Increasing Shipping Traffic through the Bering Strait: Challenges of International Policy in a Rapidly Changing Climate and Managing Impacts to Regional Cetacean Populations

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Increasing Shipping Traffic through the Bering Strait: Challenges of International Policy in a Rapidly Changing Climate and Managing Impacts to Regional Cetacean Populations

By

Laura Morse

Submitted to the Faculty of Halmos College of Natural Sciences and Oceanography in partial fulfillment of the requirements for the degree of Master of Science with a specialty in:

Coastal Zone Management

Nova Southeastern University

October 20, 2016
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ABSTRACT

The Arctic region is experiencing growth in marine traffic as seasonal ice conditions shift to longer periods of open water and vessel improvements that have allowed for transit in heavier ice conditions. Regionally, Russia is improving existing transportation infrastructure to support increased traffic along the Northern Sea Route. As a result of these and other factors, shipping traffic is increasing through the Bering Strait and Bering Sea. Regulating traffic in these areas is more complex than most other areas in US waters given the presence of an international strait subject to international regulation through the International Maritime Organization. The US Coast Guard has recognized the hazards of increased traffic and is developing shipping guidelines to mitigate ship traffic risks. Further work will be needed to translate those guidelines into international law. In addition, research and management, focus has been on impacts to the Arctic Ocean, biological resources within, and the human residents at its margin while the Bering Sea/Bering Strait region tends to receive less attention. Of significance is the potential risk of increased ship strikes for endangered whales species, such as fin and humpback, that rarely enter the Arctic Ocean but aggregate in large numbers in the northern Bering Sea. To establish appropriate international and domestic regulations that mitigate ship strike risk, a greater understanding of ship traffic patterns, marine mammal densities and behaviors, and encounter risk will be needed. Accomplishing this will require a collaborative approach among multiple stakeholders utilizing established pathways such as Alaska Marine Exchange and the Arctic Data Integration Portal. 

Key words: Arctic, Shipping, Bering Strait, Bering Sea, Marine Mammals

INTRODUCTION

The Arctic region has a long history of human presence, exploration, and commercialized resource extraction. The Inuit people are the most recent of a series of indigenous cultures that have occupied the area for thousands of years (McGhee, 2004). Though cultural traditions shifted over time, their dependence upon the local resources for survival remained the same. As contact with non-natives increased, the northern indigenous peoples have faced the additional pressures of introduced diseases, alcohol, foreign religious and cultural beliefs, and competition for their subsistence resources.
Now a rapidly changing climate is adding one additional challenge to that long list (Wohlforth, 2004).

Exploration of the Arctic Ocean can be traced back to the days of the Viking explorers. However, it was not until the early 1600s that the start of a more serious exploration into the Arctic region began with the advancements in maritime travel and a desire to find alternate shipping routes from the European markets (Williams, 2009). As multiple European nations began to explore further, commercial exploitation in the region grew as knowledge of the region’s natural resources spread. The fur trade was the primary industry that initially drove western expansion into polar terrestrial regions (Bockstoce, 2009), coinciding with commercial whaling, which expanded from Atlantic waters as faster sailing vessels were built for longer voyages that lasted years. By the 1800s, the whaling grounds off the coasts of what is now Alaska were “discovered” (Ellis, 1991). Despite decades of whaling success, the Arctic environment dramatically accelerated the decline of the New England whaling industry with an ice storm that destroyed 32 whaling vessels off the coast of Wainwright, Alaska in 1871 (Nichols, 2009). Though whaling declined, commercialized extraction of other wildlife resources such as fish increased and continues to this day.

Mining was also an area of increasing development; the Alaska-Yukon gold rush from 1896-1899 was one notable early example (Morse, 2003). Since the gold rush period commercial mining has expanded throughout the arctic region for additional resources such as coal and a wide range of metals. For some mines such as Red Dog Mine located in Alaska near Kotzebue, shipment of their product (Zinc) is dependent on marine transportation (Emmerson, 2010).

Although oil presence was known to exist in polar region’s based on observed surface seepages, commercial exploitation did not begin until the late 1960s with the discovery of the Prudhoe Bay oil field (Sale and Potapov, 2010). Since then oil and gas development in the region has grown and is currently expanding to include additional fields offshore (Shell Global, 2015).

Human exploration into the region was originally driven by the desire to locate shorter shipping routes from Europe to China through Russia (the Northeast Passage, also known as Northern Sea Route) or North America (the Northwest Passage). However, ice
conditions severely limited the expansion of shipping routes through these waters. Many maritime explorations were thwarted and many lives were lost in the quest to find these passages. It was not until 1878 that Baron Nordenskjöld successfully navigated the Northeast Passage and in 1905 Roald Amundsen navigated the Northwest Passage (Williams, 2009). As ships transitioned from sail to steam, and then diesel and nuclear, exploration continued into the Arctic region. Vessel icebreakers also evolved and their capabilities improved. Military activity increased, linked in part to Cold War politics with the use of submarines (Anderson, 2009).

In 1932 Russia formally established the Northern Sea Route as a shipping lane through their coastal waters. Arctic ports were developed subsequent to this but the overall infrastructure to support the route has experienced both improvements and declines linked to Russia’s economic health. Recently, Russia has made a substantial push to revitalize the route and is rapidly expanding their infrastructure to support traffic along the route (Medvedev, 2008; Grant, 2010; Blunden, 2012).

Driving this recent development has been the diminishing ice extent in the Arctic Ocean (Fetterer, et al., no date). In September 2015 the Arctic sea ice extent reached its annual minimum and was ranked 4th lowest in the historic satellite record (Jeffries et al., 2014; NSIDC, 2015); those ranked 1 to 5 all occurred since 2007. With this environmental change, the opportunity for rapid development of these maritime highways between the Atlantic and Pacific oceans has become a reality (Borgerson, 2008; Arctic Council, 2010; Ho, 2010; Liu and Kronbak, 2010).

In the US Arctic region, commercial shipping traffic has received less attention. Marine traffic in the U.S. Chukchi and Beaufort seas currently consists primarily of tug and barge traffic to local communities, oil and gas industry support vessels, research vessels, small numbers of cruise ships, and local traffic (Arctic Council, 2009). Of these categories of marine activity, the regulatory requirements stemming primarily from the National Environmental Policy Act (NEPA) have focused federal funding and attention on studies of the impacts of oil and gas activities and associated noise (BOEM, 2014; NMML, 2014). These studies are concentrated in the Chukchi and Beaufort seas where oil and gas activities occur. Regardless, concern about the impacts to the environment of international commercial shipping traffic travelling the polar routes is on the rise, though
the interest still remains largely on the seas north of the Bering Strait where potential impacts to subsistence activity is greatest (Reeves et al., 2012; Reeves et al., 2014). What has not been given the same level of attention are the impacts of increased commercial vessel traffic to the Bering Strait and Bering Sea marine environment, and, more specifically, impacts to marine mammals in those regions. In particular, the risk of mortality from ship strikes would be of primary concern due to the immediate loss of individuals from the population (Laist, 2001).

Oil and gas development are regulated in U.S. waters; however, international commercial traffic lacks the same level of oversight. Impacts of shipping traffic to U.S. managed marine mammal species in the Bering Strait and Bering Sea must be examined more closely and, if warranted, the application of domestic statues such as the Endangered Species Act and Marine Mammal Protection Act to manage international traffic should be considered.
STATEMENT OF PURPOSE

While many people focus on the impacts of oil and gas development to the Arctic region, the equally -- if not more -- serious risks associated with shipping traffic have received far less attention. This capstone will examine the increasing shipping traffic in the Bering Strait region and assess the existing international and domestic regulatory and policy frameworks in place to manage the traffic and accompanying risks. The capstone will then discuss what potential impacts there may be specifically to large whales found in the Bering Strait and along the Bering Sea slope, and will follow with an evaluation of potential mitigation measures to minimize the risk.

I. SUMMARY OF SHIPPING TRAFFIC THROUGH THE BERING STRAIT

With rapidly diminishing ice in the Arctic region (Stroeve et al., 2007; Comisco et al., 2008; IPCC, 2013a, b), commercial shipping traffic along northern sea routes (Figure 1) is expanding and increasing in frequency as multi-year sea ice thins and open water seasons lengthen (Kwok and Rothrock, 2009; Laughlin et al., 2012; AKDOT and USACE, 2013). The traffic anticipated would be from support of exploration and production of newly discovered oil and gas fields in the Arctic (Gautier et al., 2009), as well as transport of various other goods and resources between Atlantic and Pacific or Indian ocean ports. Projections of Arctic conditions out to 2100 indicate an increase in accessible areas to marine traffic of approximately 49% (for open water [OW] class vessels) to 95% (for Polar Class 3 [PCS]), and predict an increase of navigation season length to approximately 103 days (OW) to 120 days (PC3) (Stephenson et al., 2013a).

This section will describe the two primary sea routes, the Northeast Passage (NEP), that includes the Northern Sea Route (NSR), which lies above the Asian continent through mostly Russian waters, and the Northwest Passage (NWP) that is above the North American continent and passes through Canadian and U.S. waters. One additional route characterized for the Arctic is the Transpolar Passage (TPP) that is the route across the North Pole.

This section will also review historic ship traffic patterns and discuss the rise in large commercial traffic as well as summarize recent vessel activity in the Bering Strait region.
and current and planned infrastructure to support shipping. Recent marine incidents that highlight the hazards of marine transport in the Arctic will also be described. This section will conclude with an overview of the types of impacts marine transport may have on the environment and communities, such as pollution, introduced species, subsistence impacts, and injury to wildlife.

Transpolar Passage (TPP)

The Transpolar Passage (TPP) route will only be discussed in brief. As stated previously, this route transects the Arctic Ocean across the North Pole. Historically and currently, limited traffic (icebreakers and submarines) can actually navigate the thick ice present year-round in the central Arctic Ocean. These conditions are unlikely to change.
significantly in the near future (Le Miere and Mazo, 2013; Stephenson et al., 2013b; Humpbert and Raspotnik, 2012) Projections, however, into the mid-21st century (Figure 2) do indicate the TPP may be a preferred route for moderately ice-strengthened polar class vessels (Smith and Stephenson, 2012). If utilized, this route will be more direct and thus a shorter transit, crossing primarily through high sea waters, outside the Exclusive Economic Zone (EEZ) of the Arctic coastal states. Ship traffic, nonetheless, would still be subject to the international standards set by the International Maritime Organization (IMO). The TPP may ultimately become the preferred route, avoiding more challenging coastal routes for both navigational and political reasons (Humpbert and Raspotnik, 2012).

Figure 2: Projected shipping routes early and mid-21st century for two climate change scenarios (from Smith and Stephenson, 2012)
Northeast Passage (NEP) (including Northern Sea Route [NSR])

The NEP, as described above, crosses along the top of the Asian continent from Europe to Northeast Asia. This route is roughly 24-40% shorter than a transit via the Suez Canal depending on ports of call and exact route taken (Farré et al., 2014; Liu and Kronbak, 2010). The portion of the route within Russian waters between the tip of Novaya Zemlya in the west and Cape Dezhneev in the Bering Strait in the east (Farré et al., 2014; Humpbert, 2014) is formally designated by Russia as the Northern Sea Route. Russia has claims to waters in this route as both historic and internal waters (i.e. waters that the coastal state has full authority over, and rights-of-passage by international vessels are not conferred) under international law. These claims have been subject to dispute by the U.S. who considers several straits within the route as international straits and, therefore, foreign vessels have the right to innocent passage (i.e. passage without coastal state permission) (Sale and Potapov, 2010; Byers, 2013). Russia has also claimed jurisdiction over the NSR through citing article 234 of the UN Convention Law of the Sea (Ragner, 2008; Zellen, 2013; Tedsen et al., 2014) that states:

*Ice-covered areas*

Coastal States have the right to adopt and enforce non-discriminatory laws and regulations for the prevention, reduction and control of marine pollution from vessels in ice-covered areas within the limits of the exclusive economic zone, where particularly severe climatic conditions and the presence of ice covering such areas for most of the year create obstructions or exceptional hazards to navigation, and pollution of the marine environment could cause major harm to or irreversible disturbance of the ecological balance. Such laws and regulations shall have due regard to navigation and the protection and preservation of the marine environment based on the best available scientific evidence. (UNCLOS, Article 234)

As Arctic ice conditions continue to shift to longer open water periods, the reliance on this article by Russia may be challenged in the future as the authority is conditional upon, as stated above, by the presence of ice covering such areas for most of the year. Currently, Russia requires all ships entering the NSR to request permission in advance and pay a fee for entry/use of the route and ice breaker and pilot support (Farré et al.,
2014; Zellen, 2014). Not all vessels are granted access, such as occurred in 2013 when Russia denied a Greenpeace’s vessel request to enter the NSR claiming the vessel did not meet requirements for operations in Arctic waters (Farré et al., 2014). It is more likely the decision was political given Greenpeace’s ongoing protests of oil and gas development (Farré et al., 2014). The denial is a cause for concern for other traffic wishing to utilize the route; unpredictable access combined with previously described uncertainties over jurisdiction and interpretation of UNCLOS weakens the NSR’s economic viability (Blunder, 2012; Le Miere and Mazo, 2013).

Additional significant constraints are the insurance industries trepidation to cover vessel activity in a high-risk area and the cost to vessel owners to upgrade vessels to meet polar standards (Marsh, 2014). Russia nonetheless has made clear its intention to fully develop the NSR. They are investing heavily in infrastructure development and capacity to support increased shipping traffic with the opening of 3 of the 10 planned search and rescue centers, increasing their icebreaker capacity, and expanding their military presence in the region (Snider, 2014). Russia has also established a NSR administration to manage the route and has streamlined regulatory requirements for entry that are considered more in alignment with international law (Farré et al., 2014).

Data compiled by the Arctic Council for 2004 (AMSA, 2009), by CMTS for 2008-2010 (CMTS, 2015) and by the NSR information office between 2011-2015 indicate there is an increase in use of the NSR (Table 1), though much of it still appears to be domestic traffic and export of oil and gas as indicated in analysis of the 2013 data (Humpert, 2014). Variable ice conditions and dynamic global economic and political conditions related to oil price and sanctions against Russia impacted the use of the route in 2014 and 2015 and will likely continue to do so in the near future (Ruskin, 2014; Mayer, 2015).

Northwest Passage

The Northwest Passage (NWP) includes several navigable routes through Arctic waters across the Canadian archipelago. It is considered the northern alternative to transiting through the Panama Canal. The NWP has a long and dramatic history of exploration that has taken place over centuries. While limiting ice conditions in the region are now on the decline, the area remains a challenge for commercial navigation due to the relatively uncharted waters, and has yet to see increases in large vessel traffic that has been
<table>
<thead>
<tr>
<th>Year</th>
<th>Total Transits of NSR¹</th>
<th>Tanker</th>
<th>Cargo/Container/Bulk Carrier</th>
<th>Other²</th>
<th>Russian Flagged Transits</th>
<th>Non-Russian Flagged Transits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>0</td>
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<tr>
<td>2009</td>
<td>2</td>
<td></td>
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<tr>
<td>2010</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>41</td>
<td>17</td>
<td>14</td>
<td>10</td>
<td>26</td>
<td>15</td>
</tr>
<tr>
<td>2012</td>
<td>46</td>
<td>26</td>
<td>6</td>
<td>14</td>
<td>18</td>
<td>28</td>
</tr>
<tr>
<td>2013</td>
<td>71</td>
<td>32</td>
<td>4</td>
<td>35</td>
<td>46</td>
<td>25</td>
</tr>
<tr>
<td>2014</td>
<td>53</td>
<td>27</td>
<td>16</td>
<td>10</td>
<td>47</td>
<td>6</td>
</tr>
<tr>
<td>2015</td>
<td>18</td>
<td>2</td>
<td>4</td>
<td>12</td>
<td>10</td>
<td>8</td>
</tr>
</tbody>
</table>

¹: Not all transits go the entire length of the NSR and through the Bering Strait
²: Other: Tugs, Icebreakers, cruiseships, research vessels, fishing/trawlers, vessels with ballast, vessels repositioning, heavy lift

Table 1: Summary of Northern Sea Route Transit Activity, 2004-2015
(Retrieved from: From NSR Information Office; http://www.arctic-lio.com/nsr_transits)

documented in the NSR (Lasserre and Pelletier, 2011). The route is estimated to be 40% shorter than transits through the Panama Canal.

The Canadian government requires that all vessels over 300 tons operating in Arctic waters around Canada report to the Canadian Coast Guard (Stewart and Dawson, 2011). This process is managed by the Northern Canada Vessel Traffic Services (NORDREG). Similar to Russia, Canada claims sovereignty over the waters in the Canadian Archipelago that include the NWP, and similarly, the U.S. has challenged this position, which remains an unresolved issue (Byers, 2009; Byers, 2013). Historic milestones in commercial ship transit through the NWP include:

1969: 1st icebreaker assisted transit of a tanker, the ice reinforced tanker SS *Manhattan* (ballast only) (Coen, 2012)

1984: 1st passenger ship to navigate NWP, *MV Explorer* (The *Explorer* in a twist of fate, sank in 2007 after hitting submerged ice while crossing the Drake Passage in Antarctica) (Steward and Dawson, 2011)
2012: Largest passenger ship (644 ft) to date, to transit the NWP; *MS The World*

2013: First Icebreaker assisted transit of a loaded (coal) polar class bulk carrier *Nordic Orion* (Snider, 2014)

2014: First unassisted transit of a loaded (Nickel concentrate) polar class bulk cargo ship *MV Nunavik* travelling from Quebec to China (Snider, 2014)

2016: Crystal Cruises completed a transit of the NWP with over 1000 passengers and 600 crew aboard the *Crystal Serenity* in August-September 2016. (Crystal Cruises, 2015; 2016)

Data compiled by NORDREG between 1906-2014 indicates an increase use of the NWP (Figure 3). The majority of the traffic is recreational vessels such as sailboats, passenger ships and icebreakers. Vessels supporting oil and gas activity in the Beaufort Sea and research vessel activity is also steadily increasing (NWT, 2015). Notably, Crystal Cruises has plans for a NWP transit in 2016 which highlights the urgent need for improved infrastructure and capacity for emergency response. Not only are the numbers of vessels transiting on the rise, so are the number of people aboard those vessels.

![Figure 3: Summary of NWP Transit Activity, 1906-2014](http://www.enr.gov.nt.ca/state-environment/73-trends-shipping-northwest-passage-and-beaufort-sea)
Tracking Traffic through the Bering Strait

Tracking ship traffic in the Arctic is challenging at best given its remoteness and limited infrastructure. Globally, most large ships are required by the International Maritime Organization under the international convention for the Safety of Life at Sea (SOLAS) to have Automatic Information System (AIS) on board; however, it is the responsibility of the flag state of the vessel to ensure compliance with that requirement. The system transmits information such as vessel position, speed, identification information, cargo, and destination. Vessels with this equipment can be tracked with land-based receivers or via satellite (Aarsaether and Moan, 2009).

As described above, Russia also requires that vessels request permission to enter the NSR and they document those transits. This includes commercial vessels transiting through the Russian side of the Bering Strait that is considered part of the NSR.

Additional sources of traffic likely to occur which are not registering through the NSR system in Russian waters of the Bering Strait region include local traffic between coastal villages and commercial fishing activity. No data, however, were found to indicate the level of activity of these vessels. In US/Alaskan waters, the US Coast Guard, in coordination with the Alaska Marine Exchange, relies on a AIS network of receivers in the Alaska (Figure 4) to track vessels in US waters and to a limited degree in Russian waters (CMTS, 2013; Robards et al., 2014). The terrestrial receivers are limited to line-of-site. Additional tracking is possible with satellite receivers, albeit with less resolution of vessel track’s as the updates are not as frequent. The satellite network is improving as the network expands, though satellite coverage for the Arctic region is still limited (Robards et al., 2016).

As part of the 2009 Arctic Marine Shipping Assessment Report for the Arctic Council, an assessment of shipping traffic in the Arctic was performed with data from 2004 (Arctic Council, 2009). A regional case study of the Bering Strait was conducted as part of this (Figure 5; Brigham et al., undated). Documented vessel activity in the region was diverse, including commercial and subsistence fishing and hunting, resource extraction activities, local shipping, tourism, and research (Table 2). Additional reviews of traffic in the region were completed by other groups for 2010, 2012, and 2013 and resulted in similarly diverse, albeit increased levels of activity (Figures 6-8) (Laughlin et al. 2012;
Figure 4: Locations of Automatic Identification Systems in Alaska
(Retrieved from: http://www.mxak.org/vtrack/vtrack_intro.html)

<table>
<thead>
<tr>
<th>Vessel Category</th>
<th>Summary of Activity Level for 2004</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fishing/Hunting</strong></td>
<td>Limited to small skiffs; large commercial vessels predominately to the south, associated with Bering Sea fisheries.</td>
</tr>
<tr>
<td><strong>Local Shipping</strong></td>
<td>Barge (380 ⚓) traffic predominately in Norton Sound. ~1-2 transits through Bering Strait</td>
</tr>
<tr>
<td><strong>Tourism</strong></td>
<td>~4-5 transits of Cruise Ships through Bering Strait</td>
</tr>
<tr>
<td><strong>Research</strong></td>
<td>~15 transits of large research vessels north or south through Bering Strait</td>
</tr>
<tr>
<td><strong>Oil and Gas</strong></td>
<td>~30 transits of support, exploration and production vessels north or south through Bering Strait</td>
</tr>
<tr>
<td><strong>Red Dog Mine</strong></td>
<td>~50 transits of Bulk Carriers north or south through Bering Strait; ~250 local ship-shore transits near mine; ~10 north or south barge support transits</td>
</tr>
</tbody>
</table>

Table 2: Summary of Bering Strait Transit Activity, 2004 (from Brigham et al., undated)
McConnell et al., 2013; Northern Economics, 2014). As summarized in Figure 9 and Table 3, which are derived from available AIS data, a moderate increase in oil and gas related vessel activity coincides in part with exploration activities occurring in the
However the majority of traffic remains associated with local shipping/supply barges, Red Dog Mine activity, and transit of tankers and other commercial ships through the western Bering Strait in the NSR. As indicated in the summary data in Figure 9 and Table 3; some inconsistencies exist in interpretation of AIS data; for example, the total vessel/transit count for 2012 in Figure 9 is 250/480 vs 314 in Table 3. The reports from which this information was obtained appear to consider different datasets for the same year and lacked clarity on transit counts versus individual vessels (Northern Economics, 2014; USCG, 2015). Vessel type, individual identity, and transit frequency will lend value to future assessments. It will be necessary to understand the level of activity of different class of vessels and it will also be essential to identify which individual vessels transit more frequently than others. As will be described later in this paper, these will inform
development of mitigation measures to reduce impacts to the environment.

Projected Transit
The U.S. Committee on the Marine Transportation System (CMTS) recently completed a 10-year projection of vessel activity in the U.S. Arctic. The analysis included in its baseline dataset traffic coming and going along the NSR or NWP. The projections were bounded by large confidence intervals (Figure 10) highlighting the difficulties in projecting regional traffic patterns that are influenced by global factors. The results indicated, as expected, growth in vessel transits through the Bering Strait, highlighting the anticipated growth regionally in oil and gas exploration and mining activities (CMTS, 2015). What the study unfortunately lacked was an associated analysis of traffic to and from the Strait from the south. The CMTS study predicted a growth in large vessels associated with commercial shipping traffic going to and from the NSR and NWP,
though separate studies indicate, as did the CMTS study, that growth is dependent on many factors such as safety and economic viability (DNV, 2010, Liu and Kronback, 2010; Lasserre and Pelletier, 2011; Humpert and Raspotnik, 2012; Sakuja, 2013; Marsh, 2014; Lasserre, 2015).
These vessels are generally exempt from U.S. regulation as they are granted innocent passage that is the allowance for passage of international vessels through territorial seas
under international law. It is critical to understand the transit behavior anticipated of those ships through the Bering Sea to better assess risk and impacts to the environment in that area. Predicting with some confidence the level of growth of vessel traffic and the associated environmental impacts both regionally and pan-Arctic is far more challenging and also biased by personal assumptions, and data with varying levels of uncertainty (Arbo et al., 2014). For example, Shell Oil announced in the fall of 2015 that they would cease exploration activities in offshore Alaska for the foreseeable future, thus resulting in a reduction of oil and gas related vessel traffic (Shell, 2015). In contrast, the Chinese shipping company COSCO announced in the fall of 2015 that they intend to develop a regular route through the Northern Sea Route to Europe in the future. Korea and Iceland are also in discussion to develop an Arctic trade route between their two countries (ADN, 2015; AFP-JIJI, 2015). Recognizing these variability’s and circling back to track projected versus actual outcomes will benefit the long term assessments of the rapidly changing Arctic.
Table 3: 2009-2013 Bering Strait Vessel Traffic Count
(from Northern Economics, 2014, source Marine Exchange of Alaska)

Bering Sea Traffic
Though this paper is focused on Arctic and Bering Strait vessel traffic, it is useful to briefly discuss traffic patterns in the southern Bering Sea. A recent Commercial Shipping Vulnerability Analysis (Robards et al., 2014) was completed for the Aleutian Islands and
Figure 10: Comparison of projected vessel numbers in 2025 for the U.S. Arctic passing through the Bering Strait (from CMTS, 2015)

Table 4: Annual average number of vessels using different passes in the Aleutian archipelago. Data are from July 2010 through August 2013. (Retrieved from: https://absilcc.org/science/SitePages/MVT%20gifs.aspx)

<table>
<thead>
<tr>
<th>Pass (west to East)</th>
<th>Bulk Carriers</th>
<th>Dry Goods</th>
<th>Tankers</th>
<th>Fishing</th>
<th>Oil and Gas</th>
<th>Misc.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attu</td>
<td>1,447</td>
<td>1,498</td>
<td>106</td>
<td>36</td>
<td>0</td>
<td>18</td>
<td>3105</td>
</tr>
<tr>
<td>Agattu/Buldir</td>
<td>696</td>
<td>948</td>
<td>5</td>
<td>120</td>
<td>0</td>
<td>8</td>
<td>1,777</td>
</tr>
<tr>
<td>Amchitka</td>
<td>102</td>
<td>88</td>
<td>3</td>
<td>84</td>
<td>0</td>
<td>8</td>
<td>285</td>
</tr>
<tr>
<td>Amukta</td>
<td>111</td>
<td>161</td>
<td>2</td>
<td>234</td>
<td>0</td>
<td>7</td>
<td>515</td>
</tr>
<tr>
<td>Unimak</td>
<td>2,145</td>
<td>2,460</td>
<td>94</td>
<td>418</td>
<td>16</td>
<td>206</td>
<td>5,339</td>
</tr>
</tbody>
</table>

Bering Sea and notes substantial bulk carrier and dry good ships transiting east-west along the great circle route. As expected, high levels of fishing traffic were also noted in the eastern Bering Sea (Table 4). Animated graphics of the findings can be reviewed here: https://absilcc.org/science/SitePages/MVT%20gifs.aspx.
Traffic Incidences

As traffic in the Arctic region increases, so too will the risk of traffic accidents. A few notable events that have occurred in Arctic and/or Alaskan waters in the past two decades include:

**Nov 28, 2004:** The bulk carrier *Selendang Ayu* loaded with fuel and soybeans enroute to China along the Great Circle Route lost power Northwest of Dutch Harbor, eventually running aground on Unalaska Island and spilling 66 million metric tons of soybeans, 1.7 million liters of fuel oil, and 55,564 liters of marine diesel. During the rescue operations, the USCG helicopter took sea spray, lost power and crashed, killing 8 of the *Ayu* crew members aboard. The 3-person crew of the helicopter and 1 *Ayu* crew member survived (AMSA, 2009).

**Early August, 2010:** The fuel tanker *MV Mokami* ran aground in the harbor at Pangnirtung, Nunavut in Northern Canada with fuel on board. No spills occurred (Drouin, 2011).

**August 27, 2010:** The cruise ship *Clipper Adventurer* ran aground of a known navigation hazard in Coronation Gulf in Northern Canada. No injuries were reported and all passengers and crew were rescued. No oil spills were reported, but the hull did sustain serious damage. By the end of September, the salvage crew and Canadian Coast Guard towed the vessel out of the area. It was the benefit of calm sea conditions and the coincidental close proximity of Canadian Coast Guard support that resulted in a positive outcome (Stewart and Johnson, 2011).

**September 2010:** The oil tanker *MV Nanny* ran aground in Simpson Strait in Northern Canada with 9 million liters of diesel on board. No spills occurred (Drouin, 2011).

**December 2010:** The cargo ship *MV Golden Seas* transiting from Canada to UAE carrying canola seed and laden with fuel and oil became disabled 50 miles north of Adak Island. The ice breaker/tug support vessel *Tor Viking II* operating in Alaska in support of Shell Oil exploration activities responded and towed the *Golden Seas* to Dutch Harbor. Shell Oil subsequently supported installation of an emergency mooring buoy in Dutch Harbor (Rosenthall, 2012; Schuler, 2014).

**October 2012:** The *MV Nanny* once again ran aground in Nunavut waters in
Northern Canada after diverting from a chartered course. The vessel was carrying fuel product but though the hull was damaged, no product was spilled. The ship owners have followed up with safety reform and improvements in procedures for operating in narrow waterways (TSB, 2014).

**December 31, 2012:** During transit of the drilling unit *Kulluk* to the Pacific Northwest, the tow-line parted, and after multiple attempts to reconnect, the vessel ran aground on Kodiak Island. All personnel were rescued prior to the grounding. No fuel or other hazardous material was spilled and salvage operations resulted in removal the vessel on January 6th and the tow out of the region later that month (USCG, 2013).

**March 2013:** The passenger vessel *MS Marco Polo* (578 ft) and ferry/passenger vessel *MS Kong Harald* (400 ft) both struck submerged rocks within a week of each other in separate incidents and locations in remote Norwegian Fjords. No injuries and no spills were reported, and both vessels were able to return to port unassisted. Both vessels returned to service after repairs (Bergman, 2013).

**September 4, 2013:** The Russian tanker ice class 1 *Nordvik* loaded with Arctic diesel fuel struck submerged ice in Matisen Strait (along the NSR) and was taking on water. The vessel was operating in ice conditions that exceeded its ice capability and was in violation of the issued permit. Two nuclear icebreakers operating in the area provided response support and the fuel was transferred to a separate tanker. The hull breach on the *Nordvik* was temporarily plugged and both tankers were escorted to ice free waters on September 14. No fuel was spilled in this event (NSRIO, 2013).

**November 13, 2015:** Two product tankers, the *Svyatoy Petr* and *Svyatoy Pavel*, collided while following in a convoy behind a nuclear icebreaker in heavy ice. No fuel or product loss was reported, however, both vessels sustained damage, including a crack in the hull above the waterline. One vessel returned to port without support while the other required a tow from the icebreaker (Birkett, 2015).

Allianz Global Corporate and Specialty conducts annual reviews of Safety and Shipping. The 2015 report provides a summary of Arctic Casualties in 2014 and reviews data...
collected since 2005. The report clearly indicates, as does the events described above, that vessel incidents are on the rise in Arctic waters, with significant risks associated with vessel capability and navigation hazards (Figure 11 and Table 5). International efforts to tackle these risk areas will be discussed further in Section II where I will review the IMO’s passing of the Polar Code.

Figure 11: 2014 Arctic Shipping Casualties (from AGCS, 2015)

*Regional Infrastructure*

A frequent point mentioned when discussing the opening up of the Arctic to traffic is the limited infrastructure to support increased activity and what the U.S. and the State of Alaska plan to do about that (Alaska Legislature, 2012; O’Rourke, 2013; Northern Economics, 2014). In the Bering Strait region limited port facilities exist in the Bering
Table 5: 2014 Arctic Circle Waters Shipping Casualties 2005-2014 (from AGCS, 2015)

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
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<td>3</td>
<td>5</td>
<td>13</td>
<td>14</td>
<td>16</td>
<td>12</td>
<td>13</td>
<td>20</td>
<td>27</td>
<td>125</td>
</tr>
<tr>
<td>Wrecked/stranded</td>
<td>1</td>
<td>4</td>
<td>10</td>
<td>11</td>
<td>14</td>
<td>9</td>
<td>9</td>
<td>8</td>
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<td>14</td>
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<td>Miscellaneous</td>
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<td>4</td>
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<td>6</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td></td>
<td></td>
<td>32</td>
</tr>
<tr>
<td>Fire/explosion</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>6</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td></td>
<td></td>
<td>25</td>
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<tr>
<td>Collision</td>
<td>1</td>
<td>4</td>
<td>10</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>Contact (eg harbor wall)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Hull damage</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td>19</td>
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<td>Founndered</td>
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<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>3</td>
<td>8</td>
<td>28</td>
<td>30</td>
<td>47</td>
<td>50</td>
<td>39</td>
<td>37</td>
<td>50</td>
<td>55</td>
<td>347</td>
</tr>
</tbody>
</table>

Source: Lloyd’s List Intelligence Casualty Statistics Analysis AGCS

Strait Region. To address this, the State of Alaska and the U.S. Army Corps of Engineers initiated an Alaska Deep-Draft Arctic Port System Study in 2012 (AKDOT and USACE, 2013) following up on initial recommendations from the AMSA 2009 study and from The Alaska Northern Waters Task Force 2012 report (Alaska Legislature, 2012). The result of the report recommended Nome and Port Clarence as the two primary sites to proceed with feasibility assessments. Lateral to this, the Bering Straits Native Corporation, in collaboration with Crowley Marine, conducted a study to develop a support base on native owned land in Port Clarence (Northern Economics Inc., 2014). The USACE recently completed its assessment which resulted in a determination that improving the port of Nome was the most economically feasible and is moving forward with plans to deepen the entrance channel and extend the causeway (USACE, 2015). The Northern Economics report (2014) determined that development of a support base at Port Clarence was dependent upon revenue from the oil and gas industry as it would most likely service that business sector. With the proposed plan to improve the Port of Nome and the cessation of exploration efforts by major oil companies such as Shell Oil in the outer continental shelf of the Chukchi and Beaufort seas, efforts to develop Port Clarence will likely be tabled for now.

In addition to port facilities, the U.S. is notably limited in its icebreaker capacity, with only 2 heavy polar icebreakers, the U.S. Coast Guard Cutters (USCGC) *Polar Star* and *Polar Sea* (which is currently deactivated), and one medium polar icebreaker, the *Healy*.
In addition to the limited number of vessels, the Polar Star and Polar Sea are well past their 30-year service “life”, and have undergone continual maintenance to keep them active. Unfortunately, despite continued efforts by the USCG and Alaska state senators and congressmen, the nearly 1 billion dollars needed to build a new vessel has yet to be approved due to the current economic environment (Zellen, 2013). This should be a significant area of concern for the U.S. since the U.S. has committed to supporting Search and Rescue efforts in the Alaskan Arctic as part of a 2011 international agreement signed through the Arctic Council. The current icebreaker fleet leaves the U.S. under-prepared to meet the commitments for emergency response in U.S. Arctic waters. This situation also begs the question as to how this impacts the U.S. from a military perspective with Russia rapidly increasing its icebreaker capacity. This will continue to be an issue tossed about in Washington D.C., among legislatures who are largely disconnected from the U.S. position as an Arctic nation (Murray, 2015). It is hoped, that with the U.S. as current Chairman of the Arctic Council, this will generate increased awareness and knowledge in congress and the senate of the U.S. Arctic resource and infrastructure gaps and will result in approval of the expenditure needed to support expansion of the icebreaker fleet. A more detailed discussion of the Arctic Council is presented in section II.

Impact to the Environment

The increased activity in the Arctic also has the potential to impact the environment in a variety of ways, such as disturbance to biological resources that the local communities depend upon and increased pollution from various shipboard sources. For example, one study estimates an increase in CO$_2$ emissions that variably increase global warming potential by 17%-78% (Corbett et al., 2010). Of particular concern and interest for this paper is the increased risk for ship strikes of marine mammals, particularly large whales, most species of which are listed as endangered under the Endangered Species Act (ESA). In Sections III and IV I will focus specifically on this concern and provide recommendations to mitigate the risk.

Summary and Recommendations

To bring some perspective to the discussion, transits in 2008 through the Panama Canal numbered 13,000 and the Suez Canal 21,000 (Laserrre and Pelletier, 2011). It is not
expected that the traffic through the Bering Strait will ever reach those levels. The current analyses of commercial vessel traffic and anticipated future use of Arctic shipping routes indicate commercial viability of the route is dependent upon many variables and not just the length or openness of the route. Infrastructure limitations, emergency response capacity, vessel capability and cost of entry and use of routes are just a few of the factors that determine whether companies choose to use the northern routes as opposed to transits through the Suez or Panama canals. Nonetheless, slow growth in this sector is anticipated. Growth is also expected in domestic traffic associated with maritime support, oil and gas activities, other resource extraction activities, infrastructure development, and research. One outcome of this section is a recommendation to stakeholders to:

- Develop one online source of summary vessel transit statistics, providing a consistent baseline dataset for multiple stakeholders to evaluate. Support for the portal will be necessary to maintain, process and summarize the data and a collaborative approach that engages all stakeholders including local communities, industry, non-profits, state, and federal entities is suggested.

II. SUMMARY OF INTERNATIONAL AND DOMESTIC ARCTIC POLICY AND REGULATION

Arctic waters are associated with a complex set of maritime laws (UN, 1982; Larson and Roth, 1989; Byers, 2009, 2013). Its core is a “pool” of international water referred to as the “high seas” bordered by a series of state controlled waters and international maritime passageways (Pratt, 2010; Tanaka, 2012). In this section I will discuss the international and domestic legal frameworks that dictate management of commercial traffic in the Arctic and, more specifically, the Bering Strait and Bering Sea regions. I will also discuss the United Nations Convention on the Law of the Sea (UNCLOS) and why the US is not a signatory to it. I will elaborate on the role the International Maritime Organization (IMO) has in regulating international ship traffic (SOLAS, 2002; VanderZwaag, 2008), and detail the recent steps taken by the organization to develop a Polar Code specifically for vessels operating in Arctic waters (Jensen, 2008; IMO, 2014). There are limitations to what UNCLOS and IMO can dictate or do, and it is the existing gaps which another international body, the Arctic Council, is attempting to fill (Stokke, 2007; Berkman,
I will discuss the soft-legal construct of the Arctic Council that is comprised of representatives from the eight Arctic nations, and reference the Antarctic Treaty (1959) for comparison (Berkman, 2002; Koivurova, 2005; Lennon, 2008; Trigg, 2011). I will then summarize the U.S. domestic regulatory landscape highlighting the USCG’s role in management of the ship traffic, and briefly summarize relevant environmental statutes that serve to mitigate anthropogenic impacts, including shipping traffic, to marine mammals.

**Maritime Boundaries and International Law**


The United Nations Convention on the Law of the Sea (UNCLOS) was the result of the third United Nations Conference on the Law of the Sea in 1982. UNCLOS replaced four prior treaties from 1958 and entered into force in 1994. It is UNCLOS that establishes the maritime boundaries (Figure 12) and concepts many are familiar with such as:

- **Internal Waters:** These are waters inland of the territorial seas that the coastal state has full authority over, and rights-of-passage by international vessels are not conferred.
- **Territorial Seas:** These include waters out to 12 nm from the measured “baseline” as defined in UNCLOS. The coastal state has sovereign rights over these waters, the seabed and airspace above. International vessels are allowed innocent passage in these waters, and in some straits allowed transit passage.
- **Contiguous Zone:** This area extends an additional 12 nm beyond the territorial waters. In this region coastal states are allowed to enforce laws related to customs, taxation, pollution and immigration.
- **Exclusive Economic Zone (EEZ):** This area extends out to 200 nm from a coastal states baseline. In this area, a coastal state has the rights to all natural resources including marine and seabed resources. Foreign vessels have the rights of navigation and over-flight, and also the right to lay cables or pipelines.
- **Innocent Passage:** This concept is the allowance for passage of international vessels through territorial seas. Article 21 of UNCLOS allows coastal states to adopt laws and regulations that pertain to several areas of concern, including safe navigation and regulation of marine traffic, the conservation of living marine resources, and the preservation of the coastal States environment. Article 22 provides further allowances for
coastal states to require vessels exercising innocent passage through the territorial seas to use prescribed and published sea lanes and/or traffic separation schemes; however, Article 22 also indicates the Coastal State “shall take into account the recommendations of the competent international organization”, thus implying the need to involve an organization such as the International Maritime Organization. Article 24 dictates that coastal states shall not impose requirements that impair or deny the right of innocent passage.

Transit Passage: This concept is the allowance for passage of international vessels through a “strait between one part of the high seas or an exclusive economic zone and another part of the high seas or an exclusive economic zone” (UNCLOS, Article 38). Article 41 of UNCLOS provides allowance for establishment of sea lanes and traffic separation schemes however this must be done in consultation with associated coastal states and shall be adopted through the IMO.

International Strait: A strait that includes the territorial waters of two or more coastal
states. The Bering Strait is considered an international strait.

The U.S. has an interesting history as it pertains to UNCLOS and has yet to ratify the agreement. It has accepted all but one provision of UNCLOS as customary international law. At issue is Part XI of UNCLOS, which are the provisions for The Area and International Seabed Authority (ISA) (Sale and Potapov, 2010). The U.S. strongly considered this section economically limiting and also a security threat. The Area refers to “the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction” (UN, 1982) and is considered the common heritage of mankind. The International Seabed Authority is the entity created by the UNCLOS that manages The Area for mankind (Tanaka, 2012). The delineation of the EEZ and the “high seas” is relatively straightforward and defined as the 200nm limit from the shore baseline. The delineation between national jurisdiction and The Area is far more complicated and is defined by the 200 nm distance from shore baseline or the limit of where the continental margin exceeds 200 nm, though not greater than 350 nm (Pratt, 2010; UN, 1982). The extension is not automatic however, thus states must submit a claim to the Commission on the Limits of the Continental Shelf, established under UNCLOS. Only parties to the convention can submit claims, thus the U.S. is currently unable to do so. Several Arctic nations including Russia have already submitted initial claims, though it will take years for those to be processed (Byers, 2013; Hong, 2013). With the opening of the Arctic and the actions taken by Russia, U.S. legislators will have to address this thorny issue given the U.S. claims to an extended continental shelf beyond 200nm (Hutchinson et al., 2012) can only be made once the U.S. has ratified the treaty. Figure 13 shows current and anticipated claims beyond the 200nm EEZ limit in the Arctic Ocean.

1990 U.S.-U.S.S.R. Maritime Boundary Agreement

In 1990 the U.S. and the USSR agreed to the maritime boundary between the two nations (1990 U.S.-U.S.S.R. Maritime Boundary Agreement) (Figure 14). Though the former USSR did not ratify the agreement before its collapse and the successor state of Russia has yet to approve, the boundary is generally recognized by both (Byers, 2013). Russia and the U.S. accept the Bering Strait as an international passage (Byers, 2013) therefore neither can mandate navigation standards seaward of territorial Seas without IMO approval because the Law of the Sea Convention does not allow for it (Tedsen et
For territorial waters outside of the Strait, as indicated previously, coastal states do have the authority to develop regulations that pertain to safe navigation, regulation of marine traffic, the conservation of living marine resources as well as designate sea lanes and traffic separation schemes (TSS). However, UNCLOS does imply the IMO should be a party to their development, and the regulations may not impede a vessel’s innocent passage. The USCG has begun the initial process of designating sea lanes and TSS’s in the Bering Strait which will be discussed in greater detail later in this section.

*International Maritime Organization*

The Inter-Governmental Maritime Consultative Organization (IMCO) was established as an agency of the United Nations through a convention adopted in 1948 and entered into force in 1958. In 1982, IMCO was renamed The International Maritime Organization (IMO). There are currently 171 member states, of which the U.S. is one. Article 1 (United
Nations, 1948) of the convention summarizes the purpose of the IMO:

"...to provide machinery for cooperation among Governments in the field of governmental regulation and practices relating to technical matters of all kinds affecting shipping engaged in international trade; to encourage and facilitate the general adoption of the highest practicable standards in matters concerning maritime safety, efficiency of navigation and prevention and control of marine pollution from ships".

Since entry into force multiple conventions have been adopted that deal with safety at sea, prevention of marine pollution, liability, and maritime trade. Notable conventions include, Convention on the International Regulations for Preventing Collisions at Sea
(COLREG), *International Convention for the Safety of Life at Sea* (SOLAS) and *International Convention for the Prevention of Pollution from Ships* (MARPOL). The IMO does not function to implement and enforce the conventions it adopts. It is the responsibility of the member states that agree to the conventions to do so.

There are multiple committees and subcommittees that carry out the work of the IMO. Two in particular, the Maritime Safety Committee (MSC) and the Marine Environment Protection Committee (MEPC), have been involved in recent efforts to establish a Polar Code. The Polar Code has a long history in the IMO and notable milestones include:

- **2002**: Recognizing the need for improved regulation of maritime activity in polar waters the MEPC and MSC approved the *Guidelines for Ships Operating in Arctic Ice-covered Waters* (IMO, 2002). Non-binding, this document provides recommendations for states to address ship construction, equipment, operational needs, and environmental protection for arctic waters (Jensen, 2008).

- **2006-07**: The IMO adopted *Enhanced Contingency Planning Guidance For Passenger Ships Operating In Areas Remote From SAR Facilities* (IMO, 2006) and the *Guidelines On Voyage Planning For Passenger Ships Operating In Remote Areas* (IMO, 2007) to address the safety concerns for the increased cruise ship traffic in remote areas such as polar regions (Dawson et al., 2014).

- **2009**: The MEPC and MSC approved the *Guidelines for Ships Operating in Polar Waters*, which added recommendations for Antarctic waters. The aim of the guidelines was “to promote the safety of navigation and to prevent pollution from ship operations in polar waters.” (IMO, 2010)

- **2009**: The MSC approved a proposal by the U.S., Norway, and Denmark (IMO-MSC, 2009) to develop a mandatory polar code and the IMO began the process of developing the code (DNV, 2011; Chircop, 2014).

- **2010**: THE MEPC adopted an amendment to MARPOL that prohibits the carriage and use of heavy grade oils in Antarctic waters (IMO-MEPC, 2010).

- **2012**: The MSC adopted mandatory ship reporting requirements for the Barents Sea that entered into force in June 2013 and includes mandatory reporting for the majority of commercial shipping traffic in that area (IMO, 2012).

- **Dec 2014/ Jan 2015**: The MSC and MEPC approved the mandatory polar code that is
scheduled to enter into force January 2017 and will be implemented through changes to SOLAS and MARPOL (IMO, 2015). With that, all IMO member states will be bound to the new requirements and as such are actively engaging to implement the new requirements through domestic regulations.

The Polar Code establishes new standards for vessels operating in the defined polar waters (Figure 15). Vessels will be required to obtain a Polar Ship Certificate and will be given a classification of:

**Category A:** Ships designed for operation in polar waters at least in medium first-year ice;

**Category B:** Ships not included in category A, designed for operation in polar waters in at least thin first-year ice;

**Category C:** A ship designed to operate in open water or in ice conditions less severe than those included in Categories A and B.

![Figure 15: Polar Code Safety Requirements](http://www.imo.org/en/MediaCentre/HotTopics/polar/Pages/default.aspx)
Additional environmental measures in the defined polar waters will prohibit discharge into the sea of oil or oily mixtures and noxious liquid substances or mixtures from any ship; require oil fuel tanks be separated from outer shell; and increase the restrictions of discharge of sewage and garbage into the sea. Though comprehensive the code still has gaps and future areas of focus will be on invasive species, further refinement of discharge requirements, heavy oil use and associated black carbon emissions in Arctic waters, underwater noise reduction, and increased oil spill response requirements (Marine Executive, 2015).

**Arctic Council**

In 1996 eight arctic nations including Canada, Denmark (including Greenland and the Faroe Islands), Finland, Iceland, Norway, Russia, Sweden and the United States signed the *Ottawa Declaration* to form the Arctic Council as a forum for “promoting collaboration, coordination, and interaction among the Arctic States with involvement of the Arctic indigenous communities and other Arctic inhabitants on common Arctic issues in particular issues of sustainable development and environmental protection in the Arctic.” (Article 1a, Ottawa Declaration). Six international organizations representing Arctic Indigenous Peoples also have permanent participant status. The agreement is not a treaty nor does the council have regulatory authority. The Council also approves Observers that currently include twelve non-arctic countries, nine intergovernmental and inter-parliamentary organizations, and eleven non-governmental organizations (Arctic Council, 2015).

There are six working groups that carry out the work of the Council:

- Arctic Contaminants Action Program (ACAP)
- Arctic Monitoring and Assessment Programme (AMAP)
- Conservation of Arctic Flora and Fauna (CAFF)
- Emergency Prevention, Preparedness and Response (EPPR)
- Protection of the Arctic Marine Environment (PAME)
- Sustainable Development Working Group (SDWG)

The Council’s work to date has included facilitation of two binding agreements signed by the eight nations:

- Agreement on Cooperation on Marine Oil Pollution, Preparedness and Response in
the Arctic (Arctic Council, 2013)

• Agreement On Cooperation on Aeronautical And Maritime Search and Rescue in the Arctic (Arctic Council, 2011)

The chairmanship of the Council shifts every two years among the nations, with the U.S. having taken over this role in April, 2015, represented by U.S. Secretary of State John Kerry (Ulmer, 2015; Ulmer et al, 2015). The US has chosen a theme for this period: One Arctic: Shared opportunities, challenges and responsibilities with a focus on ocean safety, security and stewardship; addressing impacts of climate change; and improving economic and living conditions of Arctic people (Ulmer, 2015).

The Council is not without challenges ahead. More nations want to join and there is concern that a large presence of observers will interfere with the interactions between the primary nations and permanent participants. The Council also lacks the legal authority to truly establish any hard law (i.e. binding law) (Koivurova, 2014). Comparisons are often made to the success of the Antarctic Treaty System (ATS), and potential applicability of a similar system for the Arctic. While the concept seems reasonable, the challenge lies with the fundamental difference between the Arctic and Antarctic regions. Under the ATS no country may claim rights of sovereignty in Antarctica and no mining or oil exploration is allowed. In stark contrast, the majority of the Arctic is legally claimed by multiple nations and oil and gas exploration is ongoing (Lennon, 2008; Trigg, 2011). It is sovereignty, access to resources, and perceived threats to those that can derail creation of binding agreements among Arctic nations.

The Council, though, has proven to be successful as a vehicle for negotiating binding agreements between the council members and has produced notable work products such as the Arctic Marine Shipping Assessment 2009 Report that has influenced the progression of the Polar Code within the IMO. With that in mind, the Council will likely continue to influence and guide governance in the multinational region (Johansson and Donner, 2015).

**Domestic Laws and Policy**

In 2009, President Obama issued a new Arctic Policy Directive (The White House, 2009) that refreshed and refocused the U.S. Arctic policy position, and indicated a heightened awareness of the U.S. placement as an Arctic nation. Following the 2009 directive, the
White House followed up with multiple initiatives with regards to Arctic domestic policy including strategy and implementation documents in 2013, 2014, and 2016 (U.S. White House, 2013, 2014, 2016). In 2013 the Department of Defense also released their Arctic Strategy document that is linked to the national strategy (DOD, 2013). The U.S. strategy is focused on protecting U.S. national and homeland security interests; promoting responsible stewardship; and fostering international cooperation and the implementation plan established 10-year goals. The first annual assessment of the implementation plan was released in January 2015 (U.S. White House, 2015a). In 2015, in advance of the U.S. taking over the Arctic Council chairmanship, President Obama issued an executive order, *Enhancing Coordination of National Efforts in the Arctic*, (U.S. White House, 2015b) that established a steering committee to engage with the State of Alaska and Alaska Native Tribal governments and coordinate and provide guidance to federal agencies regarding Arctic strategy and implementation. Looking forward, the parallel activity of the Arctic Council with the U.S. as chair and the refreshed national strategy and associated steering committee will be the mutually influential and determinant forces for arctic policy outcomes in U.S. waters.

*Committee on the Marine Transportation System (CMTS)*

The Committee on the Marine Transportation System (CMTS) is a federal, cabinet level committee created in 2005 that reports directly to the President of the U.S. (CMTS, 2015b). The committee consists of multiple federal agencies and departments and is chaired by the Secretary of Transportation. The committee’s purpose is to coordinate multi-agency policies and actions as they relate to the Maritime Transportation System in U.S. waters. The CMTS authority has evolved through the years with the most recent change occurring with the authorization of the Coast Guard and Marine Transportation Act of 2012 that formalized by law the delegated authority of the CMTS.

*U.S. Coast Guard*

One of the five armed forces, the U.S. Coast Guard (USCG), sits within the Department of Homeland Security. In addition to safeguarding our coastline, and search and rescue support, the USCG is also responsible for marine safety in U.S. waters and protecting the marine environment. The USCG establishes and enforces marine traffic routes in U.S. waters. They are given that authority under the Ports and Waterways Safety Act of 1972.
(PWSA) as amended by the Port and Tanker Safety Act of 1978 (PWSA, 1978). The act does limit the USCG’s authority and requires it to align with international law as follows:

“Except pursuant to international treaty, convention or agreement, to which the United States is a party, this act shall not apply to any foreign vessel that is not destined for, or departing from, a port or place subject to the jurisdiction of the United States and that is in- 1) innocent passage through the territorial sea of the United States or 2) transit through the navigable waters of the United States which form a part of an international strait. “ (PWSA, 1978)

Innocent passage and international straits as discussed earlier come into play in the Bering Strait region.

To adjust existing or establish new vessel traffic separation schemes (TSS’s), the USCG must conduct what is called a Port Access Route Study (PARS) to determine the need for TSS’s. Resulting recommendations can then be used to develop regulations or develop proposals for consideration within international regulatory mechanisms such as the IMO (PWSA, 1978).

Recognizing that shipping traffic is rising through a narrow and not well chartered region, the USCG, through the authority of the PWSA, initiated a PARS in 2010 for the Bering Strait (DHS, 2010). Comments received for that study prompted a second study in 2015 and expanded the route study to include the Chukchi and Bering seas that are north and south of the strait, respectively (Figure 16; DHS, 2015). As indicated above, resulting recommendations from this particular PARS study will not automatically lead to domestic regulation. International traffic factor into the assessment and the USCG does not have the authority to regulate such traffic that is not headed to or coming from a U.S. port. Consideration will have to be given for the most effective regulatory pathway with this in mind.

From a broader perspective the USCG sees the challenges ahead for their operations in the Arctic and issued a 10-year strategy document for operations in the Arctic in 2013 with the focus on three goals to: improving awareness, modernize governance and broaden partnerships (USCG, 2013b). The PARS study as detailed above will be one of many actions the USCG will need to take in the coming years to achieve their Arctic strategic objectives.
Figure 16: USCG Proposed Vessel Routing Scheme (from DHS, 2014)

**U.S. Maritime Administration (MARAD)**

The U.S. Maritime Administration (MARAD) is an agency within the Department of Transportation. MARAD has broad duties including building and maintaining capacity of the U.S. merchant marine that support domestic and foreign commerce; serving as a domestic naval auxiliary for wartime and national disasters; and ensuring that the U.S.
has robust maritime services including ports, ship repair, transportation systems, and reserve shipping capacity.

**U.S. Army Corps of Engineers**

The U.S. Army Corps of Engineers (USACE), an agency with the Department of Defense, is mandated to build and maintain infrastructure including maintaining waterways and expanding ports as needed (USACE, 2015). In collaboration with the State of Alaska, the USACE has been conducting studies to identify suitable Arctic ports in Alaska to build appropriate infrastructure for the anticipate growth in shipping traffic (AKDOT-USCACE, 2013). The study has resulted in the identification of Nome as the preferred port to begin infrastructure development. Currently, the plan is under review and has yet to be finalized (USACE, 2015).

**National Oceanic and Atmospheric Administration (NOAA) and United States Fish and Wildlife Service (USFWS)**

The National Oceanic and Atmospheric Administration (NOAA), an agency within the Department of Commerce, and the United States Fish and Wildlife Service (USFWS), an agency within the Department of the Interior, have broad authority over management of marine and terrestrial habitat and biological resources. In particular through the *Marine Mammal Protection Act* (MMPA) and the *Endangered Species Act* (ESA), both NOAA and USFWS have regulatory authority over actions that have the potential to harm protected marine mammals and other endangered and threatened marine species. Both statutes have a range of prohibitions, with prohibited take at the core of the acts.

Take is defined by the MMPA as:

“means to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal” and as stated in the act “…it is unlawful-- (1) for any person subject to the jurisdiction of the United States or any vessel or other conveyance subject to the jurisdiction of the United States to take any marine mammal on the high seas; (2) except as expressly provided for by an international treaty, convention, or agreement to which the United States is a party and which was entered into before the effective date of this title or by any statute implementing any such treaty, convention, or agreement— (A) for any person or vessel or other conveyance to take any marine mammal in waters or on lands under the
Take as defined in the ESA:

“means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. “ and as stated in the act: “...it is unlawful for any person subject to the jurisdiction of the United States to— (B) take any such species within the United States or the territorial sea of the United States; (C) take any such species upon the high seas; ..” (ESA, 1973)

Activities in U.S. waters or high seas are subject to U.S. jurisdiction; exemption for take can be authorized through extensive permit processes. To be issued these permits, the activity must have negligible impact to the population or species, take small numbers of individuals and, in Alaska, not have an unmitigable adverse impact to the availability of marine mammal for subsistence purposes (MMPA, 2007). That said, neither NMFS nor the USFWS currently provide permit exemptions in the form of incidental take authorizations for maritime transit. Given the enormity of maritime activity, it would be challenging at best for the agencies to authorize permits for all transits and currently it is treated as an activity not likely to result in take of a marine mammal and therefore would not require an incidental take authorization.

The ESA has an additional feature of creating critical habitat for listed species and is defined as specific areas:

“within the geographical area occupied by the species at the time of listing, if they contain physical or biological features essential to conservation, and those features may require special management considerations or protection; and outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation.” (ESA, 1973)

Critical habitat though is not like a reserve or sanctuary, and is only considered when the federal government takes an action such issuing a permit or creating regulations. As part of a federal action, the action agency must consult with ESA biologists in NOAA and/or USFWS to determine if the action is “not likely to jeopardize the continued existence of a listed species, or destroy or adversely modify its designated critical habitat.” (Section 7; ESA, 1973) This results in a Biological Opinion with a jeopardy or no-jeopardy opinion and either could include terms and conditions intended to minimize take.
NOAA also has authority under the National Marine Sanctuaries Act (NMSA, 2000) to create marine sanctuaries and regulate activities within the area. This is a powerful tool to protect marine habitat, however like the other statutes, NMSA regulations “shall be applied in accordance with generally recognized principles of international law, and in accordance with treaties, conventions and other agreements to which the United States is a party” (305(a); NMSA, 2000).

I will discuss further the application of the MMPA, ESA, and NMSA to regulating shipping traffic in subsequent sections of this paper.

State of Alaska

The State of Alaska is the only U.S. state to border Arctic waters. While state authority is limited to waters out to 3 nm, it bares the weight of the outcome of management decision made for the adjacent federal waters. The state, therefore, has a significant role to play in steering national policy decisions made at a federal level. Recognizing this, the Alaska legislature formed the Alaska Northern Waters Task Force (ANWTF) in 2010 to evaluate the expanding activity in Arctic waters (Alaska Legislature, 2012). One focus of the report was marine transportation and the findings resulted in recommendations for:

- The U.S. to work with the international community to finalize Polar Code
- Establishing non-tank vessel rules and standards for Arctic transit
- Updating navigational charts and aids and to improve AIS capacity
- Support of NOAA bathymetric surveys, and recommended focus on near shore areas
- The state and legislature to support maritime training centers
- Support of completion of an Aleutian Risk Assessment; state participation in PARS study; and development of Bering Strait traffic separation scheme

All of these recommendations have seen progress, including progression of a traffic separation scheme in the Bering Strait. The report also recommended the creation of the Alaska Arctic Policy Commission to develop an Arctic Policy for the state as well as an implementation plan. The commission was established in 2012 and in January 2015 a draft policy and implementation plan was forwarded to the state legislature (AAPC, 2015a, b). A final policy on the Arctic was signed into law in May 2015 and took effect in August 2015. The policy establishes for priorities for the state to (AAPA, 2015):
• Uphold the state's commitment to economically vibrant communities sustained by development activities consistent with the state's responsibility for a healthy environment
• Collaborate with all levels of government, tribes, industry, and nongovernmental organizations to achieve transparent and inclusive Arctic decision-making
• Enhance the security of the Arctic region of the state and, thereby, the security of the entire state
• Value and strengthen the resilience of communities and respect and integrate the culture, language, and knowledge of Arctic peoples

Stakeholder Concerns
The human heart of the Arctic is the Inuit people and other related indigenous groups spread across the region. In most Arctic nations, these groups have significant influence on actions taken by their respective countries in the Arctic. The Arctic Council as described above exemplifies the importance of the role indigenous groups play in international discussions pertaining to the Arctic. In the U.S. native Alaskans also have a powerful voice, enhanced by strong legal rights conferred them through various statutes and agreements such as the Alaska Native Claims Settlement Act and their rights to harvest marine mammals under the MMPA and ESA. For communities in the Bering Strait region, such as Point Hope, St Lawrence Island, Gambell, Savoonga, Kotzebue, and Nome, the increasing vessel traffic in the region is of paramount concern. The 2009 AMSA assessment indicated marine mammals (bowheads, seals, walrus, and belugas) are a significant portion (68%) of their subsistence harvest (Figure 17). Given the dependence on marine resources for food, they are particularly aware of any changing condition that could affect that harvest. Understanding the harvest needs, locations, and risks to the activity will be essential for developing effective mitigation measures for the region (Danielson et al., 2014).

North Slope community members have taken the initiative to establish a few different groups to begin tackling the issues of increasing shipping traffic. In the fall of 2014, the
North Slope Borough (NSB) established under municipal code a Port Authority which can plan and fund port infrastructure projects within the boundary of the borough (NSB, 2015).

In 2015 the Arctic Waterway Safety Committee was formed by multiple stakeholder groups including community, subsistence, resource/extractive industries, and marine transport representatives. The groups mission statement is to “implement lawful best practices to ensure a safe, efficient, and predictable operating environment for all Arctic waterway users.” The committee is modeled on other successful waterway committees established in other U.S. regions that have worked closely with and provided an effective forum for engagement with the USCG and other federal and state entities. Given the committee is in its infancy, time will tell if it’s able to achieve the intended goals. Many committee members, as typical for Alaska, are associated with multiple other groups and with people and their time spread thin, the groups’ effectiveness will be conditional on the active engagement of all members.

**Summary and Recommendations**

In summary, the international and domestic laws in place are complex and the Bering
Strait region will be more of a challenge due to its classification as an International Strait. Advocating for changes to domestic law to impose additional regulatory oversight of shipping traffic may not achieve the value desired if the vessel traffic of concern is not subject to those laws. With limited resources and the energy required to effect change to domestic or international law; careful consideration should be made to choosing the most effective path. One outcome of this section is a recommendation to:

- Evaluate the baseline date recommended in the first section and evaluate level and timing of innocent passage transits and transit course.

III. BERING SEA REGION MARINE MAMMAL CASE STUDY

The Bering Strait and Bering Sea are biologically rich areas occupied seasonally by multiple protected and endangered marine mammal species, including bowhead, gray, fin, minke, North Pacific right, and humpback whales (Allen and Angliss, 2014). In the summer gray whale densities are high in the Bering Strait with small aggregations of fin, minke and humpback whales present in the area (Clarke and Moore, 2002; Clarke et al., 2013). Further south along the Bering Sea shelf break, high-density aggregations of fin and humpback whales occur (Friday et al., 2012; Friday et al., 2013; Thompson et al., 2013). In the late fall through winter season, bowhead whales move south into the western Bering Sea and aggregate along the ice edge (Citta et al., 2012; Citta et al., 2014; Reeves et al., 2014). In the southeast Bering Sea a very small, but highly endangered, population of North Pacific right whales occurs in the summer season and critical habitat has been designated for the area (NMFS, 2008; Baumgartner et al., 2013). In this section I will review in greater detail the status of large whale species in the region including current abundance estimates, projected trends in the populations, and the concept of Potential Biological Removal (PBR) (Allen and Angliss, 2014). I will discuss the nationwide and international issue of large whale mortality from vessel strikes and discuss evidence that ship strikes are a present risk for whales populations the Bering Strait and Bering Sea region (George et al., 1994; Panigasa et al., 2006; Vanderlaan and Taggart, 2007; Silber et al., 2008; Vanderalaan et al., 2008; Bettridge and Silber, 2009; Vanderlaan et al., 2009; Silber et al., 2010; Silber et al., 2012).
**Bowhead Whale (Balaena mysticetus)**

Bowhead whales are limited in their range and are found only in the Arctic and sub-Arctic regions, ranging in latitudes from 60° North to 75° North. They are divided into 4 stocks: Okhotsk, Spitsbergen, Hudson Bay/Davis Strait and the Western Arctic also known as the Bering-Chukchi-Beaufort (BCB) stock (Allen and Angliss, 2015). These animals undertake seasonal migration from southerly wintering grounds to more northerly feeding areas (Figure 18). The stock that travels through the Bering Strait is the Western Arctic stock which migrates from March through June from wintering grounds in the Bering Sea up through the Chukchi and Beaufort seas in leads, or openings in the sea ice, that develop in the largely frozen waters to the main feeding grounds in the Canadian Arctic. The whales reverse migration typically in September, moving west along the Alaska coast and across the Chukchi Sea and south along the Russian coast to the Bering Sea taking advantage of additional feeding areas en-route.

Their minimum population estimate is 13,796 (Allen and Angliss, 2015), and the population is considered to be at the cetacean maximum theoretical net productivity rate ($R_{max}$) of 4%. The calculated level of potential biological removal (PBR) is 138 animals (Allen and Angliss, 2015). Taking into account the current growth trends and the estimated pre-exploitation levels of bowheads (up to 55,000), the population is considered to be approaching its carrying capacity. Bowheads are currently listed an endangered species under the ESA and depleted under the MMPA by NMFS.

Bowhead whales are legally harvested by Alaska natives for subsistence purposes. The International Whaling Commission, established through the International Convention for the Regulation of Whaling (ICRW), regulates and establishes the harvest limits. As the U.S. is a signatory to the treaty, it is subject to the international regulation. For the 2013-2018 period, the IWC established a quota of 306 harvested whales with an allowance of up to 67 strikes per annual and 15 carry over of unused strikes. This provides a buffer for whales that are struck and lost (Allen and Angliss, 2015).

Potential anthropogenic sources of mortality for bowheads include gear entanglement and ship-strikes. There are multiple records of observed whales, both alive and dead, entangled in fishing gear. Currently no records exist of any bowhead mortalities resulting from ship-strikes (Rosa, 2008; Neilson et al., 2012; Allen and Angliss, 2015). It is the
spring and fall migration that places bowheads at the greatest risk of overlap with ship traffic as waters are relatively ice-free and oil and gas exploration and development activities are occurring (Reeves et al. 2014; Robards et al., 2014). Figure 19 shows the potential overlap of bowhead whales and shipping traffic based on bowhead tagging data (Quakenbush et al., 2010; Citta et al., 2012; Robards, et al., 2014). A variable that will need to be considered, however, in assessing risk for this species is their feeding behavior. Unlike fin, humpback, and right whales that will be discussed later, bowhead whales are benthic feeders but they also feed throughout the water column. Their deeper dives may significantly alter their risk of vessel strikes comparatively.

**Gray Whale (Eschrichtius robustus)**

There are two populations of gray whales in the North Pacific. The western Pacific stock
Figure 19: Potential overlap of tagged bowhead whales and shipping traffic
(Retrieved from: https://absilcc.org/science/Shared%20Documents/AMSS_3_Low%20Res.pdf)

is the smaller of the two and is found near Sakhalin Island and off the southeastern Kamchatka peninsula in the summer season. There is some evidence the some of the animals migrate east to the west coast of North America in the winter (Caretta et al., 2015). The current minimum population estimated to be 135 animals and the stock is considered endangered under the ESA and depleted under the MMPA by NMFS (Caretta et al., 2015). Photo-identification studies of this population suggest significant anthropogenic impacts from fishing and ship strikes; however, far more work will be needed to quantify these risks (Bradford et al., 2009).

The eastern Pacific gray whale population is the larger of the two populations and the minimum population estimate is currently 20,125 (Caretta et al., 2015). The population is considered to be at the cetacean maximum theoretical net productivity rate ($R_{max}$) of
6.2%. The calculated level of potential biological removal (PBR) is 624 animals (Caretta et al., 2015). The eastern Pacific stock is not considered endangered or depleted by NMFS.

The eastern Pacific stock undertake a migration that spans from the calving grounds in Baja California (calving grounds) to feeding grounds along the North American west coast as far north as the Beaufort Sea (Caretta, et al., 2015). Feeding areas coincide with the vessel traffic in the Bering Strait and Arctic regions. Gray whales are found in high densities on the open water period from late spring through late fall throughout the Bering Strait area and along the Alaska coastline in the Chukchi Sea (Figures 20 and 21).

Figure 20: Sightings of gray whales from aerial surveys in the Bering Strait between 1981-1985 and 2002
(Retrieved from http://www.beringclimate.noaa.gov/essays_moore_maps.html)
Figure 21: Sightings of feeding gray whales from aerial surveys in the Chukchi Sea 1982-2013 (Retrieved from http://access.afsc.noaa.gov/pubs/posters/pdfs/pBrower05_gray-whale-foraging.pdf)

(Moore et al., 2003; Grebmeier et al., 2006; Sekiguchi et al., 2009; Brower et al., 2014; Berchok et al., 2015). Due to changing climatic conditions, and increasing prey utilization due to a growing population, the density and distribution of gray whales may shift (Moore et al., 2003; Coyle et al.; 2007; Moore and Huntington, 2008). There have been no documented ship strikes of gray whales in the Bering Sea and north, but the risk is likely to be high given known whale densities and overlap with vessel traffic in this bottleneck region. Gray whales are benthic feeders and their deeper dives may significantly alter their risk of vessel strikes.

**Fin Whale (Balaenoptera physalus)**

Fin whales are a wide-ranging, global species. In the North Pacific Ocean, three stocks of fin whales are recognized, including Alaska (Northeast Pacific), California/Washington/
Oregon, and Hawaii. (Allen and Angliss, 2015). It is the Alaska stock that is of specific interest with fin whales of this stock found in the Bering and Chukchi Seas. Survey data for the greater North Pacific population is limited and there is no reliable population estimate available. However, a minimum estimate of 1,368 has been calculated for a portion of the Alaska stock range and the population is considered to be at the cetacean maximum theoretical net productivity rate ($R_{\text{max}}$) of 4%. Because there is no available minimum population estimate, the PBR has not been calculated. Fin whales are currently listed as an endangered species under the ESA and depleted under the MMPA by NMFS. The year-round migratory patterns of the Alaska stock are not well known; however, high densities of fin whales are known to exist in productive feeding areas along the Bering Sea shelf (Figure 22) during the summer and fall (Moore et al., 2000; Friday et al., 2012, 2013), and acoustic recordings indicate a presence through the early winter season (Stafford, 2010; Stabeno et al., 2012a; and Thompson et al., 2013). Fin whales are also being visually and acoustically detected with increasing numbers throughout the Bering Strait region and into the Chukchi Sea (Figures 23 - 25) though uncertainty does exist as to whether this increase is an artifact of increased survey effort (Clarke et al., 2013 and 2016; Aerts et al., 2014; Delarue et al., 2014; Berchok et al., 2015). Similar to gray whales, their feeding areas coincide with the vessel traffic in the Bering Strait and Arctic regions and like gray whales, the changing climatic conditions may shift prey and the density and distribution of fin whales. It has already been documented that densities of fin whale are less in oceanographically warm years along the Bering Sea shelf (Friday et al., 2012, 2013). There have been no documented ship strikes of fin whales in the Bering Sea northward, but the risk is likely to be high given known whale densities and overlap with vessel traffic in this bottleneck region. Unlike, gray or bowhead whales, fin whales feed on patches of small fish and invertebrates throughout the water column. Little is known of their dive profiles in the region that will be an important variable to understanding their risk to vessel strikes.

**Minke Whale** (*Balaenoptera acutorostrata*)

Minke whales, like fin whales, are also a global, wide-ranging species but are found predominately in the northern hemisphere (Jefferson et al., 2015). There are currently no population estimates available for minke whales in the North Pacific and while an Alaska
Figure 22: Sightings of fin whales from shipboard surveys in the Bering Sea in 2002, 2008, and 2010 (from Friday et al., 2013)
stock has been designated, there is only provisional estimates for a portion of the Alaska range including an estimate of 1,813 for the central eastern and southeastern Bering Sea and 1,233 for a portion of the Gulf of Alaska. There is no estimate on the growth rate of the stock and no estimate of PBR (Allen and Angliss, 2015). Minke whales are not currently listed as endangered or threatened species under the ESA nor are they designated as depleted under the MMPA by NMFS.

Minke whales are an understudied species in the North Pacific and their migratory behavior is poorly understood. However, their presence and distribution in Alaska has been well documented. In the Bering Sea the whales are found along with fin whales in
Figure 24: Acoustic detections of fin, humpback, minke, and killer whales from sonobuoys deployed during research cruise from 2010-2012 (from Clarke et al., 2013)

Figure 25: Visual detections of fin and minke whales during vessel and aerial surveys from 2009-2012 (from Clarke et al., 2013)
productive feeding areas along the Bering Sea shelf (Figure 26) during the summer and fall (Friday et al., 2012; Allen and Angliss, 2015). Minke whales are also visually and acoustically detected, indicating increased numbers throughout the Bering Strait region and into the Chukchi Sea (Figures 23 - 25) though like fin whales, uncertainty does exist as to whether this increase is an artifact of increased survey effort (Clarke et al., 2013, 2016; Aerts et al., 2014; Berchok et al., 2015). Similar to the previous baleen whales discussed, it is these feeding areas that coincide with the vessel traffic in the Bering Strait and Arctic regions and the changing climatic conditions may shift prey and the density and distribution of minke whales. There has been one documented ship strike of a minke whale in 2007 (location unknown; Allen and Angliss, 2015) and there is likely to be a high risk of ship strikes in the Bering Strait region given the known whale densities and overlap with vessel traffic. Similar to fin whales, minke whales feed on patches of small schooling fish throughout the water column. Little is known of their dive profiles in the region which will also be an important variable to understanding their risk to vessel strikes.

**Humpback Whale (Megaptera novaeangliae)**

Humpback whales are found throughout the world’s oceans. Currently in the North Pacific, three stocks of humpback whales are recognized including: California/Oregon/Washington, Central North Pacific and Western North Pacific (Allen and Angliss, 2015). It is the Central and Western North Pacific stocks that are of specific interest as they are found in the Bering and Chukchi seas. A minimum estimate of 7,890 has been calculated for the Central North Pacific stock and 865 for the Western North Pacific stock with both stocks considered to have a maximum theoretical net productivity rate ($R_{max}$) of 7%. The calculated level of potential biological removal (PBR) is 82 animals for the Central Pacific stock and 3 animals for the Western Pacific stock. On September 8, 2016, NMFS formally revised the listing status of humpback stocks, delisting nine Distinct Population Segments and listing one as threatened (Mexico) and 4 as endangered (including Western North Pacific and Central American) under the ESA and depleted under the MMPA by NMFS (NMFS, 2015; NMFS, 2016) (Figure 27). The year-round migratory patterns of humpback whales are one of the most well studied for baleen whales with a 2004-2006 study, *The Structure of Populations, Levels of*
Figure 26: Sightings of Minke whales from shipboard surveys in the Bering Sea in 2002, 2008, and 2010 (from Friday et al., 2013)
Abundance, and Status of Humpbacks (SPLASH), contributing significantly to the knowledge of Pacific humpback population distribution and movement (Calambokidis et al., 2008; Barlow et al., 2011). In the spring, humpbacks migrate north from winter breeding areas to areas throughout Alaskan waters to feed. In the Bering Sea, humpbacks are regularly found in large numbers in the southern Bering Sea along the Aleutian Islands as well as far west into Russian waters, but they have also been recorded much further north historically (Friday et al., 2012; Allen and Angliss, 2015). Recent visual and acoustic surveys in the northern Bering Sea, Bering Strait and Chukchi Sea indicate possible increase in numbers and potentially higher densities of humpback whales in those regions (Figures 23, 24, 28 and 29) (Clarke et al., 2013 and 2016; Aerts et al., 2014; LGL, 2014; Berchok et al., 2015).

Similar to the other baleen whale species discussed thus far, it is these feeding areas that overlap with increasing vessel traffic in the Bering Strait and Arctic regions. In addition the changing climatic conditions may shift prey and increase the density and shift distribution of humpback whales further north. There have been no documented ship
Figure 28: Sightings of humpback whales from shipboard surveys in the Bering Sea in 2002, 2008, and 2010 (from Friday et al., 2013)
strikes of humpback whales in the Bering Sea northward, but the risk is likely to be high given known whale densities and overlap with vessel traffic in this bottleneck region. Like fin whales, humpbacks feed on patches of small fish and invertebrates (euphausiids, copepods, herring, capelin, and sandlance) throughout the water column. Little is known of their dive profiles in the region and that will be an important variable to understanding their risk to vessel strikes.

**North Pacific Right Whale (Eubaleana japonica) and Critical Habitat**

The North Pacific right whale population is considered to be one of the most endangered large whale populations in the world. The population was decimated by commercial and illegal whaling that occurred well into the 1960’s. Currently, the population is divided into two stocks, a Western stock that predominately feeds in the Sea of Okhotsk, and an Eastern stock that feeds predominately in the southeast Bering Sea and offshore of Kodiak Island. Very little is known of the migratory patterns of the population and single
individuals have appeared as far south as off of Baja, California and Hawaii (Allen and Angliss, 2015). The current minimum population estimate for the Eastern stock is 26 that is derived from the photo-identification estimate of 31 (Wade et al., 2011; Allen and Angliss, 2015). There is no reliable estimate for the net productivity rate and the PBR for this stock is 0. Recognizing the localized habitat use based on sighting data, NMFS designated critical habitat for this species in Alaskan waters (Figure 30). The habitat has been shown to be associated with high copepod productivity (Zerbini et al., 2015). As a result of this designation, it is as required by section 7 of the ESA that “Each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency (hereinafter in this section referred to as an “agency action”) is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary, after consultation as appropriate with affected States, to be critical, unless such agency has been granted an exemption for such action by the Committee pursuant to subsection (h) of this section.” (ESA, 1973)

While these feeding areas are well south of the Bering Strait region, there is overlap with commercial fishing activity, increasing vessel traffic transiting north and south from Arctic routes, and shipping traffic east and west along the great circle route. The USCG has proposed a traffic routing scheme that currently is placed through the Bering Sea critical habitat (Figure 30) and the USCG will be required to consult with NMFS regarding the potential impacts to both right whales as well as the designated critical habitat. This proposed action will be discussed further in the next section. There have been no documented ship strikes of right whales in Alaska, but it is frequently indicated by NMFS that the North Atlantic right whale population has a significantly high risk of vessel strikes and serves as a good proxy for the highly endangered North Pacific population (NMFS, 2013b; Allen and Angliss, 2015). North Pacific Right whales likely feed on patches of copepods throughout the water column (Baumgartner et al., 2013); however, little is known of the dive profiles for this population which will be an important variable to understanding their risk to vessel strikes.
Potential Biological Removal

In the species summaries reference to Potential Biological Removal (PBR) was made. This term is has regulatory significance and is defined in the MMPA to be:

“... the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. The potential biological removal level is the product of the following factors: (A) The minimum population estimate of the stock. (B) One-half the maximum theoretical or estimated net productivity rate of the stock at a small population size. (C) A recovery factor of between 0.1 and 1.0.”

Calculation of PBR is required by the MMPA as it pertains to regulation of commercial
fishing. The number is not directly applied to authorization of incidental take for other non-fishing activities, but does inform the development of regulations such as vessel speed restrictions that serve to mitigate mortality risks. These will be discussed further in the next section.

Sources of Injury or Mortality
In Alaskan waters there are multiple anthropogenic sources of injury and/or mortality for marine mammals (Huntington, 2010; IWC, 2014). These include habitat degradation from noise, pollution, prey depletion, prey shift due to climate change, directed harvest/whaling, gear entanglement, and ship strikes (George et al, 1994; McDonald et al., 2006; Nowacek et al., 2007; Alter et al., 2010; Sigler et al., 2011; Moore et al., 2012; Reeves et al., 2012; Citta et al., 2013). While all of these are significant in their own right, this paper is focused on the effects of increasing vessel traffic in the Bering Strait region. The increased vessel traffic increases noise pollution and also poses a range of pollution risks from ocean dumping to a vessel running aground. Most significant to an individual whale though is the risk of being struck and killed. Next this paper will discuss ship strikes in both a global and regional context.

Focus on Ship Strikes
Increasing ship traffic is a worldwide phenomenon. Data analyzed between 1992-2012 indicate a fourfold increase in shipping traffic globally (Tournadre, 2014). For marine mammals this has been a significant change to their environment. For large whales in particular, it has become an issue of particular concern with an increase in documented ship strikes of several species of large whales occurring globally (Laist et al., 2001; Felix and VanWaerebeek, 2005; De Stephanis and Urquiola, 2006; Panigada et al., 2006; Van Waerebeek et al., 2006 and 2007; Behrens and Constantine, 2008; Bradford et al., 2008; Kemper et al., 2008; Carrillo and Ritter, 2010; David et al., 2011; Guzman et al., 2012; Ritter, 2012). Ship struck species most frequently documented include fin, humpback, sperm, southern right and Bryde’s whales. Recognizing this trend, the International Whaling Commission established a Ship Strike Working Group (SSWG) to examine the issue (IWC, 2014b). A ship strike database has been established and currently contains over 1200 reported instances of injury or mortality of marine mammals resulting from ship strikes (IWC, 2016). In addition to establishing baseline data, the SSWG is actively
developing recommendations through the IWC to the IMO on ways to mitigate and reduce ship strike occurrence.

In the U.S. ship strikes have been documented widely (Knowlton and Kraus, 2001; Jensen and Silber, 2004; Douglas et al., 2008; Berman-Kowaleski et al., 2010; Lammers et al., 2013; Monnahan et al., 2015). North Atlantic right, blue, fin, humpback and gray whales are species with highest rates of documented ship strikes. In Alaskan waters, there have been numerous reports of likely ship struck whales resulting in injury or mortality. Neilson et al. (2013) summarized 108 reports between 1978-2011 (Figure 31). The majority of the animals were humpback whales and were primarily documented in southeast Alaska where there are high densities of feeding humpbacks in summertime that overlap with high levels of vessel traffic. Of the 108 events reported, 25 resulted in mortality of an individual whale. In provisional unpublished reports between 2012 and 2015, 25 humpback whales, 1 gray whale, 2 fin whales and 3 unknown whales were struck by vessels (NMFS 2013, 2014, and 2015; K. Savage pers comm May 22, 2016). Of these, only two fin whales were documented near the Bering Sea on the Pacific Ocean side of the mid-Aleutian Island chain. On May 30, 2016, a dead fin whale was found on the bow of a cruise ship entering the port of Seward, Alaska (Figure 32) (R. Andrews; pers comm, May 30, 2016). The cause of death has yet to be determined by NOAA. While there currently exists no documented cases of ship struck whales in the Bering Sea, Bering Strait or Chukchi-Beaufort Seas regions, these are remote regions and vessels may not be aware or chose not to report struck whales. Injured or killed whales may also go unobserved or undocumented as there are fewer “eyes on the water” and less awareness of the issue as compared to Southeast Alaska. I will discuss further in the next section, steps the U.S. is taking to reduce ship strikes of marine mammals throughout U.S. waters.

**Quantifying Ship Strike Risk**

An important step to developing appropriate mitigation measures is understanding the risk of ship strikes to a particular species (JWG 2012, 2014). Documenting occurrence of ship strikes is essential and can be accomplished through photographic analysis of vessel strike scarring of individuals in a population (George et al., 1994; Bradford, 2009) or actual recorded incidences of vessel strikes as previously discussed. Understanding these
rates of occurrences and their temporal variability is an important factor in determining risk (Vanderlaan et al., 2009). An understanding of the density of animals, their spatial and temporal use of an area and, surface behavior is also essential to quantifying risk (Bezamat et al., 2014; Irvine et al., 2014; McKenna et al., 2015). It is also necessary to quantify the density, type and “behavior” of shipping traffic, along with the average speeds, course, and size of the vessel (Laist et al., 2001; Jensen et al., 2015). Vessel speed in particular has been identified as a key factor in determining risk, with vessels transiting above 10 knots having significantly higher risk of striking whales (Vanderlaan and Taggart, 2006; and Gende et al., 2011; Wiley et al., 2011). Combining these datasets, spatially explicit assessments can be done to assess overall risk for a species and populations (Williams and O’Hara, 2010; Redfern et al., 2013). Once completed these risk assessments can be viewed against regulatory limitations under the MMPA and ESA including take and potential biological removal.
Summary and Recommendations

In summary, multiple large whale species, most of which are endangered, occupy the Bering Strait region and areas to the north and south. These species overlap in time and space with documented vessel transit paths and are likely at risk from vessel strikes, that is a source of mortality documented globally as well as regionally in Southeast Alaska where vessel traffic is high. Bowheads currently may have the lowest risk given their temporal and spatial separation from vessel traffic through the Bering Strait for most of the ship traffic season, however late fall as the whales migrate to their wintering grounds is likely to be a high risk period. Fins, humpbacks, minkes, and gray whales appear to have the greater risk given their density and spatial overlap with vessel traffic in the Bering Strait for most of the ship traffic season. North Pacific Right whales, the
most endangered species, is not likely to have as high an encounter risk from Bering Strait traffic, though encounter risk from East-West traffic and fishing vessels may be significant. Additional research on dive patterns as well as temporal and spatial use will be needed to quantify the risks by species. Two outcomes of this section are recommendations to:

- Conduct studies to better understand marine mammal distribution in the Bering Sea.
- Combine marine mammal data with transit data to develop a ship strike risk assessment for key species including bowhead, fin, humpback, minke, gray, and right whales.

IV. POTENTIAL SOLUTIONS

As demonstrated earlier in this paper, the risk of ship strikes and marine mammal mortality is a significant concern for the Bering Strait and Bering Sea regions (George et al., 1994; Huntington, 2010; Robards et al., 2014). Unlike other regions of the U.S., the legal complexities of managing this risk are complicated by the presence of an international maritime passageway that allows for shipping traffic to pass through U.S. waters without the same level of regulatory oversight that domestic vessels incur (Hartsig et al., 2012). In this section I will discuss mitigation measures that are being explored to address this situation and will suggest other measures that could be considered. As a comparison, I will summarize the case of North Atlantic Right whales and ship strike reduction efforts ongoing in U.S. waters of the Atlantic and elaborate on current measures taken in other regions of the U.S. to minimize ship strikes. I will examine ongoing international and domestic efforts to mitigate shipping impacts. The U.S. Coast Guard (USCG) is currently working to develop vessel routing measures for the Bering Strait through the IMO (USCG, 2010). However, that process is lengthy and constrained by the U.S.’s non-signatory status with UNCLOS. Therefore, in the interim, the USCG is exploring agreements with international vessel insurers to insert mitigating safety conditions in issued insurance policies, and they are also reaching out to Russian counterparts to establish ship transit protocols for the region (IMO, 2008; IMO, 2009). I will discuss these steps and others being taken by federal, state, and local regulators and concerned stakeholders, and will draw on lessons from ongoing domestic regulatory
constructs that mitigate ship strike risk to inform this discussion. These constructs include marine mammal mitigation and monitoring programs developed in the Arctic region for oil and gas activities and vessel tracking with Automatic Identification Systems (AIS) (Aarsaether and Moan, 2009). I will examine vessel speed restrictions along the Atlantic seaboard and consider application of similar measures to the Bering Strait and Bering Sea regions. Finally, I will explore what regulatory authority the U.S. does have over vessels transiting through U.S. waters.

**Current Measures to Reduce Ship Strike Risk in Other Areas**

Currently in the U.S. and elsewhere in the world there are several measures being employed to reduce ship strike risk to large whales (Couvat and Gambaiani, 2013). These include vessel speed reduction requirements as well as voluntary measures, AIS tracking, designation of areas to be avoided, shipping lanes, and real-time monitoring of and reporting of whale presence (Vanderlaan et al., 2008; Vanderlaan and Taggart, 2009; Silber et al., 2012 and 2015; Conn and Silber, 2013; Wiley et al., 2013; Constantine et al., 2015). While these measures have achieved encouraging results, it is not absolute that all regulatory measures succeed in reducing and mitigating risk and therefore ongoing assessment of the efficacy of imposed mitigation requirements will be necessary. In the case of North Atlantic Right whales, there was no significant decrease in vessel strikes after regulations were put in place to reduce ship speeds in specified areas early on. This result was due to a high level of non-compliance (Van Der Hoop, et al., 2012). However, subsequent analysis indicated a high level of success in reducing ship strike risk due to speed reductions, with improved compliance linked strongly to issued fines and citations (Conn and Silber, 2013; Laist et al., 2014; Silber et al., 2014). In California voluntary speed reduction measures were implemented for a portion of a shipping lane off southern California, however minimal compliance was observed (McKenna et al., 2012).

**North Atlantic Right Whale Example**

North Atlantic right whales serve as an excellent example of how one population’s high risk of ship strikes is mitigated and the pathways taken to achieve it. In the late 1990’s it became clear to biologists studying the highly endangered population that at the time numbered at around 300, that mortality from entanglements and ship strikes was significant. Between 1970 and 1999, 45 whales right whale deaths were documented with
16 of those due to ship strikes and 3 to entanglement (Knowlton and Kraus, 2001). Since 1999, mortalities from ship strikes and entanglements have continued at an alarming rate and is estimated to be 4% of the population per year. In particular loss of calving females have been a notable concern, given the impact that has on growth rate and genetic variability for the population (Kraus et al., 2005).

To address this issue, the U.S. initially provided an information document on the issue of vessel strikes and right whales to the IMO in 1997, laying the groundwork for subsequent mitigation measure requests. In 1998 the U.S. followed up with a proposed measure to establish Mandatory Ship Reporting Systems (MSRs) which was approved the same year and came into force in July 1999 and continues to remains in effect (Figures 33 and 34). All vessels greater than 300 gross tons are required to report in to the USCG when they enter these areas and in return receive notifications of right whale presence and mitigation measures that can be taken to avoid striking a whale (Silber et al., 2015). An important step in the U.S. regulatory process was following the IMO decision the USCG developed regulations to codify the IMO approved measures.

In 2003 Canada submitted a proposal to the IMO to modify the traffic separation scheme (TSS) in place through the Bay of Fundy. The modified route would reduce the probability of vessel strikes of North Atlantic right whales (Figure 35). The IMO approved and adopted the proposal that went into effect in July 2003. Similar adjustments to the TSS in and out of Boston was proposed by the U.S. in 2006 and 2008 and were approved and entered into force in the following years.

In 2007 Canada proposed establishment of an Area to be Avoided (ATBA) in Roseway Basin off of Nova Scotia for June through December (Vanderlaan et al., 2008). In 2008, the U.S. proposed an ABTA for the Great South Channel for April through July. Both areas are known feeding grounds for North Atlantic right whales. Both proposals were approved, adopted and entered into force in 2008 and 2009, respectively. The ATBA is a recommendation for vessels > 300 GT; and remains in effect annually (Silber et al., 2012).

In 2008, the U.S. published a final rule regulating the speeds of vessel traffic in seasonal management areas (SMA’s) (Figure 36). In these areas all vessels ≥ 65 ft in length and subject to U.S. jurisdiction and all vessels ≥ 65 ft entering or departing a port or place
Mandatory Ship Reporting System

NOAA Chart 13009 - Whalesnorth
(See USCG Local Notice to Mariners No. 27/99 (MONTHLY))
These charts have been edited for use on the World Wide Web

Figure 33: Location of Mandatory Ship Reporting Area Whalesnorth
Mandatory Ship Reporting System

NOAA Chart 11009 - Whalessouth

(See USCG Local Notice to Mariners No. 27/99 (MONTHLY))

These charts have been edited for use on the World Wide Web

Figure 34: Location of Mandatory Ship Reporting Area Whalessouth
Figure 35: TTS in the Bay of Fundy before and after modification relative to North Atlantic right whale density (from Allen, 2014)
subject to U.S. jurisdiction are required to maintain speeds of 10 knots or less (NMFS, 2008b). The rule also allows for NMFS to designate Dynamic Management Areas (DMA’s) for “unpredictably occurring aggregations” of right whales. Vessels are requested, but not required to avoid these areas or travel through them at less than 10 knots. In 2013, language found in the original rule to “sunset” or expire the regulation on December 09, 2013 was removed and the rule remains in force (NMFS, 2013c).
Evaluating the effectiveness of this rule was a key component to extending the rule in 2013. The reviews completed indicate compliance has improved with time within the SMA’s (Figure 37), though lags for foreign flagged vessels, however voluntary compliance with DMA’s has been relatively poor with few vessels avoiding the DMA’s and vessel speeds are not significantly lower than outside the DMA’s (Silber and Bettridge, 2012; Silber et al., 2013). This lack of compliance with voluntary speed reduction measures has also been documented in southern California where the measures were put in place to reduce collisions with blue whales (McKenna et al., 2012). While voluntary compliance does not appear to be effective for DMA’s, it is notable that voluntary compliance with IMO approved areas to be avoided has shown to be high such as the case of Roseway Basin. Understanding these differences in compliance will be essential when developing voluntary measures elsewhere (Raustiala, 2000, Vanderlaan and Taggart, 2009). Analysis of ship strike data shows positive results for the SMA’s with no ship struck right whales found in any SMA or within 45 miles of any SMA for the initial 5 year period of the rule (Laist et al., 2014). Of applicability to the Bering Strait region, this analysis indicated that humpback whales did not benefit as much from the

Figure 37: Vessel speeds in all SMA’s between 2009-2011 (from Silber and Betridge, 2012)
SMA’s and this may be due to differences in seasonal occurrence not aligned with the SMA dates that were tailored for right whales. This is an important point when developing measures that will apply to multiple species.

What should now be clear is that achieving effective measures to mitigate ship strikes of large whales takes time, many years in fact. The jurisdictional status of the traffic is significant and for the case of the Bering Strait that will include substantial international traffic, will necessitate involvement of the IMO.

**International Measures**

There are multiple international mechanisms available to protect marine life and habitat (DNV, 2014). Some of these measures in particular are useful for mitigating ship strike risk. In all cases, the actions involve an international regulatory body (Bodansky, 2010; Tedsen et al., 2014).

As previously highlighted the measures most likely to be effective are to require mandatory reporting into and out of a defined area, develop Traffic Separation Schemes (TSS) that minimize passage through areas of high whale density, define Areas to be Avoided (ATBA) which may be challenging for the narrow and shallow Bering Strait region, and implement vessel speed restrictions in particular along sections of the route than cannot by adjusted due to bathymetric limitations (Allen, 2014; Huntington et al., 2015). Both Russia and the U.S. would need to work cooperatively to propose these measures to the IMO for the region.

Particularly Sensitive Sea Areas (PSSA) is another option through the IMO. The member state proposing designation of a PSSA must demonstrate that the area possesses significant ecological, social, economic, and cultural, or scientific and educational resources and that the identified resources are vulnerable to international vessel traffic. Once identified, Associated Protective Measures (APM), such as TSS and ATBA, must be included in the proposal that will reduce the impacts of the vessel traffic (DNV, 2014; Hillmer-Pegram and Robards, 2015; Paramita, 2015). Once designated, a member state then has authority to promulgate regulations that apply to all vessels, including international vessels on innocent passage and those going through the international strait (in the members states waters). In this case the U.S. would be limited to promulgating regulations for only half the strait, which limits the overall effectiveness of the measures,
if they are not equally matched by Russian regulation. While PSSA’s are certainly a significant designation, the U.S. in coordination with Russia may be able to more quickly achieve mitigation measures through directly applying to the IMO for individual measures such as TSS, ATBA, and mandatory ship speed reductions that apply across the entire strait region.

One important step taken by the IMO recently has been the approval of the Polar Code that will enter into force in January 2017. One component of the code is the requirement as a part of voyage planning that “the master shall consider a route through polar waters, taking into account the following... current information and measures to be taken when marine mammals are encountered relating to known areas with densities of marine mammals, including seasonal migration areas; current information on relevant ships’ routing systems, speed recommendations and vessel traffic services relating to known areas with densities of marine mammals, including seasonal migration areas.” (IMO, 2015) These requirements are also linked to the IMO approved Guidance Document for Minimizing the Risk of Ships with Cetaceans (IMO-MEPC, 2009). This provides an avenue to inform international vessels of high-density areas and recommend mitigation measures to reduce the risk of ship strike. Longer term, any measures approved by the IMO for the Bering Strait region will likely be integrated into the Polar Code.

Bilateral and multilateral agreements are another pathway that nations such as Canada, Russia and U.S. are exploring to impose requirements on transiting vessels (Laughlin et al 2012). In such an agreement, a vessel departing a foreign port and transiting on innocent passage through U.S. waters could be subject to U.S. regulation if stipulated in said agreement with the nation of said foreign port (Ristroph, 2014; Tedsen et al., 2014). This type of agreement provides potentially a quicker mechanism than the IMO to impose regulation on a broader set of vessels, though not all. Still such an agreement would need to be made at the U.S. State Department level and like all things are subjected to the political environment at the time.

One novel avenue to impose mitigation measures on international vessel traffic is through vessel insurers and subsequent conditions that insurers impose (Sarrabezoles et al., 2014). Insurance companies are rapidly aligning their requirements with the Polar Code, but the avenue exists to also advocate for compliance with domestic regulations that international
traffic might not otherwise be required to follow. Additional types of international protective designations such as World Heritage Sites or Biosphere Reserves exist but these will not provide the regulatory authority to impose the necessary mitigation measures on vessel traffic as this must be done through the IMO.

Joint US/Russia Cooperation
Achieving successful mitigation measures in the Bering Strait region will require cooperation with Russia who has authority over one-half of the strait region (Ristroph, 2014). Precedence exists for successful cooperation to address environmental issues in the region; for example in 2001 Russia and US signed Agreement between Government of the Russian Federation and the United States of America on Cooperation in Combating Pollution in the Bering and Chukchi Seas in Emergency Situations (AMSA, 2009). Moving forward, development of truly effective mitigation measures or a proposal of a PSSA and APM for the Bering Strait region will necessitate a bilateral submission from Russia and the U.S. to the IMO given both nations waters are involved (Laughlin et al., 2012). The U.S. and Russia could also establish a Vessel Tracking Service (VTS) which governments are allowed to establish under SOLAS “when, in their opinion, the volume of traffic or the degree of risk justifies such services.” (SOLAS, 2002) A VTS does not regulate the traffic but serves as a vehicle for information to and from vessels to facilitate safe navigation of an area. A ship reporting system as approved by the IMO can also be managed by a VTS. Along with improved AIS, a VTS can provide the much needed vessel traffic detail to assess ship strike risk (McGillivary et al., 2009; Robards et al., 2016) That said, the current political climate between the two nations is politically challenging, and may limit the speed of progress on joint proposals.

Domestic Measures Used to Mitigate Risks
As discussed in the preceding section, there are a few domestic statutes by which the U.S. regulates impacts to marine mammals and associated habitat. These include the MMPA, ESA, and NMSA as well as the National Environmental Policy Act (NEPA, 1970). NEPA in itself is a powerful statute by which all agencies are subject. NEPA was signed into law in 1970 requires that a range of actions taken by the federal government, including permitting, go through a review process that assesses the environmental impacts of the proposed action. These reviews can range from a one-page categorical
exclusion memo to a one thousand page plus environmental impact assessment (EIS) that can take years to produce. It is the NEPA process and legal challenges to it, which in fact typically slow and many times halt permitting of many activities.

*NMFS and USFWS*

In U.S. waters, activities that have the potential to harass or injure marine mammals are required by the MMPA and ESA (for listed species) to obtain exemptions in the form of incidental take authorizations (ITA). Currently as the law is applied, general maritime traffic including shipping traffic, are not issued ITA’s; however, NMFS has promulgated ship speed rules in various U.S. region. Activities that do necessitate ITA’s include those that result in significant sound output such as construction, military operations, and energy related activity. In Arctic waters, the oil and gas industry does obtain ITA’s for their activities and they employ robust mitigation measures to reduce impacts to marine mammals. Marine Mammal Monitoring and Mitigation plans (4MP’s) have been developed through consultation with federal agencies, local stakeholders, and expert scientists. In addition the public has an opportunity to review and comment on these measures (NMFS, 1996 a, b). These measures range in form but generally involve having a trained Protected Species Observer (PSO’s) on board a vessel that carry out the requirements of the issued authorizations. Mitigation measures may include restrictions on vessel speed, distance from marine mammals, time/area closures, and other relevant conditions pertinent to the project. PSO’s typically maintain watches during daylight hours and at nighttime when equipment and conditions allow. The PSO’s are trained and experienced field biologists with expertise in detection and identification of marine mammals at sea. In addition to the direct benefit of mitigation, the 4MP program educates and raises the level of awareness of mariners on board of the risks of vessel strikes of marine mammals both regionally and worldwide (NMFS, 2015c; Shell, 2015). These requirements, however, only pertain to areas of operation and do not apply to their transit activities. While the 4MP is an effective tool under an ITA reduce impacts to marine mammals, it exists within an ITA. In the absence of ITA’s, applying similar mitigation requirements to all maritime traffic is more challenging. NMFS and USFWS are able to develop independent regulations, as the fore mentioned ship speed rules, which would apply to all US regulated traffic, but would not be applicable to international traffic.
Mandatory PSO coverage is a potential option long-term, and there are lessons that can be drawn from a range of marine mammal and fishery observer programs (Read, 2006; Moore et al., 2009; Weinrich et al., 2010; Nowacek et al., 2013). However, PSO programs are costly, logistically challenging, have limitations and can be difficult to win acceptance. An adaptive mitigation approach that combines PSO coverage and alternatives detection measures and mitigations such as ship speed reductions, routing measures, real time passive detection systems, active acoustic whale detection systems, automated detection systems such as infrared technology, and other dedicated seasonal visual surveys will be necessary for a truly effective mitigation program (Bernasconi et al., 2013a and b; Couvat and Gambaiani, 2013; Nowacek et al., 2013; Baumgartner et al., 2014).

USCG
In 2010 the U.S. Coast Guard initially proposed a Port Access Route Study (PARS) (refer to Section II for further detail) to evaluate vessel routing schemes through the Bering Strait region to address concerns over the growth in ship traffic and increased risk of a maritime casualty event that could be catastrophic for the region. After reviewing comments received, the Coast Guard revised their proposal for voluntary ship routing measures and was made available for public comment in 2014 and extended in 2015 (USCG, 2015b).

In response to the proposed routing, both NOAA and the Marine Mammal Commission provided comments to the USCG and suggested routing changes that would avoid North Pacific right whale critical habitat and shift traffic further east of St Lawrence Island to minimize impacts to subsistence activities. The MMC also recommended an Area to be Avoided be designated on either side of the proposed TSS within the Bering Strait as well as speed restrictions (Figure 38) (MMC, 2015; NOAA 2015). The MMC also recommended improvements to AIS coverage in the Bering Strait region and that the PARS study be extended to include a vessel routing system through Unimak Pass with TSS, ATBA, and speed restrictions below 12 knots.

The USCG is continuing to review the comments received, thus any implementation of mitigation measures in the region is likely a few years off. The USCG may take a voluntary or mandatory approach for vessel traffic subject to U.S. jurisdiction and the
Figure 38: NOAA Recommended Routing Scheme (from NOAA, 2015)
final study outputs are likely to form the basis for a U.S. proposal to the IMO to mandate vessel routing measures in the region.

Additional Domestic Measures-Habitat Protection

To protect habitat in U.S. waters there are multiple regulatory options such as National Marine Sanctuary designation, National Parks, National Monuments (Antiquities Act provides Presidential Authority) (NOAA/NMFS), National Wildlife Refuges, National Estuarine Research Reserve System and ESA Critical habitat designation (such as right whale critical habitat) (Laughlin et al., 2012). The state of Alaska also has the ability to regulate out to three nautical miles. While these designations may provide mechanisms to take steps to addressing ship strike risk through increased research opportunities, public awareness, or in some cases limiting use of an area, it is unlikely that these are the best paths forward to addressing ship strikes. A primary stakeholder in the Bering Strait region it is the native Alaska communities that maintain an active subsistence lifestyle tied to the marine environment. These communities tend to have strong opposition to any form of protected area designation that could limit their use and access to the waters they depend upon. In addition, while these designations may afford opportunities to regulate vessel traffic subject to U.S. jurisdiction, the designations would not apply to international vessels on innocent passage.

Summary and Recommendations

In summary, there are multiple options ranging from the international level to the local level to address and mitigate the risk of ship strikes of marine mammals. The most effective path is to pursue new ship routing measures for the Bering Strait region through the IMO. Potential economic impacts are a necessary factor that will have to be considered when proposing regulations, as international trade agreements come into play significantly and can stall progress of new measures (ICS, 2014). The U.S. may also be able to develop bilateral agreements with neighboring countries to address vessel traffic coming and going from their ports and transiting through the Bering Strait region. Domestically the U.S. can regulate traffic under their jurisdiction in various ways, however the U.S. regulated traffic is not likely the true source of risk and perceived arbitrary regulation of lower risk traffic could backfire politically and slow the process of
more effective regulation through the IMO.

Important to achieving success with international regulation through the IMO is building support for such an action through increased awareness, local community involvement, and a better understanding and quantification of the risk. One outcome of this section is a recommendation to:

- Propose ship speed limits in high density/high risk zones and establish area avoidance measures as reasonably applicable through the IMO.

**SUMMARY and CONCLUSION**

In conclusion, it is abundantly clear that climate change is dramatically altering the Arctic marine environment. These alterations are creating opportunities for economic growth through shorter, and potentially less expensive shipping routes. These routes, however, track through one of the few narrow international straits in the world that is also a biologically and culturally rich region. The risk to the biological resources and the communities themselves is high, and quantifying that risk has only just begun. Attention in the U.S. Arctic has been largely focused on oil and gas activities and the associated risks and impacts to the environment. It is only recently that awareness has grown for other marine activity that is expanding in the region. What has become apparent is that there are gaps in understanding of the activity growth, specifically vessel transit activity, and data collection capacity is in need of improvement. The first recommendation of this paper is for:

- **Development of one online source of summary vessel transit statistics, providing a consistent baseline dataset for multiple stakeholders to evaluate. Support for the portal will be necessary to maintain, process and summarize the data and a collaborative approach that engages all stakeholders including local communities, industry, non-profits, state, and federal entities is suggested.**

A greater resolution of the jurisdictional status of vessels, individual vessel type and routing is also necessary to determine the best course of regulatory action. This leads to the second recommendation:

- **Evaluate the baseline date and evaluate level and timing of innocent passage transits and transit course.**
Not all vessel types will have the same risk for striking a marine mammal and mitigation measures do not equally impact all parties. Regional detail of marine mammal distribution, density, and behavior is limited and to quantify risk reliably, additional detail will be essential. Without this supporting information, proposed mitigation measures will be difficult to impose domestically and are not likely to succeed in the IMO if the measures result in substantive economic burden. This leads to the third and fourth recommendations to:

- **Conduct studies to better understand marine mammal distribution in the Bering Sea.**
- **Combine marine mammal data with transit data to develop a ship strike risk assessment for key species including bowhead, fin, humpback, minke, gray, and right whales.**

Finally, the most effective measures found to date in other regions of the world are ship speed requirements and vessel routing measures such as a traffic separation scheme and areas to be avoided. The USCG has begun development of routing measures through the Bering Strait region that are designed for safer passage but are also taking into consideration risk to the marine resources. This study will form the basis for any proposals submitted to the IMO and leads to the final recommendation for the U.S. to:

- **Propose ship speed limits in high density/high risk zones and establish area avoidance measures as reasonably applicable through the IMO.**

Unfortunately, this entire process is slow at best and requires navigation of a political quagmire both domestically and internationally. Lessons learned from the North Atlantic right whale tell us that it is possible to achieve effective solutions but success will only come with patience, fortitude and an abundance of evidence demonstrating the risk that will carry the proposals forward.
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