16 January 2009

DRAFT AMSA Recommendations

[As discussed by PAME and edited by the AMSA Team, 16 January 2009]

The AMSA recommendations are in three broad themes: Enhancing Arctic Marine Safety; Protecting Arctic People and the Environment; and Building the Arctic Marine Infrastructure. It is recognized funding for these recommendations should come from the Arctic states, industry and/or public-private partnerships.

The recommendations are as follows: [Arctic States decide to:]

I. Enhancing Arctic Marine Safety:

A. Linking with International Organizations: [That the Arctic states agree], on a continuing basis, to identify areas of common interest and develop unified positions and approaches with respect to international rule making bodies and other organizations such as: the International Maritime Organization (IMO), the International Hydrographic Organization (IHO), the World Meteorological Organization (WMO) and, the International Maritime Satellite Organization (IMSO) to advance the safety of Arctic marine shipping; and encourage regular meetings of member state national maritime safety organizations to coordinate, harmonize, and enhance the implementation of the Arctic maritime regulatory framework.

B. IMO Measures for Arctic Shipping: [That the Arctic states agree] to lead efforts at the International Maritime Organization (IMO) to strengthen, harmonize, and regularly update international standards for ship construction, design, equipment, crewing, and operations for vessels operating in the Arctic. This includes the following:
–--Support updating and consider the mandatory application of the *Guidelines for Ships Operating in Ice-covered Waters;*
---[Consider] developing mandatory safety and environmental measures that are more extensive than current SOLAS and MARPOL provisions in the context of Arctic shipping, including training and certification standards, and crew qualification endorsement for Arctic marine operations;
–--Develop a model course for Arctic navigation and marine operations under the IMO's Standards of Training, Certification and Watchkeeping (STCW 78/95); and,
–--Support the implementing and regular updating of polar class ship designations by the International Association of Classification Societies (IACS).

C. Uniformity of Arctic Shipping Governance: [That the Arctic states agree] to explore the harmonization of Arctic marine shipping regulatory regimes [within their own jurisdiction] and uniform Arctic safety and environmental protection regulatory regimes, consistent with UNCLOS

that could provide a basis for protection measures in regions of the central Arctic Ocean beyond coastal state jurisdiction for consideration by the IMO.

D. Strengthening Passenger Ship Safety in Arctic Waters: [That the Arctic states agree] to support the application of the IMO's *Enhanced Contingency Planning Guidance for Passenger Ships Operating in Areas Remote from SAR Facilities*, given the extreme challenges associated with rescue operations in the remote and cold Arctic region. In addition, Arctic states agree to strongly encourage cruise ship operators to develop, implement, and share their own best practices for operating in such conditions, including consideration of measures such as timing voyages so that other ships are within rescue distance in case of emergency.

E. Arctic Search and Rescue Instrument (SAR): [That the Arctic states agree] to support developing and implementing a comprehensive, multi-national Arctic Search and Rescue (SAR) instrument, including aeronautical and maritime SAR, among the eight Arctic nations [and interested non-Arctic states with Arctic shipping interests] in recognition of the remoteness and limited resources in the region. [The Arctic states should also encourage all shipping companies to have contingency plans, as well as improvement and enhancement of national monitoring systems] such as the Automated Mutual Vessel Emergency Response (AMVER) system, VTS Victoria or similar response instruments.

II. Protecting Arctic People and the Environment:

A. Survey of Arctic Indigenous Marine Use: [That the Arctic states agree] to collect and compile information on traditional marine use in order to more accurately assess the human impacts from Arctic shipping.

B. Engagement with Arctic Communities: [That the Arctic states should determine] if effective communication mechanisms exist to ensure engagement of Arctic coastal communities and, where there are none, develop mechanisms to engage and coordinate with the shipping industry, relevant economic activities, and Arctic communities (in particular during the planning phase of a new marine activity) to increase benefits and help reduce the impacts from shipping.

C. Areas of Heightened Ecological and Cultural Significance: [That the Arctic states agree] to identify areas of heightened ecological and cultural significance in light of changing climate conditions and increasing multiple marine use, and where protective measures are not already in place, to encourage implementation of measures to protect these areas from the impacts of Arctic marine shipping, in coordination with all stakeholders and consistent with international law.

D. Specially Designated Arctic Marine Areas: [That the Arctic states agree] to explore the need for internationally designated areas for the purpose of environmental protection in regions of the Arctic Ocean. This could be done through the use of appropriate tools, such as Particularly Sensitive Sea Areas (PSSA) or 'Special Areas' designation through the IMO and consistent with the existing international legal framework in the Arctic.

E. Protection from Invasive Species: [[That the Arctic states should consider] ratification of the IMO International Convention for the Control and Management of Ships Ballast Water and Sediments [without delay]. Arctic states should also assess the risk of introducing invasive species through ballast water and other means so that adequate prevention measures can be implemented in waters under their jurisdiction.] [That the Arctic states should assess the risk of introducing invasive species through ballast water in view of further ratification and implementation of IMO International Convention for the Control and Management of Ships Ballast Water and Sediments.]

F. Oil Spill Prevention: [That the Arctic states agree] to enhance the mutual cooperation in the field of oil spill response and, in collaboration with industry, support research, and technology transfer to prevent release of oil into Arctic waters, since prevention of oil spills is the highest priority in the Arctic for environmental protection.

G. [Lessening] Impacts on Marine Mammals: [That the Arctic states agree] to engage with the IMO and other relevant international organizations to assess the effects on marine mammals due to ship noise, disturbance and strikes in Arctic waters and consider, where needed, developing and implementing mitigation strategies.

III. Building the Arctic Marine Infrastructure:

A. Addressing the Infrastructure Deficit: [That the Arctic states agree] [that making vast improvements in] Arctic marine infrastructure is needed to enhance safety and environmental protection in support of sustainable development. Examples of infrastructure where critical improvements are needed include: qualified people, navigational charts, communications systems, port services, accurate and timely ice information (ice centers), and icebreakers to assist in response.

B. Arctic Marine Traffic System: [That the Arctic states agree] to support continued development of a comprehensive Arctic marine traffic awareness system to improve monitoring and tracking of marine activity, to enhance data sharing in near real-time, and to augment vessel management services. Such a circumpolar and integrated system could: reduce incident risk, facilitate response, and provide awareness of potential user conflict.

C. Circumpolar Environmental Response Capacity: [That the Arctic states agree] to continue to develop a circumpolar environmental pollution response capacity [for oil and other spills] that is critical to protecting the unique Arctic ecosystem. This can be accomplished by: international Arctic framework agreement(s); regional bilateral capacity agreements; and establishment of places of refuge.

D. Investing in Hydrographic, Meteorological and Oceanographic Data: [That the Arctic states agree] to significantly improve, where appropriate, the level of and access to data and information in support of safe navigation and voyage planning in Arctic waters. This will entail increased efforts for: hydrographic surveys to bring Arctic navigation charts up to a level acceptable to support current and future safe navigation; and, systems to support real-time acquisition, analysis, and transfer of meteorological, oceanographic, sea ice, and iceberg information.

AMSA 2009 REPORT – COMBINED FINDINGS

1. Introduction *(no findings)*

2. Arctic Marine Geography, Climate and Sea Ice: Findings

1. Arctic sea ice coverage (extent) has been decreasing since the 1950s in all seasons. Observations of sea ice in the central Arctic Ocean have also indicated thinning during the past four decades. However, there remains a significant, year-to-year variability in regional sea ice coverage.

2. Global Climate Model simulations indicate a continuing "retreat" of Arctic sea ice through the 21st century. Observed sea ice trends and GCM simulations show coastal Arctic regions to be increasingly ice-free or nearly ice-free for longer summer and autumn seasons. Importantly, all simulations indicate that an Arctic sea ice cover remains in winter.

3. Recent simulations indicate the possibility of an ice-free Arctic Ocean for a short period of time in summer by earlier than mid-century. The key implication for this physical change will be the near (or complete) disappearance of multi-year sea ice.

4. Future sea ice conditions remain uncertain. It is highly plausible that Arctic sea ice will be more mobile in partially ice-covered coastal seas, particularly in spring, summer and autumn. Coastal seas may experience an increase and greater frequency of ice ridging and shorter periods of coastal fast ice.

5. The resolutions of GCM simulations are much too coarse for adequate coverage of complex geographies such as the narrow straits and waterways of the Canadian Arctic and waterways of the Russian Arctic. GCM Arctic sea ice simulations also lack robustness to provide detailed information on future marine operating conditions such as the length of navigation season, "residence time" of ice-free conditions, frequency of leads and ridges and more.

6. Recent GCM Arctic sea ice simulations cannot replicate the observed sea ice reductions from the 1950s to today. For example, the model simulations have not been able to show the drastic decrease of observed sea ice extent during this period.

7. Climate change as indicated by Arctic sea ice retreat is a facilitator of marine access. It is highly plausible there will be greater marine access and longer seasons of navigation, except perhaps during winter, but not necessarily less difficult ice conditions for marine operations.

3. History of Arctic Marine Transport: Findings

1. Despite attempts through history to make the Northwest Passage (NWP) a viable route between the East and West, the passage has not become the global trade route it was originally envisioned.

2. The Northern Sea Route (NSR) was highly developed during the Soviet Union era as an important national waterway facilitating Arctic marine transport. Notably, year-round navigation on the western NSR (i.e., from the port of Dudinka on the Yenisei River to Kara Gate) has been maintained since the 1978-79 winter season.

3. No amount of icebreaking ship modeling or studies without field data can provide the at-sea ground truthing and insight needed to reduce the perceived risks of year-round marine transportation in the Arctic.

4. Icebreaking technology has been key to the development of Arctic marine transport in all regions of the Arctic Ocean.

5. Previous Arctic marine transport studies, workshops and reports contain a wealth of findings, recommendations and research agendas of significant relevance to AMSA and to any regulatory framework for the future.

6. Joint agency/ministerial research, public-private partnerships and international cooperation have been beneficial to tackling the many challenges of future Arctic marine transport systems.

4. Governance of Arctic Shipping: Findings

1. Differing national viewpoints over what waters may legitimately be claimed as internal and what waters constitute straits used for international navigation have yet to be fully resolved and could give rise to future disputes concerning the exercise of jurisdiction over shipping activities.

2. Coastal state authority to regulate foreign shipping in the Arctic Ocean in order to preserve, reduce and control marine pollution was substantially bolstered by Article 234 of UNCLOS. However, the precise geographic scope of coverage (waters covered by ice most of the year within the limits of the Exclusive Economic Zone) and the breadth of regulatory powers, in particular to the extent to which a coastal state may unilaterally impose special construction, crewing and equipment standards, given the "due regard to navigation" requirements, could give rise to differing interpretations.

3. The IMO international voluntary Arctic Guidelines for the safety of ships and seafarers in the Arctic are currently under review. This review provides an opportunity to assess and strengthen guidance in the area of ship construction,

equipment and operations and to consider the need for a legally-binding code in the future.

4. Safe navigation in ice-covered waters depends much on the experience, knowledge and skill of the ice navigator. Currently, most ice navigator training programs are *ad hoc* and there are no uniform international training standards. This could be addressed by developing training standards for navigation in polar conditions and in Arctic safety and survival for seafarers that could be incorporated into IMO's Standards of Training, Certification and Watchkeeping (STCW 78/95).

5. The International Association of Classification Societies (IACS) has developed Unified Requirements for member societies addressing essential aspects of construction for ships of *Polar Class*. The IACS polar rules are incorporated into the IMO Arctic Guidelines. An effective way to strengthen safety and environmental protection in the Arctic waters would be for Arctic states to support mandatory application of harmonized *Polar Classes*.

6. Specific international construction requirements for cruise ships operating in polar waters have not been adopted. The cruise ship industry has formed a Cruise Ship Safety Forum to further develop specific design and construction criteria for new vessels, but it remains to be seen how navigation in polar waters will be addressed.

7. MARPOL 73/78 establishes international standards for waste management and pollutant discharges from ships and is applicable to Arctic waters. The Convention sets out minimum standards but, pursuant to Article 234 of UNCLOS, coastal states may unilaterally impose more stringent requirements within the limits of their Exclusive Economic Zone (EEZ) when certain conditions are met. At this time, national standards for regulating ship-source pollution in the Arctic are not consistent.

8. Marine environmental standards have been set by MARPOL 73/78; in particular, discharge standards. Stricter environmental standards have not been established through the IMO. For example, under MARPOL the Arctic Ocean beyond national jurisdiction could be designated as a "special area" where more stringent than normal standards could apply to the discharge of oil, noxious liquid substances and garbage from ships.

9. With an increase in international shipping, it is likely that ships in need of assistance may need to request refuge in sheltered waters of Arctic states. There are likely to be significant practical difficulties to be encountered in finding and supporting suitable places of refuge for ships in need of assistance in the Arctic and in providing ships in need of assistance with adequate support.

10. Port state control enforcement efforts are not widely coordinated today within the Arctic Ocean. The advent of higher regulatory standards applicable to the Arctic would provide opportunities for regional enforcement agreements regarding port state control.

11. Expanded international shipping in the Arctic Ocean increases the possibility of introduction of alien species and other pathogens through the discharge of ballast water. The Ballast Water Convention imposes management (i.e., exchange and treatment) requirements on Party ships to protect marine areas from the hazards posed by ballast water and encourages establishment of regional approaches such as the Guidelines for Ballast Water Exchange in the Antarctic.

12. In the Arctic Ocean there is a very little commercial or government salvage and ship repair response capacity. Salvage and ship repair are important to support commercial shipping and the lack of this capacity is of concern to the marine insurance industry.

13. The availability and cost of marine insurance is a major restraint on shipping in many parts of the Arctic. The underwriting of present shipping activities takes place only on a case-by-case basis.

14. The international liability and compensation regime is fragmented and limited, with separate conventions addressing pollution from oil tankers, bunker fuel from non-tankers, and hazardous and noxious substances from all ships. The Bunkers Convention and HNS Convention are not yet in force; among the Arctic states, Norway and the Russian Federation have ratified the Bunkers Convention and only Russia has ratified the HNS Convention. None of the conventions address damage to the high seas beyond national jurisdiction.

5. Current Shipping Database and Activities: Findings

1. There were 5,980 vessels in the Arctic in 2004: 46%, or 2,759 vessels, were operating on the Pacific Great Circle Route. Of the remaining vessels, 48%, or 1,551, were fishing vessels.

2. Shipping took place throughout the Arctic region in 2004, but primarily in areas that were ice-free, either seasonally or year-round.

3. Currently there are only a few places in the Arctic with year-round shipping operations, where seasonal ice forms. These year-round operations are largely driven by perishable cargoes.

4. Most shipping in the Arctic today is destinational, moving goods into the Arctic for community re-supply or moving natural resources out of the Arctic to world markets.

5. No commercial vessel transited the Northwest Passage or the Northern Sea Route in 2004.

7. Hotspots of shipping activity in the Arctic in 2004 appear to be along the Norwegian coast, around Greenland, Iceland and in the Bering Sea and through the Bering Strait.

8. Most of the fishing activity reported took place in the Bering, Barents and Kara seas, on the west coast of Greenland and around Iceland and the Faroe Islands.

9. Arctic Council member states generally do not collect and share Arctic ship activity data in any systematic manner.

10. Availability of data and reporting on vessel activity varied greatly between states. As a result, the AMSA shipping activity database likely underestimates the level of activity for 2004.

11. Information about vessel incidents and accidents in the Arctic is not shared among Arctic states. Knowing such information is an important step toward understanding and assessing future risks.

12. Cruise ship traffic into and around Greenland has increased exponentially in recent years. The majority of cruise ships observed recently in Arctic waters are *not* purpose-built for Arctic operations. Many are built for voyaging in open water in lower latitudes and warmer climates.

6. Scenarios and Futures: Findings

1. Natural resource development and regional trade are the key drivers of increased Arctic marine activity. High global commodities prices for oil, gas, hard minerals, coal, etc., are driving the search for Arctic natural wealth. New Arctic resource discoveries are highly probable and most new developments will require marine transport and operational support.

2. Exploration and development of new Arctic natural resources take place in continually changing and hugely complex physical, economic, social and political environments. Few (if any) predictive/forecast capabilities of this broad scope and magnitude are available to provide quantitative information on these global sectors interacting together (and their relationships to Arctic marine transport requirements).

3. Complex interactions and relationships among uncertainties are defining the future of Arctic marine activity. These uncertainties include: the legal and

governance situation, degree of Arctic state cooperation, climate change variability, radical changes in global trade, insurance industry roles, an Arctic maritime disaster, new resource discoveries, oil prices and other resource commodity pricing, multiple use conflict (indigenous and commercial) and future marine technologies.

4. There will be plausible, slow movement of Arctic marine ecosystems northward with retreating seasonal sea ice. Fish stocks and fishing in higher latitudes are highly plausible in the future.

5. Plausible longer seasons of navigation will have significant implications for multiple uses in regional Arctic waterways. The overlap and/or competing indigenous and new marine uses will provide many challenges for the Arctic coastal states.

6. There is anticipation that new Arctic ship technologies will set a norm for independently operated, icebreaking commercial ships. Requirements for future conveying by polar icebreaker are uncertain.

7. Increased marine traffic in Central Arctic Ocean is a *reality* - for exploration and tourism. The future holds increasing exploration voyages, plausible increases in tourism and fishing and plausible trans-Arctic voyages in summer on an experimental basis.

8. Arctic voyages in the near-term will be overwhelmingly destinational (regional trade), not trans-Arctic. These destinational voyages are driven by natural resource development, marine tourism and supply/import of materials/goods.

9. Most ships built today for Arctic operations are purpose-built, such as bulk ore carriers, tankers and LNG carriers. There is an economic penalty to use these same ships in long, open ocean voyages since their higher construction standards and thicker steel plating for sailing in the Arctic adds considerable weight.

10. Arctic offshore leases in the Beaufort and Chukchi seas and large investments already made in offshore Arctic Norway and northwest Russia (Barents Sea) should stimulate decadal increases in coastal Arctic marine activity.

11. A lack of major ports and other maritime infrastructure is a significant factor (limitation) in evolving and future Arctic marine operations. There are significant linkages between infrastructure and to most environmental protection and marine safety measures and strategies.

12. It is highly probable many non-Arctic stakeholders, such as non-Arctic states, marine shippers, insurers, shipbuilders, tour ship operators and more, will become actively involved in the future use of the Arctic Ocean.

13. It is highly probable that socio-economic responses to global climate change (for example, emission controls) will impact all elements of future Arctic marine activity.

Regional Futures to 2020 / Bering Strait Region: Findings

14. The Bering Strait region is an international strait for navigation and a natural chokepoint for marine traffic in and out of the Arctic Ocean from the Pacific Ocean.

15. The region, seasonally ice-covered, is a highly productive area extensively used by many species of seabirds, marine mammals and fish. The highly productive continental shelf supports a rich array of benthic feeders; ice-dependent species also move through the region as sea ice retreats and advances. The Bering Strait serves to concentrate species associated with the ice edge and is the only migration corridor for many species.

16. The Bering Strait region is a prolific location for nesting seabird colonies making it a vulnerable location for ecological disruptions.

17. Indigenous people have continually inhabited the coastline of the Bering Strait region for several thousand years. Marine resources today are of vital importance to coastal American and Russian populations throughout the Bering Strait region. They are dependent on marine resources including marine mammals, fish, birds, macro algae, shellfish and other invertebrates. Hunting of large marine mammals can take place 50-80 nautical miles offshore.

18. Ships related to a spectrum of uses are found in the Bering Strait region: fishing, hard minerals/mining, science and exploration, tourism and offshore oil and gas development. Approximately 25 large (foreign-flag) commercial ships annually sail north through the Bering Strait region (in the ice-free season) to the DeLong Mountain Terminal off Kivilina in northwest Alaska.

19. There are no formally established vessel routing measures in the Bering Strait region and there are very few visual aids to navigation in the region. Any future voluntary set of traffic routes, or a vessel traffic system, would have to be proposed by the United States and the Russian Federation to the International Maritime Organization.

20. Increased marine traffic in the Bering Strait region will be driven during the next several decades by offshore oil and gas development. Missing today are a range of multiple use management practices and measures to mitigate potential impacts (noise, emissions, ship strikes, discharges, etc) from these new uses.

Regional Futures to 2020 / Canadian Arctic and Northwest Passage: Findings

21. The Northwest Passage is not expected to become a viable trans-Arctic route through 2020 due to seasonality, ice conditions, a complex archipelago, draft restrictions, chokepoints, lack of adequate charts, insurance limitations and other costs, which prohibit the likelihood of regularly scheduled services from Pacific to Atlantic.

22. Destinational shipping is anticipated to increase incrementally in the Canadian Arctic.

23. Community growth will drive a steady increase in the demand for seasonal re-supply activity; yet, the primary areas of increased activity will be resource driven.

24. The risks presented by shipping activity in the Canadian Arctic are manageable so long as there is effective oversight, support and high level of owner/operator competency.

25. Canada has a solid regulatory system that should be updated and harmonized with the world regime and consistent with international law in order to provide effective monitoring and oversight of shipping activities that maximize the benefits that shipping can bring while minimizing any negative environmental, safety, security, social or economic consequences resulting.

26. Key to achieving sustainable shipping in the Canadian Arctic are the following:
    a. An appropriate policy and administration framework, supported by effective regulatory and enforcement capabilities sufficient to ensure a high degree of compliance consistent with international law; together with
    b. Appropriate investments in support equipment and infrastructure, particularly communication, hydrography and SAR capabilities.

Regional Futures to 2020 / ARCOP and Northwest Russia: Findings (EU project findings – not to be negotiated by AMSA)

27. The marine transportation of oil from the Pechora Sea to Europe was considered to be both technically and economically feasible.

28. Russian rules and requirements are mostly consistent with international law and requirements (UNCLOS, IMO, IACS). However, the Russian Maritime Register is developing its Arctic rules beyond those developed by IACS. Russia's Northern Sea Route (NSR) regulations have features that go beyond international practice (for example, inspections and ice pilots).

29. The Russian fee system for the NSR is continuously developing and is not as transparent as the system used in the Baltic Sea. The level of NSR fees was also considered to be high.

30. There have been some negative experiences among the local people from past oil developments. These experiences relate to both environmental impacts and land use.

31. The benefits of increased industrial activity are understood by the local populations.

32. There is concern that the traditional way of Arctic living is lost forever, while the ongoing oil developments are only temporary (40-50 years).

33. The major increase in marine traffic in the region will be the shipping of oil and gas. The volumes will be 40-120 million tons per year in 2020. The volume will be dependent on decisions for the construction of major pipelines (such as the ESPO, the East Siberia Pacific Ocean pipeline).

34. Generally, the environmental impacts from shipping in the region are considered low. The probability for major accidents is considered to be low even with the increased traffic volumes; however, the consequences of a major accident would be serious due to the lack of overall response capabilities.

35. There are several, key infrastructure challenges for the ARCOP region: the ice information services require support; there is no proper vessel traffic management information system (VTMIS) in the region; adequate hydrographic services may become an issue; and the icebreaker services may not be able to handle the increasing marine traffic in the future.

36. The lack of adequate search and rescue (SAR) capability is an issue. A regional agreement between Norway and Russia on SAR has improved the situation in the Barents Sea area.

37. New Arctic marine technologies can help solve several of the problems related to transportation economics. With proper technology, marine transportation costs in the region will be lower than those of pipeline transportation of oil and gas.

7. Human Dimensions: Findings

1. Marine shipping is one of many factors affecting Arctic communities, directly and indirectly. The variety of shipping activities and the range of social, cultural and economic conditions in Arctic communities mean that shipping can have many effects, both positive and negative.

2. While economic effects of marine shipping may be positive, there are many concerns expressed by Arctic coastal communities about social, cultural and environmental effects.

3. There is insufficient information to identify with any precision the likely effects of marine shipping for most Arctic coastal communities. No current database exists for indigenous use in local Arctic waterways that could be used to develop multiple use management measures and potential mitigation strategies.

4. The costs and benefits from marine shipping will be unevenly distributed among and within communities and regions.

5. Constructive engagement of local residents at the earliest time in a planned Arctic marine development project can help reduce negative impacts, assist in a smooth interaction and increase positive benefits from marine shipping.

6. The marine environment and marine resources have long sustained Arctic communities. Thus, Arctic settlement patterns demonstrate a strong marine influence. Local Arctic residents today depend heavily on marine resources for subsistence and the local economy. A combination of over-the-ice travel (i.e., using ice as a platform and means of travel for hunting and fishing) and boat transport (i.e., for fishing, hunting and travel) allows the use of large Arctic marine areas during much of the year. Life in the Arctic is dependent on movement and sea ice is integral to this movement in the high Arctic. Remote indigenous coastal communities are especially vulnerable to marine accidents as they risk losing not only their vital marine resources, but the natural foundation of their cultures and way of life.

7. AMSA town hall meetings revealed that Arctic residents think about shipping, not by itself, but in a broader context of economic, environmental, political and social change. Shipping did not appear to be a cause of great hope or fear; rather, as an additional factor that would influence the future of Arctic communities in various ways.

8. AMSA town hall meetings indicated that from an environmental perspective, shipping is viewed as a potential disruption to marine species. Oil spills are one of the largest concerns. Hunters are also concerned about the impacts of ships on the animals and on their hunting practices.

8. Environmental Considerations/Impacts: Findings

1. From an environmental point of view, Arctic shipping poses a threat to the region's unique ecosystems. This threat can be effectively mitigated through careful planning and effective regulation in areas of high risk.

2. Release of oil into the Arctic marine environment, either through accidental release or illegal discharge, is the most significant threat from shipping activity.

3. Ship strikes of whales and other marine mammals are of concern in areas where shipping routes coincide with seasonal migration and areas of aggregation.

4. The introduction of invasive species into the Arctic marine environment from shipping can occur and the risk may be enhanced due to changing climate, possibly making conditions more favorable to some species. The most risk exists where a transfer of organisms from ecosystems of similar latitudes and conditions can occur. Of particular future concern is the transfer of organisms across the Arctic Ocean from the North Pacific to the North Atlantic or vice versa.

5. There are certain areas in the Arctic region that are of heightened ecological significance, many of which will be at risk from current and/or increased shipping. Many of these areas are located in geographically restrictive locations or "chokepoints" where much shipping activity also occurs, such as the Bering Strait, Hudson Strait, Lancaster Sound, Pechora Sea and the Kara Port.

6. Migratory marine mammals such as bowhead, beluga, narwhal and walrus have wintering areas in the southern extent of the sea ice and spring migration routes into the Arctic through systems of leads and polynyas also used by many seabirds, ducks and other marine birds during spring migration. These migration corridors correspond broadly to the current main shipping routes and travel through geographic "chokepoints".

7. The black carbon emitted from shipping in the Arctic could have significant regional impacts due to its effects on ice melt acceleration.

8. Sound is of vital biological importance to marine mammals and anthropogenic noise produced through shipping and other vessel activity can have various adverse effects on Arctic species.

9. Subarctic seas support some of the richest fisheries in the world in the Bering Sea and the Barents Sea. These two areas are also the location of the heaviest shipping traffic now occurring in the Arctic region. An accidental spill of oil or other harmful substances in these areas could have large economic, social and environmental impacts.

10. Environmental effects on marine mammals, seabirds and fisheries from ship sourced disturbances, noise, or accidental/illegal release of oil and other harmful substances may impact culturally and economically significant subsistence harvests of these animals.

11. The most immediate impacts of climate change in the Arctic will be the reduction of summer sea ice, longer open water seasons in the fall and the reduction of the year-round presence of multi-year ice. These changes may have far reaching implications for Arctic ecosystems and will also result in the lengthening of the current shipping season. Shipping in the future may be occurring much later into the fall and possibly earlier in the spring, thereby increasing the possibility of interaction between migrating species and ships.

9. Arctic Marine Infrastructure: Findings

1. Considering the Arctic operational environment and the lack of infrastructure, safe navigation in the Arctic is often dependent on the skills of a limited number of seasoned northern mariners. The demand for skilled mariners is increasing, the number of experienced Arctic mariners is decreasing and there are no universal or mandatory formal education, training and certification requirements in place for ice navigators or crew to prepare them for Arctic marine operations.

2. Based on the information provided, significant portions of the primary Arctic shipping routes do not have adequate hydrographic data, and therefore charts, to support safe navigation. This appears most critical in the Canadian Archipelago and the Beaufort Sea, although Russia has broadly identified a requirement for updated hydrography in its Arctic waters. In addition, expansion of the current routes is required to allow alternative courses when hazardous ice conditions are encountered, for entry to points of refuge when necessary, and to support access to natural resources.

3. Electronic Chart Display and Information Systems, especially when coupled with Digital Global Positioning System, improves navigational safety by providing precise, real-time positioning along with holistic display of navigation and environmental information critical for safe navigation in the Arctic. ECDIS may also reduce the requirements and costs associated with deploying and maintaining traditional aids to navigation systems. However, the benefits of ECDIS are wholly dependent on the availability of accurate navigational charts, which rely on comprehensive hydrographic surveys and data.

4. Arctic Maritime Traffic Awareness - There are few systems to monitor and control the movement of ships in ice-covered Arctic waters as an effective way to reduce the risk of incidents, particularly in areas deemed sensitive for environmental or cultural reasons.

5. There are serious limitations to radio and satellite communications for voice or data transmission in the Arctic because there is not complete satellite coverage of the region.

6. There is no binding requirement to implement the recently developed and adopted International Association of Classification Societies (IACS) Unified Requirements concerning *Polar Class* and the December 2002 IMO Guidelines for Ships Operating in Ice-covered waters; consequently polar vessel construction standards are unevenly applied.

7. For safe operations, ships navigating in the Arctic need the same suite of meteorological and oceanographic data, products and services as in the other oceans plus a comprehensive suite of data, products and services related to sea ice and icebergs. As the shipping season becomes extended, significant increases in resources will be needed to expand the information services accordingly.

8. Emergency Response capacity for saving lives and pollution mitigation is highly dependent upon a nation's ability to project human and physical resources over geographic distances in various seasonal and climatic circumstances. The current lack of infrastructure in all but a limited number of areas, coupled with the vastness, and harsh environment makes carrying out a response significantly more difficult in the Arctic. Without further investment and development in infrastructure, only a targeted fraction of the potential risk scenarios can be addressed.

9. The operational network of meteorological and oceanographic observations in the Arctic, essential for accurate weather and wave forecasting for safe navigation, is extremely sparse.