Who's Paying the Bill? Assessing and Valuing Damage to the Marine Environment in Accordance with the Polluter Pays Principle for the Practical Purpose of Compensation after Ship-Source Oil Spills

By

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Acronyms and Abbreviations

CCG	Canadian Coast Guard
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLC	Civil Liability Convention
CSA	Canadian Shipping Act
EC	European Commission
EDF	Environmental Damages Fund
EEZ	Exclusive Economic Zone
EG	Environmental Group
EIA	Environmental Impact Assessment
ELD	Environmental Liability Directive
IMO	International Maritime Organization
IOPC Funds	International Oil Pollution Funds
ITOPF	International Tanker Oil Pollution Federation
MLA	Marine Liability Act
MPCF	Maritime Pollution Claims Fund
NRDA	Natural Resource Damage Assessment
OPA	Oil Pollution Act
OSLTF	The Oil Spill Liability Trust Fund
PPP	Polluter pays principle
PREMIAM	The Pollution Response in Emergencies: Marine Impact Assessment and Monitoring
RP	Responsible Party
RUB	Russian Rubble
SDR	Special Drawing Rights
SOPF	Ship-source Oil Pollution Fund
SWOT	Strengths, Weaknesses, Opportunities, Threats Analysis
TEEB	The Economics of Ecosystems and Biodiversity
TEV	Total Economic Value
UK	United Kingdom
US	United States
USCG	United States Coast Guard
USD	United States Dollar
WTP	Willingness-to-Pay
WTA	Willingness-to-Accept

Abstract

The objective of this study is to evaluate how marine environmental damage caused by a ship-source oil spill is assessed intergovernmentally and nationally for the practical purposes of determining compensation. A comparative analysis of five case studies involving environmental damages caused by specific ship-source oil pollution incidents was performed. In completing the comparative analysis, the strengths, weaknesses, opportunities and threats (SWOT) method was applied to each case study, which then informed a gap analysis resulting in recommendations for improving Canada's existing regime. The results of the comparative case study analysis supported the conclusion that assessing and pricing marine environmental damage is a challenging practice and different jurisdictions have developed distinct approaches. Results indicated that further scientific study, including baseline monitoring of ecosystem services and their projected monetary values, are required in order to advance the practice of assessment both internationally and domestically. Results also revealed significant gaps in Canada's current regime in terms of comprehensively assessing marine ecosystem goods, services and functions to enable appropriate compensation. The gaps identified within Canada's regime include having no assessment guidelines in place for polluters and having no government agency appointed the task of performing consistent environmental damage assessment. Recommendations for addressing these gaps and strengthening Canada's regime include enforcing guidelines for assessment of environmental damage after pollution incidents and implementing mandatory cooperative assessment between the polluter and the government. Canada's existing regime for assessing damage to marine environment for the practical purpose of compensation is under-developed, and could be improved by incorporating measures that would more comprehensively assess ecosystem goods, services, and functions.

Keywords: polluter-pays principle; liability; compensation regime; ship-source oil spill; maritime law; environmental economics; decision-making; management

1.0 Introduction

There are many conceptual and empirical challenges inherent in assessing the monetary value of the marine environment. Within the marine environment there are diverse ecosystems. An ecosystem is a community of living organisms in conjunction with the nonliving components of their environment, interacting in a system (Molnar & DSF, 2015). These biotic and abiotic components are regarded as linked via nutrient cycles and energy flows (Molnar & DSF, 2015). Thus, ecosystems are complex. Moreover, how humans perceive the benefits that flow from them are highly variable consequently.

Ecosystems have both intrinsic and utilitarian values that are significant to human welfare as they provide goods, services, and functions. Ecosystem functions refer variously to the habitat, biological, or systems properties or processes of ecosystems (Costanza et al., 1997). Ecosystem functions include support functions such as cleansing and renewal, and they may confer intangible aesthetic benefits (Daily, 1997). Ecosystem services represent the benefits human populations derive, directly or indirectly, from ecosystem functions (Costanza et al., 1997). Further, ecosystem services are the conditions and processes through which natural ecosystems, and the species that compose them, sustain and fulfill human life (Daily, 1997). They maintain biodiversity and the production of ecosystem goods such as seafood, forage, biomass fuels, natural fiber, many pharmaceuticals, industrial products, and their precursors (Daily, 1997). The goods, services, and functions of ecosystems consist of what is referred to as natural capital, which is considered vital to human welfare (Molnar & DSF, 2015).

It is natural capital, and its benefits to human welfare, that is difficult to quantify. Natural capital falls into two categories: those with market values that are traded services, and those without market value that provide services for which no price typically exists, such as clean air, groundwater, and biodiversity. These categories are referred to as use values and non-use values. Use values can be associated with private or quasi-private goods, for which market processes usually exist (Kumar, 2010). Use values can then be divided further into two categories: 1) direct use value, related to the benefits obtained from direct use of ecosystem goods and services; or 2) indirect use values that are usually associated with regulating services, which can be seen as public services that are generally not reflected in market transactions (Kumar, 2010). Non-use values from ecosystems are those values that do not involve direct or indirect uses of an ecosystem service. They reflect the satisfaction that individuals derive from the knowledge that biodiversity and ecosystem services are maintained and that other people have, or will have access, to them (Kumar, 2010). Non-use values involve greater challenges for establishing the environment's value than do use values, as price markets do not exist to represent non-use values (Kumar, 2010). The necessity of having to quantify both use values and non-use values makes assessing and valuing the natural capital of the marine environment as a whole, difficult.

Economists have developed a number of methods for quantifying the economic value of natural capital, as there are multiple policy purposes and uses for the assessment and valuation of natural capital. These purposes include: 1) to provide comparisons of natural capital to physical and human capital in regard to their contributions to human welfare; 2) to monitor the quantity and quality of natural capital over time with respect to its contribution to human welfare; 3) to contribute to the evaluation of projects that propose to change natural capital; or 4) to provide for

evaluation of damages to natural capital (Liu, Costanza, Farber & Troy, 2010). Unfortunately, the majority of applied natural capital damage assessment and valuation approaches and methods focus on use values that equate to economic loss, rather than non-use values, that equate to social or environmental loss. Therefore, applied assessment and valuation approaches within intergovernmental and international regimes may not account for both the use and non-use values that ecosystem goods, services, and functions provide as a whole.

This study explores the adequacy of Canada's existing regime for assessing and valuing damage to the marine environment for compensation purposes, in particular with regard to ecosystem goods, services, and functions. To assist this inquiry, this study analyses several intergovernmental and international regimes to determine the most effective approaches taken to assessing and valuing the marine environment for the practical purpose of determining compensation after damage has occurred. Identified world-leading approaches will then be translated into recommendations for the improvement of Canada's existing regime, as appropriate.

The scope of this study identifies approaches to assessing and valuing damages to the marine environment for the practical purpose of compensation after a ship-source oil spill has occurred. This study focuses on assessment and valuation regimes surrounding ship-source oil spills, as these polluting incidents have triggered the advancement of approaches and methods taken to assess and value the marine environment for the practical purpose of compensation. Intergovernmental and international legislation surrounding ship-source oil spills applies the polluter pays principle (PPP), which holds the polluter accountable for industry's externalities. Five case studies correlated to five separate regimes have been selected for a comparative analysis. The subsequent chapters of this paper will provide further detail on ecosystem assessment and valuation, polluter liability, marine shipping and ship-source oil spills, as well as approaches taken by intergovernmental and international compensation regimes to limit the externalities of the marine oil shipping industry.

2.0 Context

This section provides background information for the comparative analysis, assessment, conclusions and recommendations for Canada's existing regime. Subsequent chapters provide further detail on assessing ecosystems for pricing and the challenges associated with their valuation, as well as methods established to monetarily value ecosystems. Further, the context of this study provides background as to how the PPP has developed within the marine shipping context and how it may continue to be limited to a strictly economic perspective rather than a social or environmental perspective.

2.1 Ecosystems' Inherent Value

The value of ecosystem goods, services, and functions, and the roles they play, rarely enter into intergovernmental and international policy debates. Despite their importance, the recognition of ecosystem goods, services and functions, and the significant roles they play, are vastly undervalued by society, government and compensation regimes. In addition to the production of tangible goods, ecosystems services are life-support functions, such as recycling and renewal, and they confer many intangible aesthetic and cultural benefits (Daily, 1997). An

intangible ecosystem service like gas regulation is the product of an ecosystem function such as the regulation of atmospheric chemical composition. This example of an ecosystem function provides a balance between carbon dioxide and oxygen and ozone for UVB protection (Costanza, et al., 1997). A detailed list of ecosystem services and functions along with examples of their roles and impacts can be found in Appendix A. The listed services and functions are the product of billions of years of evolution, and have existed in forms very similar to those seen today for at least hundreds of millions of years (Daily, 1997). They are pervasive, but unnoticed by most of society and thus, commonly undervalued.

Over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history. These changes have occurred largely to meet rapidly growing demands for food, fresh water, fuel and have contributed to substantial net gains in human well-being. However, these gains in well-being have been achieved with growing costs in the form of the degradation of many ecosystem services (MEA, 2005). This degradation, unless addressed, will substantially diminish the benefits that future generations obtain from ecosystems (MEA, 2005). The challenge of slowing and potentially reversing the degradation of ecosystems while meeting increasing demands for services will require significant changes to policies, institutions, and practices that are currently underway. It will require society to acknowledge the value of natural capital.

The term 'value' is used to mean the contribution of an action or object to user-specified goals, objectives or conditions. A specific value of that action or objective is tightly coupled with a user's value system, because the latter determines the relative importance of an action or object compared to others within their perceived world (Farber, Costanza & Wilson, 2002). For example, some individuals might maintain a value system in which ecosystems or species have intrinsic rights to a sustaining condition that is irrespective of human satisfaction (Farber, Costanza & Wilson, 2002). However, some individuals may maintain a utilitarian value system which assesses the contribution of a particular object or action to meeting a particular goal, whether or not that contribution is fully perceived by the individual (Liu, Costanza, Farber & Troy, 2010). These utilitarian values are fundamentally anthropocentric in nature. Whether an individual holds utilitarian or intrinsic values, if they are undertaking valuation they are implementing an anthropocentric perspective (Farber, Costanza & Wilson, 2002). Thus, policies toward the environment tend to be based on a mix of intrinsic and utilitarian value systems, and are necessarily based on an anthropocentric perspective (Farber, Costanza & Wilson, 2002).

Applying a mix of both intrinsic and utilitarian value systems, environmental economists have attempted global ecosystem valuation as a means of impacting policy and exemplifying the value of natural capital to human welfare. These valuations have been done using the anthropocentric perspective as no other alternative is available. The Economics of Ecosystems and Biodiversity for Business Coalition (TEEB) assessed risks to natural capital imposed by business and found that risks to natural capital are costing the economy $4.7 trillion per year in terms of environmental and social costs of lost ecosystem services and pollution (TEEB, 2013). The TEEB 2013 study highlighted the fact that many ecosystem services are public goods. Therefore, their use levels are difficult to regulate, even when they are at or near the point of depletion. Many people benefit from ecosystem services, but individuals or groups usually have insufficient incentives to maintain ecosystems for continued provisioning of services (Kumar, 2010). Thus,

in spite of the growing awareness of the importance of ecosystems and biodiversity to human welfare, loss of biodiversity and degradation of ecosystems still continue on a large scale.

2.2 Challenges of Assessing Environmental Damage for the Purpose of Compensation

Fundamental changes are needed in the way ecosystems and their services are valued by society. Without changes in institutions and incentives, further declines in natural capital are likely, as those who gain from actions that deplete natural capital will continue to avoid paying the full costs of their actions and pass those costs on to poor societies and future generations (Srinivasan et al., 2007). The problems of management and governance of ecosystems stem from both poor information and institutional failures. In some cases, knowledge is lacking about the contribution of ecosystem processes and biodiversity to human welfare and how human actions lead to environmental change impacts on human welfare. In other cases, institutions, notably markets, provide the wrong incentives (Kumar, 2010). Given the scale of human activities on the planet, the point has been reached where the cumulative losses in ecosystem services are forcing society to rethink how to incorporate the value of these services into societal decision-making (Kumar, 2010). However, progress in incorporating the value of ecosystems into decision-making has been slow.

Lack of progress stems from failures of markets, systems of economic analysis and accounting to capture the values of ecosystem services. The common metric in economics is monetary valuation and some critics say the reliance in this metric has plagued many ecosystem service assessments by failing to incorporate several types of value which are critical to understanding the relationship between society and nature (Kumar, 2010). The limitations of monetary valuation are especially important as ecosystems approach critical thresholds (Kumar, 2010). Current markets only shed information about the value of a small subset of ecosystem processes and components that are priced and incorporated in transactions as commodities or services. This poses structural limitations on the ability of markets to provide comprehensive pictures of the ecological values involved in decision processes (MEA, 2005). At best, estimates of economic value reflect only the current human choice pattern given a multitude of socio-ecological conditions (Kumar, 2010).

It is difficult to assign a value to non-use ecosystem services as non-use values involve the production of experiences that occur in the valuer's mind (Kumar, 2010). Use and non-use values can be further divided into value-subtypes (Kumar, 2010). Use values can also be referred to as direct use value, indirect use value, or option value. Non-use values can be sub-divided as option value, altruist value, and existence value. A description of each sub-type of both use and non-use values can be found in Table 1. Historically, most efforts have gone into assessing ecosystem services with use-values and human preferences for ecosystem services which are directly consumed, including recreation benefits and water quality change (Liu, Costanza, Farber, Troy, 2010). In comparison, most non-use values of ecosystems that provide supporting and regulating services are undervalued if they are valued at all (Liu, Costanza, Farber, Troy, 2010).

Table 1: Use & Non-Use Value Categories (Adapted from Kumar, 2010)

Value Type	Value Sub-Type	Meaning
Use Values	Direct Use Value	Results from direct human use of biodiversity (consumptive or non-consumptive).
	Indirect Use Value	Derived from the regulation services provided by species and ecosystems.
	Option Value	Relates to the importance that people give to the future availability of ecosystem services for personal benefit (option value in a strict sense).
Non-use Values	Bequest Value	Value attached by individuals to the fact that future generations will also have access to the benefits from species and ecosystems (intergenerational equity concerns).
	Altruist Value	Value attached by individuals to the fact that other people of the present generation have access to the benefits provided by species and ecosystems (intragenerational equity concerns)
	Existence Value	Value related to the satisfaction that individuals derive from the mere knowledge that species and ecosystems continue to exist.

2.3 Assessment Approaches and Methods

A variety of approaches and methods have been developed for the purpose of assessing and valuing the use and non-use values of ecosystems in order to determine their monetary value. If applied correctly the aggregation of value categories can be reflected as a Total Economic Value (TEV). Within the TEV framework values are derived, when available, from market transactions relating directly to the ecosystem service (Kumar, 2010). In the absence of such information, price information must be derived from parallel market transactions that are associated indirectly with the good to be valued. If both direct and indirect price information on ecosystem services are absent, hypothetical markets may then be created in order to elicit values (Kumar, 2010). A directory of assessment approaches commonly found throughout the literature and descriptions of their associated methods of valuation can be found in Table 2.

Table 2: Assessment Methods Used to Financially Value Ecosystem Services in Primary Studies

Assessment Approach		Method		Value	Description
Compensatory	**Direct Market Valuation**	Market Price-Based	**Market Prices**	Direct and Indirect Use	Estimates the economic value of ecosystem goods and service that are bought and sold in markets. For example, the value of subsistence food can be based upon the market value of commercially available food
		Cost-Based	**Avoided Cost**	Direct and Indirect Use	Estimates value of ecosystem services based on cost that would have been incurred in the absence of these services. For example, storm protection provided by barrier islands avoid property damages along the coast
			Replacement Cost	Direct and Indirect Use	Estimates value of ecosystem services based on the costs of replacing ecological services or the cost of providing substitute services. For example, waste treatment provided by wetlands can be replaced with built treatment systems
			Mitigation/ Restoration Cost	Direct and Indirect Use	Cost of preventative expenditures in the absence or relocation of an ecosystem service. For example, flood barriers provided by wetlands
		Production-Based	**Production Function Approach**	Indirect Use	Estimates values of ecosystem services based on the economic value of the service that contributes to the production of market goods. For example, water-quality improvements increase commercial fisheries catch and therefore fishing incomes
Punitive	**Revealed Preference**	**Travel Cost Method**		Direct Use	Estimates the value of ecosystem services based on economic use values associated with an ecosystem. For, example recreation areas can be valued at least by what visitors are willing to pay to travel to it, including the imputed value of their time
		Hedonic Pricing		Direct and Indirect Use	Estimates value of ecosystem services based on ecological services that directly affect market prices. For, example housing along the coastline tend to exceed the prices of inland homes
		Opportunity Cost		Direct Use	Estimates value of ecosystem services based on the next best alternative use of resources. For example, travel time is an opportunity cost of travel because this time cannot be spent on other pursuits
	Stated Preference	**Contingent Valuation**		Use and Non-Use	Estimates value of ecosystem services by posing hypothetical scenarios that involve some valuation of alternatives such as willingness to pay.
		Choice Modelling/Conjoint Analysis		Use and Non-Use	Can be applied through different methods, which include choice experiments, contingent ranking, contingent rating and pair comparison
		Contingent Ranking		Use and Non-Use	Ranks and scores relative preferences for amenities in quantitative rather than monetary terms.
		Deliberative Group Valuation		Use and Non-Use	Estimates value of ecosystem services through discourse-based contingent valuation, which results from bringing a group of stakeholders together to discuss societal value. For example, a First Nations group comes together to discuss the cultural values of an area

As demonstrated in Table 2, the three most common approaches to assessment and valuation found in the literature are: direct market valuation approaches, revealed preference approaches, and stated preference approaches. There are benefits and drawbacks associated with direct market valuation approaches, revealed preference approaches, and stated preference approaches. No approach or method solves the uncertainties in both ecological science and the assessment of ecosystem services for the purpose of determining a market value. Rather, the approaches and methods listed in Table 2 provide insight into what is most commonly applied in primary studies in order to determine TEV.

Direct market valuation approaches are straightforward, as they rely primarily on cost data, which is easily obtained. However, when applied to ecosystem service valuation, these approaches have limitations. The fact that not all ecosystem services have markets limits this approach. If markets do not exist, either for the ecosystem service itself or for goods and services that are indirectly related, then the data needed for these approaches are not available (Kumar, 2010). Further, the production function-based approach has the additional problem that adequate data on and understanding of the cause-effect linkages between the ecosystem service being valued and the marketed commodity are often lacking. In other words, "production functions" of ecosystem services are rarely understood well enough to quantify how much of a service is produced, or how changes in ecosystem condition or function will translate into changes in the ecosystem services delivered (Kumar, 2010). Thus, the direct market valuation approach is preferable when possible as it is primarily based on cost data.

Revealed preference and cost-based methods are grounded in mainstream economics since they rely on market price data to inform valuations (TEEB, 2013). Revealed preference techniques are based on the observation of individual choices in existing markets that are related to the ecosystem service that is the subject of valuation (Kumar, 2010). It is said that economic agents 'reveal' their preferences through their choices. Methods of the revealed preference approach include: the travel cost method, the opportunity cost method, and hedonic pricing. In order to undertake a revealed preference valuation, the existence of a surrogate market that is related to the ecosystem service in question must be determined. Then, appropriate data are required that can be used to estimate the demand function for the good traded in the surrogate market. Further, inferring the value of a change in the quantity or quality of an environmental resource from the estimated demand function and aggregating values across relevant populations (TEEB, 2013). In revealed preferences methods, market imperfections and policy failures can distort the estimated monetary value of ecosystem services. Scientists need large sets of quality data, as well as complex statistical analysis. As a result, revealed preference approaches are expensive and time-consuming. Generally, these methods have the appeal of relying on observed behavior, but their main limitations are their inability to estimate non-use values and the dependence of the estimated values on the technical assumptions made on the relationship between the environmental good and the surrogate market good (TEEB, 2013). Thus, the revealed preference approaches, due to its grounding in mainstream economics, suffers from many of the same limitations as direct market valuation, while also relying on estimation.

Stated preference approaches simulate a market and demand for ecosystem services by means of surveys on hypothetical changes in the provision of ecosystem services (Kumar, 2010). The purpose of simulation for the stated preference approach is estimation of both use and non-use

values of ecosystems when no surrogate market exists from which the value of ecosystems can be deduced. Stated preference techniques are often the only way to estimate non-use values (Kumar, 2010). The limitations of stated preference techniques are determining whether a respondent's hypothetical answers correspond to actual behavior when faced with real costs (Kumar, 2010). One of the main problems that has been flagged in the literature on stated preference methods is the divergence between willingness-to-pay (WTP) and willingness-to-accept (WTA) (Kumar, 2010). From a theoretical perspective, WTP and WTA should be similar in competitive private markets; however, studies have shown that for identical ecosystem services, WTA amounts systematically exceed WTP (Kumar, 2010). There is also controversy as to whether non-use values are commensurable in monetary terms. For instance, can a bequest value that may be attributed to coastline be considered within the same framework as the economic value of recreation at that coastline? This issue remains largely unresolved. Furthermore, the application of stated preference methods to public goods that are complex and unfamiliar has been questioned on the grounds that respondents cannot give accurate responses as they may have little experience making trade offs (Kumar, 2010). Thus, while stated preference approaches are a solution to assessing and valuing non-use values, they too have limitations that are debated among experts.

While all three approaches to assessment and valuation have benefits and limitations, in the literature some approaches appear to be better suited to assessing certain ecosystem services. As previously discussed, certain approaches have been developed to be applied to ecosystem services which hold a market value, while others have been developed to be better suited to the assessment and valuation of non-use values. Experts have created synthesis studies based on the extensive literature available on ecosystem service valuation and created tables which give overviews of the link between certain assessment methods and ecosystem services and functions (Costanza et al., 1997; De Groot, Wilson & Boumans 2002). Based on an adaptation of the De Groot, Wilson & Boumans synthesis (2002), Table 3 illustrates the most appropriate method of valuation commonly applied to each of the ecosystem services that can be found Appendix 1 of this paper. Along with outlining appropriate and commonly applied methods of valuation, Table 3 also lists the ecosystem's amenability to economic valuation and its transferability across sites.

Table 3: Application of Assessment Methods in Primary Studies (Adapted from De Groot et al., 2002)

Number	Ecosystem Service	Type of Ecosystem Function	Amenability to Economic Valuation	Transferability Across Sites	Most Appropriate Method for Valuation	Most Commonly Applied Method of Valuation
1	Gas Regulation	Regulation	Medium	High	CV, AC, RC	AC
2	Climate Regulation	Regulation	Low	High	CV	AC
3	Disturbance Prevention	Regulation	High	Medium	AC	AC
4	Water Regulation	Regulation	High	Medium	M, AC, RC, H, P, CV	P, AC, M
5	Water Supply	Regulation	High	Medium	AC, RC, M, TC	M, RC
6	Soil Retention	Regulation	Medium	Medium	AC, RC, H	AC, RC
7	Soil Formation	Regulation	Medium	Medium	AC, RC, H	AC
8	Nutrient Regulation	Regulation	Medium	Medium	AC, CV	RC
9	Waste Treatment	Regulation	High	Medium to High	RC, AC, CV	RC, CV
10	Pollination	Regulation	Medium	High	AC, P, RC	RC, P, AC
11	Biological Control	Regulation	Medium	High	AC, P	RC, P, M
12	Refugium	Habitat	Low	Medium	M	M, CV
13	Food Production	Production	High	High	M, P	M, P, CV
14	Raw Materials	Production	High	High	M, P	M, P, CV
15	Genetic Resources	Production	Low	Low	M, AC	M, P
16	Recreation	Information	High	Low	H, TC, CV, Ranking	M, CV, P, TC, HP
17	Cultural	Information	Low	Low	CV, Ranking	CV

Based on the results shown in Table 3 it is clear that for each ecosystem function usually several valuation methods can be used. The table also shows that for each function usually only one or two methods are used primarily. There may also be a relationship between the type of function and the preferred valuation method (De Groot, Wilson & Boumans 2002). For example, regulation functions were mainly valued through cost-based and production-based valuation methods, whereas, habitat functions and production functions are mainly valued through direct market pricing. Only information functions are valued using revealed and stated preference approaches. Thus, the literature concludes that there are various methods that may be applied to determine TEV and that they have been applied in a number of primary studies.

2.4 The Polluter Pays Principle Attempts to Ensure Liability for Damages

The aforementioned methods of ecosystem valuation can be applied in order to estimate the monetary value of ecosystem services and functions when polluters damage the marine environment, thereby addressing the issue of ensuring liability. In 2013, TEEB reported that the primary production and primary processing sectors are estimated to have unpriced natural capital costs totalling $7.3 trillion, which equates to 13% of the global economic output in 2009 (TEEB, 2013). Additionally, the report declared that no high impact industries generate sufficient profit to cover the costs of their environmental impacts, which causes them to pass on these costs (TEEB, 2013). Meaning, that industries' may have externalities. This information indicates that the PPP is not being applied successfully in many cases.

The PPP is one of the fundamental principles of modern environmental law and policy. In simple terms, the PPP means that the cost of pollution abatement should be paid by the polluters and not by their governments or citizens (Munir, 2013). For decades, economists have been struggling to identify and measure the externalities of industry. Since the early 1900s, economists have suggested different economic incentives to force the polluter to internalize their external costs so that the complete production costs of goods are reflected in pricing. In economic literature it is known as the internalization of external costs (Munir, 2013). Thus, the potential solution to the problems of externality is the basis of the PPP.

In 1990 the PPP was, for the first time, explicitly recognized in an international convention related to marine pollution (Zhu & Zhao, 2015). It has now been adopted as a management mechanism and incorporated within many international and regional marine environmental instruments. On an intergovernmental and international level, these include: Agenda 21, the Rio Declaration on Environment and Development, and the International Convention on Oil Pollution Preparedness, Response and Co-operation 1990. However, arguably, the PPP has been best implemented as a marine environmental instrument in ship-source pollution law.

2.5 The Risk of Ship-source Oil Spills and the Development of Ship-source Pollution Law

The PPP is now reflected in ship-source pollution law in several ways at the international level. The application of the PPP in ship-source pollution law has taken two approaches intended to internalize the marine shipping industry's possible externalities. One approach has been preventative, including legislation, permits, limitations and charges – with consequences for failure to comply (Zhu & Zhao, 2015). Other laws apply a curative approach and impose civil liability and compensation for environmental damage (Zhu & Zhao, 2015). Within the legislation of the marine shipping industry the implementation of the PPP has evolved from an economic principle for allocating polluters the costs of pollution, to a principle requiring polluters to pay for emergency response and clean-up costs, to having polluters pay compensation to the victims of pollution (Chircop et al., 2012). Thus, the most effective regime for preventing marine pollution might not only include effective liability laws, compensation, and consistent enforcement of regulations aimed at protecting and preserving the marine environment, but also the application of the PPP to its fullest extent (Zhu & Zhao, 2015; Chircop et al., 2012). This is especially true in the case of ship-source pollution law developed specifically for ship-source oil spills from tankers.

As with any other mode of transport, the shipment of oil is not without risks. There are a number of regulations, safety protocols, and practices now in place and overseen by numerous government and non-government bodies to help mitigate these risks (CCA, 2016). Tanker design standards mariner training programs, systematic vessel inspections, insurance requirements, and advanced navigation technologies all play a role in reducing the likelihood that an accident will occur (CCA, 2016; Law et al., 2011). These developments have collectively decreased the number of oil spills in recent decades. However, there are still occasional high-profile incidents (CCA, 2016).

Even with the implementation of advanced standards, oil spills are likely to remain inevitable marine pollution (Maes, 2005; Kirby, Gioia & Law, 2014). For tanker accidents to occur and result in an impact of significance, several factors must come together, some controllable – such as the condition of a vessel or safety practices – and others less so – such as strong currents or harsh weather conditions (CCA, 2016). "These factors come into play first, in the likelihood that an accident will occur and, second, in the extent to which impacts will be realized after the accident" (CCA, 2016, p. 50).

Further, ship-source oil spill incidents have additional factors which may affect the extent of impacts. The intensity of impacts after an oil spill depend on: the quantity spilled, the toxicity of the hydrocarbons spilled, the meteorological and hydrodynamic conditions, the distance of the spills to possible sensitive targets, the time the oil spill takes to travel, and the sensitivity of the ecosystems that may be affected, etc. (Maes, 2005). The effect is a high level of complexity in characterizing the risk of a ship-source oil spill (CCA, 2016).

It is well known that when harmful substances such as oil are spilled into the sea environmental damage may occur (AASA, 2007). Ever since the *Torrey Canyon* shipwrecked off the western coast of England in 1967, carrying 120,000 tonnes of crude oil, research has been undertaken to determine the effects of oil in the marine environment. The environmental impacts of an oil spill depend on the size, rate, location and type of oil spilled (Ramseur, 2012). The range of biological impacts after an oil spill can encompass physical and chemical alterations of natural habitats, physical smothering effects on flora and fauna, lethal or sub-lethal toxic effects on flora and fauna, and changes in biological communities resulting in effects to key organisms (Dicks, 2006). Open waters of the oceans and the associated pelagic and seabed communities have rarely shown any impact from spills (Dicks, 2006). The high dilution potential that this habitat provides is a major mitigating factor. Shorelines, especially those with fine sediments, are most impacted by the effects of a ship-source oil spill and may face long-term problems (Dicks, 2006). Recovery to an apparently normal balance is usually achieved in 1-5 years, but the complete re-establishment of a shore can take many years in some situations (Dicks, 2006). Some contend the marine environment will always recover naturally after an oil spill given time (Dicks, 2006); however, the total effects of a persistent oil spill in the marine environment may still remain unknown.

In addition to being the starting point for research of the impacts of oil spilled into the marine environment, the *Torrey Canyon* also sparked the development of ship-source oil pollution law. When the *Torrey Canyon* ran aground the incident exposed a number of serious shortcomings. In particular, the absence of an international agreement on liability and compensation in the event of such a spill (IOPC Funds, 2016). It led the international community to establish a regime for compensation for victims of pollution (IOPC Funds, 2016). Thus, the International Maritime Organization (IMO) was tasked with developing a separate intergovernmental agency that would have a regime capable of handling liability and compensation for victims of pollution after a ship-source oil spill occurred.

The IMO, established by a means of a Convention adopted under the auspices of the United Nations in Geneva on the 17th of March 1948, is a specialized agency of the United Nations with 171 Member States. It is responsible for measures to improve the safety and security of

international shipping and to prevent pollution from ships (IMO, 2016a). In 1971 the IMO established a separate intergovernmental agency specifically intended to handle liability and compensation for victims of pollution after a ship-source oil spill originating from a tanker occurred called the International Oil Pollution Compensation Funds (IOPC Funds).

3.0 Research Question and Methods

As demonstrated within the context of this paper, assessing and valuing marine environmental damage is challenging. There is no standardized approach to assessing and valuing environmental damage for the purpose of compensation. Numerous assessment and valuation approaches are applied by intergovernmental and national compensation regimes. Therefore, this realm of study requires further investigation in order to determine which existing assessment and valuation practices best apply the PPP. Thus, the purpose of this study is to assess approaches to environmental assessment and valuation, and determine which practices best apply the PPP by limiting industry's externalities and safeguarding both society and the environment.

The scope of this research has been narrowed to focus on environmental assessment and valuation techniques best suited to the marine environment as further challenges are experienced in marine ecosystem assessment and valuation for the purpose of compensation due to the ecosystems' complexity. Legislation developed with the intention of applying the PPP to environmental assessment and valuation in the marine environment has been furthest advanced in tanker regulation. Thus, this paper investigates the marine shipping industry, specifically the tanker industry, and existing approaches to environmental assessment for the purpose of compensation after a ship-source oil spill has occurred.

In order to better understand assessment and valuation approaches applied worldwide the following research question has been posed:

> *How is environmental damage caused by a ship-source oil spill assessed and valued intergovernmentally and nationally for the practical purposes of determining compensation, and what lessons can be learned for compensation regimes from existing practices?*

To answer this research question, an extensive literature review relating to ecosystem valuation and assessment, polluter liability, marine shipping and ship-source oil spills, as well as approaches to assessment taken by various intergovernmental and international compensation regimes has been conducted. In addition to library-based, secondary resource research, this study has been augmented by informal interviews in order to discover objective data that was not publicly available. Interviews were conducted with the representatives of organizations, such as the International Oil Pollution Compensation Funds, the International Tanker Oil Pollution Federation, and government employees such as those employed by the Canadian Coast Guard (CCG), Transport Canada, Environment Canada, and the Environmental Damages Fund (EDF). Interviews were conducted in a variety of ways: 1) in person; 2) over the phone; and 3) via email. However, all followed a semi-structured format where a guideline with topics intended to be discussed by the interviewer was established prior to engagement. For a complete list of participants please see Appendix B.

Data collected is presented in the form of a comparative analysis examining five contemporary cases of ship-source oil pollution and their associated compensation regime. The selected cases and their associated intergovernmental or national compensation regime can be found in Table 4. These incidents have been compared in order to determine the best approaches to environmental assessment and valuation for the purpose of compensation currently applied. Canada was selected for examination as this is a Canadian study with the intention of providing recommendations to strengthen Canada's regime if necessary. The IOPC Funds' regime was chosen for this study as its approach is fundamentally tied to the approach applied by Canada, as Canada is a Member State to the IOPC Funds. The UK's regime was selected for this study as the UK is also a Member State of the IOPC Funds and a nation that has played a fundamental role in the development of Canada's legislation; thus, the two nations were thought likely to have many similarities. Additionally, the UK's regime came highly recommended from experts at the International Tanker Oil Pollution Federation (ITOPF). The regime of the US was selected, as the US is not a Member State of the IOPC Funds, and applies an independent approach to environmental assessment and valuation after ship-source oil spills occur. Lastly, *the Directive 2004/35/EC of the European Parliament and of the Council of 21 April 2004, on environmental liability with regard to the prevention and remedying of environmental damage* (*ELD*) was selected for this study. The *ELD* is an intergovernmental regime that does not have legislation corresponding to ship-source oil spills. However, it has been included in this study for the purpose of providing a modern alternative intergovernmental approach to that of the IOPC Funds. The approach taken by the European Commission (EC) to the implementation of the *ELD* provides for an intriguing comparison as it represents the interests of twenty-seven of the IOPC Funds' Member States. Further, there have been discussions of the EC including ship-source oil spills in the *ELD*'s legislation rather than applying the Conventions of the IOPC Funds (Della Mae & Cuesta, personal communication, 07-2016).

Table 4: Case Studies

Compensation Regimes	Case	Year of Incident
IOPC Funds	VOLGONEFT 139	2007
United Kingdom	MSC NAPOLI	2007
Canada	MARATHASSA	2015
United States	COSCO BUSAN	2007
EC	*ELD*	2016

It is important to note that there are many ship-source oil spill incidents and environmental assessment and valuation approaches available beyond what is demonstrated by these five cases and their associated regimes. However, due to constraints the primary focus of the comparative analysis is on the incidents and compensation regimes listed in Table 4.

The comparative analysis within this study consists of four steps. The first, is an in-depth description of each selected compensation regime's legislation and theoretical approach including accepted valuation methods, the circumstances of selected incidents and the practical approach to environmental valuation and assessment applied by the associated compensation regime. Selected intergovernmental or national regimes are then considered through the lens of a SWOT analysis in order to determine the strengths, weaknesses, opportunities and threats of each regime. The SWOT then informs two matrices. The first matrix, using the stop sign method,

visually demonstrates which valuation methods prevalent in the literature are theoretically accepted by each selected compensation regime. The second matrix lists twenty indicators of best practice determined via the research process and the results of each SWOT analysis. Using the stop sign method this matrix visually demonstrates the selected regimes' compliance with best practice indicators. Finally, based on the results from the SWOT analysis of each regime and the twenty best practice indicators, a gap analysis is applied to Canada's existing regime in order to determine recommendations, if required, for improvement. The gap analysis seeks to: 1) determine the regime's current state; 2) envision an improved future state; 3) determine any gaps between the two; and 4) provide recommendations for improvement. The results of the analysis are discussed in the assessment portion of this paper.

4.0 Comparative Analysis

In order to determine the best practices available for environmental assessment and valuation, five intergovernmental and national approaches have been comparatively analysed. The following examines and describes a selection of theoretical and practical approaches applied by various intergovernmental and national compensation regimes.

4.1. Selected Leading Practices

This first section of the comparative analysis examines and describes the theoretical approach to environmental assessment and valuation applied by the IOPC Funds, Canada, the UK, the US, and the *EC*.

4.1.1 The CLC and IOPC Funds

Since their initial implementation, the IOPC Funds have influenced and advanced the application of the PPP in maritime legislation. However, conventions related to the IOPC Funds have been developed in a reactionary manner. Historically, when ship-source oil spills have occurred an increased scope and application of the PPP within related legislation has been demanded. The scope of the intergovernmental regime which includes the *International Convention on Civil Liability for Oil Pollution Damage*, 29 November 1969, 973 U.N.T.S. 3 (*CLC*) and the IOPC Funds, has been increased on two separate occasions following incidents which made it clear there were still shortcomings within the regime (IOPC Funds, 2016). The development and expansion of the *CLC* and IOPC Funds and their approach to assessing environmental damage claims and compensation are discussed in further detail in this chapter.

The *CLC* was adopted to ensure that adequate compensation is available to persons who suffer pollution damage resulting from maritime casualties involving oil-carrying ships (IMO, 2016b). The *CLC* places the liability for damage on the owner of the ship from which the polluting oil escaped or was discharged (IMO, 2016b). The *CLC* covers private pollution damage claims resulting from spills of persistent oils suffered in the territory of a Member State to the Convention and is applicable to ships which actually carry oil in bulk as cargo (IMO, 2016b). The *CLC* applies to all seagoing vessels actually carrying bulk oil as cargo, but requires ships carrying more than 2,000 tonnes of oil to maintain insurance in respect of oil pollution in sums equivalent to the owner's total liability for one incident (IMO, 2016a). Since its original implementation in 1969, the *CLC* has been amended. Relevant to this study, the 1992

amendment widened the scope of the *CLC* to cover damage caused in the exclusive economic zone (EEZ) or the equivalent area of a Member State (IMO, 2016b). In the 1992 amendment to the *CLC,* environmental damage compensation became limited to costs incurred for reasonable measures to reinstate the contaminated environment (IMO, 2016b). The most recent amendments, which were introduced in 2003, raised the compensation limits by 50% compared to the limits set in the 1992 amendment (IMO, 2016b). They are as follows:

- For a ship not exceeding 5,000 gross tonnage: liability is limited to 4.51 million Special Drawing Rights (SDR) (US$5.78 million)
- For a ship 5,000 to 140,000 gross tonnage: liability is limited to 4.51 million SDR plus 631 SDR for each additional gross ton over 5,000
- For a ship over 140,000 gross tonnage: liability is limited to 89.77 million SDR

Anyone who has suffered pollution damage in a Member State may make a private claim against the polluting ship owner under the *CLC*. Pollution damage claims above and beyond the limit of liability under the *CLC* are transferred to the IOPC Funds, which operate under separate conventions.

The IOPC Funds is an intergovernmental compensation regime with three separate conventions, which provide compensation for oil pollution damage resulting from spills of persistent oil from tankers. They are: the 1992 Fund, the 2003 Supplementary Fund and the 1971 Fund. In 1971, the *International Convention on the Establishment of an International Fund for Compensation for Oil Pollution* was implemented (IOPC Funds, 2016). Over time, incidents indicated the amount of compensation available for major incidents needed to be increased and the scope of the regime widened. This resulted in a further instrument, known as the *1992 Fund Convention*. Following the *Erika* and *Prestige* incidents came a third instrument: the *Protocol to the 1992 Fund Convention,* also known as the Supplementary Fund Protocol. It was adopted in 2003 providing additional compensation beyond that available under the 1992 Fund Convention (IOPC Funds, 2016). Similar to the *CLC,* these conventions also apply to all seagoing vessels carrying oil in bulk as cargo as long as the incident occurs within the territory or EEZ of a Member State. There are currently 114 States Parties to the 1992 Fund Convention and 31 States Parties to the Supplementary Fund Protocol (IOPC Funds, 2016). Since their establishment, the 1992 Fund and the preceding 1971 Fund have been involved in 149 incidents (IOPC Funds, 2016). The 1992 Fund is financed by contributions levied on any person who has received more than 150, 000 tonnes of crude oil and/or heavy fuel oil in one calendar year in a Member State of the 1992 Fund (IOPC Funds, 2016). Annual contributions to the Supplementary Fund are made on the same basis as contributions to the 1992 Fund. However, the contribution system for the Supplementary Fund differs from that of the 1992 Fund in that, for the purpose of paying contributions, at least 1 million tonnes of contributing oil are deemed to have been received each year in each Member State (IOPC Funds, 2016). The 1992 Fund pays compensation when:

- the damage exceeds the limit of the shipowner's liability under the 1992 *CLC*, or
- the shipowner is exempt from liability under the 1992 *CLC*, or
- the shipowner is financially incapable of meeting his obligations in full under the 1992 *CLC* and the insurance is insufficient to pay valid compensation claims.

The maximum compensation payable by the 1992 Fund is 203 million SDR for incidents irrespective of the size of the ship (IOPC Funds, 2016). Previous to the implementation of the 1992 Fund, the maximum was 135 million SDR (IOPC Funds, 2016). These maximum amounts include the sums actually paid by the shipowner under the most recently amended *CLC* (IOPC Funds, 2016). If a state is also a Member to the 2003 Supplementary Fund the total amount available for compensation for each incident is 750 million SDR, including the amounts payable under the 1992 Conventions as seen in Figure 1 (IOPC Funds, 2016). The right to compensation under the IOPC Fund Conventions is limited to three years after the date on which the damage occurred and within six years of the date of the incident. Thus, the PPP has been adopted and expanded by the ship-source oil pollution regime; however, due to liability caps, time restrictions, as well as other factors, the marine environment may still be at risk under this regime.

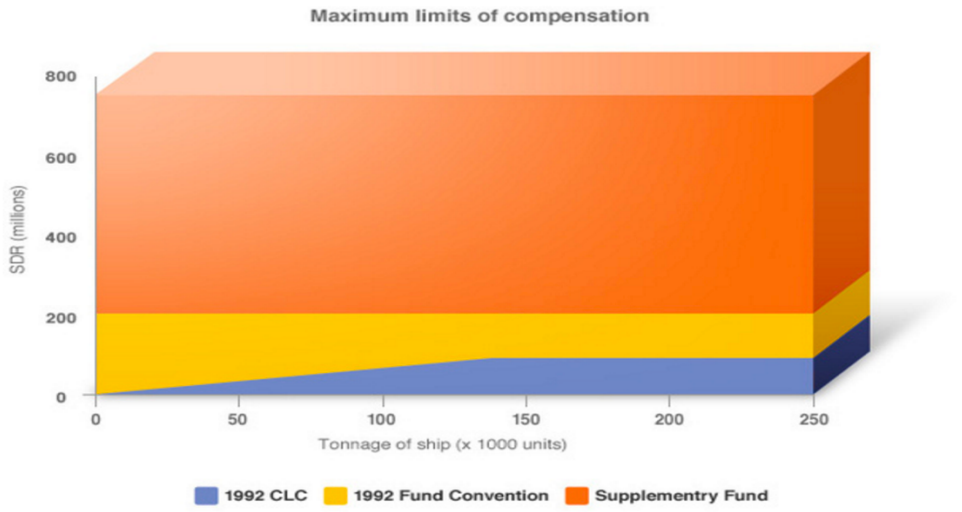

Figure 1 - The Maximum Limits of Compensation under the CLC and IOPC Funds Retrieved from: www.iopcfunds.com

The 1992 Convention and Supplementary Protocol cover pollution damage defined as: loss or damage caused outside the ship by contamination resulting from the escape or discharge of oil from the ship, wherever such escape or discharge may occur, provided that compensation for impairment of the environment other than loss of profit from such impairment shall be limited to costs of reasonable measures of reinstatement actually undertaken or to be undertaken (IOPC Funds 2013). This includes preventative measures and measures which aim to re-establish a biological community in which the organisms, characteristic to that community at the time of an incident, are present and functioning normally (IOPC Funds, 2013). Compensation for impairment of the environment under the Conventions requires a direct market cost as the Conventions were created through the economic lens. However, traditional markets do not always have the capacity to represent the intrinsic or utilitarian value of the environment. Under the Conventions, compensation is payable for the cost of reasonable clean-up measures, which are considered to be environmental reparation (IOPC Funds, 2013; Chiara Della Mae, personal communication, 07-2016). Clean-up measures have direct costs that may be compensated for. For example, if a response were undertaken in order to prevent or reduce pollution damage within the territorial sea or EEZ of a Member State, the cost of the response would in principle

qualify for compensation (IOPC Funds, 2013). Compensation is also payable for reasonable costs associated with the capture, cleaning and rehabilitation of wildlife (IOPC Funds, 2013). Compensation is also payable for costs of reasonable reinstatement measures aimed at accelerating natural recovery of environmental damage. Compensation may be claimed for the cost of post-spill studies, provided that they relate to damage which falls within the definition of pollution damage under the Conventions, including studies to establish the nature and extent of environmental damage caused by an oil spill and whether or not reinstatement measures are necessary and feasible (IOPC Funds, 2013). Thus, compensation is payable for direct costs incurred in the process of clean-up, as clean-up operations are usually intended to minimize environmental damage, but compensation is not available for damage itself.

Therefore, the IOPC Funds compensate for direct market costs reflecting use values rather than non-use values. Non-use values require abstract quantification and compensation is not paid by the IOPC Funds for environmental damage based on abstract quantification calculated in accordance with theoretical, or abstract, models. For this reason, they insist studies be carried out with professionalism, scientific rigour, objectivity and balance (IOPC Funds, 2013).

As an intergovernmental organisation, the IOPC Funds must have an approach suitable to all Member States. At this time, compensating for economic loss is the only approach that translates to the legislation of each of the IOPC Funds' Member States (Anna Cuesta, personal communication, 07-2016). Therefore, examples of acceptable claims for economic loss due to environmental damage include a reduction in revenue for a marine park or nature reserve which charges the public for admission or a reduction in catches of commercial species of marine products directly affected by the oil (IOPC Funds, 2013). These claims reflect ecosystem goods and services with a use value correlated to a direct market value. Claims for economic loss as a result of environmental damage that can be quantified in monetary terms can be assessed, and are assessed in a similar way to other economic loss claims (IOPC Funds, 2013). Small advances to the approach of the IOPC Funds are underway. Environmental Damage Claims Guidelines are in the process of being drafted which emphasize the fact that post-incident studies are required to establish the nature and extent of environmental damage caused by an oil spill and to determine whether or not reinstatement measures are necessary and feasible (Liliana Monsalve, personal communication, 07- 2016). The IOPC Funds compensates for assessment and monitoring studies, as well as further reinstatement actions if the initial studies can prove it is required (Anna Cuesta, personal communication, 07-2016). Thus, a claim is not accepted solely on the grounds that a pollution incident occurs. In order for an environmental damage claim to qualify for compensation under the *CLC* and the IOPC Funds there should be a sufficiently close link of causation between the contamination and damage and economic loss that can be measured in direct markets (Anna Cuesta, personal communication, 07-2016).

4.1.2 Canada

In addition to being a Member State of the *CLC*, the 1992 Fund Protocol and the Supplementary Fund, Canada has also developed and implemented domestic oil spill legislation. In a reaction to the *Arrow* tanker spill, the *Canadian Shipping Act,* S.C. 2001, c.26 (*CSA*) was amended to include new oil spill legislation and became a part of Canadian Law on June 30, 1971 (SOPF, 2015). The new amendments generated the first national regime for oil spill liability in the western world (SOPF, 2015). The principal elements of the amended *CSA* are:

- Establishing the strict liability of shipowners to be responsible for costs and damages for a discharge of oil.
- Allowing the shipowner, in certain circumstances, to limit his liability.
- Creating a new fund, the Maritime Pollution Claims Fund (MPCF), to be available for claims in excess of the shipowner's limit of liability.
- Giving the Minister of Transport the power to move or to dispose of any ship and cargo discharging or likely to discharge oil

This regime was modified in 1989, when Canada became a Member State to the IOPC Funds' intergovernmental regime. That same year the Ship-source Oil Pollution Fund (SOPF) came into force. The SOPF was established under the amendments to the former *CSA* and is governed by the *Marine Liability Act,* S.C. 2001, c.6 (*MLA*) Statutes of Canada, 2001, Chapter 6, and since 2010 has been governed by Part 7 of the *MLA*, as amended by the Statutes of Canada, 2009 Chapter 21 (SOPF, 2015). The SOPF is liable to pay claims for oil pollution damage or anticipated damage occurring any place in Canada caused by the discharge of oil from a ship (SOPF, 2015). The SOPF varies from the intergovernmental regime in that it is not limited to spills from sea-going tankers or persistent oil (SOPF, 2015). The SOPF is a fund of the first resort and of the last resort as it is also available to provide additional compensation in the event that compensation from the shipowner under the *CLC* and the IOPC Funds is insufficient to cover all established claims arising from such spills (SOPF, 2015). The maximum liability of the SOPF is $165,837,463 CDN (SOPF, 2015). This amount accrued while a levy of 15 cents per ton was imposed from February 15, 1972, until September 1, 1976. During that period a total of $34,866,459.88 CDN was collected and credited to the MPCF from 65 contributors. By 1989 the fund had accumulated $149,618,850.24 CDN (SOPF, 2015; Louise Murgatroyd, personal communication, 06- 2016). The accumulated amount of the MPCF was transferred to the SOPF, which is now credited with monthly interest by the Minister of Finance (SOPF, 2015). The SOPF has not yet handled an environmental damage claim and does not have a claims guideline in place. Should an environmental damage claim to be submitted to the SOPF, the approach would be to mimic the approach of the IOPC Funds (Charles Gadula, personal communication, 06-2016).

Canadian legislation although untested, has been developed similarly to that of the intergovernmental regime in order to allow for consistency. For example, the *MLA* makes the shipowner strictly liable for oil pollution damage caused by their ship, and for the costs of clean-up and preventive measures to the extent that both are reasonable. Reasonable is not defined by the *MLA*, but according to the IOPC Funds, reasonable is generally interpreted to mean that the

measures taken or equipment used in response to an incident were, on the basis of an expert technical appraisal at the time the decision was taken, likely to have been successful in minimizing or preventing pollution damage. Environmental experts have argued the *MLA* appears sufficiently broad to allow the Administrator of the SOPF to entertain claims for environmental damages for a loss not tied to some identifiable economic consequence. Others argue that in light of the particular provisions respecting liability for the costs of reasonable measures of reinstatement, it is quite clear that non-use value claims are not provided for under the SOPF governing statute. Without precedent and clear environmental damage claim guidelines it is difficult to determine to what extent environmental damage claims would be entertained by the SOPF (Charles Gadula, personal communication, 06-2016).

Canadian legislation regarding environmental damage arising from a ship-source oil spill varies from that of the intergovernmental regime in its implementation of the EDF. The objective of the EDF is to assist in the rehabilitation of injured or damaged environmental or natural resources and to ensure that proposed projects to help rehabilitate the environment are cost effective and technically feasible (GOC, 2013). The EDF applies the PPP to ensure that those who cause environmental damage or harm to wildlife take responsibility for their actions.

The EDF is a specified purpose account to manage funds received as compensation for environmental damage (GOC, 2013). Environment Canada administers the EDF on the behalf of the Government of Canada. Funds may be received through fines, court-ordered payments, out-of-court settlements, voluntary payments, and through intergovernmental liability funds (GOC, 2013). Legislation related to the EDF includes the *Canadian Environmental Protection Act,* 1999, S.C. 1999, c.33*,* the *Fisheries Act,* R.S.C., 1985, c. F-14*,* the *Canadian Environmental Protection Act 1999, Migratory Birds Convention Act,* 1994, S.C. 1994, c.22, and the *Canadian Shipping Act*, 2001, S.C. 2001, c.26*,* which may be used to direct funds to the EDF. The purpose of any contribution to the EDF, is to restore the environment and conserve wildlife in a scientifically sound and cost-effective way. Each award directed to the EDF is accounted for separately, and is used to fund projects in the region where the offence occurred (GOC, 2013). Although there is no direct link to the *CSA,* the direct link between the *Fisheries Act* and the EDF could be applied in order to penalize polluting ship owners. Note that section 40 of the *Fisheries Act* states that it is a requirement that "all fines received by the Receiver General in respect of the commission of an offence under this section are to be credited to the EDF, an account in the accounts of Canada, and used for purposes related to the conservation and protection of fish or fish habitat or the restoration of fish habitat, or for administering that Fund" (Natalie Chavarie, personal communication, 07-2016). However, currently in Canada it is the shipowner who is responsible for undertaking environmental damage assessment after a ship-source oil spill occurs (Karolyn Jones, personal communication, 06-2016). Thus, the EDF cannot be readily applied as no Canadian agency is currently tasked with assessment.

4.1.3 The United Kingdom

The Pollution Response in Emergencies: Marine Impact Assessment and Monitoring (PREMIAM) project has established expert assessment guidelines in the UK for post-incident monitoring and environmental impact assessment. Following the *Sea Empress* incident in 1996, the Donaldson Report recommended the setting up of environment groups (EGs) to provide response units with environmental advice and guidance as well as an operational impact

assessment co-ordinating body. As a result, the PREMIAM project started as a Defra-funded project aimed at improving post-spill monitoring guidance and co-ordination (PREMIAM, 2016). Today, the PREMIAM project has brought together 22 government departments and agencies from across the UK with an interest in marine spill response and the protection of the marine environment (PREMIAM, 2016). These interests are being addressed through the production of expert guidelines for post-incident monitoring and impact assessment and the development of a fully co-ordinated mechanism for overseeing the practical aspects of the project.

The PREMIAM monitoring guidelines are the first to be nationally focused. Spillages of oil and chemicals at sea can be high-profile events, which give rise to significant environmental impacts (Law et al., 2011). Under the UK National Contingency Plan for Marine Pollution from Shipping and Offshore Installations, if a marine pollution incident is expected to have a significant environmental impact, arrangements should be made to begin to monitor and assess the long-term, as well as the short and medium-term, environmental impacts (Law et al., 2011). In addition to providing environmental and public health advice to the response centers, the EG established during the incident should initiate and encourage the collection and evaluation of data for the assessment of the environmental damages of the incident (Law et al., 2011). The purpose of monitoring , what to monitor, and how frequently to monitor is outlined in the PREMIAM post-incident monitoring guideline. The PREMIAM guidelines outline an effective approach to environmental assessment which can then provide evidence for claims submitted to the intergovernmental regime.

Similarly, as of this writing, to Canada, the UK is a Member Party to the intergovernmental regime including the *CLC*, the 1992 IOPC Fund and the 2003 Supplementary Fund Protocol. Unlike Canada, the UK does not have a top-up fund similar to the SOPF in place (GUK, 2016). No matter the incident, the total amount of compensation available to the UK via the intergovernmental regime is the total amount available to claimants (GUK, 2016). If the total of all valid claims from one incident were to exceed the total amount of compensation available, claimants would only receive a percentage of their claims (GUK, 2016). While the UK has determined the level of compensation made available by the intergovernmental regime ought to be sufficient, the US has implemented an entirely different approach.

4.1.4 The United States

The US applies a freestanding approach to the intergovernmental ship-source oil spill compensation scheme. Two environmental statutes provide the principal sources of federal authority for environmental damage of all kinds: *The Comprehensive Response, Compensation, and Liability Act,* 42 U.S.C. §§ 9601 *et seq.*(*CERCLA*) and the *Oil Pollution Act*, 33 U.S.C. §§ 2701-2761 (*OPA*). *CERCLA*, provides a comprehensive group of authorities focused on one main goal: to address any release, or threatened release, of hazardous substances, pollutants, or contaminants that could endanger human health, or the environment. The statute also provides authority for assessment and restoration of natural resources that have been injured by a hazardous substance release such as a ship-source oil spill (EPA, 2016). *OPA* was enacted in reaction to the Exxon Valdez oil spill and provides authority for oil pollution liability and compensation as well as for the Federal government to direct and manage oil spill cleanups (EPA, 2016). Similar to *CERCLA*, *OPA* contains authorities to allow the assessment and

restoration of natural resources that have been contaminated by the discharge, of oil (EPA, 2016). Section 1002 of *OPA* states that responsible parties are liable for the discharge of oil from a vessel or facility to navigable waters, adjoining shorelines, or the EEZ of the US (Ramseur, 2012). Thus, the US attempts to apply the PPP, but does not adhere to the intergovernmental conventions that limit liability.

In the US the owner or operator of a facility from which oil is discharged is referred to as a responsible party (RP) and is liable for the costs associated with damages resulting from a spill. The approach taken to environmental assessment for the purpose of compensation is co-operative and referred to as natural resource damage assessments (NRDAs). NRDAs vary from environmental damage assessments under the intergovernmental regime in that they appraise how much society values the destruction of natural resources. Under *CERCLA* and *OPA*, the responsibility of natural resource protection falls to the Federal, State, and Tribal Trustees. Both *CERCLA* and *OPA* provide authority for designated Trustees to act as Natural Resource Trustees on behalf of the public (EPA, 2016). Thus, legislation in the US requires cooperative assessments between a governmental agency, or agencies, and a willing RP (Michael Anderson, personal communication, 07-2016). One of the primary responsibilities of Trustees under both *CERCLA* and *OPA* is to assess the extent of injury to a natural resource and the economic value of the injury to determine appropriate ways of restoring and compensating for that injury.

A NRDA is the process of collecting, compiling, and analyzing information to make these determinations. The overall intent of the assessment regulations is to determine appropriate restoration and compensation for injuries to natural resources. Assessments undertaken by Trustees are given rebuttable presumption, meaning it will be the task of the potentially RP to disprove the Trustee's assessment (EPA, 2016). Under *CERCLA*, compensation recovered from NRD claims are to be used for restoration or replacement of the injured natural resource, or for acquisition of an equivalent resource (EPA, 2016). Under *OPA*, recovered compensation is to be used to reimburse or pay costs incurred by the Trustee with respect to natural resources including costs incurred while conducting NRDAs and developing and implementing plans for the restoration, rehabilitation, replacement, or acquisition of the equivalent, of the damaged natural resources (EPA, 2016). Any compensation in excess of costs incurred is to be deposited in the Oil Spill Liability Trust Fund (OSLTF).

The OSLTF is a domestic fund in the US created as a first resort fund that can immediately cover costs incurred after a ship-source oil spill occurs, including environmental damage costs that go uncompensated by a RP (USCG, 2016). The fund was created in 1986 and came into force when *OPA* was established in 1990 (USCG, 2016). The primary source of revenue for the Fund was a five-cents per barrel fee on imported and domestic oil consumed in the US. Today, revenue sources include: interest on the fund, cost recovery from the parties responsible for the spills, and any fine or civil penalties collected (EPA, 2016). The Fund is administered by the US Coast Guard (USCG) Pollution Funds Center and can provide up to $1 billion USD for any one pollution incident, including $500 million USD for the initiation of natural resource damage assessments and claims in connection with any single incident (USGC, 2016). Thus, the US' regime is principally designed to return injured resources to baseline condition, and may also compensate the public for interim losses of injured resources from the onset of injury until baseline conditions are re-established (EPA, 2016).

Therefore, the US government has been the first to legitimize non-use values as a component of assessing environmental damage. Because primary restoration measures do not compensate for the loss of ecological and human services, otherwise known as interim losses, compensatory restoration measures are taken to compensate for that loss (Maes, 2005). Thus, theoretical models, such as contingent valuation, may be applied within the US to complete a NRDA (Maes, 2005). Further, while the National Oceanic and Atmospheric Administration handles the assessment of major spills and applies a guideline of assessment, under *OPA* and *CERCLA* individual states retain the right to develop their own assessment models that incorporate non-use values. For example, Washington State has developed a model capable of considering non-use values called the compensation schedule (Alison Meyers, personal communication, 07-2016). Thus, the regime of the US broadens the scope of the application of the PPP to include the assessment of non-use values; however, there are no strict federal guidelines in place as to what models may be applied by Trustees under NRDA (Alison, Meyers, personal communication, 07-2016).

4.1.5 The EU Environmental Liability Directive

The legislation and approach of the *ELD* is a modern balance between the traditional approach of the intergovernmental regime and the regime implemented by the US. All 28 Member States of the EU had implemented the Directive by July, 2010 (EC, 2013). The purpose of the Directive was to establish a framework of environmental liability, based on the PPP, to prevent and remedy environmental damage. The overall goal of the *ELD* is the full remediation of damages to natural resources and their services to baseline conditions (EC, 2013). The *ELD* provides for supplemental remediation with the goal of compensating the public for interim loss. It is also required that the polluter bears the cost of assessment and remediation actions.

Primary responsibilities under the *ELD* lie with the 'Competent Authority' and the liable operators. The *ELD* provides that 'any natural or legal person' whose rights have been impaired, as defined under national law, may notify the Competent Authority of any environmental damage which is being or has been caused, or of which there is an imminent threat, and shall be entitled to request the Competent Authority to take action (EC, 2013). The *ELD* also specifies that any NGO that promotes environmental protection and meets any requirements under national law should be deemed to have a sufficient interest and to have rights capable of being impaired (EC, 2013). Thus, the *ELD* is in place to ensure negative impacts to the environment are assessed and compensated for.

Compensation under the *ELD* is referred to as 'in kind'. This assures compensation is not punitive. Where primary remediation measures do not fully return damaged natural resources and services to baseline conditions at the damaged site, further complementary remediation measures are required (EC, 2013). Complementary remediation refers to supplemental remediation actions taken offsite, or of services that differ somewhat from the specifically damaged services, with the goal of restoring the baseline level of the affected resource or service (EC, 2013).

In many cases, full remediation to baseline levels of a damaged resource or service may not be achievable, even following implementation of primary and complementary remediation, because of practical or site-specific limitations. Thus, compensatory remediation action may be

required in order to address interim loss, which is done by implementing a resource equivalency method (EC, 2013). Unfortunately, beyond the implementation of the resource equivalency method, the *ELD*'s guidelines on how to measure the extent of the injuries to natural resources, as well as how to determine the appropriate scale of the restoration measures, are not detailed (Maes, 2005).

4.2 Case Studies

The second section of this comparative analysis examines and describes the practical approach to environmental assessment and valuation taken by the IOPC Funds, Canada, the UK and the US after ship-source oil spill incidents occurred within their respective marine environments. An *EC* case study has not been selected as the *EC*'s legislation does not pertain to ship-source oil spills.

4.2.1 The Volgoneft 139

On November 11th 2007, the Russian-registered *Volgoneft 139*, broke in two in the Kerch Strait (IOPC Funds, 2010). The tanker was loaded with 4,077 tonnes of heavy fuel oil and it is estimated that between 1,200 and 2,000 tonnes of fuel oil was spilled at the time of the incident (IOPC Funds, 2010). Some 250 kilometres of shoreline in the Russian Federation and in the Ukraine were affected by the oil (IOPC Funds, 2010). Claims totalling RUB 8,529.8 million were submitted to the IOPC Funds as a result of the incident (IOPC Funds, 2010).

The Russian Federation is a Party to the 1992 *CLC* and the 1992 Fund Convention (IOPC Funds, 2010). The Regional Government of the Affected Russian Federation submitted claims for costs incurred for environmental restoration of RUB 1,819.6 million (IOPC Funds, 2010). Additionally, the *Federal Service for Supervision in the Sphere of the use of Nature* submitted a claim totalling RUB 753, 332 for costs incurred in environmental monitoring, which was provisionally assessed at RUB 515 092 (IOPC Funds, 2010). The IOPC Funds stated the claims lacked the information necessary for its assessment (IOPC Funds, 2010).

The Federal Service on the Supervision in the Sphere of the use of Nature also submitted a claim totalling RUB 6,048.6 million, for environmental damage based on a model called Metodika, which is not admissible under the 1992 Conventions as it is deemed abstract (IOPC Funds, 2010). The Metodika model is used to quantify both use and non-use values for damage compensation. The Metodika claim is based on the quantity of oil spilled, multiplied by an amount of RUB per tonnage of oil spilt (IOPC Funds, 2010). The Secretariat informed the Russian authorities that a claim based on an abstract quantification of damages calculated in accordance with a theoretical model was in contravention of *Article 1.6 of the 1992 CLC* and therefore not admissible for compensation. However, the 1992 Fund was prepared to examine the activities undertaken by the *The Federal Service on the Supervision in the Sphere of the use of Nature* to determine if, and to what extent they qualified for compensation under the 1992 Conventions (IOPC Funds, 2010). The claim for environmental damage was also submitted in court to comply with national legislation (IOPC Funds, 2010). However, the claimants accepted that the claim is not admissible under the 1992 Conventions and that it was likely to be rejected by the Court (IOPC Funds, 2010). At a hearing in September 2010 the Arbitration Court of Saint Petersburg and Leningrad Region issued a judgement rejecting the Methodika claim (IOPC

Funds, 2010). In its judgement, the Court noted that under *Article 1.6 of the 1992 CLC* compensation for damage to the environment other than loss of benefit caused by such damage, should be limited to expenses for reasonable reinstatement measures, as well as the expenses for the preventive measures and subsequent damage caused by such measures (IOPC Funds, 2010).

Therefore, the environmental damage claims submitted to the IOPC Funds regarding the *Volgoneft 139* incident were handled in accordance with the IOPC Funds' theoretical approach. Claims regarding environmental monitoring and restoration were accepted where accurate documentation was provided. Thus, reasonable reinstatement measures as outlined in the claims manual of the IOPC Funds, are accepted under the 1992 Conventions. Further, as stated by the 1992 Conventions, models such as the Metodika based on abstract quantification are not accepted by the IOPC Funds. Thus, all non-use value quantifying methods based on abstract quantification are not accepted by the IOPC Funds. Therefore, the approach taken by the IOPC Funds to assess and value damage to marine environment does not allow for holistic valuation of ecosystem goods, services, and functions.

The following SWOT analysis addresses the current strengths, weaknesses, opportunities and threats of the IOPC Fund's theoretical and applied approach to environmental damage assessment and valuation. This SWOT analysis, informed by the literature review, interviews and the case study, determined the IOPC Funds' approach has many strengths. However, in terms of best available practices, the current approach of the fund has equally as many weaknesses. The detailed results the IOPC Funds' SWOT can be seen in Table 5.

Table 5 – SWOT of the IOPC Funds' Approach

SWOT	
Strengths	**Weaknesses**
• Is establishing claims guidelines concerning environmental damage • Has established a partnership agency with the administrative and technical capacity to oversee environmental assessment and monitoring of a spill (ITOPF) • Accepts claims for environmental monitoring and restoration • Has a fund capable of compensating victims of a spill • Has developed an approach for valuing damages to the environment • Is transparent in assessment and valuation approach and processes	• Has not mandated and legislated cooperative assessment processes • Has not incorporated non-use values into their established environmental valuation approach • Environmental Damage claims submission are temporally limited • Has not developed an approach for valuing cultural loss • Does not allow for public participation • Does not take, compensatory action to further science and baseline data gathering • Does not asses the environment as a whole • Does not successfully apply the PPP
Opportunities	**Threats**
• Lobby Member States to legislate required cooperative assessment • Lobby Member States to legislate temporal extensions on environmental damage claims • Encourage Member States to implement baseline monitoring in their heavily trafficked marine environments • Establish claims guidelines for cultural loss claims • Donate a percentage of the funds to hire experts to undertake research capable of determining acceptable methods of quantifying • Devote a portion of the fund to researching appropriate methods of quantifying the monetary value of non-use value ecosystem services and functions.	• Member States may prefer the approaches applied under the *ELD*, or by the US. • IOPC Funds may become outdated and loose the support of their Member States

4.2.2 The MSC Napoli

On January 18th 2007 the *MSC Napoli*, a 275 metre-long container ship, suffered catastrophic hull failure in the English Channel, UK (Ship Disasters, 2016; Savill, 2008). The cargo was diverse, including 3,664 tonnes of heavy fuel oil and 45 tonnes of diesel oil (Neuparth et al., 2012). Even though some 300 tonnes of oil leaked into the sea, this incident was not covered by the IOPC Funds since the MSC Napoli was not a tanker vessel. The London Steam-Ship Owner's Mutual Insurance Association, which insured the *MSC Napoli*, revealed the claims from the wreck accumulated to £120 million (Savill, 2008).

The response to the *MSC Napoli* spill was organized by a Unified Command composed of state agencies as well as the responsible polluter (Cariglia, personal communication, 07-2016). This ship-source spill did not fall under the legislation of the 1992 *CLC* or the 1992 Fund as the *MSC Napoli* was not a tanker. It instead fell under the *1995 Merchants Shipping Act* of the UK (Ship Disaster, 2016). Under the *1995 Merchants Shipping Act* ship owners, excluding tankers, are liable for oil pollution: 1) damage caused outside the ship in the territory of the UK by contamination resulting from the discharge or escape; and 2) for the cost of any measures reasonably taken after the discharge or escape for the purpose of preventing or minimising any damage so caused in the territory of the UK by contamination resulting from the discharge or escape; and 3) for any discharge so caused in the territory of the UK by an measures taken (Open Government License, 2016). However, ship owners may limit their liability. In the case of the MSC Napoli the legal limitation was capped at £15 million (Ship Disasters, 2016).

As claims handled directly by ship owners' insurers are confidential, the environmental damage claims submitted after the *MSC Napoli*, and the methods as to how they were assessed, are not publicly available. However, in the case of the *MSC Napoli*, the salvage operation alone cost in excess of £50 million (Ship Disasters, 2016). Thus, total claims exceeded the limit of liability under the 1995 *Merchants Shipping Act* and left local councils paying out of pocket as they received only a third of what they had spent from insurers (Ship Disaster, 2016). A marine lawyer handling the compensation claims advised that claims above the limit of liability for the *MSC Napoli* exceed £65 million (Ship Disasters, 2016).

This approach is inadequate, as it allows for significant externalities to be passed on to society. In order to mitigate uncertainty, it would be best if the UK implemented a domestic supplementary fund, similar to that of Canada's, which can provide another layer of safety for victims of all varieties of ship-source spills. The *MSC Napoli* has demonstrated the limits of liability imposed by the 1992 *CLC*, the 1992 Funds, and the 2003 Supplementary Fund, can be exceeded. Thus, it is best for nations to additionally implement a domestic fund.

One of the major strengths of the UK's regime is its approach to post-spill monitoring. The monitoring programme developed after the *MSC Napoli* spill was based on three main assumptions: 1) oil was lost and could have affected the local environment and hence, hydrocarbons should be monitored; 2) during the salvage operation the hazardous chemicals aboard may have been lost and; therefore, a monitoring of those compounds could be necessary in water, sediments and biota; and 3) the spill occurred in a major nature conservation where it was important to assess the damage of the local flora and fauna (Neuparth et al., 2012). Chemical, biological, and ecological monitoring were all undertaken after the *MSC Napoli* incident took place. Experts agree that strategies such as the PREMIAM project will be an important step for the standardisation of post-spill monitoring methodologies; thereby, improving the quality and effectiveness of environmental monitoring programs (Neuparth et al, 2012; Cariglia, personal communication, 07-2016).

The following SWOT analysis further addresses the current strengths, weaknesses, opportunities and threats of the UK's theoretical and applied approach to environmental damage assessment and valuation. This SWOT analysis, informed by the literature review, interviews and the case study, determined that although the UK's approach has many strengths, in terms of

available best practices the current approach of the fund has equally as many weaknesses. The detailed results the UK's SWOT can be seen in Table 6.

Table 6 – SWOT of the United Kingdom's Approach

SWOT	
Strengths	**Weaknesses**
• Has created region specific conservation objectives with specific definitions of significant damage • Has the capacity to organize effective clean-up operations • Has integrated environmental monitoring procedures into contingency plans • Has established an agency with the administrative and technical capacity to adequately perform the monitoring and assessment of a spill • Has established assessment guidelines with pre-defined objectives that aim to establish causality and has embedded these guidelines into the response framework • Has mandated a cooperative assessment process between the polluter an an appointed agency • Has assigned region specific 'trustee' equivalents which are separate from those tasked with clean-up • Has implemented a post-spill monitoring program	• Has not established a fund capable of compensating victims of a ship-source oil spill and therefore does not accepts claims for environmental monitoring and restoration, nor have they established a domestic approach for valuing environmental damages. • As a Member State to the IOPC Funds they have not incorporated non-use values into the assessment approach • Does not create or fund citizen oversight systems • As a member Member State of the IOPC Funds they have not established an approach for assessing and valuing cultural loss • Are not transparent in all assessment and valuation processes • Does not allow for public participation of assessment decisions • Does not include compensatory action which funds further science and baseline data gathering • Does not successfully apply the PPP
Opportunities	**Threats**
• Could establish a domestic fund to supplement what is already available through the *CLC* and IOPC as well as spills occurring from ships of the non-tanker variety • Lobby fellow Member States to the IOPC Funds to incorporate non-use values into the environmental assessment and valuation approach • Encourage and fund citizen science systems to gather baseline data • Implement a baseline marine monitoring program • Lobby fellow Member States to the IOPC Funds to establish an approach for assessing and valuing cultural loss • Lobby fellow Member States to the IOPC Funds to permit extensions on environmental damage claims • Ensure transparency by requiring claims dealt with by ship owner's insurers to be made public data • Allow for public participation in assessment and valuation processes	• The costs of a catastrophic spill could exceed the funds available • IOPC Funds scheme may narrowly value the UK's environments • Externalities of industry may be transferred to society and to the environment

4.2.3 The Cosco Busan

On November 7th 2007, the *Cosco Busan* freighter, struck the Bay Bridge as it attempted to depart San Francisco Bay. The accident created a gash in the hull of the vessel, causing it to spill 1,687 tons of heavy oil into the San Francisco Bay (CBOST, 2012). Wind and currents took some of the oil outside of the Bay, where it impacted the outer coast of California from approximately Half Moon Bay to Point Reyes. The appointed Trustees of this incident settled the NRDA portion of the case with the polluter for $32.3 million USD.

The *Cosco Busan* spill precipitated widespread beach closures, fishery closures, and the cancellation of many activities associated with boating or use of the Bay waters (CBOST, 2012). The clean-up response was organized through a Unified Command, which was made up of several federal and California state agencies as well as the responsible polluter (CBOST, 2012). In addition to the response and clean-up effort, the natural resources Trustee agencies conducted a NRDA to quantify the injuries and seek compensation in the form of restoration projects (CBOST, 2012). In this case, the Trustees for the injured natural resources were the US Fish and Wildlife Service, the National Park Service, the Bureau of Land Management, the National Oceanic and Atmospheric Administration, and the California State Lands Commission.

The Trustees' task was to determine the scale of restoration actions that would adequately compensate the public for injuries resulting from the spill (CBOST, 2012). In order to do this, Trustees undertook injury assessments. The goal of their injury assessment was to determine the nature, extent and severity of injuries to natural resources, thus providing a technical basis for evaluating and properly scaling potential restoration actions to compensate for resource injuries (CBOST, 2012). Each injury assessment focused on determining both the magnitude of the injury as well as the time it would take to reach a full recovery (CBOST, 2012). This produced an estimate of the initial and interim losses resulting from the oil spill (CBOST, 2012).

The Trustees applied the Resource Equivalency Analysis (REA), an approach that quantifies both the injury from the spill and the benefits of potential restoration projects (CBOST, 2012). For human recreational losses the Trustees applied a valuation approach capable of estimating the number of lost user-days for various activities and locations, and then calculated the lost monetary value of that lost use (CBOST, 2012).

Extensive assessment was undertaken, which determined the spill caused serious impacts to wildlife, habitats, and human recreational uses (CBOST, 2012).

- Birds: An estimated 6,849 birds were killed, representing 65 different species.
- Fish: An estimated 14-29% of the winter 2007-8 herring spawn was lost due to widespread egg mortality.
- Shoreline Habitats: 3,367 acres of shoreline habitat were impacted, and recovery was expected to vary from a few months to several years, depending upon the habitat type and degree of oiling.
- Human Uses: 1,079,900 user-days were lost.

The Trustees selected 12 restoration projects that are designed to address the various resources impacted by the spill and to identify various recreational use projects (CBOST, 2012).

All of the projects are designed to restore, replace, or acquire the equivalent of the lost resources and their services through restorative actions (CBOST, 2012). The projects were selected based upon the biological needs of the injured species and the feasibility of restoring the resources (CBOST, 2012).

The Trustees settled claims for natural resource damages with the RP (CBOST, 2012). The following amounts were allocated to fund the determined restoration projects:

- Birds: $5 million
- Fish/Eelgrass: $2.5 million
- Habitat: $4 million
- Recreational Use: $18.8 million

The following SWOT analysis further addresses the current strengths, weaknesses, opportunities and threats of the US' theoretical and applied approach to environmental damage assessment and valuation. This SWOT analysis, informed by the literature review, interviews and the case study, determined that the US' approach has many strengths in terms of available best practices and sets the standard for successful implementation of the PPP. The detailed results the US' SWOT can be seen in Table 7.

Table 7 - SWOT of the United States' Approach

SWOT	
Strengths	**Weaknesses**
• Has created region specific conservation objectives • Has the capacity to organize effective clean-up operations • Has integrated environmental monitoring procedures into contingency plans • Has established an agency with the capacity to adequately monitor and assess a spill • Has established a fund capable of compensating victims of a spill • Accepts claims for environmental monitoring and assessment. • Has mandated a cooper assessment process • Has assigned region specific Trustees • Trustees are separate from those tasked with response and clean-up • Has established an approach for valuing damages to the environment • Has incorporated non-use values into the established approach. • Permits extensions on environmental damage claims • Proactively involves citizen oversight systems which establish baseline data and inform assessment • Has established an approach for assessing and valuing cultural loss • Is transparent in valuation decisions • Allows the public to comment on the assessment and valuation process • Successfully applies the PPP and safeguards citizens	• Has established assessment guidelines that could be further defined at the federal and state level to develop consistency • Does not include compensatory action which funds further science and baseline data gathering
Opportunities	**Threats**
• Could implement a post-spill monitoring program with specific guidelines similar to that of the PREMIAM guidelines • Create a legislative means which legitimises compensatory action and funds further science, baseline data gathering. • This information could further develop methods for valuing environmental damage.	• Could deter industry from utilizing the US' Navigable Waters • Could alienate insurers

4.2.4 The Marathassa

On November 8th 2015, a sailing vessel observed a sheen of oil in English Bay, Vancouver and reported it to the CCG (CCG, 2015). Although the Captain and representative for the *M/V Marathassa* initially denied responsibility, it was subsequently determined on the morning of April 9th, 2015 that the *Marathassa* had discharged an unknown quantity of intermediate fuel oil

into English Bay on April 8th (CCG, 2015). The *Marathassa* is a panamax-sized bulk grain carrier with a deadweight tonnage of 81,000 (CCG, 2015). It was estimated that 2.8 tonnes of fuel was discharged and that 1.4 tonnes was recovered (CCG, 2015).

The response to the *Marathassa* received many criticisms as it was delayed (Nagel, 2015). Due to negative feedback from the public and media the Commissioner of the CCG initiated a review to identify what worked well and what could be improved. A major criticism of the report was that the CCG did not have the initial capacity to respond and that it took days for the Unified Command to achieve its rhythm (CCG, 2015). Further, the alerting of municipalities, indigenous groups, and stakeholders of the incident was delayed (CCG, 2015). Many noted the immediate need to engage partners in the development of an efficient and effective plan was not adequately addressed (CCG, 2015). Most notably, in this incident there appeared to be confusion among some partners regarding the roles and responsibilities of key agencies in oil spill response (CCG, 2015). Specifically, Environment Canada, the agency tasked with providing sound, independent scientific and environmental advice, lacked a physical presence during response, which impacted the effectiveness and efficiency of the Environmental Response Unit (CCG, 2015). Thus, no governmental agency was initially tasked with on-site assessment (CCG, 2015).

Within Canada, polluters are tasked with undertakingenvironmental assessment. An environmental assessment planning and decision-making tool referred to as environmental impact assessment (EIA) is to be applied retrospectively. The objectives of an environmental assessment are to minimize or avoid adverse environmental effects before they occur and incorporate environmental factors into decision-making (CEAA, 2016). EIA identifies potential adverse environmental effects, proposes measures to mitigate adverse environmental effects, predicts whether there will be significant adverse effects after mitigation measures are implemented; and includes a follow-up program to verify the accuracy of the environmental assessment and the effectiveness of mitigation measures (CEAA, 2016).

Hemmera Envirochem Ltd., was retained by the polluter to complete an independent EIA (Hemmera, 2015). The Environmental Unit established under the Unified Command led by the CCG, conducted various surveys, sampling programs and clean-up support efforts, which was then used to inform Hemmera's EIA (Hemmera, 2015). Surveys and monitoring programs during response included aerial overflights, underwater surveys to determine surface and subtidal oiling extent, sediment, water and biological sampling and analyses, and wildlife rescue and rehabilitation (Hemmera, 2015). Additionally, shoreline assessment and clean-up was conducted using the Shoreline Cleanup and Assessment Technique (SCAT) which took place from April 9th – 24th, 2016.

Hemmera's EIA assessed the potential effects of the oil spill to ecosystem components identified as valued (Hemmera, 2015). The assessment used four valued components as representatives potentially affected by the spill (Hemmera, 2015). The assessment area included all shorelines surveyed by the SCAT teams and captured the maximum extent of observed oiling (Hemmera, 2016). Overall, the EIA concluded that there were no prolonged effects on water quality, minor effects to sediment, and potential local uptake in tissues of some fish and invertebrates was indicated by the data (Hemmera, 2016). Further, no toxicological effects were anticipated in humans and temporary limited access of people to recreational areas was

concluded to have been of no long-term consequence (Hemmera, 2016). No valuation of environmental damage was undertaken.

The following SWOT analysis further addresses the current strengths, weaknesses, opportunities and threats of the Canada's theoretical and applied approach to environmental damage assessment and valuation. This SWOT analysis, informed by the literature review, interviews and the case study, determined that Canada's existing regime for assessing damage to marine environment for the practical purpose of compensation is inadequate when compared to other regimes. The detailed results of Canada's SWOT can be seen in Table 8.

Table 8 - SWOT of Canada's Approach

SWOT	
Strengths	**Weaknesses**
• Has the capacity to organize effective clean-up organizations • Has established a fund capable of compensating victims of a ship-source oil spill • Theoretically accepts claims for environmental monitoring and restoration • Has established an approach for valuing damages to the environment under the IOPC Funds • SOPF claims assessment is transparent	• Does not have region specific conservation objectives • Has not integrated environmental monitoring procedures into contingency plans • Has not established an agency dedicated to adequately monitoring, assessing, and valuing a spill • Has not established assessment guidelines • Has not mandated a cooperative assessment process • Has not assigned region specific 'trustee' equivalents • Assessment is not separate from response and clean-up • Has not incorporated non-use values into the established valuation approach • Does does not permit extensions on environmental damage claims • Has not implemented implemented a post-spill monitoring program • Does not support citizen oversight systems • Has not established an approach for assessing and valuing cultural loss • Does not involve the public in assessment and valuation • Does not include compensatory action

Opportunities	Threats
• Create region specific plans with conservation objectives • Appoint regions specific 'trustees' to be involved in assessment • Increase the SOPF in order to be capable of handling claims from a catastrophic spill • Implement a post-spill monitoring program with specific guidelines similar to that of the PREMIAM guidelines • Establish one agency separate from response trained and capable of on-scene assessment and monitoring that is also responsible for submitting environmental claims • Implement a cooperative assessment approach • Lobby fellow Member States to the IOPC Funds to incorporate non-use values into the environmental assessment and valuation approach • Lobby fellow Member States to the IOPC Funds to permit extensions on environmental damage claims • Encourage and fund citizen science systems to gather baseline data • Implement a baseline marine monitoring program • Lobby fellow Member States to the IOPC Funds to establish an approach for assessing and valuing cultural loss • Ensure transparency by requiring claims dealt with by ship owner's insurers to be made public data • Allow for public participation in assessment and valuation processes • Implement compensatory approach which funds research aimed at better assessing and valuing environmental damage	• Inadequate clean-up due to disorganized response • Limited resources may limit the implementation of the PPP • Environment may go unassessed • Externalities of industry may be transferred to society and to the environment

4.3 The Theoretical and Applied Approaches of Selected Intergovernmental and National Compensation Regimes

Two matrices comparing the approaches of Canada, the UK, the US, the IOPC Funds, and the *ELD* are presented in this section. They are informed by data collected throughout the literature review, interviews, and the previous SWOT analyses. By utilizing the stop light method, which indicates compliance through colour association, these matrices are intended to visually compare and contrast the theoretical and applied approaches of the selected intergovernmental and international compensation regimes.

The first matrix seen in Table 9, visually demonstrates which valuation methods, prevalent in the literature, are theoretically accepted by the selected compensation regimes. Colours in the matrix represent the level of validity each valuation method holds within the indicated compensation regime. Green indicates assured acceptance within the intergovernmental or national regime. Amber indicates the method has not yet been accepted, but with precedent could foreseeably be accepted. Red indicates the method has never been accepted as a method of valuation and never will be accepted based on the regime's legislation.

Table 9 – Stop Light Matrix of Selected Compensation Regimes' Theoretically Accepted Valuation Methods

Valuation Approach		*IOPC Funds*	*United Kingdom*	*Canada*	*United States*	*ELD*
Direct Market Valuation	***Economic Loss***					
	Market Prices					
	Avoided Cost					
	Replacement Cost					
	Mitigation/Restoration Cost					
Revealed Preference	***Production Function Approach***					
	Travel Cost Method					
	Hedonic Pricing					
	Opportunity Cost					
Stated Preference	***Contingent Valuation***					
	Choice Modelling/Conjoint Analysis					
	Contingent Ranking					
	Deliberative Group Valuation					

This matrix indicates that the only approach to valuation accepted with certainty by all five compensation regimes is that of economic loss. Under the correct circumstances the US and the *ELD* are willing to accept environmental damage claims formulated using direct market, revealed preference, or stated preference approaches. The IOPC Funds, the UK, and Canada are only willing to accept 1 of 5 direct market valuation approaches. As Member States, Canada and the UK must adhere to the IOPC Funds' Conventions, and the IOPC Funds does not compensate for claims of environmental damage based on abstract quantification (IOPC Funds, 2013). Thus, valuation methods categorized as revealed preference approaches or stated preference approaches are not accepted. No method beyond that of the valuation of direct economic loss has yet to be accepted by the IOPC Funds and therefore Canada and the UK (Della Mae & Cuesta, personal communication, 07-2016). However, based on the IOPC Funds' soon to be released environmental claims guide and information gleaned from interviews conducted with claims managers at the IOPC Funds, if given precedent, all valuation methods characterized as direct market valuation claims could be considered valid under the IOPC Fund's regime. Thus, the valuation methods of market prices, avoided cost, replacement cost, and mitigation/restoration cost may one day be accepted by the IOPC Funds. It is important to note that these valuation

methods are all capable of pricing both use values and non-use values, but would likely only be applied when valuing direct use values (Della Mae & Cuesta, personal communication, 07-2016).

The second matrix, seen in Table 10, lists twenty indicators of best practice. These indicators were determined by the strengths demonstrated within the SWOT analyses and influenced by recommendations made by experts at ITOPF during interviews. ITOPF is the maritime industry's primary source of objective technical advice, expertise, assistance and information on effective response to ship-source pollution (ITOPF, 2016).

This matrix visually demonstrates the level of compliance with best practice indicators each selected compensation regime currently achieves in both its theoretical and practical approach to environmental assessment and valuation. In this matrix green signifies the selected compensation regime successfully applies a best practice indicator, amber signifies a best practice indicator is only partially achieved and red signifies a best practice indicator has not been incorporated into the regime. Finally, black signifies the indicator is not applicable to the compensation regime.

The matrix indicates that the more modern *ELD* incorporates more best practice indicators than the IOPC Funds. The *ELD* incorporates seven indicators of best practice while the IOPC Funds successfully incorporates five of the possible twelve indicators. Therefore, in terms of intergovernmental approaches, the *ELD* performed better than the IOPC Funds by successfully incorporating more indicators of best practice into its regime.

It also indicates that the US successfully incorporates more environmental assessment and valuation best practice indicator than any of the other examined intergovernmental or international regimes. The US successfully or partially incorporated all twenty indicators of best practice into its regime. In comparison, Canada successfully or partially incorporated only five indicators of best practice into its regime.

Of the compensation regimes selected for examination, Canada's incorporated the least indicators of best practice. Therefore, in comparison to the US and the UK, Canada's existing regime for assessing and valuing damage to the marine environment after a ship-source oil spill occurs is ineffective and could be improved.

Table 10 – Stop Light Matrix of Selected Compensation Regimes' Current Regimes Vs. Best Practices

#	Best Practice Indicator	IOPC Funds	Canada	United Kingdom	ELD	United States
1	Has created region specific conservation objectives with specific definitions of 'significant damage'					
2	Has the capacity to organize effective clean-up operations					
3	Has integrated environmental monitoring procedures into post-spill contingency plans					
4	Has established an agency with the administrative and technical capacity dedicated to adequately performing/overseeing the monitoring and assessment of a spill					
5	Has established a fund capable of compensating victims of a ship-source oil spill					
6	Accepts claims for environmental monitoring and restoration					
7	Has established assessment guidelines with pre-defined objectives that aim to establish causality and has embedded these guidelines into the response framework					
8	Has mandated a cooperative/joint assessment process between the polluter and an appointed agency					
9	Has assigned region specific 'trustee' equivalents from federal, provincial, local, and indigenous governments and agencies to implement damage assessment and restoration					
10	Team tasked with assessment is separate from those tasked with response and clean-up					
11	Has established an approach for valuing damages to the environment					
12	Has incorporated non-use values into the established environmental valuation approach					
13	Permits extensions on environmental damage claims submissions due to their temporal nature					
14	Has implemented a baseline monitoring program					
15	Creates, funds and proactively involves citizen oversight systems which establishes baseline data and informs damage assessment and valuation					
16	Has established an approach for assessing and valuing cultural loss					
17	Is transparent in assessment and valuation processes and publishes all valuation decisions					
18	Allows the public to comment on the assessment and valuation process					
19	Includes compensatory action which funds further science and baseline data gathering					
20	Successfully applies the PPP by attempting to assess and value the environment as a whole					

4.4 Gap Analysis of the Canadian Regime and Specific Recommendations for Canada

The results of a gap analysis conducted on Canada's domestic regime, full details of which can be found in Appendix C, can be found in Table 10. The gap analysis has been applied for the purpose of providing recommendations to strengthen Canada's current regime. The gap analysis describes indicators of an ideal regime. In order to provide consistency, nineteen of the indicators selected for the best practice matrix seen in Table 10 have also been selected to describe an ideal regime in this analysis. The twentieth indicator, '*Successfully applies the PPP by attempting to assess and value the environment as a whole',* is not included as the recommendation to successfully achieve this indicator would be to address the previous nineteen recommendations as a whole. Each indicator of the ideal regime is compared to a correlating element of Canada's existing regime. Gaps between Canada's existing regime and the ideal regime are identified and a recommendation of required implementation to meet best practice is made. The complete list of 19 recommendations to strengthen Canada's existing regime can be seen in Table 11 and are discussed in the assessment portion of this study.

5.0 Assessment

The following section of this study reviews and assesses the results of the analysis. The assessment considers the challenges of assessing and valuing the marine environment for the purpose of compensation after a ship-source oil spill occurs and the varied advantages and disadvantages of the approaches selected for examination in this study. Canada's standing amongst the selection of theoretical and practical approaches applied is then explained and recommendations intended to strengthen the nation's existing regime are provided. Lastly, the significance of assessing and valuing the environment in order to successfully manage the marine environment is discussed.

5.1 The Scientific Versus Prescriptive Approach

Assessing and valuing marine environmental damage is a challenging practice and different jurisdictions have developed varied approaches. Globally, there are three generalized approaches to environmental damage assessment and valuation (Figure 2). The three approaches are generally categorized as: 1) no defined approach; 2) a science-based approach; or 3) a prescriptive approach (Cariglia, 2016). Science-based approaches can be further subdivided into: a) the intergovernmental regime, and b) the intergovernmental regime with a national top-up fund. Prescriptive approaches can also be further subdivided into: a) a fixed formulae approach, or b) a theoretical approach (Cariglia, 2016).

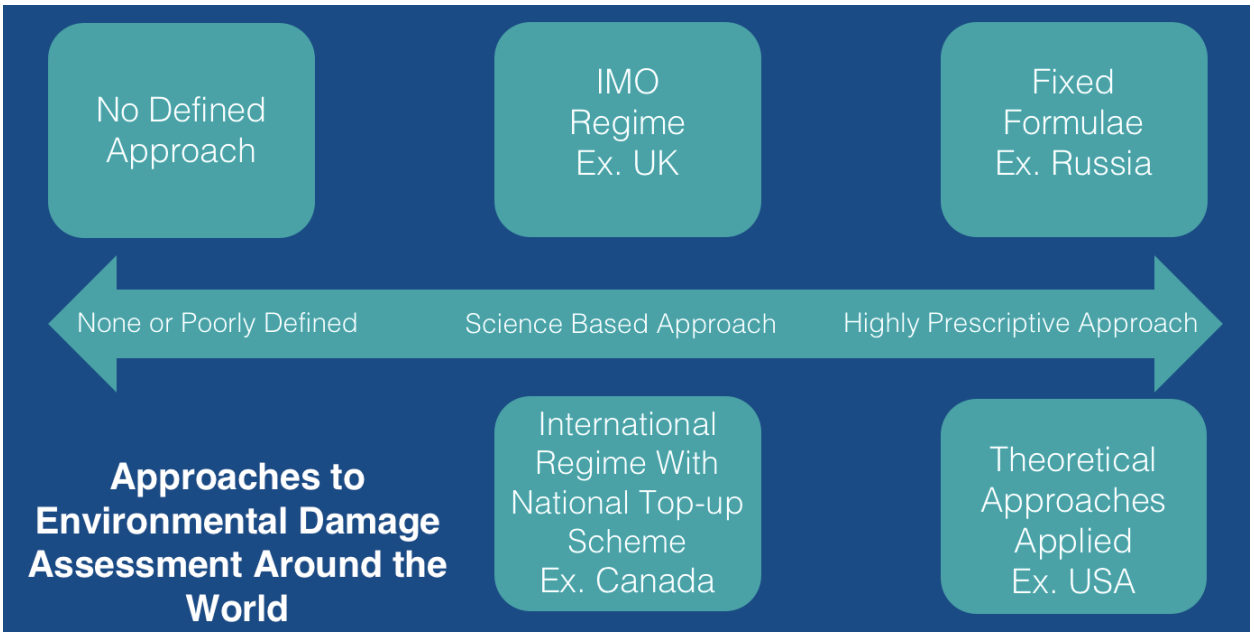

Figure 2 - Approaches to Environmental Damage Assessment and Valuation Around the World (Adapted from Cariglia, 2016)

The comparative analysis revealed that the environmental damage assessment and valuation regimes of all five intergovernmental and international compensation regimes selected for analysis in this study differed from one another to varying degrees. Selected compensation regimes have a defined approach to environmental damage assessment and valuation. The IOPC Funds apply a science-based approach which was demonstrated in the examination of the IOPC Funds' practical approach to assessing and valuing environmental damage in the case of the *Volgoneft 139*. In the examination it was revealed that Russia, although a Member State to the IOPC Funds, applies abstract models such as the Metodika under its domestic legislation. The application of abstract models is known as a prescriptive approach (Cariglia, 2016). Whereas the UK and Canada, also Member States of the IOPC Funds, apply science-based approaches. However, they too differ as Canada also funds a national top-up scheme in addition to the intergovernmental regime, known as the SOPF. Interestingly, the US was found to apply a prescriptive theoretical approach. Lastly the *ELD*, an intergovernmental compensation regime with many of the same Member States as the IOPC Funds, also applies a prescriptive theoretical approach modelled similarly to that of the US.

A prescriptive approach implies that a regime utilizes assessment and valuation techniques developed by economists to monetarily quantify non-use values (Cariglia, 2016). Table 10 demonstrates that the *ELD* and US incorporate these approaches and thus, have a larger scope of assessment for ecosystem goods, services, and functions as a whole. Thus, both regimes have partially or successfully applied the PPP. However, in order to successfully apply the PPP and incorporate non-use values, the US applies a prescriptive theoretical approach, which is controversial.

Critics of the prescriptive approach applied by the US most commonly argue that claims of environmental damage ought to be based on science (Cariglia & Patel, personal communication,

07-2016). The unpredictability of oil spills, coupled with the dynamism of the marine environment means that each incident presents its own set of circumstances and concerns (Cariglia, 2016). Therefore, critics argue prescriptive methodologies are neither realistic or practical (Cariglia & Patel, personal communication, 07-2016). Additional critiques of the US' approach include considerations of insurability as well as self-imposed economic barriers (Faure & Wang, 2008).

Others argue compensation for environmental damage caused by ship-source oil spills is being valued too narrowly (Faure & Wang, 2008). Insurability has not hindered the US' marine shipping industry. Further, as the IOPC Funds do not compensate for claims of environmental damage based on theoretical quantification, no environmental assessment mechanism beyond valuing victims' economic losses has yet satisfied the IOPC Funds (Cuesta, personal communication, 07-2016). Yet, victims' losses do not encompass all losses to the environment.

Yes, the direct market valuation approach is preferable when possible, as it is based primarily on readily available cost data. However, as many ecosystem services do not have associated markets, this approach is limited. The environment ought to be considered a victim in incidents of environmental damage. No matter the faults of a prescriptive approach, approaches which altogether discount the assessment and valuation of non-use values, at a time when human activities have taken the planet to its threshold, are no longer acceptable (MEA, 2005). Environmental policies and legislation cannot rely exclusively on use values and market prices because most environmental benefits are not market priced (Fullerton & Stavins, 1998).

Prescriptive methods of assessment and valuation, such as Methodika, may not be practical considering the unpredictability of oil spills and that each incident presents its own set of circumstances and concerns. However, over the past few decades, economists have developed a number of flexible methods for quantifying the financial value of natural capital intended for various policy purposes and uses including assessment and valuation (Liu, Costanza, Farber & Troy, 2010). As Groot et al. reported (2002), circumstances suited for all developed methods have been explicitly described. For example, economists have a preference for revealed rather than stated preference approaches when assessing and valuing environmental damage (Fullerton & Stavins, 1998). These methods, developed for the purpose of compensating for damaged non-use values, may not be based in the natural sciences, but they are approaches developed by economists to be applied within current economic constructs.

Neither approach is without its faults. While the US' regime has successfully applied the PPP by successfully addressing the assessment and valuation of the environment as a whole and who is responsible for claiming on behalf of the environment, it too could benefit from better science-policy integration (Cariglia & Patel, personal communication, 07-2016). In many cases, the US will apply prescriptive approaches such as resource equivalency analysis (REA) (DARRP, 2016). REA is conducted when a pollution incident has significant effect on particular animal or plant populations (DARRP, 2016). The application of methods such as REA in the marine environment are criticized because unlike land based habitats and resources, marine habitats and resources are difficult to quantify. Therefore, the effects of human intervention are harder to quantify and can perhaps generate more damage than the pollution itself (Cariglia & Patel, personal communication, 07-2016). Thus, all analysed compensation regimes, those which

adhere to a science-based approach and those which adhere to a prescriptive approach, ought to put greater emphasis on methods developed by environmental economists for the specific purpose of assessing and valuing environmental damage for the practical purpose of compensation rather than the cost of complementary restoration.

Globally, science and policy ought to be better integrated. In order to achieve better integration, interdisciplinary communication must be improved. Improving interdisciplinary communication should enable natural scientists to take economic analysis and prescription more seriously (Fullerton & Stavins, 1998).

5.2 Analysis Finds Canada's Current Regime is Under-Developed

In comparison to the four other regimes selected for analysis, Canada incorporates the fewest determined best practice indicators into its environmental damage assessment and valuation regime. Canada scored worse than the UK, a fellow Member State of the IOPC Funds. Thus, Canada's regime could be improved by incorporating measures that would allow ecosystem goods, services, and functions to be more comprehensively assessed and valued.

In many respects Canada and the UK could improve their existing regimes by examining and implementing aspects of the other's. The UK could further strengthen their regime by implementing a domestic fund similar to Canada's SOPF, capable of compensating victims of a ship-source oil spill. The UK would then be able to accept claims for environmental monitoring and restoration beyond the limitations imposed by the IOPC Funds. Further, the UK would also then be able to establish an approach for valuing environmental damage domestically, which could better incorporate best practice indicators and successfully apply the PPP by attempting to assess and value the environment as a whole.

Although Canada created a domestic fund, there are seven best practice indicators successfully implemented by the UK that ought to be adopted by Canada. These indicators include:

- region specific conservation objectives with specific definitions of 'significant damage';
- environmental monitoring procedures integrated into post-spill contingency plans;
- an agency with the administrative and technical capacity dedicated to adequately perform/oversee the monitoring and assessment of a spill;
- established guidelines with pre-defined objectives that aim to establish causality embedded into the response framework;
- a mandated cooperative assessment process between the polluter and the appointed agency; and
- assigned region specific 'trustees'.

As a result of the gap analysis, 19 recommendations have been made with the intention of strengthening Canada's existing environmental damage assessment and valuation regime (Table 11). Key recommendations and steps to implementation which would not affect Canada's status as a Member State to the intergovernmental Conventions, are discussed below.

The first recommendation for Canada stems from conversations with ITOPF experts. Experts stated there is often an absence of area-specific conservation objectives in nations where incidents occur (Cariglia & Patel, personal communication, 07-2016). Thus, it is important that nations create area-specific definitions of 'significant damage' (Cariglia & Patel, personal communication, 07-2016). These definitions as recommended by experts, force decision-makers to consider the ecological importance of the marine environment and therefore, ought to be implemented in Canada. Area-specific definitions of significant damage could be integrated into the geographic response plans proposed by the Tanker Safety Expert Panel in their 2013 Report.

Fortunately, Canada has never had a major ship-source oil spill occur within its territorial waters (Transport Canada, 2013). However, a lack of incidents can be seen as having hindered development of Canada's regime, as little precedent for an event has been set. Due to this, there is a lack of experience amongst Canada's responders (CCG, 2015). Preventative measures are the best way to limit damage to the environment and Canada's inadequate response capacity must be addressed in order to implement best practice response. Thus, it is recommended that Canada's responders be mandated to prepare to successfully respond to ship-source oil spills over 10, 000 tonnes. This recommendation to increase response capacity has also been made by the Tanker Safety Expert Panel and experts at ITOPF (Cariglia & Patel, personal communication, 07-2016; Transport Canada, 2013).

Globally, there is often an exclusion of environmental authorities in contingency planning for ship-source oil spills and this is true of Canada (Cariglia, personal communication, 07-2016). Thus, Canada must integrate environmental authorities and environmental monitoring procedures into contingency plans (Cariglia, personal communication, 07-2016). Further technical knowledge for spill specific monitoring ought to be developed through regional agreements and information sharing (Cariglia, personal communication, 07-2016). Further, Canada must select and develop a government agency prepared to respond to all spill scenarios and to ensure environmental assessment occurs. After the Marathassa incident representatives from Environment Canada and their subdivision, the National Environmental Emergencies Centre (NEEC), were hesitant to respond (Cariglia, personal communication, 07-2016). A Canadian agency must be determined and clearly tasked with responding to ship-source oil spills for the purpose of overseeing environmental damage assessment and valuation. Otherwise, no agency is tasked with submitting environmental damage claims on behalf of Canadians when a ship-source oil spills occur. This report recommends that NEEC's current mandated response be expanded in order to undertake this task.

Moreover, the determined agency must have adequate resources to respond and must be trained correctly (Raymond, personal communication, 07-2016). Mandatory drills and exercises for the selected agency must be implemented and should seek to include environmental regulators (Cariglia, personal communication, 07-2016). ITOPF experts indicated that during the Marathassa incident responders tasked with assessment were unauthorized and below training standards (Cariglia & Patel, personal communication, 07-2016). Therefore, training standards for the selected agency must be elevated in order to meet best practices. Additionally, the agency tasked with assessment should not also be tasked with response or clean-up (Cariglia, personal communication, 07-2016; Challenger, personal communication, 06-2016). The overlap of tasks

creates distractions, slows both processes, and is a drain on resources (Cariglia, personal communication, 07- 2016; Challenger, personal communication, 06-2016).

Canada must also create and implement mandatory assessment guidelines for the government agency tasked with environmental damage assessment post spill, or at minimum the consulting agency hired by the polluter, to utilize when undertaking assessment (Cariglia & Raymond, personal communication, 07-2016). Canada's assessment guidelines should seek to replicate the UK's PREMIAM guidelines as they are recommended by experts at ITOPF (Cariglia & Patel, personal communication, 2016). ITOPF experts have found those tasked with environmental assessment lack pre-defined objectives that aim to establish causality which often leads to an inefficient use of resources (Cariglia, personal communication, 07-2016). To resolve this, it is suggested that the PREMIAM guidelines be applied as they are not prescriptive, but flexible to a case per case basis (Cariglia, personal communication, 07-2016).

Further, world-leading regimes such as that of the IOPC Funds, the UK, and the US implement cooperative assessment between the polluter and a government agency. A cooperative approach facilitates social license and removes perceived bias from the process (Cariglia, Patel, Raymond & Meyers, personal communication, 07-2016). Thus, it is recommended that Canada implement cooperative assessment.

In addition to implementing cooperative assessment, it is also recommended that Canada assign region specific 'trustee' equivalents from federal, provincial, local, and indigenous governments and agencies within the geographic response plans proposed by the Tanker Safety Expert Panel (Transport Canada, 2013). World-leading systems proactively involve a broad coalition of potentially impacted parties in both the pre and post-spill processes, establishing baseline data that informs damage assessment, restoration, and recovery (DeCola, 2015). Canada must create independent, autonomous councils with defined missions and ensure a broad representation of regional stakeholder interests.

The Alaska Regional Citizens Advisory Council (ARCAC) is an excellent example of a regional 'trustee'. The ARCAC includes a range of regional stakeholder groups, has a clearly defined scope of activities tied to local oil operations, focuses on a specific sub-region of Alaska, is required by federal statute and is funded by industry (DeCola, 2015). The inclusion of this best practice indicator ensures sustained citizen-level oversight as long as oil operations are underway (DeCola, 2015).

In addition to establishing 'trustee' councils, Canada ought to be encouraging and providing funding for citizen oversight systems which establish baseline data and inform damage assessment and valuation. Washington's coastal observation and seabird survey team (COASST) is an example of a world-leading citizen oversight systems that operates with sufficient funding and autonomy while maintaining clear separation from both industry and government. COASST is a project of the University of Washington that creates a network of citizens from coastal communities and engages them in rigorous data collection. Data collected are up to a level that can be admissible in courts and can contribute to establishing baselines against which any impact can be assessed (DeCola, 2015). Canada ought to model citizen oversight systems after that of

COASST with the intention of collecting baseline data in order to better protect Canadian ecosystems and citizens in the event of a ship-source oil spill.

In order to incorporate many best practice indicators into its regime Canada needs to better involve the public in its regime. In addition to creating citizen oversight systems, recommendation eighteen suggests the public ought to be able to comment on claims decisions involving environmental damage and participate in the development of environmental valuation practices. Further, recommendation seventeen suggests that in order to create transparency in decision-making all environmental damage claims ought to be made accessible to the public. At the time of this writing, claims submitted directly to the ship owner under the *CLC* are not public record (Murgatroyd & Jones, personal communication, 06-2016). As environmental damage claims concern public resources, it ought to be legislated that the settlements of these claims are made accessible to the public so that citizens may be better informed of how their environment is monetarily valued, if at all. Transparency is a principle of social responsibility under the PPP and must be applied when incidents concern public interest.

The SOPF is transparent in its approach to valuation, but is inadequately prepared to handle claims from ship-source oil spills over 10,000 tonnes (Cariglia & Patel, personal communication, 07-2016). Experts find Canada's top-up fund to be superficial (Cariglia & Patel, personal communication, 07-2016). Thus, this recommendation is to bolster the SOPF by implementing a temporally limited levy and to create legislation which ties the *CSA* to the EDF so that the fund may be utilized when ship-source oil spills occur. Establishing a threshold for the levy is beyond the scope of this research, but must be considered.

The US' OSLTF is an example of a world-leading oil spill response funding approach because it makes funding immediately accessible to federal response agencies for spill response (DeCola, 2015). Up to US$1 billion dollars is available per incident and US$50 million is immediately accessible to deferral response agencies (DeCola, 2015). The OSLTF provides financial assurance in cases where the polluter is unknown or insolvent, or if liability caps are exceeded (DeCola, 2015). Canada must implement a similar approach and evaluate fund reserve per-incident limits, ensuring adequate funding is available to cover worst case spill scenarios, as well as ensuring funding can be used for restoration and recovery activities (DeCola, 2015).

Best practice response systems have an established process for evaluating spill damages, restoring injured resources, and compensating parties who experience damages as a result of an oil spill (DeCola, 2015). The SOPF does not have established environmental damage guidelines and is currently without precedent (Gadula, personal communication, 06-2016). Thus, this recommendation is to create publicly available environmental damage claims guidelines tailored to the SOPF. Further, guidelines tailored for the SOPF should include a developed approach for assessing and valuing cultural loss designed to accommodate Canada's Aboriginal populations. In order to accommodate for cultural loss, the SOPF would require an assessment and valuation approach incorporating non-use values, which would incorporate yet another best practice indicator.

Additionally, cultural and environmental damage guidelines for the SOPF must permit claims extensions. Practices such as those implemented by the US and the *ELD*, permit temporal

extensions for environmental damage claims based on the fact that environmental damage may be long-term, or may not surface immediately. Evidence of the need to permit temporal extensions was demonstrated by the *Exxon Valdez* (NOAA, 2016). Thus, Canada ought to adopt policies allowing extensions for environmental damage claims submitted to the SOPF.

Lastly, in order to achieve best practices Canada must ensure that any environmental damage claims resulting in compensation whether submitted to the SOPF or EDF result in environmental studies which seek to better understand the value of ecosystem goods, services, and functions. Experts at ITOPF and the IOPC Funds emphasized the point that nations will frequently win compensation through litigation, but will not invest those gains back into the environment for future assessment and valuation improvement (Cuesta, Cariglia & Patel, personal communication, 07-2016). In fact, all of the selected compensation regimes examined in this study would benefit from the creation of legislation which ensures polluters must compensate for environmental damage by contributing a monetary sum towards developing baseline monitoring programs and methods of assessing and valuing ecosystem services and functions. Legislating mechanisms which support the need for further baseline monitoring will only allow natural scientists and economists alike to better develop methods of understanding the direct market value of ecosystems.

One of the largest obstacles to submitting successful environmental damage claims after a ship-source oil spill occurs is a lack of baseline data. Ecosystems in marine environments are vast, complex, and highly varied on sometimes small geographic scales and rarely is consistent baseline data collected to a level that can be admissible in courts. Thus, it can be difficult for post-spill assessment and monitoring to prove environmental damage when a ship-source oil spill occurs, as spills are unlikely to occur in an area which happens to be monitored consistently (Cariglia, Patel, Cuesta & Della Mae, personal communication, 07-2016). Fortunately, there is a stronger demand today to demonstrate an understanding of possible impacts of an oil spill to the environment than in the past (Reynolds, 2015). Since the mid-1990s, ITOPF has observed an apparent increase in the number of post-spill studies being carried out (Reynolds, 2015). Post-spill studies now occur at over 40% of the of the cases ITOPF responds to (Reynolds, 2015). Thus, Canada ought to be conducting robust post-spill studies and baseline monitoring in order to increase data availability. A complete list of recommendations to strengthen Canada's existing regime can be found in Table 11.

Table 11 – Recommendations for Improving Canada's Existing Regime

#	***Recommendations for Required Implementation***
1	Geographic response plans, with region specific conservation objectives and specific definitions of significant damage, ought to be implemented.
2	Implement the recommendations made by the Tanker Safety Expert Panel. Specifically, increase required response capacity.
3	Develop and mandate post-spill environmental monitoring procedures and integrate them into contingency planning.
4	Establish an agency with an administrative and technical capacity, dedicated to adequately performing/overseeing the monitoring and assessment of a spill. Mandate regular drills and exercise training and their presence at major ship-source spills. Explore Canada's National Environmental Emergencies Centre (NEEC) as an option. Further, ensure the agency has the legislative capacity to claim environmental damages from spills.
5	Implement a temporally limited levy to bolster the SOPF to be capable of funding large scale spills and increase the maximum liability of the SOPF. Create legislation to tie the EDF to the *CSA*.
6	Create SOPF specific environmental damage claims guidelines which are accessible to all possible claimants.
7	Establish assessment guidelines with pre-defined objectives that aim to establish causality. Utilize the PREMIAM guidelines as a standard and embedded these guidelines into the response framework.
8	Establish an agency to be mandated with undertaking cooperative assessment in every spill over 1,000 tonnes in order to foster public trust and assurance.
9	Assign region specific 'trustee' equivalents from federal, provincial, local, and indigenous governments and agencies within the geographic response plans to implement damage assessment and restoration.
10	Select an agency tasked with assessment and ensure they are not also responsible for response.
11	Proactively create SOPF specific environmental damage claims guidelines which are accessible to all possible claimants and incorporate methods of monetarily valuing non-use values.
12	Incorporate non-use values into the valuation approach of the SOPF and lobby fellow Member States to the IOPC Funds to include non-use values.
13	Permit extensions under the SOPF and lobby fellow Member States to the IOPC Funds to permit extensions for environmental damage claims.
14	Develop and mandate environmental monitoring procedures and integrate them into contingency planning. Develop a baseline monitoring program.
15	Encourage and provide funding for citizen oversight systems which establishes baseline data and informs damage assessment and valuation such as those running in Washington and Alaska U.S.
16	Develop an approach that could be applied by the SOPF and lobby fellow Member States to the IOPC Funds to incorporate an approach for assessing and valuing cultural loss.
17	All assessment and valuation practice documents should be made available to the public. Transparency is a principle of social responsibility under the PPP and must be applied when incidents concern public interest.
18	Allow the public to comment on claims decisions and participate in the development of valuation practices.
19	Form legislation which ensures polluters are funding the development of methods which can appropriately assess and value ecosystem services and functions as well as further baseline data gathering.

5.3 Canada as a World Leader

Careful consideration and implementation of the previously discussed recommendations oughtt be implemented within the Canadian regime in order for Canada to successfully incorporate best practice indicators and achieve a world-class approach to environmental damage assessment and valuation. In addition to domestically strengthening Canada's regime, Canada must take steps at the intergovernmental level to become a world-leader in environmental assessment and valuation. Canada is currently a Member State of the IOPC Funds and is also one of the fifteen Members of the current 1992 Executive Committee (IOPC Funds, 2016). Ultimately, both international and intergovernmental compensation regimes ought to aim to incorporate non-use values into their assessment and valuation approach.

In order to attend to issues such as valuing environmental and cultural loss, non-use values must be considered. Canada must first find solutions to these issues within its domestic regime. For example, Canada can integrate best practice indicators into the SOPF. Further, Canada must use its influence to lobby other nations that are also Member States to the IOPC Funds and demand that they consider non-use values in the current intergovernmental system. Ultimately, progressive legislation which better accounts for environmental damage must be implemented.

Another outstanding issue within the intergovernmental regime is how to deal with potential benefits associated with future use. For example, current functions like wildlife as a food source, water purification, or attractive scenery in a remote area may have great economic potential for future use (DeCola, 2015). The US addresses this issue by applying prescriptive valuation methods. Under the IOPC Funds this is not possible at this time, but Canada could extend the amount of time available to file environmental damage claims under the SOPF and lobby fellow Member States to the IOPC Funds to extend temporal limitations in regards to environmental damage claims. Thus, temporal limitations must be set, but limitations ought to apply differently to direct market claims and environmental damage claims. World-class funds, such as the OSLTF do not prevent future cost recovery actions (DeCola, 2015).

Resistance to better assessing and valuing environmental damage at an intergovernmental level occurs due to two main reasons. Firstly, it is difficult to change policy and legislation at an intergovernmental level, as so many nations must agree to ratify newly introduced policies and legislation. One hundred and fourteen nations are currently Member States to the 1992 IOPC Funds Convention. Each of those one hundred and fourteen nations has its own domestic approach to assessing and valuing environmental damages caused by ship-source oil spills; therefore, consensus is unlikely (Cuesta & Della Mae, personal communication, 07- 2016). Thus, rather than lobby for changes within the intergovernmental regime, historically nations that have suffered environmental damages take legal action against ship owners outside of the intergovernmental regime (Cuesta & Della Mae, personal communication, 07- 2016). Secondly, environmental damage claims tend to be quite costly (Cuesta & Della Mae, personal communication, 07- 2016). Were environmental damage claims that account for non-use values accepted by the IOPC Funds, the Supplementary Fund would be required much more frequently and would perhaps be exceeded (Cuesta & Della Mae, personal communication, 07- 2016). When the IOPC Funds and Supplementary Funds are exceeded claims may be settled only partially on a basis of priority (IOPC Funds, 2016). Thus, the full cost of environmental damage

cannot be considered, or the victims of a spill that the IOPC Funds and Supplementary Fund are intended to compensate may not be compensated correctly (Cuesta & Della Mae, personal communication, 07- 2016). Therefore, when the Funds refer to victims, they refer specifically to the economic loss of human victims. This definition of a victim is too narrow as it is known that environmental damage does, and will continue to, economically impact humans. This narrow definition also implies that the polluter is responsible for only certain damages. Yet, the PPP is intended to hold polluters responsible for all damages they may cause. Thus, environmental damages ought to be weighted as heavily as economic damages and perhaps the limits of liability set by the Fund are too narrow (Faure & Wang, 2008).

Based on this analysis, Canada and the intergovernmental regime Canada is a party to, are not successfully applying the PPP in terms of assessing and valuing environmental damage. In order to successfully apply the PPP, as Canada aims to do in its regime, Canada must use its influence to lobby fellow Member States of the IOPC Funds to better apply the PPP. This will include developing an approach for valuing non-use values and cultural loss while permitting extensions on environmental damage claims. The implementation of these best practice indicators is already successfully done by another intergovernmental organization, the *ELD*. Thus, Canada should begin by lobbying Member States to the *ELD*. After all, assessments should explicitly factor in levels of social, economic and cultural dependence as well as future change (Spalding et al., 2014).

5.4 The Profound Impact Environmental Assessment and Valuation on Marine Management

Human security depends on equitable development within the means of nature (Rees, 2002). It is known that coastal ecosystems play a critical role in reducing human vulnerability. In order to sustainably manage coastal ecosystems and the marine environment, the value of ecosystems must be acknowledged and assessed (Spalding et al., 2014). When it comes to environmental impacts, marine managers and policy makers often omit the true value of ecosystem services in national and global accountings (Harley et al., 2007). This happens for several reasons including the fact that ecosystem services are intangible, non-excludable and often invisible. Moving forward, marine managers must strive to wholly assess the value of ecosystems and consider long-term impacts (Harley et al., 2006; Spalding et al., 2014). Non-use values must be integrated into the mainstream planning process and should be thoughtfully examined by managers – including considerations of food security, livelihoods, and vulnerability to culture (Spalding et al., 2014).

The complexities of natural systems are not yet fully understood (Weinstein, 2007). However, managers must - in the face of imperfect science - attempt management and make decisions with a lack of information (Weinstein, 2007). Economists have done the same for decades by working to successfully value ecosystems and have constructed numerous methods capable of incorporating use values and non-use values in valuation. These methods have been successfully used to monetize the intrinsic value that humans place on the environment.

The utilization of a broad range of monetary valuation tools can enable society to begin to capture the complexity of ecosystems and include its value in decision-making (Chee, 2004; De Groot, 2012). Furthermore, valuation forces policy and decision-makers to consider trade-offs,

and most importantly, consider decisions on a long-term scale (Chee, 2004; De Groot, 2012). In order to successfully undertake marine management and planning, creating a prioritized structure is imperative for long-time implementation success (Scherer et al., 2014). Further, in order to accurately prioritize marine management and planning the value of ecosystems, their goods, services and functions, must be known (Scherer et al., 2014). By placing a distinct value on natural capital, policy and decision-makers can seriously prioritize and consider restorative and remedial options when making choices related to the environment.

Therefore, monetary valuation can provide information to policy and decision-makers that would otherwise be inaccessible (Wainger et al., 2014). Without these values it is likely and conceivable that people would simply not consider the innate importance of natural capital when developing policy. The utilization of a broad range of monetary valuation methods can enable society to begin to capture the complexity of ecosystems and include their value in decision-making (Chee, 2004; De Groot, 2002)

Decision-making is transpiring in the current marine management system with little to no consideration of the increasing degradation to our ecosystems (Chee, 2004, Costanza et al., 1997, De Groot, 2002). Illuminating the immense value of ecosystems will require political support (Scherer et al., 2014). In the case of assessing and valuing environmental damage after a ship-source oil spills occurs, an unprecedented level of cooperation rooted in a sense of sustainability and social justice is required.

6.0 Conclusions

The ideal outcome of management is socio-economic development that is integrated into a dynamic and natural system without loss of natural capital or the functional integrity of ecosystems. Given the scale of human activities on the planet, the point has been reached where the cumulative losses in ecosystem services are forcing decision-makers to incorporate the value of these services into societal decision-making. As a result, decision-makers must be striving to successfully apply the PPP.

This study has shown that both intergovernmental and international compensation regimes regarding ship-source oil spills are failing to successfully apply the PPP. Therefore, both the environment and society are at risk of having the externalities of industry transferred to them when ship-source oil spills. The PPP has evolved to require polluters to pay compensation to the victims of pollution, but is ineffective when the environment in not considered a victim.

In order to adequately compensate for environmental damages, compensation regimes must develop legislation and policies that incorporate both the use values and non-use values of natural capital. This study concludes that there are valuation methods that may be applied to successfully determine TEV. Thus, decision-makers should be applying the appropriate methods of valuation as determined by experts and referenced in Table 3.

The only compensation regime examined which successfully attempts to apply the PPP is that of the United States. Comparatively, Canada's compensation regime is under-developed. This study has provided nineteen recommendations intended to strengthen Canada's existing

regime. Recommendations provided can be achieved within Canada's current legislation and ought to be implemented immediately.

In order to further progress compensation regimes, Canada included, must better align science with policy. There is a need for both intergovernmental and international compensation regimes to fund and implement baseline monitoring within the marine environment. Baseline monitoring programs provide baseline data which better allow scientists to assess and value environmental damage. Specifically, these programs ought to be emphasized for coastal shoreline areas when impacts may be significant.

Further, in order to progress to a point where compensation regimes must support science to transition to an approach within ecological economics capable of holistically assessing and valuing environmental damage. The common metric in economics is monetary valuation and some critics say the reliance in this metric has plagued many ecosystem service assessments by failing to incorporate several types of value which are critical to understanding the relationship between society and nature. The limitations of monetary valuation are especially important as ecosystems approach critical thresholds as they are. Thus, it is challenging to quantify the utilitarian and intrinsic value of ecosystems, but as they approach thresholds it is critical that compensation regimes adopt valuation approaches which allow for holistic valuation thereby successfully applying the PPP.

References

Primary

International Treaties and Agreements

International Convention on Civil Liability for Oil Pollution Damage, 29 November 1969, 973 U.N.T.S. 3

Protocol to the International Convention on Civil Liability for Oil Pollution Damage, 1969, 19 November 1976, 1225 U.N.T.S. 356

Protocol to Amend the International Convention on Civil Liability for Oil Pollution Damage, 1969, 25 May 1984, 23 I.LM. 177

Protocol to Amend the International Convention on Civil Liability for Oil Pollution Damage, 1969, 27 November 1992, U.K.T.S. 1996 No.87

International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 18 December 1971, 1110 U.N.T.S. 57

Protocol to Amend the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage of December 18 1971, 19 November 1976, 16 I.L.M. 621

Protocol of 1984 to Amend the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971, 25 May 1984, 23 I.L. M. 195

Protocol of 1984 to Amend the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971, 27 November 1992, 1996 A.T.S. 3

Directive 2004/35/EC of the European Parliament and of the Council of 21 April 2004, on environmental liability with regard to the prevention and remedying of environmental damage

Canada

Canadian Environmental Protection Act, 1999, S.C. 1999, c.33

Canadian Shipping Act, 2001, S.C. 2001, c.26

Fisheries Act, R.S.C., 1985, c. F-14

Marine Liability Act, S.C. 2001, c.6

Migratory Birds Convention Act, 1994, S.C. 1994, c.22

The United States

*Oil Pollution Act***,** 33 U.S.C. §§ 2701-2761

The Comprehensive Response, Compensation, and Liability Act, 42 U.S.C. §§ 9601 et seq.

Reports

Canadian Coast Guard (CCG). (2015). Independent review of the M/V Marathassa fuel oil spill environmental response operation. Retrieved from http://www.ccg-gcc.gc.ca/folios/00018/docs/Marathassa_Report-eng.pdf

Cariglia, N. (2016). Preparedness for oil spill environmental monitoring: An international perspective. Retrieved from https://www.cefas.co.uk/media/53091/preparedness-for-oil-spill-environmental-monitoring-an-international-perspective.pdf

Cosco Busan Oil Spill Trustees (CBOST). (2012). Cosco Busan Final Damage Assessment and Restoration Plan/Environmental Assessment. Retrieved from https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=42442&inline=true

Council of Canadian Academies (CCA). (2016). Commercial marine shipping accidents: understanding the risks in Canada. Retrieved from http://www.scienceadvice.ca/uploads/eng/assessmentspublicationsnewsreleases/marineshippingrisks/cca_marine_shipping_risks_en_fullreport.pdf

Damage Assessment, Remediation, and Restoration Program (DARRP). (2016). Habitat Equivalency Analysis. Retrieved from https://darrp.noaa.gov/economics/habitat-equivalency-analysis

DeCola, E. (2015). Marine oil spill prevention preparedness, response and recovery: World-leading approaches from select jurisdictions. Retrieved from http://www.env.gov.bc.ca/main/west-coast-spill-response-study/docs/BC-World-Leading-Approaches-for-Select-Jurisdictions-Oct2015.pdf http://www.env.gov.bc.ca/main/west-coast-spill-response-study/docs/BC-World-Leading-Approaches-for-Select-Jurisdictions-Oct2015.pdf

Dicks, B. (2006). Compensation for environmental damage caused by oil spills: An international perspective. Retrieved from http://www.itopf.com/fileadmin/data/Documents/Papers/amureBD.pdf

Environmental Protection Agency of the United States (EPA). (2016). Natural resource damages: A primer. Retrieved from https://www.epa.gov/superfund/natural-resource-damages-primer

European Commission (EC). (2013). *Environmental Liability Directive: Training handbook and accompanying slides*. Retrieved from

http://ec.europa.eu/environment/legal/liability/pdf/eld_training/ELD%20Training%20Handbook%20-%201%20Day%20-%20Final%20Version%20-%2020.2.2013.pdf

Government of Canada (GOC). (2013). *Environmental Damages Fund.* Retrieved from http://www.ec.gc.ca/edf-fde/

Government of Canada. (2014). *Ship-source oil pollution fund claims manual: 2014 Edition*. Retrieved from http://www.ssopfund.ca/CMFiles/SOPF-Claims-Manual-2014-Electronic-Booklet-ENGLISH.pdf

Government of the United Kingdom. (GUK, 2016). Liability & compensation for pollution damage. Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/338799/130802_Liability_and_Compensation_for_Pollution_Damage.pdf

Hemmera. (2015). M/V Marathassa Fuel Spill Environmental Impact Assessment. Retrieved from http://www.ccg-gcc.gc.ca/folios/00025/docs/Marathassa-Hemmera.pdf

Law, R., J., Kirby, M.F., Moore, J., Barry, J., Sapp, M. and Balaam, J. (2011). PREMIAM – Pollution Response in Emergencies Marine Impact Assessment and Monitoring: Post-incident monitoring guidelines. Science Series Technical Report, Cefas, Lowestoft, 146, *164*.

Millennium Ecosystem Assessment (MEA). (2005). Overview of the millennium ecosystem assessment. Retrieved from http://www.millenniumassessment.org/en/About.html

Molnar, M., David Suzuki Foundation (DSF). (2015). Sound investment: Measuring the return on Howe Sound's ecosystem assets. Retrieved from http://www.davidsuzuki.org/publications/downloads/SoundInvestment-HoweSoundEcosystemAssets.pdf

Munir, M. (2013). History and evolution of the polluter pays principle: How an economic idea became a legal principle. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2322485

National Oceanic and Atmospheric Administration – Office of Response and Restoration (NOAA). (2016). Exxon Valdez Oil Spill. Retrieved from http://response.restoration.noaa.gov/oil-and-chemical-spills/significant-incidents/exxon-valdez-oil-spill

PREMIAM. (2016). Pollution response in emergencies: Marine impact assessment and monitoring. Retrieved from https://www.cefas.co.uk/premiam.aspx

Ramseur, J. L. (2012). Oil spills in U.S. coastal waters: Background and governance - Congressional Research Service. Retrieved from https://www.fas.org/sgp/crs/misc/RL33705.pdf

Reynolds, L. (2015). Are post-spill environmental studies becoming the norm? Retrieved from http://interspill.org/previous-events/2015/WhitePapers/Interspill2015ConferenceProceedings/25%20MARCH%202015/Future%20Risk%20-%20Recent%20Trends/Are-post-spill-environmental-studies-becoming-the%20norm.pdf

Ship Disasters. (2016). MSC Napoli. Retrieved from http://www.ship-disasters.com/commercial-ship-disasters/container-ship-disasters/msc-napoli/

Ship-source oil pollution fund (SOPF). (2015). The administrator's annual report 2015-2016. Retrieved from http://www.ssopfund.ca/CMFiles/reports-en/SOPF-Annual-Report-2015-2016-EN.pdf

Transport Canada. (2013). A review of Canada's ship-source oil spill preparedness and response regime: Setting the course for the future. Retrieved from www.tc.gc.ca/eng/tankersafetyexpertpanel/menu.htm

The Economics of Ecosystems and Biodiversity for Business Coalition (TEEB). (2013). Natural capital at risk: The top 100 externalities of business. Retrieved from http://www.longfinance.net/images/PDF/trucost_naturalcapital_2013.pdf

The International Maritime Organization (IMO). (2016a). *Introduction to IMO*. Retrieved from http://www.imo.org/en/About/Pages/Default.aspx

The International Maritime Organization (IMO). (2016b). International Convention on Civil Liability for Oil Pollution Damage (CLC). Retrieved from http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-on-Civil- Liability-for-Oil-Pollution-Damage-(CLC).aspx

The International Oil Pollution Compensation Funds (IOPC Funds). (2016). *The International Oil Pollution Compensation Funds.* Retrieved from http://www.iopcfunds.org/

The International Oil Pollution Compensation Funds (IOPC Funds). (2013). *International oil pollution compensation fund 1992: Claims manual*. Retrieved from http://www.iopcfunds.org/uploads/tx_iopcpublications/claims_manual_e.pdf

The International Oil Pollution Compensation Funds (IOPC Funds). (2010). Incidents involving the IOPC Funds – 1992 Fund: Volgoneft 139. Retrieved from file:///Users/kaylaglynn/Downloads/IOPC_OCT10_3_9.pdf

United States Coast Guard (USCG). (2016). Oil Pollution Act (OPA) Frequently Asked Questions. Retrieved from https://www.uscg.mil/npfc/About_NPFC/opa_faqs.asp

Wainger, L., A., Johnston, R., J., Bagstad, K., J., Clyde, Casey, C., F., Vegh, T. (2014). Monetary valuation methods for ecosystem service benefits. Retrieved from http://sites.nicholasinstitute.duke.edu/nesp-frmes/files/2014/06/Monetary-valuation_040914_DRAFT.pdf

Secondary

Australian Association of Maritime Affairs (AAMA). (2007). Air pollution and greenhouse gas emissions from ocean-going ships: Impacts, mitigation options and opportunities for managing growth: International council on clean transportation. Maritime Studies, 15, 3-10.

Chee, Y. E. (2004). An ecological perspective on the valuation of ecosystem services. Biological Conservation, 20, 549-565.

Chricop, A., Letalik, N., McDorman, T., L. & S., J., Rolston. (Ed.). (2012). The regulation of international shipping: International and comparative perspectives: Essays in honour of Edgar Gold. Netherlands: Martinus Hijhoff Publishers.

Costanza, C., Dearge, R., de Groot, R., S., Farber, S…& R., O'Neill. (1997). The total value of the world's ecosystem services and natural capital. Nature, 387, 253-260.

Daily, G. (1997). Nature's services: Societal dependence On natural ecosystems. Washington, DC: Island Press.

De Groot, R., S., Wilson, M., A., & R., M., J., Boumans. (2002). A typology for the classification, description and valuation of ecosystem functions, goods and services. Ecological Economics, 41(3), 393-408.

Faure, M., & Wang, H. (2008). Financial caps for oil pollution damage: A historical mistake? *Marine Policy, 32*(4), pp. 592- 606.

Farber, S., C., Costanza, R., & M., A., Wilson. (2002). Economic and ecological concepts for valuing ecosystem services. *Ecological Economics, 41*(3), 375-392.

Fullerton, D., & R., Stavins. (1998). How economists see the environment. *Nature, 395*, 433-434.

Harley, C., D., G., Randal, H., A., Hultgren, K., M., Miner, B., G…& S., L., Williams. (2016). The impacts of climate change in coastal marine systems. Ecology Letters, 9(2), 228-241.

Kirby, M., F., Gioia, R., & R., J., Law. (2014). The principles of effective post-spill environmental monitoring in marine environments and their application to preparedness assessment. Marine Pollution Bulletin, 82, 11-18.

Kumar, P. (Ed.). (2010). The economics of ecosystems and biodiversity ecological and economic foundations. London: Earthscan.

Liu, S., Costanza, R., Farber, S., & T., Austin. (2010). Valuing ecosystem services. Annals of the New York Academy of Sciences, 1181(1), pp. 54-78.

Maes, F. (Ed.). (2005). Marine resource damage assessment: Liability and compensation for environmental damage. Dordrecht: Springer.

Neuparth, T., Moreira, S., M., & Santos, M., M., & M., A., Reis-Henriques. (2012). Review of oil and HNS accidental spills in Europe: Identifying major environmental monitoring gaps and drawing priorities. Marine Pollution Bulletin, 64(6), 1085-1095.

Rees, W. (2002). An ecological economics perspective on sustainability and prospects for ending poverty. Population and Environment, 24(1), 15-46.

Scherer, M., Andrade, J., Emerim, E., G., Felix, A… & F., A.,Veiga. (2014). Prioritizing actions for coastal management: A methodological proposal. Ocean and Coastal Management, 91, 17-22.

Spalding, M., D., Ruffo, S., Lacambra, C., Meliane, I…& M., W., Beck. (2014). The role of ecosystems in coastal protection: Adapting to climate change and coastal hazards. Ocean & Coastal Management, 90, 50-57.

Srinivasan, T., U., Carey, S., P., Hallstein, E., Higgins, P., A., T…& R., B., Norgaard. (2007). The debt of nations and the distribution of ecological impacts from human activities. Proceedings of the National Academy of Sciences of the United States of America, 105(5), 1768-1773.

Weinstein, M., P., Baird, R., C., Conover, D., O., Gross, M…& H., Windt. (2007). Managing coastal resources in the 21st Century. Frontiers in Ecology and the Environment, 5, 43-48

Zhu, L., & Y., Zhao. (2015). A feasibility assessment of the application of the polluter-pays principle to ship-source pollution in Hong Kong. Marine Policy, 57, 36-44. doi:10.1016/j.marpol.2015.03.010

Tertiary

Savill, R. (2008, November 7). MSC Napoli second most expensive wreck in history, shows insurance report. The Telegraph. Retrieved from http://www.telegraph.co.uk/news/uknews/3397327/MSC-Napoli-second-most-expensive-wreck-in-history-shows-insurance-report.html

Appendices

Appendix A

An Exemplary Listing of Ecosystem Services and Functions

Number	*Ecosystem Service*	*Ecosystem Functions*	*Examples*
1	Gas Regulation	Regulation of atmospheric chemical composition	CO2/O2 balance, for O3 for UVB protection, and SOx levels
2	Climate Regulation	Regulation of global temperature, precipitation, and other biologically mediated climatic processes at global or local levels	Greenhouse gas regulation, DMS production affecting cloud formation
3	Disturbance Prevention	Capacitance, damping and integrity of ecosystem response to environmental fluctuations	Storm production, flood control, drought recovery and other aspects of habitat response to environmental variability mainly controlled by vegetation structure
4	Water Regulation	Regulation of hydrological flows	Provisioning of water for agricultural or industrial processes or transportation
5	Water Supply	Storage and retention of water	Provisioning of water by watersheds, reservoirs and aquifers
6	Soil Retention	Retention of soil within an ecosystem	Prevention of loss of soil by wind, runoff, or other removal processes, storage, of stilt in lakes and wetlands
7	Soil Formation	Soil formation processes	Weathering of rock and the accumulation of organic material
8	Nutrient Regulation	Storage, internal cycling, processing and acquisition of nutrients	Nitrogen fixation, N, P and other elemental or nutrient cycles
9	Waste Treatment	Recovery of mobile nutrients and removal or breakdown of excess or xenic nutrients and compounds	Waste treatment, pollution control, detoxification
10	Pollination	Movement of floral gametes	Provisioning of pollinators for the reproduction of plant populations
11	Biological Control	Trophic-dynamic regulations of populations	Keystone predator control of prey species, reduction of herbivory by top predators
12	Refugium	Habitat for resident and transient populations	Nurseries, habitat for migratory species, regional habitats for locally harvested species, or overwintering grounds
13	Food Production	That portion of gross primary production extractable as food	Production of fish, game, crops, nuts, fruits, by hunting, gathering, subsistence farming or fishing
14	Raw Materials	That portion of gross primary production extractable as raw material	The production of lumber, fuel or fodder
15	Genetic Resources	Sources of unique biological materials and products	Medicine, products for materials science, genes for resistance to plant pathogens and crop pest, ornamental species
16	Recreation	Providing opportunities for recreational activities	Eco-tourism, sport fishing, and other outdoor recreational activities
17	Cultural	Providing opportunities for non-commercial uses	Aesthetic, educational, spiritual, and/or scientific values of ecosystems

Appendix B

Listing of Contacts Interviewed

Contact	*Associated Organization*	*Time of Contact*
Chiara Della Mea	IOPC Funds	07-2016
Anna Cuesta	IOPC Funds	07-2016
Liliana Monsalve	IOPC Funds	07-2016
Nicky Cariglia	ITOPF	07-2016
Miguel Patel	ITOPF	07-2016
Alex Hunt	ITOPF	07-2016
Lisa Crowle	AMSA	07-2016
Michael Anderson	California Department of Fish and Wildlife	07-2016
Alison Meyers	Spill Prevention, Preparedness, and Response Program	07-2016
Tom Leschine	University of Washington	07-2016
Kim Beasley	Clean Islands Council	07-2016
Kate Emmings	Islands Trust Fund	07-2016
Natalie Chavarie	Environmental Damages Fund	07-2016
Greg Challenger	Polaris Applied Sciences	06-2016
Karolyn Jones	Canadian Coast Guard	06-2016
Charles Gadula	SOPF	06-2016
Margaret Phelan	Environmental Damages Fund	06-2016
Chris Raymond	Environment Canada	06-2016
Louise Murgatroyd	Transport Canada	06-2016

Appendix C

Gap Analysis of Canada's Current Regime

Gap Analysis			
Current Regime	**Ideal Regime**	**Gaps Between the Two**	**Required Implementation**
Does not have region specific conservation objectives with specific definitions of 'significant damage'	Has created region specific conservation objectives with specific definitions of 'significant damage'.	Conservation objectives are overlooked.	Geographic response plans with region specific conservation objectives and specific definitions of significant damage ought to be implemented.
Has the capacity to effectively respond to a spill under 10,000 tonnes – when response was tested it was delayed	Has the capacity to organize effective clean-up operations.	Is not equipped to handle catastrophic spills that over 10,000 tonnes and has delayed response times.	Implement the recommendations made by the Tanker Safety Expert Panel. Specifically, increase required response capacity.
Has not integrated environmental monitoring procedures into contingency plans	Has integrated environmental monitoring procedures into contingency plans.	Monitoring is not required within current regime.	Develop and mandate post-spill environmental monitoring procedures and integrate them into contingency planning.
Has established that Environment Canada should provide environmental recommendations. However, they do not have the resources to do so.	Has established an agency with the administrative and technical capacity dedicated to adequately performing/overseeing the monitoring and assessment of a spill.	No agency is specifically mandated with performing/overseeing the monitoring and assessment of a spill, nor do they have capacity to perform adequately.	Establish an agency with the administrative and technical capacity dedicated to adequately performing/overseeing the monitoring and assessment of a spill. Mandate regular drills and exercises and their presence at major ship-source spills. Explore Canada's National Environmental Emergencies Centre (NEEC) as an option. Further, ensure the agency has the legislative capacity to claim environmental damages from spills.
SOPF is established and creates another safety layer above and beyond the IOPC Funds. However, it does not have the capacity to limit externalities were a catastrophic spill to occur.	Has established a fund capable of compensating victims of a ship-source oil spill.	Does not have the capacity to limit externalities were a catastrophic spill to occur.	Implement a levy to bolster the SOPF to be capable of funding large scale spills and increase the maximum liability of the SOPF. Create legislation to tie the EDF to the *CSA*.

Theoretically accepts claims for environmental monitoring and restoration under the IOPC Funds guidelines.	Accepts claims for environmental monitoring and restoration.	There is no precedent for how an environmental damage claim would be handled within Canada.	Create SOPF specific environmental damage guidelines which are accessible to all possible claimants.
Has not established assessment guidelines.	Has established assessment guidelines with pre-defined objectives that aim to establish causality and has embedded these guidelines into the response framework.	Does not have established guidelines and must create and implement best practice guidelines.	Establish assessment guidelines with pre-defined objectives that aim to establish causality such. Utilize the PREMIAM guidelines as a standard and embedded these guidelines into the response framework.
Polluter is solely responsible for the assessment process.	Has mandated a cooperative/joint assessment process between the polluter and an appointed agency.	No agency is appointed and no policy or legislation requires joint assessment.	Agency tasked with assessment ought to be mandated to undertake cooperative assessment in every spill over 1,000 tonnes in order to foster public trust and assurance.
Does not have region specific ‘trustees’ assigned.	Has assigned region specific 'trustee' equivalents from federal, provincial, local, and indigenous governments and agencies to implement damage assessment and restoration.	Only Environment Canada is meant to participate in damage assessment.	Assign region specific 'trustee' equivalents from federal, provincial, local, and indigenous governments and agencies within the geographic response plans to implement damage assessment and restoration.
Those responsible for clean-up measures are also responsible for assessment.	These 'trustees' are separate from those tasked with response and clean-up.	Trustees are not assigned and Environment Canada is involved in both response and assessment.	Select agency tasked with assessment and ensure they are not also responsible for response.
Theoretically follows the same approach as the IOPC Funds in terms of valuing damages to the environment.	Has established an approach for valuing damages to the environment.	There is no precedent for an environmental damage claim would be handled within Canada, but ought to follow the IOPC Funds approach.	Proactively create SOPF specific environmental damage claims guidelines which are accessible to all possible claimants and incorporate methods of monetarily valuing non-use values.
Has not incorporated non-use values into the established environmental valuation approach.	Has incorporated non-use values into the established environmental valuation approach.	Does not incorporated non-use values into the established environmental valuation approach.	Incorporate non-use values into the valuation approach of the SOPF and lobby fellow Member States to the IOPC Funds to include non-use values.
Does not permit extensions.	Permits extensions on environmental damage claims submissions due to their temporal nature	Does not permit extensions.	Permit extensions under the SOPF and lobby fellow Member States to the IOPC Funds to permit extensions for

			environmental damage claims.
Will undertake post-spill monitoring, but has not implemented a program.	Has implemented a post-spill and baseline monitoring program.	Monitoring is not mandatory and no program has been developed. No baseline monitoring is currently done to prepare for spills.	Develop and mandate environmental monitoring procedures and integrate them into contingency planning. Develop a baseline monitoring program.
Does not actively support citizen oversight systems.	Creates, funds and proactively involves citizen oversight systems which establishes baseline data and informs damage assessment and valuation.	Does not actively support citizen oversight systems**.**	Encourage and provide funding for citizen oversight systems which establishes baseline data and informs damage assessment and valuation such as those running in Washington and Alaska U.S.
Has not established an approach for assessing and valuing cultural loss.	Has established an approach for assessing and valuing cultural loss.	Has not established an approach for assessing and valuing cultural loss**.**	Develop an approach that could be applied by the SOPF and lobby fellow Member States to the IOPC Funds to incorporate an approach for assessing and valuing cultural loss.
Is transparent in all claims handled by the IOPC Funds and the SOPF, but all claims handled via the *CLC* are not transparent.	Is transparent in assessment and valuation processes and publishes all valuation decisions.	Claims handled directly by ship owners under the *CLC* are not made public.	Legislate that all claims in relation to the environment, a public resource, be made accessible to the public.
Does not allow for public commentary.	Allows the public to comment on the assessment and valuation process.	Does not allow for public commentary**.**	Allow the public to comment on claims decisions and participate in the development of valuation practices.
Does not include compensatory action.	Includes compensatory action which funds further science and baseline data gathering.	Does not include compensatory action**.**	Form legislation which ensures polluters are funding the development of methods which can appropriately assess and value ecosystem services and functions as well as further baseline data gathering.