

# **Navigating Marine Ecosystem Services and Values**

by

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## Abstract

It is broadly recognized that local knowledge and values should play a prominent role in natural resource decision-making. This research was based on the concept of ecosystem services (ES), which are the ecological processes through which nature provides benefits to people. A primary methodological research goal was to test an interview protocol to solicit the verbal articulation, spatial identification and a quantitative measure of local monetary values, non-monetary values and threat intensities associated with marine ES.

This research identified and characterized a wide range of ways in which people value marine ecosystems in the Regional District of Mount Waddington in British Columbia, Canada to inform an ongoing marine spatial planning process. A total of 30 semi-structured interviews were conducted based on non-proportional quota sampling to target interviewees from across the district who have a variety of marine-related occupations.

The interview protocol was successful in eliciting emotive expressions of intangible benefits and values pertaining to ES. All interviewees verbally identified these benefits and values, but some (30%) refused to assign quantified non-monetary value to specific locations and others (16%) chose not to identify specific locations of non-monetary importance. Given that the spatial quantification of non-monetary values was not broadly acceptable, it is recommended that these research findings and methods complement deliberative processes to enable decision makers to more fully consider stakeholder's non-monetary values and threats associated with ES.

When explaining values and threats across the seascape, respondents bundled various services, benefits, and values associated with ecosystems. For articulating specific values, many used metaphors quite different from the implicit ES metaphor of *nature as service provider*. This protocol did not fully crowd out these alternative metaphors.

Based on the spatial analysis, there was significant overlap among all three pairwise comparisons of monetary values, non-monetary values, and threat intensity values. People tended to assign greater monetary and non-monetary value closest to inhabited locations. Employment in salmon aquaculture, the most divisive marine issue in the region, correlated with the perception that the ocean does not face environmental threat associated with this industry.

## **Preface**

Chapters 2 and 3 are intended to be stand-alone peer-reviewed manuscripts. I will be the primary author of these manuscript chapters. Dr. Kai Chan and Dr. Terre Satterfield are co-authors for the Chapter 2 manuscript. Dr. Kai Chan is a co-author for Chapter 3. Dr. Kai Chan contributed to the research design and writing of both chapters. He and Dr. Terre Satterfield provided guidance in the development of my research objectives, methodology and analysis. Dr. Kai Chan's extensive feedback on multiple drafts improved all chapters. I benefited tremendously from being part of a National Center for Ecological Analysis and Synthesis (NCEAS) working group on cultural ecosystem services. Dr. Terre Satterfield, a critical member of this group, played a lead role in developing a semi-structured interview script to elicit cultural ecosystem service values, which has been piloted in several case study regions including my own. I modified this interview script and blended it with spatial and quantitative interview prompts. Discussions with Jordan Levine about his work on conceptual metaphors contributed to Chapter 2. Dr. Terre Satterfield's pointed comments on drafts of Chapter 2 improved this research greatly. Dr. Kai Chan helped me determine appropriate statistical analyses to conduct in Chapter 3.

This research was approved by the UBC Research Ethics Board for human ethics, certificate H09-02192.

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## **Dedication**

I dedicate my thesis to the Richard Klains in my life, my father and grandfather.

They have always shared their love for the sea with me. Time after time, perhaps because I have not fully listened, they have reminded me of Mark Twain's words to "never let my schooling interfere with my education."

# **1 Introduction to Navigating Marine Ecosystem Services and Values**

At an unprecedented level of severity and scale of impact, humans are dominating and altering ecosystems, which often diminishes biodiversity and degrades the important goods and services that ecosystems provide (MA 2003; Halpern, Walbridge et al. 2008; Weinstein et al. 2007). Implementing ecosystem-based management (EBM) boldly promises to restore degraded ecosystems, safeguard remaining biodiversity, and enhance the capacity of the environment to meet people's needs (Lubchenco et al. 1991; Slocumbe 1993). With a broader vision than sector by sector management, EBM recognizes that management must consider both the long-term health of ecosystems and human well-being. EBM explicitly links social systems and ecosystems through the provision of ecosystem services (ES) (Lubchenco et al. 1991; McLeod et al. 2005), which are the ecological processes through which nature provides benefits to people (Levine and Chan in press). EBM considers multiple objectives as well as the cumulative impacts of different activities (McLeod and Leslie 2009).

## **1.1 Ecosystem Services Frameworks**

For both marine and terrestrial management, ES frameworks have considerable potential to account for a more complete range of the ecological processes that provide benefits to people (Kremen and Ostfeld 2005; de Groot, Wilson, and Boumans 2002; Tallis et al. 2008; MA 2003). Scientists and economists conducting ES research tend to measure ES in biophysical units (Worm et al. 2006; Balvanera et al. 2006; Palumbi et al. 2009) and assign monetary value to provisioning ES (e.g., food, fibre and fresh water), regulating ES (e.g., flood regulation, climate regulation) and supporting ES (e.g., pollination, nutrient cycling) (Costanza et al. 1997; Boyd and Banzhaf 2007; TEEB 2009).

ES researchers often refer to another category of *cultural ecosystem services* (CES), which are the contribution from ecosystems to the non-material benefits, such as experiences and capabilities, that people derive from human-ecological relations (Chan, Satterfield, and Levine 2009). After briefly recognizing CES, ES researchers largely ignores these less tangible contributions to well-being that are not necessarily appropriately expressed in utilitarian or economic measures. This research tests methods to facilitate the articulation of tangible and intangible values associated with the ocean in a way that can inform marine EBM.

## **1.2 Ecosystem Based Management for the Ocean**

Similar to terrestrial management, ocean management has historically been siloed by activity, such as fishing, transportation, aquaculture, and oil and gas. The multiple, interactive, and cumulative effects of this sectoral management has likely contributed to the degradation of marine biodiversity, fisheries, and entire ecosystems (Crowder, Osherenko et al. 2006; Young, Osherenko et al. 2007).

EBM for the ocean, which lags behind EBM for land (McLeod and Leslie 2009), poses different policy-related challenges compared to land management because the seabed, water column and marine resources tend to be publically owned and managed. Consequently, marine resource allocation and use tends to be publically rather than privately managed. Many marine resources are common pool resources (McLeod and Leslie 2009), which makes them potentially vulnerable to congestion or overuse and tends to require active engagement of the resource users to create rules to improve the sustainability of using the resource (Ostrom 1990).

Spatial management along with the incorporation of ecological, social, economic, and institutional perspectives is critical for EBM to address current ocean management challenges. Integrating these perspectives to develop marine use plans that support livelihoods through the long-term provision of ES poses formidable challenges. The scientific challenges are in part due to our limited understanding of marine ecosystem dynamics and how such changes impact ES provision (McLeod and Leslie 2009). This integration also has political challenges based on inevitable competing and at times incompatible objectives for various ocean-users (Crowder and Norse 2008).

## **1.3 Marine Spatial Planning: A Process for Zoning the Ocean**

Marine Spatial Planning (MSP) is an integrated process designed to advance EBM for the oceans. In addition to better accounting for biophysical, socioeconomic, and jurisdictional considerations, MSP promises to improve the management of multiple uses of marine space and reduce conflict among resource users (Douvere 2008; Ehler and Douvere 2009). Zoning the ocean is generally an outcome of a MSP process intended to manage multiple and frequently competing objectives of ocean-users. Zoning could contribute toward improving the health and productivity of ocean ecosystems (Botsford, Castilla et al. 1997; Pauly, Christensen et al. 2002; Lubchenco, Palumbi et al. 2003).

In broad terms, MSP is based on the analysis and allocation of marine space for particular uses to realize economic, ecological and social objectives that are identified in a political process (Ehler and Douvere 2007). Since MSP is linked to the priorities of political processes, stakeholders need opportunities to collaboratively identify the activities, benefits and values that they associate with marine ecosystems.

#### **1.4 Using Ecosystem Service Frameworks in Marine Spatial Planning**

MSP efforts are incorporating the ES concept (Crowder and Norse 2008; Douvere 2008; Halpern, McLeod et al. 2008) which has focused on provisioning ES (tangible goods and services that are often bought and sold), regulating ES (processes that maintain functioning ecosystems) and supporting ES (inputs to other services from ecosystems)(MA 2003). In contrast, CES, which can be associated with complex social and ethical concerns, have yet to be explicitly incorporated into MSP processes. In recognition of the marginalization of cultural values in the past in relation to managing natural resources (Turner et al. 2008; Jackson 1995), it is not certain that CES are expressed through or integrated into the political processes that set the goals and objectives of MSP. This research is an effort to facilitate and examine the articulation of tangible and intangible values associated with marine ES in a manner conducive to informing MSP.

#### **1.5 Research Objectives**

This research is intended to address challenges in the elicitation and representation of intangible ES and benefits. The methodological research goals in Chapter 2 are to (1) test the effectiveness of an innovative interview protocol designed to enable people to articulate what matters most to them in marine ecosystems; (2) identify obstacles to its effectiveness in collecting spatial and quantitative information through the analysis of why some are not comfortable spatially identifying or quantifying intangible values. This contributes to a better understanding of incommensurability in regards to ES, benefits and values. The findings particularly relevant to the case study region involve (3) exploring the extent to which resource users bundle ES, benefits and values; and (4) determining the extent to which the implicit ES metaphor of *nature as service provider* might ‘crowd out’ other metaphors of human-environment relations. This study aims to make progress in identifying and understanding a wider range of values associated with ecosystems than is typically considered in ES research.

The primary research goals of Chapter 3 are to (1) test methods to map monetary, non-monetary and threat values; (2) analyze the spatial distribution and correlation of monetary, non-monetary and threat values across individuals and aggregated categories of value and threat; and (3), determine the implications of these spatial distributions for how people perceive ES and benefits related to the hypotheses described below.

In Chapter 3, the analysis of the spatial correlation of monetary, non-monetary and threat values tests non-mutually exclusive hypotheses with potentially overlapping predictions. This research tests the hypothesis that people put more value on places that are closer to where they live. This prediction is based on aspects of the place-based theory of environmental evaluation, which states that the intensity of value associated with places are discounted the further away the places are from people's homes (Brown, Reed, and Harris 2002; Norton and Hannon 1997). This assumes that places that are closer to people's home are also more accessible, more visited and consequently more valued by the people who live nearby.

People may strongly associate non-monetary benefits with the places and practices from which they derive monetary benefits (Chan, Satterfield, and Goldstein in prep; Chan, Hoshizaki, and Klinkenberg in press). This research tests the hypothesis that areas of non-monetary and monetary value correlate for each individual.

Alternatively, people may assign the highest non-monetary value to pristine areas, places where humans have had minimal impact. Two derivative hypotheses from this speculation is that (1) non-monetary value is negatively spatially correlated with monetary value; and (2) non-monetary value is negatively spatially correlated with threat value. The first hypothesis could explained in light of people placing a higher non-monetary value on pristine areas chiefly because these regions are relatively untouched and not used for economic activities. Consequently, areas valued for non-monetary reasons would have little monetary value. A possible explanation for hypothesis 2 is that areas under threat are assumed to be heavily used and impacted by people. If people only value pristine areas, non-monetary value would not be associated with areas under threat.

This research also briefly tests the hypothesis that people employed in an industry will tend not to perceive environmental threats from that industry. Explanations for this perception will be explored.

The conclusion provides an overview of the research findings. This section outlines the strengths as well as limitations associated with this research as it relates to EBM, MSP and ES and highlights potential application of the study's results. Future research directions are also outlined.

## References

- Balvanera, P., A. B. Pfisterer, N. Buchmann, J. S. He, T. Nakashizuka, D. Raffaelli, and B. Schmid. 2006. Quantifying the evidence for biodiversity effects on ecosystem functioning and services. *Ecology Letters* 9 (10):1146-1156.
- Boyd, J., and S. Banzhaf. 2007. What are ecosystem services? The need for standardized environmental accounting units. *Ecological Economics* 63 (2-3):616-626.
- Brown, G. G., P. Reed, and C. C. Harris. 2002. Testing a place-based theory for environmental evaluation: an Alaska case study. *Applied Geography* 22 (1):49-76.
- Chan, Kai M. A., Lara Hoshizaki, and Brian Klinkenberg. in press. Featuring ecosystem services in conservation planning: less costly as costs. *PLoS Biology*.
- Chan, Kai M. A., Terre Satterfield, and Joshua Goldstein. in prep. Values & Ecosystem Services: Navigating Intangibility and Incommensurability. *Conservation Biology*.
- Chan, Kai M.A., Terre Satterfield, and Jordan Levine. 2009. National Center for Ecological Analysis and Synthesis cultural ecosystem services working group, proposed definition of cultural ecosystem services. Santa Barbara.
- Costanza, Robert, Ralph d'Arge, Rudolf de Groot, Stephen Farber, Monica Grasso, Bruce Hannon, Karin Limburg, Shahid Naeem, Robert V. O'Neill, Jose Paruelo, Robert G. Raskin, Paul Sutton, and Marjan van den Belt. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387 (15 May 1997):253-260.
- Crowder, Larry, and Elliott Norse. 2008. Essential ecological insights for marine ecosystem-based management and marine spatial planning. *Marine Policy* 32 (5):772-778.
- de Groot, R. S., M. A. Wilson, and R. M. J. Boumans. 2002. A typology for the classification, description and valuation of ecosystem functions, goods and services. *Ecological Economics* 41 (3):393-408.
- Douve, F. 2008. The importance of marine spatial planning in advancing ecosystem-based sea use management. *Marine Policy* 32 (5):762-771.
- Ehler, C., and F. Douve. 2007. Visions for a sea change. Report of the first international workshop on marine spatial planning. In *IOC manual and guides*. Paris: Intergovernmental oceanographic commission and man and the biosphere programme, UNESCO.
- Ehler, Charles, and Fanny Douve. 2009. Marine Spatial Planning: a step-by-step approach toward ecosystem-based management. In *IOC Manual and Guides No. 53, ICAM Dossier No. 6*. Paris: Intergovernmental Oceanographic Commission and Man and the Biosphere Programme, UNESCO.
- Halpern, B. S., K. L. McLeod, A. A. Rosenberg, and L. B. Crowder. 2008. Managing for cumulative impacts in ecosystem-based management through ocean zoning. *Ocean & Coastal Management* 51 (3):203-211.
- Halpern, B. S., S. Walbridge, K. A. Selkoe, C. V. Kappel, F. Micheli, C. D'Agrosa, J. F. Bruno, K. S. Casey, C. Ebert, H. E. Fox, R. Fujita, D. Heinemann, H. S. Lenihan, E. M. P. Madin, M. T. Perry, E. R. Selig, M. Spalding, R. Steneck, and R. Watson. 2008. A global map of human impact on marine ecosystems. *Science* 319 (5865):948-952.
- Jackson, S. E. 1995. The water is not empty: cross-cultural issues in conceptualising sea space. *Australian Geographer* 26 (1):87 - 96.
- Kremen, C., and R. S. Ostfeld. 2005. A call to ecologists: measuring, analyzing, and managing ecosystem services. *Frontiers in Ecology and the Environment* 3 (10):540-548.
- Levine, Jordan, and Kai M. A. Chan. in press. Global Human Dependence on Ecosystem Services.

- Lubchenco, J., A. M. Olson, L. B. Brubaker, S. R. Carpenter, M. M. Holland, S. P. Hubbel, S. A. Levin, J. A. Macmahon, P. A. Matson, J. M. Melillo, H. A. Mooney, C. H. Peterson, H. R. Pulliam, L. A. Real, P. J. Regal, and P. G. Risser. 1991. The Sustainable Biosphere Initiative - an Ecological Research Agenda - a Report from the Ecological-Society-of-America. *Ecology* 72 (2):371-412.
- MA. 2003. Millennium Ecosystem Assessment, Ecosystems and Human Well-being: A Framework for Assessment. Washington, DC: Island Press.
- McLeod, K. L., J. Lubchenco, S. R. Palumbi, and A. A. Rosenberg. 2005. Scientific Consensus Statement on Marine Ecosystem-Based Management. *Communication Partnership for Science and the Sea*
- McLeod, Karen, and Heather Leslie. 2009. Why Ecosystem-Based Management? In *Ecosystem-Based Management for the Oceans*, edited by K. McLeod and H. Leslie. Washington, DC: Island Press.
- Norton, B., and B. Hannon. 1997. Environmental values: a place-based approach. *Environmental Ethics* 19 (3):227-245.
- Ostrom, Elinor. 1990. *Governing the commons : the evolution of institutions for collective action, The Political economy of institutions and decisions*. Cambridge ; New York: Cambridge University Press.
- Palumbi, S. R., P. A. Sandifer, J. D. Allan, M. W. Beck, D. G. Fautin, M. J. Fogarty, B. S. Halpern, L. S. Incze, J. Leong, E. Norse, J. J. Stachowicz, and D. H. Wall. 2009. Managing for ocean biodiversity to sustain marine ecosystem services. *Frontiers in Ecology and the Environment* 7.
- Slocombe, D. S. 1993. Implementing Ecosystem-Based Management. *Bioscience* 43 (9):612-622.
- Tallis, H., P. Kareiva, M. Marvier, and A. Chang. 2008. An ecosystem services framework to support both practical conservation and economic development. *Proceedings of the National Academy of Sciences of the United States of America* 105 (28):9457-9464.
- TEEB. 2009. The Economics of Ecosystems and Biodiversity for National and International Policy Makers – Summary: Responding to the Value of Nature. Wesseling, Germany
- Turner, N. J., R. Gregory, C. Brooks, L. Failing, and T. Satterfield. 2008. From Invisibility to Transparency: Identifying the Implications *Ecology and Society* 13 (2).
- Weinstein, M. P., R. C. Baird, D. O. Conover, M. Gross, J. Keulartz, D. K. Loomis, Z. Naveh, S. B. Peterson, D. J. Reed, E. Roe, R. L. Swanson, J. A. A. Swart, J. M. Teal, R. E. Turner, and H. J. van der Windt. 2007. Managing coastal resources in the 21st century. *Frontiers in Ecology and the Environment* 5 (1):43-48.
- Worm, B., E. B. Barbier, N. Beaumont, J. E. Duffy, and C. Folke. 2006. Impacts of Biodiversity Loss on Ocean Ecosystem Services. *Science* 314:787-790.



## **2 Bundles of Marine Cultural Ecosystem Services and Values**

### **2.1 Introduction**

From overfishing to oil spills to habitat degradation, human activities around the world are unquestionably degrading ecosystems and consequently ecosystem services (ES)(Levin and Lubchenco 2008), the ecological processes through which nature provides benefits to people (Levine and Chan in press). The global scientific community has pushed for a more comprehensive assessment of nature's value to improve natural resource management and prevent further degradation (MA 2003; UNESCO 2003). To capture these frequently overlooked negative consequences of ecosystem degradation, ES research attempts to inform natural resource decision-making through better identification and consideration of the effects of resource use on human welfare (Wainger and Boyd 2009). This includes accounting for externalities, defined as the positive and negative consequences or side-effects of an activity that are not reflected in the market prices of goods or services (MA 2003).

Momentum for the ES concept has grown rapidly as demonstrated by its incorporation into ecosystem based management (Tallis et al. 2010; McLeod and Leslie 2009) and marine spatial planning (Crowder and Norse 2008; Douvere 2008; Halpern, McLeod et al. 2008). Various influential institutions have also begun to use ES frameworks and conduct ES research including the World Business Council for Sustainable Development (Hanson et al. 2008), the US National Oceanic and Atmospheric Administration (NOAA)(Tallis et al. 2010) and the U.S. Environmental Protection Agency (EPA)(SAB 2009).

ES frameworks have considerable potential in accounting for a more complete range of the ways that ecological processes benefit people (Kremen and Ostfeld 2005; de Groot, Wilson, and Boumans 2002; Tallis et al. 2008; MA 2003). Ecologists and economists have played a leading role in advancing ES science research, which has largely focused on biophysical units (Worm et al. 2006; Balvanera et al. 2006; Palumbi et al. 2009) and monetary valuation as it relates to provisioning (e.g., food, fiber and fresh water) and regulating services (e.g., flood regulation, climate regulation)(Costanza et al. 1997; Boyd and Banzhaf 2007; TEEB 2009).

### 2.1.1 Cultural Ecosystem Services

Numerous ES studies tend to briefly refer to a separate category of *cultural ecosystem services* (CES), defined as the contribution from ecosystems to the non-material benefits, such as experiences and capabilities, which people derive from human-ecological relations (Chan, Satterfield, and Levine 2009). After quickly acknowledging this subset of ES, ES research largely ignores these contributions to well-being that are not necessarily quantifiable in utilitarian or economic terms. Examples include fishing as a valued way of life, any sense of place inextricably linked to a non-built landscape, the transformative value of witnessing a spectacle of nature, the educational value of experientially learning about wildlife, and the sacredness of a particular wild place. These intangible values can provide strong motivation for protecting and restoring ecosystems. However, when assessing anthropogenic environmental change and making choices about the future use of natural resources, quantifying the importance of these intangible values and communicating them in economic terms tends to be controversial (Norton and Noonan 2007), particularly when decision makers are faced with development options that promise economic benefits but require altering natural ecosystems or subjecting ecosystems to additional anthropogenic risk (Turner 2000).

CES contribute to dimensions of well-being, for instance identity and sense of place. Well-being needs to be understood in more dimensions than monetizable attributes such as material living standards, income, consumption and wealth. Other crucial elements of well-being consist of health, education, finding meaning in personal activities including work and other activities, governance and political voice, social connections and relationships, the present and future condition of the environment, and physical and well as economic security (Stiglitz, Sen, and Fitoussi 2009). Just as decision makers increasingly recognize that GDP growth is often an incomplete or erroneous measure of social progress (Stiglitz, Sen, and Fitoussi 2009), there is growing recognition that using only dollar metrics or biophysical units (e.g., number of species) inadequately expresses environmental values associated with ES (Bockstael et al. 2000; Chan, Satterfield, and Goldstein in prep; Spash 2008).

Much ES research assumes that critical ES can be identified based on the biophysical characteristics of a region and brief interactions with relevant natural resource managers and stakeholders. For informing difficult natural resource decisions involving trade-offs, it is likely that a more comprehensive and systematic approach to identifying important tangible *and*

intangible ES in a region is warranted. Soliciting information from a wide variety of people about non-use, intangible and cultural values could inform decision-making. These types of values, which can be ethically charged or not instantaneously available to consciousness at a moment's notice (Satterfield 2001), may be difficult to ascertain.

Valuating intangible benefits including CES is fraught with challenges in the context of informing environmental decision-making. Determining what is most important to people in regards to ES can involve valuation methods structured around cost-benefit analysis (CBA). CBA can consider the monetized value of non-market goods derived from different types of non-market valuation methods (e.g., travel cost method, hedonic pricing, contingent choice models, contingent valuation)(Philcox 2007). CBA assumes that ES are amenable to disaggregation and that each ES can be valued separately in monetary terms (Pearce, Atkinson, and Mourato 2006). These valuation methods focus on consumer or individual preferences without soliciting citizen or societal preferences (Sagoff 1998). Another shortcoming of these types of non-market valuation is their reliance on dollar metrics without providing means for the expression of values grounded in moral concerns.

### **2.1.2 Incommensurability of Different Values**

A related source of controversy that arises in CBA involving non-market goods is *incommensurability*, which pertains to items that cannot be measured by the same value scale (Chang 1997; Chan, Satterfield, and Goldstein in prep). CES and related benefits can be incommensurable. Contributions to non-material benefits have no single unifying metric, e.g., the value of a sacred grove of trees cannot be quantitatively compared to the cultural value of subsistence fishing. In much ES research, dollars are used as a common metric (e.g. Costanza et al. 1997), but attempting to use dollars as a universal measure of value for CES can be morally offensive (Chiesura and de Groot 2003).

### **2.1.3 Protected Values**

CES may involve protected values, which are values that people are not willing to trade-off with other values, especially economic values (Baron and Spranca 1997). These types of values are problematic for optimizing across a variety of different values because individuals treat a protected value as if it was infinitely more important than others. Protected values, often associated with moral obligations, are characterized by quantity insensitivity in that violating this type of value once is as morally offensive as violating it multiple times (Baron and Spranca

1997; Ritov and Baron 1999). A protected value may be incommensurate with other values (not measurable according the same value scale). The more critical issue, however, could be that determining trade-offs involving protected values may not be feasible if people assume that they must sacrifice an important principle as part of a decision-making negotiation (Chan, Satterfield, and Goldstein in prep). Assigning a quantitative measure to a protected value could be interpreted as a method to inform trade-off decisions, such that any kind of quantitative characterization may be resisted by those who hold protected values.

#### **2.1.4 Value Pluralism**

To make progress in accounting for potentially incommensurate and protected values in decision-making, decision-making processes have been developed that allow *value pluralism*, which recognizes that people value nature in diverse ways and that equally correct values may be in conflict with each other (Norton and Toman 1997). Learning to manage the diversity of values is likely more important than reducing elements of nature to monetized costs and benefits associated with anthropogenic changes in ecosystems (Norton and Noonan 2007).

Values that are intangible, deeply held and/or based on ethics can be difficult for study participants or stakeholders to articulate if they are not provided with an appropriate opportunity for such expression (Satterfield 2001). To overcome this difficulty in communicating values not easily reduced or simply irreducible to economic terms, this research builds upon methods that advance *value literacy*, defined as the capacity for study participants to articulate the non-utilitarian characteristics and values that best convey why nature is important (Satterfield 2001).

#### **2.1.5 Enabling Articulatory of Cultural Ecosystem Services**

Based on environmental value literacy literature (Kalof and Satterfield 2005; Dietz, Fitzgerald, and Shwom 2005; Satterfield 2001; O'Neill, Holland, and Light 2007) combined with an ES typology of values, benefits and services (Chan et al. 2010; Chan, Satterfield, and Goldstein in press), it was anticipated that semi-structured interviews with narrative-based environmental value elicitation prompts would provide the opportunity for interviewees to share experiences and opinions that shed light on the contributions of ecosystems to their well-being, including CES. It was expected that semi-structured interviews would be an appropriate format for value elicitation because they can be well suited for expanding our understanding of both subjective and experiential topics (Lindlof and Taylor 2002), including values linked to ES (Cast et al. 2008).

This research tests the extent to which this innovative semi-structured interview protocol is effective in enabling people to articulate CES.

#### ***2.1.5.1 Bundles of Ecosystem Services, Benefits and Values***

Given the complexity of ecosystems and how people interact with them, ES research tends to be reductionist. Various services provided by nature are often classified and quantitatively valued (Slootweg, van Beukering, and November 2008; Rodriguez et al. 2006; de Groot, Wilson, and Boumans 2002). Reductionist approaches include separately valuing ES, often through modeling tangible ES through production functions based on cause and effect relationships between ecosystem processes and a commodity (Boyd and Banzhaf 2007; Nelson et al. 2009; Knowler et al. 2003; Chee 2004). Using a reductionist approach in accounting for CES could be problematic. It is possible that people may not perceive ES as distinct categories of benefits, which can be disaggregated then summed. Instead, people may value bundles of benefits that are particularly important because they occur together. For example, an individual may value recreational fishing for the physical activity, aesthetics of the experience, satisfaction in eating the catch and enjoyment in sharing both the activity and fish with others. The importance of the experience as a whole is likely not substitutable with fishing unsuccessfully in a fish-depleted area, then buying fish from a market.

To partially address the interconnectivity and interdependency of tangible ES, several analyses bundle provisioning and regulating ES across the landscape (Cumming and Peterson 2005; Bennett, Peterson, and Gordon 2009; de Groot et al. 2010; Nelson et al. 2008; Raudsepp-Hearne, Peterson, and Bennett 2010). In contrast to these studies that focus on the biophysical characteristics of places that provide multiple ES, this research explores bundles of tangible and intangible ES and benefits from the perspective of resource-users. This research explores the extent to which people tend to think of CES as bundles.

#### ***2.1.5.2 Use of Multiple Metaphors***

In contrast to how this research tests the extent to which people generally articulate CES as bundles, this research also examines how people articulate specific values in metaphorical terms. Metaphors are employed not simply for linguistic flourish, but for structuring how people understand the world and how we act (Lakoff and Johnson 1980). Critics of the ES metaphor contend that this metaphor constricts how people can legitimately value nature (Norton and Noonan 2007). The ES metaphor is only one way of characterizing the relationship between

people and ecosystems. Implicit use of this metaphor could inhibit the elicitation of intangible ES, benefits and values that may not be conceptually compatible with *nature as service provider*. The presence of alternative metaphors, including ones that possibly conflict with the concept of ES, may signal that the value elicitation protocol tested in this research does not fully crowd out other metaphors that people use to explain their relationships with ecosystems (Levine in prep).

#### **2.1.6 Research Goals**

This research both tests the effectiveness of an innovative value articulation method and documents findings that advance our understanding of CES. This research addresses some of the challenges in eliciting intangible ES and benefits, because it (1) tests an innovative semi-structured interview protocol for its ability to elicit stakeholders' articulation of what matters most to them in marine ecosystems. To better understand appropriate ways of characterizing what is important in marine ecosystems, this research (2) analyzes why some study participants are uncomfortable quantifying intangible values, which contributes to a better understanding of incommensurability in regards to ES, benefits and values. In characterizing how people articulate CES, this research (3) explores the extent to which resource users bundle ES, benefits and values. Pertaining to articulation, this research also (4) analyzes how study participants describe the value of nature using metaphors. This study aims to make progress in identifying and understanding a wider range of values associated with ecosystems than is typically considered in ES research.

#### **2.1.7 Paper Overview**

As revealed in semi-structured interviews conducted in northern Vancouver Island, Canada, this research explores the numerous tangible and intangible ES, benefits and values that people associate with marine ecosystems. Elicited through CES prompting, people's perceptions of the monetary and non-monetary value and threats are discussed across a seascape to which many are deeply attached. This research is an analysis of how people bundle ES, benefits and values together, linking them in descriptions of places, experiences and values connected to the sea. This research interprets how many interviewees did not employ the ES metaphor of *nature as service provider* when describing the importance of the ocean. Instead, several used metaphors that conveyed a more personal significance of the ocean in their lives.

## 2.2 Methods

### 2.2.1 Case Study Site

This research focused on how people explain the tangible and intangible benefits that they associate with or derive from the marine and coastal environment in the Regional District of Mount Waddington (RDMW), a relatively remote and sparsely populated region of British Columbia (BC), Canada (Figure 3.1). One local explained how his well-being was connected to this region:

*We lived on the water, we worked on the water, a lot of our food came from the ocean. We had our crab traps out, we had our prawn traps out, and we did a little bit of fishing now and then. And you're always cognizant of the fact that the ocean provided you with your wealth such as it was. But your food, your recreation, you were almost a marine animal. To go visit your friend or your neighbor you had to go on your boat or your kayak and paddle there and linger over. And they lived the same like you did and it was a wonderful life.*

Although not all interviewees were as intimately tied to the ocean as this respondent, this research explores how residents of the RDMW articulate the ways in which they rely directly and indirectly on marine ecosystems for their livelihoods and well-being.

Commonly referred to as the “North Island” since it spans the northern tip of Vancouver Island (Figure 3.1), the RDMW spans 9,880 km<sup>2</sup> of ocean and 20,288 km<sup>2</sup> of land. The study area is part of the Kwakwaka'wakw First Nation traditional territory. At 11,651 individuals in 2006, the population of the RDMW is 23.4% First Nation, 73.5% Caucasian and 3.1% other visible minorities. Between 2001 and 2006, the RDMW's population declined by 11.1%. The average family income of \$65,683 is substantially lower than the average BC family income of \$80,511 (BCStats).



**Figure 2.1 Regional District of Mount Waddington (RDMW)**

The RDMW boundaries are included in the inset map. This study focused on the different ways in which the nearshore and marine environment within the RDMW are important to residents.

Similar to many other regions of coastal BC, the communities of the RDMW face economic challenges. This region's economic issues are largely attributed to declines in forestry combined with the closure of a local mine in 2000 (Ellis 2000) and a substantial reduction in locally-based fishing fleets during the last 20 years (Young 2008).

The RDMW is part of the Pacific North Coast Integrated Management Area (PNCIMA). As of late 2010, communities within PNCIMA have been engaged in an ongoing marine spatial planning process to improve the integration of ocean management. The environmental values identified and explored in this research could contribute toward this planning process through the articulation of values, benefits and services associated with the ocean.

### **2.2.2 Sample**

Using non-proportional quota sampling, people who play an active role in marine resource management and people with livelihoods that rely on the ocean were interviewed. This sampling



method was used to solicit a wide range of values from engaged and knowledgeable stakeholders rather than trying to get a sufficiently high sample size for proportional quota sampling (Tashakkori and Teddlie 2003).

Project partners at the regional district government and Living Oceans Society, a locally-based marine conservation non-governmental organization, provided recommendations on whom to select for the in-depth interviews. When conducting in-depth interviews, the number of new concepts associated with each additional interview generally tends to diminish between 20-30 interviews (Morgan 2002). Accordingly, this research used a sample size of 30 since the goal was to identify a wide range of ways in which marine ecosystems are important to people.

#### ***2.2.2.1 Interviewees***

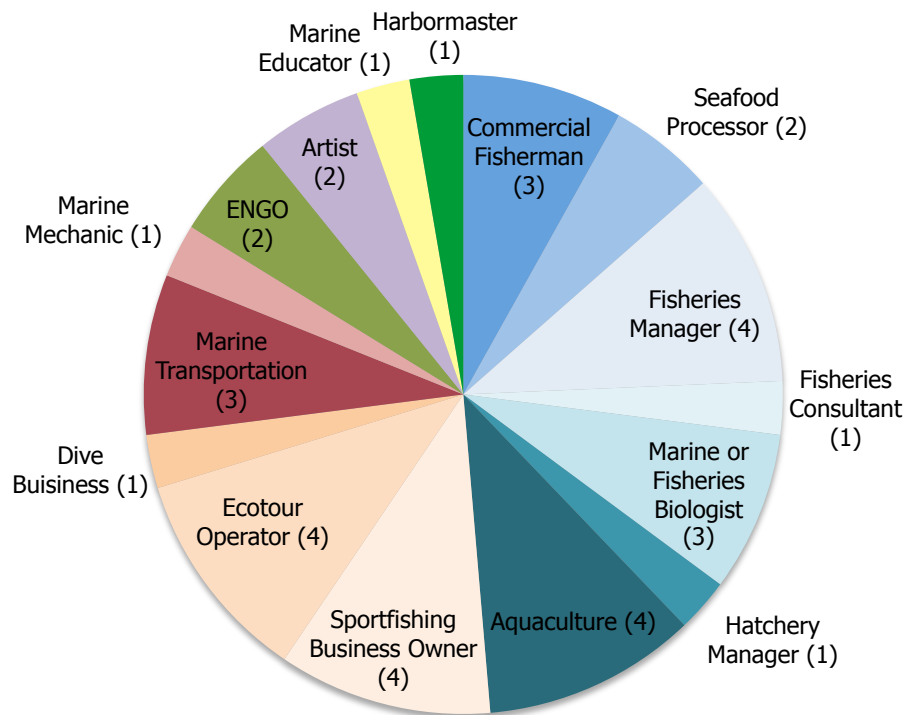
The interviewees included seven women and 23 men. This gender skew reflects the relatively higher number of men involved in marine-related professions than women<sup>1</sup>. Out of the 30 interviewees, two were members of the Kwakwaka'wakw First Nation<sup>2</sup> and 28 were Caucasian. As previously noted, First Nations represent 23.4% of the region's population (BCStats) but they were only 6.6% of the interviewees (2 out of 30). Effort was made to schedule interviews with additional First Nation fishermen and fisheries managers from other bands, but they did not occur due to time constraints and remoteness of many of their communities.

The length of time that interviewees lived within the RDMW ranged from 8 to 65 years, with an average of 30 years. The occupations of the interviewees represent a wide range of employment activities linked to the ocean (Figure 2.2). Interviewees were from ten communities in the regional district (Figure 3.3). Due to time and travel constraints, interviewees lived in towns accessible by roads, frequent ferries or short boat rides. This limited the representation of more remote communities in this study.

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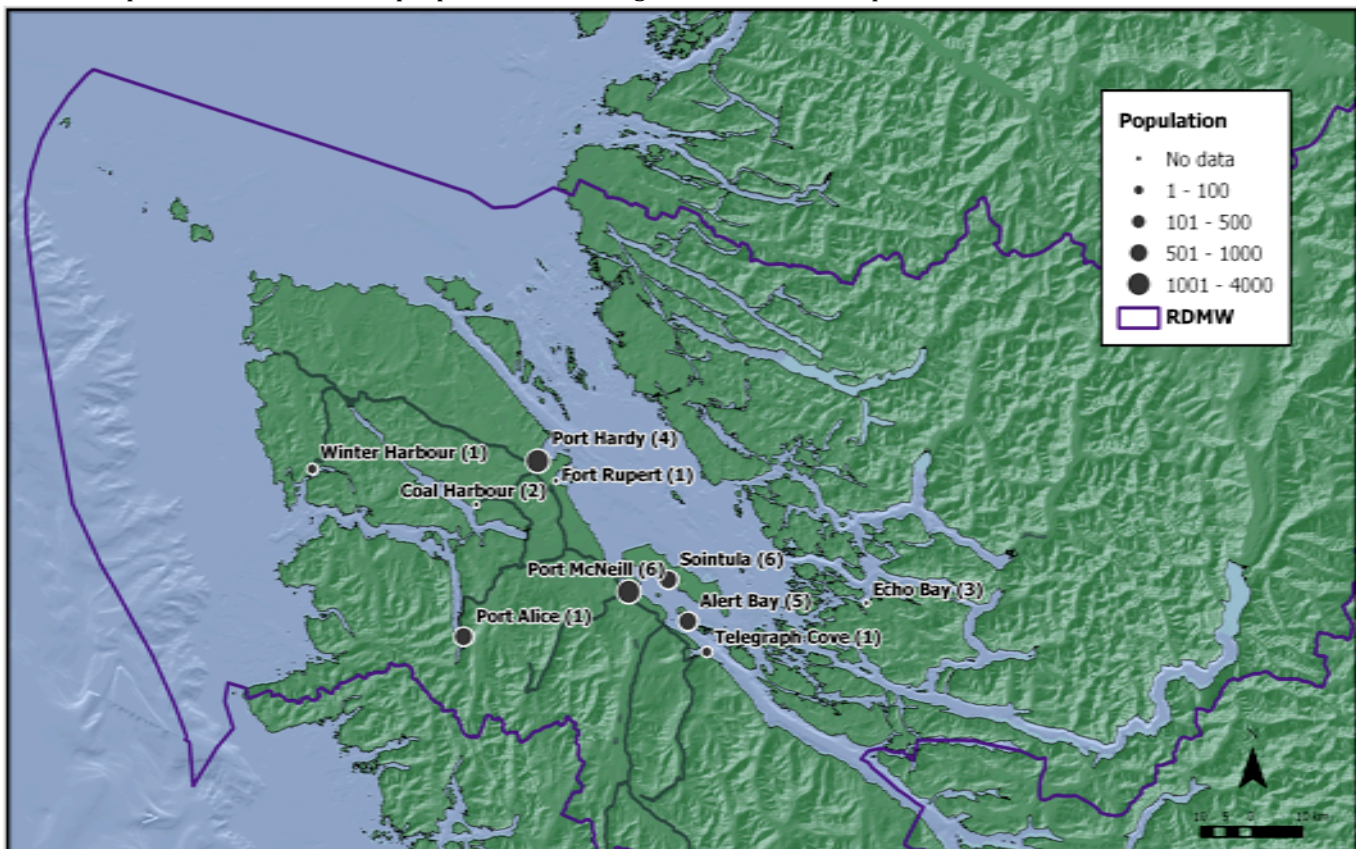
<sup>1</sup> In the North American Industry Classification System, agriculture, forestry, fishing, and hunting are aggregated. As of 2006, 32% of the male labor force and 6.1% of the female labor force is employed in this economic sector in the RDMW (BCStats). Also, the list of people that the project partners recommended for interviewing included far more men than women. Thus, it was assumed that more men are employed in marine-related professions than women in the study site. Gender in relation to ES perceptions could be part of future studies.

<sup>2</sup> The members of the Kwakwaka'wakw First Nation who live in the region are united by their traditional language group (Galois 1994), but the 17 different Kwakwaka'wakw band governments have differing opinions on a range of topics. Research time constraints prevented representation from all bands in this study.



**Figure 2.2 Professions of interviewees.**

Seven interviewees had two professions, bringing the total number of professions to 37. Several occupations, particularly related to tourism, are seasonal, part-time and/or contract-based in this region, which is why some have several jobs. Also, many who invest in boats use them for multiple purposes such as providing marine transportation for industrial purposes and running ecotourism boat trips.



**Figure 2.3 Hometown and number of interviewees (n= 30).**

### 2.2.3 Interview Design

Semi-structured interviews were used to collect subjective perspectives on what people value from marine ecosystems. It is broadly recognized that narratives can be subjective and biased when it comes to revealing objective truths (Blee 1993; Teski and Climo 1995; Perks and Thomson 1998). Interview methods, however, can be well-suited for exploring subjective and experiential topics (Lindlof and Taylor 2002), including values associated with ecosystem services (Cast et al. 2008).

A semi-structured interview protocol was developed to facilitate the articulation of CES (Chan et al. in prep). It was used to solicit monetary, non-monetary and threat values associated with the ocean. This interview process provided an opportunity for participants to articulate what they value with regards to the marine and nearshore<sup>3</sup> environment.

A total of 30 people were interviewed between April 9 and June 7, 2010. A contact letter (see Appendix B) was sent to 45 interviewees inviting them to participate. Interviews were scheduled in locations convenient and comfortable for the participant. When possible, interviews were conducted in people's homes or private offices to maximize their comfort level. Two interviews were conducted in boats belonging to the interviewees, three were done in quiet cafes, eight took place in the interviewees' offices, and 17 occurred in interviewee's homes. Interviews began with signing a consent form and confidentiality agreement along with a brief project description. Interviews lasted from 54 minutes to 3 hours and 30 minutes. A total of 56 hours of interviews were transcribed.

All interviews followed a semi-structured script (see Appendix A). A similar script has been used to explore CES in other study sites, including Hawaii and the West Coast of Vancouver Island. Interviews included open-ended questions as well as spatial prompting. The process was largely respondent-driven, in that respondents were free to define benefits and threats in their own way and they were asked to expand on their environmental values as they arose.

The implicit metaphor underlying ES and the value-elicitation interview script was *ocean as service provider*. This metaphor is embedded in many of the interview questions that are

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<sup>3</sup> Interviews focused on values pertaining to the ocean, beaches and the confluence of rivers with the ocean.

structured around identifying the tangible and intangible benefits that people derive from marine ecosystems.

Interviews began with warm-up questions that encouraged respondents to provide a personal context for their perspectives on links between their livelihoods and the ocean and the non-monetary benefits they receive from the sea. This helped in developing rapport with the interviewee and familiarity with their professional backgrounds. Initial questions covered occupational activities related to the ocean including how they came to have their jobs.

Since ES link ecological systems to human well-being, interviewees were asked if they thought of connections between the ocean's health and their well-being and/or the well-being of their communities. Respondents were asked what indicated ocean health and what indicated the health of human communities. They were also asked about the type of information and sources of information that they rely on related to ocean health. Respondents were asked how ocean management could be improved then they ranked their suggestions in order of importance.

Respondents were asked to spatially identify the areas of the ocean important for their economic livelihood. Each interviewee was asked to allocate 100 tokens representing monetary value to these areas. To elicit opinions on marine protected areas and opening the area for oil and gas transportation as well as drilling, they were asked if spatial restrictions on fisheries harvests and allowing oil and gas transportation and drilling would impact the things that they value economically from the ocean. For an analysis of the spatial data see Klain *et al.* (in prep).

After the initial spatial prompting, interviewees were asked to reflect on the meaning or importance that they associate with particular places in the seascape or experiences on the water. Interviewees were guided through a series of CES prompts related to sense of place/heritage, identity, activity/subsistence, spiritual value, artistic value, educational value and intergenerational value. They were asked if and how they associate their heritage, identity and spirituality with marine ecosystems. They were asked to recount marine-related educational experiences and if the ocean was a source of artistic inspiration. Respondents were also asked about intergenerational values pertaining to the ocean. They were asked to distribute 100 tokens representing non-monetary value in the places that they identified. Similar to the previous

section, they were asked if spatial restrictions on fisheries and oil and gas development and transportation would effect the things or experiences valued for non-monetary reasons.

The interviewer concluded the interview by asking if the respondent could spatially identify areas where the benefits that they receive from the ocean are most threatened. If threats were spatially identified, interviewees were asked to describe the threats and allocate 100 threat tokens according to the relative threat level in each location.

#### **2.2.4 Data Processing**

After the 58 hours of interviews were transcribed using the software ExpressScribe, transcripts were imported into NVivo, a qualitative analysis software program. The section of each interview pertaining to the seven CES prompts was coded according to an ES, benefits and values typology (Table 2.1). This typology distinguishes *services* as processes involving biotic features of the environment that produce *benefits*. These *benefits* consist of goods, conditions and experiences that are important to people. *Values* are preferences, principles and virtues (NCEAS 2010; Chan, Satterfield, and Goldstein in prep; Chan et al. 2010).

To assess the extent to which interviewees bundle different services, benefits and values, the presence of each category from the typology in response to the seven prompts was recorded for all interviews.

**Table 2.1 Typology of services, benefits and values associated with ecosystems**

This typology (NCEAS 2010; Chan, Satterfield, and Goldstein in prep; Chan et al. 2010) was used to assess the degree to which interviewees bundle various services, benefits and values tied to marine and nearshore ecosystems.

<b>Ecosystem Category</b>	<b>Definition</b>
<b>Services</b>	Production of benefits which involves ecosystems
Provisioning, market goods	The production of tangible goods and services that are bought and sold
Regulating	Processes that maintain functioning ecosystems, including air, soil and water quality
Supporting (processes, organisms, sites, habitats)	Inputs to final products from ecosystems that contribute to human well-being, e.g., pollination, nutrient cycling, primary production
Subsistence	Use of renewable wild resources for food, shelter, fuel, clothing, tools or transportation
Outdoor recreation	Activities in natural or semi-natural settings for the purpose of relaxation or amusement, e.g., kayaking, recreational fishing
Education & research (nature-based)	Activities associated with learning about the natural world or research related to a natural or semi-natural landscape/seascape
Artistic	Associated with the creation and appreciation of beauty from nature
Ceremonial	Set of actions performed on a special occasion for symbolic value and linked to biotic features of land/seascape
<b>Benefits</b>	Valued goods, experiences and conditions
Material	Tangible products of ecosystems, e.g., fish, wood
Aesthetic	Relating to beauty or appreciation of beauty
Place/heritage	Meaning or importance associated with a location; locations that serve as reminders of past events for people and communities
Activity	Intangible benefits associated with an action, e.g., satisfaction from collecting wild food
Spiritual	Related to metaphysical forces that exist beyond the individual
Inspiration	Mental stimulation to do or feel something
Knowledge	Theoretical as well as practical information and/or skills
Existence/bequest	Intangible non-use benefits associated with knowing that something exists or satisfaction in preserving a natural landscape for future generations
Option	The predicted benefit of future use of a natural resource
Social capital & cohesion	Contributing to enhancing relationships among people
Identity	Ideas, relationships and sense of belonging that shape people
Employment	Contribution to work that provides monetary income
<b>Values</b>	Underlying ideals or properties of physical and/or abstract objects or actions representing degrees of importance (Brown 1984)
Preferences, principles, virtues	Types of values
Market	Economic value derived from a marketed good or service
Non-market	Valued independent of a commodity; something that is valued intrinsically
Self-oriented	Valued for an individual's enjoyment
Other-oriented	Valued for the enjoyment of others, particularly friends and family
Individual	Value held by one person
Holistic/group	Value held by group or community
Physical	Value derived from experience involving tangible things or activities
Metaphysical	Value from conceptual experience, e.g., existence value
Transformative	Important for its contribution towards changing values
Anthropocentric	Human-centered value
Bio/eco-centric	Value centered on all life, including ecological processes

Due to time limitations, data on opinions pertaining to marine protected areas, oil and gas development and ranked priorities for improving management are not analyzed in this study.

## **2.3 Results and Discussion**

The interview protocol proved to be highly successful at eliciting people's experiences of benefits they derive from the ocean. The interviews yielded a wide variety of responses from participants, many of whom spoke at length about the tangible and intangible benefits they associated with the marine environment.

Out of the 45 people contacted to participate in this study, 15 were unable to participate. One potential interviewee declined saying that her professional experience was not directly connected to the marine environment. A total of 13 interviewees did not respond or were unavailable. One verbally expressed his refusal based on his perception of researcher bias. In the contact letter (see Appendix B), research participants were offered a raffle ticket for a wild salmon steak. Given that salmon farming is arguably the most contentious environmental issue in the region, this was a poor choice for an incentive to encourage people in the salmon aquaculture industry to participate in this research. Furthermore, the project partner Living Oceans Society, which is mentioned along with the RDMW in the contact letter, is vocal in its opposition to open net pen salmon aquaculture. Despite this one refusal, others who worked for salmon aquaculture companies were willing to participate in this research.

For analysis of the spatial component of this project see Klain *et al.* (in prep). One point relevant to the spatial data is that five interviewees were not comfortable spatially identifying areas associated with non-monetary value. For the interviewees willing to assign quantitative value to locations, the protocol was useful in the freedom that it gave to interviewees to choose how to determine what metric to use in the allocation of non-monetary value.

### **2.3.1 Testing Multiple Modes of Value Articulation and Description**

To allow for the expression of multiple and potentially incommensurate values, interviewees were prompted to share narratives and descriptions pertaining to the different ways in which ecosystems are important to them. All interviewees verbally characterized CES that they valued. During the spatial prompting section of each interview, respondents were asked to quantify the relative non-monetary value of particular places that they identified across the seascape. They were not constrained by a specified metric. Rather, they were left to define their own metric to distribute 100 tokens according to relative importance. Out of the 30 respondents, 15 allocated non-monetary units of value across the seascape without complaint. One interviewee expressed

frustration with the task that she described as “quantifying the unquantifiable,” but she nonetheless allocated the units of non-monetary value. Therefore, just over half of the respondents (16/30) found it acceptable to express non-monetary values verbally, spatially and quantitatively. A total of 30% (9/30) of the interviewees articulated non-monetary values verbally and spatially, but they would not express non-monetary value linked to place quantitatively. They identified places that were important for non-monetary reasons, but they refused to assess relative value. They justified their refusal by saying that no single place that they identified on the nautical chart was more valuable than any other place that they identified.

Approximately 17% (5/30) interviewees did not identify areas important for non-monetary reasons and therefore did not allocate units of relative value. This signals that many people were only willing to express non-monetary values verbally, not spatially and not in quantitative terms. Two refused to identify areas as important for non-monetary reasons because, as one said, “it’s all special,” implying that one place with associated ES and benefits is not more important than any other place. Another said the waters of the RDMW “should be looked at as a whole picture and not little places. Everything is connected.... It’s all public and should all be valued, respected.” All interviewees were encouraged to identify areas of personal significance, but two were not comfortable sharing this information out of fear of how the information could be used. For example, one said “the only way we have here to prevent open access to fishing grounds ...for food, for recreational, even for commercial purposes, is by .... keeping your knowledge private....[sharing this knowledge] is like handing somebody a key to your food, to your house, to your front door.” This respondent emphasized the sensitive nature of this information and the potential negative consequences of sharing it. It is not clear if more effort on the part of the researcher to gain participants’ trust would have resulted in more participants assigning relative non-monetary value.

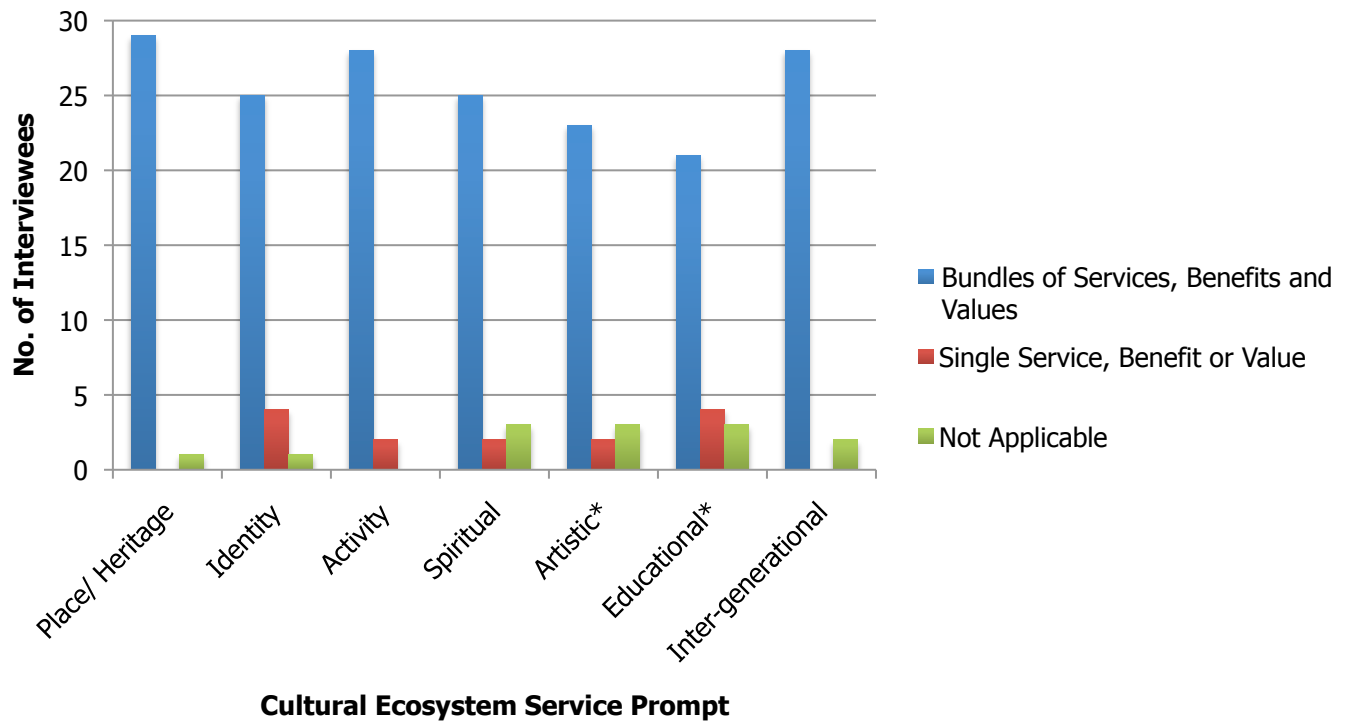
The responses of the interviewees who would not draw areas of non-monetary importance (5/30) and interviewees who would not allocate relative importance across the places that they identified (9/30) highlight problems associated with mapping and quantifying the non-monetary importance of places and the associated ES, benefits and values linked to these places. The fact that just under half (14/30) of the interviewees refused to allocate relative importance of intangible values across the seascape can be interpreted as an indication that the spatial quantification of non-monetary values, even if respondents define their own metrics, is not



broadly acceptable. For close to half of the respondents, assigning relative importance across space is simply inappropriate with these intangible values. Consequently, it is possible that valuation studies that isolate and attempt to quantify CES will likely not have substantial traction at a community level and other means of expressing non-monetary value should be explored, potentially through a deliberative decision-making process.

### 2.3.2 Articulation of Bundles of Services, Benefits and Values Associated with Ecosystem Services

The full participation of all interviewees in the verbal articulation of non-monetary values related to ecosystems stands out in contrast to the limited participation in the spatial identification and quantification components of this study. Interviewees mentioned multiple services, benefits and values after each CES prompt (Figure 2.4, Table 2.2 and Figure 2.5).



**Figure 2.4 Type of articulation of services, benefits and values by number of interviewees.**

When prompted with CES questions, respondents tended to mention multiple services, benefits and values associated with the prompt. Few responses included explicit mention of only one service, benefit or value. Some respondents refused to answer the question or replied in ways unrelated to the interview prompt. These responses are shown as “not applicable.”

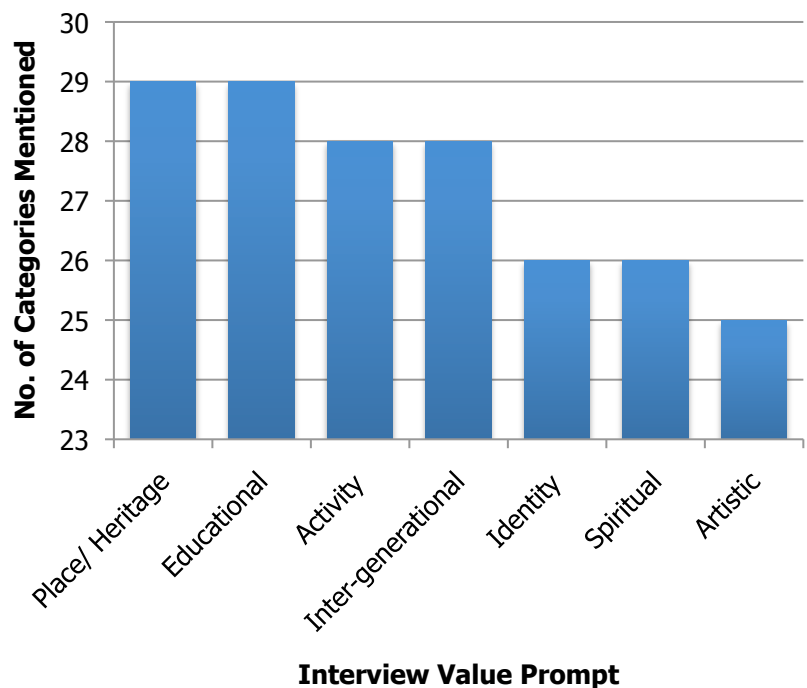
\*Due to interview time constraints and interviewer error after unexpected interruptions, two interviewees were not prompted for artistic and educational values associated with places in the seascape.

**Table 2.2 Frequency of service, benefit and values summed across interviewees in response to CES prompts.**  
The numerical values represent the number of interviewees who explicitly mentioned a specific category of service, benefit or value in response to one of the seven CES prompts. The order of the columns reflects the chronological sequence in which the CES questions were asked. This table provides evidence that this semi-structured interview method facilitated the articulation of a wide breadth of services, benefits and values from multiple interviewees. The variety in the number of interviewees who mention particular categories demonstrates the variability in how different people bundle CES.

		Place/ Heritage	Identity	Activity	Spiritual	Artistic	Educational	Inter- generational	Total
<b>Services</b>	Provisioning, market goods	5	2	9	0	2	2	4	24
	Regulating	0	0	0	0	0	0	0	0
	Supporting (processes, organisms, sites, habitats)	8	5	1	5	4	8	7	38
	Subsistence	6	3	15	0	0	3	8	35
	Outdoor recreation	17	6	13	5	5	3	11	60
	Education & research (nature-based)	7	4	3	3	3	15	12	47
	Artistic	3	1	2	2	18	4	1	31
	Ceremonial	2	1	0	1	1	1	0	6
<b>Benefits</b>	Material	3	1	17	0	1	1	9	32
	Aesthetic	14	2	2	12	13	3	3	49
	Place/heritage	24	23	5	16	12	14	4	98
	Activity	15	13	15	6	7	4	16	76
	Spiritual	9	3	8	19	3	3	3	48
	Inspiration	5	0	1	8	4	1	4	23
	Knowledge	4	1	2	2	2	7	11	29
	Existence/bequest	5	3	0	2	0	2	1	13
	Option	0	0	0	0	0	0	0	0
	Social capital & cohesion	5	4	10	1	1	2	6	29
	Identity	8	15	4	1	2	4	3	37
	Employment	8	7	2	3	4	1	4	29
<b>Values</b>	Preferences, principles, virtues	5	3	6	2	2	1	4	23
	Market	5	0	5	2	1	1	5	19
	Non-market	1	3	7	0	0	1	4	16
	Self-oriented	8	6	4	3	3	2	2	28
	Other-oriented	15	5	13	5	5	6	22	71
	Individual	2	5	2	4	1	1	1	16
	Holistic/group	6	4	3	3	1	1	6	24
	Physical	14	3	14	5	0	2	11	49
	Metaphysical	4	1	3	4	1	2	0	15
	Final	0	0	0	0	0	0	0	0
	Supporting	0	0	0	0	0	0	0	0
	Transformative	6	3	2	8	4	2	1	26
	Anthropocentric	1	0	2	1	1	0	3	8
	Bio/ecocentric	0	0	2	4	0	1	3	10
<b>Total</b>		215	127	172	127	101	98	169	1009

Outdoor recreation was the most frequently mentioned service followed by nature-based education and research (Table 2.2). Place/heritage benefits were the most commonly identified benefits followed by activity benefits (Table 2.2). Other-oriented values, often related to friends and family, were mentioned by more interviewees across the various prompts than other values. Physical values were the next most frequently mentioned type of value.

The highest number of interviewees spoke about these various categories in response to the place/heritage prompt (Table 2.2). The place/heritage prompt was the first of seven CES prompts, which may have contributed to the high number of services, benefits and values mentioned in response to it. During proceeding prompts, interview fatigue may have occurred. This is plausible but not certain given that the last CES prompt, intergenerational value, solicited the third highest frequency of services, benefits and values (Table 2.2). Interviewees may have associated additional services, benefits and values with later prompts, but not mentioned them again if they had already touched upon them in response to earlier prompts. These factors may have contributed to the relatively high number of services, benefits and values mentioned in association with place/heritage.



**Figure 2.5 Number of services, benefits and values mentioned for each CES value prompt.**  
The occurrence of each category from the typology in Table 2.2 was summed across seven non-monetary value prompts. The number of categories mentioned reflects the variety of categories articulated in this research. When asked about one CES, people bundled together numerous different ES, benefits and values.

Bundling is a common characteristic of how people speak about CES (Figure 2.4). ES literature has primarily focused on bundles of provisioning, supporting and regulating ES (Cumming and Peterson 2005; Bennett, Peterson, and Gordon 2009; de Groot et al. 2010; Nelson et al. 2008; Raudsepp-Hearne, Peterson, and Bennett 2010). This research demonstrates the large extent to which people bundle CES. When interviewees were prompted about one particular type of CES, such as place/heritage value, identity or educational value, their responses generally included multiple types of services, benefits and values (Figure 2.4, Table 2.2 and Figure 2.5).

The place/heritage and education prompt solicited the widest variety of services, benefits and values (29 out of 34) (Figure 2.5), reflecting the diversity of ways in which people find meaning in a sense of place and heritage as well as the educational value of parts of the seascape. The education prompt solicited the lowest frequency of types of services, benefits and values (Figure 2.4) which may reflect difficulty in assigning education value to particular places.

Study participants bundled services, benefits and values in response to CES prompts (Figure 2.4, Figure 2.5, and Table 2.2). One interviewee complained, “you keep asking me to separate things” when she was asked to think about non-monetary values rather than monetary values. This frustration may stem from the value associated with the entire ecosystems that is potentially greater than the sum of its parts. A reductionist approach to characterize or value constituent parts of these bundles of services, benefits and values may misrepresent the value of the components and miss the value of the whole.

It is important to understand various ways in which these bundles are bound together. This research identifies some of the interdependencies among tangible and intangible services, benefits and values.

#### ***2.3.2.1 Interdependency within Bundles***

The importance of marine ecosystems was frequently described in ways that highlighted the interdependency of various services, benefits and values that inextricably link cultural and provisioning ES. The most frequently mentioned intangible cultural benefits were associated with provisioning services. This demonstrates that cultural services are inextricably linked to provisioning services. The theme of wild food and sense of place clearly demonstrate this interdependence.

In accordance with the idea that “the way we eat represents our most profound engagement with the natural world” (Pollan 2007), every interviewee, with one exception, explained why they valued eating wild food. Collecting and consuming marine species was a common yet profound way in which many residents of the RDMW experienced their local environment. Influencing the lifestyles of all interviewees, these practices were tied to numerous values, benefits and services associated with ecosystems. Out of the 30 interviewees, 29 expressed the satisfaction they derive from eating fish that they or their friends caught. Fishing, gathering, and processing wild food involved significant amounts of time interacting with other people, biota, and the natural environment. It is widely established that monetary values cannot adequately represent the spiritual, cultural, and nutritional value derived from subsistence harvests (Condon, Collings, and Wenzel 1995; Chan et al. in press). One example of this interdependency between a provisioning ecosystem service and the multiple facets of cultural importance is highlight in this excerpt of an interviewee who described catching fish and serving it to his family:

*Especially now that I have children... when you cook food that you've caught with your own hands and set it down in front of your own offspring and its good food, like a salmon that's so good for you, it's a spiritual act... That's like such a connection to place, to earth, doing something so tangible, eating and getting nutrients.... you're out there just trawling this single line and to be able to catch it, to do battle with it, sometime you win, sometimes it wins, it's more like a dance than a battle.*

This passage shows the bundle of cultural and other ES derived from the experience of catching fish and eating it with family. Values expressed in this passage include the physical, provisioning service of fish as well as the metaphysical values associated with serving nutritious food to children. There are also physical benefits associated with the hands-on experience of fishing and eating healthy food. Artistic value is expressed since the act of fishing is described as a dance, an art form. The interviewee later attributed the simile of fishing as a dance to the author of *The River Why* (Duncan 1984). Catching fish is also a powerful connection to place.

The interdependency of values linked to each other and to a place was clear when interviewees described meaning associated with the seascape. When asked about important places to him and his community, an interviewee responded:

*I can see ... clam gardens in my mind. I can see middens, I can see some villages sites... I can see rich clam grounds that I've been on, I can see depleted clam grounds.... I can see places*

*where I kayaked, I can see places where I've traveled with fishermen and fished and stayed in and lived in and I can see houses that I lived in, ... [and places where I] visited with people who are no longer with us. I can see potlatches that I have attended, that had to do with kin and to an extent with geography in this region. I can see kids that I know, I can see married couples, I can see life and death and tragedy... It's [a] historically rich landscape.*

This passage provides evidence of the depth to which culture interacts with place. The meaning or value of a place is largely derived from the interaction of people with nature *and* other people in a particular environment. Intangible values associated with ES depend not just on the biophysical characteristics of a place, but also social experiences in a place. *Seeing* means knowing the bundles of value of the seascape which requires an understanding of the patterns of human life across time in this setting. This interviewee's response including his refusal to spatially identify and therefore isolate constituent parts of this "historically rich landscape" may signal that he does not think it appropriate to reduce this richness associated with the entire land and seascape into constituent parts to be considered separately.

### **2.3.3 Articulating Importance of Nature Through Metaphors**

An emerging theme from the interviews was the use of metaphor to express physical and emotional attachment to and dependence on the ocean and particular places in the seascape. Some respondents conformed to the ES metaphor of *ocean as service provider*. This anthropocentric metaphor implies a producer-consumer interaction between people and marine ecosystems. Other interviewees employed alternative metaphors to characterize relationships between people and the ocean.

#### **2.3.3.1 Ecosystem Service Metaphor, Ocean as Service-Provider**

Some interviewees' perspectives aligned with the metaphor of *ocean as service provider*. People acknowledged many concrete ways in which the ocean contributed to their livelihood and well-being. One interviewee described collecting edible seaweed then said simply "if the ecosystem is thriving, we have more food." When asked if he saw connections between his own well-being and the health of the ocean, another interviewee responded that the ocean can provide jobs and recreation.

*A[n] ocean that's per se healthy can provide for the communities. If the ocean can't provide for the communities then it's a real drawback for the community. People need to work. If they're in recreation they need to see something when they're there. Like for example, I wouldn't want to see the salmon disappear because so many people rely on the salmon populations that are out there for their livelihoods, for their recreation... there's a lot of dependency [of communities] on the oceans... I value that and always have.*

However, several other responses provide evidence that this notion of *ocean as service provider* is either misrepresentative and/or inadequate in capturing the depth of value associated with the marine environment. For these respondents, the producer-consumer relationship is not an apt characterization of their interaction with the ocean. People explained their tangible and intangible connections to the seascape in ways that differ substantially from the ocean as a source of useful products and processes for people. It is important to recognize that the implicit ES metaphor embedded in the interview script (see Appendix A) did not suppress the articulation of metaphors that starkly contrast with *ocean as service provider*.

### **2.3.3.2 Embodied Ocean**

During the elicitation of CES, the human body was used metaphorically when people explained why they value nature. Some participants used this metaphor for conceptual purposes and to give additional meaning to and justification for their environmental advocacy work. After being asked to reflect on spiritual values associated with particular places that remind the person of forces greater than the individual, one respondent drew parallels between the marine ecosystem and a cardiovascular circulatory system.

*Just really trying to hear what its saying and then going to the places where people used to live and imagining the children on the beach and the villages and the wood smoke and trying to get a sense of not just seeing it now, but seeing the whole pattern because it is such a pulse. I ... feel like the tides are the lungs, its on this slow breath all the time. The salmon are the bloodstream and they're moving the nutrients around the body and you don't want to interrupt either one of those things.*

This respondent imagines the past generations of people in this region while describing the patterns of life as a pulse. She elaborates by drawing parallels between the tidal movement of ocean water as breathing, which is essential for human and marine life for moving oxygen that feeds into the circulatory system. The parallel between salmon and the bloodstream signifies how salmon are essential – the lifeblood – of this ecosystem. The movement of salmon, with the nitrogen and other nutrients in their bodies, supports this region's aquatic ecosystems. Restricting the flow of this salmon has detrimental implications for the entire system. Ensuring that this salmon bloodstream continues to pulse, so the nutrients move and the ecosystem maintains its health, likely provides this respondent with a purpose that transcends her professional work and encompasses her spiritual beliefs.

Another interviewee said, “We do really function with the incoming and outgoing tides....That’s the heartbeat, how everything works.” He too endowed the seascape with a pulse, implying that his family’s livelihood (how we function) is determined by the tides.

### **2.3.3.3 Feminized Ocean**

When asked about possible kinds of meaning or importance that may exist over and above economic uses of the marine environment, two interviewees, with university degrees in biology, described nature in human terms despite their cognizance of the strong push from science away from anthropomorphism (e.g., Wynne, 2004). One used the metaphor of *ocean as mother*.

*I feel tears swelling up in my eyes and I, in all my verbosity, don't know that I can explain it. I don't even think we have the language in many ways to explain our connection to nature and certainly to the connection to the ocean. What: is it aesthetics? Is it emotional? I see it as you know - I'm even afraid, because I have a science background, to use the jargon that I use - I see it as being Mother Ocean. And Mother Ocean is life giving.*

The connection between the interviewee and the ocean is clearly emotional and personal. She initially had trouble articulating the link between herself and the ocean. After expressing her fear of using unscientific terms, she adapted the personification of *Mother Nature* to a marine context.

Another interviewee said, “When you untie from the dock, you leave everything behind, and then mother nature’s there. You’re dealing with her. You can’t predict the storms, you can’t predict what’s there. You see the whales and they’re huge and you just realize that you’re one little thing—cog—in the whole big planet Earth.”

The term *Mother Ocean* connotes the nurturing, life-supporting and fertile characteristics of the archetype *Mother Nature* (*mater natura*, Jung 2003, p. 7 and p. 29) applied to marine ecosystems. The universal appeal of this metaphor *Mother Nature* or *Mother Earth*, a repeating theme found in cultures around the world, was recently demonstrated in the United Nations General Assembly proclaiming April 22 as “International Mother Earth Day”(UN 2009).

A second interviewee described her devotion to her home seascape in terms of a relationship with a dominant, powerful female. The interviewee explained:

*It's a very domineering female force that's basically ordering me around and I'm under her. She's like this incredible boss that just won't let me go. We breathe together. I just really feel it. When I want to relax myself, I just run through the inlets and try to remember every little bay and it ... brings me back ...it's a big part of me.*



The interviewee referred to her devotion to her home seascape as dominating and directing her work but also, at other times, calming her. The interviewee is apparently tuned to the natural life of the place, as described in “we breathe together.” The seascape clearly has emotional power over her and is a substantial part of her identity. This metaphor could be interpreted with a feminist neo-paganist lens. The metaphor *seascape as Goddess* invokes the Goddess figure, which is commonly associated with the nature, womanliness and spiritual strength (Buell 1995). Associating the ocean with metaphysical forces is not unusual; various cultures around the world have sea goddesses, including the Inuit Senda (Kennedy 1997), Chinese Mazu (Irwin 1990), and Finnish Vellamo (Friberg, Landström, and Schoolfield 1998).

#### **2.3.3.4 Ocean Embodied in Self**

When asked about places that are important to his sense of identity, a fisherman expressed his connection not to a specific place, but rather to the ocean as a whole. His visceral tie to the marine environment was explained through his physical body:

*The ocean is important to me as my sense of identity. That is where I am from.... Like the old saying goes, I have salt water in my blood. That's about the only way I can say it. The ocean is a very special place to me.*

The ocean does more than provide this fisherman with income from harvesting fish. The marine environment, “where I am from” played a central role in his upbringing. “Salt water in my blood” signifies that ocean is embodied in his identity as expressed in his physical body. Instead of externalizing the *ocean as service provider*, this interviewee internalizes the ocean, figuratively using the metaphor *ocean as part of my body*.

When describing her profession, another interviewee said:

*I've always been concerned about the fishing licenses for people, that's my love, is fisheries, always has been, because we grew up here... [we are] called the Salmon People. It's in my blood, and it's just concern for people and the marine resources in our area.”*

This passage also uses the theme of blood, which in this case is used to illustrate how essential fisheries are to her personal and community identity. This close association over thousands of years between a staple fish and her people, which she refers to as “Salmon People,” signifies the depth of this association. The interviewee seems to suggest that the value of fisheries, central to the identity of her people, exceeds the use value of the fish as a commodity provided by the

ocean. For this interviewee, the metaphor of(*ocean as service provider* does not convey the full significance of the marine environment to her people .

Fisheries enable people to have deep and lasting connections to place and ancestors, which is critical to their cultural identity, heritage and spirituality. In this region, salmon could be understood as a *cultural keystone species*, playing a fundamental role in both the diet and spiritual practice of this region's inhabitant (Garibaldi and Turner 2004). Clearly, the natural environment is far more than a service provider for these study participants who describe nature as part of themselves.

## **2.4 Conclusion**

### **2.4.1 Methodological Contribution to CES Value Articulation**

In light of the first research goal, the semi-structured interview elicitation approach used in this research provided methodological insight into the tangible and intangible ways in which the ocean is important to people. The protocol was effective at eliciting a wide variety of emotive explanations of services, benefits and values. With a foundation in methods to facilitate the articulation of why ecosystems are important beyond monetary reasons (Kalof and Satterfield 2005; Dietz, Fitzgerald, and Shwom 2005; Satterfield 2001; O'Neill, Holland, and Light 2007), this research highlights people's willingness to verbalize intangible values, but mixed reception to both spatially identifying places important for non-monetary reasons and quantifying the relative importance of such places.

Based on the second research goal, these methods identified problems with the spatial identification and quantification of non-monetary values. Despite the freedom for interviewees to determine their own metric to assess relative non-monetary importance, some interviewees resisted. Justifications included 1) it was not appropriate to isolate locations associated with particular services and benefits because they see the marine and coastal environment as one interconnected system; 2) one place was not any more important than any other place; and 3) they feared misuse of the resulting information. A total of 30% (9/30) of the interviewees verbally explained the significance of different places in the seascape which were important for different reasons, but they would not allocate relative value. This can be interpreted as interviewee's holding incommensurate values associated with specific places important for different reasons that cannot be compared using the same scale or metric of relative importance.

These quantification refusals may be the result of protected values; interviewees may have interpreted the spatial prompt as requiring them to sacrifice or potentially compromise certain places by assigning zero or low value to some places and high value to other locations. To navigate these values, it is important to consider the rich verbal articulations of CES in which people clearly bundle services, benefits and values linked to ecosystems.

#### **2.4.2 Contribution of Research Findings**

Regarding the third research goal, this study demonstrated that people generally communicate experiences of ecosystem-related services, benefits and values as bundles (Figure 2.4). When conducting ES valuation, researchers should not assume independence of services, especially when considering CES. When people explain why nature is important, the co-occurrence of various services, benefits and values associated with multiple CES prompts suggests interdependence.

In terms of the fourth research goal, people used metaphors to explain how nature is important to them. The underlying ES metaphor of *nature as service provider*, or in this particular case, *ocean as service provider*, does not encompass the variety of ways in which people conceptualize the importance of the link between humans and marine ecosystems. The various alternative metaphors identified by study participants could be interpreted as imbuing nature with substantially more importance than simply being a service provider. The interview protocol provided sufficient freedom for study participants to express other metaphors pertaining to people and ecosystems. Several interviewees, including some with scientific backgrounds, were self-conscious that the meaning they associated with the ocean could not be fully explained in scientific terms. Nonetheless, they provided emotive explanations of how they conceptualized themselves in relation to the ocean and marine life. The meaning that many interviewees associated with the ocean often differed considerably from the conception of ecosystems as simply service providers. In describing what they value from the ocean and how they perceive their relationship with the ocean, some thought of the ocean as part of themselves and their bodies. Others associated the ocean with a powerful, life-giving, feminine force larger than themselves.

There is considerable variation in how people conceptualize nature and conceive of its importance. Regardless of the metric employed, there is also a great diversity in willingness to

spatially identify and quantify the relative importance of different ES, benefits and values. It is recommended that ES valuation researchers respect the limitations inherent in quantifying nature's benefits to people. Given that close to half of the interviewees (14/30) would not assign quantitative value representing relative non-monetary importance to different locations in the seascape, other means of representing these values in natural resource decision-making contexts ought to be explored, particularly in the design of deliberative processes.

### **2.4.3 Relevance to Natural Resource Decision-Making**

Ideally, natural resource decision-making processes should provide opportunities for stakeholders to express the importance of nature in their own terms, which can differ substantially from the ES metaphor of *nature as service provider*. In recognition of the diversity of values, that may include incommensurable and protected values, discourse-based approaches are more likely to be effective in reaching consensus or a reasonable compromise than decisions based on quantified estimates of the tangible and intangible values associated with ES (Cowling et al. 2008; Wilson and Howarth 2002; Chan et al. in press). Acknowledging multiple values and the variety of ways that people express these values can contribute toward negotiation of potential conflicts, which could enable stakeholders to re-conceptualize problem situations (Norton and Noonan 2007).

The interview protocol developed for this research could be adapted and used as a tool for stakeholders to reflect upon and articulate what they value from ecosystems, ranging from economic to ethical value. These methods facilitated the identification of intangible benefits from ecosystems that do not translate into monetary values. In the majority of interviews, the one-on-one interview style enabled respondents to expand upon deeply held values involving emotional and personal topics, such as spiritual connections to place and the underlying motivation and meaning behind their work connected to the ocean. After the completion of the interview, one participant expressed her gratitude for “invoking the ponderings of what we take for granted at times.” This type of stakeholder engagement could be used to prime a deliberative group process to identify priorities, set objectives and evaluate trade-offs in natural resource decision-making.

In the context of the case study, the study participants were selected based on their marine-related professions and expertise. It is likely that several study participants are engaged stakeholders in the PNCIMA marine spatial planning process. As demonstrated in the wide

variety of responses related to ES, benefits and values, this research process helped them to reflect upon and communicate what they value in relation to marine ecosystems. It is possible that study participants will bring these values explored and voiced during this research into the PNCIMA marine spatial planning process, which should be carefully structured to accommodate and account for a wide range of values.

Due to the limited time frame for this research, participant views on the threats to what they value from marine ecosystems were not analyzed. Future research could focus on factors that influence the wide variation in how participants perceive environmental threat from different economic activities.

Integrating CES into decision-making is an inherently difficult task given how they involve intangible, incommensurate and/or protected values. This research constitutes progress towards the explicit identification of bundled ES, benefits and values and provides insight into the issues associated with associating particular environmental values with specific locations and assigning quantitative measures in proportion to their importance. This research also highlights alternatives to the ES metaphor of *nature as service provider*. These alternatives, including the embodiment and feminization of nature, underscores the central role that the ocean plays in the lives of some interviewees, a role that is more affectively charged and personal than *nature as service provider*. Identification of tangible and intangible values, services and benefits associated with ecosystems is a first step in the ongoing challenge for both ES researchers and practitioners to better integrate this diversity of economic and non-monetary environmental values into practical on-the-ground policies.

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## References

- Balvanera, P., A. B. Pfisterer, N. Buchmann, J. S. He, T. Nakashizuka, D. Raffaelli, and B. Schmid. 2006. Quantifying the evidence for biodiversity effects on ecosystem functioning and services. *Ecology Letters* 9 (10):1146-1156.
- Baron, J., and M. Spranca. 1997. Protected values. *Organizational Behavior and Human Decision Processes* 70 (1):1-16.
- BCStats. Regional District 43 - Mount Waddington, Statistical Profile. Victoria, BC: Provincial Government of British Columbia.
- Bennett, E. M., G. D. Peterson, and L. J. Gordon. 2009. Understanding relationships among multiple ecosystem services. *Ecology Letters* 12 (12):1394-1404.
- Blee, K. M. 1993. Evidence, Empathy, and Ethics - Lessons from Oral Histories of the Klan. *Journal of American History* 80 (2):596-606.
- Bockstael, Nancy E., A. Myrick Freeman, Raymond J. Kopp, Paul R. Portney, and V. Kerry Smith. 2000. On Measuring Economic Values for Nature. *Environmental Science & Technology* 34 (8):1384-1389.
- Boyd, J., and S. Banzhaf. 2007. What are ecosystem services? The need for standardized environmental accounting units. *Ecological Economics* 63 (2-3):616-626.
- Brown, Thomas C. 1984. The Concept of Value in Resource Allocation. *Land Economics* 60 (3):231-246.
- Buell, Lawrence. 1995. *The environmental imagination: Thoreau, nature writing, and the formation of American culture*. Cambridge: Harvard University Press.
- Cast, Andrea, Darla Hatton MacDonald, Agnes Grandgirard, Tina Kalivas, Sarah Strathearn, Marcia Sanderson, Brett Bryan, and David Frahm. 2008. South Australia Murray-Darling Basin Environmental Values Report. In *CSIRO*. Glen Osmond, SA CSIRO: Water for a Healthy Country National Research Flagship.
- Chan, Kai. M. A., J. Goldstein, T. Satterfield, N. Hannahs, K. Kikiloi, R. Naidoo, N. Vadeboncoeur, and U. Woodside. 2010. Chapter 12: Cultural services and non-use values. In *The Theory & Practice of Ecosystem Service Valuation in Conservation*, edited by P. Kareiva, G. Daily, T. Ricketts, H. Tallis and S. Polasky: Oxford University Press.
- Chan, Kai M. A., Anne Guerry, Patricia Balvanera, Ratana Chuenpagdee, Mary Ruckelshaus, Xavier Basurto, Jordan Levine, and Sarah Klain. in prep. Integrating cultural and social into ecosystem services: a framework for value-based ecosystem decision-making
- Chan, Kai M. A., Terre Satterfield, and Joshua Goldstein. in prep. Values & Ecosystem Services: Navigating Intangibility and Incommensurability. *Conservation Biology*.
- Chan, Kai M.A., Terre Satterfield, and Jordan Levine. 2009. National Center for Ecological Analysis and Synthesis cultural ecosystem services working group, proposed definition of cultural ecosystem services. Santa Barbara.
- Chang, R. 1997. *Incommensurability, incomparability, and practical reason*. Cambridge: Harvard University Press.
- Chee, Yung En. 2004. An ecological perspective on the valuation of ecosystem services. *Biological Conservation* 120 (4):549-565.
- Chiesura, Anna, and Rudolf de Groot. 2003. Critical natural capital: a socio-cultural perspective. *Ecological Economics* 44 (2-3):219-231.
- Condon, R. G., P. Collings, and G. W. Wenzel. 1995. The best part of life: subsistence hunting, ethnicity, and economic adaptation among young adult Inuit males. *Arctic* 28 (1):31-46.
- Costanza, Robert, Ralph d'Arge, Rudolf de Groot, Stephen Farber, Monica Grasso, Bruce Hannon, Karin Limburg, Shahid Naeem, Robert V. O'Neill, Jose Paruelo, Robert G. Raskin, Paul Sutton, and Marjan van den Belt. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387 (15 May 1997):253-260.

- Cowling, R. M., B. Egoh, A. T. Knight, P. J. O'Farrell, B. Reyers, M. Rouget'll, D. J. Roux, A. Welz, and A. Wilhelm-Rechman. 2008. An operational model for mainstreaming ecosystem services for implementation. *Proceedings of the National Academy of Sciences of the United States of America* 105 (28):9483-9488.
- Crowder, Larry, and Elliott Norse. 2008. Essential ecological insights for marine ecosystem-based management and marine spatial planning. *Marine Policy* 32 (5):772-778.
- Cumming, G., and G. Peterson. 2005. Ecology in global scenarios. In *Ecosystems and human well-being: scenarios, Findings of the Scenarios Working Group, Millennium Ecosystem Assessment*, edited by S. R. Carpenter, P. L. Pingali, E. M. Bennett and M. B. Zurek. Washington, D.C., USA: Island Press.
- de Groot, R. S., R. Alkemade, L. Braat, L. Hein, and L. Willemen. 2010. Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. *Ecological Complexity* 7 (3):260-272.
- de Groot, R. S., M. A. Wilson, and R. M. J. Boumans. 2002. A typology for the classification, description and valuation of ecosystem functions, goods and services. *Ecological Economics* 41 (3):393-408.
- Dietz, Thomas, Amy Fitzgerald, and Rachael Shwom. 2005. Environmental Values. *Annual Review of Environment and Resources* 30 (1):335-372.
- Douvere, F. 2008. The importance of marine spatial planning in advancing ecosystem-based sea use management. *Marine Policy* 32 (5):762-771.
- Duncan, David James. 1984. *The River Why*. New York City: Bantam.
- Ellis, Derek. 2000. Island Copper Mine fonds.  
[http://library.uvic.ca/site/archives/featured\\_collections/esa/fonds\\_island\\_copper\\_mines/default.html](http://library.uvic.ca/site/archives/featured_collections/esa/fonds_island_copper_mines/default.html).
- Friberg, Eino, Björn Landström, and George C. Schoolfield. 1998. *The Kalevala: epic of the Finnish people*. Champaign, IL: University of Illinois Press.
- Galois, Robert. 1994. *Kwakwaka'wakw Settlements, 1775-1920, A Geographical Analysis and Gazetteer*. Vancouver: UBC Press.
- Garibaldi, A., and N. Turner. 2004. Cultural Keystone Species: Implications for Ecological Conservation and Restoration. *Ecology and Society* 9 (3):1.
- Halpern, B. S., K. L. McLeod, A. A. Rosenberg, and L. B. Crowder. 2008. Managing for cumulative impacts in ecosystem-based management through ocean zoning. *Ocean & Coastal Management* 51 (3):203-211.
- Hanson, Craig, Janet Ranganathan, Charles Iceland, and John Finisdore. 2008. The corporate ecosystem services review: guidelines for identifying business risks and opportunities arising from ecosystem change. Washington, DC: World Business Council for Sustainable Development, Meridian Institute, World Resources Institute.
- Irwin, Lee. 1990. Divinity and Salvation: The Great Goddesses of China. *Asian Folklore Studies* 49 (1):53-68.
- Jung, Carl Gustav. 2003. *Four archetypes: mother, rebirth, spirit, trickster*.
- Kalof, Linda, and Terre Satterfield. 2005. *The Earthscan reader in environmental values*. London ; Sterling, VA: Earthscan.
- Kennedy, Michael P.J. 1997. The Sea Goddess Sedna: An Enduring Pan-Arctic Legend from Traditional Orature to the New Narratives of the Late Twentieth Century. In *Echoing Silence: Essays on Arctic Narrative*, edited by J. G. Moss. Ottawa: Univeristy of Ottawa Press.
- Klain, Sarah, and Kai Chan. in prep. Mapping Marine Ecosystem Services and Values. *Ecological Economics*.

- Knowler, D. J., B. W. MacGregor, M. J. Bradford, and R. M. Peterman. 2003. Valuing freshwater salmon habitat on the west coast of Canada. *Journal of Environmental Management* 69 (3):261-273.
- Kremen, C., and R. S. Ostfeld. 2005. A call to ecologists: measuring, analyzing, and managing ecosystem services. *Frontiers in Ecology and the Environment* 3 (10):540-548.
- Lakoff, George, and Mark Johnson. 1980. *Metaphors We Live By*. Chicago: University of Chicago Press.
- Levin, S. A., and J. Lubchenco. 2008. Resilience, robustness, and marine ecosystem-based management. *Bioscience* 58 (1):27-32.
- Levine, Jordan. in prep. Homo Analogicus. In *International Association for the Study of the Commons*. Hyderabad.
- Levine, Jordan, and Kai M. A. Chan. in press. Global Human Dependence on Ecosystem Services.
- Lindlof, T.R., and B.C. Taylor. 2002. *Qualitative Communication Research Methods*. Thousand Oaks, CA: Sage Publications.
- MA. 2003. Millennium Ecosystem Assessment, Ecosystems and Human Well-being: A Framework for Assessment. Washington, DC: Island Press.
- McLeod, Karen, and Heather Leslie. 2009. Why Ecosystem-Based Management? In *Ecosystem-Based Management for the Oceans*, edited by K. McLeod and H. Leslie. Washington, DC: Island Press.
- Morgan, Mellett Granger. 2002. *Risk Communication*. Cambridge: Cambridge University Press.
- NCEAS. 2010. NCEAS Cultural Ecosystem Services Working Group. Santa Barbara.
- Nelson, E., S. Polasky, D. J. Lewis, A. J. Plantingall, E. Lonsdorf, D. White, D. Bael, and J. J. Lawler. 2008. Efficiency of incentives to jointly increase carbon sequestration and species conservation on a landscape. *Proceedings of the National Academy of Sciences of the United States of America* 105 (28):9471-9476.
- Nelson, Erik, Guillermo Mendoza, James Regetz, Stephen Polasky, Heather Tallis, DRichard Cameron, Kai MA Chan, Gretchen C Daily, Joshua Goldstein, Peter M Kareiva, Eric Lonsdorf, Robin Naidoo, Taylor H Ricketts, and MRebecca Shaw. 2009. Modeling multiple ecosystem services, biodiversity conservation, commodity production, and tradeoffs at landscape scales. *Frontiers in Ecology and the Environment* 7 (1):4-11.
- Norton, B. G., and D. Noonan. 2007. Ecology and valuation: Big changes needed. *Ecological Economics* 63 (4):664-675.
- Norton, B. G., and M. A. Toman. 1997. Sustainability: Ecological and economic perspectives. *Land Economics* 73 (4):553-568.
- O'Neill, J., A. Holland, and A. Light. 2007. *Environmental Values*. New York: Routledge.
- Palumbi, S. R., P. A. Sandifer, J. D. Allan, M. W. Beck, D. G. Fautin, M. J. Fogarty, B. S. Halpern, L. S. Incze, J. Leong, E. Norse, J. J. Stachowicz, and D. H. Wall. 2009. Managing for ocean biodiversity to sustain marine ecosystem services. *Frontiers in Ecology and the Environment* 7.
- Pearce, David William, Giles Atkinson, and Susana Mourato. 2006. *Cost-benefit analysis and the environment: recent developments*. Paris: Organisation for Economic Co-operation and Development Publishing.
- Perks, Robert, and Alistair Thomson. 1998. *The oral history reader*. London and New York: Routledge.
- Philcox, N. 2007. Literature review and framework analysis of non-market goods and services provided by British Columbia's ocean and marine coastal resources. Government of British Columbia.
- Pollan, Michael. 2007. *The omnivore's dilemma: a natural history of four meals*. New York: Penguin Books.



- Raudsepp-Hearne, C., G. D. Peterson, and E. M. Bennett. 2010. Ecosystem service bundles for analyzing tradeoffs in diverse landscapes. *Proceedings of the National Academy of Sciences of the United States of America* 107 (11):5242-5247.
- Ritov, I., and J. Baron. 1999. Protected values and omission bias. *Organizational Behavior and Human Decision Processes* 79 (2):79-94.
- Rodriguez, J. P., T. D. Beard, Jr., E. M. Bennett, and G. S. Cumming. 2006. Trade-offs across space, time, and ecosystem services. *Ecology and Society* 11 (1):28.
- SAB. 2009. Valuing the protection of ecological systems and services, a report of the EPA Science Advisory Board. Washington, DC: Environmental Protection Agency.
- Sagoff, M. 1998. Aggregation and deliberation in valuing environmental public goods: A look beyond contingent pricing. *Ecological Economics* 24 (2-3):213-230.
- Satterfield, T. 2001. In search of value literacy: Suggestions for the elicitation of environmental values. *Environmental Values* 10 (3):331-359.
- Slootweg, R., P. van Beukering, and November. 2008. Valuation of ecosystem services & strategic environmental assessment: Lessons from influential cases.
- Spash, Clive L. 2008. How Much is that Ecosystem in the Window? The One with the Bio-diverse Trail. *Environmental Values* 17 (2):259-284.
- Stiglitz, Joseph E., Amartya Sen, and Jean-Paul Fitoussi. 2009. Report by the Commission on the Measurement of Economic Performance and Social Progress. The Commission on the Measurement of Economic Performance and Social Progress.
- Tallis, H., P. Kareiva, M. Marvier, and A. Chang. 2008. An ecosystem services framework to support both practical conservation and economic development. *Proceedings of the National Academy of Sciences of the United States of America* 105 (28):9457-9464.
- Tallis, Heather, Phillip S. Levin, Mary Ruckelshaus, Sarah E. Lester, Karen L. McLeod, David L. Fluharty, and Benjamin S. Halpern. 2010. The many faces of ecosystem-based management: Making the process work today in real places. *Marine Policy* 34 (2):340-348.
- Tashakkori, A., and C. Teddlie. 2003. *Handbook of Mixed Methods Sampling in Social and Behavioural Research*. London, UK: Sage Publications.
- TEEB. 2009. The Economics of Ecosystems and Biodiversity for National and International Policy Makers – Summary: Responding to the Value of Nature. Wesseling, Germany
- Teski, Marea C., and Jacob J. Climo. 1995. *The Labyrinth of Memory: Ethnographic Journeys*. Westport, CT: Bergin & Garvey.
- Turner, R. K. 2000. Integrating natural and socio-economic science in coastal management. *Journal of Marine Systems* 25 (3-4):447-460.
- UN. 2010. *General Assembly proclaims 22 April 'International Mother Earth Day' adopting by consensus Bolivia-led resolution*. United Nations Department of Public Information 2009 [cited September 6 2010]. Available from <http://www.un.org/News/Press/docs/2009/ga10823.doc.htm>.
- UNESCO. 2003. Linking universal and local values: managing a sustainable future for world heritage. In *World Heritage Conference*. UNESCO World Heritage Centre, Paris: UNESCO.
- Wainger, Lisa A., and James W. Boyd. 2009. Valuing Ecosystem Services. In *Ecosystem-Based Management for the Oceans*, edited by K. McLeod and H. Leslie. Washington, DC: Island Press.
- Wilson, Matthew A., and Richard B. Howarth. 2002. Discourse-based valuation of ecosystem services: establishing fair outcomes through group deliberation. *Ecological Economics* 41 (3):431-443.
- Worm, B., E. B. Barbier, N. Beaumont, J. E. Duffy, and C. Folke. 2006. Impacts of Biodiversity Loss on Ocean Ecosystem Services. *Science* 314:787-790.
- Wynne, Clive D. L. 2004. The perils of anthropomorphism. *Nature* 428 (6983):606-606.

Young, Nathan. 2008. Radical Neoliberalism in British Columbia: Remaking Rural Geographies.  
*Canadian Journal of Sociology* 33 (1):1-36.

### **3 Mapping Marine Ecosystem Service Values and Threats**

#### **3.1 Introduction**

Around the world, marine ecosystems show signs of distress, including drastically diminished fish stocks, habitat destruction and pollution (Worm et al. 2006). An array of commercial activities have degraded marine ecosystems with some detrimental impacts on human well-being (Dayton et al. 2005; UNEP 2006; MA 2003). In order to work towards more biologically diverse and productive oceans, many countries are conducting marine spatial planning (MSP)(Ehler and Douvere 2009). MSP is a public process that involves the analysis and allocation of human activities over space and time (Ehler and Douvere 2009). This process promises to advance ecosystem-based management, which recognizes both the dynamic relationships among human activities and ecosystem conditions as well as the cumulative impacts of different sectors on ecosystems (McLeod and Leslie 2009; McLeod et al. 2005). MSP also aims to protect, maintain, and restore ocean ecosystem health, reduce conflicts among ocean users and facilitate development that integrates ecological, social and economic objectives (Botsford, Castilla, and Peterson 1997; Lubchenco et al. 2003; Pauly et al. 2002; Foley et al. 2010). By providing a common language and set of metrics for evaluating the flow of benefits and trade-offs associated with natural resource decisions (Daily et al. 2009), an ES framework may help to achieve the goals of MSP. In turn, MSP has the potential to contribute to the long term provision of ecosystem services (ES)(Foley et al. 2010), the ecological processes through which nature provide benefits to people (Levine and Chan in press).

Biophysical features and economic values are often used to identify priorities for and evaluate trade-offs in conservation planning (Naidoo et al. 2006; Klein et al. 2008; Ban and Klein 2009). A framework has been developed for land use planning for biodiversity and ES, which includes locating and prioritizing management effort associated with the production of multiple ES and high levels of biodiversity (Chan et al. 2006; Chan, Hoshizaki, and Klinkenberg submitted). In marine conservation planning, fisheries-focused socioeconomic considerations have been incorporated into the design of networks of marine protected areas (Ban and Klein 2009; Klein et al. 2008). The quality of ecological and economic information used for planning processes is crucial, but it is broadly recognized that the success of changing marine resource policies

including marine zoning largely depends on the extent to which stakeholders support the changes. Many who rely on commercial fishing may perceive changes in spatial regulations as a potential loss of commercial use of areas or foreclosed harvests if restrictions are applied (Stewart and Possingham 2005; Sumaila et al. 2000; Roberts et al. 2003). Community support for different marine spatial plans can depend on what people value in the marine environment and perceptions of who benefits and who suffers from changes in management. To improve marine management, understanding context, history and how people affect and are affected by the ocean is important (Shackeroff, Hazen, and Crowder 2009; NCCOS 2007).

The ocean has typically been viewed as *unpeopled*, a place where people move in and out for extractive or recreational purposes, but have little attachment to specific places. Expanding our understanding of the human dimensions of the ocean should inform the priorities, goals and objectives of a MSP process (Crowder and Norse 2008). Accounting for the human dimensions of the ocean includes increasing knowledge about the value of marine resources to different people and how people depend on specific places (Crowder and Norse 2008; St Martin and Hall-Arber 2008).

To conserve ecosystems and sustain livelihoods as well as other benefits tied to the productivity of ecosystems, a broader accounting of the highly valued tangible and intangible ES values associated with the oceans is needed (Carpenter et al. 2006). Influential decision-making bodies, such as the National Oceanic and Atmospheric Administration (NOAA) and the Environmental Protection Agency (EPA) have begun to use ES frameworks and conduct ES research (Tallis et al. 2010; SAB 2009). Substantial progress has been made to account for the monetary value of ES (Boyd and Banzhaf 2007; TEEB 2009; Daily and Ellison 2002).

Economic valuation of ES, however, has been criticised for the limitations inherent in the commodification of benefits people get from nature, particularly ES with substantial cultural and non-use value (Spash 2008; Kumar and Kumar 2008; Chan et al. 2010). Use value is the utility associated with consuming a good. Non-use (or passive use) values refer to non-consumptive benefits that do not require observable use (Arrow et al. 1993; Pearce and Moran 1994). One type of non-use value is existence value, defined as the satisfaction in knowing something exists (Pearce and Moran 1994). Another non-use value is bequest value, which is the fulfillment from giving something to others (Gilipin 2000). Many ES values, including non-use values, simply do

not translate into monetary terms. The limitations in reducing benefits from nature to monetary values are apparent when considering values based on a principle or virtue (Chan, Satterfield, and Goldstein in prep; Sagoff 1998). For example, it would likely be offensive to quantify in dollars the moral opposition to allowing the extinction of species like salmon, which are expensive to conserve.

Another set of values that do not translate well into monetary terms is spiritual values, which are related to metaphysical forces that exist beyond the individual (e.g., the spiritual value of a sacred place). The value of transformative experiences enabled by certain ES that change how we think cannot be expressed appropriately or effectively in monetary terms (e.g., the value of a transformative experience of watching a massive salmon migration) (Chan et al. in press).

Although ES frameworks are designed to account for a wide variety of reasons as to why nature is important, they have been critiqued for facilitating only the expression of anthropocentric perspectives. The representation of bio or eco-centric perspectives is not explicitly part of the ES concept (Moore and Russell 2009).

MSP attempts to coordinate planning for a wide variety of ocean-based activities. Currently, MSP calls for additional mapped layers of human use of the ocean. Various projects have used interviews and community workshops to document fishing grounds (St Martin and Hall-Arber 2008; Scholz et al. 2006), but MSP research has yet to focus on spatially identifying non-monetary values associated with particular places in the marine environment and integrating this information with areas of monetary value. Research has been conducted to map stakeholder values and perception of threat on land (Raymond et al. 2009; Brown 2005), but there is no explicit distinction between monetary and non-monetary values in this research. Given the wide array of potential values associated with ES, it is speculated that there is need for a variety of processes that can facilitate the articulation of these values, particularly non-monetary values that can be overlooked or marginalized in decision-making (Chan et al. in prep). This research is an innovative effort to bridge a gap in the literature by documenting spatial local knowledge to map not only areas associated with monetary value but also non-monetary value and places under environmental threat.

Relative human impacts to marine ecosystems on a global scale have been mapped (Halpern, Walbridge et al. 2008). Although no global map of monetary and non-monetary importance of the oceans has been created, this analysis of correlation focusing on values and threats conducted at a substantially finer resolution may offer insights applicable to coarser scales.

This research was conducted through an interview-based mapping exercise in the Regional District of Mount Waddington (RDMW), a sub-region of the Pacific North Coast Integrated Management Area (PNCIMA). To address marine-related conservation, sustainable use, and economic development, Fisheries and Oceans Canada (DFO) identified PNCIMA as a priority for marine use planning. This research contributes to PNCIMA's marine spatial planning efforts through the demarcation of places that provide ES that are considered particularly valuable and places where the benefits that people receive from marine ecosystems are under threat.

### **3.1.1 Research Objectives**

A methodological contribution from this research is testing the feasibility of an innovative protocol that combines verbal value elicitation with spatial identification as well as quantification of monetary, non-monetary and threat values. It is expected that some of the findings are particular to the case study and others likely apply more broadly.

A major research goal was to map monetary, non-monetary and threat values, where and when it was appropriate to map such values. This research addressed the question of how acceptable for interviewees is the protocol for eliciting spatial values? If participants were unwilling to share spatial information, were the refusals attributed to the method used or the intrinsic nature of the value and threat mapping exercise? It was anticipated that some people would not be willing to share this type of information that could be seen as too personal, sensitive or simply not applicable

Using the information willingly shared, another research goal was to identify the spatial distribution and correlation of monetary, non-monetary and threat values across individuals and aggregated categories of value and threat. A research objective was to identify places of high value and threat in the RDMW.

The analysis of the spatial correlation of monetary, non-monetary and threat values tests hypotheses with potentially overlapping predictions. Part of the place-based theory of environmental evaluation states that the intensity of values associated with places are discounted the further away the places are from people's homes (Brown, Reed, and Harris 2002; Norton and Hannon 1997). This research tests the hypothesis that people put more value on places that are closer to where they live. This assumes that places that are closer to people's home are also more accessible, more visited and therefore more valued by the people who live nearby.

Although research has been done to map monetary value, particularly related to fisheries landings (Watson et al. 2004), this has not been complemented with maps pertaining to non-monetary values. It has been speculated that people associate non-monetary benefits with the places and practices from which they derive monetary benefits, in part because these various categories of benefits may stem from the same or concomitant activities (Chan, Satterfield, and Goldstein in prep; Chan, Hoshizaki, and Klinkenberg in press). Therefore, two hypotheses are that areas of non-monetary and monetary value correlate at the level of the individual and these values correlate when aggregated across respondents. This would occur if people derive both monetary and non-monetary benefits from the same places.

Alternatively, people may deeply value pristine places where people have had minimal impact. Hypotheses from this speculation are that 1) non-monetary value is not spatially correlated with monetary value; and 2) non-monetary value is not spatially correlated with threat value. The first hypothesis could be explained in light of people placing a higher non-monetary value on pristine areas chiefly because these regions are relatively untouched and not used for economic activities. Consequently, areas valued for non-monetary importance would have little monetary value. A possible explanation for this second hypothesis is that areas under threat are assumed to be heavily used and impacted by people. If people only value pristine areas, non-monetary value would not be associated with areas under threat.

Expression of environmental threat to ecosystems may be correlated with specific professions, particularly in regions similar to the case study site where job opportunities are scarce and/or declining. It is possible that people who are employed in a specific industry may be less likely to perceive environmental threats associated with the activities of their employer. It was

speculated that this may be the case in the RDMW with regards to perceived threats associated with the salmon aquaculture industry in the region. From the local to national scale, salmon aquaculture is arguably Canada's most controversial, divisive and intense industrial development conflict (Young and Matthews 2010). In the last 20 years, particularly in this study region, net-pen salmon aquaculture has grown along with controversy over the ecological consequences of this industry's operations (Young and Matthews 2010). Given the polarization on this politically charged topic (Gross 1998; Young and Matthews 2010), it was expected that people whose employment was directly associated with the industry would not articulate, spatially identify or assign relative value to threats associated with their employer.

In addition to these hypotheses and advancing academic understanding of the spatial distribution of values and threats, this spatial analysis has local relevance. This type of spatial data derived from these methods could contribute to elucidating local perspectives on ES in this other locations and contribute toward other marine spatial planning processes that incorporate local knowledge and perceptions of value and threat.

## **3.2 Methods**

### **3.2.1 Project Partners**

This project was a collaboration involving the marine conservation organization, Living Oceans Society (LOS), the RDMW and the University of British Columbia (UBC). The monetary and non-monetary value research in this project is complemented by an economic assessment of the contributions of the marine environment to the region's economy including regional economic data on wild fish harvests, aquaculture and marine tourism operations (LOS in prep).

### **3.2.2 Study Area**

This ES value elicitation and mapping method was tested within the RDMW the northern region of Vancouver Island in British Columbia, Canada (Figure 3.1).





**Figure 3.1 Regional District of Mount Waddington**

In British Columbia, the RDMW spans 20,288 km<sup>2</sup> of land and 9,880 km<sup>2</sup> of ocean.

In 2006, the population was 11,651, of which 23.4% are First Nation (Aboriginal), 73.5% are Caucasian and 3.1% are other visible minorities (BCStats). Between 2001 and 2006, the population declined by 11.1%. Life expectancy is 75.8 years compared to 82.1 in Greater Vancouver. The average family income is \$65,683 as compared to the average BC family income of \$80,511 (BCStats).

Several communities in the RDMW, particularly Alert Bay and Sointula, historically relied on timber and fishing industries. Forestry was the main economic driver for much of coastal British Columbia. During the past 20 years, forestry along Canada's Pacific coast has declined sharply due to many factors including trade liberalization. Declines in forestry combined with a substantial reduction in fishing fleets have created economic challenges in the RDMW and much of rural, coastal BC (Young 2008).

### **3.2.2.1 Fisheries Context**

The BC fishing industry has undergone drastic change since the mid 1980s. In an effort to reduce pressure on fish stocks, much of the BC fishing fleet was consolidated. The activity of fishing fleets based in the RDMW and many other communities in BC has declined sharply in the past two decades (Brown 2005). Fleet reductions have been accompanied by some fisheries-related spatial management efforts, including Rockfish Conservation Areas (RCAs).

### **3.2.2.2 Existing Marine Spatial Management Measures**

After a precipitous drop in rockfish abundances, Rockfish Conservation Areas (RCAs) were implemented in 2002 to rebuild populations of these fish (Yamanaka and Logan 2010). Within RCAs, fishing gear that disturbs benthic habitat is prohibited. In BC, RCAs cover ~4,847 km<sup>2</sup>. RCAs cover ~1,036km<sup>2</sup> of the waters in the RDMW, which is ~10% of the waters of this regional district (DFO 2007).

The waters of the RDMW, particularly Johnstone Strait, are summer habitat for BC's northern resident orca (killer) whales, *Orcinus orca*. Whale watching is a popular activity in this Strait. Recognized as critical orca habitat, the Robson Bight Michael Bigg Ecological reserve is closed to recreational boat traffic and it is a voluntary no-entry zone for commercial boats. Orca whales tend to aggregate in this location and use it preferentially over other habitat for beach rubbing as well as feeding (Williams, Lusseau, and Hammond 2009).

### **3.2.2.3 Salmon Aquaculture**

Net-pen salmon aquaculture is Canada's biggest and most profitable type of aquaculture. As of 2005, the gross domestic product (GDP)<sup>4</sup> contribution of aquaculture to the BC economy was \$274 million, sportfishing was \$248 million, fish processing was \$173 million and commercial fishing was \$103 million. Fisheries and aquaculture accounted for 0.6% of BC's GDP in 2005 (MOE 2007).

As of 2007, a total of 42 finfish farm tenures exist in the RDMW. Of these, 26 farms are located in the Broughton Archipelago (MAL 2007; LOS 2007). Salmon net-pen aquaculture is a major source of employment in this region. The expansion of this industry has been accompanied by controversy over the environmental, social and economic ramifications of this industry's

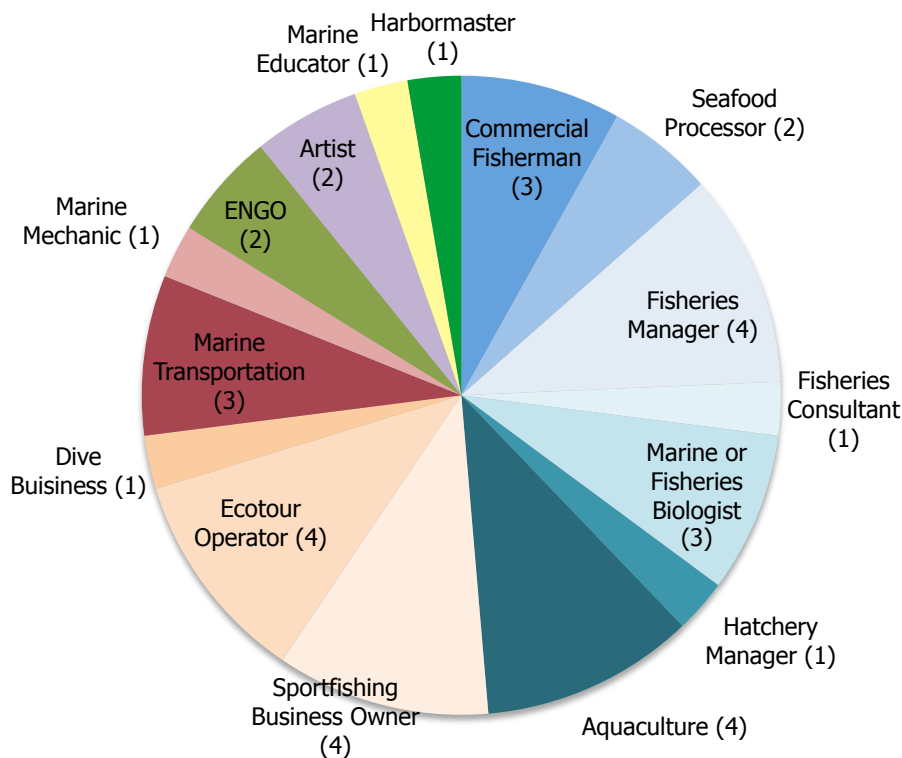
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<sup>4</sup> GDP measures the value added by an industry or activity to the economy. It is calculated by the total revenue from the sale of goods or services produced by an industry minus the cost of materials and purchased services consumed in the production process.

operations. From the local to national scale, salmon aquaculture is arguably Canada's most controversial, divisive and intense industrial development conflict (Young and Matthews 2010).

### 3.2.3 Interview Sample

People who play an active role in marine resource management as well as others whose income relies on the ocean were interviewed using non-proportional quota sampling. The sampling method was used to solicit a wide range of values from engaged and knowledgeable stakeholders rather than trying to get a sufficiently high sample size for proportional quota sampling (Tashakkori and Teddlie 2003). Project partners at the regional district government and a local marine conservation NGO provided recommendations on who to select for the in-depth interviews. The 30 people who were interviewed represent a wide range of employment activities and live in several communities across the RDMW (Figure 3.2 and Figure 3.3). Due to time and travel constraints, interviewees lived in towns accessible by roads, frequent ferries or short boat rides. This limited the representation of more remote communities in this study.

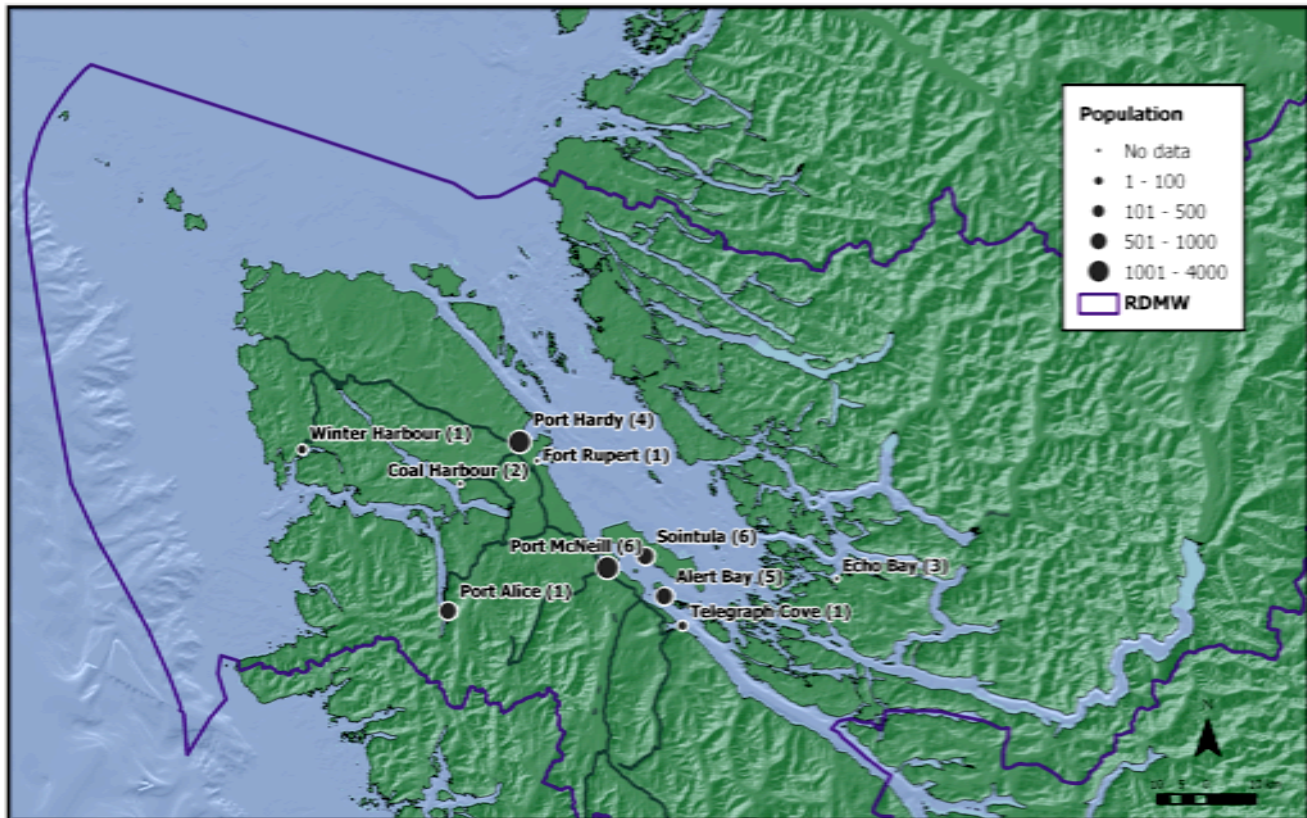


**Figure 3.2 Interviewees by profession.**

The total is 37 because seven interviewees had two professions. Several occupations, particularly related to tourism, are seasonal, part-time and/or contract-based in this region, which is why some have several jobs. Also, many who invest in boats use them for multiple purposes, e.g., marine transportation for industrial purposes and ecotourism.



A total of seven women and 23 men were interviewed; two were of First Nations descent, and 28 were Caucasians. Participants had lived in the RDMW from 8 to over 65 years with an average duration of 30 years. Interviewees represented a wide range of professions related to the ocean (Figure 3.1) and lived in towns across the regional district (Figure 3.2).



**Figure 3.3 Hometown and number of interviewees (n= 30).**  
Spatial population data was not available for other small communities in the RDMW.

### 3.2.4 Interview Design

A total of 30 interviews were conducted between April 9 and June 7, 2010 by one interviewer. After 45 potential interviewees were sent a contact letter inviting them to participate, interviews were scheduled in locations convenient and comfortable for the interviewees. A total of 15 were unresponsive or unavailable for interviewing. When possible, interviews were conducted in people's homes or private offices to maximize their comfort level. Two interviews were conducted in boats belonging to the interviewees, three were done in quiet cafes, eight took place in the interviewees' offices, and 17 occurred in interviewee's homes. Interviews began with signing a consent form and confidentiality agreement along with a brief project description, both

in writing and verbalized by the interviewer. Interviews lasted from 54 minutes to 3 hours and 30 minutes. A total of 56 hours of interviews were transcribed.

Open-ended questions were asked to gain insight into how the individual came to have a profession related to the ocean. This was followed with questions pertaining to possible links between the ocean's health and personal as well as community well-being. Interviewees were asked questions about what he/she values from the ocean. Questions about non-monetary value were framed around cultural ES identified in the Millennium Ecosystem Assessment (MA 2003).

The subject was also asked what, if anything, threatens the physical things (e.g., fish and shellfish harvests) or experiences (e.g., recreational boating and fishing) that he/she values in association with the ocean. For an analysis of the verbal content of the in-depth interviews refer to Klain *et al.* (in prep).

A 1m x 2m laminated compilation of nautical charts covering the RDMW at a scale of 1:400,000 was unfurled, usually on a large table or the floor. The chart compilation was made with ten digital nautical charts in ArcGIS 9.3 using the Albers Equal Area projection (NAD83). A mosaic of charts was required to cover the study area because no existing single nautical chart extended across the entire study region with adequate detail.

Interviewees were asked to identify areas in the ocean that they rely on for their economic livelihood by drawing polygons with a green pen around these locations. Interviewees were asked why each area is important to him/her. Relative importance was assessed by asking interviewees to allocate a set number of units symbolizing relative value (Raymond et al. 2009). Building on methods used in other marine planning processes (Scholz et al. 2006), the interviewee was asked to distribute 100 tokens according to the relative monetary importance of each area to him/her.

After open-ended questions on cultural ES to encourage people to think about the connection between place and heritage, identity, activities including subsistence food collection, spirituality, art, education and intergenerational values, interviewees were asked to use a blue marker to identify regions important for non-monetary reasons. Once the locations were marked, he/she was asked to distribute 100 blue wooden tokens that represented non-monetary value. No

specific metric of non-monetary value was provided to the interviewees. Each individual decided how to allocate relative non-monetary value based on a wide range of experiences, benefits, and emotions associated with natural elements of particular places.

The final interview questions covered threats to the marine ES that people value. Interviewees were asked to draw polygons with a red pen around areas that are threatened and/or sources of threat. In some cases, the sources of threat were not spatially explicit (e.g., ocean acidification, marine debris, PCB and heavy metal contamination). These non-localized threats were recorded, but not mapped.

The sequence of value elicitation, starting with monetary, then non-monetary and lastly threat, was consistent for all interviews. The rationale behind this order was that asking the more straightforward, concrete questions about monetary value helped interviewees become accustomed to the style of the questions asked, particularly the spatial prompt. This was followed with several questions intended to facilitate the articulation of intangible ways in which marine ecosystems contributed to their well-being. The semi-structured style of these interview questions likely helped interviewees develop a higher level of comfort with the interviewer. Given the affective and sensitive nature of information regarding non-monetary values, this rapport likely contributed to interviewees sharing their areas of non-monetary importance with the interviewer. When identifying threatened areas or sources of threat, interviewees often referenced their areas of monetary and non-monetary importance and the associated notes about why areas were important.

Initially, interviewees were provided wooden tokens, which they placed on the polygons that they drew. Distributing three sets of 100 1x0.25 cm discs proved difficult to keep track of so later interviewees allocated relative value by writing numbers in erasable pen within the polygons drawn on the nautical chart. The participants often erased and adjusted units as he/she distributed them.

A D-SLR Nikon D70s on a tripod was used to photograph the chart marked with each interviewee's green, blue, and red polygons with notes on associated values as well as numerical relative values. The nautical chart was then erased after the photos were taken. These photos were imported as images (jpg files) into ArcGIS 9.3, set to semi-transparent, overlaid on top of

base layers of land, coastline the regional district boundaries and the appropriate digital nautical chart. The images were georeferenced based on these layers. Shapefiles were created by digitally tracing interviewees' polygons from the georeferenced photo. In the table associated with each shapefile, the relative value and different ES value was recorded. For each interview with spatial information, a total of three shapefiles were created, each with polygons associated with monetary, non-monetary or threat values.

### **3.2.5 Spatial Analysis**

#### ***3.2.5.1 Calculating Relative Value***

The relative value by area was calculated by dividing the number of monetary, non-monetary or threat tokens associated with the shape by the area of the polygon. Each shapefile was overlaid with a grid of 500x500m cells. This cell size (0.25-km<sup>2</sup>) was chosen as being slightly larger than the smallest polygon drawn by an interviewee (0.2-km<sup>2</sup>), which we assumed to indicate roughly the scale at which interviewees conceive of areas of value and threat. This cell size provided a reasonable level of detail given the extent of the study region (9,880 km<sup>2</sup> of ocean) and allowed us to avoid artificial autocorrelation by analyzing data at a resolution smaller than that of responses. A coarser resolution would have diminished the level of spatial detail that the interviewees provided.

Each grid cell was assigned a unique numerical identification number. The shapes drawn by interviewees were overlaid and intersected with the grid to spatially summarize the monetary value, non-monetary value or threat intensity by each cell. The relative value associated with each grid cell was calculated according to the following methods.

The relative importance of each grid cell was weighted based on the number of assigned discs and the area of the polygons of each type drawn by the interviewee. Polygons representing monetary, non-monetary and threat values were overlaid separately.

Each interviewee was constrained by a budget of 100 units of monetary, non-monetary and threat value. Some proportion of this value,  $T$ , was allocated to each polygon,  $i$ .

Given:

$i$  = polygon

j = interviewee

$A_{ij}$  = area (km<sup>2</sup>) of polygon i drawn by an interviewee j

$V_{ij}$  = relative value per grid cell within i

$T_{ij}$  = assigned relative value to i

$n_j$  = number of polygons drawn by j<sup>th</sup> interviewee

k = grid cell

Where:

$$\sum_{i=1}^{n_j} T_{ij} = 100$$

$V_{jk}$  is calculated as follows where k belongs to i:

$$V_{jk} = T_{ij} / A_{ij}$$

Some interviewees said that they valued each area the same as any other area where they drew a polygon. In these cases, the relative value by area was calculated in proportion to the area of each polygon. Each grid cell overlaid on a particular polygon was assigned the same relative value. Interviewee responses were interpreted in this way so that all cells within the polygons considered important for non-monetary reasons would be assigned identical value.

When the j<sup>th</sup> interviewee said all areas were valued equally:

$$V_{jk} = 100 / \sum_{i=1}^{n_j} A_{ij}$$

The monetary, non-monetary or threat values across all interviews was added for a total monetary, non-monetary or threat value for each cell. Spatially overlapping grid cells derived from shapes drawn by different interviewees for the same type of value (monetary, non-monetary, or threat) were calculated according to the following equation:

$$V_k = \sum_{i=1}^{n_j} V_{jk}$$

Relative value was calculated in this way to understand the difference in value intensities across the study region.



### 3.2.5.2 *Overlap Analysis*

An overlap analysis was done to test the hypotheses pertaining to spatial correlation. Overlap analysis was conducted rather than correlation due to the abundant zeros and little variation in the values associated with cells for each individual. To determine the extent to which monetary, non-monetary and threat values spatially coincide in relation to the expected overlap by chance alone, the ratio of observed to expected overlap was calculated for each individual and for the summed responses. Data on the presences or absence of monetary value, non-monetary and threat value for each interviewee was summarized to 0.25-km<sup>2</sup> cells associated with a unique identification number. The overlap analysis was conducted with this tabular data. The relative value or threat intensity associated with each cell was not considered in the overlap analysis but is addressed in the correlation analysis.

Given:

E = expected overlap

C<sub>m</sub> = cells (0.25-km<sup>2</sup>) of monetary value

C<sub>n</sub> = cells (0.25-km<sup>2</sup>) of non-monetary value

C<sub>th</sub> = cells (0.25-km<sup>2</sup>) of threat value

C<sub>tot</sub> = total cells (0.25-km<sup>2</sup>) in study area

The following equations were used to calculate expected overlap proportion, which could range from 0 to 1:

$$E(C_m, C_n) = (C_m/C_{tot}) * (C_n/C_{tot})$$

$$E(C_m, C_{th}) = (C_m/C_{tot}) * (C_{th}/C_{tot})$$

$$E(C_n, C_t) = (C_n/C_{tot}) * (C_t/C_{tot})$$

For any two values, the observed overlap proportion is the union of two sets divided by the study area. That is, given:

S = observed overlap proportion

A = number of overlapping cells (0.25-km<sup>2</sup>)

The following equations were used to calculate observed overlap:

$$S(C_m, C_n) = A(C_m, C_n)/C_{tot}$$

$$S(C_m, C_{th}) = A(C_m, C_{th})/C_{tot}$$

$$S(C_n, C_t) = A(C_n, C_t) / C_{tot}$$

If two sets of values were randomly distributed relative to each other, the observed:expected overlap ratio would equal 1. Frequency distributions were calculated across individuals based on the observed overlap over the expected overlap.

Given:

OE = observed to expected overlap probability ratio

These equations were used to calculate the observed:expected overlap probability ratio:

$$OE = S(C_m, C_n) / E(C_m, C_n)$$

$$OE = S(C_m, C_{th}) / E(C_m, C_{th})$$

$$OE = S(C_n, C_t) / E(C_n, C_t)$$

### **3.2.6 Relative Value Spatial Correlation**

Bivariate correlations were used to explore the relationships between the summed relative values assigned to 0.25-km<sup>2</sup> cells of monetary value, non-monetary value and areas under threat across all interviewees. Since the aggregate values were not normally distributed across cells, the nonparametric Spearman's rank correlation coefficient or Spearman's rho correlation was calculated for each pair (monetary, non-monetary; monetary, threat; non-monetary, threat) to determine the statistical dependence between the two variables. This statistic converts each variable to ranks, thus overcoming statistical issues with the non-normality of the variables.

### **3.2.7 Employment and Perception of Threat**

To test the correlation of perception of threat and employment (hypothesis 5), a chi-square test was performed with Excel. This tested the hypothesis that full and part time employment in salmon aquaculture is correlated with not identifying aquaculture as a threat to marine ecosystems.

## **3.3 Results and Discussion**

Adding the valuation scores is a rough estimate of the relative monetary, non-monetary and threat values associated with particular locations. Data was mapped based on responses from a

wide range of stakeholders but a relatively small sample (n=30). Justifications for not participating in the mapping exercise are also important research findings.

### **3.3.1 General Refusals to Identify Locations**

Two interviewees did not answer any spatial questions. One interviewee with a background in community planning said, “as soon as you start isolating things and say this is important to me, you lose the rest...that’s the risk...we start drawing lines, suddenly what’s outside of the line becomes available for development.” This participant was worried that assigning importance to specific places signifies a lack of importance outside of the areas identified, which is a valid concern. This perception may also be based on past negative experiences with spatial planning processes.

Another reason for not drawing polygons on the map reflected an interviewee’s rejection of hard boundaries and preference for gradients. He explained, “I like things that have continuity, that don’t have edges, that’s part of my values and spirituality and aesthetics.” He also said, “the only way we have here to prevent open access to fishing grounds ...for food, for recreational, even for commercial purposes, is by ... keeping your knowledge private....[Sharing this knowledge] is like handing somebody a key to your food, to your house, to your front door.” This justification for not drawing on the nautical charts can be interpreted as believing that sharing spatial knowledge of important resources could result in potentially losing access to these resources or contributing to the degradation of these resources. This is an important concern based on the historical and current conflict over access to both land and sea resources in the RDMW where First Nations continue to struggle for resource rights in treaty negotiations (Tobias 2009).

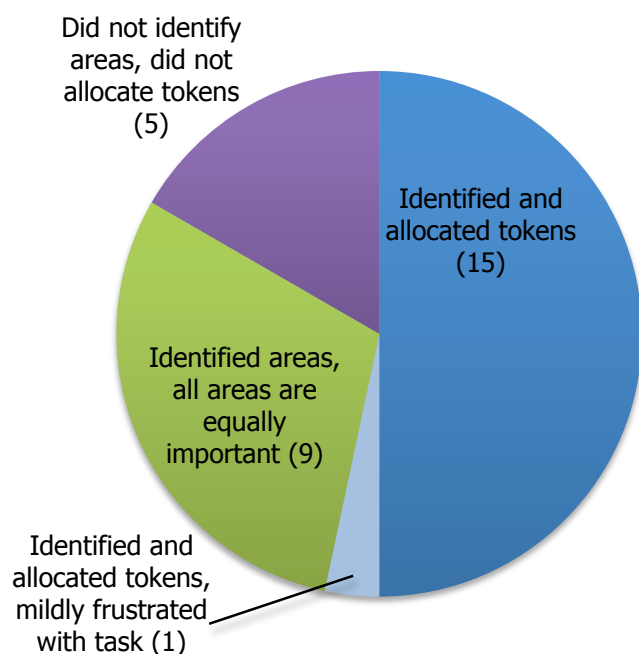
Another respondent simply did not think that any areas are more valuable than others. This respondent did not conceive of value being tied to specific locations, but he did articulate non-spatial ways in which marine ecosystem were important to him.

### **3.3.2 Refusals to Specific Spatial Identification Prompts**

A total of 23 out of 30 people interviewed drew polygons over the areas that are monetarily important to their work. The remaining seven had income that did not rely on specific locations (e.g., an artisan whose work was inspired by the region, but not specific places and managers concerned with fisheries governance issues related to the region as a whole, not particular locales).

Out of the 30 interviewees, 25 identified areas important for non-monetary reasons. Justifications for not identifying areas of non-monetary importance ranged widely. One interviewee did not want to identify culturally sensitive locations (e.g., a shell midden or a setting from a culturally important First Nation myth) or other areas of non-monetary importance out of fear that the information would be misused. The three others chose not to identify areas of personal significance because they felt this importance was based on places where they had memorable experiences with friends and family in certain natural areas, but the natural area itself was not particularly unique, special or valuable. These interviewees interpreted the spatial prompting as asking for aggregate place value, rather than the importance of the area to themselves as individuals. Every interviewee was encouraged to share areas of personal importance even if they felt geographically limited by their own experiences. Despite this encouragement, these three interviewees refrained from identifying areas of non-monetary importance.

Out of the 25 who identified areas of non-monetary importance, 16 allocated tokens of relative non-monetary importance, whereas the remaining nine interviewees said that no one place that they identified was any more important than any other place (Figure 3.4).



**Figure 3.4 Interviewee responses to non-monetary value prompt for spatial identification and relative value allocation.**

A total of 17 interviewees drew polygons around areas that are under threat. Several people who did not identify threatened areas explained that the major threats they perceive, including pollution, toxins, acoustic concerns, and marine debris, are not spatially explicit threats. Some said they lacked the expertise to identify areas under threats. Six interviewees did not think that there are threats to their local marine ecosystems.

### **3.3.1 Spatial Precision**

Given the broad interview topics of monetary value, non-monetary value and threats, there is inherent subjectivity in the responses of interviewees based on each person's expertise, opinions and biases. Similar to local fishing knowledge interviews conducted in 2002 and 2004 in a subsection of the RDMW (Ardron 2005), some interviewees refused to draw shapes, some drew large polygons covering hundreds of square kilometers and others drew small ones covering less than one square kilometer. Some drew polygons carefully while others drew bigger shapes with less precision. It is important to note that there is likely variation in the precision of shapes drawn by an individual; it's not certain that the exact location and shape would be repeated if the interviewee was asked to do the same task at another time. There may also be some variation in accuracy, which is the match between what an interviewee drew and the shape of the area of importance. This could result from the nautical chart being misread.

### **3.3.2 Trimming Spatial Data to the Study Area**

It is important to note that this research was bounded within the waters of the RDMW. This ignores ecological boundaries and does not include the full extent of many ocean activities and threats. Despite the focus on the waters of the RDMW, some interviewees identified areas of importance and threat outside of the boundaries, such as fishing grounds of economic importance extending beyond the boundaries or a heavily trawled areas outside of the RDMW perceived as being under threat. These shapes were trimmed to fit within the RDMW boundaries and the associated relative value or relative threat was assigned to the smaller shape to consistently allocate 100 units of monetary, non-monetary and threat values.

Although the interviews were intended to focus on marine ecosystems, the polygons that interviewees drew included land because several people expressed value associated with the coastline, particularly specific beaches. Also, many identified threats to marine ecosystems associated with land-based practices, such as logging. The confluence of certain ecosystems, particularly where salmon rivers flow into the ocean, are considered highly valuable for both

monetary and non-monetary reasons. For the analysis, the polygons were trimmed to the coastline, but the values that included the interface of land and/or rivers with ocean were recorded in association with the trimmed polygons in GIS.

### 3.3.3 Types of ES Values and Threats

Interviewee responses were categorized by activity or associated value. The categories of monetary activity reflect the variety of professions of the interviewees. The relative value associated with each type of activity reflects the relative intensity of value or threat across 28 interviewees (Table 3.1).

**Table 3.1 Activities and values associated with marine ecosystems across all participants.**

The number of polygons represents the total number of each type of polygon drawn during the interviews. The relative value is the sum of the monetary, non-monetary or threat units assigned to the corresponding type of polygon (monetary, non-monetary, threat) per interviewee. The number of participants is the number of interviewees who drew a particular type of polygon. The green section relates to the interviewee's various types of employment.

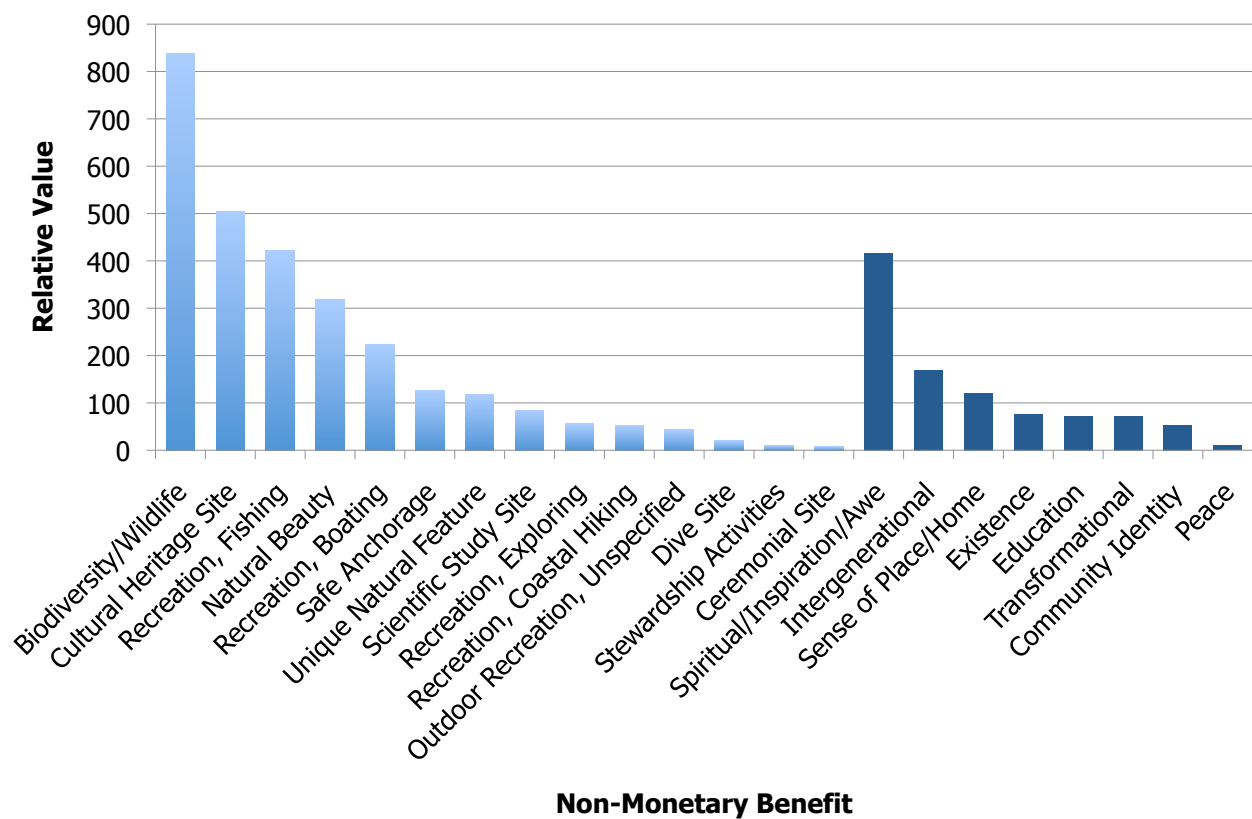
Category	No. of Polygons	Relative Value	Area (km <sup>2</sup> )	No. of Participants
<b>Economic Activity</b>				
Commercial fishing	32	570	5,411	6
Sportfishing	25	415	4,383	5
Marine Transport	19	297	3,774	4
Eco-tourism	20	524	10,762	7
Science & Biological Monitoring	9	314	2,683	4
Artistic	4	100	217	1
Fisheries Management	2	115	2,148	2
Education	1	30	88	1
<b>Tangible Non-Monetary Benefit</b>				
Biodiversity/Wildlife	61	839	6,151	18
Natural Beauty	59	318	2,144	9
Cultural Heritage Site	37	505	727	10
Outdoor Recreation, Unspecified	30	44	663	2
Recreation, Fishing	24	421	2,516	11
Safe Anchorage	14	126	24	4
Recreation, Coastal Hiking	12	52	93	3
Unique Natural Feature	10	118	246	9
Recreation, Boating	7	223	227	5
Ceremonial Site	4	8	25	1
Recreation, Exploring	3	56	923	2
Dive Site	3	21	9	2
Stewardship Activities	2	11	7	2
Scientific Study Site	2	85	129	2

Category	No. of Polygons	Relative Value	Area (km <sup>2</sup> )	No. of Participants
<b>Intangible Non-Monetary Benefit</b>				
Spiritual/Inspiration/Awe	28	417	1,320	9
Education	8	72	2,434	5
Peace	5	10	49	2
Sense of Place/Home	4	121	465	4
Transformational	3	72	811	2
Intergenerational	3	170	143	2
Community Identity	2	53	6	1
Existence	1	77	880	1
<b>Threat Activity</b>				
Salmon Aquaculture	53	1442	13,190	17
Commercial development	5	51	9	3
Logging	5	23	77	3
Pollution (from wood or sewage)	4	74	377	3
Boat traffic congestion	2	20	12	1
Fish Processing Plant	2	6	4	1
Overfishing	2	107	1,001	2
Pulp Mill	2	105	3	2
Potential Dam	2	22	28	2
Dragging	1	80	591	1
Dredging	1	80	591	1
Fisheries				
Mismanagement	1	10	28	1
Gravel Mining	1	1	6	1
Poaching	1	7	22	1

Value ascribed to biodiversity and wildlife was higher than value assigned to other non-monetary values (Table 3.1 and Figure 3.5). This can be partially explained by the categorization systems and the range of interviewees' activity preferences. Biodiversity/wildlife was summarized as one category rather than species by species because interviewees tended to mention multiple species associated with the same location. People with different recreational and other activity preferences (e.g., sportfishing, boating, hiking, stewardship activities) identified locations associated with wildlife in addition to places where they recreate outdoors or enjoy other tangible non-monetary benefits from the ocean. Consequently, the number of polygons, relative value, area and number of participants who identified particular activities is lower than for wildlife/biodiversity.

One interviewee expressed existence value for a region where he had never been that has a high density of nesting seabirds. The other interviewees assigned relative value associated with

wildlife based on personal experiences on the water with marine animals and plants, often associated with seeing large congregations of wildlife or awe-inspiring wildlife behavior (e.g., orca whales rubbing themselves on pebble beaches). Wildlife is clearly a prominent and valued feature in the RDMW.



**Figure 3.5 Relative value assigned to non-monetary benefits.**  
 Light blue denotes tangible non-monetary benefits and dark blue denotes intangible non-monetary benefits.

It is likely that it is more straightforward and comfortable for interviewees to assign value to places associated with tangible non-monetary benefits as compared to intangible non-monetary benefits. Given the personal and sensitive nature of spiritual value, it was unexpected that people identified numerous areas associated with spiritual value, inspiration and/or awe (Table 3.1). Respondents also assigned more relative value to areas associated with spirituality, inspiration or awe than any other intangible non-monetary benefit (Figure 3.5). These results provide indication of the success of the interview protocol in verbally, spatially and to a limited degree quantitatively eliciting a wide array of benefits from nature.

According to the 17 interviewees, salmon aquaculture was associated with the highest number of threat polygons, greatest area (km<sup>2</sup>) under threat, and highest relative threat value (Table 3.1).



Commercial development, logging and pollution were considered threats by 4 or more interviewees.

### **3.3.4 Intensity of ES Values and Threats**

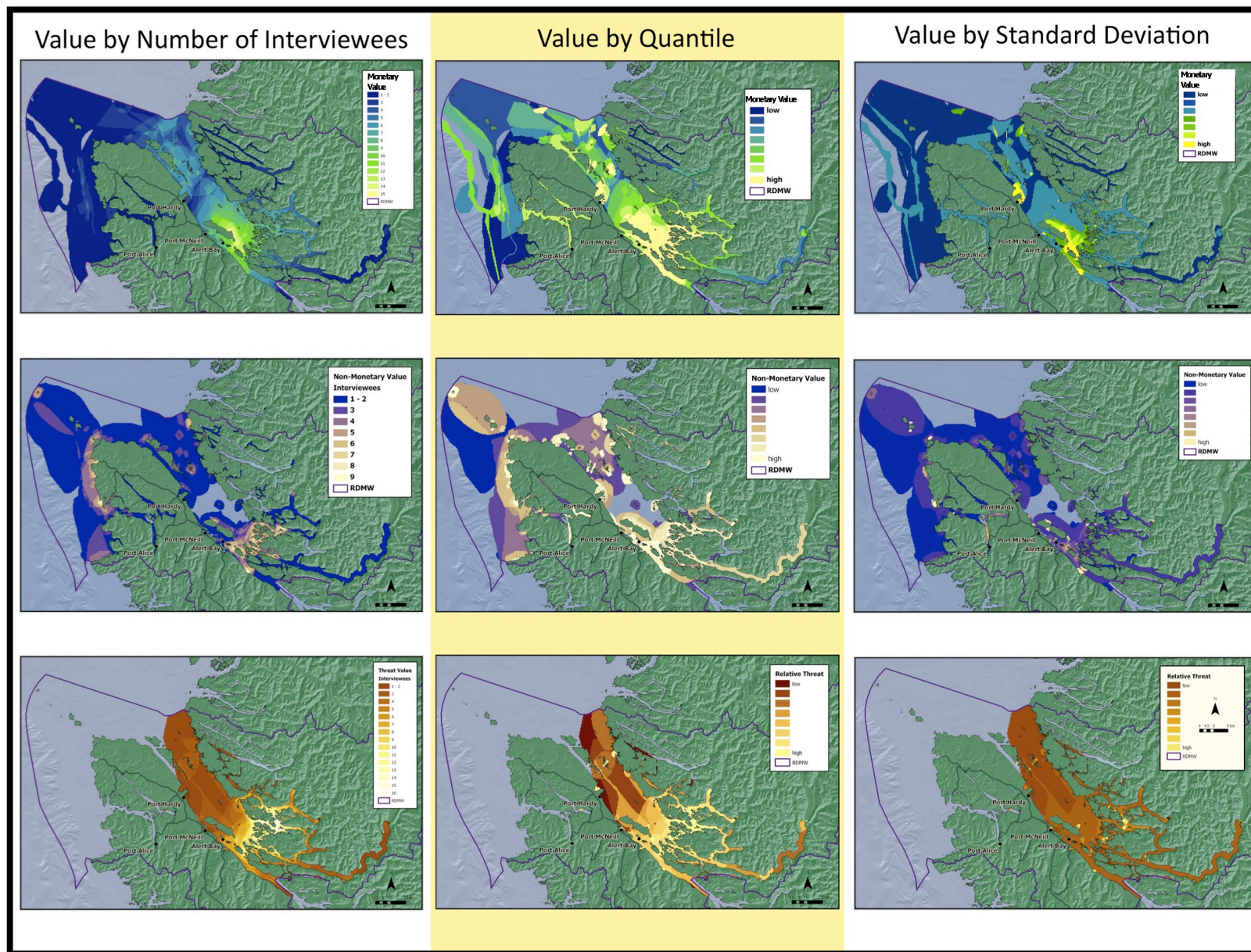
The resulting maps of ES values and threats reflect the responses of 28 individuals with expertise related to working on the ocean. Many cells were not associated with a value or threat (Figure 3.6). The areas of high value include areas with considerable overlap among the different respondents and/or areas assigned a high number of tokens by one or several respondents (Figure 3.6). It is important to recognize that this spatial method isolating specific locations tends to privilege spatially compact and/or concentrated values over diffuse and/or diluted values.

The *Value by Number of Interviewees* column (Figure 3.6) maps the number of interviewees who assigned value to any cell. This does not consider relative value but does convey the spatial extent of the values and how many interviewees assigned value to the same location. As shown in the *Value by Quantile* column (Figure 3.6) in which relative values are colored according to eight ranges that each span 12.5% of the data, there is considerable variation in the intensity of values assigned across the seascape. Some interviewees drew small shapes and attributed high relative value to these small areas. Consequently, the relative value of the cells within these small polygons was sometimes orders of magnitude higher than cells overlaid on larger polygons in which the relative value was spread over a bigger area. This is apparent in the *Value by Standard Deviation* column (Figure 3.6). Relative value assigned to large polygons was diffused whereas value to small polygons was concentrated. Therefore, when the data was aggregated, areas where people assigned high values to small areas are associated with far higher relative value scores than areas where people had drawn large polygons.

The spatial methods used required respondents to represent value in conjunction with discrete polygons. The implications of conceptualizing value across the seascape based on the maps in the *Value by Standard Deviation* column (Figure 3.6) may overemphasize small, specific places without recognizing the connectivity of marine ecosystems. If monetary and non-monetary values linked to places and activities on the ocean are perceived as discrete and isolated, MSP efforts and ocean zoning plans may not adequately consider how activities in one zone may impact an adjacent zone. MSP could be reduced to assigning locations in the ocean to particular

uses deemed as highly valuable for particular activities without accounting for how the broader ecosystem will be impacted. Focusing on small, discrete locations associated with relatively high monetary, non-monetary or threat value could also detract from accounting for gradients of value across space.

The resulting maps, particularly those in the *Value by Standard Deviation* column, may reflect the cognitive difficulty in tying value to spatial locations, a task that respondents had likely never or rarely done before. The methods used to ask people to identify particularly important or threatened areas may have biased respondents towards representing fewer, particularly high value places. Interviewees tended to identify locations important to them for specific provisioning and cultural services, but they did not explicitly identify areas valued for the supporting role that those locations or habitat types play in providing the products and experiences that people value. Also, some interviewees may have responded strategically by assigning high value to only a few distinct places to call attention to the places with issues that are most important to them personally rather than thinking more broadly about values and threats associated with the ocean.



**Figure 3.6 Stakeholder perspectives on marine ecosystem service values and threats.** These maps reflect aggregate values across all interviewees. In the *Value by Number of Interviewees* column, each cell is colored according to the number of respondents who identified monetary value, non-monetary or threat value. Quantiles are sets of values that contain an equal fraction of the total number of values. In the *Value by Quantile* column, each color includes 12.5% of the cells associated with a set range of values or threats. The maps in the *Value by Standard Deviation* column are colored according to equal data value intervals set according to half standard deviations of the distribution of relative economic, non-monetary or threat values. For all maps, lighter colors indicate greater aggregate monetary, non-monetary or threat value. For aggregation methods, see section 2.5.1 Calculating Relative Value.

### 3.3.4.1 Place-Based Environmental Evaluation

The importance of proximity in explaining high non-monetary value conforms to predictions based on the place-based theory of environmental evaluation (Norton and Hannon 1997) since the highly valued places, both for non-monetary and monetary importance tended to be close to inhabited areas (Figure 3.6). Due to research time constraints, statistics relating the proximity of interviewees' homes to the places that they valued were not calculated. Consequently, these results are not statistically substantiated but they are supported in the verbal responses of interviewees and intuitively when viewing the resulting maps (Figure 3.6). Although one individual explicitly expressed existence value for a place that he had never visited, most people identified areas with which they were familiar. The relatively low value associated with the western region of the case study area (Figure 3.6) likely reflects the smaller number of people in the study sample who have experience in this remote and largely uninhabited region.

### 3.3.5 Correlation Among Aggregated Responses

The aggregate relative values were not normally distributed across the 0.25-km<sup>2</sup> cells. Given the non-normal data distribution, the nonparametric Spearman's rho correlation was calculated to compare value and threat data summarized to 0.25-km<sup>2</sup> cells (n=43,988). The overlap is significant ( $p < 0.001$ ) (Table 3.2). This overlap analysis, however, does not account for spatial autocorrelation, the extent to which, for example, monetary values of a given cell tend to be more similar to those of nearby cells than expected by chance alone. This also assumes that the spatial fragmentation of the shapes drawn in association with the values and threats is similar.

**Table 3.2 Correlation of non-monetary, monetary and threat values.**

	<b>Correlation</b>
<b>Non-Monetary &amp; Monetary</b>	0.371**
<b>Non-Monetary &amp; Threat</b>	0.394**
<b>Monetary &amp; Threat</b>	0.579**

\*\* Correlation is significant at the 0.01 level (2-tailed).

The significant value intensity correlation is highest for threat and monetary values (0.579) (Table 3.2). Interviewees tended to identify high levels of threat in areas important to their economic livelihoods and low levels of threat in areas that are less important to them economically. The magnitude of overlap is greater for most individuals (Figure 3.7) than for the aggregate values (Table 3.3). This suggests that people tend not to perceive their activities as

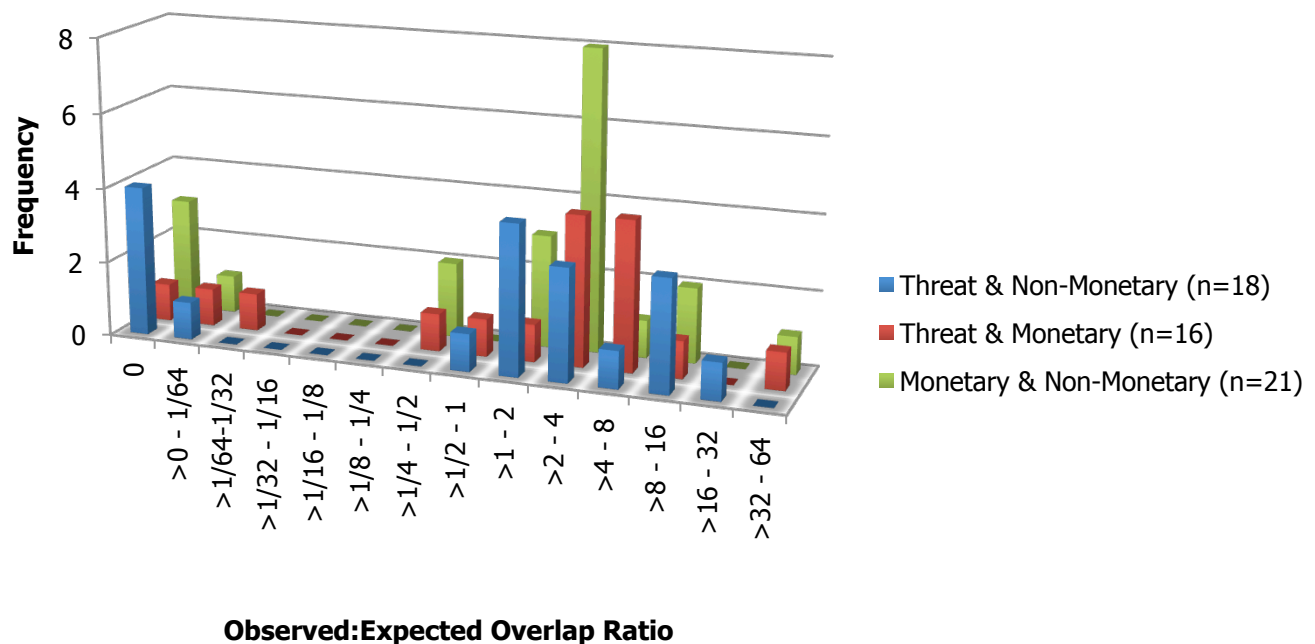


threats. Given the complexity of issues facing the ocean and the multiple stressors in the ocean (Halpern, McLeod et al. 2008), this result is not surprising since it is in people self-interest not to associate environmental threat with their livelihoods.

### 3.3.6 Overlap Analysis of Individual Responses

For individual interviewees, 38 out of 55 (69%) of the observed:expected overlap ratios are greater than one across all three pair-wise comparisons of monetary, non-monetary and threat value (Figure 3.7). Thus, for the majority of individuals, values overlapped more than would be predicted by chance alone.

The non-normality of the observed:expected overlap ratios (Figure 3.7) are due to a minority of respondents who drew largely non-overlapping polygons for each of the three categories or completely non-overlapping polygons as reflected by 0 overlap ratios. These individuals separate areas of monetary, non-monetary and threat value. The majority drew overlapping shapes reflecting value and threats covering some of the same areas across the seascape.



**Figure 3.7 Histogram of observed:expected overlap ratio for individuals.**

A geometric scale was used to provide symmetry in the range of ratio frequencies displayed. This scale emphasizes the bimodal distribution of the ratio of observed:expected overlap.

### 3.3.6.1 Overlapping Monetary and Non-Monetary Values for individuals

The majority of interviewees that spatially identified monetary and non-monetary values (~81% or 17/21) had overlapping areas of monetary and non-monetary importance, but a minority (~19% or 4/21) drew polygons that did not overlap (Figure 3.7). Many interviewees qualified their responses with the recognition that their expertise was limited to a particular part of the study region, so their responses reflect their geographically bounded knowledge and experience of specific locations. This research supports the hypothesis that areas associated with monetary and non-monetary value correlate. Klain *et al.* (in prep) provides additional evidence for this interdependence of monetary and non-monetary value.

### 3.3.1 Overlap Analysis of Aggregated Responses

When the areas of observed:expected overlap were considered using every cell identified in association with a value or threat across all interviewees, the ratios were slightly greater than 1 (Table 3.3). A high percentage of cells are included in the aggregate values and threats (Table 3.3). Thus, the expected overlaps are far higher for the aggregate overlaps (Table 3.3) than when considering individual overlaps (Figure 3.7). This is reflected in the aggregate observed:expected overlap ratios being close to one (Table 3.3).

**Table 3.3 Observed:expected overlap probability ratios and percentage of cells assigned value or threat across all interviews.**

This ratio includes every cell identified by at least one interviewee in association with a value or threat.

	<b>Observed:Expected Overlap Probability Ratio</b>	<b>Percentage of 0.5km<sup>2</sup> cells assigned value</b>
<b>Non-Monetary &amp; Monetary</b>	1.054	67.1%
<b>Non-Monetary &amp; Threat</b>	1.103	29.0%
<b>Monetary &amp; Threat</b>	1.110	36.9%

The implications of the significant correlations between threats and values as well as the overlap ratios greater than one among monetary value, non-monetary value and threat (Figure 3.7 and Table 3.3) are expressed in the paraphrased words of an interviewee: to have healthy ecosystems, we need to learn how to work with the ecosystem rather than just take from it. Developing employment opportunities that minimize environmental risks and support livelihoods through the long-term provision of ES is a central challenge for communities around the world. In this case study, given the prevalence and intensity of threats associated with

economically important areas, it would be wise to invest management resources into involving stakeholders, businesses and scientists to better address these threats.

### **3.3.1.1 Valuing Pristine Places**

The hypothesis of a negative correlation between threat and non-monetary value can be rejected. This would imply that people value places more when they are pristine and less when they become threatened. The high degree of overlap of monetary, non-monetary and threat values in the study area reflects high value associated with places that people perceive as being under threat. People also associate non-monetary value with locations that they or others rely on for their incomes that are assumed to be far from pristine.

This data shows that people value both pristine and threatened regions of the seascape. For instance, the Scott Islands near the northwestern boundary of the study site (Figure 3.6) are a remote location with minimal impact from anthropogenic factors. The high non-monetary, medium monetary, and zero threat value assigned to this area supports evidence that people value pristine areas.

### **3.3.2 Correlation of Employment and Threat Perception**

The correlation between employment associated with open net-pen salmon aquaculture and not identifying threat from this industry is -0.81 ( $p < 0.001$ ) based on Phi (Pearson's coefficient of mean-square contingency)(Table 3.4).

**Table 3.4 Contingency table of employment association with salmon aquaculture and perception of environmental threat associated with the salmon aquaculture industry.**

	<b>Salmon aquaculture is threat</b>	<b>Salmon aquaculture is not a threat</b>	<b>Total</b>
<b>Employment associated with salmon aquaculture</b>	0	5*	5
<b>Employment not associated with salmon aquaculture</b>	23	2	25
<b>Total</b>	23	7	30
<b>Phi</b>	-0.811**		

\* This number differs from the 4 people working in aquaculture (Figure 3.2) because an additional interviewee's work relied on grants from salmon aquaculture even though he is not an employee of a salmon aquaculture company.

\*\*  $p < 0.001$

### ***3.3.2.1 Perception of Threat and Profession***

Employment in open net-pen salmon aquaculture was correlated with not identifying threats from this industry (Table 3.4). For this case study, this correlation supports the hypothesis that perception of environmental threat can correlate with type of employment. It should be noted that is based on a non-random sample, which breaks the assumption of the statistical test. This correlation suggests that people employed by the salmon aquaculture industry tend not to perceive environmental threat associated with the operations of their employers. It is possible that net-pen salmon aquaculture employees feel that it is part of their job to downplay the environmental threat of this industry. It could also be possible that only people who do not perceive environmental threats with regards to the industry find employment in this line of work. Another explanation is that people whose economic livelihoods do not depend on salmon aquaculture are more receptive to information about the environmental risks associated with this industry. The generalizability of this strong correlation may not apply to other places, people and industries since this information was collected from a small sample (n=30) within one geographic region. The sample is not fully independent since there were only two salmon aquaculture companies employing people in the sample.

### **3.3.3 Limited Representation**

In order to better assess community values, representative surveys are needed (Brown 2005). The study aimed for variety rather than proportional representation. In particular, this study does not provide a wide variety of indigenous perspectives on ES values and threats within the study site. The members of the Kwakwaka'wakw First Nation who live in the region are united by their traditional language group (Galois 1994), but the 17 different Kwakwaka'wakw band governments have differing opinions on a range of topics. First Nations represent 23.4% of the region's population (BCStats) but they were only 6.6% of the interviewees (2 out of 30). Effort was made to schedule interviews with additional First Nation fishermen and fisheries managers, but they were not possible due to time constraints and remoteness of many of their communities. Also, representatives of two aquaculture companies (Marine Harvest and Mainstream) were sent contact letters requesting their participation in this study. Mainstream did not respond and the public relations representative of Marine Harvest vocally refused to be part of the study.



### **3.3.4 Limitations of Mapping Marine ES**

#### ***3.3.4.1 Indigenous People, Power and Mapping***

The results of these mapping methods need to be understood in the context of the study region. This research was conducted where indigenous people, through protest or partnership, are more capable than ever before in influencing development in their traditional territories. Aboriginal claims in BC to not only land but also ocean resources and marine areas are heatedly disputed (Young and Matthews 2010).

Cultural spatial knowledge plays a prominent role in First Nations exerting their right to control land and sea resources in their traditional territories. Locations of culturally significant places, such as historical or sacred sites, are not readily shared with outsiders. The emphasis of this project was on the perceptions of ES according to a wide range of people who professionally rely on the ocean. It is not representative of the region's diverse First Nation perspectives, nor does it take the place of traditional use and occupancy mapping.

#### ***3.3.4.2 Many values are not spatially explicit***

Three interviewees expressed mild frustration with drawing shapes on the chart because they did not think that the monetary and/or non-monetary values they associate with the ocean are appropriately expressed as pegged to discrete locations. One said that drawing arbitrary boundaries around distinct locations misses the point that marine ecosystems have gradients rather than discrete boundaries and they are highly interconnected as well as dynamic. For the practical purpose of collecting local knowledge and values in a way that's conducive to a spatial planning process, interviewees were asked to draw boundaries around areas important to them or under threat and did not have the option of assigning gradients across areas.

#### ***3.3.4.3 Recognition without spatial identification of supporting ES***

Supporting ES are inputs to final product from ecosystems that contribute to human well-being (MA 2003). Habitat can be considered a supporting ES that provides, e.g., wildlife for ecotourism, such as whales, and/or for sustenance, such as fish. When asked about the non-monetary importance of marine ecosystems, many focused not on the value of specific places as habitat, but rather on how much they value wildlife. Several of this region's most culturally and economically valuable species, including orca whales, salmon, and herring, are highly migratory and inhabit different habitats during different life stages. Capturing the value of certain species to people and tying it to specific locations can be problematic. Several interviewees did not draw

polygons around areas where they had encounters with wildlife because the species are so transitory. Some questioned the utility of isolating different patches as more valuable than others given the extensive range of the valued species. Sometimes, interviewees circled large swaths of ocean and assigned high value to it to broadly account for the significance of wildlife encounters. They verbally recognized the supporting role that other places and habitats play in the lives of the animals that they enjoy, but they did not identify areas important to other life stages of the animal.

### **3.3.5 Implications for Management & Decision Making**

This method of directly linking an ES-related activity or value to discrete locations could help inform MSP processes through the identification of places that are important to stakeholders for a variety of reasons. In descending order of frequency, people from the RDMW identified areas associated with biodiversity/wildlife, natural beauty, cultural heritage sites, and sites for outdoor recreation (Table 3.1). It is likely that memorable encounters with wildlife contribute to this high value for places associated with animals. When zoning for future development, protecting these valued attributes and locations for particular activities should be a priority in MSP.

To make the outputs of this research better reflect a wider range of people, stakeholders ought to be engaged in reviewing the aggregate spatial data and identifying potential gaps in the information. This line of research could help stakeholders, marine spatial planners and managers visualize various types of values and threats across the seascape according to a wide range of people whose livelihoods are closely associated with the ocean.

Given that the interviews and data analysis are time and labor intensive, getting a representative sample of the general population would likely be difficult. However, similar to Raymond *et al.* (2008), this type of research could sample a targeted list of decision-makers and leaders of various sectors that rely on the ocean. A larger sample size including more decision-makers and leaders representing their constituencies would strengthen the representativeness of the results.

Despite the fact that people spoke at length about intangible values (Klain, Chan, and Satterfield in prep), it was less common for interviewees to spatially identify areas associated with less tangible values, such as spiritual value, education, peace, or sense of place/home (Table 3.1).

Given the varied response to the spatial prompts pertaining to non-monetary values (Figure 3.4),

isolating non-monetary values should not be the only method to solicit information pertaining to such values. This relative infrequency of spatially identifying areas associated with intangible values signals that the intangibles are difficult to map, *not* that they are less important. This means that the aggregate maps and correlation analyses do not fully represent intangible values. If a MSP process was based on a similar mapping and valuation process, it too would be incomplete. Mapping and valuation cannot represent the full range of intangible values.

More could be done unrelated to both spatial prompting and “quantifying the unquantifiable” to explicitly recognize, respect and accommodate intangible values associated with ecosystems when choices are made regarding ocean-based development. In recognition of these limitations with mapping and quantifying non-monetary values, using maps in this interview protocol was very useful for eliciting a wide variety of reasons explaining why parts of the seascape are highly valued. There is complementarity between this mapping-interview process and a deliberative process. The intangible values represented in deliberative processes involving stakeholders could compliment the results from this type of mapping. Deliberative processes include social learning and the exchange of information as values are carefully considered and discussed (Spash 2008; Sagoff 1998).

Maps of the relative importance of places based on aggregated responses to questions about marine ES and threats could inform and prime a deliberative MSP process. ES often involve a public good, defined as a good from which one person can benefit without reducing the availability for others to benefit from it and no one can be excluded from using the good. Given the public good characteristics of many ES, deliberative processes based on outcomes of groups of citizens that work together to value ES (Wilson and Howarth 2002). Therefore, determining the relative importance of multiple values and identifying trade-offs, particularly when it comes to intangible ES values, should be a deliberative process rather than primarily based on aggregated responses of multiple individuals. After being reviewed and where necessary updated with input from multiple stakeholders, the mapped identification and relative intensity of values and threats (Figure 3.6 and Table 3.1) could provide a useful starting point for a deliberative MSP process. This process would entail public discourse on what is at stake (tangible and intangible, monetary and non-monetary) and what social, economic and environmental trade-offs exist when choices are made regarding where or if to site different types of marine economic activities (e.g., offshore wind energy, aquaculture pens, shipping

routes) and conservation zones (e.g., marine reserves). Such a process should allow stakeholders should have the opportunity to voice their concerns as to whether a proposed spatial plan will adequately protect their intangible values.

Pomeroy and Douvere (2008) recommend that stakeholders play a central role in the process of setting and prioritizing the objectives of MSP. This type of research could inform the deliberative creation of MSP priorities that could account for a wider array of ES provided by the ocean, including the monetary value of activities in particular places as well as the meaning and importance that people associate with the marine environment.

### **3.4 Conclusion**

This research piloted an innovative interview protocol that facilitated verbal elicitation, spatial identification and quantification of monetary, non-monetary and threat values. Several research findings are likely broadly applicable. The findings support the theory of place-based environmental valuation in that areas of high value tend to be near people's homes. Areas of monetary and non-monetary value overlap. This can be partially explained based on the geographically bounded knowledge and experience of people in these specific locations and a tendency to apply non-monetary values to places that are also associated with monetary value. This research also shows that people highly value both threatened and pristine areas.

Many research findings are specific to the RDMW. The places valued for biodiversity and wildlife were assigned the highest relative value. The Broughton archipelago (the southeast region of the cases study) was assigned high relative threat attributed to salmon aquaculture. People who are employed by the open net-pen salmon aquaculture companies do not associate environmental threats with this industry.

These methods were used to collect in-depth information on perceptions of ES values and threat across a seascape. Summarized spatial information from these methods can be used to identify relative monetary, non-monetary and threat value associated with particular places. Non-monetary values, however, are only partially represented spatially. Findings collected through these innovative methods could inform deliberative MSP decision-making processes.

### **3.4.1 Future Research Directions**

For future research as MSP progresses, it is important to understand the degree to which various ES values are compatible with existing threats and potential future uses of an area. More accounting is needed to characterize how community-based ES values have changed in the past and identify potential triggers for these changes to predict how community values may evolve in the future. More research is also needed to identify types of economic development that would have minimal impact on the ES that people value.

### **3.4.2 Final Remarks**

These methods facilitate the articulation of a broad range of spatial and non-spatial values associated with marine ecosystems. People ascribe meaning to places and parts of ecosystems that goes beyond instrumental and monetary value. This research documents substantial differences in ES values and perceptions of threat across the study area.

The outputs of this method can augment biophysical and economic information on ES and complement a deliberative process to enable decision makers to more fully consider stakeholder's non-monetary values and threats associated with ES. This method holds promise for integrating local perspectives on ES to support inclusive and informed environmental decision-making.

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## References

- Ardron, J. A. 2005. Quantifying Local Knowledge for use in Marine Planning: A Pilot Project in British Columbia's South Central Coast. Dissertation/Thesis, Environment and Management, Royal Roads University, Victoria.
- Arrow, Kenneth, Robert Solow, Paul R. Portney, Edward E. Leamer, Roy Radner, and Howard Schuman. 1993. Report of the NOAA Panel on Contingent Valuation. Washington, D.C.: National Oceanic and Atmospheric Administration.
- Ban, Natalie Corinna, and Carissa Joy Klein. 2009. Spatial socioeconomic data as a cost in systematic marine conservation planning. *Conservation Letters* 2 (5):206-215.
- BCStats. Regional District 43 - Mount Waddington, Statistical Profile. Victoria, BC: Provincial Government of British Columbia.
- Botsford, Louis W., Juan Carlos Castilla, and Charles H. Peterson. 1997. The Management of Fisheries and Marine Ecosystems. *Science* 277 (5325):509-515.
- Boyd, J., and S. Banzhaf. 2007. What are ecosystem services? The need for standardized environmental accounting units. *Ecological Economics* 63 (2-3):616-626.
- Brown, D. 2005. *Salmon wars: the battle for the west coast salmon fishery*. Madeira Park: Harbour Publishing.
- Brown, G. 2005. Mapping spatial attributes in survey research for natural resource management: Methods and applications. *Society & Natural Resources* 18 (1):17-39.
- Brown, G. G., P. Reed, and C. C. Harris. 2002. Testing a place-based theory for environmental evaluation: an Alaska case study. *Applied Geography* 22 (1):49-76.
- Carpenter, S. R., R. DeFries, T. Dietz, H. A. Mooney, S. Polasky, W. V. Reid, and R. J. Scholes. 2006. Millennium Ecosystem Assessment: Research needs. *Science* 314 (5797):257-258.
- Chan, K. M. A., J. Goldstein, T. Satterfield, N. Hannahs, K. Kikiloi, R. Naidoo, N. Vadeboncoeur, and U. Woodside. 2010. Chapter 12: Cultural services and non-use values. In *The Theory & Practice of Ecosystem Service Valuation in Conservation*, edited by P. Kareiva, G. Daily, T. Ricketts, H. Tallis and S. Polasky: Oxford University Press.
- Chan, K. M. A., M. R. Shaw, D. R. Cameron, E. C. Underwood, and G. C. Daily. 2006. Conservation planning for ecosystem services. *Plos Biology* 4 (11):2138-2152.
- Chan, Kai M. A., Lara Hoshizaki, and Brian Klinkenberg. in press. Featuring ecosystem services in conservation planning: less costly as costs. *PLoS Biology*.
- Chan, Kai M. A., Terre Satterfield, and Joshua Goldstein. in prep. Values & Ecosystem Services: Navigating Intangibility and Incommensurability. *Conservation Biology*.
- Crowder, Larry, and Elliott Norse. 2008. Essential ecological insights for marine ecosystem-based management and marine spatial planning. *Marine Policy* 32 (5):772-778.
- Daily, G. C., and K. Ellison. 2002. *The New Economy of Nature: The Quest to Make Conservation Profitable*. Washington, D.C.: Island Press.
- Daily, Gretchen C, Stephen Polasky, Joshua Goldstein, Peter M Kareiva, Harold A Mooney, Liba Pejchar, Taylor H Ricketts, James Salzman, and Robert Shallenberger. 2009. Ecosystem services in decision making: time to deliver. *Frontiers in Ecology and the Environment* 7 (1):21-28.
- Dayton, Paul, Sara Curran, Adrian Kitchingman, Matthew Wilson, Alessandro Catenazzi, Juan Restrepo, Charles Birkeland, Steven Blaber, Syed Saifullah, George Branch, Dee Boersma, Scott Nixon, Patrick Dugan, Nicolas Davidson, and Charles Vorosmarty. 2005. Coastal Systems. In *Ecosystems and Human Well-being: Current Status and Trends*. Millennium

- Ecosystem Assessment*, edited by T. Agardy and J. Alder. Washington, DC 1: 513-550: Island Press.
- DFO. 2010. *Rockfish Conservation Areas*. Fisheries and Oceans Canada 2007 [cited Aug 10 2010]. Available from <http://www.canbcdw.pac.dfo-mpo.gc.ca/ows/metadata/RockfishConservationAreas.htm>.
- Ehler, Charles, and Fanny Douvère. 2009. Marine Spatial Planning: a step-by-step approach toward ecosystem-based management. In *IOC Manual and Guides No. 53, ICAM Dossier No. 6*. Paris: Intergovernmental Oceanographic Commission and Man and the Biosphere Programme, UNESCO.
- Foley, M. M., B. S. Halpern, F. Micheli, M. H. Armsby, M. R. Caldwell, C. M. Crain, E. Prahler, N. Rohr, D. Sivas, M. W. Beck, M. H. Carr, L. B. Crowder, J. E. Duffy, S. D. Hacker, K. L. McLeod, S. R. Palumbi, C. H. Peterson, H. M. Regan, M. H. Ruckelshaus, P. A. Sandifer, and R. S. Steneck. 2010. Guiding ecological principles for marine spatial planning. *Marine Policy* 34 (5):955-966.
- Galois, Robert. 1994. *Kwakwaka'wakw Settlements, 1775-1920, A Geographical Analysis and Gazetteer*. Vancouver: UBC Press.
- Gilpin, A. 2000. *Environmental Economics : A critical Overview*. Wiley: Chischester, UK.
- Gross, Mart R. 1998. One species with two biologies: Atlantic salmon (*Salmo salar*) in the wild and in aquaculture. *Can J Fish Aquat Sci* 55:131-144.
- Halpern, B. S., K. L. McLeod, A. A. Rosenberg, and L. B. Crowder. 2008. Managing for cumulative impacts in ecosystem-based management through ocean zoning. *Ocean & Coastal Management* 51 (3):203-211.
- Halpern, B. S., S. Walbridge, K. A. Selkoe, C. V. Kappel, F. Micheli, C. D'Agrosa, J. F. Bruno, K. S. Casey, C. Ebert, H. E. Fox, R. Fujita, D. Heinemann, H. S. Lenihan, E. M. P. Madin, M. T. Perry, E. R. Selig, M. Spalding, R. Steneck, and R. Watson. 2008. A global map of human impact on marine ecosystems. *Science* 319 (5865):948-952.
- Klain, Sarah, Kai Chan, and Terre Satterfield. in prep. Bundles of Marine Cultural Ecosystem Services and Values. *Ecology and Society*.
- Klein, C. J., A. Chan, L. Kircher, A. J. Cundiff, N. Gardner, Y. Hrovat, A. Scholz, B. E. Kendall, and S. Airame. 2008. Striking a Balance between Biodiversity Conservation and Socioeconomic Viability in the Design of Marine Protected Areas. *Conservation Biology* 22 (3):691-700.
- Kumar, M., and P. Kumar. 2008. Valuation of the ecosystem services: A psycho-cultural perspective. *Ecological Economics* 64 (4):808-819.
- Levine, Jordan, and Kai M. A. Chan. in press. Global Human Dependence on Ecosystem Services.
- LOS. 2010. *British Columbia Salmon Farm Licences and Applications*. Living Oceans Society 2007 [cited July 29 2010]. Available from [http://www.livingoceans.org/files/Maps\\_PDF/ff\\_bc\\_tenures\\_march2008.pdf](http://www.livingoceans.org/files/Maps_PDF/ff_bc_tenures_march2008.pdf).
- . in prep. Quantifying the Contribution of Marine Ecosystems to the Communities of the Regional District of Mount Waddington. Sointula, BC: Living Oceans Society.
- Lubchenco, J., S. R. Palumbi, S. D. Gaines, and S. Andelman. 2003. Plugging a hole in the ocean: the emerging science of marine reserves. *Ecological Applications* 13 (1):S3-S7.
- MA. 2003. Millennium Ecosystem Assessment, Ecosystems and Human Well-being: A Framework for Assessment. Washington, DC: Island Press.
- MAL. 2007. Marine Water Farm Sites, December 31, 2007. Ministry of Agriculture and Lands.
- McLeod, K. L., J. Lubchenco, S. R. Palumbi, and A. A. Rosenberg. 2005. Scientific Consensus Statement on Marine Ecosystem-Based Management. *Communication Partnership for Science and the Sea*

- McLeod, Karen, and Heather Leslie. 2009. Why Ecosystem-Based Management? In *Ecosystem-Based Management for the Oceans*, edited by K. McLeod and H. Leslie. Washington, DC: Island Press.
- MOE. 2007. British Columbia's fisheries and aquaculture sector, 2007 Edition. Victoria: BC Stats.
- Moore, Kathleen Dean, and Roly Russell. 2009. Toward a new ethic for the ocean. In *Ecosystem-Based Management for the Oceans*, edited by K. McLeod and H. Leslie. Washington, DC: Island Press.
- Naidoo, R., A. Balmford, P. J. Ferraro, S. Polasky, T. H. Ricketts, and M. Rouget. 2006. Integrating economic costs into conservation planning. *Trends in Ecology & Evolution* 21 (12):681-687.
- NCCOS, (National Center for Coastal Ocean Science). 2007. NCCOS human dimensions strategic plan, FY2009-FY2014. Silver Springs, MD: National Oceanic and Atmospheric Administration, National Ocean Service, NCCOS.
- Norton, B., and B. Hannon. 1997. Environmental values: a place-based approach. *Environmental Ethics* 19 (3):227-245.
- Pauly, D., V. Christensen, S. Guenette, T. J. Pitcher, U. R. Sumaila, C. J. Walters, R. Watson, and D. Zeller. 2002. Towards sustainability in world fisheries. *Nature* 418 (6898):689-695.
- Pearce, David W., and Dominic Moran. 1994. *The economic value of biodiversity*. London: IUCN Biodiversity Programme, Earthscan.
- Raymond, Christopher M., Brett A. Bryan, Darla Hatton MacDonald, Andrea Cast, Sarah Strathearn, Agnes Grandgirard, and Tina Kalivas. 2009. Mapping community values for natural capital and ecosystem services. *Ecological Economics* 68 (5):1301-1315.
- Roberts, Callum M., George Branch, Rodrigo H. Bustamante, Juan Carlos Castilla, Jenifer Dugan, Benjamin S. Halpern, Kevin D. Lafferty, Heather Leslie, Jane Lubchenco, Deborah McArdle, Mary Ruckelshaus, and Robert R. Warner. 2003. Application of ecological criteria in selecting marine reserves and developing reserve networks. *Ecological Applications* 13 (sp1):215-228.
- SAB. 2009. Valuing the protection of ecological systems and services, a report of the EPA Science Advisory Board. Washington, DC: Environmental Protection Agency.
- Sagoff, M. 1998. Aggregation and deliberation in valuing environmental public goods: A look beyond contingent pricing. *Ecological Economics* 24 (2-3):213-230.
- Scholz, A. J., C. Steinback, M. Mertens, and K. Birney. 2006. Commercial fishing grounds and their relative importance off the Central Coast of California. *Ecotrust*.
- Shackeroff, Janna M., Elliott L. Hazen, and Larry B. Crowder. 2009. The Oceans as People Seascapes. In *Ecosystem-Based Management for the Oceans*, edited by K. McLeod and H. Leslie. Washington, D.C.: Island Press.
- Spash, Clive L. 2008. How Much is that Ecosystem in the Window? The One with the Bio-diverse Trail. *Environmental Values* 17 (2):259-284.
- St Martin, K., and M. Hall-Arber. 2008. The missing layer: Geo-technologies, communities, and implications for marine spatial planning. *Marine Policy* 32 (5):779-786.
- Stewart, R. R., and H. P. Possingham. 2005. Efficiency, costs and trade-offs in marine reserve system design. *Environmental Modeling and Assessment* 10:203-213.
- Sumaila, Ussif Rashid, Sylvie Guenette, Jackie Alder, and Ratana Chuenpagdee. 2000. Addressing ecosystem effects of fishing using marine protected areas. *ICES Journal of Marine Science* 57 (3):752-760.
- Tallis, Heather, Phillip S. Levin, Mary Ruckelshaus, Sarah E. Lester, Karen L. McLeod, David L. Fluharty, and Benjamin S. Halpern. 2010. The many faces of ecosystem-based management: Making the process work today in real places. *Marine Policy* 34 (2):340-348.



- Tashakkori, A., and C. Teddlie. 2003. *Handbook of Mixed Methods Sampling in Social and Behavioural Research*. London, UK: Sage Publications.
- TEEB. 2009. The Economics of Ecosystems and Biodiversity for National and International Policy Makers – Summary: Responding to the Value of Nature. Wesseling, Germany
- Tobias, Terry. 2009. *Living Proof*. Vancouver: Ecotrust Canada.
- UNEP. 2006. Marine and coastal ecosystems and human wellbeing: A synthesis report based on the findings of the Millennium Ecosystem Assessment. Nairobi, Kenya: United Nations Environment Programme.
- Watson, R., A. Kitchingman, A. Gelchu, and D. Pauly. 2004. Mapping global fisheries: sharpening our focus. *Fish and Fisheries* 5 (2):168-177.
- Williams, Rob, David Lusseau, and Philip S. Hammond. 2009. The role of social aggregations and protected areas in killer whale conservation: The mixed blessing of critical habitat. *Biological Conservation* 142 (4):709-719.
- Wilson, Matthew A., and Richard B. Howarth. 2002. Discourse-based valuation of ecosystem services: establishing fair outcomes through group deliberation. *Ecological Economics* 41 (3):431-443.
- Worm, B., E. B. Barbier, N. Beaumont, J. E. Duffy, and C. Folke. 2006. Impacts of Biodiversity Loss on Ocean Ecosystem Services. *Science* 314:787-790.
- Yamanaka, KL, and G Logan. 2010. Developing British Columbia's Inshore Rockfish Conservation Strategy. *Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science* 2:28-46.
- Young, Nathan. 2008. Radical Neoliberalism in British Columbia: Remaking Rural Geographies. *Canadian Journal of Sociology* 33 (1):1-36.
- Young, Nathan, and Ralph Matthews. 2010. *The Aquaculture Controversy in Canada: Activism, Policy, and Contested Science*. Vancouver, Toronto: UBC Press.

## **4 Conclusion**

This research is part of the substantial and growing effort to advance EBM and ES theory in a direction relevant and linked to practice (Daily and Matson 2008; McLeod and Leslie 2009). With a focus on why marine ecosystems are important to people, this research provides insight on the types of benefits people received from the ocean and how people conceptualize value and threats across the seascape.

### **4.1 Methodological Insight**

The semi-structured interview elicitation approach tested in this research provided methodological insight into the tangible and intangible ways in which the ocean is important to people. This research was to an extent based on methods that enable people to articulate why ecosystems are valuable beyond monetary reasons (Kalof and Satterfield 2005; Dietz, Fitzgerald, and Shwom 2005; Satterfield 2001; O'Neill, Holland, and Light 2007). This research demonstrated people's willingness to verbalize intangible values when guided through a suitable interview protocol. The mixed reaction to the spatial and quantification prompts provided insight into limitations associated with mapping and numerically quantifying non-monetary values. Interviewees were given the freedom to determine their own metric to assess relative non-monetary importance, but some interviewees resisted. Justifications for refusals to map and quantify monetary, non-monetary and threat values included that (1) it is inappropriate to isolate specific places associated with monetary, non-monetary and threat values since the marine environment is an interconnected system; (2) one place is not more valuable than any other place; and (3) the information could be misused. Just under half of the interviewees (14/30) were unwilling to quantify spatially explicit value associated with areas of non-monetary importance. These interviewees valued places for different non-monetary reasons. Their refusal to quantify these values can be interpreted as interviewees associating incommensurable values with specific places important for different non-monetary reasons that cannot be compared using one metric of relative importance. These quantification refusals may also be attributed to protected values; interviewees could have interpreted the spatial prompt as requiring them to sacrifice or potentially compromise certain locations in the seascape by assigning zero or low value to some places and high value to other locations. Clearly, people's perspectives differ greatly on the extent to which non-monetary values can be appropriately

expressed verbally, spatially and in quantitative terms. Given the refusals to spatially identify and quantify non-monetary values, it is thus critically important to consider the verbal articulations of tangible and intangible values as well as the spatial identification of areas of importance or under threat and the relative value and/or threat intensity assigned to these areas.

Based on the spatial analysis, the findings support the theory of place-based environmental valuation in that areas of high value tended to be near people's homes. From the resulting aggregations of spatial data, it is clear that people highly value both threatened and pristine areas for non-monetary reasons. Areas of monetary importance overlap with areas on non-monetary importance.

## **4.2 Insight Pertinent to Case Study**

When carrying out ES valuation, researchers should not assume independence of services, especially when considering cultural ecosystem services (CES). In this research, people tended to speak about experiences of ecosystem-related services, benefits and values as bundles. When people articulated why nature is valuable, the co-occurrence of various services, benefits and values associated with multiple CES prompts suggests interdependence.

People used metaphors to explain how nature is important to them. The ES metaphor of *nature as service provider*, or in this case, *ocean as service provider*, does not convey the diverse conceptualizations of the connections linking humans and marine ecosystems. The interview protocol enabled study participants to articulate alternative metaphors relating people and ecosystems. Various interviewees, including two with scientific backgrounds, were self-conscious that the meaning they associated with the ocean could not be fully explained in scientific terms. They explained how they thought of themselves in relation to the ocean and marine life. The meaning that many interviewees associated with the ocean differed considerably from *ocean as service provider*. In their descriptions of the ocean and how they perceive their relationship with the ocean, some thought of the ocean as part of their bodies. Others associated the ocean with a powerful, life-giving, feminine force larger than themselves.

People in the RDMW assigned the highest non-monetary relative value to places associated with wildlife and biodiversity. They assigned the highest threat to the Broughton Archipelago and

they identified salmon aquaculture as the source of this environmental threat. People employed by the open net-pen salmon aquaculture companies did not associate environmental threats with this industry.

### **4.3 Strengths**

This research engaged a wide range of stakeholders with diverse marine-related professional backgrounds. All of interviewees articulated numerous ways in which their well-being was linked to marine ecosystems.

One of the main strengths of this research was the multiple ways in which information was solicited (verbally, spatially and quantitatively). The method provided interviewees with the flexibility to explain in their own terms why the ocean is important.

After the conclusions of an interview, one participant expressed her gratitude for “invoking the ponderings of what we take for granted at times.” This research helped people express their connection to natural areas.

### **4.4 Limitations**

Greater First Nation representation could have provided additional insight into the diversity of ways in which different people conceptualize the importance of the ocean. Also, the chosen method of spatial analysis was one option among many in interpreting information from interviewees and aggregating this information into maps. Another analysis option would have been to normalize the

More spatial statistics could have been conducted to determine the extent of spatial autocorrelation present in the data. More robust overlap analyses could have been done with smaller or larger cell sizes to determine if the observed:expected overlap probability ratio remained constant or varied considerably by cell size. This would have improved the robustness of the overlap analysis.

### **4.5 Relevance to Management and Decision-Making**

Natural resource decision-makers and institutions are increasingly using ES frameworks both for designing their research and communicating the importance of ecosystems to people (Hanson et

al. 2008; Tallis et al. 2010; SAB 2009). As the uptake of ES frameworks increases, both researchers and managers should be aware of the implicit ES metaphor of *nature as service provider*. Facilitators of decision-making processes should strive to provide opportunities for stakeholders to express the importance of nature in their own terms, which can differ substantially from the consumer-producer relationship conveyed in the concept of ES. In light of the diversity of values associated with ecosystems, discourse-based approaches are more likely to be effective in reaching consensus or a reasonable compromise than decisions based primarily on numerical estimates of ES (Cowling et al. 2008; Wilson and Howarth 2002; Chan et al. in press). The protocol in this research acknowledged multiple values and the variety of ways that people can express these values. This diversity could contribute toward negotiation of conflicts, which may enable stakeholders to re-conceptualize problem situations (Norton and Noonan 2007).

This interview protocol could be used in diverse settings as a means of enabling stakeholders to articulate what they value from ecosystems. These methods facilitated the identification of intangible benefits from ecosystems that often do not translate into monetary values. It is recommended that ES valuation researchers respect the limitations inherent in quantifying nature's benefits to people.

These value articulation, spatial identification and quantitative methods can provide research outputs that are complimentary to a deliberative process. The particular research findings in the RMDW could complement the existing Pacific North Coast Integrated Marine Area marine spatial planning process currently underway.

#### **4.6 Future Research Directions**

Understanding the degree to which various ES values are compatible with existing threats and potential future uses of areas is an important future direction for research. Additional insight into how community-based ES values have changed in the past could be informative for understanding and choosing among scenarios for the future. Identifying triggers for these past changes could be useful to predict how community values may evolve in the future. More research is also needed to identify types of economic development that would have minimal impact on marine ecosystems.

## **4.7 Closing**

The methods developed for this research facilitate the articulation of a broad range of spatial and non-spatial values associated with marine ecosystems. People ascribe meaning to places and parts of ecosystems that exceeds instrumental and monetary value. This method holds promise for integrating local perspectives on ES to support inclusive and informed environmental decision-making. The study also provides a deeper understanding of the diversity of ways in which people value marine ecosystems in the RDMW.

## References

- Chan, K. M. A., J. Goldstein, T. Satterfield, N. Hannahs, K. Kikiloi, R. Naidoo, N. Vadeboncoeur, and U. Woodside. in press. Chapter 12: Cultural services and non-use values. In *The Theory & Practice of Ecosystem Service Valuation in Conservation*, edited by P. Kareiva, G. Daily, T. Ricketts, H. Tallis and S. Polasky: Oxford University Press.
- Cowling, R. M., B. Egoh, A. T. Knight, P. J. O'Farrell, B. Reyers, M. Rouget'll, D. J. Roux, A. Welz, and A. Wilhelm-Rechman. 2008. An operational model for mainstreaming ecosystem services for implementation. *Proceedings of the National Academy of Sciences of the United States of America* 105 (28):9483-9488.
- Daily, G. C., and P. A. Matson. 2008. Ecosystem services: From theory to implementation. *Proceedings of the National Academy of Sciences of the United States of America* 105 (28):9455-9456.
- Dietz, Thomas, Amy Fitzgerald, and Rachael Shwom. 2005. Environmental Values. *Annual Review of Environment and Resources* 30 (1):335-372.
- Hanson, Craig, Janet Ranganathan, Charles Iceland, and John Finisdore. 2008. The corporate ecosystem services review: guidelines for identifying business risks and opportunities arising from ecosystem change. Washington, DC: World Business Council for Sustainable Development, Meridian Institute, World Resources Institute.
- Kalof, Linda, and Terre Satterfield. 2005. *The Earthscan reader in environmental values*. London ; Sterling, VA: Earthscan.
- McLeod, Karen, and Heather Leslie. 2009. Why Ecosystem-Based Management? In *Ecosystem-Based Management for the Oceans*, edited by K. McLeod and H. Leslie. Washington, DC: Island Press.
- Norton, B. G., and D. Noonan. 2007. Ecology and valuation: Big changes needed. *Ecological Economics* 63 (4):664-675.
- O'Neill, J., A. Holland, and A. Light. 2007. *Environmental Values*. New York: Routledge.
- SAB. 2009. Valuing the protection of ecological systems and services, a report of the EPA Science Advisory Board. Washington, DC: Environmental Protection Agency.
- Satterfield, T. 2001. In search of value literacy: Suggestions for the elicitation of environmental values. *Environmental Values* 10 (3):331-359.
- Tallis, Heather, Phillip S. Levin, Mary Ruckelshaus, Sarah E. Lester, Karen L. McLeod, David L. Fluharty, and Benjamin S. Halpern. 2010. The many faces of ecosystem-based management: Making the process work today in real places. *Marine Policy* 34 (2):340-348.
- Wilson, Matthew A., and Richard B. Howarth. 2002. Discourse-based valuation of ecosystem services: establishing fair outcomes through group deliberation. *Ecological Economics* 41 (3):431-443.

## **Appendix A Interview Script**

### **Contributions of Marine Ecosystems to Local Communities**

#### **Interview Script**

The interview starts with:

- Consent form and confidentiality agreement
- Project description
- Overview of interview
- A reminder that this is an exploration and there are no right or wrong answers

The nautical chart of the Regional District of Mount Waddington (RDMW) should be displayed with the overlaid Mylar. The camera will be ready to take the photo of the Mylar with shapes. The colored pens and discs should be easily accessible.

Introduce yourself and the project. Thank the participant in advance. Start the digital recording device.

What is your name and occupation?  
Have you had previous marine related jobs?

How long have you lived in the RDMW?

What activities do you do related to the ocean?

How did you come to have your position in X organization?

Can you tell me if and/or why your involvement in [your marine-related business or organization] is important to you?

Has your interest or involvement in ocean related issues/business changed over time? If so, how?

Do you think of the ocean's health and your own well being as being connected in any way? If so, can you describe that link? *How does it work? How do you know it exists? How strong is that link?*

Is what you describe for yourself also true for your community – that it's well-being might also be linked to the ocean's health? Can you think of any examples that demonstrate or speak to that relationship? *These examples can be either things you've witnessed personally or that you've heard from other people.*

What does the phrase or idea of "a healthy marine ecosystem" mean to you? What first comes to mind when you hear that phrase?

*When you think of a "healthy marine ecosystem" are their parts of that system that come to mind in particular? What are they?*



How do you know if an ecosystem is healthy or not? What indicates ocean health to you?

What kind of information do you rely on to know if an ecosystem is healthy? These could be your own observations, information from fishermen on the water, scientific surveys and studies or other types of information.

Can you describe any changes in ocean health in MWRD that you have noticed over time? Let's talk first about changes for the better.

What about changes for the worse?

Let's think about the same question but in reference to healthy human communities instead of marine ones. What does the term a "healthy human community" mean to you? What kinds of things tell you or indicate to you that a community is healthy? Feel free to think about 'health' in the broadest sense of the word including any type or dimension of health you want to consider.

Ok, let's return to talking about the ocean environment.

Do you think we need to improve or change how we manage the ocean? Are there specific things you think we should be doing to manage the ocean's ecological health? *What are they and why do they matter? Feel free to recommend or think out loud about anything that's important that way.*

Do you think certain sectors should be managed differently? By sectors, I mean things like sport fishing, local recreational fishing, First Nation fishing, commercial fishing, aquaculture, wind energy, shipping, marine tourism etc.

Ok, you've mentioned several issues that ought to be addressed to improve ocean management. Here's the list. Can you rank these management issues in importance?

### **Spatial Questions**

Gesture towards the nautical chart overlaid with Mylar. Get out the green, purple and red fine tipped marker and the colored discs (100 green, 100 purple and 100 red discs), which will be allocated to shapes drawn by interviewees.

Using the green marker, can you outline the areas that are most important to you economically? *Can you draw around the areas that you rely on for your work?*

Introduce the green discs representing economic value. The number of discs that an interviewee allocates to an area will represent relative importance/value intensity for generating income.

If these 100 green discs represent the monetary income that you have gotten from the ocean over your entire career, can you allocate them on the map indicating how important each place on the map is or was to your livelihood?

Would restricting access to the fisheries in these locations enhance the monetary value that you derive from this area?

What about the reverse: Would restricting access to the fisheries resources in all or some of these locations diminish the monetary value that you derive from this area?

What about restricting access to oil and gas exploration, drilling and transportation? Would that enhance, diminish or not do anything to the value that you get from this area?

What are the main factors that could most impact the things you value in the places that you've marked with the green marker? Is there anything that you think could or should be done to protect what you value in each place?

### **Place/Heritage**

I'd like to talk with you now not just about marine ecosystems and how we use them, but also about some possible kinds of meaning or importance that might exist over and above uses that are economic or about specific resources.

Are there places on the coast that are especially important to you in the sense that they are places where you go to or visit -- physically or even in your mind -- simply because they are valuable to you? Can you describe why they are important?

Are there places that remind you of past events that are important to you and your community?

Can you give me some flavor of what the experience of that place and/or your attachment to it feels like? Feel free to use stories about your experiences in these places if that helps. These can be things specific to you or your family or community. They can be recent or historical.

### **Identity**

*Identity is the ideas, relationships, and sense of belonging that help shape who we are – who or where we belong to, the community we are a part of and so on. In this sense, you could even say that identity is tied to physical spaces and/or the things people do within those places.*

Are there places that are important to your sense of identity or the identity of the group to which you see yourself as a member? How does that work? How would you describe, if at all, the nature of the link between places and people as it relates to identity, belonging or more simply, who you as a person or member of a group *are* and even who you are 'not' or who you are different from?

### **Activity/Subsistence**

Let's talk about the non-physical qualities or experiences derived from doing a physical activity involving the ocean.

Activities such as physical recreation, labor and/or practices such as fishing and boating occur in this area. Some of the tangible, concrete benefits from these activities include food, income, and physical stamina. But there might be additional benefits over and above the physical things just mentioned. For example, suppose that you caught your own fish or you went to a store to buy a frozen fish. What would you be missing? Or gaining?

Describe to me how these two are different. Why does one way of doing things matter to you more than the other?

What about other kinds of things that you think benefit you or come to you as part of these activities, things that are important but not just about 'the fish'?

### **Spiritual**

I find spiritual value connected to place difficult to define, but I generally associate it with places that are powerful because the place inspires me to be aware of forces or entities larger than myself. This can be the basis for both negative and positive feelings including emotions like awe, reverence, humility, and even fear.

Can you describe or speak to me about experiences of this kind that might be associated with a physical place in this region? You can be as general or specific as you like about both the feeling or experience and the places with which you associate those experiences.

(Prompt: Remind people that their thoughts not need to be profound.)

### **Artistic**

Some places are a source of creative inspiration. Has a place ever provided you with ideas or images that you think could or does inspire art or some other visual or creative form?

### **Educational**

Have you made observations in a particular place and learned something new through those observations? Have you ever had the experience of a place teaching you things?

Are there places that are particularly well suited for educational experiences? Which places in particular? Be as detailed as possible in your descriptions.

### **Intergenerational**

Are there particular experiences associated with the ocean that you hope your kids and/or youth in your community will experience? What are these and what makes them important to both the generations that have come before you and those that will follow?

Why are these things in particular important across generations?

### **Mapping Non-Market Values**

These last few questions have explained what we could call "non-material" benefits from the ocean. They are much harder usually to describe or pin down. Even though this is true, can you use the purple pen to outline the areas that are most important to or most associated with some of the things you've described? I mean, again, important for reasons beyond economic or material ones.

Introduce purple discs representing non-monetary value of ES.

Can you distribute the 100 purple discs on the map based on places you value for these reasons – places that are important for the reasons we've been talking about and so not

necessarily related to or dependent on personal monetary gain? *Can you locate and describe places that are of particular importance to you on the ocean? Why are they important?*

If access to the fisheries and extractive uses of this areas, say the ones you've said are important for reasons other than 'material' reasons, was restricted, what kind of impact would that have on you or your community? Would that restricted access make the area more valuable and if so why (or why not)? How much more – a little, some, a lot?

What about the reverse? Let's say that access to the fisheries in the places that are important to you was restricted. Would restrictions reduce the value of the nonmaterial things you get from these areas? Would it make these things more valuable or less? Why?

What kinds of things or "main factors" would impact what you value in the purple shapes?

Could any actions be taken to protect what you value within the purple shapes? What are they?

### **Threats**

Using the red pen, can you outline the areas where the benefits you get from the ocean are most threatened? Why is each area threatened? What are the main sources of those threats?

Introduce red discs that represent threats to the benefits that you get from the ocean that we've been talking about so far.

Can you allocate these 100 red discs on the map according to how threatened each place is?

### **Conclusion**

Just to close, I want to make sure that I haven't missed any places that are particularly important to you.

What about other places that you haven't yet mentioned that are also threatened, again, for any reason that comes to mind?

Thanks for your time. I'll send you a copy of the confidential digitized version of your mapped responses so you can identify and I can correct any mistakes.

## Appendix B Contact Letter



Institute for Resources,  
Environment & Sustainability  
2202 Main Mall  
Vancouver, BC Canada V6T 1Z4  
Tel: (604) 822-7725  
Fax: (604) 822-9250

Website: [www.ires.ubc.ca](http://www.ires.ubc.ca)

### **Interview Request Letter Mapping Community Values at Sea in the Regional District of Mount Waddington**

Dear

Due to your marine expertise, you have been selected to take part in a research project to identify monetary and non-monetary benefits that you receive from the ocean within the Regional District of Mount Waddington (RDMW). The purpose of this project is to collect information from a wide range of stakeholders to better understand values and threats associated with the local marine ecosystem.

If you are willing to take part in this study, we will ask questions about your activities on the ocean, your role in marine resource management and what you value as well as what is threatened in the ocean in this regional district. We will ask you to identify areas of the ocean and coastline that are important to you and places that are threatened.

This research project was made possible by a grant from the Social Sciences and Humanities Research Council of Canada. The University of British Columbia is conducting this study in conjunction with the Regional District of Mount Waddington and Living Oceans Society.

Participating in this study entails an interview that will last approximately one hour. You will be asked questions about your participation in marine resource management and activities on the water. You will be asked to assess relative monetary, non-monetary and threat values across the waters of the RDMW. Only aggregated data and information that does not reveal the identity of the participant will be published and presented publicly.

Your participation in this study will help inform marine planning processes in the region and province. The intent of this research is to better account for community values in local and regional marine resource management and marine ecosystem-based management.

To compensate you for your participation in this interview, you will receive a ticket in a raffle to win one of five wild salmon steaks valued at \$30.

If you are able to make time for an interview, please contact Sarah Klain at 778.227.8190 or email [REDACTED]. Also, if you wish to obtain a digital copy of the output of this research, please email or call her.

Sincerely,

**Sarah Klain**

MSc Candidate  
Institute for Resources, Environment and Sustainability  
University of British Columbia  
AERL 438 - 2202 Main Mall  
Phone: [REDACTED]

**Principal Investigator**

**Dr. Kai Chan**

Institute for Resources, Environment and Sustainability  
University of British Columbia  
AERL 438 - 2202 Main Mall  
Phone: [REDACTED]

This research will contribute towards Sarah Klain's master's thesis.

## Appendix C Consent Form



Institute for Resources,  
Environment & Sustainability  
2202 Main Mall  
Vancouver, BC Canada V6T 1Z4  
Tel: (604) 822-7725  
Fax: (604) 822-9250

Website: [www.ires.ubc.ca](http://www.ires.ubc.ca)

### Consent Form

#### Mapping Community Values at Sea in the Regional District of Mount Waddington

To:

#### Principal Investigator

Dr. Kai Chan  
Institute for Resources, Environment and  
Sustainability  
University of British Columbia  
AERL 438 - 2202 Main Mall  
Phone: [REDACTED]

#### Co-Investigator

Sarah Klain  
MSc Candidate  
Institute for Resources, Environment and  
Sustainability  
University of British Columbia  
AERL 438 - 2202 Main Mall  
Phone: [REDACTED]

This research will contribute towards Sarah Klain's master's thesis.

#### Sponsor

This research project was made possible by a grant from the Social Sciences and Humanities Research Council of Canada. The University of British Columbia is conducting this study in conjunction with the Regional District of Mount Waddington and Living Oceans Society.

#### Purpose

You are invited to take part in this research because of your marine expertise from working on the ocean and involvement with marine resource management. The purpose of this project is to collect information from a wide range of stakeholders to better understand the various monetary and non-monetary benefits that people get from the ocean. We are also interested in identifying threats to the benefits that you get from the ocean. We will be asking questions about your activities on the ocean, your role in marine resource management, and what you value from marine ecosystems. We will ask you to show us areas of the ocean and coastline that are important to you and places that are threatened.

#### Study Procedures:

Participating in this study entails an interview that will last approximately one hour. You will be asked questions about your participation in marine resource management and activities on the water. You will be asked to assess relative monetary, non-monetary and threat values across the waters of the RDMW. With your consent, the interview will be audio recorded. After the interview, the digital audio recording will be transcribed and the original files will be deleted to protect confidentiality.

#### Potential Risks:

The topics of this interview, marine resources and access to these resources, may be contentious and emotional issues. To minimize and avoid psychological stress, the confidentiality of the information that you share is guaranteed and you are free to stop participating in the interview at any point.

The risk of exposing confidential information from these interviews is reduced if not eliminated by research procedures to code all data and delete the original audio files. Only aggregated data and information that does not reveal the identity of the participant will be published and presented publically.

**Potential Benefits:**

Information from your participation in this study will inform marine planning processes in the region and province. The intent of this research is to better account for community values in local and regional marine resource management and marine ecosystem-based management.

If you are interested in receiving a digital copy of the output of this research, please email Sarah Klain at [REDACTED].

**Confidentiality:**

Your identity in this research will be kept strictly confidential. All notes and digital audio recordings will be coded and stored on an external hard drive that will be kept in a locked file cabinet. Participants will not be identified by name in project reports.

**Remuneration/Compensation:**

To compensate you for your participation in this interview, you will receive a ticket in a raffle to win one of five wild salmon steaks valued at \$30.

**Contact for information about the study:**

If you have questions or want to know more information about this study, please call or email Kai Chan at [REDACTED] or Sarah Klain at [REDACTED].

**Contact for concerns about the rights of research subjects:**

If you have any concerns about your treatment or rights as a research subject, you may contact the Research Subject Information Line in the UBC Office of Research Services at 604-822-8598 or if long distance e-mail to RSIL@ors.ubc.ca.

**Consent:**

Your participation in this study is entirely voluntary and you may refuse to participate or withdraw from the study at any time without jeopardy to your employment.

Your signature below indicates that you have received a copy of this consent form for your own records. Your signature also indicates that you consent to participate in this study.

\_\_\_\_\_  
Subject Signature

\_\_\_\_\_  
Date

## Appendix D UBC Research Ethics Board Certificate

### CERTIFICATE OF APPROVAL - MINIMAL RISK

<b>PRINCIPAL INVESTIGATOR:</b>  Kai Chan	<b>INSTITUTION / DEPARTMENT:</b> UBC/College for Interdisciplinary Studies/Resources, Environment & Sustainability	<b>UBC BREB NUMBER:</b>  H09-02192
<b>INSTITUTION(S) WHERE RESEARCH WILL BE CARRIED OUT:</b>		
<b>Institution</b>	<b>Site</b>	
UBC	Vancouver (excludes UBC Hospital)	
<b>Other locations where the research will be conducted:</b> Interviews will be conducted in harbormaster offices, local government offices, non-governmental organizations' offices and subjects' homes.		
<b>CO-INVESTIGATOR(S):</b> Sarah Klain		
<b>SPONSORING AGENCIES:</b> Social Sciences and Humanities Research Council of Canada (SSHRC)		
<b>PROJECT TITLE:</b> Quantifying Nature's Bounty: The Contribution of Marine Ecosystems to Local Communities		

**CERTIFICATE EXPIRY DATE: March 22, 2011**

<b>DOCUMENTS INCLUDED IN THIS APPROVAL:</b>	<b>DATE APPROVED:</b> March 22, 2010	
<b>Document Name</b>	<b>Version</b>	<b>Date</b>
<b>Protocol:</b> Contribution of Marine Ecosystems to Local Communities		
	1	March 3, 2010
<b>Consent Forms:</b> RDMW Consent Form		
	1	March 3, 2010
<b>Questionnaire, Questionnaire Cover Letter, Tests:</b> Interview Script RDMW		
	1	March 12, 2010
<b>Letter of Initial Contact:</b> Interview Request Letter RDMW		
	1	March 8, 2010
The application for ethical review and the document(s) listed above have been reviewed and the procedures were found to be acceptable on ethical grounds for research involving human subjects.		
Approval is issued on behalf of the Behavioural Research Ethics Board and signed electronically by one of the following:  _____		
Dr. M. Judith Lynam, Chair Dr. Ken Craig, Chair Dr. Jim Rupert, Associate Chair Dr. Laurie Ford, Associate Chair Dr. Anita Ho, Associate Chair		