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Connecting Value and Knowledge of Marine Environmental Issues: A  
Social Survey in Coastal Nova Scotia

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Honours Thesis

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## Abstract

The maritime province of Nova Scotia maintains a strong cultural and economic connection to the sea, but is increasingly under threat from various anthropogenic stressors, such as climate change, overfishing, and pollution. Currently, only 0.59% of Nova Scotia's marine environment is protected under federal legislation. My thesis aims to understand the level of knowledge on marine environmental issues among coastal Nova Scotians, the value they place on the marine environment and their perception of ocean management in Nova Scotia, through the development of a social survey. Over 1500 surveys were sent to ten select postal codes in coastal Nova Scotia with a response timeframe of 5 weeks. Of the 1500 surveys, 160 surveys were returned (a 10% response rate). Most respondents were life-long residents of the province and over 50 years old (73%), held a University or College degree (39%), and lived within 1km of the sea (58%). Survey results indicate that 75% of respondents believe the marine environment to be "Very" or "Extremely" important to them, mostly (99%) for 'Environmental' reasons (value of marine life, sustainability, and healthy oceans, for example). A majority (71%) of respondents feel Nova Scotia's marine environment is under threat, while over 50% believe there is need for better ocean management in Nova Scotia, and desire to protect at least *half* of Nova Scotia's physical marine environment. Additionally, 50% of the respondents consider themselves to be only "Somewhat Aware" of marine environmental issues; indicating a potential weakness in provincial ocean literacy. Since 73% of our survey respondents were aged 50 and older, there is a need to expand our survey to capture the missed demographic groups such as youth, fishermen, and aboriginal peoples. The final results of this study will help provide valuable insight to policy makers and environmental educators on the level of ocean knowledge and perceived threat among Nova Scotians, and the value they place on the marine environment.

**Key words:** Public knowledge, marine environmental issues, ocean literacy, environmental education, marine management, social survey, marine citizenship

**"The oceans deserve our respect and care, but you have to know something before you can care about it."**

**- Dr. Sylvia Earle**

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# 1. Introduction

The Earth's ecosystems upon which humans depend are increasingly under pressure from damaging anthropogenic activities (Millennium Ecosystem Assessment 2005; Pachauri & Reisinger 2007; Côté et al. 2012). Our oceans and coasts are particularly vulnerable to increasing exploitation, pollution, habitat alteration and climate change. Meanwhile, human populations are increasing in coastal areas; 11 of the 15 largest cities in the world are located on coastlines (Small et al. 2000). Legislated environmental protection efforts to counter negative anthropogenic impacts have increased in the past 30 years; however, *marine* conservation areas have not been as quick to emerge compared to their terrestrial counterparts (Wood et al. 2008). In order to create effective environmental policy and ensure compliance of protection measures, it is essential to understand the knowledge base and value citizens place on the oceans. This study was conducted to understand how important the ocean is to coastal Nova Scotians and why, as well as assess their current knowledge base and perceptions of marine environmental threats and management in the province.

## 1.1 Marine Environmental Issues

The marine environment encompasses all oceanic and coastal ecosystems on the planet. These ecosystems are highly diverse, and span from polar waters and deep-sea trenches to shallow tropical coral reefs. This diversity has contributed to humans' connection with the oceans around the world; they are valuable economic,

social, and ecological resources (Costanza 1999). We have long used the marine environment as a source of food and other raw materials, and its seemingly endless size may have created a false sense of infinite abundance (Jackson et al. 2001). Today, we have exhausted many fisheries, over-harvested some species to near extinction, and polluted several marine ecosystems beyond quick repair (Pauly et al. 1998; Pandolfi et al. 2003; Lotze et al. 2006; Myers et al. 2007). Indeed, we have proved the ocean is not limitless.

Long-term ecosystem health is dependent on maintenance of biological diversity and ecological processes through the structure, composition, and function of that ecosystem. Under this definition, global marine ecosystems currently have declining health. Many fish stocks have been depleted and exhausted due to lack of proper regulation, rapid improvements in fishing gear technology, and a growing human population's demand (Pauly et al. 1998; Lotze & Worm 2009). More recently, expanding aquaculture operations raise questions of marine health and sustainability (Naylor et al. 2001). Pollution has become a major source of marine health deterioration. Oil spills, accumulating bio-toxins, and improper waste management all contribute to this problem (Derraik 2002). Anthropogenic stress on the natural environment can be largely attributed to a growing human population, increased affluence and consumption levels in developed countries, and increased resource extraction technology (Ehrlich & Holdren 1971). Comparison of current conditions with historical baselines of marine environmental parameters shows a dramatic shift in ecosystem health and function (Lotze et al. 2006; Lotze & Worm 2009; Harnik et al. 2012). There are many anthropogenic activities that currently

negatively affect the marine environment; climate change, over-fishing, marine litter, oil spills, pollution, and many more. In the following, I provide a brief synthesis of some of these problems.

Climate change is the most widely recognized environmental issue of today, however its effects are also the most difficult to predict on a long-term scale. In 2007, the Intergovernmental Panel on Climate Change (IPCC) reported, “Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level.” The cause of this warming is primarily driven by increased anthropogenic CO<sub>2</sub> emissions into the atmosphere. The increased levels of CO<sub>2</sub> are also causing the oceans to acidify; the absorption of CO<sub>2</sub> by the ocean lowers the pH, which will negatively affect many species of marine biota (Hoegh-Guldberg & Bruno, 2010). Without curbed CO<sub>2</sub> emissions, the coming centuries may see more ocean acidification than in the past 300 million years (Caldeira & Wickett, 2003).

Increasing global food demand coupled with improved fishing gear technologies has made over-fishing one of the largest threats to the marine environment (Millennium Ecosystem Assessment, 2005). Over the past centuries, coastal ecosystems have been most severely disturbed by over-exploitation followed by habitat loss, pollution, introduced species and, more recently climate change (Jackson et al. 2001; Lotze et al. 2006). As top predators are depleted, fisheries opt for the next best thing, often ‘fishing down the food web’ (Pauly et al. 1998) or ‘fishing through the food web’ (Essington et al. 2006). Such serial



exploitation patterns have now reached invertebrate fisheries, which are expanding worldwide in terms of catch, value, the number of species targeted and the countries involved in the fisheries (Anderson et al. 2008, 2011). As a consequence, an increasing number of invertebrate species are being depleted or have already collapsed (Anderson et al. 2011). The consequences of overexploitation are strong shifts in ecosystem structure and functions (Worm et al. 2006; Myers et al. 2007; Baum & Worm 2009). Such ecosystem shifts can change food web dynamics, ecosystem stability and resilience (Lotze et al. 2011), often with unpredictable effects on marine ecosystems and local fisheries.

One such example is the now defunct Atlantic cod (*Gadus morhua*) fishery on the Grand Banks and Scotian Shelf off the Atlantic Canadian coast. Once an incredibly abundant stock, the cod population is now decimated to a fraction of its previous size (Rose 2004; Rosenberg et al. 2005). Increases in fishing gear technology and large-scale industrial practices in the 20<sup>th</sup> century were major contributory factors in this population decline (Rose et al. 2000), while changes in the food-web and oceanographic features may be contributing to its so far non-recovery (Frank et al. 2005). The cod collapse had dramatic effects on local communities, and many fishers have now switched to expanding invertebrate fisheries (Anderson et al. 2008).

By-catch from trawlers, long-lining, and gill netting are responsible for killing large numbers of sharks, sea turtles, seabirds, dolphins and other non-target species (Lewison et al. 2004). Consequently, many species face population declines even though they are not directly targeted by the fishing industry. Bottom trawling and

dredging has also resulted in severe damage to seafloor ecosystems (Thrush & Dayton 2002). While this fishing method is effective in catching everything in its path, it does so at a high ecological cost. Large weighted nets essentially 'scrape' the seafloor, thereby destroying any three-dimensional habitats created by marine plants and animals and transforming formerly diverse benthic communities into barren bottoms. Scientists agree that this type of destructive fishing is one of the leading threats to the global marine environment (Halpern et al. 2007).

Pollution affecting the oceans comes in many forms; chemical pollution, material litter, and nutrient loading to name a few. The existence and persistence of marine litter has been increasing, and is becoming recognized as a prominent environmental problem. Anthropogenic marine debris (AMD) is responsible for the death of marine wildlife, introduction of invasive species, and alteration of the pelagic water column micro-habitat (Bravo et al. 2009). This form of non-point source pollution comes from a variety of sources that are often difficult to identify, making prevention policy difficult to create. Point-source pollution, such as oil spills, industrial wastewater discharge, and municipal sewage are easier to trace to the offender and, as a result, have produced high profile media stories (Anderson 2002). The emergence of aquaculture has been highly debated within both scientific and societal domains, as some potential threats of aquaculture to the health of the marine environment include pathogens, antibiotic contamination, nutrient and organic loading from open-sea nets, and the potential dilemma of escaped fish interbreeding in the wild (Ford & Myers 2008; Côté, et al. 2012).

## 1.2 Research Problem

This study will investigate Nova Scotians' self-assessed knowledge on marine environmental issues, and the value they place on the marine environment. It will also explore the level of perceived threat to the marine environment, type of threat, and effectiveness of marine management. The project will be focused on answering the following research questions:

- How knowledgeable do coastal Nova Scotians consider themselves to be on marine environmental issues?
- How much and what types of value (cultural, environmental, recreational, economic) do coastal Nova Scotians hold for the marine environment?
- Do coastal Nova Scotians think the marine environment is under threat? What level of threat do they believe that to be?
- Do coastal Nova Scotians think we need better marine management in the province?

I will be assessing the collective 'knowledge base' through individual's self-reported knowledge on a list of ten marine environmental issues. A 'gap' in knowledge will be identified if the average ranking of knowledge on a particular marine environmental issue is below 'Moderate', or significantly lower than other marine issues. I believed that the current knowledge base for 'overfishing' and 'aquaculture' would be high, due to Nova Scotia's traditionally fisheries-based economy. Knowledge on pollution issues was also anticipated to be high due to the correlation with human health. However, the lack environmental education in the

province's public education system led me to believe that knowledge of marine biodiversity and climate change would be relatively low.

'Value' for oceans will be measured directly, using the question 'How important is the marine environment to you?'. Several parameters may affect and influence a person's value for the ocean. To understand these influences, this question will be followed with 'Why is the marine environment important to you?'. I will be comparing individuals' self-assessed awareness of marine environmental issues with their 'value' level to determine if there is a relationship between how informed a person feels about an environment with how much they value that environment. I will also investigate what other parameters might affect a person's value; data on age and education will be collected in the survey, to explore their relationship to value. I expected that citizens would hold a high value for the oceans; for primarily economic and cultural reasons. I anticipated that the perception of marine management in the province would be negative; that is, people will desire to see increased levels of effective management.

### **1.3 Significance of Study**

There are currently no Environmental Education or Marine Sciences courses available in Nova Scotian secondary schools, yet the Nova Scotia Department of Education defines environmental citizenship as one of the six pillars of learning (NS Dept. Education, 2003-2004). To understand what people value, and create effective policy, we need to find out directly from citizens. This can be achieved through use

of social surveys, which are a commonly used tool to assess public perception on certain issues (Statistics Canada, 2009).

Understanding both citizen and special interest group knowledge of environmental issues can provide much insight to policy enforcement, management, and identify problems likely to arise due to lack of awareness. For example, in 2008 a Dalhousie University student found that scientist's and manager's knowledge on newly expanding low-trophic-level fisheries in the province was low, which poses significant risk for developing sustainable fisheries (Anderson et al. 2008).

Furthermore, identifying a discrepancy between value for the oceans and understanding of marine ecological knowledge may illuminate a potential reason why citizen or community engagement in creation and enforcement of sustainable policy is lacking.

Given the current limitations in effective marine protection and management in Canada, marine education offered in Nova Scotia, and marine stewardship and governance offered by the province and citizens in protecting the natural resources of the ocean, a public knowledge assessment and value survey is needed. A study of this nature will be valuable to decision makers, researchers, educators, and the general public itself. Understanding public perception and value for the marine environment is the first step to creating effective education, stewardship and successful marine management plans.

## 2. Literature Review

### 2.1 Overview

The aim of this literature review is to explore and explain some central concepts of public ocean literacy, marine citizenship, and marine management. Initial searches for literature were completed by querying academic journal databases using various combinations of the keywords; *marine, ocean, environmental, literacy, knowledge, public, awareness, value, and citizenship*. These were coupled together in various orders to maximize relevant results from 1990-2012. Cited works within articles found by this search method were then examined for other relevant sources. To conclude, I will identify knowledge gaps that highlight the need for a study of this nature in Nova Scotia.

Marine environmental issues are viewed globally as a pressing ecological and political problem of our time (Millennium Ecosystem Assessment, 2005). From climate change to marine debris; anthropogenic activities have been (and are) acting as stressors on marine ecosystems worldwide. The current state of knowledge on public perception of marine environmental issues is expanding; much of the reviewed literature on public ocean literacy and understanding was done in the past 20 years. This may be due to increased global environmental awareness, increased awareness for the marine environment, and greater availability of funding for environmental research in both social and natural sciences. The concept of 'marine citizenship', which celebrates the citizen's role in marine management, is becoming more prevalent in the literature. Yet in Nova Scotia, a province with

limited marine protection and a history of strong anthropogenic impact on the oceans, there are very few published studies on the investigation into public knowledge and value.

## **2.2 Public Ocean Literacy**

The term 'literacy' refers to an individual's ability to interpret available information pertaining to the natural environment, while 'education' refers to the dissemination of that information to the general public (Stables & Bishop, 2001). The studies I focus on in this review, which sought to investigate public knowledge base for marine issues, were conducted in the United States, New Zealand, and the United Kingdom (Steel et al. 2005b; Fletcher et al. 2009; McKinley & Fletcher 2012; WWF-NZ 2011). These studies have examined topics that were strongly related to my research questions, and allow me to observe differences between distinct coastal populations. They have employed various survey methods such as in-person interviews, telephone surveys, and 'waves' of mail surveys. General results indicate relatively low levels of perceived marine ecology and issues awareness across studies, yet high levels of support for marine education and protection programs.

The media plays a critical role in the dissemination of environmental information to the public (Culbertson & Stempel 1986). However, the interpretation of environmental science in popular media can be harmful if presented incorrectly. For example, oil spills are often reported with a low level of associated scientific knowledge, which can cause critical scientific concepts to be misrepresented to the public (Anderson 2002). Steel et al. (2005b) found that some media sources, namely

television and radio, have a specifically negative effect on the level of ocean knowledge held by U.S. citizens, while others (newspapers and the use of the internet) can improve individual marine knowledge. Gender is another named index for environmental value; the notion that females value the environment more than males is a commonly mentioned, yet empirically inconsistently theory (Stern & Dietz 1994).

An inquiry into public marine knowledge in the UK found that although marine flora create structurally complex ecological habitats which are critical for ecosystem function, these species are often viewed as 'less interesting' when compared with 'cute' animals or charismatic megafauna such as puffins (Jefferson 2012). Steel et al. (2005a) has argued that increasing knowledge of more complex or technical marine issues will lead to increased public support of those issues. However, use of these animals can be important gateways to marine education in youth and children, who are most interested in learning about whales, dolphins, and sharks (Ballantyne 2004), yet have been reported to possess very little knowledge on marine policy (Brody 1987).

### **2.3 Environmental Value & Marine Citizenship**

Some investigations into public knowledge base for marine environmental issues have found that an increase in knowledge and awareness often leads to a higher *value* placed on those environments (Steel et al. 2005b; Fletcher et al. 2009). Marine citizenship is the translation of environmental awareness to action (Jefferson 2012); it is founded on the idea that a global society understands the



value of a healthy marine environment to human health (Fletcher & Potts 2007). From this understanding, citizens can recognize their ability to act as stewards of the environment through individual action, behavior changes, and support of sustainable policy. For example, individual choices such as purchasing power can have a large market effect if exercised collectively.

Understanding the value that citizens place on marine systems is imperative to encouraging marine stewardship. If citizens don't value their environment, they will not take individual or collective action to protect and conserve it, whereas issues valued highly by a populace will be more likely to take precedence on governmental agendas (Steel et al. 2005b). McKinley and Fletcher (2012) argue that in order for individuals to act responsibly towards the ocean and its resources an 'enhanced' awareness of marine environmental issues is required. Some have argued that increased pro-environmental behaviour would likely be the result of governmental expectation of citizens (McKinley & Fletcher 2011), while others contend it that the onus is on scientists to effectively communicate their research to the public and turn knowledge into action (Bickford et al. 2012). Therefore it is imperative to understand the average awareness of the current populace, in order to determine if increased marine environmental education is needed.

## **2.4 Marine Management and Nova Scotia**

Efforts to curb marine environmental degradation and mitigate existing stressors have been exercised at local, national, and international levels. The Millennium Ecosystem Assessment (2005) highlights the need for international

cooperation and quick action to prevent further degradation of the terrestrial and marine environment. In Canada, the government has committed to several marine protection policies yet fulfilled its obligations for very few (Côté et al. 2012).

The Nova Scotian marine environment has been strongly affected by anthropogenic activities. Following the collapse of the cod fishery on the Atlantic Coast in the 1990s, entire trophic changes occurred (Frank et al 2005). Fisheries have since shifted towards lower trophic level species (Anderson et al. 2008), making Nova Scotian fisheries a perfect example of 'fishing down the food web' (*sensu* Pauly et al. 1998). In addition, threats from aquaculture have long been a public concern in the Maritime provinces (Milewski 2001). Poor waste management techniques have resulted in the accumulation of metals and other pollutants in some waters (Buckley et al. 1995), and sewage, fertilizer run-off and other nutrient loading has contributed to eutrophication in Atlantic Canadian waters, and subsequent decline of particularly vulnerable ecosystems (Schmidt et al. 2012).

Despite extensive media coverage of some of these issues (e.g. cod fishery and salmon aquaculture) and a large number of scientific publications documenting these changes in the marine environment, this information has clearly failed to translate into an increase in marine reserves or protected areas. Currently only 0.56% of the Nova Scotian marine environment is listed as a Marine Protected Area (MPA) or Marine Reserve (World Wildlife Fund, Canadian Parks and Wilderness Society, and Ecology Action Center, 2008).

## **2.5 Identification of Knowledge Gaps**

Although the field of public environmental education research is growing, relatively few studies have focused on gauging Nova Scotians' value of the marine environment and their understanding of the issues affecting it. The Government of Canada has made *some* steps towards understanding traditional ecological knowledge (Maclean et al. 2009), and held public stakeholder meetings for issues such as the management of fisheries, as well as the selection of marine protected areas (Fisheries and Oceans Canada 2010). Yet it is imperative to understand how important the oceans are to Nova Scotians, as well as their attitudes towards marine management in the province. Finally, there is need for comparison with other studies on marine literacy from around the world, to determine regional differences that should be reflected in education and policy.

## **3. Methods**

### **3.1 Survey Design**

The primary means of investigation in this study was a social survey. To answer the four main research questions, a four page, 23-question survey was designed to gauge participants' knowledge of marine environmental issues, the value they place on the oceans, and their opinion on marine management in Nova Scotia (see Appendix A). This survey was approved by the Dalhousie Research Ethics Board (REB, see Appendix B for the completed and approved application).

The first portion of the survey was designed to collect demographic information from participants. Factors such as age, gender, education, frequency of eating seafood, and proximity to the ocean were included. Following this, respondents were asked to rate the value they held for the marine environment, as well as the reasons *why* it is important to them; cultural reasons, economic reasons, recreational reasons, or environmental reasons. Respondents were provided with examples for reasons why the ocean might be important to them, and were offered space to write their own reasons. Next, a general marine issue ‘awareness’ question and a series of ranking questions asked participants to rank their own level of knowledge (from ‘Very Low’ to ‘Very High’) on ten prominent marine environmental issues as determined by the researchers based on the literature review of current marine environmental issues. Respondents were also asked to report their top three sources of information on these issues. Finally, respondents were asked to select the top two or three threats to the global marine environment out of a possible 18 (See Appendix A). The survey concludes with questions on the state of Nova Scotia’s marine environmental protection and general marine management in the province. A section of the survey which asked participants if they identified with any of the following groups; fisher, aboriginal member, activist, or academic was later excluded from formal analysis, as there was insufficient data for each group. A second question “How much time do you spend near or on the ocean for job or recreational purposes (e.g. not living)? “ was omitted because the wording of the question (“near or on” and “not living”) may have been confusing to participants.

### 3.2 Survey Distribution

A total of 1560 surveys were sent to residential households in selected areas of the province in December 2012. A response deadline of January 31<sup>st</sup> 2013 was indicated on the surveys. A 10-20% response rate (Haggard, 1998) was anticipated.

To select the regions which surveys would be sent to, I used Canada Post's "Precision Targeter" system online (<http://canadapost.ca/precisiontargeter>). This system provides a map of the 'Forward Sortation Areas' (FSAs) in the province; which are delineated by the first 3 letters and numbers of a postal code. Ten FSAs that bordered on the ocean were chosen using non-random judgement sampling; effort was made to cover as much of the province's perimeter as possible (Table 3.0). Within FSAs, a letter-carrier route was chosen randomly; within the letter carrier route, it was at the discretion of the Canada Post employee which specific houses along their respective route to deliver the surveys to. This distribution system means that there are elements of controlled and uncontrolled sample selection. The non-random method of sample selection does not allow for inferences to be made about the greater population (coastal Nova Scotians), only the sample itself. Coverage error, the probability that the sample is not representative of the target population, could also occur due to underrepresentation. A non-response error will be present with any survey method; those who were unable, unwilling, or unavailable to answer the survey were omitted from the sample. Sources of error aside, it was determined that this method was the best given scope of this project because judgement sampling is quick, convenient, and cost-effective (Statistics Canada, 2009).

**Table 3.0** Number of surveys sent to each selected FSA in the province. The Halifax area received less surveys due to a printing error whereby less surveys than expected were prepared for delivery as of the mailing date.

<b>Geographic Region</b>	<b>Forward Sortation Areas</b>	<b>Surveys Sent</b>
<b>Halifax</b>	B3Z, B3H	280
<b>South Shore</b>	B0T	320
<b>Yarmouth Shore</b>	B0W	320
<b>Fundy Shore</b>	B0P, B0V	320
<b>Northumberland Shore</b>	B0K	320
<b>Cape Breton</b>	B0E	320
<b>Eastern Shore</b>	B0H, B0E	320

There were no eligibility restrictions for respondents; any person who received a survey was eligible to respond; there were no limitations in age, gender, or demographic group.

### **3.3 Statistical Analysis**

The foremost method of interpreting results was using simple descriptive statistics whereby means, modes, and percentages of responses were calculated for each survey question. Questions that asked respondents to ‘rate’ their knowledge were converted from qualitative measures (Very low, Low, Moderate, High, Very high) to numerical values (Very low being ranked as ‘1’ to Very high ranked as ‘5’) for evaluation, and were treated as ordinal, discrete data.

A one-factor analysis of variance (ANOVA) was conducted using Minitab 16 Statistical Software to evaluate significant differences (at a significance level of  $\alpha=0.05$ ) in means of responses between groups and within answers to questions (Table 3.1). Prior to doing these comparisons, a test of homoscedasticity was done using Bartlett’s test to satisfy the assumption of equal variance for an ANOVA test. However, there were other assumptions that were not satisfied; ANOVA assumes

that data are continuous, while mine are discrete, yet ordinal. A statistician advised that the failure to fulfill this assumption would not affect results due to the nature of categorical data and sample sizes.

**Table 3.1** Summary of ANOVA tests performed in Minitab with a significance level of  $\alpha=0.05$

<b>Predictor</b>	<b>Response</b>
<b>Age</b>	Value
<b>Age</b>	Awareness
<b>Education</b>	Value
<b>Education</b>	Awareness
<b>Awareness</b>	Value
<b>Marine Issue</b>	Knowledge Level of that issue (scale 1-5)

Comparisons were done for individuals' value and awareness level; these were also measured against several variables of interest; namely level of education, and age (see Table 3.1). Analyses that yielded significant differences in means were further examined using a Tukey's HSD post-hoc comparison.

## 4. Results

### 4.1 Survey Demographics

A total of 160 surveys were returned, yielding a response rate of 9.75%. Almost all (91%) respondents were life-long residents of Nova Scotia or had lived in the province for 10 or more years. Surveys were returned from every targeted postal code – yet the spread was not equal among them. The highest number of respondents came from the Eastern and South Shore regions, while the least were from the Northumberland and Fundy Shore regions (See Figure 4.0).

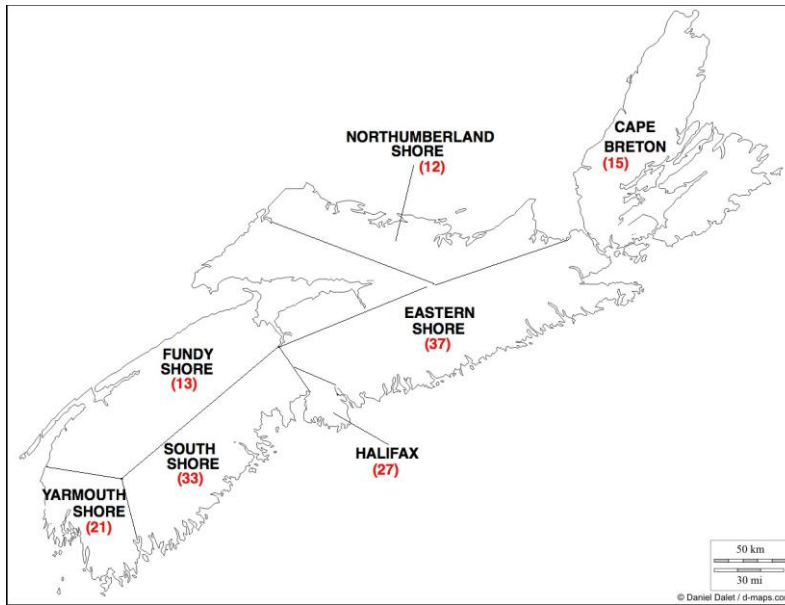


Figure 4.0. Number of survey responses by region (in red brackets). Map was created using <http://d-maps.com/>

Most respondents (73%) were over the age of 50, and only 15% were under 39. Gender was relatively evenly distributed, 51.25% identifying as male, and 45.63% as female (0.006% identified with ‘Other’ and 2.5% chose not to respond). The most common education level held among respondents was a University or College degree (39%), while the least common was completion of Junior High (3%). Only 9% of respondents lived more than 10km from the ocean, with most (58%) living within 1km (See Figure 4.1). A total of 9 respondents reported eating seafood ‘rarely’, while the majority (70%) of respondents reported eating seafood at least ‘once per week.’



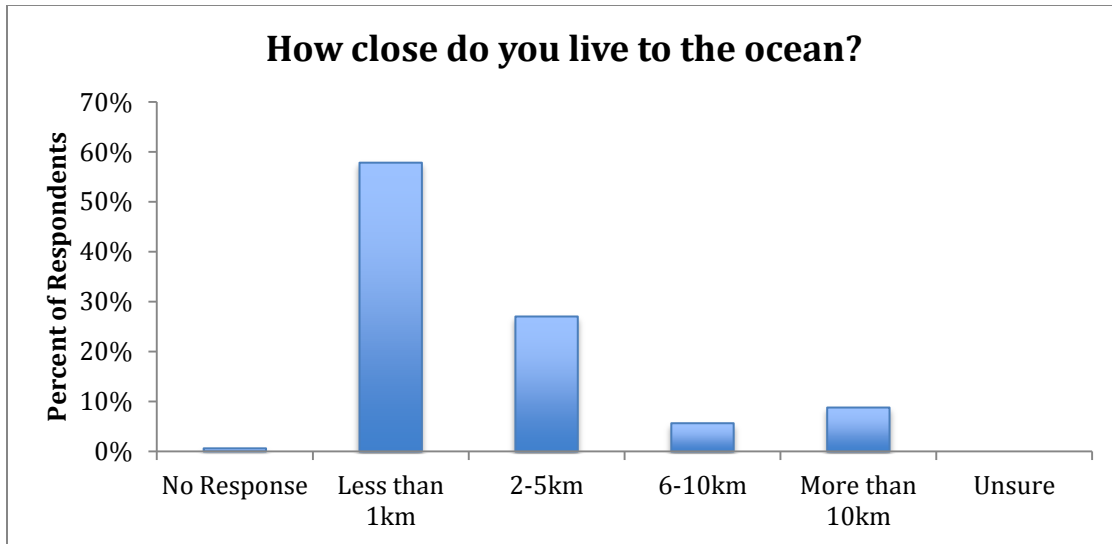


Figure 4.1. Respondents' reported proximity to the ocean.

Finally, the most common sources of information for participants were television, and newspapers, while the least commonly noted source of information was newsletters (see Table 4.0).

**Table 4.0** Information sources as reported by respondents. Respondents could select more than one answer for this question.

<b>Information Source</b>	<b># Respondents</b>
<b>Television</b>	115
<b>Newspaper</b>	109
<b>Radio</b>	63
<b>Friends/Family</b>	49
<b>Magazines</b>	43
<b>Internet</b>	33
<b>School/College/University</b>	13
<b>Other</b>	13
<b>Newsletters</b>	9

## 4.2 Knowledge & Awareness

While none of the respondents reported being “Not aware at all” on marine environmental issues, the level of self-assessed awareness among respondents

could be considered low (see Figure 4.2). Most (51%) considered themselves to be “Somewhat aware”, with the other half feeling “Quite” (42%) or “Very” (5%) aware.

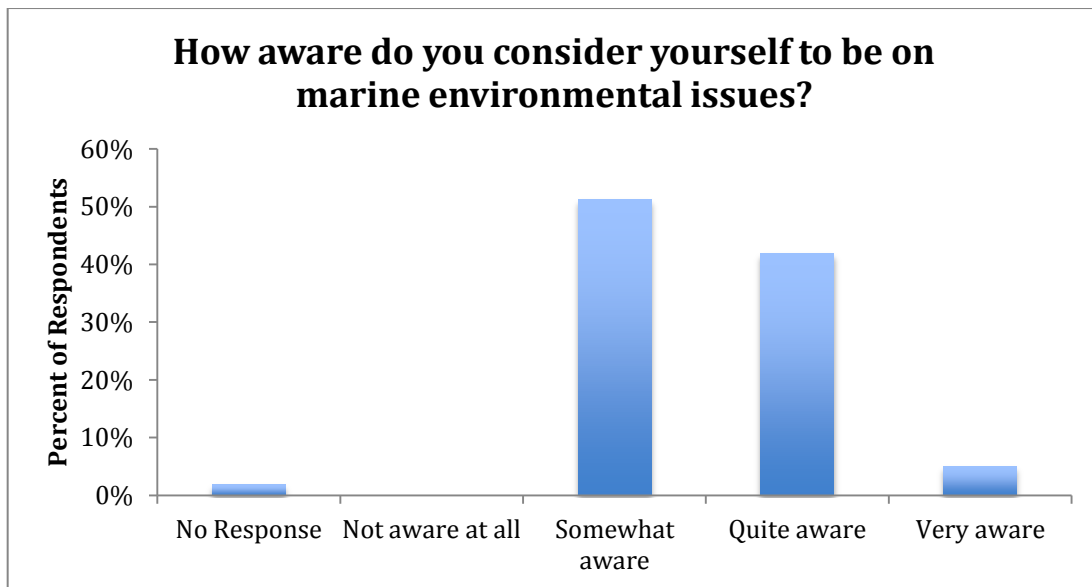


Figure 4.2. Level of self-assessed awareness of marine environmental issues among respondents.

A marginally significant difference was found between the means of self-reported awareness within the level of education held by individuals (One way ANOVA,  $p=0.055$ ). However, when the category of Jr. High was omitted (due to a small sample size), no difference was observed (ANOVA,  $p=0.115$ ). Post-hoc comparisons for both tests yielded no significant difference among means (Tukey’s HSD), indicating that the respondents’ education level did not influence how aware they considered themselves on marine environmental issues. There was a significant difference in self-reported awareness across age categories, with 40-49 year olds reporting higher levels of awareness than 30-39 and 50-59 year olds (ANOVA,  $p=0.004$ , Tukey’s poc-hoc).

There was a significant difference in self-reported knowledge level across the ten marine environmental issues presented to respondents (ANOVA,  $p = 0.010$ , Figure 4.3). When asked to rank their knowledge from “Very Low” (score of 1) to “Very High” (score of 5), a low mean knowledge score was found for ocean acidification (2.32), biodiversity loss (2.48), and invasive species. (2.57).

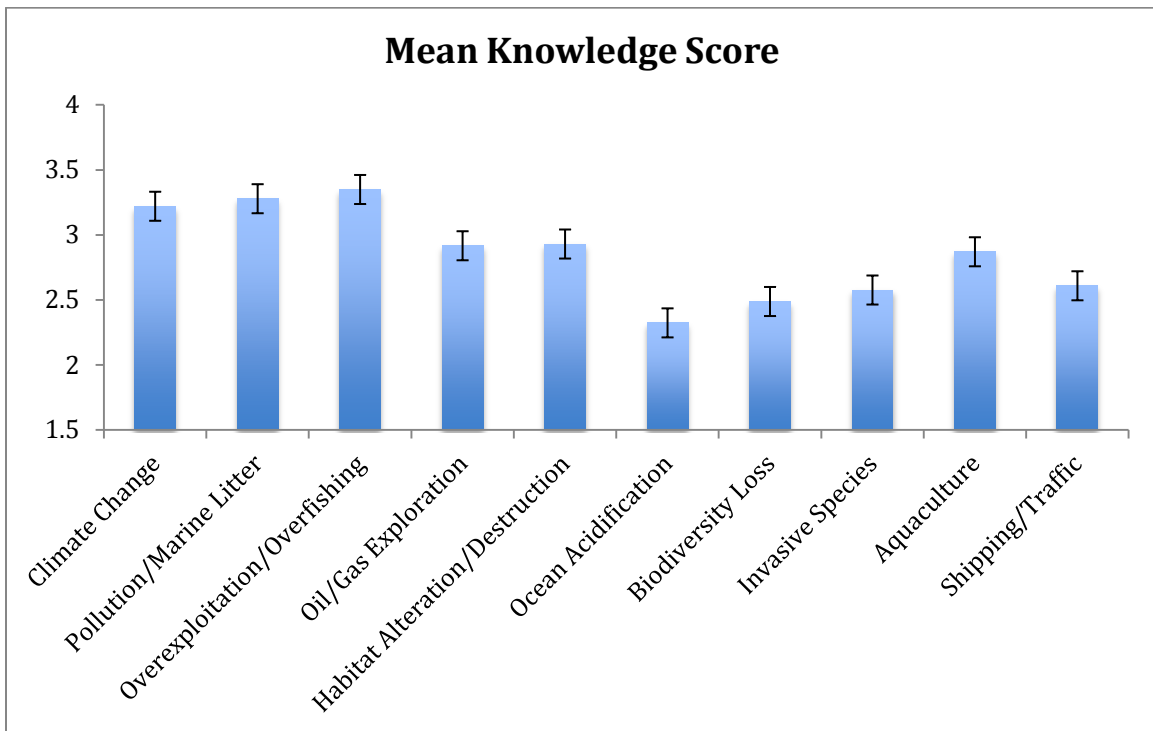


Figure 4.3. Mean ( $\pm$  SE) respondent knowledge scores for ten marine environmental issues (Answers of ‘very low’ were analyzed as 1, while ‘very high’ was 5).

Respondents ranked their knowledge *highest* for the issues of overexploitation/over-fishing (3.34), pollution/marine litter (3.28), and climate change (3.22). The grouped differences in issue knowledge are shown with letters in Table 4.1.

**Table 4.1.** Sample size, mean, and grouping information for knowledge of marine issues using Tukey’s HSD test. Means that do not share a letter are significantly different.

Marine Issue	N	Mean	Grouping
<b>Overexploitation/Overfishing</b>	155	3.35	A
<b>Pollution/Marine Litter</b>	155	3.28	A
<b>Climate Change</b>	155	3.22	A B
<b>Habitat Alteration/ Destruction</b>	155	2.93	B C
<b>Oil/Gas Exploration</b>	154	2.92	B C
<b>Aquaculture</b>	153	2.87	C D
<b>Shipping/Traffic</b>	153	2.60	C D E
<b>Invasive Species</b>	153	2.58	D E
<b>Biodiversity Loss</b>	152	2.49	E
<b>Ocean Acidification</b>	152	2.32	E

### 4.3 Value for the Marine Environment

The level of value held for the marine environment was measured using the question “How important is the marine environment to you?” The most chosen response was the highest level of importance provided, “Extremely Important” (41%), followed by “Very Important” (34%). No respondents felt the marine environment was “Not important at all” to them (See Figure 4.4). This measurement of ‘importance’ was positively correlated with ‘value’ in this study.

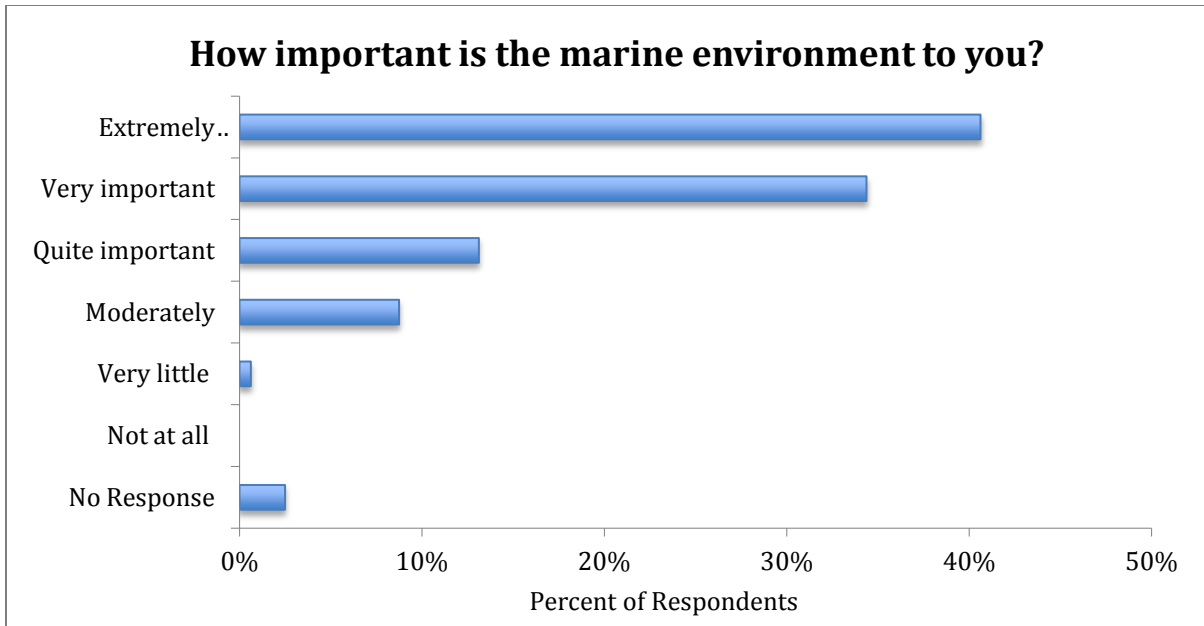


Figure 4.4 Most respondents rated the marine environment to be 'Very' or 'Extremely' important to them.

While no relationship was found between an individuals' value for the marine environment and their education level ( $p=0.742$ ), or age ( $p=0.397$ ), there was a positive association between value and awareness ( $p=0.01$ , see Figure 4.5).

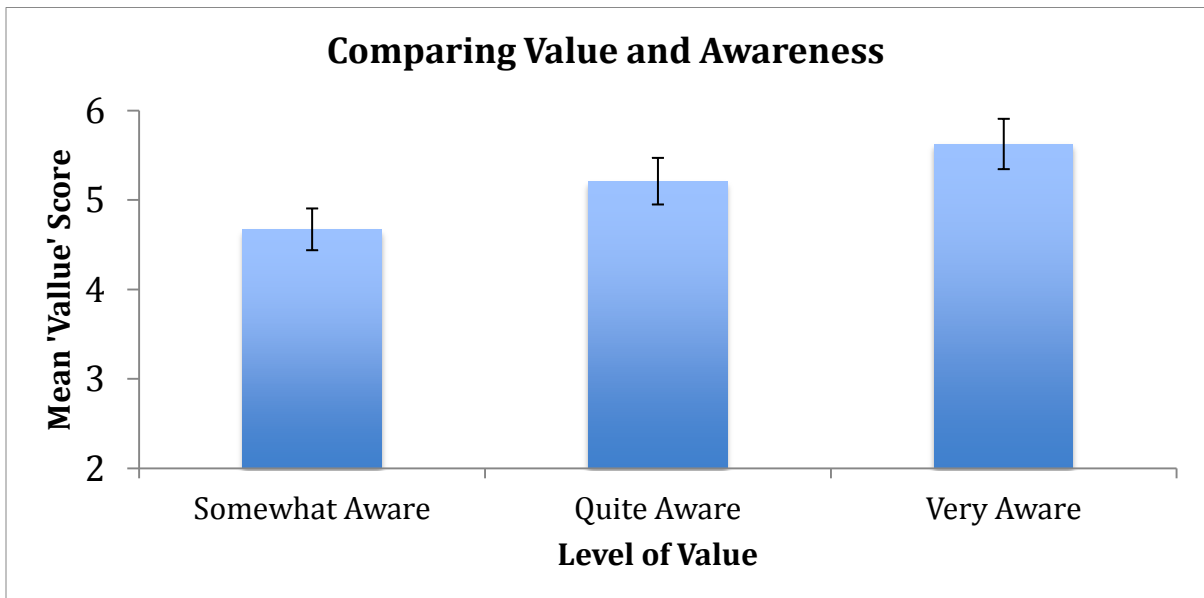


Figure 4.5 Mean ( $\pm$  SE) of respondents' value for the marine environment ("Not at all"=1, to "Extremely important"=6) and self-reported awareness level of marine environmental issues ("Not aware at all" =1, "Very Aware" =4). The category 'Not Aware at All' was omitted from this graph due to a sample size of 0.

Following this question was “Why is the marine environment important to you?”. Examples were provided for reason of importance under the headings of Cultural, Economic, Recreational, and Environmental Reasons. Ninety-nine percent of the respondents chose an environmental reason as driving its importance, followed by economic and recreational reasons with cultural reasons as being the lowest (see Table 4.2).

**Table 4.2.** Ranked participant responses for their reasons why they value the marine environment. ‘n’ is the number of participants that chose a particular response. There was no limit to the number of answers a participant could select.

Reason for Value	Percent of Respondents	Ranked Common Responses
<b>Environmental</b>	99%	<ol style="list-style-type: none"> <li>1. A healthy ocean is beneficial to humans (n=144)</li> <li>2. I value a healthy ocean (n=141)</li> <li>3. We have a responsibility to care for the oceans (n=140)</li> <li>4. I value marine life (135)</li> <li>5. I value sustainability (126)</li> </ol>
<b>Economic</b>	95%	<ol style="list-style-type: none"> <li>1. Important for the local economy (n=143)</li> <li>2. Important for the global economy (n=120)</li> <li>3. I collect some food from the ocean (n=46)</li> <li>4. Source of major income (n=38)</li> <li>5. Source of minor income (n=20)</li> </ol>
<b>Recreational</b>	91%	<ol style="list-style-type: none"> <li>1. Going to beach/coast (n=134)</li> <li>2. Swimming (n=94)</li> <li>3. Boating/Sailing (n=89)</li> <li>4. Fishing (n=74)</li> <li>5. Bird/Wildlife Watching (n=89)</li> <li>6. Whale Watching (n=44)</li> <li>7. Diving (n=31)</li> <li>8. Surfing (n=10)</li> </ol>
<b>Cultural</b>	77%	<ol style="list-style-type: none"> <li>1. Family history with ocean/seas (n=67)</li> <li>2. I belong to a fishing village (n=58)</li> <li>3. Spiritual value (n=46)</li> <li>4. Artistic inspiration (n=31)</li> <li>5. Study interest (n=21)</li> </ol>

#### 4.4 Threats to the Marine Environment

The majority of respondents think that Nova Scotia's marine environment is under threat (see Figure 4.6). The perceived level of threat varied from 'Moderate' (27%) to 'Somewhat High' (37%), while only 3% believed there to be 'No threat'. No comparisons to factors influencing answers to this question were done due to the low sample size (n=9) of respondents who answered 'No'.

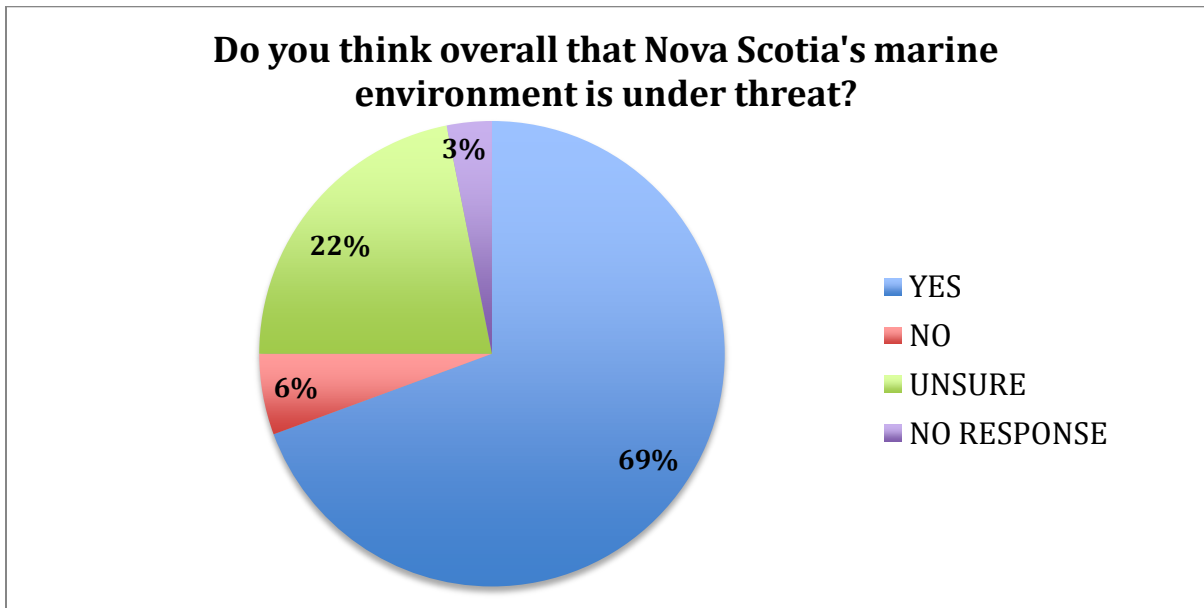


Figure 4.6. Percent of respondents who believe Nova Scotia's marine environment to be under threat.

A list of 18 marine environmental threats was presented and respondents were asked to select the top two or three they believed were most threatening (see Figure 4.7). However, many respondents selected more than 3 for this question. The most commonly chosen responses were 'climate change' (n=69), 'sea level rise', (n=60) and 'over-fishing' (n=57). The least common chosen responses were 'recreational fishing' (n=0), 'marine noise' (n=1) and 'marine shipping/traffic' (n=3).

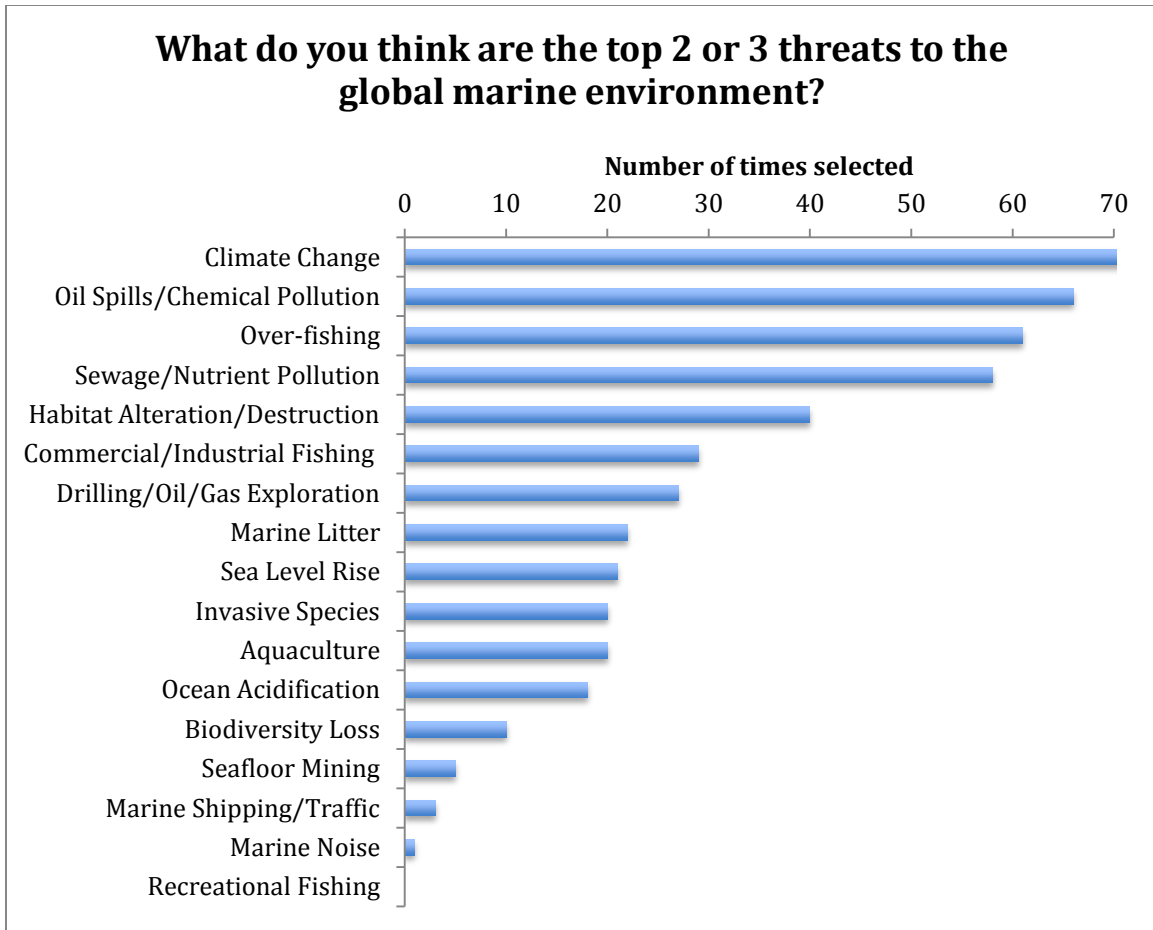


Figure 4.7 Top marine environmental threats as perceived by respondents.

#### 4.5 Marine Management in Nova Scotia

There was a clear demand for better ocean management measures in Nova Scotia, with 93% of respondents answering “Yes” or “Probably Yes” to the question “Do you think we need better marine management in the province?”. Thirty eight percent of the respondents believed that 2-10% of the local marine environment was currently protected under legislation, yet 56% of people wanted to see more than half the marine environment protected in the future (see Figure 4.8).



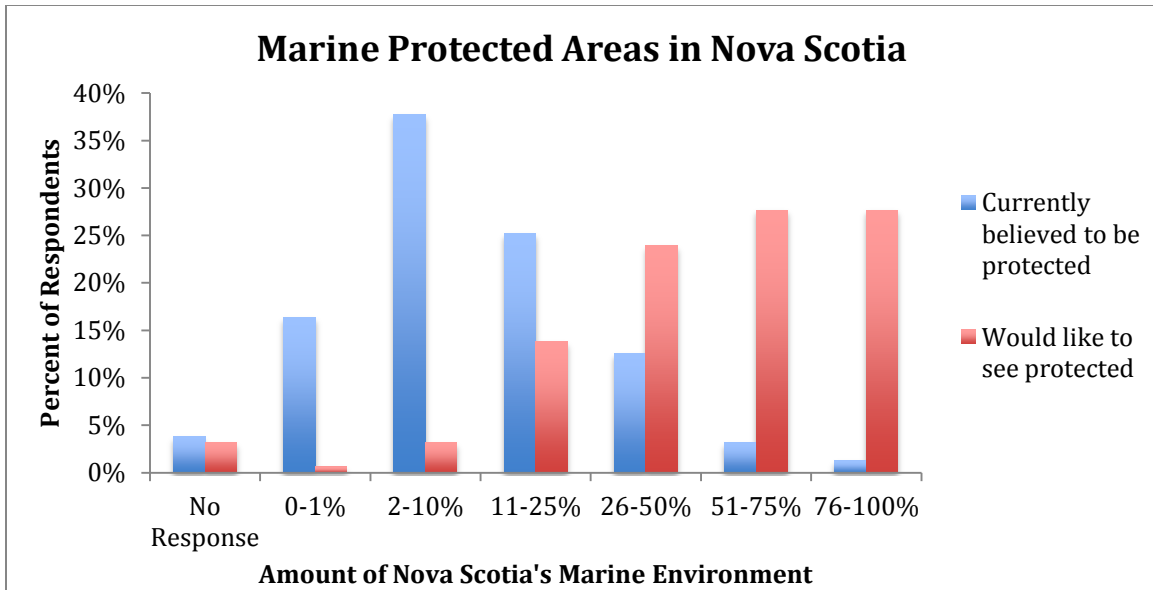


Figure 4.8 Percentages of Nova Scotia's marine environment that respondents believed is currently under protection (blue) and how much they would like to see protected in the future (red).

Although people wanted more protection, there was a slight discrepancy in perception of resource use by human beings within an MPA. When asked “When a region of the ocean becomes a marine protected area (MPA), people who are currently using the area may have to stop activities such as commercial and recreational fishing, collecting and dredging. Do you think this is reasonable?” about 1 in 4 respondents were either unsure or did not believe this to be reasonable.

## 5. Discussion

Using a mailed social survey, this thesis explores how residents of Nova Scotia judge their own knowledge on marine environmental issues, assess their value for the marine environment, and perceive current threats, protection and management of marine ecosystems in their home province.

## 5.1 Respondent Demographics

Overall, 160 Nova Scotians responded to the mail-out survey. Response rate was slightly below the expectation of 10% (Haggard, 1998). This could have been due to the timing of the survey being sent out during the December holiday season, the busiest time of year for mailings in Canada (Canada Post 2011). The demographic representativeness of the survey is somewhat skewed. While male/female ratio was generally on par with provincial statistics, age and education level were not. The majority of respondents (56%) in the study possessed a University/College degree or higher, while the provincial number of individuals holding this level of education is only 42.2% (Statistics Canada 2006). The age distribution was strongly skewed to age 50 and over, with only 13 respondents under the age of 30. This may be due to the nature of the survey method; surveys were sent to residential homes, and homeowners are likely to be older, and perhaps have more time to answer a survey if retired or semi-retired. Also, younger people tend to communicate using web-based mediums rather than the postal system. This was reflected in respondents' reported information sources with television ranking highest followed by newspaper and radio, while the internet was ranked as one of the least common sources for information (see Table 4.0). Interestingly, in a study of citizens over the age of 18 in the United States, newspapers and the Internet were likely to improve citizen knowledge on ocean issues, while television and radio were found to have a negative effect (Steel et al. 2005). However, newspapers and radio are information sources arguably less commonly used by youth today. Ballantyne

(2004) found that younger children aged 10-11 learned most of their information about the sea at school, reading books, and aquarium visits.

The amount of responses by region was also not homogeneous. A higher response rate on the Eastern and Southern Shores of the province was observed, while the Fundy and Northumberland Shores had relatively low response rates. Still, almost all respondents (85%) indicated they live very close (<5km) to the ocean, and ate seafood frequently (70%); indicating the majority of the sample do have a physical relationship with marine ecosystems.

## **5.2 Awareness and Knowledge**

Most respondents considered their awareness level of marine environmental issues to be relatively low. The most chosen response for “How aware do you consider yourself to be on marine environmental issues?” was ‘Somewhat Aware’. If the possible answers for this question are considered ordinal (that is, categories are scaled), then the most chosen response would be associated with an awareness level of 2 out of a possible 4. However there is concern over the interpretation of available answers provided for respondents; whether the subjective terms “Somewhat”, “Quite” and “Very” would be considered ordinal to individuals. For the purpose of interpretation, this data was treated as equally ordered, with the caveat considered before making conclusions. Still, the results of this study indicate that coastal Nova Scotians do not feel they are very aware of marine environmental issues. These results are similar to the level of self-assessed awareness reported by

U.S citizens (Steel et al. 2005b), yet lower than that measured of museum-goers in the UK (Fletcher et al. 2009).

It is important to note that this is a measure of citizen's belief of their own personal knowledge level; this study did not quantify coastal Nova Scotians' marine issues knowledge via test, quiz, or other method. However, an individuals' perception of their own knowledge level is certainly valuable to identify, and is a measure that has been used in many other environmental knowledge studies (Steel et al. 2005b).

There was a significant difference in perceived knowledge levels of the ten marine environmental issues provided for respondents when asked to rank their level of knowledge on a scale from 1-Very low to 5-Very high. Overall, the lowest ranking issues by mean was ocean acidification, followed by biodiversity loss and invasive species; while the highest were climate change, pollution/marine litter, and overexploitation/overfishing. Generally, 'climate change', 'pollution', and 'overexploitation/overfishing' are easy to understand concepts most people can relate to. Moreover, these are terms widely used and discussed in mainstream media, which Steel et al. (2005b) argues may give the "illusion of building better knowledge". In contrast, 'ocean acidification', 'biodiversity loss', and invasive species' may be more abstract, technical or scientific and less widely used or known in the media. For comparison, a quick search in Google News (<https://news.google.ca>, searched on March 26, 2013) revealed much higher results for ocean climate change (15,200 hits), overfishing (3,880), and ocean pollution

(13,300) compared with ocean acidification (1,020), ocean biodiversity loss (654), and marine invasive species (1,740).

The most commonly perceived threats for the marine environment were also the issues respondents considered themselves most aware of 'climate change', followed by 'oil spills/chemical pollution' and 'over-fishing' (see Figure 4.7). These responses match precisely a National Marine Museum survey in the UK (Fletcher et al. 2009), with the only exception being general 'pollution' ranking higher than climate change. These findings are also somewhat comparable to a World Wildlife Fund study conducted in New Zealand (WWF-NZ 2011), which found 'commercial fishing' and 'pollution and sewage' were top threats to the marine environment. However, New Zealand respondents also highlighted 'recreational fishing' while *zero* respondents in this study identified this as a top marine threat. These comparisons lead me to believe that regional-social differences affect individuals' perceptions of marine issues. A growing scarcity of fish stocks in coastal New Zealand has led to intense conflicts between commercial and recreational fishers (Kearny 2001; Wheeler & Damania 2001;), while pollution and a major oil spill in 1967 have historically been issues of industrial and environmental concern in the UK.

Scientific literature varies in agreed upon 'top threats' to the marine environment, however commonly cited issues are 'overfishing', 'climate change' and 'biodiversity loss' (Côté et al. 2012, Millennium Ecosystem Assessment 2005). The Royal Society of Canada's 2012 report places a strong emphasis on biodiversity loss, which is caused by a wide number of anthropogenic stressors. In addition to

biodiversity loss, the report identified other top marine threats to be climate change (in association with sea level rise and ocean acidification), fishing, aquaculture, and habitat destruction (primarily from fishing activities). The Millennium Ecosystem Assessment (2005) focuses almost solely on marine fisheries and their connection to ecosystem health and economic sustainability. The relatively low knowledge (see Table 4.1) and concern (see Figure 4.7) for biodiversity loss reported by respondents indicates a strong need for articulation of the causes and effects of marine environmental issues to the public.

### **5.3 Value for the Marine Environment**

The survey results clearly demonstrated that respondents held a high level of importance for the marine environment. Three-quarters of participants felt the marine environment was 'very' or 'extremely' important to them. This proxy of 'value' for the marine environment was compared across education level, age, and self-assessed awareness to determine what may influence one's value. The results indicated a significant difference in value across 3 'awareness' categories, with those who felt 'Very aware' of marine environmental issues having a higher value than those who felt 'Somewhat aware'.

Interestingly, the reasons *why* the marine environment was important to individuals were very different than expected. It was predicted that economic and cultural reasons would be the most predominantly chosen; yet the cultural reasons category was *least* chosen, and 99% of respondents selected an answer within the environmental reasons category. More specifically, the most selected reason for

valuing the marine environment was that “a healthy ocean is beneficial to humans”. This suggests that coastal Nova Scotians understand the connection between ecosystem function and human well-being; an principle understanding needed for marine citizenship. This benefit, however, may still be primarily due to economic reasons, as 143 respondents circled “Important for the local economy” in the economic reasons category.

#### **5.4 Marine Management and Protection in Nova Scotia**

While 69% of respondents believed Nova Scotia’s marine environment to be under threat, just 16% of respondents knew that only 0-1% of the Nova Scotian sea is currently designated as a marine protected area. Respondents in a New Zealand study believed 31% of their marine environment is protected, when in fact it is also less than 1% (WWF-NZ 2011). This major misconception about the level of Federal protection of the marine environment, which many considered to be ‘extremely important’ to them, highlights an important knowledge gap in marine policy and legislation. Interestingly, 56% of respondents indicated a desire to see up to *three quarters* of the marine environment protected in the future, which is almost *double* what New Zealand respondents reported wanting (36%, WWF-NZ 2011). In contrast, a quarter of people surveyed did not think it reasonable to cease activities such as commercial and recreational fishing, collecting, and dredging in those areas if protected, despite being provided with the definition of what a marine protected area is (see survey, Appendix A). This discrepancy between the desire for more protection and the unwillingness to reduce resource extraction activities is another

important piece of information for policy makers and educators, as it indicates a need for better on the harmful effects of these activities and the purpose of marine protected areas.

Regardless of how informed respondents felt on marine environmental issues, their value for the marine environment, or other demographic factors – an overwhelming 93% of respondents in this survey believed that we need better marine management in the province of Nova Scotia. This is similar to the 96% of New Zealanders who think that a larger proportion of their oceans should be protected in marine reserves than is currently the case. This is likely related to the high proportion of respondents who perceive that Nova Scotia’s marine environment is under threat and the desire for a larger area to be protected. This desire for more protection can be used by decision-makers and educators in public information campaigns or ocean related community projects to build public awareness on ocean issues and marine protection.

## **5.5 Limitations and Recommendations**

First, there are some inherent limitations to a survey of this nature. I used a non-probabilistic method of survey sampling. This means I cannot draw inferences about the total population; only about the sample.

Second, the small sample size of 160 respondents, although expected, does provide limited insight into the issues addressed and there are potential biases in several respects. The timing of the survey, which was sent in December 2012, may have coincided with distractions of the holiday season thereby limiting our response



rate. To increase response rate, it is suggested that a longer 'response time' is given for contacted citizens. Sending 'waves' of mail surveys followed by telephone or mail reminders could yield response rates over 50% (Steel et al. 2005b).

There is a need to expand this survey to gain a more representative sample of coastal Nova Scotians; youth, urban communities, marine academics, fishers, and aboriginal members are all groups of interest that should be included in a study of this nature. About a quarter of respondents identified with one of 6 possible 'special interest' groups, particularly with industrial or small-scale fishers and environmental activists (however, the overall sample size was small and therefore no formal analysis was performed on this data at this time). The residential mail responses likely skewed the age distribution and education level across respondents towards older and more highly-educated people since they are more likely to own a home close to the ocean. These biases could be overcome by an expanded survey in the future, that would also be provided online and over the phone to target a larger proportion of the population, as well as specific interest groups such as First Nations communities and fishers.

Finally, the limited sample size and skewed demographic distribution of respondents has limited the potential for more refined data analysis. With a potentially larger sample size, regression trees, likelihood tests, and chi-squared tests could be used for determining factors most likely to affect knowledge and value scores.

I also recommend revising the structure of several questions within the survey to eliminate bias, ambiguity, and increase statistical soundness and clarity.

The use of 'Likert' scales for all opinion questions should be used (Maurer & Pierce 1998), and numerical scales rather than subjective terms ('somewhat', 'quite') employed for questions asking respondents to rank their knowledge. For assessing personal value, I would advise use of the term 'value' over 'importance', so as to claim the measurement of value more directly. Other questions would be better suited to be broken into two or more separate sections. For example, asking respondents if they think restriction of activities such as a) commercial fishing and b) recreational fishing are reasonable within a marine reserve (one respondent wrote this suggestion on their returned survey).

## **6. Conclusion**

Being the first survey of its kind on marine environmental issues in Nova Scotia, this study provides very useful information on the public's knowledge of and value for the marine environment as well as the perceived level of threat, protection and management. Policy makers and educators can use this information for improving environmental education, and for decision-making with regards to allocation of government spending on environmental protection. In addition, scientists can use this study to revise and refine the original survey design, to capture a larger and more representative sample of Nova Scotians and enlarge the sample size using a wider variety of sampling techniques. Comparing this study to those conducted in the United States, Britain, and New Zealand has provided

valuable insights into the similarities and differences in values and marine management perceptions across different regions.

Overall, the results from this study suggest that Nova Scotians hold the marine environment to be highly important. Most respondents thought they had low to moderate knowledge on marine environmental issues, pointing to a need for enhanced marine education and ocean literacy in Nova Scotia. Coastal Nova Scotians valued the marine environment mostly for environmental but also for economic, recreational and cultural reasons; however, they also perceived a high level of threat, lack of management and generally wished for a higher protection of their marine environment. These results suggest that, in general, Nova Scotians are strongly connected to and care for the ocean, and that they would support stronger management and conservation.

## **Acknowledgements**

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## References

- Anderson, A. G. (2002). The media politics of oil spills. *Spill Science & Technology Bulletin*, 7(1), 7-15.
- Anderson, S. C., Mills Flemming, J., Watson, R., Lotze, H.K. (2011). Rapid global expansion of invertebrate fisheries: trends, drivers, and ecosystem effects. *PLoS ONE* 6(3): e14735.
- Anderson, S. C., Lotze, H. K., & Shackell, N. (2008). Evaluating the knowledge base for expanding low-trophic level fisheries in Atlantic Canada. *Canadian Journal of Fisheries and Aquatic Sciences*, 65, 2553-2571.
- Ballantyne, R. (2004). Young students' conceptions of the marine environment and their role in the development of aquaria exhibits. *GeoJournal*, 60(2), 159-163.
- Baum, J. K., & Worm, B. (2009). Cascading top-down effects of changing oceanic predator abundances. *Journal of Animal Ecology*, 78, 699-714.
- Bickford, D., Posaa, M. R., Qieb, L., Campos-Arceizc, A., & Kudavidanagea, E. P. (2012). Science communication for biodiversity conservation. *Biological Conservation*, 151(1), 74-76.
- Bravo, M., de los Ángeles Gallardo, M., Luna-Jorquera, G., Núñez, P., Vásquez, N., & Thiel, M. (2009). Anthropogenic debris on beaches in the S.E. Pacific (Chile): Results from a national survey supported by volunteers. *Marine Pollution Bulletin*, 58(11), 1718-1726.
- Brody, M., & Stilwell, S. (1987). A comparison of Canadian Maritime and Maine students' understanding of the Gulf of Maine. *OCEANS'87* (pp. 779-784).
- Buckley, D. E., Smith, J. N., & Winters, G. V. (1995). Accumulation of contaminant metals in marine sediments of Halifax Harbour, Nova Scotia: Environmental factors and historical trends. *Applied Geochemistry*, 10(2), 175-195.
- Caldeira, K., & Wickett, M. (2003). Anthropogenic carbon and ocean pH. *Nature*, 425(6956), 365-365.
- Canada Post. *Canada Post Annual Report 2011*. Canada Post.
- Costanza, R. (1999). The ecological, economic, and social importance of oceans. *Ecological Economics*, 31, 199-213.

Côté, I. M., Dodson, J. J., Fleming, I. A., Hutchings, J. A., Jennings, S., Mantua, N. J., et al. (2012). *Sustaining Canada's marine biodiversity: Responding to the challenges posed by climate changes, fisheries, and aquaculture*. Ottawa, Canada: Royal Society of Canada.

Culbertson, H. M., & Stempel III, G. H. (1986). How media use and reliance affect knowledge level. *Communication Research*, 13(4), 579-602.

Derraik, J. G. (2002). The pollution of the marine environment by plastic debris: a review. *Marine Pollution Bulletin*, 44(9), 842-852.

Ehrlich, P. R., & Holdren, J. P. (1971). Impact of population growth. *Science*, 171(3977), 1212-1217.

Essington, T. E., Beaudreau, A. H, Wiedenmann, J. (2006). Fishing through marine food webs. *Proceedings of the National Academy of Sciences of the United States of America*, 103, 3171-3175.

Fisheries and Oceans Canada. (2010). Atlantic Fisheries Policy Review. Retrieved 03 26, 2013, from Fisheries and Oceans Canada: [http://www.dfo-mpo.gc.ca/afpr-rppa/link\\_policy\\_framework\\_e.htm](http://www.dfo-mpo.gc.ca/afpr-rppa/link_policy_framework_e.htm)

Fisheries and Oceans Canada (2011). *What We Heard: Summary of DFO's Public Consultation to Select an Area of Interest on the Eastern Scotian Shelf for Marine Protected Area Designation*. <http://www.mar.dfo-mpo.gc.ca/e0020328>

Fletcher, S., & Potts, J. (2007). Ocean citizenship: An emergent geographical concept. *Coastal Management*, 35 (4), 511-524.

Fletcher, S., Potts, J., Heeps, C., & Pike, K. (2009). Public awareness of marine environmental issues in the UK. *Marine Policy*, 33, 370-375.

Ford, J., & Myers, R. (2008). A global assessment of salmon aquaculture impacts on wild salmonids. *PLoS Biology*, 6(2), e33-417.

Frank, K., Petrie, B., Choi, J., & Leggett, W. (2005). Trophic cascades in a formerly cod-dominated ecosystem. *Science*, 308(5728), 1621-1623.

Haggard, L. M. (1998). *Health Surveys and Social Science: A Primer for Applied Survey Projects*. Utah Department of Health. Bureau of Surveillance and Analysis.

Halpern, B. S., K. A. Selkoe, F. Micheli, and C. V. Kappel. 2007. Evaluating and ranking the vulnerability of global marine ecosystems to anthropogenic threats. *Conservation Biology*, 21(5) 1301-1315.

Harnik, P. G., Lotze, H. K., Anderson, S. C., Finkel, Z. V., Finnegan, S., Lindberg, D. R., et al. (2012). Extinctions in ancient and modern seas. *Trends in Ecology and Evolution*, 27(11), 608-617.

Hoegh-Guldberg, O., & Bruno, J. F. 2010. The Impact of Climate Change on the World's Marine Ecosystems. *Science*, 328:1523-1528.

Jefferson, R. L. (2012). *Communicating Marine Environmental Health: Connecting Science, Social and Policy Values* (Doctoral thesis). Centre for Marine and Coastal Policy Research, Plymouth University, UK.

Jackson, J. B. C., Kirby, M. X., Berger, W. H., Bjorndal, K. A., Botsford, L. W., Bourque, B. J., et al. (2001). Historical overfishing and the recent collapse of coastal ecosystems. *Science*, 293(5530), 629-638.

Kearney, R. E. (2001). Fisheries property rights and recreational/commercial conflict: implications of policy developments in Australia and New Zealand. *Marine Policy*, 25(1), 49-59.

Lewison, R. L., Crowder, L. B., Read, A. J., & Freeman, S. A. (2004). Understanding impacts of fisheries bycatch on marine megafauna. *Trends in Ecology & Evolution*, 19(11), 598-604.

Maurer, T. J., & Pierce, H. R. (1998). A comparison of Likert scale and traditional measures of self-efficacy. *Journal of applied psychology*, 83(2), 324-329.

Lotze, H.K., Lenihan, H.S., Bourque, B.J., Bradbury, R.H., Cooke, R.G., Kay, M.C., Kidwell, S.M., Kirby, M.X., Peterson, C.H., Jackson, J.B.C. (2006). Depletion, degradation, and recovery potential of estuaries and coastal seas. *Science*, 312, 1806-1809.

Lotze, H. K., & Worm, B. (2009). Historical baselines for large marine animals. *Trends in Ecology & Evolution*, 24(5), 254-262.

Lotze, H. K., Coll, M., Dunne, J. (2011). Historical changes in marine resources, food-web structure and ecosystem functioning in the Adriatic Sea, Mediterranean. *Ecosystems*, 14, 198-222.

MacLean, M., Breeze, H., & Doherty, P. (2009). Using fish harvesters' local ecological knowledge (LEK) in support of identifying Ecologically and Biologically Significant Areas (EBSAs) on the offshore eastern Scotian Shelf. *Oceans and Coastal Management Report Series*. <http://www.dfo-mpo.gc.ca/Library/337212.pdf>

McKinley, E., & Fletcher, S. (2012). Improving marine environmental health through marine citizenship: A call for debate. *Marine Policy*, 36, 839-843.

Millennium Ecosystem Assessment. (2005). *Ecosystems and Human Well-Being: Our Human Planet: Summary for Decision Makers* (Vol. 5). Island Press.

Milewski I (2001). Impacts of salmon aquaculture on the coastal environment: a review. In: Tlustý M. F., Bengtson, D. A., Halvorson, H. O., Oktay, S. D., Pearce, J. B., Rheault, R.B. Jr (eds) *Marine aquaculture and the environment; a meeting for stakeholders in the Northeast*. Cape Cod Press, Falmouth, Massachusetts, 166-197.

Myers, R. A., Baum, J. K., Shepherd, T. D., Powers, S. P., & Peterson, C. H. (2007). Cascading effects of the loss of apex predatory sharks from a coastal ocean. *Science*, 315, 1846-1850.

Naylor, R.L., Goldburg, R.J., Primavera, J., Kautsky, N., Beveridge, M., Clay, J., Folke, C., Lubchenco, J., Mooney, H., Troell, M. (2000). Effects of aquaculture on world fish supplies. *Nature*, 405,1017-1024.

Nova Scotia Department of Education. (2003-2004). *Public school programs 2003-2004; goals and policies, program and course descriptions services, procedures, and publications*. Department of Education, Halifax, Nova Scotia.

Pachauri, R. K., & Reisinger, A. (2007). *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Intergovernmental Panel on Climate Change*.

Pandolfi, J. M., Bradbury, R. H., Sala, E., Hughes, T. P., Bjorndal, K. A., Cooke, R. G., ... & Jackson, J. B. (2003). Global trajectories of the long-term decline of coral reef ecosystems. *Science*, 301(5635), 955-958.

Pauly, D., Christensen, V., Dalsgaard, J., Froese, R., & Torres Jr, F. (1998). Fishing down marine food webs. *Science*, 279(5352), 860-863.

Rose, G., deYoung, B., Kulka, Q., Goddard, S., & Fletcher, G. (2000). Distribution shifts and overfishing the northern cod (*Gadus morhua*): a view from the ocean. *Canadian Journal of Fisheries and Aquatic Sciences*, 57(3), 644-663



Rose, G. A. (2004). Reconciling overfishing and climate change with stock dynamics of Atlantic cod (*Gadus morhua*) over 500 years. *Canadian Journal of Fisheries and Aquatic Sciences*, 61(9), 1553-1557.

Rosenberg, A. A., Bolster, W. J., Alexander, K. E., Leavenworth, W. B., Cooper, A. B., & McKenzie, M. G. (2005). The history of ocean resources: modeling cod biomass using historical records. *Frontiers in Ecology and the Environment*, 3(2), 78-84.

Schmidt, A. L., Wysmyk, J. K. C., Craig, S. E., & Lotze, H. K. (2012). Regional-scale effects of eutrophication on ecosystem structure and services of seagrass beds. *Limnology and Oceanography*, 57(5), 1389-1402.

Small, C., Gornitz, V., & Cohen, J. E. (2000). Coastal hazards and the global distribution of human population. *Environmental Geosciences*, 7(1), 3-12.

Stables, A., & Bishop, K. (2001). Weak and strong conceptions of environmental literacy: Implications for environmental education. *Environmental Education Research*, 7(1), 89-97.

Statistics Canada. (2006). *Educational Portrait of Canada, 2006 Census: Findings*. Retrieved 03 25, 2013, from Statistics Canada: <http://www12.statcan.gc.ca/census-recensement/2006/as-sa/97-560/index-eng.cfm>

Statistics Canada. (2009). *Non-probability sampling*. Retrieved 03 25, 2013, from Statistics Canada: <http://www.statcan.gc.ca/edu/power-pouvoir/ch13/nonprob/5214898-eng.htm>

a. Steel, B., Lovrich, N., Lach, D., & Fomenko, V. (2005). Correlates and consequences of public knowledge concerning ocean fisheries management *Coastal Management*, 33, 37-51.

b. Steel, B., Smith, C., Opsommer, L., Curiel, S., & Warner-Steel, R. (2005). Public ocean literacy in the United States. *Ocean & Coastal Management*, 48, 97-114.

Stern, P. C. & Dietz, T. (1994). The value basis of environmental concern. *Journal of Social Issues*, 50(3), 65-84.

Thrush, S. F., & Dayton, P. K. (2002). Disturbance to marine benthic habitats by trawling and dredging: implications for marine biodiversity. *Annual Review of Ecology and Systematics*, 33, 449-473.

Wheeler, S., & Damania, R. (2001). Valuing New Zealand recreational fishing and an assessment of the validity of the contingent valuation estimates. *Australian Journal of Agricultural and Resource Economics*, 45(4), 599-621.

World Wildlife Fund, Canadian Parks & Wilderness Society, Ecology Action Center (2008). Are we on track? Taking stock of ocean conservation in the Scotian Shelf and Bay of Fundy Region. Retrieved 03 25, 2013, from Ecology Action Center: <http://www.ecologyaction.ca/files/images/file/Marine/Gap%20analysis%20summary%5B1%5D.pdf>.

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

Wood, L. J., Fish, L., Laughren, J., & Pauly, D. (2008). Assessing progress towards global marine protection targets: shortfalls in information and action. *Oryx*, 42(03), 340-351.

WWF - New Zealand (2011). Measuring New Zealanders' attitudes towards their oceans and marine reserves. Results of a Colmar Brunton national survey. Wellington: WWF - New Zealand.

**Appendix A – The Survey**  
**VOLUNTARY SURVEY**  
**Undergraduate Honours Project Research**  
**Dalhousie University**

*Hello!*

*The following survey is part of a Dalhousie University undergraduate student’s honours project focused on marine environmental issues. The information collected will be used to complete an honours program requirement of a thesis paper, and results may be subject to publishing in an academic journal, report, or other media. Please note that this survey is **completely anonymous**. You are **not** required to give your name.*

*This should take no more than 10 minutes of your time. Once completed, please put the finished survey in the pre-stamped return envelope (included in this package) and pop it in the mail.*

*If you have any questions, please contact the researcher at [HaleyGuest@gmail.com](mailto:HaleyGuest@gmail.com) or (902) 401-7085.*

*Thank you very much for your participation! 😊*

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*First, we just need to know a bit about you...*

**Are you a resident of Nova Scotia? (Please circle)**                      Yes                      No

**How long have you been a resident of Nova Scotia? (Please circle)**

1 year                      2-5 years                      6-10 years                      10 + years                      My  
whole life

**In which community in Nova Scotia do you currently live?**

Name of community \_\_\_\_\_ Postal code: \_\_\_\_\_

**What is your gender? (Please circle):** Female                      Male                      Other

**What is your age range? (Please circle)**

Under 18                      19-29                      30-39                      40-49                      50-59                      60-69                      70+

**What level of education do you currently hold? (Please circle)**

Junior High                      Some High School                      High School                      Some University or College  
University or College Degree                      Masters Degree                      Doctorate Degree

**Do you consider yourself belonging to one of the following groups? (Circle all that apply)**

- a) Aboriginal/First Nations
- b) Environmental Activist
- c) Marine Expert/Academic
- d) Fisher (Please specify):                      Industrial                      or                      Small scale
- e) Aquaculture (Please specify):              Fish Farming                      or                      Mussel/Oyster Farming

**How close do you live to the ocean? (Please circle)**

- Less than 1km                      2-5km                      6-10km                      More than 10km                      Unsure

**How often do you eat seafood? (Please circle)**

- Never                      Rarely                      Once per month                      Once per week                      Almost every day

**How much time do you spend near or on the ocean for job or recreational purposes**

(e.g. not living)?

- Every day                      Once a week                      Once a month                      Few times a year                      Very Rarely/Never

*The 'marine environment' refers to the global oceans, seas, coasts, and all of the creatures living in them. 'Marine environmental issues' refer to a number of factors currently affecting the world's marine systems.*

**How important is the marine environment to you? (Please circle)**

- Not at all                      Very little                      Moderately                      Quite important                      Very important  
Extremely important

**Why is the marine environment important to you? (Please circle all that apply)**

We realize that there are MANY reasons why the marine environment may be important to you. Below are simply some *examples*, if you have other reasons, please add them to 'Other'

<b>Cultural Reasons</b>	<b>Environmental Reasons</b>	<b>Recreational Reasons</b>	<b>Economic Reasons</b>
<ul style="list-style-type: none"> <li>• Artistic inspiration</li> <li>• I belong to a fishing village</li> <li>• Spiritual value</li> <li>• Study interest</li> <li>• Family history with ocean/seas</li> </ul>	<ul style="list-style-type: none"> <li>• I value marine life</li> <li>• I value a healthy ocean</li> <li>• I value sustainability</li> <li>• A healthy ocean is beneficial to humans</li> <li>• We have a responsibility to care for the oceans</li> </ul>	<ul style="list-style-type: none"> <li>• Fishing</li> <li>• Bird/Wildlife Watching</li> <li>• Boating/Sailing</li> <li>• Surfing</li> <li>• Going to beach/coast</li> <li>• Swimming</li> <li>• Diving/Snorkeling</li> <li>• Whale watching</li> </ul>	<ul style="list-style-type: none"> <li>• Source of major income</li> <li>• Source of minor income</li> <li>• I collect some food from the ocean</li> <li>• Important for the local economy</li> <li>• Important for the global economy</li> </ul>

e) Other (Please explain):

---

**How aware do you consider yourself to be on marine environmental issues? (Please circle)**

Not aware at all      Somewhat aware      Quite aware      Very aware

**How would you rate your knowledge on the following marine environmental issues? (Please circle)**

- |   |          |     |          |      |           |
|---|----------|-----|----------|------|-----------|
| a) <b>Climate Change:</b>                 | Very low | Low | Moderate | High | Very high |
| b) <b>Pollution &amp; Marine Litter:</b>  | Very low | Low | Moderate | High | Very high |
| c) <b>Overexploitation/Over-fishing:</b>  | Very low | Low | Moderate | High | Very high |
| d) <b>Oil/Gas Exploration:</b>            | Very low | Low | Moderate | High | Very high |
| e) <b>Habitat Alteration/Destruction:</b> | Very low | Low | Moderate | High | Very high |
| f) <b>Ocean Acidification:</b>            | Very low | Low | Moderate | High | Very high |
| g) <b>Biodiversity Loss:</b>              | Very low | Low | Moderate | High | Very high |
| h) <b>Invasive Species:</b>               | Very low | Low | Moderate | High | Very high |
| i) <b>Aquaculture:</b>                    | Very low | Low | Moderate | High | Very high |
| j) <b>Marine Shipping / Traffic:</b>      | Very low | Low | Moderate | High | Very high |

**Where do you get most of your information on marine environmental issues? (May circle up to 3)**

- a) Television
- b) Radio
- c) Newspaper
- d) Internet (If so, where?: \_\_\_\_\_)
- e) Magazines
- f) Newsletters
- g) Friends/Family
- h) School/College/University
- i) Other: \_\_\_\_\_

**Do you think overall that Nova Scotia's marine environment is under threat? (Please circle)**

Yes            No                    Unsure

**What do you think that level of threat is? (Please circle)**

Very high    Somewhat high    Moderate    Somewhat low    No threat    Don't know

**What do you think are the top two or three threats to the global marine environment? (Please circle 2 or 3)**

Sea Level Rise	Climate Change	Ocean Acidification
Aquaculture	Oil Spills/Chemical Pollution	Marine Shipping/Traffic
Invasive Species	Marine Litter	Biodiversity Loss
Sewage/Nutrient Pollution	Commercial/Industrial Fishing	Seafloor Mining
Recreational Fishing	Drilling/Oil/Gas Exploration	Over-fishing
Marine Noise	Habitat Alteration/Destruction	Tourism

Other:

\_\_\_\_\_

*In Canada a “marine protected area” (or ‘MPA’) protects and conserves commercial and non-commercial fish and their habitats; endangered marine species and their habitats; unique habitats; marine areas of high biodiversity or biological productivity; and any other marine resource or habitat necessary.*

**How much of Nova Scotia’s marine environment do you think is currently protected?  
(Please circle)**

0-1%            2-10%            11-25%            26-50%            51-75%            76-100%

**How much of Nova Scotia’s marine environment would you like to see protected?  
(Please circle)**

0-1%            2-10%            11-25%            26-50%            51-75%            76-100%

**When a region of the ocean becomes a marine protected area (MPA), people who are currently using the area may have to stop activities such as commercial and recreational fishing, collecting and dredging.**

**Do you think this is reasonable?**

Definitely YES            Probably YES            Probably NO            Definitely NO            Not sure

**Do you think we need better ocean management in Nova Scotia?**

Definitely YES            Probably YES            Probably NO            Definitely NO            Not sure

**Do you have any thoughts or comments on the survey or marine environmental issues?**

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*Thank you for participating in this survey! Please mail us the completed survey in the pre-stamped envelope (included in this package) by **January 31<sup>st</sup>, 2012** 😊*

*Would you like to receive a summary of the results of this study?  
If so, please include your email here: \_\_\_\_\_*

## Appendix B – Survey Consent Form



### Invitation to complete a survey!

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**Project Title:** Nova Scotians' Value of the Marine Environment and Understanding of Marine Environmental Issues

Hello!

We invite you to take part in a research study being conducted by Haley Guest, a student at Dalhousie University, as part of her Environmental Science degree. Taking part in the research is entirely up to you and there will be no impact on you should you decide not to participate in the research. The information below tells you about what you will be asked to do and about any benefit, risk, or discomfort that you might experience.

#### **So, who's conducting the research study?**

Haley Guest will be acting as the principle investigator of this survey. She will be collecting & analyzing the survey data, and presenting the conclusions of this study in her Environmental Science honours thesis. Her supervisor, Dr. Heike Lotze, will be providing guidance and suggestions during this process.

#### **What's the purpose of the research?**

This research is focused on the topics of marine knowledge and value. We are aiming to understand Nova Scotians' knowledge of marine environmental issues as well as the value that people place on the marine environment. The goal of this research is to investigate what Nova Scotians understand about the marine environment, the issues affecting it, and how much value they place on that environment. We are conducting a mail out survey to approximately 2000 addresses across the province.

#### **Who can participate in the research study?**

Anyone can participate in this study. There are no eligibility requirements that may prevent a person from completing this survey.

#### **What will I be asked to do?**

To help us assess Nova Scotians' knowledge & values for the marine environment, we ask you to fill out the survey enclosed in this envelope. The survey is 2 double-sided pages long and shouldn't take more than 10 minutes of your time. We then ask you to place the completed survey in the return enveloped (provided) and pop it in the mail by **January 31<sup>st</sup>, 2012!**

#### **What about possible benefits, risks and discomforts?**



Participating in the study might not *directly* benefit you, but we might learn things that will benefit others. The risks associated with this study are very minimal, and there are no known risks for participating in this research beyond being bored or fatigued. However, you may stop the survey at any time and come back to finish it later.

### **Is there compensation / reimbursement?**

While there is no reimbursement for participants of this study, you may ask to receive a summary of the results of the study via email (see 'How can I obtain results?') below.

### **Privacy and Confidentiality**

Information that you provide to us will be kept private. Only the research team at Dalhousie University will have access to this information. I will describe and share our findings in my undergraduate honours thesis, presenting at conferences, with environmental organizations, and media sources.

You are not asked for your name in this survey – you will remain **completely anonymous**. Attached in this package is a pre-stamped return envelope that requires no 'sent' address. When you are mailing back the completed survey to us you do not include your name or address. This means that ***you will not be identified in any way in our reports.***

All electronic records of survey data will be kept secure in a password-protected file on the researcher's personal computer, or on a Dalhousie University secure server. Only the principle researcher and supervisor will have access to the 'raw' data collected from this survey. This data will be kept on a password-protected computer and external hard-drive disk kept in a locked room.

### **How can I obtain results of the study?**

If you're interested in seeing the results of this study, there is opportunity to leave your email address at the bottom of the survey. Your email will not be used for any other purpose than sending you the results of the research. These will likely be sent out in April 2013.

### **Questions**

We are happy to talk with you about any questions or concerns you may have about your participation in this research study. Please contact:

- Haley Guest (at 902-401-7085, haley.guest@dal.ca) or
- Heike Lotze (at 902-494-3406, hlotze@dal.ca)

If you have any ethical concerns about your participation in this research, you may also contact Catherine Connors, Dalhousie University at 902-494-1462, or email: ethics@dal.ca

😊 Thank you for your participation! 😊

## Appendix C – Approved Ethics Application



### Social Sciences & Humanities Research Ethics Board Letter of Approval

November 15, 2012

Ms Haley Guest Science\Biology

**REB #:** 2012-2848

**Project Title:** Understanding Nova Scotians' Value of the Marine Environment and Knowledge of Marine Environmental Issues

**Effective Date:** November 15, 2012 **Expiry Date:** November 15, 2013

Dear Haley,

The Social Sciences & Humanities Research Ethics Board has reviewed your application for research involving humans and found the proposed research to be in accordance with the Tri-Council Policy Statement on *Ethical Conduct for Research Involving Humans*. This approval will be in effect for 12 months as indicated above. This approval is subject to the conditions listed below which constitute your on-going responsibilities with respect to the ethical conduct of this research.

Sincerely,

A handwritten signature in blue ink, appearing to read 'S. Jacques', on a light yellow background.

Dr. Sophie Jacques, Chair

# UNDERGRADUATE STUDENT SUBMISSION

HALEY GUEST  
RESEARCH ETHICS BOARDS  
DALHOUSIE UNIVERSITY

## SECTION 1. ADMINISTRATIVE INFORMATION

[File No: \_\_\_\_\_]  
Office Use

Indicate the Research Ethics Board to review this research:

Health Sciences OR  Social Sciences and Humanities

Project Title: Understanding Nova Scotians' Value of the Marine Environment and Knowledge of Marine Environmental Issues

<b>1.1 Student researcher: Haley Guest</b>			
Department	Science, Biology		
Degree program	Environmental Science		
Email	HaleyGuest@gmail.com	Phone	902-401-7085
I agree to conduct this research following the principles of the Tri-Council Policy Statement <i>Ethical Conduct for Research Involving Humans</i> and consistent with the University <i>Policy on the Ethical Conduct of Research Involving Humans</i> .			
Student signature:			

<b>1.2 Supervisor Name: Heike Lotze</b>			
Department	Biology		
Email		Phone	
I have reviewed the attached ethics application prior to its submission for ethics review, including the scientific/scholarly methods of the research project which is described in the ethics application, and believe it is sound and appropriate. I will ensure this research will be conducted following the principles of the Tri-Council Policy Statement <i>Ethical Conduct for Research Involving Humans</i> and consistent with the University <i>Policy on the Ethical Conduct of Research Involving Humans</i> .			
Supervisor signature: At the time of re-submission of this document, my supervisor Dr. Lotze is away on travel. If you require her approval of this document I can ask her to email you directly.			

<b>1.3 Department/unit ethics review (if applicable). Minimal risk research only.</b>
This submission has been reviewed and approved by the research ethics committee. Authorizing name and signature: Date of approval:

## SECTION 2. PROJECT DESCRIPTION

### 2.1 LAY SUMMARY [500 words]

In lay language, briefly describe the rationale, purpose, study population and methods.

The world's oceans are ecologically, economically, and socially important to human beings. Ecologically, they are the sole habitat for Earth's marine species, are responsible for producing critical quantities of oxygen into the atmosphere via marine algae, and provide us with numerous other ecosystem services. Economically, seas have been used as transportation routes for thousands of years, as well as aquatic flora and fauna harvested for food and resources. Socially, humans regularly utilize the ocean recreationally, and many cultures have religious and spiritual connections with ocean creatures.

However, marine management and sustainable policy creation is failing to adequately protect our ocean resources for future generations. This could be due to low levels of marine environmental education, leading to reduced perception of ocean importance. To investigate this, I will be conducting a mail-out survey across Nova Scotia, particularly focused on coastal communities.

The survey will focus on self-assessed knowledge of marine environmental issues, as well as self-reported value for the marine environment. I will attempt to use a vocabulary that is understandable to the average citizen (that is, not using overly-scientific terms). However definitions will be given for certain terms (eg. Marine protected area) to ensure uniform interpretation of each question. Questions in the survey will assess the current knowledge base as well as value individuals place on the ocean. Data will also be collected on their demographic (resident status, age, education level, and special interest group) to determine what parameters may affect a person's knowledge base & values.

The mail out survey will be sent via Canada Post to 2000 households under mostly 'coastal' postal codes in the province (that is, postal code areas that border on the ocean).

#### Relevance

This assessment is incredibly important for understanding how coastal communities understand and value their marine environment and the issues affecting it. Marine citizenship, a blossoming area of marine policy, is the concept where society recognizes the responsibility towards healthy ocean ecosystem management, and the benefits of this healthy environment to humans. Environmental education may be key to this concept – this survey will illuminate the current knowledge base Nova Scotians possess for marine environmental issues. Also, by understanding the importance Nova Scotians place on these marine issues, governments can gauge citizen's values while improving marine protection policies.

### 2.2 RESEARCH QUESTION

State the hypotheses, the research questions or research objectives.

#### Research Questions :

- i. How knowledgeable do Nova Scotians consider themselves to be on marine environmental issues?
- ii. How much and what types of value (cultural, environmental, recreational, economic) do Nova Scotians place on the marine environment? What parameters affect this?
- iii. Is there a difference in knowledge base between 4 demographic groups (fishermen,

aboriginal members, activists, academics), and, how do these groups value the marine environment?

**Hypothesis:** I hypothesize that the current knowledge base for fisheries & aquaculture will be high, due to Nova Scotia's traditionally fisheries-based economy. Pollution issue knowledge may also be high due to the correlation and fear for human health effects. However, the lack of secondary environmental education in the province leads me to believe that knowledge & awareness of marine biodiversity and climate change may be relatively low. Finally, I *do* expect the value that citizens place on the oceans is high; perhaps due to the economic ties with fisheries and the aesthetic value as a coastal tourist destination. I believe it is this discrepancy between value for oceans and understanding of ecological knowledge that prevents citizen or community engagement in creation and enforcement of sustainable policy.

## 2.3 RECRUITMENT

2.3.1 Describe how many participants are needed and how this was determined.

Research has shown that mail-out survey response rates are generally 30-50%. My supervisor has advised me that we have at least a few hundred responses to have a statistically sound analysis. Therefore we have determined a quantity of 2000 mail pieces will be sent out to individuals, in order to have an estimated and hopeful statistical sample size of 450-1000.

2.3.2 Describe recruitment plans and append recruitment instruments. Describe who will be doing the recruitment and what actions they will take, including any screening procedures. Describe any inclusion / exclusion criteria.

Canada Post will be responsible for the delivery of the survey to households in the province. The surveys can be filled out by anybody, regardless of demographic specifics.

Section on Interviews deleted

## 2.4 METHODS AND ANALYSIS

2.4.1 Discuss where the research will be conducted, what participants will be asked to do and the time commitment, what data will be recorded using what research instruments (append copies). Discuss any blinding or randomization measures. Discuss how participants will be given the opportunity to withdraw.

The mail out survey portion of this study will allow participants to contribute to the research from within their own home. The survey is expected to take no longer than 10 minutes to complete. The data collected will be concerned with the participant's personal ranking of their knowledge on marine environmental issues. The data collected on the participant's demographic group will be age, gender, residential status, and special interest group (ie. Activist, academic, aboriginal member, fisherman).

Section on Interviews deleted

2.4.2 Describe your role in this research and any special qualifications you have that are relevant to this study (e.g. professional experience, methods courses, fieldwork experience).
I will be the principle investigator of this study, with the guidance and assistance of Dr. Lotze. I have designed and conducted surveys as a part of ENV5 3001: Environmental Field School and as part of a project in ENV5 3502: Environmental Problem Solving. Given, I have relatively little experience designing a social survey, which is why several of the questions are taken directly from other research on public ocean literacy and marine understanding.
2.4.3 Describe plans for data analysis in relation to the hypotheses/questions/objectives.
<p>We will likely use the numerical responses to questions (ie. "Please rank from 1-5 how important you believe Marine Protected Areas are?") as averages between demographic groups and perform an analysis of variance (ANOVA) on the data sets.</p> <p>We will also be using a classification/regression tree to determine what factors explain or don't explain results.</p> <p>Other methods of statistical analysis include: Likelihood tests (AIC), general linear models (GLM), and a general additive model (GAM).</p> <p>- How knowledgeable do Nova Scotians consider themselves to be on marine environmental issues? <i>We have used a series of rank questions on different environmental issues to test this questions.</i></p> <p>- How much and what types of value (cultural, environmental, recreational, economic) do Nova Scotians place on the marine environment? What parameters affect this? <i>We will ask both "How important is the marine environment to you?" as well as "Why is the marine environment important to you?" In the survey.</i></p>
2.4.4 Describe and justify any use of deception or nondisclosure and explain how participants will be debriefed.
<input checked="" type="checkbox"/> Not applicable
2.4.5 Describe any compensation, reimbursement or incentives that will be given to participants (including those who withdraw).
<input checked="" type="checkbox"/> Not applicable

**2.5 INFORMED CONSENT PROCESS**

Describe the informed consent process (i.e. how and when the research will be described to the prospective participant and by whom, how the researcher will ensure the prospective participant is fully informed of what they will be asked to do). If non-written consent is proposed, describe why and the process. If a waiver of informed consent is sought, address the criteria in the guidance document and TCPS articles 3.7 and/or 5.5. Address how any third party consent (with or without assent) will be managed. Describe any plans for ongoing consent, and/or community consent. Discuss how participants will be given the opportunity to withdraw (their participation and/or their data, and any limitations on this).

Append copies of all consent forms or any oral consent script.

The survey 'package' mailed out will include a consent form (see appended) as well as brief script at the top of the page, both to be read prior to completing the survey.

It is indicated at the top of the survey that it is VOLUNTARY. The consent form and script at the top of the survey should make it clear to individuals that they are under no obligation to partake in the study, and if they do not wish not to participate, they simply need not to fill out the form.

Please see attached consent form

Section on interview deleted

**2.6 PRIVACY & CONFIDENTIALITY**

2.6.1 Describe how data will be stored and handled in a secure manner, how long data will be retained and where, and plans for its destruction.

Data will be stored on a personal hard-drive owned by the principle researcher and locked with a security password. Should the data need to be transferred onto a lab computer in the Lotze Lab, similar security measures will be taken (password only principle researcher will know). Data will be stored on this hard-drive for up to 2 years following the completion of the project, then deleted permanently. The time period of 3 years has been chosen because I may be interested in further analyzing the data in future Graduate work.

Section on interview data was deleted

2.6.2 Address any limits on confidentiality, such as a duty to disclose abuse or neglect of a child or adult in need of protection, and how these will be handled. Such limits should be described in consent documents.

Not applicable

2.6.3 Does your use of any survey company or software to help you collect, manage, store, or analyze data mean that personally identifiable information is accessible from outside of Canada?

<input checked="" type="checkbox"/> No  <input type="checkbox"/> Yes. If yes, describe your use of the company or software and describe how you comply with the University <i>Policy for the Protection of Personal Information from Access Outside Canada</i> .
<p>2.6.4 Describe the measures to be undertaken for dissemination of research results and whether participants will be identified (either directly by name or indirectly). If participants will be quoted in reports from the data, address consent for this, including whether quotes will be identifiable or attributed. Describe how participants will be informed of results that may indicate they may be at risk (in screening or data collection), if applicable.</p> <p>This survey is anonymous – participants will <u>not</u> be named or identified in any way.</p> <p>Following the completion of this project, we are offering an email summary to participants that will highlight the findings of the research and outcome of the study. Participants have the option of including their email at the end of completing the survey, which will be used solely for the purpose of disseminating this information in <u>one</u> email to them. Emails will be entered separately from their responses to the survey, ensuring that their personal results will not be correlated with their email identity.</p> <p>I also hope to present my findings to various interested parties (BIO, Environment Canada, Ecology Action Center, WWF, Sierra Club, and other marine-related organizations).</p> <p>There is extremely low, or no foresee-able risk associated with completing the survey.</p>

<p><b>2.7 RISK &amp; BENEFIT ANALYSIS</b></p>
<p>2.7.1 Discuss what risks or discomforts are anticipated for participants, how likely risks are and how risks will be mitigated.</p> <ul style="list-style-type: none"> <li>- Time allowance for survey: A participant may not wish to sit and answer questions for 10 minutes. We are attempting to make the survey as brief as possible to avoid ‘boredom’ or ‘annoyance’ with completing it.</li> </ul>
<p>2.7.2 Identify any direct benefits of participation to participants (other than compensation), and the indirect benefits of the study (e.g. contribution to new knowledge)</p> <ul style="list-style-type: none"> <li>- Contributing to marine science</li> <li>- Giving back to the community via dissemination of information: by completing the survey, individuals are ensuring a healthy sample size and therefore quality of the conclusions drawn from the study. The information package that will be emailed out at the end of the project will be important environmental information, specifically related to coastal areas of Nova Scotia.</li> </ul>



## 2.8 CONFLICT OF INTEREST

Describe whether any conflict of interest exists for any member of the research team in relation to potential research participants (e.g., TA, fellow students), and/or study sponsors, and how this will be handled.

I have applied for funding through the Dalhousie Student Union Sustainability Office (DSUSO) – a group of which I am a part. I have spoken to the 3 other executive officers and they have all agreed that this is not a conflict of interest within the office. Students may apply for funding for research projects at any time during the year – my application has been sent to a DSU Grants Review Committee (independent of the DSU Sustainability Office) to determine the outcome of my request.

Not applicable

## SECTION 3. APPENDICES

**3.1 Appendices Checklist.** Append all relevant material to this application. This may include:

- Recruitment Documents (posters, verbal scripts, online postings, any invitations to participate, etc.)
- Screening Documents
- Consent Forms (see section 3.2 below)
- Research Instruments (questionnaires, surveys, interview or focus group questions, etc.)
- Debriefing Forms
- Permission Letters (Aboriginal Band Council, School Board, Director of a long-term care facility)

### 3.2 Consent Form

Guidance on the information to be provided in the consent form is described in *Guidance for Submitting an Application for Research Ethics Review – Undergraduate Students*, available on the Research Ethics website.

A sample consent form follows and may be used in conjunction with the information in the *Guidance* document to help you develop your consent form. Remember to use clear, simple language (grade 8 comprehension level and no technical jargon or acronyms) in a readable font size.