

**Advancing an Integrated Management approach to Ship Strikes with Baleen whales on
Canada's Pacific Coast**

by

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Abstract

Ship strikes have been identified as a threat to the survival and recovery of whale species populations. On Canada's Pacific coast, ship strikes are noted as a potential threat to the recovery of baleen whales, specifically gray, blue, fin, sei, North Pacific right whale and humpback populations. Limited information on baleen species abundance and habitat has led to gaps in knowledge concerning the extent to which ship strikes pose a threat to these species within Canada's Pacific waters. This has resulted in a lack of appropriate management measures that consider the mitigation of ship strike risk.

As development in marine transportation industries on Canada's Pacific coast progresses, management of industries along with conservation objectives for whale species should be mutually addressed. This paper will provide an integrated management approach to minimizing ship strike risk within the context of Canada's Pacific coast, taking into consideration the existing opportunities and constraints. A review of experiences from other jurisdictions provide guidance on how an operational framework could be developed. Introducing an integrated management approach to mitigating ship strike risk will balance progress in marine transportation industries with conservation responsibilities to whale species.

Although information is lacking to support a thorough understanding of the risk of ship strikes on the Pacific coast, developing an IM approach will support information gathering and foster a collaborative environment for stakeholders to discuss development in a precautionary manner that can adapt as needed.

Keywords: integrated management, Canada, Pacific Coast, ship strikes, stakeholder engagement, Baleen whales

Abbreviations

ACCOBAMS	Agreement on the Conservation of Cetaceans in the Black Sea Mediterranean and Contiguous Atlantic Area
ATBA	Area to be Avoided
BCMCA	British Columbia Marine Conservation Analysis
CBD	Convention on Biological Diversity
CCG	Canadian Coast Guard
CINMS	Channel Islands National Marine Sanctuary
DFO	Fisheries and Oceans Canada
DMA	Dynamic Management Area
ECHO	Enhancing Cetacean Habitat and Observation
ESA	Endangered Species Act
GLBA	Glacier Bay National Park
HIHWNMS	Hawaiian Islands Humpback Whale National Marine Sanctuary
IM	Integrated Management
IMO	International Maritime Organization
IWC	International Whaling Commission
MaPP	Marine Plan Partnership for the North Pacific Coast
MPA	Marine Protected Area
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Atmospheric Association
PNCIMA	Pacific North Coast Integrated Management Area
SARA	Species at Risk Act
SMA	Seasonal Management Area
SOLAS	Convention for the Safety of Life at Sea
TSS	Traffic Separation Scheme
UNCLOS	United Nations Convention on the Law of the Sea
USCG	United States Coast Guard
VTS	Vessel Traffic Service

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1. INTRODUCTION

Ship strikes have been identified as a more common threat than once suspected to the survival or recovery of whale species populations (Laist et al., 2001). On Canada's Pacific coast, ship strikes are noted as a potential threat to the recovery of baleen whales, specifically gray, blue, fin, sei, North Pacific right whale and humpback populations (Fisheries and Oceans Canada, 2010; Fisheries and Oceans Canada, 2011; DFO, 2012; Fisheries and Oceans Canada, 2013b; DFO, 2013b). However, appropriate management measures have not been developed to address the issue.

Canada's Pacific coast, dubbed the "Gateway to the Pacific", provides a major shipping corridor between Asia and North America (Ministry of Environment, 2013). The level of vessel traffic is projected to increase over the next 15-20 years in container ship volumes, bulk cargo vessels and cruise ship traffic (Living Oceans, 2011). The expected increase in large vessel traffic along British Columbia's coastline may result in a greater likelihood of overlap between vessel transit routes and whale species habitat. Where there is overlap between vessel traffic and important habitat areas for whale species, it is likely the risk of ship strikes will increase. The proportion of whales within a vessel route that will be struck is a function of whale densities, volume of vessel traffic, ship speed and whale behavior (Redfern et al., 2013). Currently, there is a lack of data on whale species population density and abundance, important habitat areas, and of the extent of the risk ship strikes pose to the different baleen whale species within Canada's Pacific waters. Without information on the interactions between vessels and whales and the factors that may influence ship strike risk, it is difficult to know how to address ship strike risk (Redfern et al., 2013). Although ship strikes are not likely to be a significant threat across the entire region of Canada's Pacific waters, with increasing vessel activity and a lack of information, ship strikes may pose a greater problem due to a lack of understanding of the interactions between vessels and whales.

On Canada's east coast, ship strikes have been identified as the primary source of mortality of the endangered North Atlantic right whale and a barrier to population recovery (NMFS, 2008; Brown et al., 2009). Ongoing actions have been implemented on the east coast to reduce the risk of ship strikes, despite no uniform set of quantitative management objectives to address ship strikes across Canada. There is an absence of a clear approach to addressing ship strikes that could be applied on Canada's Pacific coast. Assessing the options available in light of

a lack of scientific data or clear operational guidelines can highlight where management and policy can be forward-looking to support development of marine navigation and transportation activities while meeting conservation responsibilities. The options available need to be grounded within the current context of the Pacific coast in order to be relevant and effective.

Given what is currently known regarding approaches to mitigating ship strike risk through lessons gained from other jurisdictions, a problem oriented contextual approach that integrates conservation goals and management of vessel activities could be applied to reduce the risk of ship strikes of whale species. This paper will focus on how to develop this approach.

2. RESEARCH METHODS

2.1 Literature Review

Ideally, conservation objectives should be incorporated into coastal and marine management and planning (Cicin-Sain and Belfiore, 2005). The Conference of the Parties to the *1992 Convention on Biological Diversity (CBD)*, 1760 UNTS 79 in its Decision II/10, called for the adoption of integrated management (IM) measures and tools to promote conservation and sustainable use of marine and coastal biodiversity.

Conservation strategies are usually developed in parallel to management frameworks, which can result in inconsistencies and ineffective conservation measures. However, where economic priorities and conservation priorities occur in similar areas, planning and management should involve a joint or compromised set of strategies (Kenward et al., 2011). Joint development of strategies will enable discussions among a broader stakeholder group, and allow for assessment of the direct and indirect impacts sectors have on marine biodiversity and conservation goals and objectives (Cicin-Sain and Belfiore, 2005). This will place accountability on sectors to consider individual and cumulative impacts on marine biodiversity and will converge conservation and economic priorities.

Joint strategies can be developed under an IM framework, which considers social, economic, and ecological features for improving the coordination of planning and management of activities that influence the quality of environmental, economic, and social opportunities, and cultural heritage present in coastal areas (Cicin-Sain and Belfiore, 2005). IM strategies and planning consider the overlap and impact of multiple anthropogenic uses on the marine

environment, balance conservation objectives in planning processes and developed strategy, where conservation goals are often omitted.

Integration describes efforts that bring together various elements of planning and management initiatives and can take several forms: intersectoral, intergovernmental, spatial, between science and management, and international where transboundary issues are present (Kay and Adler, 2005). The guiding features of IM, ecologically sustainable development, the precautionary principle, and integration, serve biological conservation purposes but lack operational guidance for implementation (Cicin-Sain and Belfiore, 2005; Kay and Adler, 2005). The lack of guidance is further challenged by opposing political and/or economic interests, confusion and lack of clarity over what IM processes look like in practice, financial constraints, and a lack of coordination and cooperation among stakeholders (Brown, 2003; Cooney and Dickson, 2005). In the end, inconsistent objectives between managing anthropogenic uses and conservation within the marine environment can result (Cicin-Sain and Belfiore, 2005).

On Canada's Pacific coast, stakeholders have committed to establishing IM plans with respect to the marine environment (Ban et al., 2008). Without operational guidance of how to implement IM, there will be an imbalance between conservation and anthropogenic uses resulting in planning and the development of strategies having limited conservation effectiveness.

As the development of vessel activity on Canada's Pacific coast progresses, management of industries along with conservation objectives for whale species should be mutually addressed. Taking an IM approach to minimizing ship strike risk will enable progress in marine transportation industries while upholding conservation responsibilities to whale species.

As there is no operational framework for developing an IM approach, this paper will examine how an IM approach to minimizing ship strike risk with baleen whales¹ in Canada's Pacific waters could be developed. To achieve this, the following will be addressed:

- the current context of Canada's Pacific waters;
- identifying suitable tools for ship strike mitigation; and
- applying the relevant tools within the context of Canada's Pacific coast to advance an IM approach.

¹ Gray, fin, blue, sei, humpback, and North Pacific right whale species

2.2 Methodology

To develop an IM approach within the current situation on Canada's Pacific coast, identification of relevant stakeholders, initiatives and projects being undertaken as well as the legislative structures were considered. Experiences from other jurisdictions where approaches to ship strike mitigation measures have incorporated an IM approach are used to build a toolkit of relevant measures for use on Canada's Pacific coast.

Information was sought through literature and policy reviews of government publications, conference proceedings, journals and books to obtain information to situate the context of Canada's Pacific coast, for jurisdictional considerations, and to support the use of IM in a problem-oriented approach to ship strikes. In addition, individuals were contacted from various groups to gain additional information on the group, interest in the marine environment with respect to transportation or conservation, and their involvement in research or project initiatives. Informal discussions concerned the role of groups in baleen whale research and conservation and protection as well as any policies or measures of the group concerning baleen whale species and the reduction of vessel-whale interactions.

Stakeholders and interested parties were determined from the literature and information gained from group members contacted. Stakeholders were defined as groups that engage in activities related to the marine environment, have an identified interest (economic, value of resources, conservation, etc.) in the marine environment, and may affect or be affected by actions or decisions related to maritime transportation and/or conservation of whale species. Groups defined as stakeholders are those that ought to be involved in consultation and decision-making. Interested parties were defined as groups that have an interest in the marine environment but are not engaged in or directly influenced by decision-making concerning the marine environment. Groups determined to be regulators/legislators are those involved in standard setting and decision-making in addressing relevant issues (e.g. regulating shipping, establishing protected areas or routing measures). Participation of these groups is needed in decision-making, making them more than a stakeholder or interested party. Identified institutions and government agencies may be defined as regulators/legislators.

The following jurisdictions were selected for review: Eastern Canada, US regions (east and west coasts, Alaska, and Hawaii), the Mediterranean Sea, and the Hauraki Gulf in New Zealand. Within these jurisdictions ship strikes with a particular whale species have been

identified as a significant threat, resulting in the development of IM approaches to address the problem. Review of the jurisdictions highlights the nature of the problem, scale, and measures used within each jurisdictional context. The similarities and differences between the jurisdictions can provide transferable lessons that could support an IM approach on Canada's Pacific coast.

Limitations of this research strategy concern thoroughness of the literature and policy review due to time restrictions and the inability to have discussions with all relevant groups or identified key persons. Additionally, organizations may be missing from the list, however it is a working list that can be amended as developments are made. A lack of baseline data of population estimates, location and frequency of ship strikes that can be considered the foundation for igniting any change is another limitation.

3. CONTEXT

3.1 Geographical

Canadian Pacific waters extend the entire coastline of British Columbia, between Alaska and Washington and outwards from the low water line of the coastline to the outer boundary of the exclusive economic zone (*Oceans Act*, S.C. 1996, c.31) (Figure 1). Within Canada's Pacific waters lies Vancouver Island and Haida Gwaii along with several other smaller islands, inlets and channels.

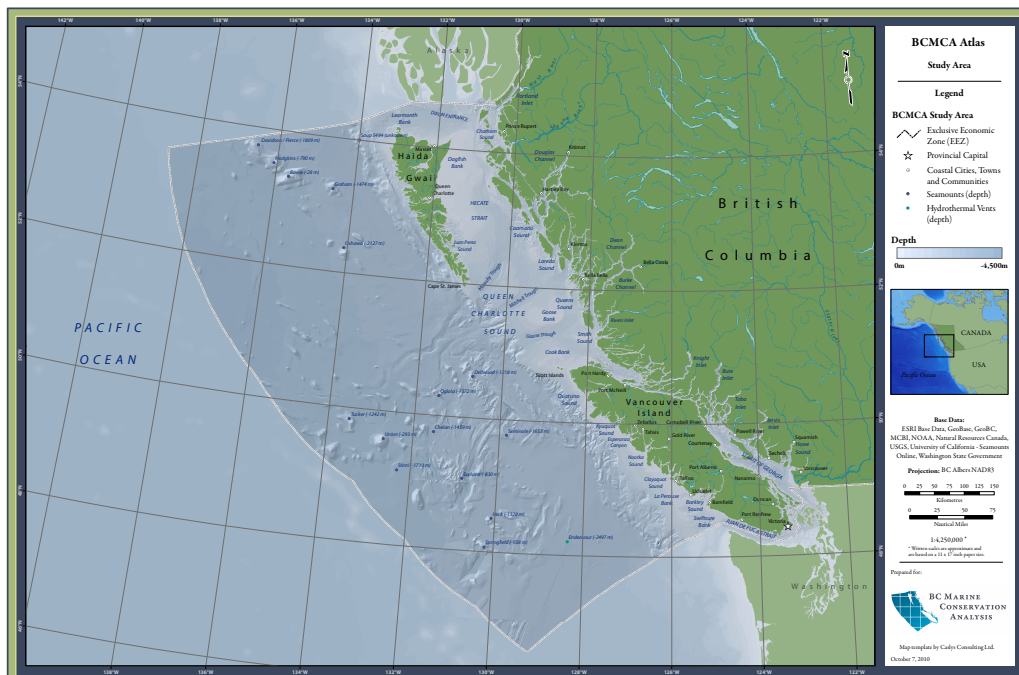


Figure 1. Map of Canada's Pacific waters. Source: BNCMA, 2011b.

3.2 Ecological

There is a presence of gray, fin, humpback, blue, sei and North Pacific right whales with varied distributions in Canadian Pacific waters (Appendix A). Despite the noted presence of these baleen species, few studies have demonstrated an accurate quantification of distribution and abundance. As a result, there is little knowledge of significant portions of coastal waters beyond 50 km from the continental shelf break, and no coverage beyond 150 km offshore (Ford et al., 2010). Due to the lack of data on distribution, there are knowledge gaps of important habitat areas and population densities of the species.

The occurrence of ship strikes between whales and ships occurs where there is overlap between the migration and feeding aggregations of whale species and shipping lanes (Fisheries and Oceans Canada, 2010). Speed is also noted as a factor. Large vessels travelling more than 14 knots (26 km/h), particularly high-speed container ships, present the greatest risk of ship strike mortality to whales (Laist et al. 2001). The difficulty in quantifying the extent of the interactions is that with large vessels, such as cruise, ferry and shipping, impacts are difficult to detect, which is likely leading to fewer strikes being reported than are occurring (Ford et al., 2009). The likelihood is that recorded ships strikes are conservative estimations. In Canada's Pacific waters, humpbacks are the most commonly reported species struck by ships, with 21 confirmed reports between 2001 and 2008 (Ford et al., 2009). Bottleneck areas, where both whale and boat densities are concentrated, have been noted as areas with a high risk of ship strike (Williams & O'Hara, 2010). For fin whales the risk was highest in the Dixon Entrance and for humpbacks it is the Queen Charlotte and Johnstone Straits (Williams & O'Hara, 2010).

Although information on ship strikes in Canada's Pacific waters is limited, humpback whales have been identified as the most common species within Canada's Pacific waters involved in ship strikes, and ship strikes have also been documented with fin whales (Ford et al., 2010; Williams and O'Hara, 2010). Williams and O'Hara (2010) have identified bottleneck areas of risk of ship strikes for humpback and fin whales within the Dixon Entrance and the Queen Charlotte and Johnstone Straits.

3.3 Jurisdiction

3.3.1 Domestic

Jurisdiction over the marine environment and the activities occurring within are set out in the *Constitution Act, 1867*. Legislation clarifies responsibilities of agencies at each level of government. The scope of powers between the levels of government is unclear resulting in overlapping and shared jurisdiction.

The courts have attempted to distinguish the division of powers laid out in the *Constitution Act, 1867*. The broad reach of federal powers over navigation and shipping extend beyond interprovincial and international shipping to vessels engaged in local shipping, pleasure boats and commercial vessels (*Whitbread v Walley*, [1990] 3 SCR 1273). The court in *Reference Re: Offshore Mineral Rights*, [1967] S.C.R. 792, held that the federal government has property rights in the bed of the territorial sea adjacent to British Columbia and that the continental shelf is outside the boundaries of British Columbia. The finding in *Reference re: Ownership of the Bed of the Strait of Georgia and Related Areas*, [1984] 1 SCR 388 (*Strait of Georgia Reference*), further clarified the distinction of the division of powers in determining that British Columbia has rights over the waters and submerged lands of the Strait of Juan de Fuca, the Strait of Georgia, Johnstone Strait and Queen Charlotte Strait. The *Strait of Georgia Reference*, may have distinguished inland waters and the territorial sea but held that in the case before the court, provincial jurisdiction refers to the straits in question. This has left open other areas of inland Pacific waters for interpretation.

Distinguishing jurisdiction justifies where the province may have interest in marine management and planning and where jurisdictional complexities should be considered. Complexities occur where provincial and federal governments have overlapping jurisdiction, and where jurisdiction is not clearly laid out, as in the Northern Pacific waters (*Ally and Topelko*, 2007). The complexity of jurisdictional powers between the levels of governments can complicate decision making abilities. It should also be noted that explicit rights over the environment, environmental protection and/or conservation have not been exclusively defined in the *Constitution Act, 1867* or *1982*.

Federal Responsibilities

Federal responsibilities over broad integrated ocean management and planning, conservation of species and transportation is laid out in several pieces of legislation. Under the

Oceans Act, the Department of Fisheries and Oceans (DFO) is responsible for developing and implementing a national integrated oceans management strategy that includes collaboration with other federal departments, provinces, aboriginal organizations, coastal communities and other persons and bodies. This responsibility is reiterated in Canada's Ocean Strategy (2002) and Canada's Oceans Action Plan (2005).

Under *Species at Risk Act*, S.C. 2002, c.29 (*SARA*), DFO is delegated responsibility over marine species (s.1, "competent minister"). *SARA* prohibits actions against endangered or threatened species group (s.32) and offers protection through the development of recovery strategies (s.37) and action plans (s.47) that should include identification of critical habitat (s.58). *SARA* limits the influence of socio-economic costs to the implementation of an action plan (s.49(1)(e)). Species listed as special concern do not receive the same level of protection under *SARA*. A management plan is to be developed for species designated as special concern and critical habitat does not need to be identified (s.65). The Act allows for a multi-species or ecosystem approach in the preparation of recovery or management strategies (s.41(3), s.67).

The federal government also has responsibilities to protect marine mammals under the *Marine Mammal Regulations*, *SOR/93-56 of the Fisheries Act*, R.S.C., 1985, c. F-14, s.7-8. Additionally, the federal government can establish protected marine areas under the *Oceans Act*, *Canada Wildlife Act*, R.S.C., 1985, c.W-9 and *Canada National Marine Conservation Areas Act*, S.C. 2002, c. 18. Protected marine areas can provide protection for important habitats for whale species as additional levels of protection that could be used in conjunction with *SARA*.

Transport Canada governs navigation and shipping along with the Canadian Coast Guard (CCG) and DFO under the *Canada Shipping Act*, 2001, S.C. 2001, c.26. Provisions on safe and efficient navigation or marine protection allow for the development of vessel traffic services (VTS) zones³ (s.136) and mandatory reporting and communication within established VTS zones (*Collision Regulations*, C.R.C., c. 1416, s.7). Additionally, the *Canada Shipping Act*, 2001 includes provisions for compulsory or recommended routes or prohibited operations of vessels

³ The *Vessel Traffic Services Zone Regulations*, *SOR/89-98* established VTS zones around Prince Rupert, Tofino on Vancouver Island, and Vancouver. A cooperative VTS zone in the Strait of the Juan de Fuca between Canada and the US designates the approach lane within US waters and the outbound lane within Canadian waters (Agreement for a Cooperative Vessel Traffic Management System for the Juan de Fuca Region signed on December 19, 1979).

including traffic separation schemes (TSS), two-way routes, precautionary areas and areas to be avoided (ATBA) (s.120(1)(j) and (k))⁴.

Navigation and shipping legislation may be designed for safety purposes but can be indirectly beneficial to the marine environment. Restricting vessel movement and imposing reporting measures are ways to navigate around environmentally sensitive areas and provide measures to adhere to when transiting through sensitive areas.

Provincial Responsibilities

British Columbia's responsibilities to facilitate sustainable management and development of ocean resources, and ensure provincial objectives stem from the 2004 Memorandum of Understanding Respecting the Implementation of Canada's Oceans Strategy on the Pacific Coast of Canada (2004 MOU). The 2004 MOU promotes shared responsibilities over specific activities and objectives outlined in the *Oceans Act*: a marine protected area (MPA) network, coastal planning and integrated oceans management planning, and an information management system. It is expected that the levels of government will collaborate and implement actions pertaining to these objectives together.

Canada and British Columbia also signed the Agreement for the Protection of Species at Risk to collaborate on addressing protection and recovery of species at risk (2005). Under the agreement, the governments should cooperate and work together in designating species, and in developing and implementing recovery and management strategies and action plans. Additionally, the 2014 Canada – British Columbia Marine Protected Area Network Strategy calls for a collaborative MPA network on the Pacific coast.

The agreements broaden provincial influence in decision-making through federal government acknowledgement of provincial input. Agreement to share federal responsibility of designating and addressing sustainable development and conservation concerns related to marine mammals with the province creates consistency between the levels of government (Canada-British Columbia Agreement on Species at Risk, 2005).

⁴ Within Canada's Pacific waters, compulsory routing systems have been established in the Strait of Georgia, Haro Strait and Boundary Pass, and the Strait of Juan de Fuca with recommended a TSS in Johnstone Strait, Broughton Strait, and for approaches to Vancouver (CCG, 2015). Additionally, a voluntary tanker exclusion zone off the Pacific coast aims to keep tankers west of the zone boundary to protect the shoreline and coastal waters from potential risk of pollution, however those tankers that enter coastal ports can enter the exclusion zone (CCG, 2015).

The provincial Ministry of Environment can develop, promote and measure provincial goals for conservation under the *Wildlife Act*, R.S.B.C. 1996, c.488. Species within the province can be designated as either threatened or endangered, and habitat can be designated as wildlife management areas, critical wildlife areas or wildlife sanctuaries. The provincial conservation status rank of species recommends species for consideration of designation under the *Wildlife Act* or under *SARA*, and is beneficial for setting conservation priorities for species found to be at risk in British Columbia (BC Conservation Data Centre, 2015).

The provincial government can designate provincial parks and conservancies under the *Environment and Land Use Act*, RSBC 1996, c.117, ecological reserves under the *Ecological Reserve Act*, RSBC 1996, c.103, park, recreation area or conservancy under the *Park Act*, RSBC 1996, c.344 and *Protected Areas of British Columbia Act*, SBC 2000, c.17. Provincially designated protected marine areas identify important marine habitat areas for species at risk and can be linked to other provincially protected areas and to federally protected areas.

First Nations

First Nations affirmed rights and titles under land claim agreements, court decisions and the *Constitution Act, 1982* need to be considered. Section 2.1 of the *Oceans Act* acknowledges that existing aboriginal or treaty rights will not be altered by the Act. Provisions under *SARA* acknowledge the responsibility to consider treaties and land claims agreement where they may relate to the designation and management of a species or habitat. *Haida Nation v. British Columbia (Minister of Forests)*, [2004] 3 S.C.R. 511, confirmed that First Nations rights and titles apply to the marine environment and species. Legislative provisions must be implemented in accordance with the requirement to collaborate.

Formal agreements between government and First Nations, such as the 2010 Gwaii Haanas Marine Agreement, shares jurisdiction with First Nations communities. Furthermore, land and the surrounding waters under First Nations responsibility are deemed protected (Parks Canada, 2010). A shared management partnership allows for First Nation influence on the legislative responsibilities of the governments.

3.3.2 International

International conventions have influenced the direction of Canadian legislation and promote cooperation with other States.

As a party to the *CBD*, Canada implemented *SARA* to meet the duty to protect species at risk from further harm and aid in the recovery of threatened species. The *Convention on the Conservation of Migratory Species of Wild Animals* 1651 UNTS 333; 19 ILM 15 (1980); ATS 1991/32; BTS 87 (1990), Cm. 1332 (*Migratory Species Convention*) is a framework convention for internationally coordinated conservation measures of migratory species through regional or global agreements⁵. Although not members to the *Migratory Species Convention*, Canada, the US and Mexico signed the *North American Agreement for Environmental Cooperation* (32 ILM 1482 (1993) and developed the Strategic Plan for North American Cooperation in the Conservation of Biodiversity (2003) to promote cooperation of conservation and maintenance of transboundary species through information sharing and the development of collaborative responses to threats.

The International Whaling Commission (IWC) seeks to conserve whale stocks by undertaking research, the development of scientific databases, and management plans to address threats in manners that are consistent with international best practice. Although no longer a member, Canada observes IWC's practices.

While *United Nations Convention on the Law of the Sea*, 1833 UNTS 3; 21 ILM 1261 (1982) (*UNCLOS*) governs the jurisdiction of the seas and the rights and responsibilities of members States, the International Maritime Organization (IMO) oversees international standards concerning vessel impacts on the marine environment, safety and security of international shipping, and maritime navigation. Under the *International Convention for Safety of Life at Sea*, 32 UST 47; 1184 UNTS 278, c V, Reg 8 (*SOLAS 1974*), the IMO is given the responsibility of adopting routing measures with respect to international shipping. Routing measures, (see Appendix C), can be used for the purpose of marine conservation in addition to safety and efficient navigation (IMO, 2003a). IMO adoptions are not enforceable but suggest compliance on a "should" basis. The onus lies with coastal states to enforce the approaches they have put into place⁶. The *Canada Shipping Act, 2001*, is the federal legislation under which routing measures are implemented and enforced.

⁵ Appendix I lists endangered migratory species that require conservation and Appendix II lists priority species that require agreements between range states due to their unfavorable conservation status.

⁶ For example, the *1972 Convention on the International Regulations for Preventing Collisions at Sea*, 1050 UNTS 16 / UKTS 77(1977) Cmnd 6962 governs navigational rules and includes Rule 10 on TSS which have been adopted by the IMO. Within Canada, Rule 10 of the *Collision Regulations*, outlines the TSSs that have been adopted by the State and IMO.

The IMO can establish international rules and standards which result in voluntary measures to adhere to and changes to international conventions and regulations or to State created restrictions. International tools concerning maritime safety and navigation can be exported for marine conservation purposes, however there must be an international component to the problem to justify their use.

3.4 Stakeholders

Relevant groups identified on the Pacific coast include government, First Nations, industries, and organizations (academic and non-governmental). Their roles and relevance are listed in Appendix B.

3.4.1 Government

Legislative jurisdiction gives responsibilities to DFO, Environment Canada, Transport Canada, CCG, and the Navy with respect to the marine environment, which would make them relevant stakeholders. In particular, as the responsible agencies, DFO and Transport Canada will need to be involved in decision making in matters concerning ship strikes with whale species.

Provincially, the Ministry of Environment is included in decision-making and planning over marine related issues as per bilateral agreements and statute. Provincial jurisdiction does not impede federal responsibilities over shipping and navigation, however they are involved in broader environmental issues.

3.4.2 First Nations

According to the Department of Aboriginal Affairs and Northern Development Canada, First Nations people are descendants of the original inhabitants of Canada, a term that is distinguishable from Metis and Inuit (all three fall under the term “Aboriginal”). British Columbia has 198 First Nations communities, many of which reside or claim territory that includes a portion of the Pacific waters. Inherent rights and titles under the *Constitution Act, 1982* and further upheld by the courts, along with land claim agreements form the basis for coastal First Nations to be considered as stakeholders in issues on the marine environment.

Coastal First Nations in British Columbia have a stated common interest in long-term protection, maintenance, and advancement of comprehensive habitat protection programs in freshwater and marine environments essential for the survival and productivity of all species and populations (First Nations Leadership Council, 2007).

Formal agreements with governments, such as the Gwaii Hanas Marine Agreement, collaboration under the Marine Plan Partnership for the North Pacific Coast (MaPP), and research programs, such as the Guardian Watchmen program, provide a basis for First Nation involvement in marine planning and management as stakeholders. In addition, concerns over the marine environment and inherent rights and titles, provide a basis for coastal First Nations communities as stakeholders.

3.4.3 Industries

Shipping, fishing, cruise, tourism, ferry, Coast Guard and Navy vessels as well as recreational vessels can be found on Canada's Pacific waters.

The British Columbia Chamber of Shipping, the Pacific Pilotage Authority, and ports have a role in discussions on navigation and safety due to their use of the marine environment and the direct influence change have on their operations.

BC Ferries and Cruise International Association Line operate within set areas of the Pacific waters. Where considering ship strikes, if operations affect whale species or imposed measures influence industry operations, they would be considered stakeholders. Additionally, BC Ferries and Cruise Line International Association Line have industry initiatives that align with measures to reduce ship strike risk to whales.

In addition to their role in managing operations, several ports are linking with other groups to initiate projects to assess the impact shipping has on whale species. Port Metro Vancouver has initiated the Enhanced Cetacean Habitat and Observation (ECHO) program to understand the impact shipping activities have on at risk whale species along the southern coast of British Columbia and Prince Rupert Port Authority has plans for a similar project (*Jason Scherr, personal communication*). As facilitators of research and potential incentive programs, port facilities will be stakeholders.

Ports, shipping, and pilotage groups are members of the Green Marine program to engage in environmental practices. As members, these stakeholders take measures to reduce their environmental footprint.

The oil and gas industry aims to broaden their market by utilizing the Pacific shipping route through expansion projects such as the Trans Mountain Pipeline Project in the Strait of Georgia and the Juan de Fuca Strait and the Northern Gateway Project along the Northern Coast. These projects may impact marine mammals through increased vessels operations in and out of

terminals (Ministry of Environment, 2013). Although not typically involved in activities concerning the marine environments, project proponents have committed to developing plans to protect marine mammals. If companies are willing to set standards for ships transporting their goods, they could be relevant to implementing measures. However, as there is no obligation consideration as a stakeholder could be limited.

Smaller vessels such as recreational boating, fishing and whale watching tourism, are interested parties in addressing the problem of ship strikes with baleen whales. These industries follow measures such as the Be Whale Wise Guidelines for managing their maneuverability around whale species given the agility of their vessels.

3.4.4 Organizations

Academics, non-government organizations, and research focused organizations, assume different roles in decision-making and addressing issues in the marine environment. Organizations that represent the marine environment are more interested parties whereas organizations involved in marine spatial planning work with other groups to research to influence decision-making. Changes to vessel activities do not impact organizations, however, organizations with involvement in research and can influence outcomes. Where organizations are contributing data, they may be more than interested parties but may not be necessary in engagement at all stakeholder levels.

3.4.5 International Considerations

International organizations can influence the development of initiatives at the global scale (Kay and Adler, 2005). When dealing with migratory species or cross-boundary vessel activities, collaboration is needed between Canada and other countries. However, regional and international parties would not be considered stakeholders but interested parties as these agreements enhance internal initiatives and are not enforceable. Although nations and international organizations are interested parties, where regional or international tools are to be applied, there could be greater involvement from external parties.

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An expected increase in vessel traffic does not guarantee ship strikes with whale species will occur, but it increases the likelihood that vessels will overlap with whale species habitat. The projected timelines of increased vessel traffic is opportunistic to begin considering and

planning measures that protect baleen whale species from potential shipping impacts given that measures to avoid or reduce ship strike risk require advanced planning (Laist et al. 2001). The realistic capability of addressing ship strikes on the Pacific coast must be done within the constraints and opportunities of the region.

4.1 Constraints

On the Pacific coast, based on the perceptions of individuals interviewed, groups are not effectively coordinating or collaborating, sharing information or participating in meaningful ways. Additionally, responsibilities under statutes are not being met and available legislative tools are not being used in an effective manner. These issues could make it difficult to adhere to an IM approach.

4.1.1 Collaboration and Coordination Between Initiatives

Although stakeholders within projects collaborate, there may be a diminished effect due to an absence of sharing information between projects. Initiatives are fragmented as they operate in different regions and do not consider efforts taken in other areas of the coast. There is a lack of information sharing between initiatives. Discussions on progress and collected data could highlight regional differences and the relevance of projects to other areas. Furthermore, where initiatives are addressing the same issues in different regions, it would be worthwhile to be aware of similar approaches and challenges.

There is a lack of information sharing along the coastline. For example, the BC Cetacean Sightings Network does not provide information to those who report sightings (*Tessa Denaka, personal communication*). Information is passed on to DFO as they have jurisdiction to respond, but mariners are not given access. A phone app for mariners was developed to increase reporting of sightings, however the information gathered would be useful in decision-making.

4.1.2 Participation Issues

The role of certain groups, such as the federal government and the shipping industry, are decidedly limited. Federal departments are involved in an advisory capacity in certain programs, such as ECHO, but further engagement is necessary from government groups that have responsibility over such matters as shipping or marine conservation. It has noted that until there is enough scientific evidence available, there is not enough to support regulation and government involvement will continue to be limited (*Kelly Larkin and Danielle Wensauer, personal*

communication). Greater participation by government is limited by the availability of information to make change, however statutory responsibilities of government include taking a direct role in acquiring the necessary information.

The shipping industry does not have any formal measures with respect to mitigating for ship strikes (*Kelly Larkin and Danielle Wensauer, personal communication*). Involvement of the shipping industry can be an opportunity to prevent damage to the industry reputation and to show stewardship to the marine environment.

4.1.3 IM Responsibilities

Canada's *Oceans Act*, Oceans Strategy (2002) and Action Plan (2005) state integrated ocean management as a guiding principle to managing Canada's oceans. Collaboration between government authorities, First Nations organizations and communities, industry and resource users, non-governmental organizations, community groups, and those from the academic, science, and the research community is to be included (Government of Canada, 2002). The Strategy and Action Plan identified large ocean management areas, such as the Pacific North Coast, as priority areas to implement integrated management (Fisheries and Oceans Canada, 2005).

The Pacific North Coast Integrated Management Area (PNCIMA) plan was initiated under the 2008 Memorandum of Understanding on Pacific North Coast Integrated Management Area Collaborative Oceans Governance (2008, MOU) to achieve this goal. The draft plan notes the presence of baleen whale populations within the PNCIMA area and identifies marine transportation and the presence of vessels as activities that can degrade the PNCIMA environment and marine mammals within it (Heise, Ford and Olesiuk, 2007; Hall, 2008; PNCIMA, 2013). However, the PNCIMA plan has not been finalized as the Federal government has not formally agreed to it. The plan remains in draft form and there has been no further discussion of moving forward with the plan.

In 2011, the Government of British Columbia and 18 First Nations communities co-led the process of developing MaPP as a result of the lack of movement with PNCIMA. Under MaPP the North Pacific Coast was divided into four sub-regions in which marine plans were developed. The plans, released in April 2015, are based on an adaptive ecosystem-based management framework that is precautionary, collaborative, inclusive of Aboriginal rights, titles and treaty rights, integrated, and scientifically based (MaPP, 2015). The framework of these

area-based plans is adapted from PNCIMA. It is an effort to implement an IM approach, however MaPP is limited due to the non-involvement of the federal government. The plans do not include federally governed activities, such as shipping and fishing, which are major operations within the planned sub-regions. Without these, the plans are not fully integrative for the region.

The collaborative MPA strategy between British Columbia and Canada was intended to meet the commitments under the 2004 MOU, the *Oceans Act*, and Target 11 of the 2010 Conference of the Parties to the *CBD* which commits to 10% of marine and coastal areas to be protected by 2020 (Canada – BC MPA, 2014). As in the rest of the country, there has been little advancement on designating MPAs at the federal level. One such example is Race Rocks, an ecological reserve under the provincial *Parks Act* that has been sought out by parties to be designated as an MPA under federal legislation. Race Rocks has been noted to meet the requirements under s.35 of the *Oceans Act* however to date has not been designated (Backe et al., 2011).

As per the *Oceans Act*, DFO has express responsibility to engage in IM and collaborative undertakings with respect to the marine environment. Additionally, signed agreements to work with the province on matters places additional obligations on the federal government to cooperate and work with other stakeholders. DFO is not meeting its responsibilities to perform integrated management and is restricting initiatives that require their engagement.

4.1.4 Duty to Conserve

The status of the populations of gray, fin, humpback, blue, sei and North Pacific right whales within Canadian Pacific waters have been designated provincially, nationally and internationally. As shown in Table 1, the designations are consistent across the different levels, which should influence the Canadian government to ensure appropriate conservation requirements are met. However, DFO has not met its obligations of developing action plans and identifying areas of critical habitat.

Table 1. Status of Baleen whale species in British Columbia

<i>Baleen Cetacean Species</i>								
			<i>Fin</i>	<i>Sei</i>	<i>Blue</i>	<i>Humpback</i>	<i>North Pacific Right</i>	<i>Gray</i>
Status	<i>Canada</i> ⁷	COSEWIC	T	E	E	SC	E	SC
		<i>SARA</i>	T	E	E	SC	E	SC
		<i>BC</i>	Red	Red	Red	Blue	Red	Blue
	<i>U.S.</i>		E	E	E	E	E	De-list
	<i>Int'l</i>	IUCN	E	E	E	LC	E	LC
CMS		I/II	I/II	I	I	I	-	
Recovery Strategy	<i>Canada</i>		2006 2013	2006 2013	2006 2013	2013	2003 (draft) 2011	2011 (mgmt plan)
	<i>U.S.</i>		1998	2011	1998	1991	-	-
Action Plan	<i>Canada</i>		Partial 2013	Partial 2013	Partial 2013	No	Partial 2013	No
	<i>U.S.</i>		-	2012	1998	1991	-	-
Critical Habitat	<i>Canada</i>		No	No	No	Yes	No	No
	<i>U.S.</i>		No	No	No	No	-	No

The recovery strategies for each species identifies ship strikes as a known potential threat (Fisheries and Oceans Canada, 2010; Fisheries and Oceans Canada, 2011; Fisheries and Oceans Canada 2013b; DFO, 2013b). Although initial reports and in some circumstances follow-up reports have been drafted, identification of critical habitat is limited or missing, a condition that should be met under *SARA*.

Members of a DFO workshop on quantifying critical habitat for aquatic species at risk, stated that uncertainty necessitates adopting a precautionary approach to defining critical habitat, which would involve defining an area initially and redefining as data becomes available through a dynamic process (Randall et al., 2003; Environment Canada, 2004). Independent data on abundance and population density could assist in defining important habitat areas is available.

The management plan for humpback whales (Fisheries and Oceans Canada, 2013b) identifies four geographic areas of habitat, which meet the definition of critical habitat under *SARA*. Research also notes that the north Hectate Strait and east Dixon Entrance are potential

⁷ B.C. Conservation Data Centre. 2015. BC Species and Ecosystems Explorer. B.C. Minist. of Environ. Victoria, B.C. Available: <http://a100.gov.bc.ca/pub/eswp/> (accessed Jun 3, 2015).

areas of critical habitat (Dalla Rosa, Ford and Trites, 2012). However, prior to designation of these two areas, humpback whales were delisted to special concern (Canada Gazette, 2014)⁸.

The partial action plan for the blue, fin, sei, and North Pacific right whale states that critical habitat is beyond the document scope (Fisheries and Oceans Canada, 2013a). Despite this, research has identified areas of distribution and in some cases areas of high density. The BC Marine Conservation Analysis which was conducted between 2006-2013 developed an atlas that includes fin whale distribution (BCMCA, 2011a). In addition, the MaPP initiative included data on identified areas of importance for blue, fin, and sei whales (MaPP, 2015b). The information used in these projects could be used to initiate identification of critical habitat as they are the best available scientific information to date.

As a listed threat, evidence is needed to assess the extent to which ship strikes pose a problem. Initial investigations have begun to identify areas of concern. In waters off Washington, fin whales have been found to be involved in the greatest number of confirmed ship strikes, however blue and humpback strikes were also noted (Douglas et al., 2008). The findings identified areas of concern for strikes, namely a feeding area directly west of the entrance to the Strait of Juan de Fuca, a main shipping channel for vessels accessing shipping ports in Seattle, Tacoma, Vancouver and Victoria and the Inside Passage between Johnstone Strait and Prince Rupert. Williams and O'Hara (2010) also highlighted areas of ship strike risk and noted that fin and humpback whale density was similar and highest in the Dixon Entrance and off the southern end of Queen Charlotte Islands and Johnstone Strait. Additional distribution information has been collected that would be beneficial to identifying the extent of ship strikes as a high risk threat: Gregr et al. (2000), Gregr and Trites (2001), Williams and Thomas (2007), Erbe et al. (2014), and Williams et al. (2011).

With independent information on whale distribution, abundance and areas of ship strikes, in particular for humpback whales, identification of areas of concern for ship strikes should be reasonably determinable. However, with delisting, humpback whales are no longer a species of focus for directed efforts, despite risks and identification of potential areas of critical habitat were reported prior to the delisting.

⁸ It is relevant to note that the *SARA* registry for humpback whales still lists the species as “threatened” (*SARA* Registry, 2015).

There is potential that defining critical habitat for certain species may restrict vessel activities⁹. Areas of distribution of fin whales would overlap with planned shipping routes along the North Pacific Coast (Williams and O’Hara, 2010). Claiming a lack of evidence and information necessary to make a determination, the area is not protected and therefore no restrictions are placed on activities in the area.

4.1.5 Legislative Tools

Current legislation is meant to protect species and clarify the manner in which marine activities can operate. However, the legislation applicable to the Pacific coast is fragmented, and unclear with respect to implementation. In addition, the lack of regulation and policy behind legislation provides opportunities for discretion in decision-making and enables socioeconomic considerations to influence the degree of effort afforded to the protection of whale species.

With a range of options available for protection and conservation under federal and provincial legislation, confusion and misunderstanding of how statutes operate with one another can arise. The relevant guidelines, agreements or statutes do not specifically address ship strikes with whales, leaving the extent to which the issues should be addressed in Canada vague (Elvin and Taggart, 2007).

SARA mandates Canada to manage marine habitat and protect endangered species, however shortcomings in the legislation can impede the ability to effectively protect whale species under the Act (Vanderzwaag and Hutchings, 2005). Shortcomings identified by Vanderzwaag and Hutchings (2005) include:

- Definitions of “disturbance”, “harm”, or “harass” are not clear which has led to difficulties in clarifying what constitutes a prohibited act, weakening enforcement of the provisions;
- Offences under sections 32 and 33, of whether actions must be intentional, reckless, or negligent are difficult to outline due to a lack of clarification on definitions (Hinch and De Santo, 2011);
- The minister has discretion under section 73(3) to permit an activity that results in incidental harm to species at risk;

⁹ Although listed as special concern under *SARA*, gray whale northward migration through Queen Charlotte Sound, Hecate Strait and Dixon Entrance overlaps substantially with proposed approaches to ports in the Northern Gateway project (DFO, 2013a).

- The requirement under section 79 on the activity proponent to bear the burden of showing whether the activity will not jeopardize the survival or recovery of the species lacks a precautionary approach;
- A lack of clarification on identification of critical habitat in procedures, ministerial responsibility, prohibitions, and implementation; and
- The phrase “will not jeopardize the survival or recovery of the species.” Does not define “jeopardy”

The deficiencies in the interpretation and execution of *SARA* have weakened the potential of the provisions to provide effective protection of marine species. As a result of humpback whales being delisted in 2014 to special concern, it is unlikely the Hectate Strait and Dixon Entrance will be designated as critical habitat. Fin, gray and blue whales are also present in the area and are also susceptible to ship strikes but it is still held that critical habitat for these species cannot be determined (Heise et al., 2006; DFO, 2013a; DFO, 2013b; National Energy Board, 2013). Vessel activity is expected to increase in these areas (DFO, 2013a), yet based on the delisting of humpback whales and the claim that critical habitat for other species in the area cannot be determined, it is unlikely the region will be designated as critical habitat resulting in no restrictions or obligations on vessel activity operating in the region.

Section 79 of *SARA* requires development projects to assess their impact on listed species and ensure measures are taken to avoid or lessen the impacts where plans overlap with designated critical habitat. The Northern Gateway project is planning a marine mammal protection framework (Stantec, 2012), but does not provide specific interventions and commitments that DFO can accurately assess as adequate (DFO, 2013a). The project proponents are not under any obligation to develop a plan or seek a permit for operating in an area not designated, therefore there is no requirement that plans should be detailed (DFO, 2013a). Even if required, *SARA* requirements do not specify what is sufficient, and although this framework may satisfy the act it may not lead to protections of whale species

Case law has attempted to clarify the obligations of the federal government under *SARA*. In his decision in *Environmental Defence Canada et al. v. Minister of Fisheries and Oceans*, 2009 FC 878 at para 36, Justice Campbell states that the “words in the provision are precise and unequivocal: the measures required to ‘prevent the reduction or loss of the species’ must still be

taken and ‘should not be postponed for a lack of full scientific certainty’”. Therefore, despite scientific uncertainty, actions are expected by DFO.

The courts have also stated that in defining critical habitat, socioeconomic and political considerations are not to be included (*Environmental Defence Canada et al. v. Minister of Fisheries and Oceans*). However, this can be circumvented by a conclusion of insufficient scientific evidence to identify critical habitat as there is no definition of “to the extent possible” and “best available information” under sections 41 and 49.

“Best available information” should include government-led, independent science, and traditional ecological knowledge (Findlay et al., 2009; Taylor and Pinkus, 2013). In *Alberta Wilderness Association v. Canada (Minister of the Environment)*, 2009 FC 710, Justice Zinn held that inclusion of all available information on critical habitat was required by stating at para 13 “there is no discretion vested in the Minister in identifying critical habitat under SARA. Subsection 41(1)(c) requires that the Minister identify in a recovery strategy document as much critical habitat as it is possible to identify at that time, even if all of it cannot be identified and to do so based on the best information available”. In *Alberta Wilderness Association v. Canada (Minister of the Environment)* the federal government excluded identification of geospatial location and extent of critical habitat in the recovery strategy by claiming a lack of comprehensive information despite there being information in the peer-reviewed literature that could have informed on critical habitat.

Section 38 of *SARA* requires a consideration of commitments to conserving biological biodiversity and to take preventative measures to reduce threats even where there is a lack of full scientific certainty. The courts have reiterated that a lack of scientific certainty does not mean recovery planning should be postponed (*Environmental Defence Canada et al. v. Minister of Fisheries and Oceans*). Despite recognition by the courts, the government has continued to exclude independent peer-reviewed information as a means to identifying critical habitat. As pointed out, peer-reviewed literature is available to assist in informing on the critical habitat of whale species off the Pacific coast, yet this information is underutilized and recovery strategies continue to claim a lack of comprehensive information to identify areas.

In addition to the limitations under *SARA*, the *Marine Mammal Regulations* do not clarify which human actions may constitute a disturbance to marine mammals, which has left commercial shipping from being scrutinized under the *Regulations* (Vanderzwaag and

Hutchings, 2005; Hinch and De Santo, 2011). The clarification of activities and definitions concerning disturbance of marine mammals is necessary to increase understanding and enforcement under the *Regulations*¹⁰.

The legislation has not been interpreted and implemented in a precautionary manner. This has led to a failure to identify critical habitat of listed species, decision making has come into question and brought before the courts for determination, and has enabled political and socioeconomic issues to have a greater influence than intended by the legislation by failing to include independent and transparent research.

4.2 Opportunities

Despite constraints, there are current opportunities in the Pacific region that would enable an IM approach.

4.2.1 Interest in Issues

There are initiatives along the Pacific coast which suggest an interest of parties in assessing and reducing the impact of ship strikes with whale species. First Nations communities have expressed interest in being involved in the management of shipping activities and industry influence on the marine environment (*Craig Outhet, personal communication; Steve Diggons, personal communication; Scott Harris, personal communication*).

Research undertaken indicates that organizations are interested in identifying whale species distribution and the impacts of marine shipping on marine mammals, both separate or cumulative. Clear Seas seeks to provide impartial information on various marine impacts of shipping (*Jody Wright, personal communication*).

The British Columbia Marine Conservation Analysis (BCMCA) was a collaborative endeavor that resulted in an atlas supportive of integrated marine management and marine spatial planning processes in British Columbia (BCMCA, 2011a). The atlas has been completed and can be used as a starting point for understanding distribution of species and vessel traffic as it compiled to information available to date and best represents marine mammal species and habitat (Ban et al., 2008).

¹⁰ Regulatory amendments are underway which will focus on addressing whale watching. Public consultation will be used in drafting changes. See: <http://www.dfo-mpo.gc.ca/acts-lois/rules-reglements/rule-reglement05-eng.htm> and <http://gazette.gc.ca/rp-pr/p1/2012/2012-03-24/html/reg2-eng.html>

Port Metro Vancouver and Prince Rupert Port Authority are developing programs to assess shipping impacts and the monitoring of marine mammals. Although focused on marine mammals and underwater noise, the information gathered will be beneficial for calculating whale species density and location, and will contribute to an overall assessment of the impacts of the shipping industry. Port Metro Vancouver intends to work with government to make legislative changes where needed, to develop a vessel notification system that identifies whales within the monitored area and to explore new technologies to identify whale locations in real-time (*Krista Trounce, personal communication*).

In addition, Port of Metro Vancouver and Prince Rupert Port Authority are contemplating developing a Mariners Guide to whales such as the one from Atlantic Canada for the west coast (*Jason Scherr, personal communication; Krista Trounce, personal communication*).

The efforts being undertaken by various groups indicate interest in the influence of marine shipping on whale species along the Pacific coast which is beneficial for assembling stakeholders in an IM approach.

4.2.2 Collaboration

Groups are making efforts to collaborate. Co-management planning between First Nations communities and government have been developed. DFO committed to collaboration for IM with First Nations, in particular, Coastal First Nations and the North Coast Skeena First Nations Stewardship Society under the 2008 MOU and under the 2010 Gwaii Haanas Marine Agreement. Under the MaPP initiative the provincial government has committed to shared efforts of collaboration with First Nations. MaPP has promoted dialogue between government and First Nations and has increased First Nation participation in management of the marine environment. Furthermore, research efforts between organizations and First Nations communities ensures that community input and interests are being addressed (*Hussein Alidina, personal communication; Kate Moran, personal communication*).

4.2.3 Proactive Approach

Projects such as the Northern Gateway Pipelines are developing plans that commit to defining the spatial and temporal boundaries of whale species along with qualitative vessel strike analysis and mitigation measures (Stantec, 2012; Environmental Consultants, 2014). The commitments to promote proactive efforts are present but the frameworks need to be developed further to ensure they are comprehensive and sufficient to reduce further risk.

The willingness to cooperate and put in place mitigation measures could be an opportunity for an integrated approach. Projects are being planned based on expected operation within 10-20 years, which provides time to conduct the appropriate research and make the necessary determinations with respect to species abundance, ship strike risk, and identification of important habitat.

It is evident stakeholders are interested in identifying and addressing risks for whale species on the Pacific coast. There are several projects operating along the coastline that are attempting to address these issues. However, there is a need for greater collaboration and a commitment to working together to avoid a duplication of effort. The focal species on the Pacific coast is killer whales, but there is opportunity to include baleen whale species within the scope of projects. As well, information on whale species gathered from studies on other vessel threats, such as noise, can be used in developing measures to address ship strikes.

5. LESSONS FROM OTHER JURISDICTIONS

Experiences from other jurisdictions provide approaches taken to achieve IM to mitigate ship strike risk. Approaches to minimizing ship strike risk have been implemented on Canada's east coast, along mainland US on both the eastern and western seaboard, Alaska, Hawaii, in the Mediterranean Sea and in New Zealand (Table 2).

The strategies and legislative, technological, management and operational tools used in the jurisdictions illustrate ways of integrating conservation and management of the marine environment through a multi-faceted approach. The experiences of how the jurisdictions have addressed ship strikes, the levels of integration, and range of stakeholders that suits the context of the region, can provide insights into approaching ship strikes from an integrated approach on Canada's Pacific coast.

5.1 Nature of the problem

Understanding the nature of the ship strike issue in each jurisdiction arose from the identification of ship strikes as a threat to a whale species through research or due to specific events (IMO 1999, Abramson et al., 2010). In each jurisdiction, the overlap between a whale species habit and vessel traffic routes has led to a rate of ship strikes that may be impeding the population recovery of the whale species population. Additionally, in defining the extent of the problem, seasonal considerations are noted.

5.2 Scale

The nature of the problem, within each region, was further defined by the spatial scale of the problem. Identifying the scale of the problem highlights areas of concern, can limit the feasibility of certain measures, and help to define the relevant stakeholders. The scale of problem also identifies the scale at which measures could be adopted. Where the scale of ship strikes covers a large area, measures can encompass the entire region and specific measures can be taken at specific sites to address ship strikes taking into consideration geographical features and activities that are taking place around the site.

Using the scales outlined in Kay and Adler (2005), the jurisdictions provide examples of site, regional, whole-of-jurisdiction and international planning scales. On Canada's east coast, two areas, the Grand Manan Basin and the Roseway Basin, have been of focus (IMO, 2007a; Brown et al., 2009; Hinch and De Santo, 2011). In the Mediterranean Sea and the eastern seaboard of the U.S., more than one scale of area planning is used. A whole jurisdiction scale was taken to indicate ship strikes are problematic over a wide area. However, within these broad regions, directed efforts have been implemented at the site level where broader measures could not apply to the entire area (Weinrich, Panigada, and Guinet, 2005; Abramson et al., 2010).

5.3 Tools

The tools used within each region aim to to either reduce the overlap between ships and whales or where collisions are unavoidable, aim to reduce the impacts of collisions if they occur. The measures in each jurisdiction rely on the use of legislative, management, operational or technical tools to mitigate ship strike risk¹¹. These can apply over the entire geographic scale, can be specific to a smaller site or to specific vessels. Additionally, measures can be mandatory or voluntary. Each jurisdiction used a range of measures, encompassing both broad and site or vessel specific measures, and an array of mandatory and voluntary tools. The measures implemented focus on changing vessel behavior through restrictions and/or prohibitions.

Tools provided regulations, prohibitions and restrictions based on seasonal, spatial and temporal considerations. Legislation was used to place mandatory prohibitions and restrictions on mariners¹² and to support efforts of enforcement through government agencies (Silber and

¹¹ Descriptions of tools can be found in Appendix C

¹² *Endangered Species Act*, (7 USC § 136, 16 USC § 1531 et seq.); *Marine Mammal Protection Act of 1972*, 16 USC Chapter 31 (1972); *National Park System Units in Alaska*, 36 CFR 13, subpart N – Special Regulations; *Hawaiian*

Bettridge, 2008; Abramson et al., 2010; Silber and Bettridge, 2012; Silber, Adams and Fannesbeck, 2014).

Placing mandatory and/or voluntary restrictions and prohibitions on vessel activities were adopted to suit the area where action is needed. On the eastern seaboard, ship strikes are being addressed across the entire region, however some measures are implemented based on specific site needs. Operational measures were implemented within several smaller sites along the eastern seaboard and used voluntary ship routes, TSS amendments, an ATBA, seasonal (SMA) and dynamic management areas (DMA) across the different areas (Laist et al., 2001; IMO, 2006c; Reeves et al., 2007; IMO, 2008; NOAA, 2008; Norris, 2008; Asaro, 2012; Laist et al., 2014; Silber et al., 2014; van der Hoop et al., 2014).

Tools could also overlap in spatial implementation to increase effectiveness. For example, SMAs and the ship speed rule were used together along the eastern seaboard of the US (NOAA, 2008).

Management actions and technological tools are used to collect data, disseminate information to mariners and raise awareness of the potential of ship strikes. Technology measures were used to detect whale species (Couvart and Gambaiani, 2013; Ports of Auckland, 2013a), for reporting sightings and ship strikes, and to collect data on whale species and vessel traffic. Technological tools can support management and operational actions implemented.

Tools that can be used to address mitigating ship strike risk are applied according to the nature of the problem, geographic demographics and stakeholders involved. There is flexibility in use of the tools and opportunity for overlapping tools to increase effectiveness of efforts.

5.4 Processes for Integration

The jurisdictions display varied levels of integration, however each approach demonstrates a degree of area planning, information sharing, collaboration and cooperation, and a precautionary and adaptive capability.

There is stakeholder participation and information sharing within each planning process. The jurisdictions highlight collaboration across governments, researchers, industry participants, and in some circumstances involve international cooperation. Information sharing is emphasized

Islands Humpback Whale National Marine Sanctuary Act [Subtitle C of Pub L 102-587, as amended by Pub L 104-283] 25 (1997); *West's Hawaii Administrative Code*, HI ADC § 13-124-1 to § 13-124-10 (1998) (*Hawaii's Wildlife Act*).

through the reliance of governments on external sources of research and opinion in decision making (IMO, 2007a; Reeves et al., 2007).

The creation of working groups, workshops and formal agreements of cooperation, such as in the Mediterranean Sea are explicit recognition of forums for cooperation (Panigada, Donovan and Guinet, 2005; Weinrich et al., 2005). Established groups provide opportunities for information sharing between stakeholders and enables a cohesive rationale to be developed for actions that are to be taken (Panigada et al., 2005). Working across government agencies and with other groups allows for decision-making that is based on agreement and brings focus to the needs of mariners, such as the importance of educating captains and crews on the issues and practical measures that could be taken to avoid collisions (Weinrich et al., 2005).

Collaboration across jurisdictions provides for greater vertical integration where necessary to address the issue¹³ (Reeves et al., 2007). Collaborative processes also provide support for data collection to fill gaps in knowledge with respect to ship strike risk and whale abundance, which allows a better understanding of the issue and to determine appropriate courses of action (Panigada et al., 2005).

Within the jurisdictions, approaches to addressing ship strikes have been taken with varied levels of understanding of the nature of the problem. In each jurisdiction it was recognized that ship strikes pose a threat to a whale species and there was some understanding of where the risk was greatest. The jurisdictions show approaches to mitigating ship strike risk over varied periods of time. Timelines of the actions taken on the eastern coasts of Canada and the US highlight efforts taken over an extended period of time. In these jurisdictions, measures are implemented in a staggered approach as information is updated. An approach that recognizes the longevity of measures and the ongoing nature of data collection, will enable necessary information to be determined and gives a jurisdiction the capability to enact measures on an ongoing basis. This approach shows deference to a precautionary approach that has the capability to adapt as the science is presented.

¹³ The right whale conservation agreement between the US and Canadian governments (Reeves et al., 2007), the Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic area (ACCOBAMS), and the International Sanctuary for the Protection of Mediterranean Marine Mammals agreement between France, Italy and Monaco extend efforts beyond jurisdictional limits for conservation purposes. Appendix I and II (Notarbartolo-di-Sciara et al., 2008) provide the English translation as the original document was published in French and Italian.

Table 2. Overview of approaches taken in other Jurisdictions

	Nature of Ship Strike Problem	Scale	Stakeholders	Tools
East Coast (Canada)¹⁴	North Atlantic right whales Commercial vessels	Roseway Basin; Grand Manan Basin (site) Critical habitats for seasonal feeding and socializing Overlap with commercial shipping routes	Government agencies (DFO, CCG, TC); Researchers; Shipping industry; New England Aquarium; Dalhousie University US government agencies	Designation of Conservation Areas; Nautical charts, Navigation Rules, Notices to Mariners; Recovery Strategy and Management Plans; Sighting reports by transiting vessels; Established ATBA; TSS Amendments; Letters to shipping companies regarding compliance; Mariners Guide
East Coast (US)¹⁵	North Atlantic right whales Various sizes of vessels	Eastern seaboard; Area specific measures (whole-of-jurisdiction & site) Calving in southern waters; Migratory route Feeding and nurse in northern waters Overlap with commercial shipping routes	Government agencies (USCG; NMFS, NOAA); US Navy; Researchers; Shipping industry; Canadian government agencies	Educational materials (multi-media CD, Coast Pilot guides, training modules); Nautical charts, Navigation Rules, Notices to Mariners; Recovery Plans; 500-yard approach restriction; Mandatory ship reporting system; Voluntary shipping routes; TSS Amendments; Established ATBA, SMAs and DMA and ship speed rule; LNG specific program; Enforcement (real-time notification; community oriented policing and problem solving program; and notice of violation and assessment of civil penalties)
West Coast (US)¹⁶	Blue whales (priority); Humpback whales	California; Area specific measures (regional & site) Foraging area	Government agencies (USCG, NMFS, NOAA); CINMS; Researchers;	Nautical charts, Navigation Rules, Notices to Mariners; TSS Amendments; Voluntary speed reduction incentive programs;

¹⁴ IMO, 1999; WWF/DFO, 2000; IMO, 2003b; IMO, 2007a; IMO, 2007b; Vanderlaan et al., 2008; Brown et al., 2009; Hinch and De Santo, 2011; Couvat and Gambaiani, 2013; CCG, 2015)

¹⁵ IMO, 2001; Laist et al., 2001; IMO, 2006c; Reeves et al., 2007; IMO, 2008; NOAA, 2008; Norris, 2008; Silber and Bettridge, 2008; Abramson et al., 2010; Asaro, 2012; Silber and Bettridge, 2012; Laist et al., 2014; Silber et al., 2014; van der Hoop et al., 2014;

¹⁶ Silber and Bettridge, 2008; Abramson et al., 2010; IMO, 2012; McKenna et al., 2012; Dettmer and Teufel, 2014

	Nature of Ship Strike Problem	Scale	Stakeholders	Tools
	Commercial vessels		Shipping industry; US Navy	Sanctuary regulations
Alaska (US) ¹⁷	Humpback whales Cruise ships	Glacier Bay National Park (site) Feeding area	Government agencies (USCG, NMFS, NOAA); Park rangers; Researchers; Cruise ship operators	Speed and course restrictions; Vessel quota system and permit process; Monitoring; Onboard education programs
Hawaii (US) ¹⁸	Humpback whales Commercial vessels Hawaiian Superferry	Hawaiian waters (whole-of-jurisdiction) Breeding, calving and nursing grounds	Government agencies (USCG, NMFS, NOAA); HIHWNMA; Researchers; Mariners; Superferry operators	Designation of humpback sanctuary (HIHWNMS); Limited vessel approach; Mariner training; Awareness campaigns; Code of good conduct; Superferry avoidance policy
Mediterranean Sea ¹⁹	Fin whales Commercial vessels Ferries	Mediterranean Sea; Area specific measures (international & site)	Members of ACCOBAMS; Specific Governments (Spain, Italy, France, Monaco); Industry; Researchers	Designation of the Pelagos Sanctuary; Real-time information system; Voluntary speed reductions; Mariner training; TSS Amendments; Designation of security area; PSSA designation (in progress) ²⁰
New Zealand ²¹	Bryde's whale Commercial vessels Ferries	Harauki Bay (site)	Government agencies; Port authorities; Industry; Researchers	Thermal imaging; Voluntary speed reduction programs; Voluntary sightings reporting; Voluntary avoidance measures; Recommended routeing

¹⁷ Silber and Bettridge, 2008; Abramson et al., 2010; Couvat and Gambaiani, 2013

¹⁸ *Hawaiian Islands Humpback Whale National Marine Sanctuary Act* [Subtitle C of Public Law 102-587, as amended by Pub. L. 104-283] 25; Silber and Bettridge, 2008; Abramson et al., 2010; Couvat and Gambaiani, 2013; Lammers et al., 2013

¹⁹ Panigada et al., 2005; Weinrich et al., 2005; IMO, 2006d; Panigada et al., 2006; Abuella and Linden, 2008; Evans, 2008; David, Alleaume, and Guinet, 2011; Silber et al., 2012; Couvat and Gambaiani, 2013

²⁰ . Resolution A.927(22) (2006) was adopted by the IMO to guide the designation of particularly sensitive sea areas (PSSA). PSSAs aim to identify areas in need of special protection from international maritime activities (IMO, 2006b). Consideration of associated protective measures, are those approved or adopted by the IMO, including “ships’ routeing and reporting systems near or in the area, under SOLAS and in accordance with the General Provisions on Ships’ Routeing and the Guidelines and Criteria for Ship Reporting Systems” (6.6.1.1, IMO, 2006a). PSSAs are not mandatory once established, however they put pressure on States to adhere to shipping measures within designated areas.

²¹ Behrens, 2009; Wiseman et al., 2011; Constantine, Soto and Johnson, 2012; Couvat and Gambaiani, 2013; Ports of Auckland, 2013a; Ports of Auckland, 2013b

5.5 Lessons Learned

The jurisdictions provide valuable lessons on the implementation of an integrated approach to addressing ship strikes with whale species. Table 3 compares the tools and processes used in the jurisdictions to highlight similar measures to mitigating ship strikes.

- *Science-management integration*

The jurisdictions show a breadth of scientific research is required to identify ship strikes as a threat to whale species. Research is needed to frame the issue of ship strikes through an understanding of whale species involved, types of vessels that pose a threat, and where the threat is greatest. Research not only substantiates actions taken, it informs on the effectiveness of measures and highlights changes over time that require adaptive actions to be taken.

- *Temporal nature of the process*

There is greater opportunity for integration of efforts over a longer period of time (Table 3). Efforts began around the 1980s with sightings data of North Atlantic right whales by both Canada and the US (IMO, 1999; Abramson et al., 2010). Efforts remain ongoing today and have required time to ensure cooperation among stakeholders and the inclusion of information.

- *Stakeholder participation*

A range of stakeholder participation between government, academics, industry, and organizations is needed (Table 3). Cooperation among stakeholders is utilized for data gathering, identifying measures and is necessary for implementing actions. All stakeholders do not need to be included in all levels of decision-making. Stakeholders relevant to measures should be engaged.

- *Role of government as facilitator*

In each jurisdiction, government agencies were engaged early on as initiators of actions, as an overseeing body of measures taken, and the relevant authority to approach the IMO. Government authorities are able to use legislation to implement, support and enforce operational and management measures.

- *Connectivity between tools*

There is interconnectivity between measures taken in each jurisdiction. Tools can be implemented in concurrence with other tools or can support to other measures taken (Table 3). Legislation can regulate technological, operational and management actions, operational measures should be supported by management actions such as education and outreach.

Table 3. Jurisdiction Tools and Process

	Canada East	US East	US West	US Alaska	US Hawaii	Mediterranean Sea	New Zealand
Process timeline	1980	1979	2007	1979	1997	2005	2009
At Risk Focal Species	✓	✓	✓	✓	✓	✓	✓
Data & Ongoing Research	✓	✓	✓	✓	✓	✓	✓
Education & Outreach	✓	✓	✓	✓	✓	✓	✓
Monitoring & Reporting	✓	✓	✓	✓	✓	✓	✓
Navigation and Charting	✓	✓	✓				
Detection Measures	✓	✓	✓	✓	✓	✓	✓
Reporting System (Voluntary)	✓	✓	✓	✓		✓	✓
Reporting System (Mandatory)		✓					
Supporting Legislation	✓	✓	✓	✓	✓		
MPA Designation		✓			✓	✓	
Routing Measures Voluntary	✓	✓	✓	✓		✓	✓
Routing Measures Mandatory		✓		✓			
Enforcement & Monitoring	✓	✓		✓	✓		
Collaboration with Others	✓	✓	✓	✓	✓	✓	✓
Collaboration with IMO	✓	✓	✓			✓ (proposed)	
Industry Involvement	✓	✓	✓	✓	✓	✓	✓

- *Use of protected marine areas for achieving conservation*

Designed protected marine areas such as the HIIWNMS and the Pelagos Sanctuary, can be created for the purposes of protecting a specific whale species or measures can be integrated into sanctuary regulations to give them formal status.

- *IMO support where international shipping at issue*

The IMO is not a stakeholder in decision-making and in developing measures to implement on a national basis. The IMO lends international support to operational measures that

are relevant to international shipping. The IMO serves as a mechanism for highlighting actions taken by jurisdictions, such as approving the designation of routing measures and protected marine areas that can influence international shipping.

- *Considerations of other whales impacted by changes*

The measures implemented are in reference to a particular whale species and their habitat. However, measures can influence other whale species that reside in the same areas. Considering the impact on other species could be relevant. For example, the SMAs established on the eastern seaboard of the US for right whales were well placed for right whales, but did not take into account humpback in the same regions but at different times of year (Laist et al., 2014).

- *Context of the problem within the jurisdiction determines tools for use*

Each jurisdiction has similar tools to choose from (Table 3), but the tools implemented and the way in which implementation occurs depends on the context of the jurisdiction. The same measure can be implemented at various scales and apply differently to industries. Mandatory and voluntary options are available and can be used together, especially where enforcing mandatory measures is difficult.

Given the contextual nature of ship strikes it is difficult to rely expressly on an approach taken in another jurisdiction. Canada's east coast may have similarities to the west coast, but there are differences that make it difficult to rely on the steps taken. The conservation areas of Roseway Basin and Grand Manan Basin were identified prior to the *Oceans Act* and *SARA* coming into force (Hinch and De Santo, 2011). These two areas remain as voluntary ATBAs, however it has been suggested that should be incorporated into an MPA network given their significance to the North Atlantic right whale (Hinch and De Santo, 2011). Additionally, the influence of First Nations communities on the Pacific coast in decision-making requires additional considerations in developing measures.

The experiences from other jurisdictions represent various levels of an integrated approach to addressing ship strikes with whale species. Integration can occur in determining the scale at which to approach the problem, through the inclusion of stakeholder groups, and in the way in which the tools are implemented. The jurisdictions highlight the flexibility in developing an IM approach to mitigating ship strike risk. The tools and processes may be similar but the operationalization of them differs between jurisdictions. This will allow stakeholders on Canada's Pacific coast to develop an IM approach that meets the needs of the region.

6. DISCUSSION

The lessons and experiences from other jurisdictions provide guidance on how to balance conservation goals and development of marine transportation activities. To advance an IM approach on Canada's Pacific coast, the lessons from other jurisdictions can be applied to the context on Canada's Pacific coast.

6.1 Problem Oriented Integrated Approach

Integrated coastal and ocean management frameworks take a multi-purpose approach to addressing the implications of multiple uses in a geographically defined area, the interrelationships between anthropogenic activities and users, and to promote collaboration and cooperation among stakeholders (Chua, 1993; Cicin-Sain and Knecht, 1998; Cicin-Sain and Belfiore, 2005). To achieve effective IM, frameworks should involve integration across sectors, intergovernmental, spatial, between science and management, and where necessary, international integration (Cicin-Sain and Knecht, 1998). To achieve horizontal and vertical integration, comprehensiveness, aggregation and consistency extending over a long period of time, should be established by incorporating relevant stakeholder interests and connecting and aggregating the interaction of alternatives among the levels (Cicin-Sain and Belfiore, 2005). This allows for actions taken at different levels and by different stakeholders to have the same underlying guiding principles towards the same objective.

IM principles can be used to develop an operational framework for a problem-oriented focus on mitigating ship strike risk. Mitigating ship strike risk through IM considers interests of biological objectives, government agencies, researchers, maritime industry, environmental non-governmental organizations, and other interested stakeholders jointly (IMO, 2009). The connection between environmental and economical implications would assess the feasibility of actions that can be taken while balancing objectives. Economical implications for commercial and recreational uses (Silber, Bettridge, and Cottingham, 2009), need to be considered alongside factors that influence the feasibility of measures being implemented: vessel maneuverability, safety of navigation, and environmental, health and economic costs (Firestone, 2009). Impact on whale species and other conservation and protection objectives would be balanced with these considerations. Balancing conservation and development allows for a specific strategy for

conservation coordination to be created in connection to a problem that could eventually be included in broader coastal and ocean IM frameworks (Cicin-Sain and Belfiore, 2005).

Within a problem-oriented integrated approach, a broad scope can be taken where the issue is far reaching while encompassing site specific initiatives that involve minimal integration between them (Guenette and Adler, 2007). Where there are variations in stakeholders, geographic demographics, relevant agencies and ongoing projects, site specific initiatives are practical. Smaller scale initiatives work within the overarching goals and principles, achieving integration in purpose and outcome, allowing for integration between stakeholders and regions at a higher level.

A relevant approach that could be taken on Canada's Pacific coast would be a nuanced integrated approach that operates within the context, keeping in mind the constraints and opportunities of the region.

6.2 An Integrated Approach for Canada's Pacific Coast

A structured IM approach for Canada's Pacific waters would balance conservation objectives of whale species with relevant vessel activities (Table 4). By doing so, conflict between stakeholders can be minimized through integration across the various levels while working within the constraints and opportunities identified on the Pacific coast. The guiding principles outlined in Table 4 should direct the framework of an integrated approach to managing ship strike risk.

i. Nature of the Problem

Currently, the extent to which ship strikes pose a problem is not fully understood. It is known that the baleen whale species identified inhabit Canada's Pacific waters and are threatened by ship strikes (Fisheries and Oceans Canada, 2010; Fisheries and Oceans Canada, 2011; DFO, 2012; Fisheries and Oceans Canada, 2013b; DFO, 2013b). Given the current level of knowledge, initially, a broad approach should consider all the baleen species identified in this paper. As noted, research has identified ship strike risk for fin and humpback whales. Given the delisting of humpback whales to special concern, if a particular whale species is to be identified from the information available, it would be fin whales (Williams and O'Hara, 2010).

Large vessels, such as commercial, ferry and cruise are mainly involved in ship strikes (Laist et al., 2001, Williams and O'Hara, 2010). As these large vessels are present along the

Pacific coast and have expectations of increased vessel traffic, they should be considered in a broad IM framework. As information is gathered, reevaluating and redefining the nature of the problem can shift focus to a single whale species and/or vessel type.

Geographically, focus should be on all Canadian Pacific waters until the nature of the problem is better understood. An adaptive approach to defining the nature of the problem allows for measures to be established that serve overall purposes of mitigating ship strike risk while focused measures can be implemented as information narrows areas of particular concern.

Table 4. Configuration of an Integrated Approach on Canada’s Pacific Coast

Nature of Problem	Endangered/Threatened Baleen species: Fin, Sei, Blue, and North Pacific Right whales Special Concern Baleen species: Humpback and Gray whales Commercial, cruise, ferry vessels	Principles Precautionary Integrated Ecosystem Based Management Adaptive Economic development
Scale	Canada’s Pacific coast; Whole-of-jurisdiction & Site specific	
Processes	Collaboration, cooperation and consensus building Information sharing Use of best available science	
Participants	Federal government agencies (TC, DFO, CCG) (facilitator) Provincial government – Ministry of Environment Ports Pilotage Authorities First Nations Communities Shipping industry Researchers Cruise and Ferry Oil & Gas companies with development projects on the coast	
Tools	See Appendix C	

ii. Scale

PNCIMA and MAPP have attempted to establish broad integrated coastal management for the Pacific North Coast, an area identified as deserving of large ocean management in the Oceans Action Plan (2005). Ship strikes have been identified within this region, (Ford et al., 2010; Williams and O’Hara, 2010), but may occur in other areas of Pacific. While acknowledging there are attempts for a higher level of integrated management for the North Pacific coast, following the principle of ecosystem based management would allow for integrations across the whole of Canada’s Pacific region. The baleen species identified are migratory and do not adhere to human imposed boundaries of management, the shipping, ferry

and cruise industries operate along the entire coastline, and there is a lack of knowledge to focus efforts in only one area. A whole jurisdiction scale allows for streamlined measures within industry, in addition to specific measures imposed at a smaller scale.

The differences in geographical features, stakeholder influences and development projects across the Pacific coast means some measures will not be appropriate for the whole jurisdiction (e.g. Alaska's permit system is effective because GLBA has only one entry or a traffic separation scheme in a narrow channel may pose navigational hazards). As the nature of the problem is clarified, site specific measures, which adhere to the broader IM structure, can be taken where necessary.

iii. Tools

A toolbox of available measures on the Pacific coast is developed out of relevant legislation, industry initiatives, and measures used in other jurisdictions (Appendix C). The tools involve varying levels of regional, national and transboundary integration and can be used alongside other measures, can be utilized broadly across the Pacific waters or in developing site specific measures. Implementation of tools should be on a precautionary basis.

As the nature of the problem remains to be clarified, measures that focus on the broader jurisdiction and establish compromise between stakeholder groups on overarching goals and objectives can prepare stakeholders for future long-term solutions (Mullen et al., 2013). To encourage collaboration, education and outreach initiatives currently being used by BC Ferries, Cruise Line International Association, and the Vancouver Aquarium can generate awareness of the concerns of ship strikes along the coast. Outreach and education can generate awareness among relevant stakeholders and initiate discussions for support of common objectives. Additionally, general practices for mariners can be established through the development of a mariner's guide by Prince Rupert Port Authority and Port Metro Vancouver. A guide will disseminate information applicable across the region and can show the link between responsibilities of industries to marine stewardship. Promoting mariner reporting to the BC Sightings Report Network can supplement systematic marine mammal surveys in building baseline data on sightings and the rate of ship strikes. These initiatives are opportunities within British Columbia to bring together stakeholders and increase their understanding of the issues while also gathering information. These will serve as starting points for developing measures that are consistent in objectives and purpose.

Specific measures are currently being considered by groups which could be advanced within an IM framework. Proposals under the Northern Gateway project and by Port Metro Vancouver to develop a marine mammal protection framework and a potential incentive program, can be developed with consideration of the principles underlying an IM approach. Additionally, these projects should be included in overall planning to achieve vertical and horizontal consistency and to ensure that the projects fit within the context of IM. Information is needed to reason mandatory change to established vessel activities, but where operations can utilize recommended measures, projects, such as those noted above, can implement voluntary measures to adjust mariner behaviour.

Formal operational measures such as routeing measures, MPAs or designations under the IMO require a clearer scope of the problem, including consideration of geographical limitations and scientific information to support implementation. As a clearer picture of the problem emerges, where specific efforts are required, tools in Appendix C can be applied as necessary.

iv. Processes & Participants

To overcome horizontal and vertical fragmentation between groups, a working group for the whole jurisdiction should be established. A working group similar to that in the Mediterranean Sea under ACCOBAMS, would enable information sharing, establish broad research goals, and provide a supportive structure for stakeholders to collaborate and cooperate. With a focus on the whole jurisdiction, stakeholders can work together to build consensus on the direction of approaches. An overarching working group should include government agencies, First Nations communities, industries, and researchers. To encourage responses to marine navigation and transportation, incorporation of industry practices into a broader framework that addresses ship strikes will create consistency across processes.

The interests of certain stakeholder groups may not extend to the entire region. Although an interest in the marine environment (CPAWS, 2009), actions taken by First Nations communities are relevant to their region. Where measures are more focused, impacted stakeholders should be involved in decision-making to ensure consensus, compliance and to ensure measures meet overarching goals.

To facilitate stakeholder cooperation, current initiatives such as the Green Marine program, ECHO, Guardian Watchman program, bilateral agreements provide a starting point for collaborative efforts. These projects may provide opportunities for gathering stakeholders but as

the majority of projects focus on specific areas of Canada's Pacific waters, ship strikes could be integrated into the projects. With stakeholders committed to working together, implementing projects under cohesive goals can promote greater collaboration between efforts. Additionally, transboundary agreements support coordination with US and Mexico to strengthen baseline knowledge of species that are at risk along the Pacific coast of North America.

Self management and regulation, such as within the ferry and cruise industries, are individual processes. Industry practices and the ability to self manage can provide incentive for collaboration and coordinating to work within a greater IM approach. Where measures imposed may influence industry practices, input from industries will achieve collaboration and the industry itself will have a voice in outlining objectives while remaining as self managers.

The need for an facilitator to organize an IM approach was highlighted in the experiences from other jurisdictions. A facilitator can bring stakeholders together and oversee the bigger picture of the initiatives to ensure they are working towards the same goals. On the Pacific Coast, Transport Canada and DFO are the responsible government agencies for overseeing navigation and shipping and conservation. Although the current level of overseeing efforts and engagements is minimal, with the recent government change there is potential for greater involvement of both agencies.

v. Recommendations

Due to the level of knowledge concerning ship strikes on Canada's Pacific coast, recommendations will support development of an IM approach to ensure objectives are met:

- *Define nature of the problem*

This should include identifying species²³ that require protection from ship strikes by identifying the level of threat to the species population, areas of importance for the species, and where areas of importance overlap with vessel activity that result in a level of ship strikes that poses a risk to the recovery of the species.

- *Use of best available science*

The federal and provincial governments may not have the financial capacity to conduct the research. Inclusion of research by academia, organizations such as Clear Seas, and First

²³ At present, fin whales could be considered the species of focus as they have been highlighted in the research to be the second most common whale struck in BC and the most common struck species worldwide and are considered endangered (Williams and O'Hara, 2010).

Nations communities will support research initiatives by providing best available information and would alleviate financial burdens on governments.

- *Determine a facilitator*

The federal government has responsibilities over navigation, shipping, and conservation and protection of species at risk. Transport Canada relies on the advice of DFO in order for changes to occur within marine shipping industries with respect to the marine environment. Having DFO as lead facilitator would allow for intergovernmental consistency and provide a government agency that is able to work with international agencies. It could also put pressure on DFO to uphold responsibilities under legislation.

- *Greater role for Provincial Government*

The 2004 MOU commits the federal government and government of British Columbia to jointly address ocean and coastal planning. With the commitment to allow the province to take a more active role in ocean management and planning, enabling a greater role for them would bring consistency between levels of government and provide avenues for stakeholder integration. The province has established working relationships with several First Nations communities and given the need to involve First Nations, the provincial government could broker relationships between government and First Nations communities.

- *Assess levels of stakeholder participation*

There are several stakeholders across the Pacific coast that have a direct interest in the issue of ship strikes. Clarification of roles and the degree to which stakeholders should be engaged should be determined. This will outline whether stakeholders should be part of a larger working group and/or involved in smaller scale efforts, and the extent to which participation is sought.

- *Participation of shipping industry*

As users of the Pacific waters and a lack of industry policies concerning whale species, the shipping industry should participate in strategies that respect the principles of sustainable management of the ocean environment. Participation of the shipping industry from an early time will allow progressive changes to be made with less conflict as there will be an open dialogue in which industry can express their opinions.

- *Ongoing research & monitoring*

Ship strikes with whale species is not a static issue. As the level of vessel activity changes over time, and whale species behaviours change, ongoing research will provide the basis for adapting efforts to change as necessary.

These recommendations seek to support the development of an IM approach to mitigating ship strike risk on the Pacific coast of Canada. Efforts should rely on the principles addressed and focus on long-term solutions. At this stage it is unknown the impact of ship strikes on whale species on Canada's Pacific coast due to a lack of knowledge and awareness, but bringing stakeholders together now will benefit long-term solutions and will bring necessary groups together to begin discussions.

7. CONCLUSION

Despite a lack of understanding of the extent to which ship strikes pose a threat to baleen whale species on Canada's Pacific coast, mitigating ship strike risk should be addressed. As vessel activities increase along the coast, efforts should be in place to ensure that impacts are minimized and cumulative impacts are reduced. This will ensure conservation objectives are being met while allowing for continued development in the marine environment.

Addressing ship strikes through an integrated approach will allow for consideration of the whole jurisdiction of Canada's Pacific waters and include actions limited to specific regions. It allows for contributing factors concerning vessel activities to be considered and creates a focus on working towards comprehensiveness in order to effectively manage complex linkages and provide balanced solutions (Kay and Adler, 2005).

The jurisdictions reviewed outline processes developed through existing social capital and social capital created through nodes of collective knowledge, valuable working relationships, concentrated actions, consensus-building, formal and informal rule making, and leadership (Guenette and Adler, 2007). As well, the management, operational and technological tools applied in the jurisdictions were similar in nature but were implemented with consideration of the nature of the problem. In each jurisdiction, a range of stakeholders and tools were utilized to create a cohesive plan to addressing ship strike risk.

The existing relationships, actions and rulemaking can be a starting point for adopting an IM approach on the Pacific coast. The application of available tools will depend on how the

nature of the problem is defined and the context in which measures are taken. Despite constraints, there are opportunities for developing an interconnected approach to addressing ship strikes.

When conservation is managed in isolation, efforts remain vulnerable, where as under IM, specific strategies involve coordination between conservation and anthropogenic activities, intergovernmental and intersectoral coordination, and enables protection to be considered in spatial development strategies for larger areas (Cicin-Sain and Belfiore, 2005).

A lack of operational guidance on implementing IM can result in inconsistency between conservation objectives and the anthropogenic uses being managed. Using available tools to apply IM can balance environmental and economic considerations. Given that baleen whale species exist across large spatial areas, eliminating all human impacts may be economically and or culturally impossible (Mullen et al., 2013). However, to minimize the imbalances currently present in the marine environment, conservation efforts of protecting, restoring and sustainably using ocean systems and their living components, including preservation of habitat or potential habitat, need to be considered with anthropogenic uses of the marine environment that impact conservation objectives.

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APPENDICES

Appendix A: Known Distribution of Baleen whale species

(Based on best available scientific information)

<i>Baleen Cetacean Species</i> ²⁴	<i>Distribution</i> ²⁵	<i>Range States</i>
Fin	Offshore Continental shelf west of Vancouver Island and Haida Gwaii, in Queen Charlotte Sound, southern Hecate Strait and Dixon Entrance and also in the confined waterways of Caamano Sound and Squally Channel on the northern mainland coast	US, Canada
Sei	Offshore – North of 40 Noted in the Dixon entrance and off southwest Haida Gwaii, however sightings have been few	US, Canada
Blue	Offshore – North of 40 Continental shelf break between Vancouver Island and Haida Gwaii, west of southern Haida Gwaii and southwest of Cape St. James and the southern tip of Haida Gwaii	US, Canada
Humpback	Near and offshore Entire length of the coast and including inshore coastal inlets, such as the Queen Charlotte Basin,	US, Canada, Mexico
North Pacific Right	Unknown due to insufficient data	US, Canada
Gray	Nearshore around Vancouver Island and migrate North	US, Canada, Mexico

²⁴ Fisheries and Oceans Canada, 1999

²⁵ Gregr et al., 2000; Fisheries and Oceans Canada, 2010; Fisheries and Oceans Canada, 2011; DFO, 2013b; Fisheries and Oceans Canada, 2013a; Fisheries and Oceans Canada, 2013b.

Appendix B: Identified Stakeholders and Interested Parties

Group	Organization	Discussion	Role	Projects involved in	Relevance R/L = Regulator/Legislator S = Stakeholder IP = Interested Party
Government					
Federal Government	Canadian Coast Guard	Email	Oversees implementation of provisions of the <i>Canada Shipping Act, 2001</i> Active on the water	BC Cetacean Sightings Network	R/L
	Environment Canada	n/a	Member of North American Agreement on Environmental Cooperation	ECHO	R/L
	Fisheries and Oceans Canada	n/a	Overseeing agency of <i>SARA</i>	Marine Mammal Response Network ECHO BC Cetacean Sightings Network PNCMIMA	R/L
	Transport Canada	Phone	Overseeing agency of marine transportation activities	ECHO Oceans Network Canada	R/L
	Navy	n/a	Active on the water		S
Provincial Government	Ministry of the Environment	In person		MaPP	R/L
Coastal First Nations					
Coastal First Nations Council	Council of the Haida Nation	Telephone discussion with member of the Council	First Nations have a unique perspective and understanding of marine systems, concerns about the status of and threats to marine resources, the potential restrictions that may placed on First Nations access to marine resources, and the ability to bring legal action based	ECHO PNCIMA MaPP Guardian Watchmen Program	S
	Gitga'at First Nation – Hartley Bay				S
	Heiltsuk Nation				S
	Kitasoo/Xai'Xais First Nation				S
	Metlakatla First Nation				S
	Nuxalk Nation				S
	Old Massett Village Council				S
	Skidegate Band Council				S
Wuikinuxv Nation	S				

Nanwakolas Council	Mamalilikulla Qwe'Qwa'Sot'Em First Nation	Telephone discussion with member of the Council	on negative impacts to Aboriginal rights and titles (CPAWS, 2009). Right to be consulted	ECHO MaPP PNCIMA	S
	Tlowsits Nation				S
	Da'naxda'xw Awaetlatla First Nation				S
	Gwa'sala-'Nakwaxda'xw First Nations				S
	We Wai Kum First Nation				S
	Kwiakah First Nation				S
	K'ómoks First Nation				S
Skeena First Nations Stewardship Society	Gitga'at First Nation – Hartley Bay	Telephone discussion with member of the Council		ECHO MaPP PNCIMA	S
	Gitxaala First Nation – Kitkatla				S
	Haisla First Nation – Kitamaat Village				S
	Kitselas First Nation				S
	Kitsumkalum First Nation				S
	Metlakatla First Nation				S
Communities with traditional coastal territory	Tsimshian First Nations	n/a			S
	Xwemalhkwu (Homalco) Indian Band	n/a			S
	Klahoose Indian Band	n/a			S
	Sliammon First Nation	n/a			S
	Sechelt Indian Band	n/a			S
	Squamish Nation	n/a			S
	Musqueam Nation	n/a			S
	Katzie Indian Band	n/a			S
	Tsawwassen First Nation	n/a			S
	Hul'q umi'num Treaty Group	n/a			S
	Snuneymuxw First Nation (formerly Nanaimo First Nation)	n/a			S
	Ditidaht First Nation/Pacheedaht First Nation	n/a			S
	Nuu-chah-nulth Tribal Council	n/a			S
	Hamatla Treaty Society (Formerly Kwakiutl)	n/a			S
	Kwakiutl Nation (negotiations suspended)	n/a			S
	Te'Mexw Treaty Association	n/a			S
	Klahoose Indian Band	n/a			S

	Maa-nulth First Nations	n/a			S
	Namgis Nation	n/a			S
	Winalagalis Treaty Group	n/a			S
	Hupacasath First Nation	n/a			S
	Nuxalk Indian Band	n/a			S
	First Nations on Vancouver Island	n/a			S
	Cape Mudge Indian Band	n/a			S
	Campbell River Indian Band	n/a			S
	Comox Indian Band	n/a			S
	Qualicum Indian Band	n/a			S
Industries					
Vessel Related	BC Ferries	Email	Operate along the Pacific coast Internal policy - BC Ferries – Washing State Ferries joint best management practices policy for the safe operation of vessels around cetaceans and reporting incidents (<i>Leslie James, personal communication</i>) Company initiatives - coastal naturalists onboard to educate passengers(<i>Leslie James, personal communication</i>).	ECHO BC Cetacean Sightings Network Marine Mammal Response Network Industry Planning Green Marine	S
	Chamber of Shipping BC	Email	Representative voice of the marine industry Industry oversight, development of projects, policy and governance related to the shipping industry Operate along the Pacific coast	ECHO Green Marine	S
	Commercial Fisheries Caucus	Phone	Industry representatives of groundfish fisheries		IP
	Cruise Lines International Association	Phone	Transit between Canadian and US waters (<i>Donna Spalding, personal communication</i>).	ECHO Industry planning	S
	Oil & Gas Companies – Enbridge, LNG	n/a	Developers on coastline Committed to developing marine mammal protection plan to manage vessels transporting their goods in	Industry planning	S

			and out of the Pacific waters (National Energy Board, 2013).		
	Pacific Northwest Whale Watching Association	Email	Group of whale watch tour operators in the Salish Sea Aim to follow best practices	BC Cetacean Sightings Network	IP
	Pacific Pilotage Authority	Phone	Ships are subject to compulsory pilotage within the majority of BC waters (<i>Pacific Pilotage Regulations, C.R.C., c. 1270</i>),	ECHO Green Marine	S
	Recreational Fishing	n/a	Active on the water		IP
	Other tourism	n/a	Active on the water		IP
Ports	Greater Victoria Harbour Authority	n/a	Given greater autonomy (MacConnachie, Hillier, & Butterfield, 2007)	Green Marine	S
	Port of Kitimat	n/a			S
	Nanaimo Port Authority	n/a	Role in management and operations Expansion and development	Green Marine	S
	Pacific Pilotage Authority	Phone			S
	Port Metro Vancouver	Phone		Green Marine ECHO Industry practices	S
	Prince Rupert Port Authority	Phone		Green marine Industry practices	S
Organizations					
Academics	University of British Columbia University of Victoria MEOPAR	n/a	Conducting scientific inquiry into issues related to whale species and vessel activities	Research ECHO ONC	S
Legal	Ecojustice	n/a	Environmental law charity		IP
NGOs	David Suzuki Foundation	Phone	Focused on <i>SARA</i> implementation (<i>Scott Wallace, personal communication</i>).		IP
	Canadian Parks and Wilderness Society (CPAWS)	n/a	Advocates of ocean conservation		IP
	Living Oceans Society	Email	Interveners in project review processes Participant in advisory committee Policy paper (<i>Karen Wristen, personal communication</i>)	Research	IP

	World Wildlife Fund (WWF)	Phone	Collaborate on research initiatives	ECHO Research with Git'Gat First Nation and Cetacean Lab	S
Research Organizations	Cetacean Lab	n/a	Research focus through different mediums	Research	S
	Clear Seas	Phone		Research	S
	North Coast Cetacean Society	n/a	Public outreach to target groups	Research	S
	Orca Lab	n/a		Research	S
	Oceans Network Canada	In person		ECHO Research	S
	Pacific Wild	n/a		Research	S
	Raincoast Conservation Foundation	In person/Email		Research	S
	Simres	n/a		Research	S
	Salish Sea hydrophone (US based)	n/a		Research	S
Vancouver Aquarium	Phone	ECHO Research Marine Mammal Response Network BC Cetacean Sightings Network	S		
International					
Regional	Washington State Ferries	n/a	Operating on the water	ECHO Industry practices	IP
	NMFS – US	n/a		Tripartite agreement	IP
	NOAA - US	n/a		ECHO Tripartite agreement	IP
	Mexico	n/a		Tripartite agreement	IP
Global	International Maritime Organization (IMO)	n/a	Overseeing organization of marine navigation and transportation		R
	International Whaling Commission (IWC)	n/a	Seeks to conserve whale stocks, undertaking research, develop scientific databases, management plans		IP

Appendix C: Potential Tools for use on West Coast

LEGISLATIVE TOOLS			
		Binding and non-binding legislation can consider direct or indirect action to reduce ship strikes within territorial or EEZ waters (IWC, 2010). Legislation can identify responsible government agencies, implement restrictions, identify protected areas, and require vessels to ensure their activities do not threaten protected species (Silber and Bettridge, 2008; Couvat and Gambaiani, 2013).	
	Sec	Description	Relevance
<i>Constitution Act, 1867</i>	s.91	<ul style="list-style-type: none"> Defence, beacons, buoys, lighthouses and Sable Island Navigation and shipping Sea coast and inland fisheries, Ferries between a province and any foreign country or between two provinces 	Defines scope and basis of federal jurisdiction;
	s.92, 95	<ul style="list-style-type: none"> Public lands Local works and undertakings²⁶, Property and civil rights 	Defines scope and basis of provincial jurisdiction
Federal			
<i>Canada Wildlife Act</i>	s.4.1	The Governor in Council may establish protected marine areas in any area of the sea that forms part of the internal waters of Canada, the territorial sea of Canada or the exclusive economic zone of Canada	Protected marine areas
<i>Canada National Marine Conservation Areas Act</i>	s.4	Creation of National Marine Conservation areas	Establishes marine conservation areas, ability to zone, sustainable use and management
<i>Marine Mammal Regulations of the Fisheries Act</i>	s.7	No disturbance to marine mammals except when fishing for marine mammals under the authority of the Regulations	Marine mammal protection
	s.8	No person shall attempt to kill a marine mammal except in a manner that is designed to kill it quickly	Marine mammal protection

²⁶ Not including:

(a) Lines of Steam or other Ships, Railways, Canals, Telegraphs, and other Works and Undertakings connecting the Province with any other or others of the Provinces, or extending beyond the Limits of the Province:

(b) Lines of Steam Ships between the Province and any British or Foreign Country:

(c) Such Works as, although wholly situate within the Province, are before or after their Execution declared by the Parliament of Canada to be for the general Advantage of Canada or for the Advantage of Two or more of the Provinces.

<i>Oceans Act</i>	35(1)(b)	A marine protected area is an area of the sea that forms part of the internal waters of Canada, the territorial sea of Canada or the exclusive economic zone of Canada and has been designated under this section for special protection for one or more of the following reasons: (b) the conservation and protection of endangered or threatened marine species, and their habitats;	Establish a MPA as a protected marine area
<i>Species at Risk Act</i>	s.6(e)	Protect the marine environment from damage due to navigation and shipping activities;	Overseeing legislation on marine mammal protection and conservation
	s.32	No person is allowed to kill, harm, harass, capture or take an individual or to possess, collect, buy, sell or trade an individual or any part/derivative thereof	
	s.33	Prohibits damaging or destroying the residence of one or more individuals of listed endangered or threatened species.	
	s.37	Competent ministers to prepare a recovery strategy for listed species	
	s.47	Action plans based on recovery strategies	
	s.58	Prohibits destruction of critical habitat – threatened, endangered, extirpated	
	s.65	Develop management plans of special concern species	
	s.97	Penalties or contravening s.32	
s.73(3)	Minister discretion to issue incidental harm permits		
<i>Shipping Act</i>	s.126(a)(i)	Establishment of VTS Zones and mandatory reporting when within a zone	Promote safety in marine transportation and recreational boating
	s.136(1)(f)	Regulating or prohibiting the navigation, anchoring, mooring or berthing of vessels for the purposes of promoting the safe and efficient navigation of vessels and protecting the public interest and the environment (recommendation by Minister of Transport)	
	<i>Collision Regulations, Rule 10</i>	Traffic Separation Schemes that have been adopted by IMO	
	<i>Vessel Traffic Services Zone Regulations</i>	Provide directions on reporting measures when operating within a VTS zone	

Provincial			
<i>Ecological Reserve Act</i>	s.2	Ensures consideration of preservation and maintenance of the natural environment in the administration of land use and resource development.	Establish an ecological reserve as a protected marine area
<i>Environment and Land Use Act</i>	s.7	Establishment of parks, recreation areas and conservancies	Establish parks and conservancies as a protected marine area
<i>Park Act</i>	s.5	Designation of parks, recreation areas and conservancies.	Establish parks, recreational areas and conservancies as a protected marine area
<i>Protected Areas of BC Act</i>	Schedule B	Designation of parks, recreation areas and conservancies	Establish parks, recreational areas and conservancies as a protected marine area
<i>Wildlife Act</i>	s.4	Designate wildlife management areas	Provides management of marine mammals within British Columbia
	s.5	Designation of critical wildlife area	
	s.6	Designation of species as threatened or endangered	
International			
<i>Convention on Biological Diversity</i>		International convention that established Canada's responsibility to protection and conservation	
<i>North American Agreement for Environmental Cooperation</i>		Establishes an agreement between Canada, US and Mexico to work together to enhance, protect, and conserve the environment including transboundary species	

	<i>Mandatory/ Voluntary</i>	<i>Description</i>	<i>Relevance</i>
MANAGEMENT TOOLS			
Research & data collection		Identify: species at risk; distribution, abundance, habitat and behavior of species that make them susceptible to ship strikes; when and where risk is present; contributing vessel traffic characteristics (e.g., types of vessels, traffic patterns, and densities) to the risk. Involved: Clear Seas, Oceans Network Canada, WWF, Guardian Watchmen Program, Vancouver Aquarium, DFO, First Nations	Can identify areas of spatio-temporal overlap, enable estimation of impact of shipping traffic and risk, modelling and mapping of areas Enables consideration of environmental and economic considerations. (Couvart and Gambaiani, 2013)
Education & Outreach		Education: curriculum and training programs for maritime academies, working with other stakeholders; incorporating ship strike reduction material into voyage planning guidelines and licensing programs; place notes on charts and in other nautical publications about the possibility of ship strikes; include information on any relevant websites (IMO, 2009; Couvat and Gambaiani, 2013)	Raise awareness of conservation measures and protocols within the shipping industry, maritime authorities, military sector, cruising industry and with other boaters Delivering information to the maritime industry using the appropriate channels ensures those in direct contact with

		Outreach: Notices to Mariners, brochures, placards, permanent signage, public service announcements and advisories, documentaries, and any other educational-informational media that is deemed most effective in scope and message (IMO, 2009; Couvat and Gambaiani, 2013). Involved: Vancouver Aquarium, BC Ferries, Cruise Line International Association, Ocean Networks Canada	whales have the relevant information to make informed decisions on actions.
Observers		Onboard vessels, trained to look for whales in or near the path of the vessel	Cost effective measure; more focused to look around than captain; limited by human error, weather, sea state and if whales are submerged
Reporting - collision		Useful collision information: date, time, location, species, whether the struck whale was seen before the collision, a description of the impact, fate of the whale or signs of injuries, type, name, and size of the vessel, vessel speed and weather conditions, and vessel damage (Laist et al., 2001). Involved: BC Cetacean Sightings Network, Marine Mammal Response Network	Assists in enabling the estimation of impact of shipping traffic and risk, modelling and mapping of areas. Can lead to development of databases nationally and/or internationally, such as BC Cetacean Sightings Network or IWC database (IMO, 2009).
Industry tools		BC Ferries and Cruise Line International Association have industry policies and best management practices that concern ship strikes with whales. They include: avoidance measures, detection methods, onboard education programs	Industry operations for limiting the interactions with whale species
TECHNOLOGICAL TOOLS			
Placed on vessel or in water		Could use: deterrent devices, active acoustics, satellite telemetry, radio and acoustic telemetry, mobilizing a pilot boat, visual observation, satellite imaging, passive acoustics: anchored buoys and towed hydrophones, laser technology, RADAR, prediction models and night vision systems using light amplifiers or thermal vision systems. (Couvat and Gambaiani, 2013) Involved: research organizations working with hydrophones, Oceans Network Canada	Low economic and environmental costs (Reeves et al., 2007). Can alert mariners to the presence of whales in real time (Brown et al., 2009, Couvat and Gambaiani, 2013).
OPERATIONAL TOOLS			
Speed Reductions	V/M	Calculated probability of whale mortality rises from 20% to 100% when vessel speed increases from 9 to 20 knots, that rise being the sharpest between 10 and 14 knots (Vanderlaan and Taggart, 2007).	Useful where overlap between vessels and whales cannot be minimized (Wiley et al., 2011). Speed is a determining factor in the rate and severity of collisions between vessels and whales as it not only increases the rate of mortality but reduces detection ability (Laist et al, 2001; Gende et al.,

		Speed reductions below 11.8 knots reduces the changes of lethal injury to below 50% and below 10 knots make it rare (Laist et al., 2001; Vanderlaan and Taggart, 2007; Wiley et al, 2011).	2011).
Routeing Measures	V/M	<p>Modification of shipping lanes or corridors</p> <p>TSS designate inbound and outbound lanes of traffic</p> <p>ATBA designates areas where mariners are asked, but not required to avoid transiting through</p> <p>DMA invoked outside of SMAs for short term periods (15-days) when 3 or more whales are spotted, can vary geographically, arise in unpredictable locations (Reeves et al., 2007; Silber and Bettridge, 2012).</p> <p>SMA invoked seasonally where whales are regularly expected to occur in relatively high densities; include imposed speed restrictions during specified periods of the year (Reeves et al., 2007; Silber and Bettridge, 2012).</p> <p>Also: inshore traffic zones, roundabouts, precautionary areas, deep-water routes (McDorman, 2012)</p>	<p>Diverts ships form whale habitat areas.</p> <p>Where shipping traffic is dense, are options to reduce potential collisions between vessels (Dettmer and Teufel, 2014).</p>
Reporting – vessel details	V/M	<p>Ships report when entering a whale designated area: position, speed and trip details to a central body from which they receive information on whale populations, threats, precautionary measures to take and positions of last observations within the area (Couvart and Gambaiani, 2013).</p> <p>Can extend to mariners, port pilots, and other port officials to record and immediately report any collisions with whales or whales carried into port on bows of ships (Laist et al., 2001).</p>	<p>Can assist in evaluating the threat of ship strikes, determine parameters (frequency, location, and circumstances of collisions) that influence risk, identify and model areas of high risk, raise stakeholder awareness and assist in implementing appropriate measures (Laist et al., 2001; Couvat and Gambaiani, 2013).</p> <p>Can be used in areas designated for whale conservation and protection.</p>
Adoption by IMO	V	Reinforces operational measures adopted by States such as TSS, ATBA, SMA, DMA (Silber et al., 2012)	Addresses issues with international vessels, not to be used for within State vessel issues
IMO – PSSA Designation	V	Designated by the IMO. Recognized for ecological, socio-economic, scientific reasons and may be vulnerable to damage by international maritime activities (IMO, 2006b). Designated where previously established protective measures adopted by State and IMO (IMO, 2006b). Can implement specific measures to control maritime activities within designated area.	Could ease need for ship strike reduction measures (Couvart and Gambaiani, 2013).