulative value score may in fact be completely different in terms of their actual economic or social importance. Furthermore, it is questionable whether adding together values for very different types of activity and value makes sense. Can economic value of a fishing ground derived from landings values be sensibly combined with areas valued for their scenic beauty by a completely different stakeholder constituency? Even a single map of economic value of fishing grounds may hide complexity - a lower value area may be the only accessible fishing ground for a particular community, for example, or close to the safety and security of a good anchorage.

When values are statistically independent ('orthogonal'), addition is mathematically incorrect, as highlighted above. Instead, the square root of the sum of squares is the correct approach (such as with a right - angled triangle). This avoids the problem where five 1's add up to a 5. The total of five 1's for the square - root of summed squares would instead be 2.2 (i.e., medium - low). However, this does not change the questionable meaningfulness of adding together very different types of value in the first instance.

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 considered separately in each type of zone.

One finding of this review is that the literature on technical methods for integrating multiple costs and objectives and trading off conservation goals with human use costs in MPA planning is strongly slanted towards theoretical studies. Methods and frameworks tend to have been designed and tested in desk studies that demonstrate how they *ought* to be applied, rather than how they have been applied within real-world MPA planning processes. There appears to be a dearth of published literature on practical case studies and examples of planning processes where a full integration of social, cultural, economic and environmental factors has been achieved in technical analyses at the MPA site selection stage.

Furthermore, where specific technical approaches have been suggested and tested, the data used, factors considered, and resulting methods are often specific to a given situation, which limits their applicability in other contexts. For example, in a desktop study in New England, there existed a previous spatial plan indicating preferred areas for wind farms, good data on lobster and flounder fisheries (which may conflict spatially with the wind farms), and high resolution seafloor sediment mapping, which fed species-habitat models (White et al. 2012). The same economic analysis may not be relevant and/or feasible in another location with a different policy history, different competing uses, and different data availability. In this example, species-habitat models require good coverage of spatial environmental data at a high enough resolution, as well as a good understanding of species-habitat linkages within the region. They can take a long time to develop and ground-truth in order to ensure they are meaningful, and require specialised skills and expertise to be available. To do this economic trade-off analysis, good location-specific fisheries data were also required. Unfortunately, in many places (including Canada) point-specific fisheries data are treated as confidential, and only coarse

resolution data are available for external analyses and public display –too coarse for the sort of analysis used in the above example. Thus, studies commonly found in the literature may suggest intriguing possibilities, but the applicability of these are predicated on comparing specific historical policy circumstances (e.g. a zoning plan for a new activity which potentially conflicts with an existing one), the availability of specific kinds of data (e.g. at a minimum spatial resolution), and specific ecological attributes (e.g. demersal species which are correlated with certain habitats). The number of such examples in the literature is rather large and growing (Appendix 3). Choosing the appropriate ones for the NSB will first require identifying the key spatial conflicts, and secondly, the available data which can be used to analyse solutions in a public planning forum.

Finally, if good models are available, it may still not be appropriate to use them. In some legal and institutional contexts, modelled data (even of high quality) may not be deemed to be a sufficient level of evidence to underpin planning decisions (e.g. see Lieberknecht et al. 2013). Therefore, in other contexts a different analysis with a very different set of variables may be needed. In any case, for politicians and the general public, the term "model" often suggests something that is make-believe, an image which is persuasive in neither cabinet discussions nor in hard-nosed trade-off negotiations.

3.4.2. Relative vs. Absolute Values

One question that was raised in the scope of work was to explore whether relative values or absolute values should be used when assessing costs of MPAs, setting targets in network design, and assessing benefits. Here, the term 'relative values' has been interpreted as allowing flexibility in the setting of conservation targets (e.g. exploring, discussing and evaluating high, medium and low target levels leading to protection of varying amounts of different conservation features), and as the assessment of costs and benefits of planning options in relative terms (e.g. higher cost / benefit vs lower cost/benefit), allowing flexibility in the planning discussions and the exploration of relative weightings of costs, targets and values as a combination of stakeholder inputs and policy constraints. The term 'absolute values' has been interpreted to mean more rigid conservation targets (e.g. national percentage targets for protected area coverage, or fixed percentage representation across different habitat types[8]), and cost / benefit analyses based on absolute values, requiring the conversion of everything into a single currency (e.g. dollars).

As noted in Ardron et al. (2015), relative values allow one to more readily blend values together, even if "high" and "low" are very different commodities across these values (although we would advise against the simple addition of relative numerical scores across multiple independent variables – see section 3.4.1). Social, ecological, and economic values are not solely seen in terms of money, so market and non-market values are both integral to a thorough analysis. This does not imply that different values will be treated in the same way, but they should be discussed at the same table.

Increased attention has recently been given to developing measurement techniques that are fungible across different values (e.g. financial values; Driml 1994) and to find ways to derive monetary returns from non-market ecosystem services (e.g. payment for ecosystem services; Redford & Adams 2009). As yet there is no commonly accepted approach, nor payment mechanism to address this change (ibid). Although there are many different and creative ways in which to attach monetary value to ecosystem services (Daily & Matson 2008), sometimes it may be best to treat certain values separately. One key

[8] Percentages can be seen as either relative or absolute depending on the context. They are relative, in that 10% of a small area is less than 10% of a large area, and in that sense are more relative than specifying a specific acreage to be protected. However, ultimately percentages are absolute in that 10% of a study area, or a nation's waters is a fixed amount, regardless of whether it is expressed as acreage or a percentage.

pitfall of monetizing ecosystems is that once a value is produced, it can become a benchmark even if we stress that our valuations are almost always incomplete (Toman 1998, p. 48-49).

A challenge when thinking about using either absolute or relative values is that available quantitative data may not adequately capture the stakeholders' personal values, which tend to be qualitative. For example, some human uses within the NSB have been mapped in the British Columbia Marine Conservation Atlas (BCMCA 2011) and were analyzed using Marxan to identify areas of potentially "higher value" for various sectors. However, of the six sectors considered in that analysis (recreational fisheries, ocean energy, shipping and transportation, tourism and recreation, tenures and commercial fishing, only two, commercial fisheries and shipping and transportation, agreed to allow the results to be made public, as concerns were raised by the other sectors about the results' validity and reliability (Ban et al. 2013). In this example, displaying relative results (e.g. generalized heat maps of higher and lower values) may have allayed the stakeholder concerns concerning the absolute nature of the in-or-out Marxan results.

Using absolute across-the-board conservation targets can create challenges in terms of stakeholder engagement as, "*rigid ideas around the best means of achieving biodiversity protection combined with a 'one size fits all' approach to planning and community engagement are likely to exacerbate conflict and division and stimulate opposition*" (Voyer et al. 2015a). Caveen et al. (2014) discuss MPAs in the North Sea and identify how fixed percentage targets led to extremely polarized positions - MPA advocates used 'precautionary principle arguments', whilst fishermen demanded proof that their activities were actually causing damage. This led to a situation of 'bargain and compromise', and no real dialogue happened (Caveen et al. 2014, p 360). Such conflict and division can be due to "*equity concerns about access to resources and spaces*" (De Santo et al. 2011, p. 258). Again, had a relative approach first been tried (i.e. identifying areas of more or less economic and environmental interest), some of the conflict could probably have been avoided.

Notwithstanding the above shortcomings, one clear advantage of absolute values is that they provide a concrete answer, readily grasped by the public and politicians alike. Protecting X or Y percent of a region, or investing Z dollars into a regional development program, is far more palpable and usually defensible, than using relative terms which can be seen as vague, uncertain, and changeable over time. Absolute values were key to the success of the Great Barrier Reef rezoning plan in a contentious environment where it was made clear that biodiversity conservation rather than fishing was the priority objective. Deciding on using relative or absolute targets in the NSB should be a choice that best reflects the local situation and will result in the best overall outcome for biodiversity protection.

Technical guidance from Ardron et al. (2015) may be helpful in the context of the NSB. We recommended that for each feature – species or habitat – it is good practice to explore a range of targets and see how they affect overall MPA network configuration. Numerical targets can be very contentious, and expert agreement can be hard to attain. A less difficult approach is to first set relative targets using relative wordings (e.g., low through medium to high). A typical representative feature should by default get the medium target label. Highly endangered or unique features should get the high (or very high) label, and widespread very common features should get the low (or very low) label. After all the features in a region have been assigned relative word targets, a range of numerical values can be assigned to each of them. This second step will also require some discussion and exploration, but is more likely to reach expert agreement than trying to get to numerical targets in one step. Choosing an exact value for any particular feature can be difficult, and one approach to finalizing numbers is to look at the overall size (footprint) of the network. If a software support tool is used, then different target ranges can be run using various values for what is the anchoring "medium" value, until the

desired overall footprint of the MPA network is found. Individual targets should be re-checked to ensure that they are (mostly) protected within the range set by experts, local knowledge, etc. If not, then the "medium" value will have to be incrementally raised, and the analysis re-run, until a good overall balance between individual feature protection and the overall network is found (p. 24).

In our view, both relative and absolute values have their roles in trade-off analyses, with absolute values providing certainty, but at the risk of pre-determined positions not based on science nor flexible to new information or circumstances. Relative values (e.g. high-medium-low) are indeed much more flexible, and allow for exploring ranges of options, but may be viewed with suspicion by some as being non-committal, with little clarity what they might ultimately mean in terms of community and personal impact. It is worth bearing in mind that percentages are often misnamed as targets when in fact they are minimum thresholds. In the last round of planning for Great Barrier Reef, 30% was set as the *minimum* coverage of highly protected areas. In the end, about 33% of the reef was actually highly protected (after other considerations such as representativity, etc. were given consideration). Likewise, Ardron et al. (2015) recommended 20% as the minimum footprint for highly protected areas in the NSB. In hindsight, this one recommendation produced more controversy and discussion than all the others combined, which were generally relative in nature. **We would suggest beginning planning process generally with relative values, but gradually migrating to absolute numbers as the process progresses towards decisions around MPA designations**. Such discussions will inevitably involve a mix of science, analysis, opinion, and politics.

3.4.3. Uncertainty about costs and benefits over time

There often is uncertainty about short term costs and long term benefits. The desired outcomes of an MPA network, while indeed positive, should not be over-stated, as this creates expectations that may not be met, particularly in the short-term. (Recovery of some rockfish species (*Sebastes*), for example, which breed roughly on the same time scale as humans, if left untouched may likewise take human generations to recover.) However, it is possible to talk in more general terms about what the network is designed to achieve. While it is possible to point to examples where benefits occurred in short time frames, e.g., GBR recovery of coral trout after 1.5 to 2 years (Ban et al. 2015), it is generally true that MPA costs are in the short term, whereas benefits are in the long term. "*This is an important point to stress to politicians who may be thinking of the short term pain associated with MPA designation, in terms of their constituent's immediate economic concerns*" (Banks & Skilleter 2010, p. 204). A study of the relationship between dive tourism, small scale fisheries and MPAs in the Philippines suggests that it is important for managers to present realistic scenarios of what benefits and over what timeframe these benefits will occur for sector groups so people know what to expect over what time frame (Fabinyi 2008).

3.5. Social Science tools and frameworks

Beyond Marxan and InVEST, there are also a variety of other frameworks and research tools available to explore, with stakeholders, the complexity of social-cultural and economic issues under consideration and produce scenarios for discussion. These include ones that can "evaluate: a) the characteristics and behaviours of constituencies, b) what constituencies want, and c) what constituencies know" (Christie et al. 2003, p. 25). These should be seen as ways to support both process and outcomes, as: "we submit that final decision makers too can best serve their own self-interest (e.g. in preserving their power to decide) as well as the collective interest they have been mandated to enhance by considering ways to promote the broadest feasible cooperation among stakeholders as well as by their own participation in

this cooperation" (Davos et al. 2007; p. 224). In the NSB planning processes for MPAs and MPA networks, ecosystem protection is the number one goal, but MPAs will also need to reflect the reality of human values and behaviour. These four frameworks below are some potential ones that could be used in MPA consultation and planning in the NSB. Each framework brings with it certain strengths, as outlined below.

3.5.1. Cultural Ecosystem Services Assessments

Cultural ecosystem services are "*ecosystem contributions to the non-material benefits that arise from human-ecosystem relationships*" (Chan et al. 2012, p. 9). In the marine environment these can include, for example: aesthetic values, place attachment, spiritual values, identity, and social capital. Plieninger et al. (2013) used participatory mapping and interviews to better understand spatial characteristics of cultural ecosystem services at the landscape and community level in terrestrial park planning in Germany. Their results included new understandings about the relationship between biodiversity objectives and human wellbeing objectives. For example, they uncovered a bundled relationship between various cultural ecosystem services that allowed them to consider how to more effectively develop social-cultural planning objectives. Similarly, Chan et al. (2012) suggested that better understanding cultural ecosystem services can "*contribute a clearer understanding of the many ways in which outcomes that matter to people are associated with ecological structures and functions*" (p. 16). In the NSB a cultural ecosystem service assessment could be carried out to better understand the non-material benefits provided to local communities by the marine environment.

3.5.2. Social Impact Assessment

Vanclay (2012), and Voyer et al. (2012) outline a framework known as *Social Impact Assessment* (SIA) with reference to integrated coastal zone planning for the Wadden Sea. Social impact assessment is typically defined as including "*the processes of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions, and of any social change processes invoked by those interventions. Its primary purpose is to bring about a more sustainable and equitable biophysical and human environment*" (Vanclay 2012, p. 150). It involves a number of tasks, including, for example, "*identifying the needs and aspirations of various communities, forecasting the social changes that may result from policy, program, plan or project and the impacts these are likely to have on different groups of people, and developing a monitoring plan to track implementation, variations from mitigation actions, and unanticipated social changes, especially negative impacts*." (Vanclay 2012, p. 150). Carrying out a social impact assessment in the NSB could be a comprehensive way to understand and communicate costs and benefits of the MPA network in the region.

3.5.3. MPA Socio-Economic Assessment (IMPASEA) frameworks

A new framework known as the *Integrated MPA Socio-Economic Assessment* (IMPASEA) framework has been developed and tested on six MPAs in France. It is a "*monitoring and assessment framework that could be applied in different contexts and to different types of sustainability assessments involving protected areas or other spatially-defined entities under certain conditions…*" (Rodriguez-Rodriguez et al. 2015, p. 44). This framework was developed to "*appraise what the social and economic consequences for communities might be in order to maximize the positive ones, or offset the negative impacts, if possible, ahead of designation*" (Rodriguez-Rodriguez et al. 2015, p. 45). The framework assesses both social and economic variables uncovered through a literature review, and then uses both qualitative and quantitative methods (interviews and surveys) to ask stakeholders about their important socioeconomic variables. A geo-statistical analysis follows. Using the IMPASEA framework could uncover previously unknown information about socio-economic factors in the NSB.

3.5.4. Multi-Criteria Decision-Analysis Frameworks

Multi-criteria decision making is a systematic approach to decision-making that could include use in MPA planning (Villa et al. 2002). "*MCA is a structured decision-support process that can facilitate dialogue between groups with differing interests and incorporate human and environmental dimensions of conflict*" (Davies et al. 2013, p. 936). One specific MPA planning framework called: "*Assessment of Group Options with Reasonable Accord" (AGORA)* has "*methodological foundations derived from the field of multicriteria evaluation and decision making*", and was used in MPA planning in the Galapagos Islands (p. 225). The authors found the use of multicriteria frameworks to be a "*user-friendly yet rigorous tool for articulating priorities and developing planning options*" (Villa et al. 2002, p. 11).

3.5.5. Addressing cumulative impacts

MPAs can be implicated in cumulative impacts (positive or negative impacts that have a compounding effect), and can be perceived by some stakeholder groups as yet another 'restriction' on use that ultimately tests social carrying capacity (thresholds of social acceptability) for managed areas and activities in the region. Lessons learned from broader integrated management planning in which MPAs are part of broad policy outcomes can help dealing with cumulative impacts or fears about future cumulative impacts.

One way to deal with these issues is to recognize that in many cases, the same stakeholders will be involved in multiple, separate processes in a region (e.g., MPAs, terrestrial resource development projects, local government zoning, etc.). These regional relationships amongst stakeholders represent an ad-hoc form of collaboration that can be used to mitigate distributional and cumulative impacts. For example, information from the MPA planning table can inform the whole community through community leaders who act as stakeholder representatives across multiple scales and sectors (Vodden 2015). An Irish study further suggests using nested plans and processes (i.e., local involvement, local plan, grassroots involvement, guided by national objectives, top down leadership) can work as long as local involvement is meaningful (Flannery & Cinneide 2008). BC's MaPP process is a case study example of this nesting, as a variety of management measures, including marine protection zones were proposed as part of a broader regional process.

Additionally, as discussed in the previous sections, tools like social-ecological systems frameworks, which offer a "*transdisciplinary approach in which various frameworks, models and case studies are used to develop models that to inform environmental policy, conservation and management*" can also be used to address cumulative impacts by considering multiple issues and activities concurrently (Leenhardt et al. 2015, p 57.) In the NSB region, many conservation and/or use planning and activities have already occurred and have involved several of the same governments and people. In this "small world" situation, the identification of potential cumulative impacts across processes should be feasible.

Just as different stakeholder groups (sectors) might be affected in different ways by the same set of measures, there can be differences in the way that impacts are distributed across different communities in different locations. A given community may be inadvertently impacted more than others due to the spatial configuration of MPAs. Using an integrated approach to MPA planning where network-level planning is taken, the siting of individual sites is more flexible. Inadvertent cumulative impacts can be reduced by shifting individual sites, after consultations with stakeholders. Negotiations with simple GIS feedback on how well targets are being met, can be used to reduce more obvious conflicts, and tools like Marxan can minimize conflicts further. However, as noted in the introduction, this is not to suggest that all conflicts can, or ought to be, avoided.

Using a systematic approach to MPA network development that involves zoned, multiple-use MPAs where meeting more than one objective is possible may be more acceptable socially than site-by-site planning where each site represents a "win" or "loss" to a particular sector. Good practices in MPA network development can be seen in examples where planners aim to develop win-win scenarios, (and even better, win-win-win scenarios), whenever possible (Bennett & Dearden 2012), while not losing sight of the primary MPA objective, i.e. biodiversity conservation. In an empirical study in the developing world, Arias et al. (2015) identified several factors associated with high compliance levels in MPAs as perceived by resource users, these included relatively small MPA size, MPAs allowing for multiple livelihoods to be pursued, fishing being allowed but regulated with effective government efforts against illegal fishing, as well as people being more involved with decisions. In an area as remote as the NSB, self-compliance (or lack of it) will be a key issue to be addressed. Seeing MPA network planning as part of a fabric of broader regional interests, increases the likelihood of support by ocean users.

3.6. Complementary marine protection strategies

Including a broad suite of conservation and protection tools, including traditional ones, can also maximize the positive.

In Curacao, "entrepreneurial marine protected areas" were developed by the diving industry to better regulate and control impacts on dive sites. One of the benefits of these was seen to be the shorter time scale for their implementation, and the potential for them to enforce good behavior by divers. In the NSB there may be examples of community or user proposed MPAs that could be supported through the planning process with the ultimate aim of folding them into the larger MPA network (deGroot & Bush 2010).

In a study looking at coral reef conservation in both Indonesia and Papua New Guinea, researchers found that "*traditional management systems involving partial or periodic closures were implemented to meet utilitarian community goals, such as providing food for celebratory feasts, rather than to fulfil western ecological concepts of conservation. Despite the periodic nature of these protected areas, the absence of external funding, and the explicit goals of resource utilization, traditional management systems still appeared to provide significant conservation benefits for reef fish stocks. In situations where the resources for proper enforcement are lacking, alternative management regimes that are better able to meet a range of community goals may achieve greater acceptance, compliance and subsequent conservation success than systems designed primarily for national interests of tourism and biodiversity conservation*" (McClanahan et al. 2006, p. 1409).

This approach was also used in Guam, within the Marianas Trench Marine National Monument where regulatory language was adapted to reflect regional realities about the nature and definition of commercial fishing. "*As indicated in the (MPA) proclamation, the regulations of the Monument do not permit commercial fishing. This prohibition means that the majority of the trips… as having the primary purpose of fishing would be prohibited. This is the case even though many of the "commercial fishing" trips to the Islands Unit in CNMI and Guam's history were so small-scale that they did not usually turn a profit. This prohibition would cut off one of the few opportunities that residents of the Marianas chain have had to visit and remain connected to the Islands Unit.*" (Richmond & Kotowicz 2015; p. 122). However, "*the regulations also provide a definition of "non-commercial" fishing. The rule states that "customary exchange of fish harvested within the Islands Unit under a non-commercial permit is allowed.*" In other words, the rule explicitly permits expense fishing as a characteristic of "traditional

indigenous fishing" in the Monument" (p. 122). In this example, regulators recognized that community members had a regional, historical connection to the region where the new large MPA was placed that was critical to their social wellbeing, and opted to include the need to meet broader social-cultural goals in their planning.

In the NSB, First Nations historical connections, and rights and title to marine and coastal areas will require an approach to MPA planning that reflects their rights and aspirations. It will also offer an opportunity for innovation in MPA planning that may assist with support for MPAs, and ensure community wellbeing.

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.

3.7. Building an Information Base

3.7.1. The need for multidisciplinary information

MPAs and MPA networks represent one of many potential uses of ocean space in a region, suggesting the need for comprehensive data about social, economic and cultural uses. Ideally, data should cover a regional area that is larger than a proposed, discrete, zoned MPA or set of MPAs, and which reflects issues relevant to adjacent communities. Stakeholders presume this scale and scope of knowledge for land-based and freshwater resource development projects that have regional (upstream and downstream) impacts and benefits; so the same "multi-dimensional" (Voyer et al. 2015a) approach to marine planning data and design should also be considered in MPA planning (de Reynier et al., 2010).

3.7.2. Filling Data Gaps

Although data gaps are a common issue in all marine sciences, social science data are often unusually incomplete. Ocean related data collection and research priorities have to date generally focused on biological and ecological information. A recent review paper looking at the use of social science data in ocean and coastal planning worldwide noted both a lack of transdisciplinary data and social spatial data: "*although social data are recognized as important, approaches that characterize the human dimensions of these ecosystems remain fragmented, sectoral, and limited in scope. Practitioners tend to rely on readily available biophysical and social data rather than information more likely to illuminate the linkages among the social and ecological systems. This knowledge gap constrains our understanding of how human–environment interactions drive ecological outcomes in coastal and ocean ecosystems. It also limits the approaches practitioners can take to achieve better social and ecological outcomes*" (LeCornu et al. 2014, p. 903).

A series of studies that have already been carried out on social, economic and environmental factors relevant for the NSB, demonstrating that there is an existing information base that MPAT can build on in MPA planning. However, while valuable contributions have been made to the current understanding of conservation options in the NSB, none of the existing analyses considered the full range of social, cultural, and economic costs and benefits. The NSB is not particularly different from other parts of the world in this regard, as most of the literature reviewed in this project notes deficiencies in social science data, information and tools in ocean and coastal planning (when compared to data, information and use of models and tools in the natural sciences). Although outside the scope of this contract to review and assess the current data holdings, is it always a good practice to: **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). This should begin with an inventory of existing social-cultural-economic data to assess gaps and usability, and efforts to collate those data to make them available to governments and stakeholders in MPA planning. Analytical techniques to combine data into surfaces are varied and will depend a lot upon the nature of the data available.

One approach for addressing data gaps is to use data proxies and surrogates. Ban et al. (2009) suggest that proxies (fishing effort, MPA costs, etc.) may be explored when socio-economic, social-cultural data are not available, but given the need for community acceptance, this should be tightly coupled with community engagement. Mascia et al. (2010) used proxies to evaluate the effect of MPAs on fishing communities, including the number of active fishers as a proxy for employment, and catch per unit effort as a proxy for food security, but stressed that lack of complete social data was a reason to use caution when generalizing about their results. Giakoumi et al. (2011) developed cost metrics for socio-economic costs of planning units in MPA planning in a location in the Mediterranean for which there were limited socio-economic data layers available. They used data on wind direction as a proxy for fisheries value (areas less exposed to northerly winter winds being particularly valuable to local fishermen), and data on tourist bed availability on different islands as a proxy for tourism value of adjacent marine areas. "*Our study shows that it is possible to develop surrogates for socio-economic information when designing marine reserves with limited social, economic and ecological data*" (Giakoumi et al. 2011 p. 760).

The advantage of using proxies is that it allows the consideration of socio-economic costs and benefits in data-limited situations. However, care needs to be taken to ensure that the proxies are an accurate enough reflection of the distribution of the actual variable of interest within a planning process. Proxies will always have limitations. Weeks et al. (2010) tested a range of proxies (population density derived from census data, number of boats per community, number of fishermen per community) as proxies for fisheries value of different coastal areas in the context of local-scale coastal MPA planning in the Philippines. They found that the latter two proxies outperformed the proxy based on census data (when compared with empirical data on the number of fishermen actually using different areas, derived from stakeholder interviews and participative mapping – see below). They point out that the validity and effectiveness of socioeconomic surrogates is likely to be dependent on the spatial scale and resolution of a given analysis. In their case, none of the surrogates they tested accurately predicted resource-use at fine spatial resolution. They conclude that surrogates may be valuable for the identification of lower-cost options in regional-scale planning, but that they cannot replace comprehensive consultation with affected communities.

Thus, we recommend that **where specific data are missing, consideration should be given to the use of data proxies / surrogates in combination with stakeholder consultation.** If surrogates are used, care should be taken to use them at appropriate spatial scales, and analysis outputs need to be interpreted and communicated thoughtfully to ensure that relevant uncertainties are clear. Wherever possible, relevant stakeholder groups should be consulted for feedback on the validity of using the surrogates for their intended purpose.

Understanding social science data gaps and filling them can be an aspect of the MPA planning process that directly engages stakeholders, who often know of information sources relating to their sectors, and who often have a lot of collective knowledge about the type and spatial distribution of human use patterns within their sectors. Participative mapping, where stakeholders are asked to map which areas they use and how important or valuable these areas are to them, can serve both to fill data gaps and to build positive stakeholder relationships (e.g. Scholz et al. 2004, 2006, and 2011, des Clers et al. 2008).

Tools such as Seasketch, which was used in the MaPP process, can be adapted for use in participative mapping. Whether or not participative data collection approaches are used to fill gaps, it is advisable to prioritize critical social-cultural-economic data collection (collation and processing) taking into account community values; i.e., what communities identify as critical. This means that **socio-cultural-economic data gathering strategies need to mesh with the wider stakeholder engagement strategy employed by the MPA planning and implementation process.**

If used, the participative mapping approach needs to be planned carefully by technicians and process managers, to ensure that the methods of data collection are appropriate to the wider stakeholder engagement process. Care needs to be taken in the interpretation, communication and analysis of any datasets generated through stakeholder knowledge mapping**. 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** (as was suggested by a scientific advisory panel in England, advice that was subsequently withdrawn when it led to resentment that threatened collaboration – see Lieberknecht et al. 2013).

Compared to the availability of relevant socio-economic information, there is generally better information in the global ecological and conservation science literature about the potential environmental benefits of MPAs, although there continue to be significant data gaps in the natural sciences, too. For example, a review paper five years ago stated that while higher density, biomass and species richness were found in temperate marine reserves, these effects differed widely among locations and more study was needed (Stewart et al. 2009, p. 243). More evidence indicating the ecological benefits of temperate water MPAs has been published in the intervening years (Ardron et al. 2015), especially when they are implemented as part of a suite of complementary biodiversity conservation and protection strategies, e.g. the combined use of both no-take MPAs and conventional fisheries management approaches (Pita et al. 2011). **It is recommended that on-going environmental research and monitoring programmes be integrated as part of the MPA planning process in the NSB, feeding into monitoring and evaluation, and ideally, adaptive management.**

3.7.3. Data Quality and Sufficiency

Social-economic data quality issues are myriad, and usually include not having fine-scale data on activities, including, for example, fishing activity (Richardson et al. 2006), or having data that do not represent marine uses equivalently as described by De Santo (2016). In a review of the use of social science data in both conservation and multi-use planning (LeCornu et al. 2014) the authors reported that there were: "*significant differences in the use of social data between multiuse and conservation plans (49.6% vs. 41.6%). Regarding conservation planning initiatives, less use of social data may reflect an epistemological bias toward biodiversity protection among conservation oriented initiatives. The relative lack of social data in conservation planning poses several potential risks to planning practitioners. First, criticisms of such approaches have long held that lack of incorporation of the social dynamics of conservation can have both significant socioeconomic and cultural impacts on local communities and stakeholders*" (LeCornu et al. 2014, p. 908). The Canada-BC MPA Strategy has a primary focus on biodiversity protection; however, social science data should not be seen as an afterthought, but as a critical set of information for use in designing MPAs and MPA networks that will work for ecosystems and people.

So how much data is enough? What level of data quality and coverage is acceptable to underpin planning decisions? A lesson learned from various processes including the Great Barrier Reef process

and processes in California is that "best available science" (Osmond et al. 2010) is usually sufficient to begin planning. This is particularly relevant advice in the NSB where some social science data have been collected through a variety of previous efforts including the BCMCA, MaPP, PNCIMA, and the LRMPs, and is a pragmatic approach when timely decisions need to be taken. However, this advice is presented with two important caveats:

Care should be taken to avoid making decisions that become skewed towards sites where better information exists. This is often in sites which have been surveyed and mapped as part of EIAs for potential economic developments, as noted in a quote from the Port of London in De Santo (2016) '*the evidence base for designations is unduly skewed towards locations of economic activity, as these marine environments are the best and most surveyed*'. Biasing site selection exclusively to areas with the best environmental information coverage is contrary to several important principles of systematic conservation planning, and it is also likely to lead to high levels of stakeholder conflict. (Biasing site selection to avoid data-rich areas to 'minimise the negative' would equally be contrary to systematic conservation planning principles.)

As will be further discussed below in the sub-section on legal and institutional context, analysts need to ensure their information base meets any existing legal or policy standards on evidence standards in public decision-making. De Santo (2016) and Lieberknecht et al. (2013) describe the many delays and loss of social capital in the English MPA process, where the evidence quality threshold for ecological information underpinning planning decisions was raised part-way through the planning process. In this light, **care should be taken if local and/or traditional knowledge is to be used alongside western scientific knowledge, to ensure that this has buy-in from all institutions with decision-making powers.** In the case of BC, there may already be good institutional buy-in supporting the use of traditional knowledge to underpin environmental decision-making.

3.8. Process design considerations

3.8.1. The design of the planning and decision-making process

Principles 6, 7 and 8 of the BC MPA Strategy are very high-level principles that can be interpreted in many potential ways. The terms 'positive' and 'negative' are value-based, what may be a positive impact to one person (or stakeholder group), may be a negative to another. This means there might not be a straightforward, absolute answer in assessing whether 'positives' outweigh 'negatives' for a given planning option. 'Maximising the positive' and 'minimising the negative' will therefore inevitably require a human decision-making process – an ultimate solution cannot be arrived at purely through data analysis. This, to some extent, takes pressure off the analyst – their analyses needn't deliver a 'perfect' answer, because they can't. All an analytical outcome has to be is appropriate in the context of a given process, its goals, participants, and available information base. Key questions to consider include: Who will carry out the technical analyses, and who will use the results? Who is involved in the process of trading-off costs/benefits during MPA design? Who is the final decision-maker? What are their social, economic, environmental priorities? For example, a process (co-)led by a given government department will inevitably reflect that department's areas of interest –fishing in the case of fisheries department, or shipping in the case of a transportation department. Consequently, identification of stakeholders and how their "costs" are resolved will differ.

As described in the introduction, one finding that emerges from the literature review is that thoughtful integrated process design is as important as sound technical methods of data analysis in order to achieve a balance between multiple costs and objectives in MPA planning. A well-designed and properly-resourced decision-making process, including a well-designed stakeholder engagement

process, is the most common recommendation encountered in the literature. (PacMARA understands that the NSB stakeholder engagement strategy is in the process of being finalized.)

When technical analyses move beyond theoretical desk studies, and are carried out to support a real-world planning and decision-making process, it is important that they are interwoven with the design of the process so the analytical outcomes serve to underpin and inform decision-making in a timely and constructive manner. For this reason, **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.** For example, a spatial analysis to minimise job loss, will end up with somewhat different results than one seeking to minimise economic impacts, even though the two objectives are related. Presenting the results of just one of these spatial analyses at the beginning of a process may impact on the planning discussions and their results in a way that a post-hoc analysis might not.

Likewise, in the design of a process and the questions it seeks to resolve, managers must remain realistic in their expectations of what the currently available data and information base can support. A Marxan with Zones analysis, for example, requires spatial GIS data for all the activities that are to be zoned, and critically, an estimation of their effects (positive or negative) on the (usually conservation) goals and objectives of the process. If not already prepared, assembling a reasonably comprehensive set of such data can take more than a year. It is noted that MPAT has some socio-economic data at hand, but that analyses to determine how these activities may affect the NSB draft Objectives have not yet been undertaken, perhaps because the Objectives have not yet been finalised. The selection of which socio-economic spatial data may be relevant in a trade-off analysis (Marxan or otherwise), and for what purposes, still needs to be decided, and will hinge to some degree on the type of decision-making process selected.

The following subsections highlight key aspects of process design that should considered in order to ensure that methodological approaches best suited to the decision-making context are chosen.

3.8.2. Level of stakeholder engagement

In view that the MPAT stakeholder strategy is in the process of being finalised, this section will be brief. We understand that MPAT are planning to engage stakeholders at multiple stages in NSB MPA planning (P. Mahaux, pers. comm., March 2016). However, PacMARA is not clear what role stakeholders will be given, or at which stages of the process. We outline a few general considerations below. Foremost, **an MPA selection process should be designed to fit the legal, institutional and political context, and the resources and capacity available.** This will vary considerably across jurisdictions, institutions, and regions.

The global MPA literature overwhelmingly cites stakeholder involvement as an important element of successful MPA planning (e.g. Pound 2009, Pressey and Bottrill 2008, Reed 2008, Ardron et al. 2010). In many parts of the world, legislation requires some degree of stakeholder participation in environmental planning, which is reflected in international law (e.g. the EU Aarhus Convention[9]) and conventions (e.g. the Convention on Biological Diversity). Participation can take many forms. Reed (2008) provides an overview of different types of engagement, based on models such as Arnstein's (1969) 'ladder of participation' or Biggs (1989) who described engagement as a relationship that range from 'contractual'

[9] EU Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, adopted in 1998 and entered into force in 2001.

or ‘consultative’ to ‘collaborative’ and, at the highest level of engagement, ‘collegiate’. As a short-hand, it is helpful to distinguish between two basic strategies: a consultative strategy (where stakeholders are given an opportunity to provide information and feedback), and a collaborative strategy (where stakeholders are given a more influential role, jointly designing plans and / or making decisions). A co-management model also exists through which stakeholders co-operate and share governance of a resource or traditional ground (more commonly found in Canada; e.g. Gwaii Haanas[10]).

There is evidence that stakeholder involvement improves planning outcomes. Reed (2008) cites Beierle (2002) who looked at 239 published case studies of stakeholder involvement in environmental decision making and found evidence that stakeholders improved the quality of decisions that were made in the majority of cases, adding new information, ideas and analysis. Some authors view the highest possible level of participation as an end in itself, on the basis that empowering stakeholders is fair and generates social capital (e.g. Pound 2009). However, collaborative strategies are not necessarily preferable to consultative strategies in all circumstances. Some successful MPA planning processes (e.g. the designation of MPAs in Scotland in 2014 and the re-zoning of Australia’s Great Barrier Reef Marine Park in 2004) have used consultative approaches, whereas others (e.g. California’s Marine Life Protection Act Initiative) have followed a collaborative strategy.

The stakeholder engagement strategy should be transparent and consistent throughout the process. Whatever level of stakeholder participation is chosen for the NSB, the governments’ expectations regarding the roles of stakeholders should be made clear from the beginning.

The disillusionment felt by many stakeholders involved in England’s Marine Conservation Zone (MCZ), process described by De Santo (2016) and Lieberknecht (2013), was largely caused by a change from a collaborative approach in the early stages (in which stakeholder groups jointly developed site recommendations) to a top-down, government agency-led consultative approach in later stages. Many stakeholders felt the later process stages undermined their earlier efforts, and the social capital generated in the early planning stages was lost.

It is beyond the scope of this contract to review good practices in stakeholder engagement or provide detailed recommendations thereon; however, the above paragraphs give an indication of the importance of careful stakeholder process design. The reason the stakeholder engagement strategies outlined above are relevant in this report is that the design and frequency of stakeholder workshops, stakeholder roles and their level of influence on the final MPA network will have significant implications for how trade-offs will be considered, and on the most appropriate data analysis approaches to use, outlined below.

In a collaborative process, multi-sector stakeholders may be directly tasked to design MPAs following ecological guidance that can be met by multiple potential site configurations. Assuming a stakeholder group is representative of all relevant interest groups, and their work is well supported and facilitated, stakeholders may effectively take on the task of exploring and assessing trade-offs between social, economic and environmental factors, and negotiate an outcome that minimises the negative and maximises the positive by finding a solution that causes minimal conflict and has maximum levels of cross-sector support.

In this kind of collaborative process, the main role of a technical analyst might be to provide relevant information to the stakeholder group, e.g. by creating accessible and well-presented maps, maintaining up-to-date information on interactive tools such as Seasketch, and developing tools for providing rapid

[10] http://www.haidanation.ca/Pages/Agreements/pdfs/GwaiiHaanasAgreement.pdf

feedback to stakeholders on how well a particular network design meets ecological guidelines, or the extent to which it overlaps with high value areas for particular human uses. There may be little need for an analyst to carry out integrated social-economic-cultural analysis using tools such as Marxan or approaches such as multi-criteria analysis (though the outputs from such analyses may serve as a useful starting point for stakeholder negotiations, and can be used to break up "log-jams" when discussions have reached an impasse).

In a predominantly consultative process that aims to integrate social, economic and environmental objectives, technical analysts will themselves need to take on the task of assessing social-economic-environmental trade-offs in order to develop a plan (or a series of options) to present for consultation. In a process that follows a purely consultative stakeholder engagement strategy, an analyst's work may be proportionally less centred on presenting and communicating baseline information, and much more focused instead on filling gaps in spatial datasets and fine-tuning cost surface calculations for use in Marxan / MwZ.

The role of technical information and data analyses within the context of planning and decision-making should be defined clearly, including who will use technical information and analyses outputs for what purpose. **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.**

3.8.3. Legal and institutional context

The technical analyses supporting an MPA planning process need to be consistent with the legal and institutional mandates of the process. This requires understanding who the ultimate decision-making and implementing bodies are going to be, what other institutions and organizations they are influenced by, what their socio-economic and environmental priorities are, and what legal requirements, policy guidelines and process conventions they are bound by. This can be revealed by who is at the planning table. For example, a trade-off analysis for Massachusetts Bay, USA highlighted conflicts with fisheries, and resolved them using an economic analysis looking at "efficiency frontiers", thus revealing several benefits for marine spatial planning in that region (White et al. 2012). However, in the actual planning process there, the fisheries sector did not participate, and hence the analysis' results were of academic interest only.

Jones (2012) notes that processes within more economically developed and relatively mature democratic countries tend to adopt an approach that is more of dominated by top-down approaches. Mulcahy et al. (2012) note that the collaborative stakeholder process of the early MPA planning stages in England 'did not sit well with England's conventional legislative process'. This meant that public institutions that received the recommendations developed during the collaborative stages subsequently reverted to a more conventional (in the UK context) top-down approach, a change that caused significant delays and challenges.

Relevant government agencies in planning should be involved where their mandates are linked to MPAs. Frameworks should be established to allow development of co-management agreements across levels of governments, including First Nation governments. PacMARA recognizes that much of this work has already been done for the NSB. We reiterate:

Within the BC context, it is recommended that MPAs be designed and implemented through government to government relationships reflecting First Nations rights and title, and historical use of marine and coastal areas. The MPAT with its tripartite structure (Federal-BC-First Nations) is well placed to ensure that this occurs.

With respect to socio-economic-environmental trade-offs, a key question to consider is whether there are any legal or policy requirements for social, economic and / or environmental impact assessments to be carried out for new plans, such as a cost-benefit analysis for a regulatory federal MPA (in the same way that such impact assessments are required for infrastructure developments in many countries). If so, it will be necessary to **ensure that regional analyses, discussions with stakeholders, and resultant decisions are not later undermined by site-by-site socio-economic impact assessments.** In England's MPA process, government-led economic impact assessments for each individual site proposal followed the design of the network as a whole, using different assumptions, benchmarks, data, and analytical approaches, which ended up invalidating the work that had been carried out previously (Lieberknecht et al. 2013). This disheartening result could have been avoided had the scientific review been incorporated as a stage into the planning process, with stakeholder feedback, rather than residing outside of it.

Also relevant to technical analysis is whether there is any legal or policy position on the type and quality of evidence needed to justify planning decisions, especially where these impact negatively on economic interests. This applies to quantitative, scientific and spatial data as well as qualitative data and local knowledge. De Santo (2016) and Lieberknecht et al. (2013) describe the delays and problems that emerged when the evidence quality threshold for ecological information underpinning planning decisions was raised part-way through the planning process, thereby undermining work that had already been carried out. **Any existing laws or policies on evidence standards in public decision-making should be identified and followed (or if necessary, developed).** This may mean that some data sets used in academic studies, while informative, cannot be used as evidence in official decision-making.

3.8.4. Building shared knowledge and understanding

At the beginning of an MPA planning process, efforts should be made to establish a shared understanding of the objectives and implications for stakeholders. Without a "common framework of problem articulation and description" (Helly et al. 2001, p. 129), stakeholders may resist participating fully and openly, leaving important information and perspectives off the table - especially for sectors who may have the most to lose (Fraschetti et al. 2009, Rosendo et al. 2011). A lack of a shared understanding of the process's purpose and implications might also mean that stakeholders attempt to seek "better alternatives to negotiated agreements" elsewhere (P. Armstrong, pers. comm., 2010), refuse to support MPAs in the final stages of designation, or fail to comply with MPA regulations once they are in place.

One obvious prerequisite for establishing a shared understanding of purpose is to have clearly defined objectives from the beginning of an MPA planning process. **The Canada-BC MPA Strategy contains multiple objectives which define the broad purpose of MPA planning - these should be developed into more specific operational guidelines to help steer the design of the MPA network**. (The MPAT has already taken steps to ensure this happens.)

Another important element in building a shared understanding of a process and its implications is to give all process participants access to technical information and knowledge. De Santo (2016) includes two quotes from stakeholder interviewees in the English Marine Conservation Zone process which illustrate the importance of good data presentation and communication: '*there is a difference between making information available and making it accessible*' and '*I think there was an assumption on the part of government and on the part of scientists, that because we know this stuff, that everyone else knows this stuff*'.

In the English MCZ process (see case study), sharing maps of administrative boundaries and patterns of the distribution of human use at an early stage in the planning process allowed mistakes and omissions

in spatial datasets to be identified and rectified by stakeholders (Lieberknecht et al. 2013). Thus, when analysts present information in an accessible way, stakeholder input can improve the information base for planning. In a collaborative process, knowledge sharing can also provide a relatively uncontentious way for stakeholders to interact and build relationships with each other as well as with technical staff supporting the process, establishing a basis of trust to underpin more difficult negotiations about economic, social and environmental trade-offs.

Much has already been done in the NSB to help build this shared understanding. Work to date includes, for example, the BCMCA and PNCIMA atlases which, over more than a decade, have collated best available data for use in decision-making. Regional and sub-regional planning processes, especially the Marine Area Planning Process (MaPP) and the use of the Seasketch tool within it, have over the years brought stakeholders together to develop sub-regional, integrated marine plans that include strategies, actions, timelines, and also zoning that includes MPAs. The MPAT should continue to build on this work, to ensure a complete and shared understanding of the purpose of the new MPAs and the ways in which they might impact on human activities, so that stakeholders can understand the implications of any trade-offs. **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.**

3.8.5. Clarify human activity restrictions in MPAs

De Santo (2016) and Lieberknecht et al. (2013) detail some of the negative implications of not providing clear, upfront decisions on site management in the early stages of a process. Stakeholders faced a great deal of uncertainty over how MPAs would impact on their interests once established, which made providing constructive input into MPA planning a challenge for them. Establishing management options upfront during the Marine Life Protection Act process in California and the Great Barrier Reef rezoning programme (e.g. Day et al. 2002) enabled stakeholders to engage with these process constructively.

Stakeholders having clarity on how future sites will impact on their activities is equivalent to an analyst knowing what human use information will be relevant in an overall cost calculation. In both cases, a pre-requisite for a constructive process (be it a fruitful round of stakeholder negotiations, or a meaningful integrated data analysis) is an understanding what human use restrictions will apply in future MPAs. For spatial analyses to proceed, it is necessary to know what will / will not be allowed in a given designation; e.g. to be used in Marxan with Zones. Therefore, **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.** These should be based on the ecological impacts of different activities.

3.8.6. Resources and timeframes

Experience shows that MPA processes can take a long time – the world's first MPA, Cape Rodney-Okakari Point (Leigh) Marine Reserve in New Zealand took 12 years to establish, and subsequent MPAs have taken longer (Banks & Skilleter 2010, p. 203). Allowing processes to draw out can have negative consequences, such as diminishing support over time, and unhelpful "side-tracks" involving politics, stakeholders, and changing perspectives (Banks & Skilleter 2010, p. 201). Once established, however, MPAs tend to garner increasing support (Pita et al. 2011, p. 303, Gelcich et al. 2008, p. 43).

Establishing a clear timeline at the very beginning has been recommended (Osmond et al., 2010, p. 49). The time required to plan and implement MPAs will depend partly on external factors such as size of the planning area, complexity of the environment, pre-existing conflicts and levels of pre-existing institutional backing, as well as availability of information. However, the design of the process and the methodological approaches used will also have an impact. A collaborative stakeholder process may require more time than a top-down process, and a process with several planning iterations will take longer than a non-iterative process. High evidence quality thresholds will significantly increase in the time required for building the information base; likewise, complex analyses require more time to complete, review and interpret than simpler ones.

Good practices found in the literature reflect to some degree the specific needs and resources of a given process, thus to date precluding the standardization of 'best practices.' **In the NSB context, methodological approaches and process design should be selected to reflect the time and resources available. Thus, as a starting point, the amount of funding available and political commitment will need to be known, to help justify why certain technical analyses will or will not be undertaken.**

Costing the project needs to consider how much time and effort will be required to gather and collate biological and environmental data as well as socio-economic-cultural data, the frequency and costs of meetings, number of staff and other supporting roles. The second attempt to design MPAs in California failed in 2003 '*when it became clear that the resources allocated to the project would not be enough to achieve its goals*' (Mulcahy et al., 2012).

3.8.7. Adaptive management

Adaptive management is often highlighted as an important approach for dealing with uncertainty in environmental planning and management, consisting of a series of management cycles in which decisions are taken, implemented, evaluated, and subsequently reviewed based on new information. In essence, it can be seen as an experimental approach to management, though practical implementation has faced significant challenges (e.g. Rist et al. 2013, Westgate et al. 2013).

Reviewing the extensive literature on adaptive management of natural resources is beyond the scope of this report, however, the term is referred to here as a reminder that plans and decisions taken now with respect to MPAs in the NSB need not, and probably should not, be irreversible. Information deficiencies and consequently imperfect data analyses should not be used as a rationale to further delay MPA planning and implementation. **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.**

3.9. Understanding context

3.9.1. The local social-economic context

The global literature reviewed in this project points towards a need for a shared understanding of the local social-economic context in order to *minimize the negative* (i.e., specific pressures and costs to community and individual wellbeing). Linkages between social and economic factors are usually the ones most clearly and quickly evident in rural coastal communities facing challenging economic times. Social-economic results of resource depletion, shifting ownership and access to resources can range, for example, from families with children leaving the region for better opportunities creating declining rural

school enrollments and frayed social networks, to the shuttering of restaurants, bookstores and other retail businesses resulting in negative impacts to the once vibrant social life of a coastal community. Negative economic situations can also affect individuals, with job losses, retraining needs, and the resulting mental and emotional health consequences, sometimes with broader social implications.

MPAs and MPA networks may also affect the social-economic environment in rural communities because, "*by restructuring human interactions with the marine environment, MPAs influence the quantity and type of tangible and intangible benefits that flow from marine ecosystems, as well as the distribution of these benefits among social groups*" (Mascia et al. 2010, p. 1425). MPA related social-economic costs can occur for a variety of specific reasons, including, for example, the timescales of MPA implementation, with costs from closing off marine areas from use usually being felt in the short term, and benefits of MPAs not realized until the longer term.

An already beleaguered sector that may be particularly negatively impacted by MPA establishment both regionally and individually is commercial fishing. In NSB communities where fishing represents a significant share of employment, historical connections and social cohesion, reductions in fishing opportunities have already caused decades of community turmoil. Impacts to fishermen and fishing communities cause particular strain due to the uniqueness of fishing as a way of life, as well as a livelihood (Coulthard et al. 2011). Further MPA related fishing restrictions may also affect individuals, prompting fishermen to leave communities entirely, or in some cases, to find work in other sectors, including tourism. However, in a recent study from Brazil, researchers looked at the relationship between fishing and new tourism livelihoods in development of full protection no-take MPAs. They did not find many fishermen migrating over to tourism, and conclude that: "*rural poor people who depend on resources are more vulnerable to environmental changes, and thus one could argue that protecting nature would benefit them the most…however this may only be true as long as prudent ways are found to reconcile conservation and use because the poor are also socially vulnerable. Excluding them [stakeholders] from one form of livelihood does not mean they will automatically find different and equivalent ways of making a living."* (Lopes et al. 2015, emphasis added).

Developing an understanding of the complex social-economic context in the region where MPAs and MPA networks are being considered will be necessary to minimize negative impacts on communities as well as resistance to MPA establishment (Bennett & Dearden 2012). *"The establishment of reserves that may cause large financial losses to displaced fishers will prove very difficult politically, therefore reserve design should be considered a joint economic and biological problem"* (Richardson et al. 2006, p. 1192). This recommendation is also supported by another study looking at two different customary management systems in Papua New Guinea, in which the author found that: "*a framework of examining resource users' spatial, occupational, and gear mobility […] may contextualize local socioeconomic conditions in ways that are helpful to conservation managers and planners*" (Cinner 2007, p. 1043).

As highlighted above, this will require clarification on what activities will be restricted within MPAs at an early stage in the planning process. **Strategies should be considered for mitigating/compensating for social-economic impacts of MPAs and MPA networks on regional communities**.

3.9.2. The local social-cultural context

Social-cultural factors include, for example, values, beliefs and worldviews on both use and conservation (Brown 1984, Buijs 2009, Dietz et al. 2005, Schwartz & Bilsky 1987). Social-cultural values underpin stakeholder perspectives and positions on MPAs (Christie et al. 2003, Voyer et al. 2015b) and therefore can be both helpful and challenging to MPA and MPA network planning. Understanding stakeholders'

social-cultural context in order to make sure perspectives and positions are fully declared and considered is fundamental to moving the discussion forward in MPA consultation, design and management (maximizing the positive and minimizing the negative) such that it is meaningful to them. "*Processes of deliberation amongst diverse stakeholders should seek not only to bring values into discussions, but also to help stakeholders articulate values in a way that both allows for diversity and, where possible, facilitates expression of shared values*" (Robinson et al. 2012, p. 580).

Some examples of social-cultural values issues in MPA planning processes include: understanding people's underlying beliefs about their relationship to legal and regulatory instruments like MPAs that may speak to a groups' "*history, power relationships between regulators and regulatees, and risk*" (Pieraccini & Cardwell 2016, p 21, 27). These beliefs, which extend more broadly to governance relationships, may have significant implications for the design of stakeholder engagement strategies in MPA planning (above). Another study advised understanding people's values about process, with the need to "*understand the difference between participation and communication (…) so that participation is treated not simply as a set of tools, but as an institutionalized process embracing an explicit philosophy of empowerment, equity, trust and learning designed to systematically identify and represent relevant stakeholders to co-define objectives and integrate local and scientific knowledges*" (Tam 2015; p. 123).

Different stakeholder cultures will naturally expect one or the other as the norm. Values and perspectives about conservation and use will also have cultural norms also cross sectoral and geographic lines so single sector-based stakeholder approaches in planning may limit opportunities for learning and collaboration, and sometimes unnecessarily exacerbate partisan and positional stances (Evans 2009, MacDonald et al. 2015).

Social-cultural concerns are also pre-existing. As one author states about resource development projects: the "*environmental (biophysical) impacts only occur when the first sod of soil is turned; social impacts occur the moment there is speculation or rumour that something will change. The direct biophysical impacts of a project can only be caused when the project commences construction, when the first sod of soil is turned. Social impacts, however, start the moment there is a rumour or speculation*." (Vanclay 2012, p. 152). Fear of the unknown can be a big part of the opposition to MPA establishment so recognizing that this fear needs to be addressed by bringing unknown variables out into the open - pre-process – can free up discussions later.

One recent research project in BC looked at both the held (strong beliefs), and assigned (values we assign to things) values of the Tla-o-qui-aht First Nations on Vancouver Island. It was noted that "*the people's held and assigned values together with what they know, believe and understand—their cognitions —lead to particular understandings of what is and is not in their interest and also shape both the vision for Tribal Parks and specific governance mechanisms*" (Robinson et al. 2012, p. 577). No doubt these localized values are to some degree different across villages and communities, with each bringing its own history to the planning table.

In the NSB, social-cultural issues include, for example, the aspirations of First Nations communities, rural BC and its varying perspectives on economic development and growth, and the realities of individual and community historical attachments to traditional fishing and forestry livelihoods. The diversity of social-cultural values in the NSB creates a complex, potentially volatile environment in which to build a shared understanding of why MPAs are needed for marine biodiversity conservation. However, it is a critical component. "*Navigating the complex world of human social-cultural values remains under-explored in marine conservation, but overall these values underpin social acceptability of MPAs and therefore are largely responsible for most challenges facing MPA and MPA network establishment"* (Voyer et al., 2015a; Voyer et al., 2015b). Recognizing that the NSB is a complex of various positions, **the**

first step in the MPA rules of engagement should be to gain acceptance from all participants to mutually respect and listen to each other's perspectives. Only then can social-cultural values be elicited, understood, and considered in planning decisions.

3.9.3. The local social-ecological context

MPAs and MPA networks also naturally have a social-ecological context, which involves the relationships and interactions between humans and the natural world (Binder et al. 2013). Marine protected areas and MPA networks are part of a toolkit of responses to the complex relationship and some of the problems caused by humans through our long history of ocean use - in which we have, among other things, altered or damaged habitats, removed significant amounts of living and non-living resources, altered the climate, added carbon dioxide (leading to acidification), as well as various pollutants and contaminants. In order for stakeholders to realize that MPAs and MPA networks can act as a potential tool to recover ocean ecosystems, and that this can also benefit communities, an understanding of the social-ecological context in which marine ecosystem services (benefits) provided by the oceans, and the impacts of human use on the oceans (costs) should be conveyed and understood (Agrawal & Gibson 1999, Adams et al. 2004, Andrachuk & Armitage 2015, Christie 2004, LeCornu et al. 2014).

Social-ecological systems approaches to planning and management reflect the fact that human and environmental systems are tightly linked. Approaching resource management this way has meant increasing ideas about the need for adaptation, landscape level thinking and the need to ensure resilience in both natural and human systems (Palomo et al. 2014). Andrachuck and Armitage (2015) worked with Vietnamese fishermen to construct a social-ecological systems picture of their fishing environment and activity to better understand how changes in governance and environmental conditions were transforming their identity as fishermen. Ban et al. (2015) looked at the social-ecological system of the Great Barrier Reef to understand the relationships between the resource system, the governance system, the actors, the resource goods and activities and outcomes to try to fill a gap looking at how changing property rights due to MPA implementation affected the linked human and ecological environment.

Local social values may not be well aligned with biodiversity conservation, putting the success of an MPA(s) at risk. Because of the complexity of interactions between humans and ecosystems there can be uncertainty about both; "*positive or negative outcomes (of changes to the resource) cannot be presumed, as they are complicated processes driven by many factors beyond the control of any single individual or group and impact individuals and groups in diverse ways*" (Andrachuk & Armitage 2015, p. 1). As well, social-cultural perceptions affect social-ecological understanding. The study involving fishermen in Vietnam found that "*fishers perceive social and ecological changes in their economic environment depending on how they are personally affected*" (Andrachuk & Armitage 2015, p. 10).

However, it would be incorrect to characterize stakeholders as only motivated by seeking personal gain. "*Collective policy outcomes, and the beliefs about whether environmental policies are efficient in solving collective problems also influence stakeholders' attitudes…Beliefs regarding collective policy outcomes are likely to influence social acceptability partly because persons naturally care about both the environment as well as other people, and because positive collective outcomes also are likely to benefit the individual*" (Sjolander 2015, p. 8; Schuitema & Jakobsson Bergstad 2012).

While environmental NGOs have in many cases done a good job of publishing environmental educational materials, they can be viewed by other stakeholders as having an agenda contrary to their own. The perceived neutrality of the information (and the presenter) is important to gaining acceptance of the basic facts concerning marine ecology and human-induced stressors. One review paper found that

specifically within the academic social-economic research literature, "*the views of the fishing industry (on MPAs) are often neglected, and studies that actually collect information concerning commercial fishers' attitudes, perceptions and opinions regarding issues related to MPAs make up only a small proportion of the literature […] and that although interest in the human dimensions of MPAs is growing, little literature originates from empirical studies aiming at examining commercial fishers' attitudes and perceptions about MPAs and issues of relevance to MPAs.*" (Pita et al. 2011, p. 302).

However, as the "climate change debate" illustrates, not all parties are open to what the scientific community views as the current state of knowledge, and it must be accepted that not all stakeholders present will necessarily agree on the benefits of MPAs, no matter how much scientific evidence is presented and views are exchanged. At some point, the process will have to move onto the next step; i.e. planning –with or without universal consensus on the value of MPAs. Nevertheless, it is important to the success of the process later on that stakeholders feel that their views have been heard and that there are examples of how they have been taken into account.

In the NSB, considerable guidance about the social-ecological interface is already available based on previous work by the BCMCA, in the PNCIMA process, MaPP, etc. Some of these were also discussed in PacMARA's 2015 report to MPAIT.

4. Considerations when cultural, social, or economic features are targeted for protection

4.1. The goals of the Canada-BC MPA Strategy

As should be evident by now, MPA planning is about much more than just ecology, while remaining of paramount importance amongst the myriad of other considerations. One of the many challenges faced in MPA and MPA network planning worldwide is the risk of: "*biological success but social failure*" (Christie et al. 2003 p. 22). This is no less true in the NSB with its rich diversity of economic, social and cultural characteristics, communities and history that can make conservation planning a complicated ordeal with many uncertain ecological and social outcomes. In the NSB it will be critical to aim to satisfy both the biological and social sides of MPA planning in order to avoid this scenario. In this light, a review of the agreed-upon Canada-BC Strategy Goals is in order:

Canada-BC MPA Strategy Goals:

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.

Goal 1 is of primary importance

Goal One of the Canada-BC MPA Strategy is about protecting biodiversity. The other five goals reflect cultural, social and economic features which may be targeted for protection as part of building the MPA network; and protection of these other features must also contribute to Goal One. It is also important to note, however, that Goals 2 to 6 are listed as goals in-and-of-themselves, and are not simply outputs of the primary goal (Goal 1). This is described in more detail in the Canada-BC MPA Strategy Document under Principle 7 as follows:

> "*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)*. "(Canada-BC MPA Strategy, 2014, p. 7)

Implementing the Canada-BC MPA Strategy Goals will require realizing Goals 2-6 as well as well as Goal 1. To do so, the term 'contribute' will need to be unpacked to explore the variety of ways that meeting Goals 2-6 in the NSB can contribute to meeting Goal 1 (e.g. look for potential synergies, such as human activities compatible with conservation objectives). Where trade-offs are required, transparency and equity will build both government accountability and stakeholder trust.

4.2. Multi-objective MPA planning in practice

As in BC, the Great Barrier Reef rezoning process also outlined its primary consideration as meeting ecological objectives. However, their approach was to adopt ecological and other goals as "a package" (Osmond et al. 2010, p. 47, also see GBR Case Study.) In a review looking at the human wellbeing implications (interventions/objectives) of marine conservation and other ocean uses, it was noted that there are both 'moral and instrumental' reasons for developing human use objectives, suggesting that humans and the environment are part of a social-ecological system (i.e., resources sustaining human lives and of humans affecting resources). One way to do this is through the use of human use focused indicators, such as equity. Including human use indicators can increase support for ecological indicators (Carneiro 2011).

Despite the recognition of the importance of social, economic and cultural objectives, the primary focus in the published academic MPA literature tends to be the achievement of ecological objectives (whilst minimising economic costs), whereas status quo development up to now has been the other way around (achieving cultural, economic or social objectives whilst minimising impacts on the environment). Developers identify areas suited to their activity (e.g. renewable energy installations, oil & gas exploration, and mining), and put forward planning applications for permits to carry out their intended activity. This usually requires a process of environmental impact assessment. This literature review has not delved into the EIA literature, as it is of limited relevance in the context of systematic planning (EIAs are development-specific and do not plan at a regional scale). However, EIAs in some countries (e.g. the UK) are required include sections on economic impacts, and cumulative environmental impacts. It may be worth exploring the EIA literature to identify any relevant methodological approaches that may have wider application in multi-objective, systematic planning.

There are some examples of cases in the literature where MPA planners have approached their task from a socio-economic angle. For example, in Mozambique, researchers asked: "given high poverty levels and dependence on marine resources, what should be prioritized: biodiversity conservation for tourism, or sustainable resource use to sustain and improve livelihoods? Both deal with conservation, but have very different implications for local communities and the creation of MPAs. An MPA for biodiversity conservation and tourism will require different management tools to achieve its goals than one established for sustaining livelihoods. No-take areas may be essential for the former, but not be suitable for the latter, which will probably involve better regulation of fishing activities, rotational or seasonal closures, and not necessarily a complete ban on fishing in certain areas" (Rosendo et al. 2011, p. 64).

Unpacking the term "contribute" (used in the Canada-BC MPA Strategy Goals 2 and 4) can offer room ideas about how to manage this dilemma of prioritizing biodiversity conservation while also ensuring other goals are met. "Contribute" is defined[11] variously as: "play a part in", "help bring about", "be a factor in", "be conducive to", "lead to", "cause" or "add". This suggests that there may be a range of ways, at various levels, in which to explore how protection of social-cultural and economic features might contribute to protecting biodiversity.

For example, in the MaPP process, opportunities for shellfish aquaculture economic development have been noted as conditionally acceptable in some marine protection zones in order to "*maintain First Nations bottom and off-bottom aquaculture economic opportunities*" (MaPP North Vancouver Island - MaPP 2015d, p. 106). This is a recognition that some sustainable economic development opportunities for First Nations in the plan area may contribute to ("play a part in") meeting ecological protection goals

[11] Dictionary.com, accessed March 2016

as these goals do not conflict; and in fact, supporting regional economic development may lead to better supported conservation objectives. These same zoned areas are also now primed to eventually become part of the Canada-BC MPA network and could then incorporate these already agreed upon social objectives within the MPA network. There are similar examples for protection of other economic-social and cultural features in the other MaPP subregional plans (Haida Gwaii, North Coast, Central Coast - MaPP 2015a-c).

In another study looking at ecotourism as an objective in the Honduras' Cayos Cochinos MPA process, the authors noted (2007) that "*In theory, MPAs are ideal stages for the development of ecotourism as an alternative development strategy because they are areas where ecosystem and community sustainability are interdependent, and therefore development specialists often suggest it as an alternative income source for previously fishing dependent communities living within or in proximity to MPAs (WWF 2005). If managed well, ecotourism has the potential to conserve the environment within an MPA, protect cultural traditions, and generate revenue for the local and national community, meeting all three of the objectives of sustainable development (France 1997; Turner 1988; Wen and Tisdell 2001)"* (Vacanti Brondo & Woods 2007, p. 5.). In this case, the authors suggest that protecting ecotourism opportunities clearly contributes biodiversity protection in the MPA. Similarly, Angulo-Valdés & Hatcher (2010) developed a benefits framework that included identifying benefits that flowed from meeting biodiversity conservation goals.

In a study looking at community acceptance of wind energy projects in the North Sea adjacent to Germany it was found that wind farms that were specifically designed to meet multiple goals (in this case): a) highlight the unique character of the landscape, and b) maximize energy production) were more acceptable to coastal residents than wind farms designed to maximise energy production alone (Walker-Springett et al. 2016). The authors describe the approach as creating a "regional meaning" for these projects (p 532). This may suggest that the key to protecting important socio-economic features that also contribute to MPA goals is that the multiple goals need to be addressed concurrently and in the context of a regional approach. This then, may contribute to more stakeholder and private sector support for biodiversity protection.

Another approach involves a reverse-analysis to look at designating use areas first rather than protection areas. A study from the UK found that fishermen feel that a "*political marginalization of the fishing industry is reflected by an unjust geographical marginalization*" (Jones, 2009, p. 765). This research suggests that for fishermen, in particular, the increasing use of ocean environments by other sectors, and now for MPA designation as well, means that they (perceive that) are running out of places to fish. Identifying and setting aside fishing areas to balance MPA network set aside areas may be needed to gain fishermen's support for no take MPAs (Jones, 2009).

Ban & Vincent (2009) explored this reversed conservation planning approach using Marxan, in which selecting commercial fishing areas was permitted rather than prohibited. "*By targeting fisheries instead of treating them as a cost, we select the most productive fishing regions while minimizing the area fished*" (Ban & Vincent 2009, p. 1). "*We found that small reductions in fisheries yields, if strategically allocated, could result in large unfished areas that are representative of biophysical regions and habitat types, and have the potential to achieve remarkable conservation gains*" (Ban & Vincent 2009, p. 1). In this example, reversing the planning paradigm showed that allocating fishing areas could contribute to biodiversity conservation.

However, it is worth noting that the Ban and Vincent approach was taken before Marxan with Zones became widely available. Now, there is no need to have to choose whether to set targets either for conservation or for human activities. Rather, they can both be set in Marxan with Zones, each for their

respective zone. Therefore, **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.** While the goal of conservation must still have primacy, actively seeking to meet socio-economic goals, through the use of targets, could go a long way towards building acceptance and support of the MPA process.

Of course trade-offs will still be inevitable and will also require innovative design strategies for understanding those trade-offs and minimize their negative impacts, through compensation or other means. In a paper looking at trade-offs between marine protected areas and marine renewable energy, the authors found that compensation mechanisms can allow for the co-existence of both and an efficient use of ocean space, when there is "*high substitutability between ocean uses that both result in sustainable uses of the sea (both economic and ecological outcomes)*" (Kyriazi et al. 2015, p. 46). To achieve this result "*transparent economic and scientific methods to calculate losses and benefits, involving all parties affected need to be ensured*." (Kyriazi et al., 2015, p 47).

Listing potential social goals in the NSB and comparing them against biodiversity goals can bring to light possible synergies as well as where trade-offs will have to be explored. Burt et al. (2014), looked at synergies and trade-offs in addressing some social objectives in the context of the Canada-BC MPA strategy's biodiversity protection objectives. They gave examples of potential social goals and strategies to meet them. In partnership with stakeholders and experts, these and others could be explored and aggregated for the NSB region as part of MPA network design and then tested against biodiversity goals and strategies to understand and mitigate where needed. The social goal categories in their report were: marine livelihoods and food security, non-monetary and intangible benefits, culture and history and education and knowledge sharing (p. 38).

Table 1: Unpacking the social goal to maintain "Marine Livelihoods and Food Security," from Burt et al. (2014).

Social Theme	Social Goal	Strategies and Practices
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
		Support local initiatives to grow the tourism industry
		Identify and develop alternative economic opportunities linked to marine resources within and outside of the MPA network
		Provide entrepreneurship and marketing training for new local marine-based enterprises
	Support local employment in the implementation and management 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

5. Summary of Good Practices Highlighted in this Report

In this section, the report's highlighted good practices and recommendations are compiled and re-ordered according to themes. Justification for each of these can be found in the sections of the report where they first appeared.

On best practices

Our literature review has broadly concluded that at a detailed technical level, clearly established and globally applicable 'best practices' relating to socio-economic trade-offs, analytical tools, or methods, do not currently exist. (However, many *good practices* can be found in the literature, of which some key ones are highlighted here.) → ***Section 2.3***

On MPA planning

1. **The Canada-BC MPA Strategy contains multiple objectives which define the broad purpose of MPA planning - these should be developed into more specific operational guidelines to help steer the design of the MPA network**. (The MPAT has already taken steps to ensure this happens.) → ***Section 3.8.4***
2. **An MPA selection process should be designed to fit the legal, institutional and political context, with the financial resources and human capacity available.** → ***Section 3.8.2***
3. **Within the BC context, it is recommended that MPAs be designed and implemented through government to government relationships reflecting First Nations rights and title, and historical use of marine and coastal areas.** (The MPAT with its tripartite structure (Federal-BC-First Nations) is well placed to ensure that this occurs.) → ***Section 3.8.3***
4. **The stakeholder engagement strategy should be transparent and consistent throughout the process. Whatever level of stakeholder participation is chosen for the NSB, the governments' expectations regarding the roles of stakeholders should be made clear from the beginning.** → ***Section 3.8.2***
5. **The first step in the MPA rules of engagement should be to gain acceptance from all participants to mutually respect and listen to each other's perspectives.** → ***Section 3.9.2***
6. **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. **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***
8. **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.***
9. **In the NSB context, methodological approaches and process design should be selected to reflect the time and resources available. Thus, as a starting point, the amount of funding available and political commitment will need to be known, to help justify why certain technical analyses will or will not be undertaken.** → ***Section 3.8.6***
10. **We would suggest beginning planning process generally with relative values, but gradually migrating to absolute numbers as the process progresses towards decisions around MPA designations**. → ***Section 3.4.2***

11. **Strategies should be considered for mitigating/compensating for social-economic impacts of MPAs and MPA networks on regional communities. → *Section 3.9.1***
12. **Care should be taken to avoid making decisions that become skewed towards sites where better information exists. → *Section 3.7.3***
13. **Care should be taken if local and/or traditional knowledge is to be used alongside western scientific knowledge, to ensure that this has buy-in from all institutions with decision-making powers.** (This may already be the case in the BC context). **→ *Section 3.7.3***
14. **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***
15. **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***
16. **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***

On Marxan, planning tools, and data

17. **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***
18. **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***
19. **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***
20. **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***
21. **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***
22. **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***
23. **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***
24. **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***

25. **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***
26. **Socio-cultural-economic data gathering strategies need to mesh with the wider stakeholder engagement strategy employed by the MPA planning and implementation process. → *Section 3.7.2***
27. **Where specific data are missing, consideration should be given to the use of data proxies / surrogates in combination with stakeholder consultation.** (If surrogates are used, care should be taken to use them at appropriate spatial scales, and analysis outputs need to be interpreted and communicated thoughtfully to ensure that relevant uncertainties are clear. Wherever possible, relevant stakeholder groups should be consulted for feedback on the validity of using the surrogates for their intended purpose.) → ***Section 3.7.2***
28. **On-going environmental research and monitoring programs should be integrated as part of the MPA planning process in the NSB, feeding into monitoring and evaluation, and ideally, adaptive management. → *Section 3.7.2***

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7. Appendix 1: Case Studies

7.1. British Columbia Marine Area Planning Process (MaPP)

7.1.1. Introduction

The Marine Area Planning Process (MaPP) was a co-led planning initiative between the Province of BC and regional First Nations that began in 2011 and whose purpose was to develop marine use plans for BC's North Pacific Coast that would be recommended for implementation by the BC Government (www.mappocean.org). The parties involved in the process were: the BC Ministry of Forests, Lands and Natural Resource Operations, Central Coast Indigenous Resource Alliance, Coastal First Nations-Great Bear Initiative, Council of the Haida Nation, Nanwakolas Council, and the North Coast-Skeena First Nations Stewardship Society. The planning process officially concluded in April 2015 when the four sub-regional marine plans were completed. These plans include:

- "Management objectives and strategies that support positive change and reinforce our approach to decision-making, stewardship, economic development and healthy coastal communities.
- Spatial zoning that identifies marine areas for special uses, protection and general use.
- Plan implementation, monitoring and amendment information which describes how we will move forward with the plans and how changes can be made". (BC Government Press Release April 27, 2015)

The next phase of the MaPP process, now underway involves developing implementation agreements and implementing the plans within the subregions on BC's North Pacific Coast. A regional action framework which integrates work in the subregions is still being developed. This short case study highlights some of the key elements of the process and addresses some specific areas that may offer guidance in development of MPAs in BC.

7.1.2. Governance

The process was governed by a letter of intent signed between the BC Government (Ministry of Forest Lands and Natural Resource Operations) and representative organizations for the 18 First Nations who originally joined this process. The letter states that "The Parties intend to undertake collaborative planning efforts for coastal and marine areas in four identified "sub-regions" of the Pacific North Coast (Haida Gwaii, North Coast, Central Coast and North Vancouver Island) (2.2) and "Notwithstanding and without prejudice to diverging viewpoints regarding ownership and control over coastal and marine lands and resources, the Parties intend to undertake coastal and marine planning for marine ecosystems and human well-being" (2.5). (Letter of Intent, 2011). This letter of intent also set up the governance structure for the process that included an Executive Committee, a Marine Working Group, Sub-Regional Technical Teams, a Science Committee and a Marine Coordination Team.

The process was advisory only, not consensus based and representation was unique to particular issues and circumstances in each sub-region. For example, the North Vancouver Island Advisory Committee did not have an academic seat, but the other three sub-regional tables did. Similarly, the North Vancouver Island table had separate representation for shellfish and finfish aquaculture, the North Coast table had one representative covering both finfish and shellfish aquaculture, and the Haida Gwaii table had no aquaculture representation at all.

One of the governance challenges facing MaPP was that the Federal Government declined to participate, and so Federal involvement and harmonization is now being pursued instead as part of the implementation phase. MaPP arose, in part, in response to a previous Federal-Provincial process known

as PNCIMA (Pacific North Coast Integrated Management Area) process which produced some overarching strategic goals at a LOMA (Large Ocean Management Area) scale. "The two marine processes are complementary, but deal with different issues at different scales" (MaPP website FAQ, 2015). "MaPP plans provide direction on areas under provincial jurisdiction, which include:

- Coastal and marine tenures for specific activities
- Provincial seafood development programs
- Marine conservation
- Community, social and economic programs related to marine and ocean interests
- Marine spill preparedness and response programs" (MaPP website FAQ, 2015)

7.1.3. Stakeholder Involvement

The process included expensive involvement from stakeholders in an advisory capacity at the four sub-regional tables on Advisory Committees and also on a Regional Advisory Committee. Each stakeholder representative was formally vetted through a submission process and worked within a Committee Terms of Reference unique to each sub-region, or to the regional process. Agendas and minutes for all meetings were posted on the MaPP website and available for anyone to review: http://mappocean.org/resources/meeting-agendas-minutes/ One of the other challenges MaPP faced was that this process design was advisory only. Stakeholders were providing advice to the BC Government and the First Nations partnership about issues in their sectors, or reflecting their interests. This can cause challenges as each sectors may feel it would achieve more dealing with its specific interests bi-laterally with the relevant minister and ministerial staff rather than as advisers at the multi-sectoral MaPP table. Another stakeholder issue that was well dealt with was the need for supporting capacity of some sectors (e.g., recreation) to participate, by providing stable funding for them to travel to meetings, and engage their constituencies.

The process used a collaborative software tool called SeaSketch to let stakeholders look at the data layers in the region and both help learn about the MaPP area and also use it to make proposals about zoning and activities. This illustrates one way to maximize the positive interactions with data and with other stakeholders in a planning process.

7.1.4. Overall Design

The MaPP process used an ecosystem-based management (EBM) framework which integrates:

1. "Ecological integrity: which describes ecosystem connectivity and habitat and species diversity. It is focused on ecosystem structure, function and resilience.
2. Human well-being: which is the combination of social, economic and cultural aspects of human communities, including spiritual and cultural connections to the marine environment.
3. Governance (and collaborative management) which focuses on a collaborative, effective, transparent and integrated governance and management, as well as public engagement." (Mapp website EBM, 2015)

Detailed analysis involving data and stakeholder input led to initial high level objectives developed within the EBM framework. These led to strategies, actions and zoning for each subregion. Examples of those are shown below. MaPP used a multiple zoning approach involving General Management Zones (GMZ), Special Management Zones (SM), and Protection Management Zones (PMZ). This multi-zoning planning reflected an integrated management approach to marine conservation and use that shows the potential for complementary activities. One of the challenges with the variety of objectives, strategies,

actions and zoning in the plan was that a range of types of implementation measures was presented, and some were stronger and more realistic than others. In general, the conservation actions were seen by some table members as more implementable than many of the economic development actions. For example, language in many of the economic focused strategies includes 'soft' language like: encourage, facilitate, work with, coordinate, etc.; whereas language in many of the protection focused strategies includes 'hard' language like: assess, develop, establish, investigate, identify, determine, undertake, etc.

7.1.5. Marine Protection Summary

The Protection Management Zones followed the International Union for the Conservation of Nature's (IUCN) protected area management categories and involve 10% of the North Vancouver Island subregion, 17.53% of the Central Coast subregion, 12.76 % of the North Coast subregion, 29.6% of the Haida Gwaii subregion. The MaPP marine plans have offered up substantial potential marine protection areas for the NSB that can now be folded into the Canada-BC MPA Network Strategy Process. This is a good example of maximizing the positive as much of the data collection, area identification and stakeholder discussion has already happened. In addition, these areas are seen as complementary to other activities in other zones.

7.1.6. Funding

The MaPP process used a public-private funding model which meant a sufficient and stable level of funding was provided to the process during its existence. Funding from a private philanthropic foundation supported both government involvement as well as stakeholder participation. However, this also caused challenges as some felt that this private funding could compromise the independence and credibility of the process. This was dealt with through "a specific MOU [memorandum of understanding] and amendment in place that segregated the responsibilities, criteria and decision-making authorities of the parties, and Tides Canada Initiatives Society, which administered the funds" (MaPP website FAQ, 2015). For the implementation phase, there are many activities proposed which need funding in order to proceed. This second stage of funding has not yet been fully secured creating a challenge for implementation.

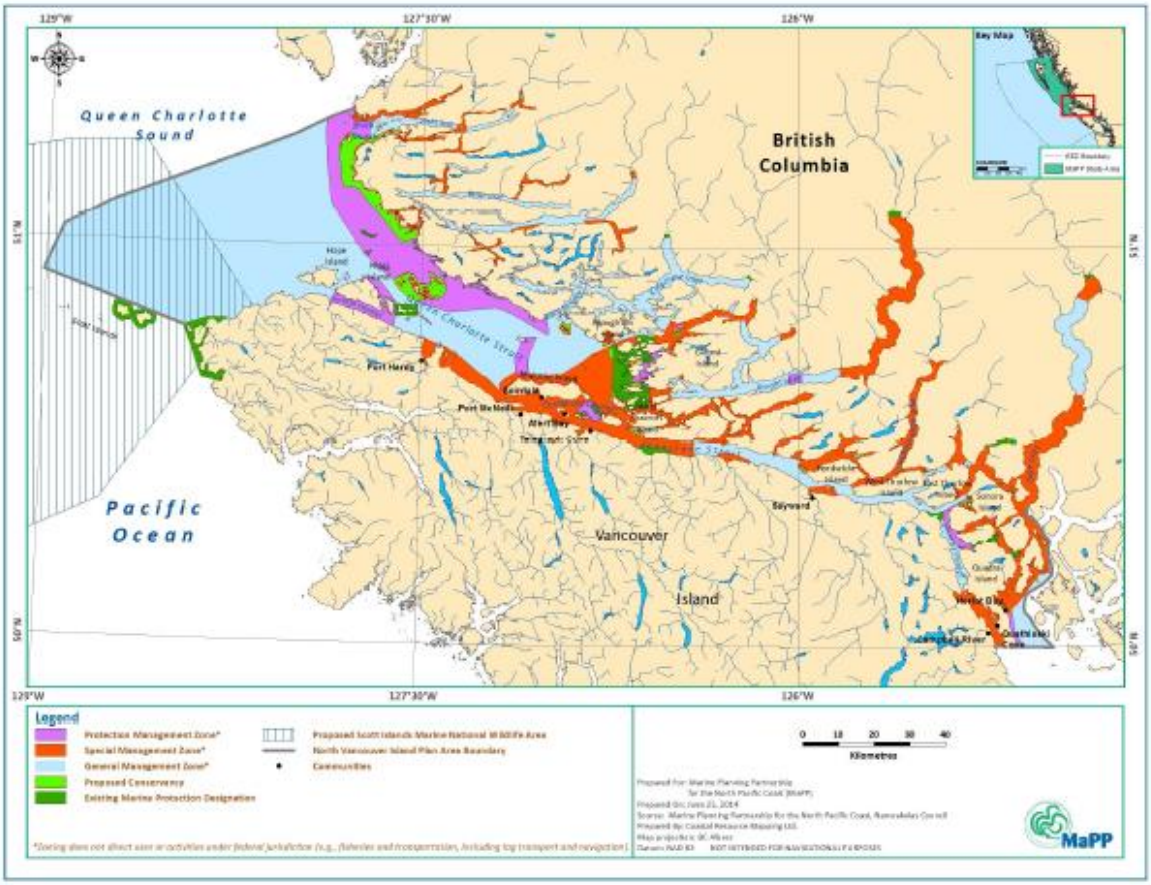
7.1.7. Summary

The MaPP process offers some guidance for the Canada-BC Network MPA team. This includes the use of a nested approach to planning through the use of regional and sub-regional teams; creating multiple-use zones that still include a high percentage of marine protection; recognizing the potential for complementary strategies that include both protection and use, and using tools like Seasketch that help with understanding data and improving collaboration in a planning process. Finally, the MaPP process also now offers a suite of potential protected areas that can provide a starting point for the upcoming Canada-BC MPA network process.

Table 2: Example MPA Objectives and Strategies (North Vancouver Island Marine Plan 2015, pg. 54)

4.3.4 - Issue 1. Adequacy of existing marine conservation and protection areas	
Objective	**Strategy**
O.1.1 Identify and support new marine conservation and protection areas for a range of requirements and values.	S.1.1.1 Through applicable processes identify and propose new conservation and protection areas for ecosystem and species representation and resilience, special or unique marine areas or features, and protection of First Nations cultural resources. *Ongoing activity, no new funding or resources required*
	S.1.1.2 Support the formal designation of provincial conservancies identified prior to the initiation of this Plan. *Ongoing activity, no new funding or resources required*
	S.1.1.3 Undertake protection management planning for Protection Management Zone areas approved as part of this Plan. *Start within 12 months, new funding or resources required, governance structure required*
4.3.4 - Issue 2. Adequacy of existing marine conservation and protection tools	
O.2.1 Improve available tools for marine conservation and protection.	S.2.1.1 Use interim protection measures (such as temporary Notations of Interest and/or map reserves) as a tool for managing proposed marine conservation and protection areas until a formal determination is made. *Start within 6 months, no new funding or resources required*
	S.2.1.2 Review the adequacy of existing protection tools to accommodate a broader range of marine values. *Start within 12 months, new funding or resources required*
	S.2.1.3 Through application processes develop and apply, where appropriate, new tools for achieving marine protection and conservation objectives, such as the Indigenous Peoples' and Community Conserved Areas and Territories designation. *Start within 12 months, new funding or resources required*
	S.2.1.4 Enhance the provincial government's Conservation Framework by incorporating marine ecosystems and species. *Ongoing activity, no new funding or resources required*

Figure 1: Plan Area Zoning Designations (North Vancouver Island Marine Plan 2015, pg. 85)



7.2. Marine Conservation Zone planning in England case study

7.2.1. Introduction

The 2009 Marine and Coastal Access Act made provision for Marine Conservation Zones (MCZs), a new type of Marine Protected Area that is designed to work in conjunction with existing MPAs (principally European designations created under the Birds and Habitats Directives) to form a network which would bring protection to a full range of marine biodiversity.

The Marine Act specifically allowed planning to 'have regard to any economic or social consequences', although it did not specify how sites would be identified.[12] This was a very different approach from designation of European designations (Special Areas of Conservation and Special Protection Areas) which are identified on solely on basis of science with no requirement to involve stakeholders.

The process to identify MCZs in England was overseen and delivered by Government's statutory nature conservation advisors: Natural England and the Joint Nature Conservation Committee through four regional, independent projects: Finding Sanctuary (South West England), Balanced Seas (South East England), Net Gain (North East England) and the Irish Sea Conservation Zone project (West England). The projects were based on the experiences of a pilot project (Finding Sanctuary) which had been running in the South West region since 2005. This pilot project had looked carefully at the experiences and approaches being used in California and ultimately all four regions adopted several components such as an independent science advisory panel, ecological targets and facilitated stakeholder groups. The planning areas in England were much bigger, extending out in some cases to 200 nautical miles and a total area of 93,000km^2, whereas in California the planning area extended to 3nm (the limit of state waters).

Natural England and the Joint Nature Conservation Committee set out the timescales and roles of the various groups involved in the process within Project Delivery Guidance[13]. They also provided Ecological Network Guidance[14] which set out the targets for what the networks should achieve, having commissioned independent research on connectivity, representativity and viability.

In September 2011, regional projects recommended a total of 127 MCZs. Following a formal consultation and Impact Assessment, Government have since implemented 50 sites in two phases in 2013 and 2016.

7.2.2. Key lessons from the English MCZ process

Maximise the positive

Solid underpinning legislation

[12] This approach was opposed by conservation organisations who felt that the socio-economics would take priority and sites of low ecological value would be selected. Following the process, this view was echoed once more by the Science Advisory Panel in their report, 'the identification of locations for protection has relied greatly on socio-economic considerations with biodiversity often of secondary consideration or taken into account late in the process.'

[13] http://jncc.defra.gov.uk/pdf/MPA_100325_MCZPDG_DRAFT_MARCH10.pdf

[14] http://jncc.defra.gov.uk/pdf/100705_ENG_v10.pdf

Stakeholders invested many hours involved in the planning of MCZs. Their motivation was through either a sense of opportunity or threat from the existence and location of MCZs. Their participation was also motivated by a recognition that they were involved a formal process that was set up by, and reporting to Government. The underpinning legislation within the Marine Act provided a clear legal intent to identify and designate MCZs. The relevant sections of the act, essentially state that a network of conservation sites (s123) should be designated (s117) to protect representative marine features and that their planning should consider economic and social consequences (s117).

Time

A collaborative process is complex and requires more time for stakeholders to build relationships and learn to trust one another so that they can work effectively. During an 18-month process, stakeholders evolved from being suspicious of the process and each other, to working productively and co-operatively. They built up a good technical understanding and a knowledge of issues beyond their own sectors. They shared a mutual responsibility for meeting ecological targets and often helped each other to find potential win-win solutions. This level of trust and co-operation was particularly strong amongst those on working groups that were meeting at monthly intervals for one or two-day planning meetings.

Maps

Data was provided in the form of large format (A2) size maps. These maps were an effective tool that allowed stakeholders to discuss options and look for trade-offs with each other. Low tech 'printed map's provided a useful communications tool through which stakeholders could talk about their activities in a spatial context. The use of marker pens and acetate overlays (to capture information) was a successful 'low tech' solution that helped to break down barriers and encourage group working. GIS analysis and other tools were used to provide feedback to stakeholders on progress towards meeting targets.

Independence

Having project teams that were independent of Government allowed them to work flexibly and innovate quickly to solve problems that arose without a large bureaucratic structure.

Professional facilitation

The use of professional facilitation in three out of four projects was recognised as an important component. Their role in designing the overall process and in each meeting. Helping stakeholders to understand how to cope with uncertainty.

Transparency

The stakeholder process was transparent and open. Reports of all meetings and maps of decisions as they developed were available to the public through the project website. In contrast, the Government decision making process that led to the selection of 50 out of 127 has been more opaque which has led to a loss of support and ownership.

Management implications

In order for stakeholders to understand the implications of their decisions they need to know what the activities are (or are likely to be) restricted. The UK uses a 'reactive' system of management in the UK, in which proposed activities are assessed for their impact on a protected feature before a licence can be granted. This is not conducive to stakeholder decision making. Management implications for different features or types of MPA need to be provided to stakeholders. In Finding Sanctuary, stakeholders overcame this uncertainty by qualifying their recommendations with their own assumptions. 'Because of the uncertainty, the conflicts that emerged during the stakeholder groups' discussions were based on a

mixture of fears, hopes, suspicions and assumptions on how MCZs would (or would not) impact on human activities. They included disagreements about assumptions on what restrictions will or should be put in place.' (Lieberknecht et al. 2013) A collaborative process for MPA design has to be provided with a clear indication of activities that will be allowed and/or restricted within a specific designation or habitat.

Minimise the negative

Science Advisory Panel
The use of a formal scientific review panel provided on balance were a negative factor within the MCZ process. Although they provided useful and pragmatic scientific advice; they ultimately undermined the stakeholder recommendations since they judged the MCZs separately based on their underpinning evidence. Stakeholders had been tasked with designing a network to meet ecological targets on the basis of best available evidence. An external scientific group should have a role that is supportive and collaborative rather than as an arbiter of merit or validity of stakeholder outputs. Secondly, the inclusion of other disciplines such as social science, ecosystem services, systematic planning would strengthen the role of the group.

Public consultation within a collaborative process
A public consultation took place a year after the recommendations were made and the stakeholder groups disbanded. Asking for views on individual sites encourages a polarisation of responses since organisations will be incentivised to provide more oppositional views since they are now 'outside' the process. There was also no opportunity for stakeholders to respond to the feedback or improve their recommendations. The use of consultations alongside shared decision making processes need to be carefully considered if they are not to undermine the shared ownership and consensus reached. They would be far more effective as a means of eliciting a broader user and public response integrated into a stakeholder decision-making process.

Political ownership and support
It is important that all levels of Government and associated authorities are fully supportive of the methodology used for decision making and the extent of power or responsibility that is handed over to stakeholders. Whilst some sectors of Government fully embraced and supported a collaborative approach, others were anxious about handing over responsibility to stakeholders or uninformed about why and how it was different from a collaborative process. This led to a clash of cultures during the final stages of the process, which undermined the stakeholder consensus that had developed.

Appropriate checks and safeguards for areas of ecological importance
The MCZ process failed to identify 'Areas of Particular Ecological Importance' (APEI). This criterion was not one of the key 'design principles' but a 'further consideration' to 'prioritise areas of high natural biodiversity' and pay particular attention to 'important areas for key life cycle stages of species such as spawning, nursery or juvenile areas'. Areas of high ecological importance are also usually important fishing grounds, therefore in deliberations the importance of fishing and livelihoods pushed this 'nice if you can' requirement to the side. The need to include areas of high ecological importance should have been given greater strength and more robust guidance to ensure that they are included.

Evidence benchmark
The guidance at the start of the process was for recommendations to be based on *best available evidence*. Stakeholders sometimes questioned the quality of data, particularly where it was modelled or

conflicted with their own first-hand experience. Eventually they were able to overcome this barrier to progress with the work. However, towards the end of the process Government produced new guidance on levels of evidence[15] which created higher 'evidence based' requirements. This meant that many of the recommended MCZs did not have 'sufficient' evidence and undermined both the stakeholder ownership and overall network integrity. Government have so far spent in excess of £4 million on surveys to gather additional data in recommended MCZs. The level of scientific data used in a stakeholder-driven project needs to be proportionate to their ability to absorb and use it effectively in meetings. Furthermore, a network designed to meet systematic design goals will inevitably have a range of data underpinning it; therefore, evidence requirements have to be 'best available'. If high evidence requirements are legally or politically required, a consultative process would be more appropriate.

7.2.3. Recognising and considering full range of uses, activities and values

Engagement with stakeholders through participatory mapping

All of the MCZ projects employed full time liaison officers. In many cases they included fishermen, as it was recognised that this sector is traditionally hardest to reach. The role of liaison officers was to engage with stakeholders through sector meetings, one-to-one chats on the beach or quayside and to gather spatial activity data. When the MCZ project started there was very little data on the spatial pattern of use for the inshore fishing sector and recreational sectors. Collecting data on activity through individual and group mapping exercises proved to be a valuable tool not only to gather data, but also to involve fishermen, anglers, divers and sailors at an individual and club level.

[15] http://jncc.defra.gov.uk/pdf/110506_LevelsOfEvidenceForMCZs.pdf

Table 3: Chronology of events

January 2005	Finding Sanctuary project starts
April 2007	Finding Sanctuary pilot project launched
September 2009	National MCZ Project Board established and role of regional projects formalised
March 2010	Project Delivery Guidance published
June 2010	Ecological Network Guidance published
September 2011	Final recommendations from regional projects
July 2012	JNCC and Natural England formal advice to Defra
July 2012	Impact Assessment published
December 2012 - April 2013	Public consultation on MCZs
November 2013	First tranche of MCZs (27) designated
December 2013	Parliamentary Environment Audit Select Committee inquiry launched
January 2016	Second tranche of MCZs (23) designated
2017 -2018	Consultation and designation of third tranche of MCZs

Figure 2: MCZ planning regions. The Finding Sanctuary project area is in blue.

4. Bibliography (England's MCZ Case Study)

There are a number of reports and published papers which analyse the UK MPA process more comprehensively:

Caveen A.J., Fitzsimmons C., Pieraccini M., Dunn E., Sweeting C.J., Johnson M.L., Bloomfield H., Jones E.V., Lightfoot P., Gray T.S., Stead S.M., Polunin N.V.C., Diverging Strategies to Planning an Ecologically Coherent Network of MPAs in the North Sea: The Roles of Advocacy, Evidence and Pragmatism in the Face of Uncertainty. In: Magnus L. Johnson and Jane Sandell, editors, *Advances in Marine Biology, Vol. 69*, Oxford: Academic

De Santo E.M., (2016) Assessing public 'participation' in environmental decision-making: Lessons learned from the UK Marine Conservation Zone (MCZ) site selection process Marine Policy 64 91-101

Jones, P.J.S (2012) Marine protected areas in the UK: challenges in combining top-down and bottom-up approaches to governance. Environmental Conservation 1-11

Lieberknecht, L.M., Qiu W., and Jones P.J.S. (2013) Celtic Sea Case Study Governance Analysis Finding Sanctuary and England's Marine Conservation Zone process MESMA Work Package 6

7.3. Great Barrier Reef Marine Park rezoning case study

7.3.1. Introduction

The Great Barrier Reef Marine Park (GBRMP) in Australia is coveted as one of the best examples globally of marine conservation (Fernandes et al. 2005). The Great Barrier Reef Marine Park Act was passed in 1975, establishing the 344,000km^2 marine park. The initial zoning scheme was implemented over the course of 1980s, with about 4% of the area designated as no-take areas (Ban et al. 2015) (Table 1). A review of one section of the GBRMP in the early 1990s indicated that the distribution of no-take areas was inadequate to ensure protection of biodiversity, with many bioregions not represented in no-take zones (Fernandes et al. 2005). The GBRMP Authority initiated the Representative Areas Program to examine options for rezoning the park (Day et al. 2002). From 1999 to 2003, the GBRMP Authority carried out extensive consultations, eventually resulting in implementation of a new zoning plan in 2004 that represented at least 20% of all bioregions in no-take zones, with 33% of the park now designated as no-take areas[16].

This case study highlights some of the lessons from the experience of rezoning the GBRMP. Lessons were drawn from the literature, and from four years of experience (by the main author of the case study, Natalie Ban) in Townsville, Australia, where the headquarters of the GBRMP Authority are located, and engaging in discussions with individuals involved in the rezoning process, within and outside of government. Decisions about protecting biodiversity were close entwined with enabling continued use of marine resources, and hence these are not separated into separate sections below.

7.3.2. Key Lessons from the GBRMP rezoning

Clear operational principles (biophysical, and social, economic, cultural and management feasibility) helped to achieve ecological objectives, and maximized positive and minimized negative impacts on people (Fernandes et al. 2005). In particular, the overall ecological goal of setting aside 20% of each bioregion as no-take areas set clear guidelines, and emphasized that the rezoning exercise was about biodiversity conservation (not fisheries, or any other use of the GBRMP). It was also emphasized that decisions were to use the best available biophysical and social science, and that lack of data should not prevent action (Fernandes et al. 2005; Day & Dobbs 2013). Indeed, the scientific advice of fully protecting at least 20% of each ecoregion has resulted in demonstrated ecological recovery within no-take areas (McCook et al. 2010) and spill-over benefits (Harrison et al. 2012).

The **existence of the GBRMP Authority** is part of the governance success of the GBRMP. The GBRMP Authority is the primary federal agency responsible for planning and management of the GBRMP. It is an independent statutory authority that has its own federal legislation, and is responsible to the federal Environment Minister (Day & Dobbs 2013). The independent role that the GBRMP Authority has been given (i.e., that it is not embedded within another federal agency) indicates the high level of commitment by Australia to protecting the Great Barrier Reef. The GBRMP Authority works in close collaboration with other jurisdictions to manage the GBRMP, and has a cooperative management arrangement with the State of Queensland, which owns waters within 3nm of shore. The GBRMP Authority has Traditional Use of Marine Resources Agreements with a number of traditional owners[17].

7.3.3. Recognizing and considering the full range of uses, activities and values

[16] Traditional use of marine resources is allowed with conditions in all zones (including the Green Zone, the main no-take zone) except for the Preservation Zone (Pink Zone, or no go zone).

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

There was **strong political** will to complete the rezoning process in a timely manner, including **allocation of sufficient resources** for the rezoning process. The rezoning process took five years, cost about AUD$12 million with over one thousand formal and informal meetings and some 32,000 written public submissions (Day 2011). Furthermore, timely completion of the rezoning process occurred because the federal government wanted to finish the task before a looming federal election (in 2004).

The rezoning process did not try to restructure all uses that might be affected, but rather focused on the stated goal of biodiversity conservation. In particular, **parallel processes assessed the sustainability of fisheries,** and actions needed to ensure long-term sustainability in fisheries, allowing the rezoning process to focus on its biodiversity conservation goals (Evans et al. 2014) (see Table 1 for some of the parallel fisheries planning that occurred).

An **extensive stakeholder engagement process** was adaptively managed to facilitate constructive input. For example, early experiences with large open houses allowed a vocal minority (largely opposed to increased biodiversity conservation) to dominate meetings. Smaller meetings, sometimes targeted to specific sectors, were found to be more constructive and allowed multiple perspectives to be heard. The focus thus shifted from an initial plan of holding fewer large open houses, to organizing many smaller meetings.

7.3.4. Maximize the positive

The consultation process focused not only on special interest groups, but also specifically sought **input by the general public**. Encouraging public input ensured that the existence and aesthetic values of the Great Barrier Reef were not forgotten. For instance, written submissions were encouraged. Indeed, such a large volume of written public submissions were received that the GBRMP Authority developed a web-based query tool to manage them (Day 2011).

The **practical guidelines** provided by the biophysical operational principles ensured that ecological objectives were achieved, and that **existing information could be used** without reliance on potentially time-consuming additional studies (Fernandes et al. 2005). For example, complex ideas such as connectivity were converted into compelling visuals that could communicate the ideas to stakeholders (e.g., Fig 1). This idea of connectivity was addressed in the rezoning by including some no-take areas that extended from estuaries to coral reefs. Furthermore, independent experts (e.g., university scientists) were used to lend credibility to the process (e.g., independent experts developed the operational principles and the reserve-design software that was used).

A **commitment to long-term monitoring** was designed to illustrate the effect of the GBRMP, including positive outcomes. The ecological Long-term Monitoring Program has existed for about 20 years, run by the Australian Institute of Marine Science. It surveys fish, corals and other bottom-dwelling organisms along the same section of reefs each visit, including inside and outside of no-take areas. Being able to show the ecological effect, especially increases in targeted fish inside no-take areas (Sweatman 2008, McCook et al. 2010, Sweatman et al. 2011), has contributed greatly to changing the opinions of some people who were initially opposed to the rezoning efforts into being advocates for the GBRMP. More recently, efforts are underway to complement the ecological monitoring with a Social and Economic Long Term Monitoring Program.

7.3.5. Minimize the negative

The use of a **conservation planning decision-support tool**, Marxan, helped to minimize impacts on users while meeting biodiversity conservation objectives. Spatial data about locations of fishing areas, and submissions received through the consultation process, were summarized and used as the “cost” within

Marxan. The outputs by Marxan presented options, but were not used as the final designs. Rather, they were used in consultations and discussions to get feedback about potential zoning options (Fig. 1).

It was acknowledged that the rezoning would have an impact on extractive users, and a structural adjustment package was put into place (e.g., buyback of fishing licenses) (Fernandes et al. 2005). While the intent was excellent, implementation of the structural adjustment package was problematic (Macintosh et al. 2010). Key problems were that clear criteria were not set for who was eligible, and over time more and more individuals and businesses received compensation. As a result, the initial estimates of compensation of about AUD $10 million spiralled out of control to ~AUD $250 million. Recommendations from this experience include putting in place robust structures that minimize opportunities for political interference and industry influence in structural adjustment projects (Macintosh et al. 2010).

Table 4: Major events characterising the management of the Great Barrier Reef Marine Park. Ecological disturbance events are in *italics*. From (Evans et al. 2014)

	Date	**Event**
Initial zoning system 1975-1999	1975	Great Barrier Reef Marine Park Act passed
	1979	Offshore Constitutional Settlement signed
		Great Barrier Reef Intergovernmental Agreement signed between Federal and State government
	1981	Great Barrier Reef World Heritage Area established
	1992/93	Aboriginal native title recognised
	1994	Fisheries Act passed
	1997	Dugong Protection Areas agreed
		AU$2.8 million license buyback in East Coast Inshore FinFish Fishery (net fisheries) as part of Dugong Protection Area Restructuring Package
		Tropical Cyclone Justin
	1998	National Representative System of Marine Protected Areas policy
		El Niño Southern Oscillation coral bleaching
Transition period 1999-2004	1999	Representative Areas Program commences
		Environment Protection and Biodiversity Conservation Act (EPBC) passed
	2000	Queensland East Coast Trawl Fisheries Management Plan published
		AU$20 million license buyback in East Coast Trawl Fishery removing 11% of effort
	2001	Croker Decision extending Indigenous Australian's rights to Sea Country
	2002	*Coral bleaching event*
	2003	Reef Water Quality Plan introduced
Re-zoned system 2004 - to date	2004	New Zoning Plan for the GBRMP passed and implemented
		Queensland Coral Reef FinFish Fishery Management Plan implemented

	Structural Adjustment Package framework to buy out or re-structure fishing businesses developed
	Queensland's Marine Parks Act passed and Great Barrier Reef Coast Marine Park established
2006	*Coral bleaching event in southern Great Barrier Reef*
2006/07	Amendment to the GBRMP Act of 1975
2008	Reef Water Quality Partnership and Reef Rescue program initiated
2009	*Tropical Cyclone Hamish*
2009	Guidelines for commercial operators in the Queensland East Coast Inshore Finfish Fishery published
2009	Great Barrier Reef Outlook Report published
2009	Great Barrier Reef Intergovernmental Agreement revised
2010	Queensland East Coast Trawl Fisheries Management Plan updated
2011	*Tropical Cyclone Yasi and coastal floods*
2012	UNESCO report on the Great Barrier Reef World Heritage Area
2013	AU$9 million license buyback in East Coast Inshore FinFish Fishery (net fisheries)

Figure 3. Poster showing connectivity from estuaries to offshore reefs for Red Emperor, used in the rezoning process to communicate the need for connectivity.

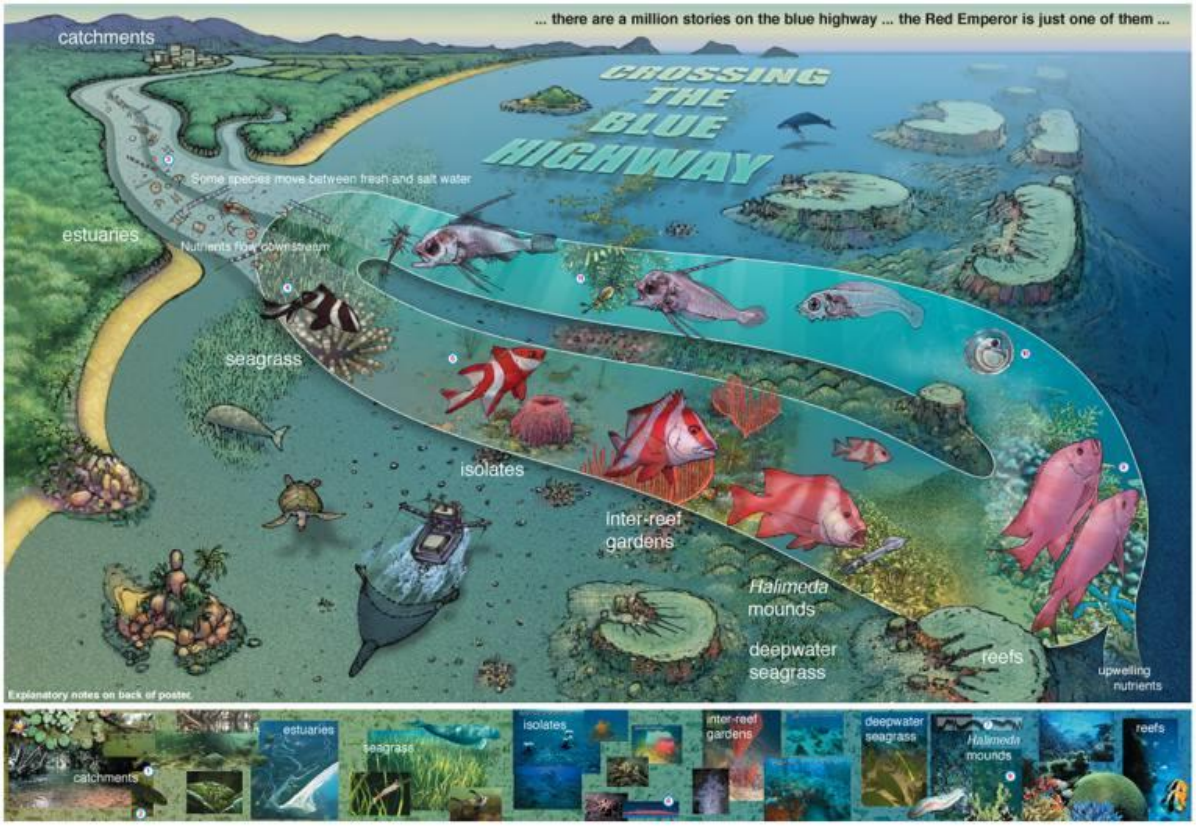
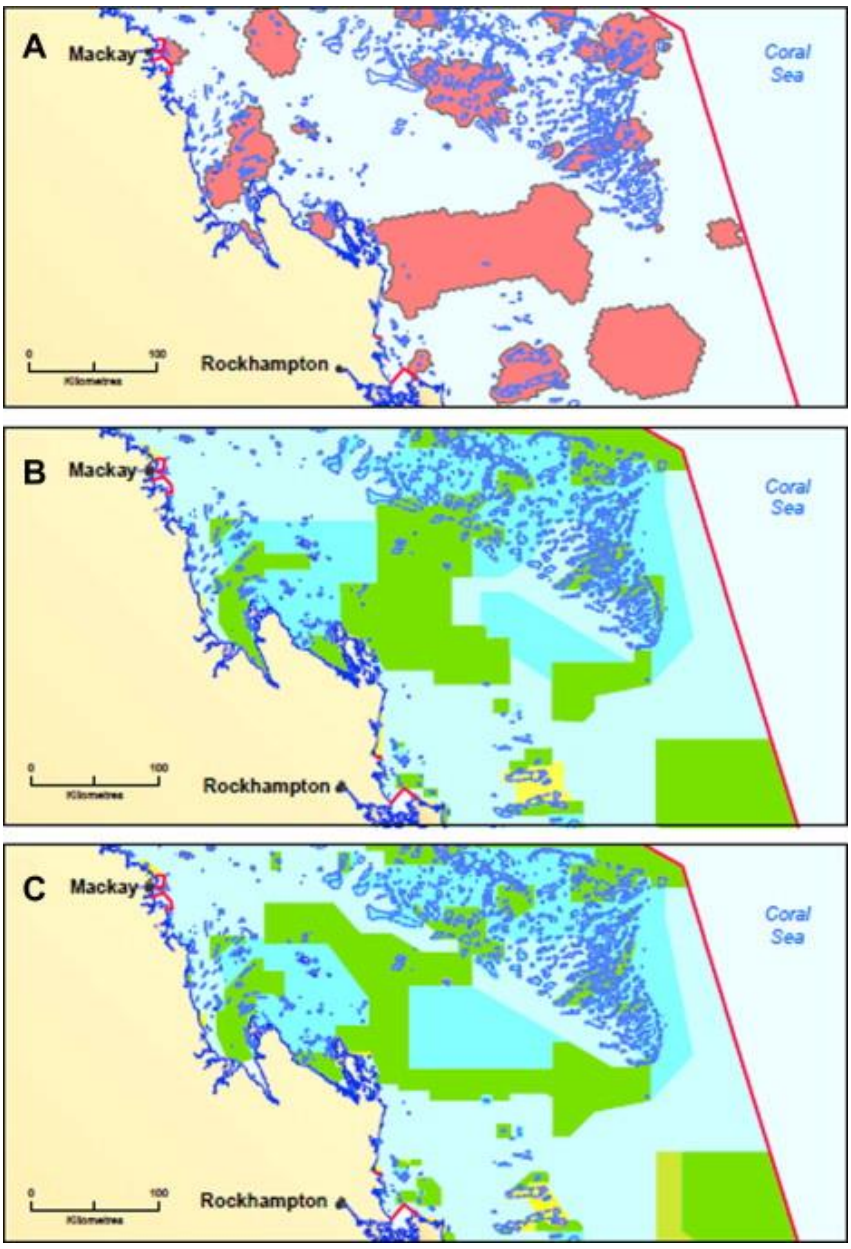


Figure 4. Taken from (Pressey et al. 2013). Progressive refinement of part of the regional design for the rezoning of the Great Barrier Reef Marine Park, implemented in 2004. The eastern red line is the outer boundary of the Marine Park. Outlines of reefs and islands are shown in dark blue. (A) Output from conservation planning software alone, showing clusters of selected planning units in red indicating potential no-take areas (see Lewis et al., 2003 for technical details). This configuration is from one of the later software iterations in early 2003. (B) Mid-2003, draft zoning plan released for public comment, including identification of multiple zones and adjustments of zone boundaries refined for ease of field navigation. (C) Mid-2004, final zoning plan, showing further adjustments of zones to deal with new data, including further information from public consultation. Zone colours: green = no-take; yellow = limited fishing; mid blue = benthic habitat protection (including prohibition of trawling); pale blue = general use. Map courtesy of the Spatial Data Centre, Great Barrier Reef Marine Park Authority, 2010.



7.3.6. Bibliography (GBRMP Case Study)

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9. Appendix 3: Literature review

(attached separately)