Opening the Arctic Seas

ENVISIONING DISASTERS AND FRAMING SOLUTIONS

Durham, New Hampshire
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Coastal Response Research Center
at the University of New Hampshire

FORWARD

The Coastal Response Research Center, a partnership between the National Oceanic and Atmospheric Administration (NOAA) Office of Response and Restoration (ORR) and the University of New Hampshire (UNH), develops new approaches to spill response and restoration through research and synthesis of information. The Center's mission requires it to serve as a hub for research, development, and technology transfer to the oil spill community. To better guide future efforts, the Center, in cooperation with the U.S. Coast Guard Office of Spill Planning and Preparedness and the U.S. Arctic Research Commission, hosted a workshop to identify key strategies, action items, and research needs for preparedness and response to potential Arctic marine incidents. The March 2008 workshop, entitled "Opening the Arctic Seas: Envisioning Disasters and Framing Solutions," was held at the University of New Hampshire in Durham, NH. This report provides a qualitative analysis of risk factors for five potential marine incidents likely to happen as shipping, tourism, exploration and development of natural resources (e.g., oil, gas, minerals) occur with the retreating Arctic ice cover. Workshop participants represented a broad spectrum of constituencies and expertise including governmental agencies, industry, non-governmental organizations and indigenous people from the Arctic nations. Incidents envisioned involved shipping (i.e., vessels caught in ice, collisions), oil spills, search and rescue, environmental damage, and disruption of indigenous communities. Research priorities were identified by workshop participants to address gaps in preparedness and response for these types of incidents. The report is designed to serve as a resource for funding entities and a tool to inform the Arctic nations and the Arctic Council about how to proceed to avoid the disasters that could result from our current state of unpreparedness.

We hope you learn from reading the report and exploring the topics. If you have any comments about it, please contact the Center. We look forward to many more similar endeavors during the coming years where we can be of service to the Arctic nations, and response community, and help protect the unique Arctic ecosystem.

Sincerely,

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I. INTRODUCTION

Sea ice coverage in the Arctic reached record lows during the summers of 2006 and 2007. In March of 2006, Arctic ice covered 14.5 million km^2, followed by a near-record low of 14.7 million km^2 in March 2007 (NSIDC, 2008). Arctic sea ice dropped to 4.28 million km^2 in September 2007, representing the lowest September extent on record and a 39% reduction from the 1979-2000 mean value. The September decline also reflected a 10% per decade decrease and equated to a 72,000 km^2 per year reduction in ice coverage (NSIDC, 2008). While some inter-annual variability exists in seasonal sea ice coverage, the overall trend is decidedly downward. Thickness measurements collected by submarines from 1956-1978 and 1990-2000 support areal trends indicating an overall 40% decrease in Arctic sea ice from an average thickness of 3.1 m to 1.8 m (UNEP, 2007). Recent modeling by the United States National Snow and Ice Data Center (NSIDC) has suggested that the Arctic will be consistently ice-free during the summer as soon as 2030.

The decline of Arctic sea ice has resulted in increased activities such as oil and gas exploration, mineral speculation and exploration, northern moving fisheries, and tourism in sub-Arctic and Arctic waters. Some of these previously un-navigable waters are becoming more available to vessel traffic. In 2005, the Arctic Climate Impact Assessment (ACIA) reported that reduced sea ice will most likely lengthen the shipping season, shorten routes, and allow for more economical offshore oil development (Weller, 2005; Symon et al., 2005). In July 2008, the United States Geological Service (USGS) estimated that the Arctic contains 90 billion barrels of oil and more than 17,000 trillion cubic feet of natural gas (USGS, 2008). With worldwide demand for energy resources growing rapidly, increased open water access, and major prospects for natural resources, shipping and offshore activities in the Arctic are increasing

To date, spills in the Arctic or sub-Arctic have been infrequent. The 1989 T/V EXXON VALDEZ spill of 262,000 bbls (990 m^3) was the largest marine spill in the vicinity of the Arctic thus far (AMAP, 2008). Smaller, yet significant, spills in terms of response cost and environmental impacts, have occurred in the active maritime region of the Bering Sea.

The U.S. National Academy of Sciences Transportation Research Board (NAS, TRB) Special Report 293 on <u>Risk of Vessel Accidents and Spills in the Aleutian Islands: Designing a Comprehensive Risk Assessment</u>, 2008, states that:

> "Historical data on accidents and spills near the Aleutian Islands show that fishing vessels account for the majority of the accidents, most of these resulting in small spills, while the large commercial fleet has experienced only a few major accidents but with much larger spill volumes. Over the past 20 years, about 20 fishing vessel accidents with spills in excess of 1,000 gallons were recorded while just 2 commercial

> cargo vessel accidents (the M/V Selendang Ayu in 2004 and the M/V Kuroshima in 1997) spilled 336,000 and 40,000 gallons, respectively. The past 20 years of data on response to spills in the Aleutians has also shown that almost no oil has been recovered during events where attempts have been made by the responsible parties or government agencies, and that in many cases, weather and other conditions have prevented any response at all." (NAS, TRB 2008).

The Aleutian Islands spill history can be a guide into what Arctic nations and indigenous communities may be facing as a result of the increasing navigable waters in the Arctic. To date, there have been several forums examining the risk of spills and other incidents in cold-water and Arctic regions as we realize that greater activity and vessel traffic increases the risk for incidents to occur in locations that thwart response and rescue operations. Ships operating in the Arctic environment must contend with difficult weather and variable ice conditions requiring ice-hardened hulls and improved navigational aids. Ships are coated with ice that can alter their stability, and difficulties arise from navigating through ice and broken-ice, and poor navigational aids and charts. All of these factors increase the likelihood a marine incident will cause an oil spill, search and rescue effort, and/or mass rescue, with insufficient resources and communications.

The Arctic Marine Shipping Assessment (AMSA), of which this workshop is an important and influential contribution, is an ongoing project of the Arctic Council. Guided by the Council's working group Protection of the Arctic Marine Environment (PAME), AMSA is led by Arctic marine experts from Canada, Finland, and the United States. The remaining Arctic states, Denmark (Greenland & the Faroe Islands), Iceland, Norway, Russia, and Sweden, have significant, national maritime interests. AMSA has conducted an historic survey of Arctic marine activity for 2004 and has researched such topics as: Arctic marine transport history, indigenous marine use, shipping governance, environmental impacts, future scenarios of Arctic marine use, and Arctic marine infrastructure. AMSA is inclusive, circumpolar in focus, and has collaborated with a wide range of stakeholders and relevant marine organizations. The indigenous Arctic groups have a prominent role in AMSA and town hall style meetings have been held in select Arctic communities to reach out to individual marine users and community leaders and elders. Three pillars or objectives provide a framework for the work of AMSA: enhancing Arctic marine safety, protecting Arctic people and the environment, and building the Arctic marine infrastructure. AMSA will produce a set of findings and recommendations for the Arctic Council to negotiate and to communicate to the world for protecting Arctic residents and the Arctic marine environment from increasing marine operations. AMSA is due to be released at the April 2009 Arctic Council Ministerial Meeting in Tromso, Norway.

The U.S. Coast Guard (USCG) recognizes that the Arctic is a dynamic environment that is quickly being transformed by climate change. As sea ice melts, marine waters are becoming more navigable allowing the Arctic to be exploited in ways not previously possible, including fishing, mineral exploration, shipping, and tourism. With these changes, the USCG will have responsibility for not only Search and Rescue

(SAR) and environmental response, but also protecting the interests and property of the United States in the region. The USCG is actively increasing its presence in the Arctic and is developing plans for new icebreakers, as well as working to gain a clearer understanding of the potential incidents that could occur and their impact on the Arctic region. This workshop was a step in the USCG's efforts to redefine its role in the Arctic.

Melting sea ice and the development of the infrastructure required to support Arctic operations has the potential to disrupt coastal communities, sites of cultural significance, and areas of ecological importance. As the future of the Arctic is contemplated, it is important to recognize that decisions made today involving shipping routes, mineral extraction, search and rescue, and environmental response have the potential to affect not only current inhabitants of the region, but also will severely impact future generations. The Arctic region contains some of the last undisturbed environment in the world, and it should remain a priority to ensure that changes in the Arctic resulting from increased development do not negatively impact it.

Since 2005, the Coastal Response Research Center (CRRC), a partnership between the University of New Hampshire (UNH) and the National Oceanic Atmospheric Administration (NOAA) Office of Response and Restoration (ORR), has been investing in research on spill response techniques and know-how in cold-water environments. CRRC is a collaborating partner with the Joint Industry Project (JIP) on Oil-in-Ice coordinated by SINTEF (Trondheim, Norway). The project includes oil companies, academic institutions, non-governmental organizations (NGOs) and government agencies from five countries. The JIP is validating chemical and physical behavior of oils and response techniques (mechanical, *in situ* burning and dispersant use), and developing best practices for spill contingency plans for a variety of sea ice conditions. CRRC's contribution to the project examines the potential for exposure to biological resources associated with first year sea ice. The Arctic food web is dependent on primary and secondary producers using the underside and brine channel networks of sea ice to support the upper trophic levels (e.g., pelagic fish, marine mammals, sea birds). Thus, understanding how oil interacts with sea ice is imperative to predict how oil will be transported and degraded through these highly dynamic and critical systems.

In order to collectively start addressing this growing risk of plausible incidents in the Arctic region, the CRRC worked with the U.S. Arctic Research Commission (USARC) and the USCG to host a workshop entitled <u>Opening the Arctic Seas: Envisioning Disasters and Framing Solutions</u>. The purposes of this workshop were to identify current international incident response capabilities, assess future needs, and identify research gaps and action items to improve the ability of Arctic nations and indigenous communities to prepare for and respond to marine incidents.

II. WORKSHOP ORGANIZATION AND STRUCTURE

The workshop agenda (Appendix A), participants (Appendix B), and incident scenarios (Appendix C) were identified and developed by a high level, international Organizing Committee. The committee represented four countries, contained experts from the oil industry and government agencies connected to the response issues facing the Arctic. The Organizing Committee identified participants from indigenous peoples; NGOs; oil, shipping and tourism industries, response organizations, and governmental entities involved in cold water response mandates and capabilities (Appendix B).

The workshop was organized around five plausible maritime scenarios to focus the participants. The scenarios were developed based on collective expertise from the Organizing Committee and its contacts in the field. Scenarios were designed to exercise spill response; search and rescue; fire fighting and salvage; communications; and governance and legal issues. Scenarios were based on existing and predicted activities, and bore some resemblance to some incidents that have already occurred (e.g., Antarctic grounding and sinking of the M/V EXPLORER in 2007) and in locations where response entities might expect one.

The scenarios were:

- A cruise ship that runs aground while exiting a fjord on the west coast of Greenland (Figure 1) in mid-September. Progressive flooding makes the vessel unstable and all 1400 passengers must abandon ship.

- A bulk ore carrier that becomes trapped in the ice while attempting a late season crossing of the Arctic en route to the Bering Sea (Figure 2). Ice damages the vessel’s rudder and propeller, making it unable to maneuver. Although initially undamaged, the vessel’s substandard structure and hull put it at elevated risk for damage if forced to winter over.

- Numerous vessels (a drill ship, two oil spill response vessels, and one ice management vessel) are in the vicinity of an exploratory drilling operation 20 miles offshore in a disputed area along the U.S. – Canada border (Figure 3) in 50 m of water. An engine room fire on the ice management vessel causes the operator to lose control and collide with the drill ship, rupturing its ballast tank. In order to maintain stability, the drill ship operator empties fuel wing tanks containing Arctic grade diesel fuel, causing the release of 700 bbls of fuel. The fire on the ice management vessel results in an additional 300 bbls of diesel spilled and several crew member injuries. Crew members on both vessels involved in the collision also suffer from impact injuries.

- An oil tanker maneuvers unsuccessfully in near-zero visibility and collides with a fishing vessel in a region of the Barents Sea disputed by Russia and Norway (Figure 4). The tanker releases 25,000 bbls of crude oil over 48 hours and must be towed to a port of refuge to avoid potentially spilling its remaining oil cargo. The fishing vessel sinks, making salvage impractical.

- A tug loses power while towing a barge laden with mining explosives and other containerized cargo destined for some Arctic communities. Pushed by the storm surge from a low pressure system, the tug and barge ground on the St. Lawrence Island (Figure 5), a critical habitat for threatened and endangered species, and a haul out area for Pacific walrus. Following the grounding, the towline snaps and the tug and barge become separated by several miles. The vessels are located off the islands north shore. The barge hits a rock and begins to take on water and the tug ruptures a fuel tank. Some containers fall into the water and sink, some remain on or near the barge, while others wash up on the beach. This incident occurs in May under broken ice conditions.

The workshop participants were divided into five groups and each group worked on the same scenario over the course of 2.5 days. Each group answered the same four questions:

1) If this incident happened today, how would we respond?
2) How would we prefer to respond?
3) What are the gaps and needs that exist today that prevent us from responding in the preferred manner?
4) What do we need to do to address those needs and fill the gaps?

After each breakout session, the groups reported their answers to all participants and discussion ensued. The results of the groups efforts included detailed recommendations on how to collectively improve the response to incidents in the Arctic.

Several plenary session presentations were made throughout the workshop on relevant topics. The slides for each are located in Appendix D.

- Arctic Shipping – Lawson Brigham
- Arctic Peoples – Gun-Britt Retter and Charles Johnson
- Search and Rescue in the Arctic – Larry Trigatti
- Arctic Tourism – John Snyder
- Biological Consequences or Implications – Jeep Rice
- Arctic Oil and Gas Exploration – Dennis Thurston

This report contains a summary of the discussion for each scenario including: details of the scenarios, expertise in the group, assumptions made regarding the incident, the 2008 response, gaps/problems identified in response to the incident, and recommendations for enhancing the response to the incident. The final section of the report contains key overarching workshop findings and recommendations.

III. <u>Cruise Ship Grounding on the Greenland Coast</u>

A. Scenario

The M/V A, with 1400 passengers on board, runs aground while exiting a fjord on the west coast of Greenland (Figure 1) in mid September. Progressive flooding makes the ship unstable, and all must abandon ship. Some passengers and crew were injured in the grounding, requiring special medical attention. Medical concerns for some passengers, approaching darkness, and less than ideal weather outlook require this be treated as an urgent search and rescue (SAR) case. The response will consider the possibility that other cruise ships may be in a position to assist within certain timeframes. It is likely that other such vessels would be available within 24 hours or less, but poor weather might reduce their ability to respond. The vessel has greater than 25,000 bbls of intermediate fuel oil on board, as well as smaller amounts of lube oil, diesel fuel, and various hazardous materials associated with refrigeration, dry cleaning, and other ship services. The initial discharge may be relatively minor, but if the ship is not stabilized within 48 hours, heavy seas may destroy the vessel. The ship is operated by a major cruise line, but under the flag of convenience.

B. Expertise in Cruise Ship Grounding Breakout Group

- John Falkingham; Canadian Ice Service
- Lawson Brigham; US Arctic Research Commission
- Trygve Ertmann; Royal Danish Navy
- Jens Peter Holst-Andersen; Royal Danish Navy
- Nancy Kinner; Coastal Response Research Center
- John Snyder; Strategic Studies, Inc.
- Robert Parsons, Parsons Associates International

C. Assumptions Regarding Cruise Ship Incident

The group assumed that because the major cruise line operates under a flag of convenience, it is difficult to locate and enforce environmental response standards with respect to the responsible party (RP). The ship was assumed to have a crew of approximately 700 and a limited medical staff. Input from group members familiar with the Arctic cruise industry noted that it is likely that most of the cruise ship passengers are between the ages of 50 and 80, some with limited mobility, including a number of wheelchair-bound individuals. The incident is assumed to occur in a portion of Disko Bay that is 50 miles away from the nearest town of Ilulissat (Figure 1), and that likely passenger injuries include broken bones, strains, shock and trauma. With the on-scene weather and water temperatures, passengers would likely have a 4.3 hour functional time, which represents the time at which a person becomes incapacitated due to cold. There is a 67% percent chance of survival within this functional time. The group assumed that although some people fall into the water during the evacuation, none are lost, and therefore the response consists of rescue operations only, with no search component. It is possible that other cruise ships are in a position to assist within 24 hours, however, poor weather could reduce their ability to respond.

The incident occurs in an area that has been designated as a Convention on Wetlands of International Importance, and a World Heritage site due to the unusually fast ice stream and glacier calving rates.

D. 2008 Response to Cruise Ship Grounding

Jurisdiction for the SAR associated with the cruise ship grounding lies with Denmark and Greenland, with a Danish Naval vessel assuming the role of on-scene command upon arrival, and the Danish Maritime Rescue Coordination Center (MRCC) coordinating international involvement. While a clear SAR chain of command exists through international agreements, this incident is likely to overwhelm local resources and thus is likely to be deemed a mass rescue operation (MRO). The pollution response proceeds after victim rescue, and would likely not commence until 48 hours after the incident. The degree of environmental harm will depend primarily on measures enacted to secure the source of spilling oil by the cruise ship salvage and recovery team, and containment and removal of released oil before it impacts sensitive shorelines. If oil is spilled, a best case scenario involves containment within 48 – 72 hours. SAR response is funded by SAR providers (Arctic governments). The SAR system maintains financial responsibility for passengers until they reach the nearby village of Nuuk (Figure 1). Environmental cleanup is provided by a cruise ship indemnity insurance company (P&I club), while the ship owners have financial responsibility for vessel salvage.

The cruise ship has approximately 15 self-propelled, rigid hull lifeboats and 10 life rafts with no propulsion. The boats contain global positioning system (GPS) navigation systems, very high frequency (VHF) communication capability, as well as at least one crew member per boat. The boats must meet minimum Safety of Life at Sea (SOLAS) standards. Royal Danish Navy vessels can respond from the east coast of Denmark, and although they have SAR and communications capabilities, they cannot take on passengers. The first vessel is likely to arrive within 12 hours of the incident, and the second vessel can arrive within 24 hours. The response from Greenland is quicker, with a 25 m police cutter with a 2 hour response time from the city of Ilulissat (Figure 1). However, as with the Danish vessels, they have communication and SAR capability, but cannot take on passengers. It is estimated that a second cruise ship capable of taking on passengers could arrive on scene within 24 hours, and fishing vessels in the area could respond within 2 to 3 hours. Pollution response and salvage can be provided by a U.S. Coast Guard (USCG) Strike Team, however, response time is typically 2-3 days. Salvage vessels are available from Halifax, NS or Iceland with a transit time of approximately 7 days.

There are numerous logistical challenges in this response. Due to the freezing weather and minimal protection offered on life boats, responders must attempt to rescue people from the boats and rafts as soon as reasonably possible. The first responders to arrive on scene will be local and therefore they will probably all speak Greenlandic. The magnitude of this response requires an international effort from all Arctic and nearby nations, including the United States, Canada, Iceland, England, Norway, and Denmark.

E. Gaps/Problems Identified in Response to an Arctic Cruise Ship Grounding

The group identified several gaps/problems in the current state of response and recovery. Cruise ships have a minimal capacity for self rescue, and due to their lack of propulsion, current life rafts could not reasonably transit the 50 miles from the incident location to Ilulissat. The passengers are also likely to be ill-prepared for the weather, which decreases their likelihood of survival, if they are not rescued quickly. Vessels may elect to follow International Maritime Organization (IMO) guidelines on a voluntary basis. Therefore, capability for self rescue will vary with the degree of adherence.

The group identified several jurisdictional problems, including the fact that although bilateral SAR agreements exist to govern responsibility for response between two adjacent nations, no agreements are currently in place to address response procedures for incidents involving multiple Arctic nations. With no agreements in place, governmental clearance may be required for some SAR operations, which could potentially slow the response. In addition, response operations could also be hampered by dated and incomplete navigational charts for the region.

SAR costs are likely to be significant. Furthermore, Arctic nations need to expend considerable funds developing the infrastructure necessary to support increasing cruise ship traffic in the region. While cruise ships use and benefit from this infrastructure, they have no financial role in its construction and maintenance. Since first responder vessels do not have the capacity to take on a large number of passengers, the only “viable” rescue vessel is a second cruise ship. A 24-hour response time for the ship is unacceptably long in this situation. Further, cruise ship crews receive minimal training for the emergency response in polar conditions.

A number of logistical challenges were identified. Ilulissat has very few hotels, and if another cruise ship cannot respond within a reasonable time frame, the food and housing needs of the rescued will quickly overwhelm such a small town. The ship and town do not have sufficient medical personnel to respond to an incident of this magnitude. As the response progresses and more international SAR resources arrive, language barriers between responders from different countries have the potential to result in an uncoordinated and inefficient response. The response will also potentially be vulnerable to political influence, as the home countries of the passengers with a vested interest in these efforts may attempt to exert control over aspects of victim/survivor management. There will also be great interest from the media and environmental organizations, which may hinder responders.

F. Recommendations for Enhancing Response to Cruise Ship Incidents in the Arctic

The group developed 17 recommendations to enhance response, recovery and restoration for this type of incident.

- **Develop preventative legislation for safe operations in the Arctic**. The legislation would revise the Polar code for ship operations above 60º N, and include the development of an agency similar to International Association of Antarctic Tour Operators (IAATO) to manage ship itineraries and maintain real-time cruise ship locations. This legislation would also strengthen and support the Association of Arctic Cruise Expedition Operators (AECO) guidelines, and implement regulations for lifeboats and rafts in the Arctic. Survival craft should meet specifications for acceptable transit distances and have equipment for ample security. Special standards should be implemented for vessels transiting through the Arctic including specifications for cold weather gear.

- **Designate potential ports of refuge and develop guidelines for cruise ships in the Arctic to use them.**

- **Adopt an Arctic regional SAR agreement that encompasses all Arctic nations to better manage incidents requiring a international response.** The agreement should be designed to avoid delaying response for government clearance. This agreement should encourage transparency and information sharing between cruise ship lines regarding operations in the Arctic.

- **Perform regular drills and exercises to ensure readiness and compliance with regional SAR agreements.**

- **Establish vessel exclusion zones within three miles of the coastline to prevent sub-standard ships from operating inside these zones**. As an additional benefit, this provision may prompt insurance companies and ship classification societies to enforce compliance with safety regulations.

- **Employ standard environmental cleanup measures.** Oil spill countermeasures should be deployed to reduce the impact of oil on sensitive shorelines as soon as possible, and pumps should be airlifted to the site in order to remove fuel from ruptured tanks.

- **Improve and update navigational charts for the Arctic region including cruise ship destinations.**

- **Determine recovery and restoration possibilities with a post-incident assessment.**

- **Develop a quasi-tariff for Arctic operations.** This will provide a mechanism for the cruise ship industry to contribute financially to aid Arctic nations with SAR costs.

- **<u>Encourage cruise ships operating in the Arctic to develop a protocol for mutual aid.</u>** The ships should carry extra immersion suits and other cold weather equipment to use when responding to an emergency on another vessel.

- **<u>Improve/use resources for air support.</u>** Supplies can be strategically located in the Arctic and sub-Arctic to facilitate air drops for quicker access and response times.

- **<u>Develop salvage plans that can be implemented if dedicated salvage vessels are not available.</u>** Icebreakers should be considered for performing a salvage tow.

- **<u>Improve first responder training among ships' crews</u>**.

- **<u>Increase availability of emergency supplies by immediately loading and deploying aircraft from Denmark and Canada with food and water</u>**. Local Arctic response agencies and governments should increase stockpiles of emergency response equipment for SAR and spill response in the Arctic.

- **<u>Plan for language issues during an international response.</u>** Responders should have translation services available, and fully use bilingual individuals within organizations for international incidents.

- **<u>Conduct a workshop on Arctic SAR.</u>** The Arctic Council and the international cruise industry could partner to host this initial dialogue.

<u>IV. Bulk Ore Carrier Trapped in Ice in the Bering Sea</u>

A. Scenario

The Bulk Ore Carrier B becomes trapped in the ice while attempting a late season (November/December) crossing of the Arctic en route to the Bering Sea (Figure 2). Ice damages the rudder and propeller shaft, making it unable to maneuver. The vessel's hull is initially undamaged, but at risk (vessel is sub-standard with questionable integrity even in the best of conditions) if forced to winter over. It carries copper ore, approximately 12,500 bbls of heavy fuel oil, and 25 crew members. The vessel is on the high seas at the time of the incident, and the response has a brief (~1 week) window where rescue/break out by an ice breaker is possible.

B. Expertise in Bulk Ore Carrier Trapped in Ice Breakout Group

- Pablo Clemente-Colón; NOAA, National Ice Center
- Tom Laughlin; NOAA, Office of International Affairs
- David Edwards; U.S. Coast Guard, Search & Rescue
- Matthew Druckenmiller; University of Alaska Fairbanks
- Dave Kirby; Task Force Northern Area HQ, DND Navy
- David Main; SMIT Salvage

- Ross MacDonald; Transport Canada
- Anita Mäkinen; World Wildlife Fund, Finland

C. Assumptions Regarding Bulk Ore Carrier Trapped in Ice Incident

This group assumed there were two likely outcomes for this scenario: The carrier drifts until sea ice breached its hull resulting in a catastrophic failure, a hazardous materials spill, and ultimately, the sinking of the vessel, or, an icebreaker extracts the vessel before it suffered damage. The group assumed the ship operates under a flag of convenience, which makes it difficult to locate and enforce environmental response standards on the RP. The group assumed the incident occurs on the high seas, which raises questions about which Arctic nation has the authority to coordinate rescue and response operations and direct vessel actions.

D. 2008 Response to Bulk Ore Carrier Trapped in Ice Incident

Because this incident occurs on the high seas and is not near any land mass, cargo or hazardous waste releases will likely disturb benthic and pelagic species. Actual harm will depend on the organisms present at the time of the incident.

The IMO guidelines for ships operating in Arctic ice covered waters apply to the ore carrier's transit in this scenario. Russia, Canada and the U.S. have a memorandum of understanding (MOU) that details the sharing of responsibility for SAR. This multilateral agreement informs the response in this scenario. Depending on the exact location, bilateral agreements exist between Russia and the U.S. that cover the Bering and Chukchi Seas. The U.S. and Canada Joint Marine Pollution Contingency Plan may apply. Government agencies, who hear the distress call, will initiate a SAR response based on pre-established SAR zones. In international waters, salvaging the cargo and recovery of the ship is the responsibility of the owners, and therefore, usually falls to the vessel's insurance company. The 25 member ship's crew will remain with the vessel while it is afloat. If the vessel sinks, the crew will attempt to evacuate to the surrounding ice. The first response priority is to rescue the crew (ideally within one week), while the second priority is environmental response. Fuel does not evaporate at the low temperatures found in the Arctic, therefore, it will remain on the ice, entrained within it, and/or trapped under it. Copper ore is a dense solid and will sink, if released. The group expects minimal environmental harm will occur. Salvaging the cargo and ship becomes the responsibility of the vessel's insurance company. The company will most likely want to salvage the ship due to the value of the copper ore (approximately $250 million USD in March 2008)

SAR assets exist in numerous Arctic nations. Russian helicopters could attempt to rescue the ship's crew or drop survival equipment, however, availability of other aircraft resources in Russia is not clear. U.S. icebreakers could respond, and helicopters stationed on the icebreakers may extend their range and shorten the initial response time. Long-range aircraft (C-130s) could arrive on scene within 24 hours with Kodiak, Fairbanks, or

Barrow, AK serving as equipment staging areas. There are presently minimal, if any, resources for pollution response in the area. No commercial salvage providers currently exist in the Arctic, however, icebreakers could conduct basic salvage operations (e.g., towing).

Local towns may have sufficient capacity to respond to the incident, but this may not be true in certain locations. Even if they have the capacity, local resources are likely to be overwhelmed quickly. The nationalities of the crew and their families may play a role, and public concerns will grow if contamination from the spill approaches a coast.

E. Gaps/Problems Identified in Response to a Bulk Ore Carrier Trapped in Ice Incident

The group identified potential environmental problems from this incident including habitat destruction due to a fuel spill. It is probable that any oil released will be transported under the ice, and if that occurs, responders have little ability to track it. As a result, the true environmental impact may not be known for several months. Scientists have not studied the synergistic effects of oil and copper, and the potential impacts they will have upon the environment.

There is currently no established place of refuge in the region of this incident that would accept a damaged ship, greatly hampering potential salvage efforts. While multi lateral agreements exist for SAR, no such agreements exist for environmental response. Coordination of response, recovery, and restoration requires the consent of multiple entities and could delay critical decisions.

Environmental effects of this incident depend on many factors including: The fate if the oil (i.e., whether it becomes entrained in the ice), the stability and integrity of the ship's hull, the presence of ice, the weather, and the success of towing the vessel. There is the potential for the fuel to contaminate sea ice for an extended period of time, and drifting ice could greatly increase the geographic area affected by the incident.

Gaps in the response would result from the remoteness of the incident. Timely rescue hinges on the use of long range helicopters. However, few such helicopters operate in this region. Fueling aircraft involved in the response could prove difficult. The exclusive use of local supplies could stress affected Arctic communities. No stockpiles of supplies of response equipment exist in this region; response assets are located far away, making response time much slower than at lower latitudes. Crewmembers may also not have the proper survival gear onboard, decreasing their chances of survival. A nuclear icebreaker would make the ideal platform to house, feed and provide medical care for survivors, but a suitable vessel may not be available.

Several communication gaps exist. High frequency (HF) radio may not transmit from the high Arctic to the U.S. and Canada, and responders may not have reliable internet access. Language barriers between the responders and survivors will complicate the response.

The ore carrier will be a liability to the waters of whichever nation it enters. As a result, there could be a political reluctance to set a precedent by allowing a damaged vessel into port.

F. Recommendations for Enhancing Response to Bulk Ore Carrier Incidents in the Arctic

The group developed 23 recommendations to mitigate the gaps/problems that were identified for this type of incident.

- **Study potential pollution impacts for this type of incident to develop a better understanding of its effects on the Arctic**.

- **Consider designating vulnerable areas as Particularly Sensitive Sea Areas (PSSAs).** PSSAs require special protection through the IMO because of their recognized ecological, socio-economic, and scientific significance. Designation as a PSSA offers protection by restricting ship traffic in the area. Special attention should be given to the Bering Sea due to its environmental sensitivity and its characteristic as a "choke point" for Arctic ship traffic (Figure 2).

- **Amend IMO guidelines to move them to codes or conventions.** The guidelines should include environmental response and route planning for environmental safety and protection of the Arctic as a function of environmental conditions, ship type, cargo, and habitat.

- **Strengthen multi-lateral agreements to include specific information on the location and quantities of resources/assets available for response.** Agreements should include provisions for environmental response, and require regular exercises of the agreements to ensure preparedness.

- **Increase ship reporting requirements so that classification societies have an accessible database that provides information about ship construction, size of tanks, onboard helipads, and other critical characteristics to facilitate response.** This information should be required as a condition for vessel entry into the Arctic.

- **Designate potential ports of refuge**. Arctic ports should be ranked and identified based on seasonal environmental conditions. Should be done in conjunction with local governments and communities.

- **Create an integrated response management center among the Arctic nations to coordinate emergency response and facilitate rapid decision making on response issues.**

- **Study and implement alternative response options.** This should include *in situ* burning and efficient technologies for SAR, oil spill prevention, and response.

- **Improve weather data quality and availability to Arctic mariners and emergency responders.**

- **Publicize insurance limitations for Arctic operations**. Responders should be made aware of insurance limits for environmental cleanup. Consideration should be given to increasing insurance liabilities for ships transiting the Arctic.

- **Communicate the challenges of Arctic marine navigation to the shipping community.** Relevant countries and the international shipping community (i.e., owners, unions, insurers, pilots) should be made aware of the unique risks of Arctic marine navigation.

- **Require appropriate survival equipment on all vessels transiting the Arctic**.

- **Improve knowledge and tracking of assets.** A circum-Arctic database of assets and infrastructure should be developed and maintained, and improvements should be made to existing Automatic Identification System (AIS) and shipping traffic monitoring capabilities.

- **Strategically locate response bases.** Develop response bases for SAR and environmental response with sufficient staff and survival equipment based on risk.

- **Increase stockpiles of emergency supplies within a readily accessible distance of the high Arctic.**

- **Improve long range helicopter availability by stationing them near the high Arctic.**

- **Incorporate specialized personnel (e.g., naval architects, salvage masters) into efforts to provide technical assistance.**

- **Designate and enforce crew training standards for cold weather emergency response.**

- **Designate a fully fueled, language compatible icebreaker to be on call for emergency response in the high Arctic.**

- **Expand communication networks for SAR, environmental response, and weather information and require satellite phones on all Polar ships.**

- **Plan appropriately for language issues during international response and ensure responders have access to translators.**

V. Drill Ship Incident

A. Scenario

A drill ship and three support vessels (two oil spill response and one ice management) are involved in drilling an exploratory well 20 miles offshore and in 50 meters of water on the U.S.-Canada border (Figure 3). A fire in the engine room of the ice management support vessel leads the loss of control and causes it to ram the drill ship, rupturing the drill ships ballast tank. In an effort to right the drill ship, the operator vacates fuel wing tanks containing Arctic grade diesel fuel resulting in a spill of 700 bbls (83 m^3). The support vessel fire results in injuries as does the collision, with an additional 300 bbls (40 m^3) of diesel spilled. The incident occurs during mid-May under broken ice conditions.

B. Expertise in Drill Ship Breakout Group

- Bruce Hollebone, Environment Canada
- Doug Bancroft, Canadian Ice Service
- Pamela Bergmann, U.S. Department of the Interior Office of Environmental Policy & Compliance
- Victoria Broje, Shell Global Solutions
- Charles Johnson, Alaska Nanuuq Commission
- Dennis Thurston, U.S. Minerals Management Service
- Larry Trigatti, Canadian Coast Guard, Dept of Fisheries and Oceans Canada
- David Westerholm, NOAA, Office of Response and Restoration
- Malcolm Williams, U.S. Coast Guard Academy, Office of Strategic Analysis

C. Assumptions Regarding Drill Ship Incident

The group did not formulate any assumptions for this incident.

D. 2008 Response to Drill Ship Incident

The group concluded that marine mammals, migratory birds and benthic filter feeders in the area were at risk in this incident, and sensitive areas including the Ivvvavik National Park and Herschel Island, in Canada's Yukon Territory, as well as the northern slope of the Alaska National Wildlife Refuge (ANWR) could be impacted if oil reaches their shorelines.

The group identified numerous policies/laws that apply in this incident, including IMO guidelines for ships operating in Arctic ice covered waters, U.S. laws (Oil Pollution Act of 1990, Comprehensive Environmental Response Compensation and Liability Act (CERCLA), Jones Act), U.S. plans (National Response Plan, State of Alaska Planning, Joint Unified Contingency Plan), Canadian laws (National Response Plan, Canada

Fisheries Act, Canada Shipping Act), Canadian plans (Canadian Coast Guard National Response Plan), and joint plans (Canada- U.S. Marine Spill Pollution Contingency Plan, Canada-U.S. North Plan).

While the Canadian and U.S. Coast Guards would respond to this incident, most of the initial responders would come from Anchorage or Fairbanks, AK. They would likely be on scene within a few hours. The USCG would most likely operate out of a small command post at Kaktovik, AK and a main command post in Prudhoe Bay, AK. In setting up the structure of the response, the Canadian Coast Guard uses the Response Management System (RMS), while the USCG uses the Incident Command System (ICS). The Canadian response would fall under the jurisdiction of the Canadian Joint Rescue Coordination Center (JRCC), and would coordinate SAR and pollution response in Canadian waters. Other Canadian agencies responding would likely include the Canadian Air Force, Environment Canada, and the Department of Fisheries and Oceans Canada. The U.S. response would fall under the jurisdiction of the USCG, which would coordinate SAR and pollution response in national waters. The SAR response will be funded by the responding governments (U.S., Canada), while the environmental response would be funded by the RP.

There are numerous assets and equipment available for this incident. The drill ship has an on-board helicopter that could conduct a rescue, as well as extensive medical capabilities, including at least one emergency medical technician (EMT). The Alaska Air National Guard operates rescue helicopters out of Anchorage, and hospitals in Anchorage and Fairbanks have specialized burn units that could be used. Canada has rescue helicopters located in Trenton that could be used to ferry survivors to hospitals. The oil spill response vessels have spill response equipment including booms (standard and fire retardant), bladders, sorbents, heliotorches, and dispersants. The drill ship will activate its commercial response contractors, who would bring additional equipment to the scene. Prudhoe Bay has a cache of spill response equipment, including dispersants and chemical herders.

This response would most likely continue for an extended period of time, requiring large numbers of personnel for each stage (i.e., SAR, pollution response, recovery and restoration). The U.S. and Canada may have to tap the personnel resources of other Arctic nations. Logistically, there should be adequate shelter available; the drill ship can support victim and responder needs for a short period of time, an icebreaker could provide temporary housing, and Prudhoe Bay has an adequate number of hotels and other logistical resources to support a large response.

Responders from two or more countries will be able to communicate on common marine frequencies in the Very High Frequency (VHF) and HF ranges. Politically, many leaders, including officials from the U.S. and Canadian governments, as well as leaders of affected indigenous communities, have a stake in how responding agencies manage the incident. Agencies such as the U.S. Centers for Disease Control (CDC) and Dept of Health and Human Services (DHHS), and Health Canada have mandates to communicate risk potential to the general public, and thus would likely be involved.

E. Gaps/Problems Identified in Response to the Drill Ship Incident

Wildlife response across national boundaries may prove challenging due to the level of coordination needed to effectively share resources. The group noted that a need exists for improved knowledge of cultural and historic sites in Arctic regions of the U.S. and Canada.

There are several gaps in policy and guidelines. IMO guidelines for safe operations in the Arctic do not sufficiently address marine pollution. The Jones Act, which governs operation of foreign pollution response vessels in U.S. waters, could hinder America's ability to accept cleanup assistance from other countries. It was also noted that no established potential places of refuge exist in the region that would accept a damaged ship, potentially delaying the response.

No immediate jurisdictional issues were identified, however, it was noted that if oil drifts into a disputed boundary area between Arctic nations, this could generate difficult legal questions about which nation should respond. Operationally, the U.S. and Canada's differing response management systems could hinder a joint response. Responders would have to seek special government approval to use alternative response options (e.g., dispersants, *in situ* burning). Both of these options have short windows of opportunity after which they no longer produce desired results, and a slow government response could prevent their use.

This incident occurs far from critical assets, including heavy lift helicopters, emergency salvage and towing capacity, and fixed wing oil spill detection and surveillance capability, which would likely hamper the response. The drill ship cannot support an extended response and an icebreaker will take several days to arrive on scene. Kaktovik, the closest U.S. town, has a population of approximately 300 and few resources to support responders. The closest Canadian town, Tuktoyaktuk, also has few resources. Transporting responders and equipment and setting up a command post in small towns local to the incident will be difficult and likely disrupt the communities. While Prudhoe Bay has adequate resources, it is 200 miles away, making it an unacceptable location for accommodating responders involved in daily operations. There will likely be language barriers that have the potential to complicate or delay the response. Communication deficiencies are also likely to exist due to a lack of infrastructure (e.g., satellites, on shore towers).

During the recovery and restoration phase, problems with the Natural Resources Damage Assessment (NRDA) process often include a lack of timely assessments and a failure to incorporate the viewpoints of indigenous people. This is especially problematic in the Arctic.

F. Recommendations for Enhancing Response to Drill Ship Incidents in the Arctic

The group developed 25 recommendations to improve response to this incident:

- **Improve Environmental Sensitivity Index (ESI) atlases and databases for the Arctic.** These updates should include shoreline types, oil sensitive biological resources and areas important for human use (e.g., shoreline access, water intakes, aquaculture facilities, cultural resource locations).

- **Acquire and continually update ecological baseline data.** Baseline studies help scientists distinguish between pollution and effects due to climate change or other environmental conditions.

- **Identify and protect critical habitats with proactive response measures.** Efforts should be focused on protecting sensitive wildlife from impact rather than cleaning wildlife after a spill.

- **Consider environmental banking options to offset resource impacts**. Environmental banking involves giving an RP credits for restoring some ecological site other than the one impacted.

- **Identify and protect priority cultural sites**. Response strategies must be developed for cultural, ecological, archaeological, and historical resources. Indigenous people should be involved in this process.

- **Develop IMO guidelines for marine protection.**

- **Ensure unimpeded international participation in the response.** The U.S. government should suspend relevant sections of the Jones Act to allow for unimpeded response assistance from other countries.

- **Update the region's oil spill contingency plans.** The plans should include sufficient operational detail to facilitate smooth responses involving international components.

- **Designate potential ports of refuge in the Arctic.**

- **Institute a joint response management regime for disputed regions of the Arctic.**

- **Harmonize response management systems**. Best practices from the U.S. and Canadian response systems should be used and augmented, as necessary, to make them compatible.

- **Improve response data** (i.e., currents, weather, environmental spill modeling, ice forecasts).

- **Improve scientific knowledge for cold water oil spill response.** New technologies for detection of oil in and under ice should be examined, as well as mechanical and alternative countermeasures.

- **Facilitate the use of alternative spill countermeasures.** Pre-approval of these countermeasures or a mechanism to provide expedited approvals for them, should be developed.

- **Increase funding for preparedness, response equipment and community outreach related to response.** This should include funding for: preparedness; acquisition of additional assets and infrastructure for SAR and marine pollution responses; ecological science and monitoring or restoration activities; and community outreach.

- **Strategically locate critical assets and equipment (i.e., pre-staging of heavy lift helicopters, tugs, and fixed wing aircraft at forward northern bases).**

- **Encourage mutual aid agreements between commercial operators to maximize sharing of limited response resources.**

- **Remove barriers to foreign responder participation (i.e., mechanisms in place to waive or modify customs and immigration requirements to smoothly integrate foreign personnel into response operations).**

- **Improve logistical capabilities for response in the Arctic.** Forward operating bases for northern locations should be established which include adequate logistical stockpiles to allow for self sufficient operations in remote and harsh environmental conditions, and investment in deployable temporary camps that can sustain responders in remote locations for several weeks.

- **Improve communications infrastructure.** Improvement in Arctic marine communication systems must be made to allow for adequate VHF and HF communication as well as satellite coverage for communications and GPS.

- **Plan appropriately for language issues during an international response and ensure responders have readily available access to translation services.**

- **Keep political entities informed.** Open dialogue between all political leaders, indigenous community leaders, and response managers should be encouraged to ensure communication of all viewpoints

- **Conduct community outreach.**

- **Integrate indigenous people and their concerns into the response system.** Indigenous people should be involved in response decisions. Flexibility must be increased to compensate individuals, families and communities. The Alaska Native

Science Commission should be used to assist in informing indigenous people about spill effects and resource impacts

VI. Oil Tanker/Fishing Vessel Collision in the Barents Sea

A. Scenario

In near-zero visibility, a tanker maneuvers to avoid a fishing vessel near the disputed boundary between Russia and Norway in the Barents Sea (Figure 4). A last minute maneuver is not entirely successful, and a collision occurs with damage to both vessels. The tanker releases 25,000 bbls (4,000 m^3) of crude oil (multiple tanks) 48 hours into the incident. The tanker should be towed to a port of refuge to avoid sinking; the fishing vessel sinks. The proximate cause of this incident is heavy icing/sleet causing near-zero visibility. The fishing vessel will require a SAR effort. The presence of sister vessels and the near-zero visibility conditions cause confusion as to how many persons or vessels are involved.

B. Expertise in the Oil Tanker/Fishing Vessel Collision Breakout Group

- Ronald Morris, Alaska Clean Seas
- Ole Kristian Bjerkemo, Norwegian Coastal Administration/EPPR
- Alexei Bambulyak, Polar Environmental Center
- Kimmo Juurmaa, Deltamarin, Ltd
- Amy Merten, NOAA Office of Response and Restoration, Coastal Response Research Center
- Gun-Britt Retter, Saami Council, Arctic & Environmental Unit
- John Weatherly, Cold Regions Research & Engineering Lab, U.S. Army

C. Assumptions Regarding the Oil Tanker/Fishing Vessel Collision Incident

The group assumed the fishing vessel likely belonged to a fleet of vessels from a non-Arctic nation and had a crew of ~20. The fishing vessel had 5,000 – 6,000 bbls (600 – 700 m^3) of diesel fuel and commercial quantities of ammonia on board. It was assumed the tanker departed from Murmansk, Russia enroute to Copenhagen, Denmark, however, the double-hulled tanker was not Norwegian or Russian flagged.

The incident occurs in March (early spring), and weather systems result in heavy fog in the area. The incident occurs 25 miles offshore in a traffic separation scheme advisory zone. Near zero visibility and the presence of several other fishing vessels in the area make it difficult for responders to determine the number of vessels and people involved.

D. 2008 Response to Oil Tanker/Fishing Vessel Collision in the Barents Sea

The proximity of this incident to land raises environmental concerns. Norway maintains a Marine Resources Database, which contains detailed information on vulnerable resources, including marine mammals, fish, zooplankton, and seagrasses, as well as environmentally sensitive areas in Norwegian waters. The Norwegian Polar Institute has maps with information on marine mammals. Russia catalogues species environmental sensitivity using mapping software. Private agencies (e.g., World Wildlife Federation (WWF)) also maintain lists of environmentally sensitive species and habitats in this region. These resources are available to assess which species may be impacted.

The group identified four policies that would apply in this incident: IMO guidelines for ships operating in Arctic ice covered waters, the Russian Federal Contingency Plan on Oil Spill Prevention, the Norwegian Pollution Control Act, and the Russia-Norway Bilateral Agreement for Pollution Response in the Barents Sea. Because the incident occurred in a disputed area, jurisdiction is not clear. Two Norwegian Joint Rescue Coordination Centers (JRCC) coordinate rescue through a cooperative effort by government, private and voluntary organizations. The Norwegian Coastal Administration manages response to pollution incidents in Norwegian waters and has final authority over response decisions. The Ministry of the Russian Federation for Civil Defense, Emergencies and Elimination of Consequences of Natural Disasters (EMERCOM) and the northern fleet of the Russian Navy have responsibility for SAR. In Russian waters, the State Marine Pollution Control, Salvage, and Rescue Administration (MPCSA) of the Ministry of Transport responds to marine pollution incidents. The RP has only an advisory role in the response operations.

The response to this incident will be large, require lots of equipment, and continue over an extended period of time. The damaged vessel will likely continue to spill oil while being towed. The best response scenario involves stationing a skimmer vessel behind the vessel as it is towed to a port of refuge. Due to prevailing winds, the spill will most likely impact the Russian coastline more than the Norwegian one. Responders will place a contaminant boom around the vessel once in port.

The recovery and restoration of this incident will depend ultimately on its location. The Russian government assigns economic value to natural resources and levies fines to restore habitats or fish stocks based on these pre-established values. In contrast, Norway follows a NRDA process with fines for habitat restoration based on actual environmental loss. Responding governments fund the SAR and pollution response. The Norwegian and Russian governments have provisions for recouping costs for response, recovery and restoration from the RP.

Russia and Norway have assets available to respond to this incident. Norway has 12 helicopters designated for SAR at sea, as well as other aircraft and vessels. The JRCC coordinates the deployment of these resources. Likewise, Russia has rescue helicopters, icebreakers and other vessels for SAR. Various ports in Norway and Russia have skimmers, containment booms, and pumps. Tankers for lightering are available in the local area. Norway has government pollution response vessels and Coast Guard vessels with equipment, as well as aircraft with side-looking airborne radar for spill tracking. Both countries have oil spill modeling capabilities.

An incident of this magnitude requires a large number of responders. If the spill comes ashore, the response could continue for several weeks and will likely impact sparsely populated and remote coastlines with minimal infrastructure. Response communication will occur on VHF marine frequencies.

The group identified numerous political players: Norwegian Ministry of Fisheries and Coastal Affairs, Norwegian Ministry of Foreign Affairs, Saami Parliament, Russian Ministry of Defense, Russian Ministry of Transport/Murmansk Salvage Department, Russian Ministry of Foreign Affairs, and local and state governments. An incident of this magnitude has the potential to damage fish stocks important for commercial and subsistence fishing, and will likely be covered extensively in the media.

E. Gaps/Problems Identified in Response to the Oil Tanker/Fishing Vessel Collision Incident

The environmental response could be hampered by differing Norwegian and Russian prioritization schemes. While Norwegian agencies employ a relatively standard system for determining environmental priorities, Russian environmental agencies use varied approaches to identify them. This disparity could cause confusion during a joint response. Cultural resources are not well defined, and therefore important sites may not receive the protection they deserve.

There are presently no places of refuge in the region that would accept a damaged ship. This may result in delays in vessel repair or offloading, worsening the environmental impact. Vessel construction and equipment standards for shipping do not adequately reflect the challenges of operations in Arctic conditions, and may exacerbate problems during a real incident. Finally, this incident occurs in Russia and Norway's disputed region of the Barents Sea, which is not covered under the bilateral agreement between the countries. As a result, there may be jurisdictional and political issues which have the potential to hamper the response.

There are several deficiencies in current response operations. Weather data sources do not provide sufficient information for response, and there is difficulty in obtaining accurate data in a timely manner. Nautical charts for the region have not been updated in many years, with some dating back as far as the 1950s. There is also a general lack of understanding of the behavior of oil and alternative response measures in cold water. In many cases, response measures that work well in temperate environments may work poorly, or not at all, in the Arctic, potentially resulting in a less than optimal environmental response.

The recovery and restoration of this incident will be limited because current habitat assessment and restoration metrics do not employ biological indicators of harm and, therefore, do not fully account for long term effects and environmental damage.

The group identified numerous gaps in the assets, capabilities and equipment available for this incident. The size of the incident will require more assets and equipment than are currently available in the local area. Critical equipment needed include: Large tugs capable of towing heavy loads, more multi purpose vessels capable of light towing, and SAR and pollution response assets, as well as additional supplies for pollution response. Although this scenario occurs in a traffic separation scheme advisory zone designed to keep passing ships clear of each other, near-zero visibility still plays a role in causing the collision.

The challenges associated with a response in this remote Arctic location include few resources for food and lodging, the cold and stormy weather, lack of roads to transport responders and equipment, and a limited number of experienced responders.

Finally, the decline of species such a salmon and/or cod as a result of this incident would have a direct socio-economic impact on the fishing industry, the local economy, and potentially the values of property and homes near the port of refuge. Contamination of marine resources could also create significant health concerns for subsistence fishing communities.

F. Recommendations for Enhancing Response to an Oil Tanker/Fishing Vessel Collision Incident in the Arctic

The group made 22 recommendations to improve the response to this incident:

- **<u>Standardize environmental priorities and sensitivity mapping across the Arctic.</u>** This can be done through an exchange of current environmental data and baseline studies among all Arctic nations, and through the creation of a unified environmental prioritization scheme based on the shared knowledge. The Norwegian model can also be used to create standardized maps depicting resources and priorities across the Arctic. Maps should have layers that include natural resources, the location of shipping routes, response equipment, response depots, and cultural sites.

- **<u>Adopt an ecosystem based approach to protecting the Barents Sea from pollution.</u>**

- **<u>Conduct an Arctic risk assessment for oil and gas similar in structure to the Arctic Council's Arctic Marine Shipping Assessment (AMSA).</u>**

- **<u>Create an oil spill response plan for the entire Arctic</u>**. The plan can be divided into regional sections centered on each sea. Indigenous communities should be involved in the planning process. The plan should address alternative response options (e.g., dispersants, *in situ* burning, sinking agents, chemical herders).

- **<u>Create a comprehensive treaty on Arctic shipping and emergency response.</u>** This treaty should: identify which countries should conduct emergency response in disputed regions and international waters; identify which nations have authority to direct vessel movement in disputed regions and international waters; facilitate international access in the territorial waters of other Arctic nations for the purposes of emergency response; set appropriate vessel construction and equipment standards for operations in the Arctic; identify optimal shipping routes based on risk assessment of vulnerable areas; mandate standardized professional training and education for Arctic mariners; and assess a user fee for Arctic ship operators to help defray the cost of the above measures.

- **Conduct response drills and exercises based on the most plausible marine disaster scenarios to evaluate plans and ensure responder preparedness.**

- **Identify potential ports of refuge while taking into consideration environmental and cultural resources at risk.** The European Union Places of Refuge Framework can be used as a model for decision making about where to accommodate ships in distress.

- **Clarify responsibilities and procedures for incidents occurring in disputed areas.**

- **Improve knowledge about oil spills in Arctic conditions.** Oil properties, fate, and transport should be examined, and research should be conducted on equipment and techniques for cold water oil spill response (e.g., *in situ* burning, dispersants, sinking agents, chemical herders, etc).

- **Improve the quality of weather and nautical information through increased observations, enhanced models, sharing of information, and improvement of maps/charts for the area.**

- **Adopt more environmentally sound practices for restoration and recovery.** Use of biomarkers should be investigated as a more accurate method of quantifying ecosystem losses. Long term monitoring protocols should be developed and input of indigenous people should be sought when planning restoration activities.

- **Explore options for increasing response funding.** Reasonable liability limits for vessels operating in the Arctic should be established. Diverse funding sources for response should be used, including governments, RPs, insurers, donors, and non-governmental organizations (e.g., WWF).

- **Increase spill response equipment and support vessel availability in the Arctic.**

- **Obtain international assistance as necessary** (e.g., response equipment can be obtained from Finland and/or Sweden)

- **Enhance vessel traffic management services throughout the Arctic by changing the traffic separation advisory zones to a mandatory vessel traffic separation schemes monitored by vessel traffic service (VTS) personnel.** Ships carrying oil and hazardous materials should be required to electronically submit standardized electronic reports on their cargo to the VTS before arrival or departure from port. Information should be shared between VTS's throughout the Arctic.

- **Use response personnel from the military and other Arctic nations for large responses.**

- **Use NATO vessels, military sealift command, cruise ships, ferries, and icebreakers to provide accommodations for responders.**

- **Enhance communications infrastructure through the use of satellite phones and improve cell phone coverage in offshore locations as well as in shore remote/isolated locations**.

- **Use political leaders to lobby for necessary changes to Arctic response plans**.

- **Implement a Municipal Risk Communication Plan that provides the public with rapid and reliable information and informs citizens of their rights with respect to claims for damages**.

- **Monitor and document environmental, human health, and economic effects of the spill on local communities.**

- **Provide adequate compensation for communities damaged by spills.**

VII. Tug and Containerized Barge Grounding on St. Lawrence Island

A. Scenario

The Tug F, towing a barge with explosives for a mining operation and other containerized cargo destined for Arctic communities loses power, is pushed by storms, and grounds on St. Lawrence Island (U.S.)(Figure 5). This region is environmentally sensitive and a haul out region for Pacific Walrus and other endangered species. Tugs in this type of operation carry large volumes of fuel, typically diesel. The U.S. and the Russian Federation have a Joint Contingency Plan covering these waters. The Bering Sea is a shallow sea, heavily used by great circle transits between Asia and North America, and by the large international fishing fleet.

B. Expertise in the Tug and Containerized Barge Grounding on St. Lawrence Island

- Vera Kingeekuk-Metcalf, Eskimo Walrus Commission
- Andrew Tucci, U.S. Coast Guard
- Laura Furgione, NOAA, National Weather Service
- Lexia Littlejohn, U.S. Coast Guard, Stanford University

- Joseph LoSciuto, U.S. Coast Guard, Seventeenth District
- Stanley “Jeep” Rice, NOAA, Auke Bay Laboratory
- Kurt Schwehr, Center for Coastal & Ocean Mapping/Joint Hydrogeographic Center, UNH
- John Whitney, NOAA, Office of Response and Restoration

C. Assumptions Regarding the Tug and Containerized Barge Grounding Incident

The group assumed that the tug had six to eight crew members onboard and carried 580 – 1200 bbls (95 – 190 m^3) of diesel fuel, as well as several intermodal containers that included numerous hazardous chemicals (i.e., chlorine, cyanide, various solvents). Following the grounding, the towline snapped and the tug and barge became separated by several miles. The tug and barge grounded off the island’s east and north shores, respectively, adjacent to the Northeast corner of the island. The barge hit a rock and took on water and the tug ruptured a fuel tank. Some containers fell into the water and sank, some remain on, or near, the barge, while others washed up on the beach. This incident occurred in May under broken ice conditions. As was the case with the container ship NAPOLI (English Channel, January 2007), the response is hindered by hundreds of poorly marked cargo containers, many containing hazardous materials.

D. 2008 Response to Tug and Containerized Barge Grounding on St. Lawrence Island

St. Lawrence Island and the surrounding area serve as a critical habitat and nesting location for protected bird species, including the Spectacled eider, and Steller’s eider, and the endangered Bowhead whale. The island also serves as a habitat for many other important species including the Pacific walrus, Glacuous gulls, Herring gulls, Dunlin, Blue King crabs, Saffron Cod, White fish, Rainbow trout, and numerous clam and mussel species. Any spill of hazardous materials will likely have a detrimental effect on the wildlife.

There are numerous policies and guidelines relevant to this incident including: the Clean Water Act, Oil Pollution Act of 1990, Magnuson-Stevens Fishery Conservation and Management Act, CERCLA, Marine Mammal Protection Act, Endangered Species Act, Migratory Bird Act, Alaska Native Claims Settlement Act (ANCSA), Oil Pollution Response Convention and a bilateral agreement between the U.S. and Russia which govern certain responses in the Bering and Chukchi Seas.

Although equidistant from Nome, Alaska and Siberia, this incident falls under U.S. jurisdiction. Within the U.S. system, the USCG will have jurisdiction over marine pollution events, while the tribal, state, and Federal governments have co-current jurisdiction over natural resources. In Russian waters, the State Marine Pollution Control Salvage and Rescue Administration (MPCSA) of the Ministry of Transport respond to marine pollution incidents.

The command structure for this incident will use the ICS format with a unified command consisting of the USCG, State of Alaska, RP, and appropriate tribal organizations. Response to the grounded vessels will likely involve offloading fuel into bladders or another vessel, followed by towing the vessels off the rocks. Responders must classify hazards (placards may have worn off) to ensure proper cleanup and removal. Once divers locate and mark underwater containers, responders will attempt to salvage them using cranes and/or float bags. In addition to sinking, debris from the incident will most likely litter nearby beaches.

Financial responsibility for environmental cleanup will fall to the RP, however, the U.S. government will likely contribute additional funds from the Oil Spill Liability Trust Fund (OSTLF) and Superfund. Under the Alaska Derelict Vessel Program, the state may charge a maximum fine of $500 in addition to state-incurred costs for removal, disposal, and environmental damage caused by abandoned vessels.

Numerous assets are available to respond to this incident. For the SAR response, the following are available: USCG small boats; large commercial fishing vessels; four wheeled/all-terrain vehicles (ATVs); National Guard helicopters; USCG helicopters; USCG long-range aircraft (C-130's) based in Kodiak, AK; small aircraft located in Nome, AK; and Alaska state troopers. For the pollution response the following are available: USCG helicopters; one commercial helicopter based in Nome; some stockpiles of equipment including boom and sorbents at nearby locations in AK; the USCG Strike Team can provide pollution response personnel and equipment, and the International Bird Rescue Response Center can provide personnel and equipment to clean oiled birds.

The unusual nature of the cargo in this incident presents several human resource challenges. Individuals involved in the response would require Hazardous Waste Operations (HAZWOPER) certifications, and responders would likely need to bring in explosives experts and specialized divers from outside the region. It is unlikely local people will have this training. Due to the storm, it will take 48 – 96 hours for specialized personnel and equipment to arrive at the scene. As a result, locals with HAZWOPER training will fill the critical role of first responders.

A local high school and various other buildings are available and could act as facilities for the incident command post, a triage center for injured personnel, or housing for responders. The island has no hotels, but shelter cabins and tents are available. The island has the capacity to house an estimated 100 responders. There are two communities on the island (Savoonga and Gambell), and each has a small airport, local fire department, and a clinic that can provide limited medical services. Severely injured people must be taken to the hospital in Nome, AK.

Responders can communicate on common marine frequencies. The island has no cell phone service and limited satellite phone coverage. Local people use citizen's band (CB) radio to communicate with one another.

E. Gaps/Problems Identified in Response to a Tug and Containerized Barge Grounding Incident

ESI atlases for the region are out of date and incomplete. These atlases contain information on shoreline types, oil sensitive biological resources, and human use resources. Incorrect data could result in areas that should be protected being neglected. Wildlife is a concern with this response, as spilled oil could alter migratory corridors for some marine mammals and birds, and response vehicles (e.g., helicopters, boats) may disturb birds and other wildlife.

Indigenous communities may choose to keep the locations of archaeological or cultural sites confidential. As a result, responders may not have knowledge of these locations and, therefore, will not include them when developing protection strategies.

A potential serious problem is the lack of an established potential place of refuge for damaged vessels in the region. Without a place of refuge, the vessels will have to stay at sea, potentially exacerbating the spill. The U.S. and Russia conduct few drills to test the effectiveness of their bilateral agreement, and, therefore, responders may not be familiar with their roles which may hamper or delay the response. The flexibility of the ICS format may cause confusion about where to place tribal entities in the structure. This may result in disagreements about the best course of action, and may impact relations between the groups.

Response operations may be delayed by a lack of up-to-date data for the region, including weather and navigation charts. As this incident occurs during a storm, accurate weather forecasts will be important for the response.

The availability of assets for this incident will vary with the season. Helicopters will be a critical asset for SAR and pollution response operations. However, helicopter support may be limited if the incident occurs during fire season in California. There is a general lack of oil spill response assets in the Bering Strait and the surrounding region, greatly limiting any potential response.

The remoteness of this incident will cause some challenges. While some locals may have received HAZWOPER training, additional certifications and more trained personnel are required for a large response. Transporting equipment to the scene will be difficult due to the island’s remote location and lack of roads. Currently, there are no agreements in place to supply housing and feeding responders. For long term responses, especially those involving more than 100 people, managing logistical requirements will prove extremely challenging.

Communications are likely to be a problem in this incident. The lack of cell phone coverage and limited satellite coverage will hinder response communications. While marine radio and CB communications exist, available channels are likely to become overwhelmed quickly. There is no internet access on St. Lawrence Island.

Due to their isolation in the Bering Sea, the indigenous people of St. Lawrence Island would suffer severe socio-economic impacts if contamination forced them to rely on other communities for food. In addition, the presence of responders would likely disrupt the local way of life.

F. Recommendations for Enhancing Response to a Tug and Barge Grounding in the Arctic

The group developed 18 recommendations to improve the response to this incident.

- **Improve ESI atlases and databases.** Detailed shoreline data should be collected and maps for the Bering Strait region should be updated. Local knowledge should be incorporated and all information should be posted on a regional website in a user friendly, searchable format. Employing the NOAA ERMA (Environmental Response Management System) technology would be an excellent way of coordinating and displaying relevant environmental and response information.

- **Alter response operations as necessary to reduce wildlife disturbances** (e.g., direct helicopter traffic around environmentally sensitive areas, as necessary).

- **Acquire and continually update ecological baseline data.** Baseline studies help scientists distinguish between pollution and effects due to climate change or other environmental conditions. U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) toxin studies for walrus, seals, and bowhead whales should be continued.

- **Identify potential ports of refuge in the Bering Strait.**

- **Conduct response drills in the Bering Strait.** The Joint Contingency Plan (SAR and pollution) with Russia and indigenous communities should be exercised. Cooperative relationships should be developed with Russia in terms of pollution response, including coordination, dialogue.

- **Develop requirements for vessel operations in the Arctic.** The USCG should determine requirements for vessel operations in the Arctic and communicate these requirements to other agencies and stakeholders.

- **Improve response data through a better weather observation system by placing more real time environmental monitoring stations throughout the region area and expanding current observational networks with multi-sensors.** Additional data including meteorological information from satellites, surface current/wind/wave data from HF radar, and ice density from Synthetic Aperture Radar should be acquired and used, as well as any available environmental data from established Arctic Ocean Observing Networks. Relevant agencies should also partner to create more robust wind and wave climatology information systems for the region.

- **Update hydrographic surveys and nautical charts in the region**.

- **Require durable and descriptive intermodal container markings geared for response.** All hazardous material containers should be properly marked and paper manifests containing adequate information should be readily available. Labels should be designed to withstand the Arctic environment.

- **Clarify the ICS role of tribal entities.** Tribal entities could be placed either in the multi agency Coordination Center (MACC) or in the Planning Section under the ICS structure.

- **Increase penalties to a value sufficient to deter owners from abandoning vessels.**

- **Establish an offshore Oil Spill** Response **Organization (OSRO) and task it with responding to incidents in the Bering Sea, Bering Strait, and southern Chukchi Seas**. The OSRO should have a base of operations located strategically within the region.

- **Encourage establishing mutual aid agreements with the other OSROs in the Alaska region (Southeast Alaska, Prince William Sound, and the North Slope)-to create expedited mutual aid agreements**. The agreements should include detail on how organizations borrow, share or purchase equipment/supplies from one another in a timely manner during emergencies.

- **Improve pollution response and salvage capabilities by increasing stores of response equipment on St. Lawrence Island and in Nome and Kotzebue, AK.** Warehouses should contain supplies (e.g., booms, bladders, float bags, pumps, hoses, ATVs, skimming vessels, and spare parts where space permits). Equipment from Nome or Kotzebue could be flown in by C-130s. Arctic nations should also require that equipment stockpiles be maintained in remote areas

- **Increase basic response training for the local population by educating more locals in ICS and HAZWOPER.** Local people should also be trained and used as marine mammal observers.

- **Improve logistical capabilities for response through establishment of agreements that detail accommodations and support services for personnel during emergency response.** Consider bringing in a barge outfitted with trailers that can serve as living quarters for responders, as well as being equipped with food and water. The benefit of housing responders on the barge is that it can be towed to different locations, as necessary.

- **Enhance communications infrastructure.** Cell phone capability should be encouraged in the Bering Strait region.

- **<u>Improve the safety of vessel transit systems in the Arctic through communication systems</u>.** Use of satellites and radio broadcasts should be encouraged to notify ships of preferred routes around ice. The Canadians Marine Information Objects (MIO) System could be used as a model.

- **<u>Require vessels transiting the Arctic to use AIS</u>**. Advance notice of arrivals and other vessel schedule information should be communicated to all interested parties.

- **<u>Integrate indigenous people and their concerns into the response system.</u>** Responders should hold meetings with local communities to relay risks to people and provide information such as seafood contamination and fisheries closures. The ideal response would integrate indigenous people into all parts of the response including assessment, response, and recovery efforts. This is especially important due to the general lack of economic opportunity on the St. Lawrence Island

<u>VIII. KEY WORKSHOP FINDINGS AND RECOMMENDATIONS</u>

On the final day of the workshop, the five breakout groups reconvened in a plenary session to share their findings and conclusions. Under the lead of the organizing committee, the groups developed 17 recommendations that were common to all incidents, or that the participants believed would significantly improve response and recovery. This section presents and discusses these recommendations. Since many of them appear relevant to several types of incidents, the hope is that Arctic planners and decision makers will use them to prepare for a multitude of potential marine incidents.

A. Ports and Waterways Management

- **<u>Designate potential ports of refuge in the Arctic and develop guidelines for their use.</u>** The incidents highlight the importance of transporting a damaged vessel to a safe haven following an accident in order to prevent further damage to the ship and the environment. In the Arctic, harsh environmental conditions and increasing marine traffic density make this course of action even more critical. Potential ports of refuge guidelines detail the process by which authorities decide where to allow a damaged ship to berth. In an attempt to balance shipping interests with the protection of natural and cultural resources, selection of such ports should incorporate input from potentially affected governments, communities, the shipping industry, and other stakeholders. Authorities should also rank ports based on seasonal environmental conditions. The European Union Places of Refuge Framework provides a model for the development of potential ports of refuge guidelines by Arctic nations.

- **<u>Control and track vessel movements.</u>**
  Policies established to control the movement of ships offer an effective way to eliminate the risk of incidents in areas deemed sensitive for environmental or cultural reasons. As a prevention measure, such policies offer better protection against environmental damage than response policies because vessel control measures serve to

lessen the hazard. Several options exist for controlling vessel movement in Arctic waters including vessel exclusion zones, PSSAs, and route planning. Vessel exclusion zones prevent ships that do not meet minimum standards for construction, survival equipment, and response from entering within a certain distance of the coastline. PSSAs require special protection under IMO for their recognized ecological, socio-economic, or scientific significance. This designation limits ship traffic in the area. Route planning refers to directing ships that carry oil and hazardous material cargos around particularly sensitive or vulnerable areas.

In order to enforce vessel control measures, Arctic nations may find it helpful to institute Vessel Tracking Services (VTS). Such systems enhance strategic awareness and improve response capabilities for SAR and pollution incidents. For example, an agency established to manage Arctic cruise ship itineraries could quickly notify other cruise ships in the area if a vessel experienced a problem. Arctic nations should also consider establishing and/or enhancing VTS capabilities and traffic separation schemes, especially in areas with potential for rapid growth such as the Barents Sea. VTS tracks vessel movements while traffic separation schemes are designed to prevent vessel collisions. In addition, VTS can track the location of dangerous cargos, if Arctic nations require ships to submit oil and hazardous material reports electronically before arrival or departure from port. Finally, Arctic nations should require Automatic Identification Systems (AIS) on ships visiting Arctic ports to facilitate vessel tracking by VTS stations.

B. Vessels and Crew Safety

- **Institute mandatory safety regulations for Arctic operations.**

  The current framework for maritime operations in the Arctic does not include detailed and legally binding regulations. The IMO Guidelines for Ships Operating in Arctic ice covered waters addresses specific fire safety, lifesaving, navigational, operational, and crew training issues, but does not provide sufficient detail. For example, Paragraph 14.2 of the guidelines states that navigators should complete an approved training program for operating in ice, yet no internationally recognized courses exist for this purpose. In addition, the IMO guidelines provide little information on how to prevent, mitigate or avoid icing. Furthermore, the IMO guidelines are not mandatory. When the IMO's Marine Environment Protection Committee approved the guidelines in 2002, they invited member nations to bring the guidelines to the attention of ship owners and concerned parties, but there were no enforceable policies issued to ensure that this occurred.

  A non-binding regulatory framework seems inconsistent with the hazards of Arctic navigation and the potential for environmental damage from such an incident. The IMO should provide specific, detailed and mandatory requirements for survival equipment (i.e., life boats, life rafts, immersion suits) and crew training. Internationally standardized crew training that includes compulsory education for ice navigation and emergency response in polar environments should exist. Crew training should include response knowledge for incidents likely to occur on specific types of ships. For example, cruise ship crew members will need more training on how to account for and direct numerous passengers during cold weather emergencies, while cargo ship crew members would benefit from salvage or other types of training. The requirements should apply to all vessels transiting the Arctic.

C. Response Agreements and Plans

- **Strengthen multinational plans and agreements or create one Arctic agreement for all types of responses.**
  Due to the Arctic's remote location and lack of response resources, marine incidents will likely require international cooperation that goes beyond that delineated in current agreements. Current bilateral and multilateral agreements detail the conduct of response between two or three Arctic nations. In some instances, agreements exist for SAR, but not for pollution response (i.e., the case with the multilateral agreement between the U.S., Russia, and Canada). Furthermore, existing SAR and pollution contingency plans do not provide enough detailed information to facilitate an effective response. Therefore, Arctic nations should forge an Arctic wide agreement for SAR and pollution response. The agreement could delineate regional sectors for response by sea (e.g., Barents, Bearing). Agreements and response plans should designate which nations respond in specific areas and clarify operations in disputed regions. Agreements and response plans should also ensure foreign responders can participate in operations unimpeded by customs and immigration issues. Contingency plans should detail specific locations for response equipment. Finally, the Arctic nations should establish an entity (e.g., integrated response management center) to manage the execution of agreements and facilitate rapid decision making.

D. Strategies to Improve Prevention and Preparedness

- **Conduct comprehensive environmental risk assessments and impact assessments for the Arctic.** Adopt a multi layered approach to marine environmental risk assessment for the Arctic to include its seas, shipping routes and ports. This will aid in decision making, including route planning, and emergency response.

- **Increase emergency response assets, equipment, and supplies in the Arctic, placing emphasis on regions of active development.** Due to the Arctic's remote location, the region has fewer assets and less response equipment than in the lower latitudes. There is a clear need for emergency response equipment for SAR and pollution response throughout the Arctic. High priority equipment (e.g., long-range and heavy-lift helicopters, fixed-wing aircraft, tugs, multi mission support vessels, icebreakers) should be designated for response and be stationed in strategic locations. Self sustaining, forward operating response bases should be established near SAR and pollution response equipment stockpiles. Response bases and equipment should be located strategically throughout the Arctic based on comprehensive risk assessments and locations modified seasonally, as needed. For private organizations charged with emergency response (e.g., OSROs), mutual aid agreements should be encouraged that detail the sharing of equipment and supplies in order to maximize use of limited resources.

- **<u>Improve knowledge for Arctic incident response through training and engagement of the local community, responders, and the shipping industry.</u>** Because marine incidents occur infrequently in the Arctic, response personnel may lack proficiency in cold weather operations. Arctic nations should conduct realistic response drills in order to better prepare responders, while testing the efficacy of response plans and agreements. To further improve knowledge of Arctic incident response, the Arctic Council and shipping industry (e.g., cruise ships, LNG, cargo transport, etc) should sponsor an Arctic SAR workshop for all interested parties. Finally, the Arctic nations should train indigenous people in response. This would allow these individuals and local communities to participate in response operations with the added benefit of providing a critical source of qualified first responders.

E. Strategies to Improve Response

- **<u>Consider alternative countermeasures for oil spill cleanup.</u>**
  Difficult environmental conditions and a general lack of responder expertise in cold water oil spill response may render mechanical cleanup measures impractical in the Arctic. Responders should consider all alternative response options (e.g., dispersants, chemical herders, sinking agents, *in situ* burning).

- **<u>Expand communications capabilities throughout the Arctic.</u>**
  Communications networks in the Arctic should be expanded to include systems for SAR, environmental response, and transmission of weather information. Specifically, shore based infrastructure for VHF and HF marine communications systems and satellite coverage for satellite phones, cell phones, and GPS should be expanded. Satellite phones should be carried on all ships transiting the Arctic to ensure each vessel has a means of communicating with responders during an emergency. In addition, plans for language issues are sure to arise during an international response and appropriate translation services should be available to responders.

- **<u>Improve logistical support capabilities for responders.</u>**
  Even if equipment and communications are in place, a response cannot occur without personnel. Remote Arctic locations typically lack suitable accommodations to feed and house such personnel, especially for large and extended responses. Vessels (e.g., cruise ships, ferries, icebreakers, barges) should be brought in to meet responder needs. This strategy will improve the response because operations can proceed more efficiently if responders receive housing and other required services near the incident site.

F. Strategies to Foster Community Involvement

- **Involve indigenous people and local communities in planning, response, recovery, and restoration decisions and operations.**
  Article 26 of the United Nations Draft Declaration of the Rights of Indigenous Peoples gives them the right to control the use of lands, waters, coastal seas, and natural resources that they traditionally use (UN Commissioner for Human Rights, 1994). In order to remain consistent with international law, the Arctic nations should facilitate participation by local and indigenous peoples in all segments of the response, particularly in roles as first responders, marine mammal observers, and NRDA trustees. This would allow local people to participate in decisions related to their land during and after an incident.

- **Conduct outreach to the local community and keep stakeholders well informed**
  Risk should be properly communicated to the local community through outreach, town hall meetings, and the media. Implement a Municipal Risk Communication Plan with the aim of providing the public with rapid and reliable information on any human health threats and managing claims for damage and socio-economic impacts.

G. Strategies to Ensure Availability of Funds For Response

- **Establish an international Arctic response fund.**
  A fund should be established to help the Arctic nations offset the costs of SAR and pollution response. Workshop groups identified several possible sources of funding. For example, the Arctic nations could assess a user fee for Arctic ship operations. Additional funding could come from Arctic governments, RPs, insurers, donors, and NGOs.

- **Increase penalties and insurance requirements for ships operating in the Arctic**
  This requirement would serve two useful purposes: (1) It would establish adequate funding for response, and (2) it would serve as a deterrent to pollution in the Arctic.

H. Research Needs

- **Update weather data and navigational charts for the Arctic.**
  Current data sources do not provide sufficient information for responses in the Arctic. Arctic nations should use all available information sources to improve predictive capabilities including meteorological information from satellites, surface current/wind/wave data from HF radar, ice density from synthetic aperture radar, and all available environmental data from established integrated ocean observing networks in the Arctic. Difficult weather and environmental conditions make navigation in the Arctic more difficult than at lower latitudes. This highlights the extraordinary importance of up-to-date navigational charts. The Arctic nations should invest in programs aimed at updating navigational charts for Arctic seas, ports, and waterways.

- **Study the behavior of oil in cold water and technologies for spill response.**
  The fate and transport of oil spilled in cold and ice infested water is not well-understood. Researchers should expand their knowledge of the behavior of oil in cold water and

explore technologies for cold water spill response. The Arctic nations should invest in examining new technologies for the detection of oil under ice, as well as mechanical and alternative cleanup countermeasures including *in situ* burning and chemical dispersants and herders. Environmental spill models for the Arctic should also be improved.

- **Improve baseline information for Arctic resources that could be affected by potential incidents**
  Scientists should develop a better understanding of pollution impacts in the Arctic and improve the quality of information contained in ESI databases and maps. ESI maps should designate the locations of oil sensitive biological resources and areas important for human use including shoreline access, water intakes, aquaculture, and cultural resources. Baseline ecological data should be acquired for important species. Baseline studies are needed to help distinguish between the effects of pollution and those due to climate change or other environmental conditions. Finally, the use of biomarkers should be investigated as a more accurate method of quantifying ecosystem losses following an incident that causes environmental damage.

IX. CONCLUSION

The reduction of polar sea ice and increasing worldwide demand for energy will likely result in a dramatic increase in the number of vessels and development in the Arctic. The geographic regions of the Arctic most at risk for incidents are those with the greatest human activity. For instance, increasing transit by large cruise ships destined for Greenland has made the adjacent waters an area of great concern for an incident. The western continental shelf of Russia and Barents Sea/Pechora Sea region has been deemed a potentially significant energy basin due to substantial oil and gas reserves. This region will likely continue to see high levels of offshore oil and gas activity in the near future and will, therefore, require proactive planning efforts to prevent incidents and pollution. In addition, if ice melts last in the Canadian Arctic, areas along the Northern Sea Route will likely experience increased hydrocarbon and cruise ship traffic before other areas of the Arctic.

In order to address the marine incidents likely to occur in the Arctic, workshop discussion centered on five plausible scenarios that involve cruise ships, drill ships, and fishing vessels, as well as various environmental threats including oil and explosives. Through this scenario based risk analysis, workshop attendees generated a list of recommended policies, strategies, and research needs aimed at mitigating risks. The main theme that resonates throughout all of the recommendations is fostering international cooperation between the Arctic nations. Such cooperation will prove critical to improving joint contingency plans and multinational agreements aimed at guiding international response efforts and developing and instituting mandatory safety regulations for Arctic operations. The second major theme that underlies nearly all of the recommendations is implementation of comprehensive prevention and preparedness measures. Such measures range from conducting extensive risk assessments for the Arctic seas, shipping routes, and ports to increasing stockpiles of emergency response equipment and supplies throughout the Arctic. By properly managing risk using appropriate policies and strategies supported by sound scientific research, opportunities for development and tourism in the Arctic can continue with reduced risk for environmental damage and loss of life.

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FIGURE 1


Location of Incident
Baffin Sea
Ilulissat
Greenland
Nuuk
Iceland
NU
NT
Canada
Hudson Bay
AB
MB
BC
SK
ON
QC
NL
Ireland
©2008 Google – Map Data © Geocentre Consulting, Tele Atlas

FIGURE 2

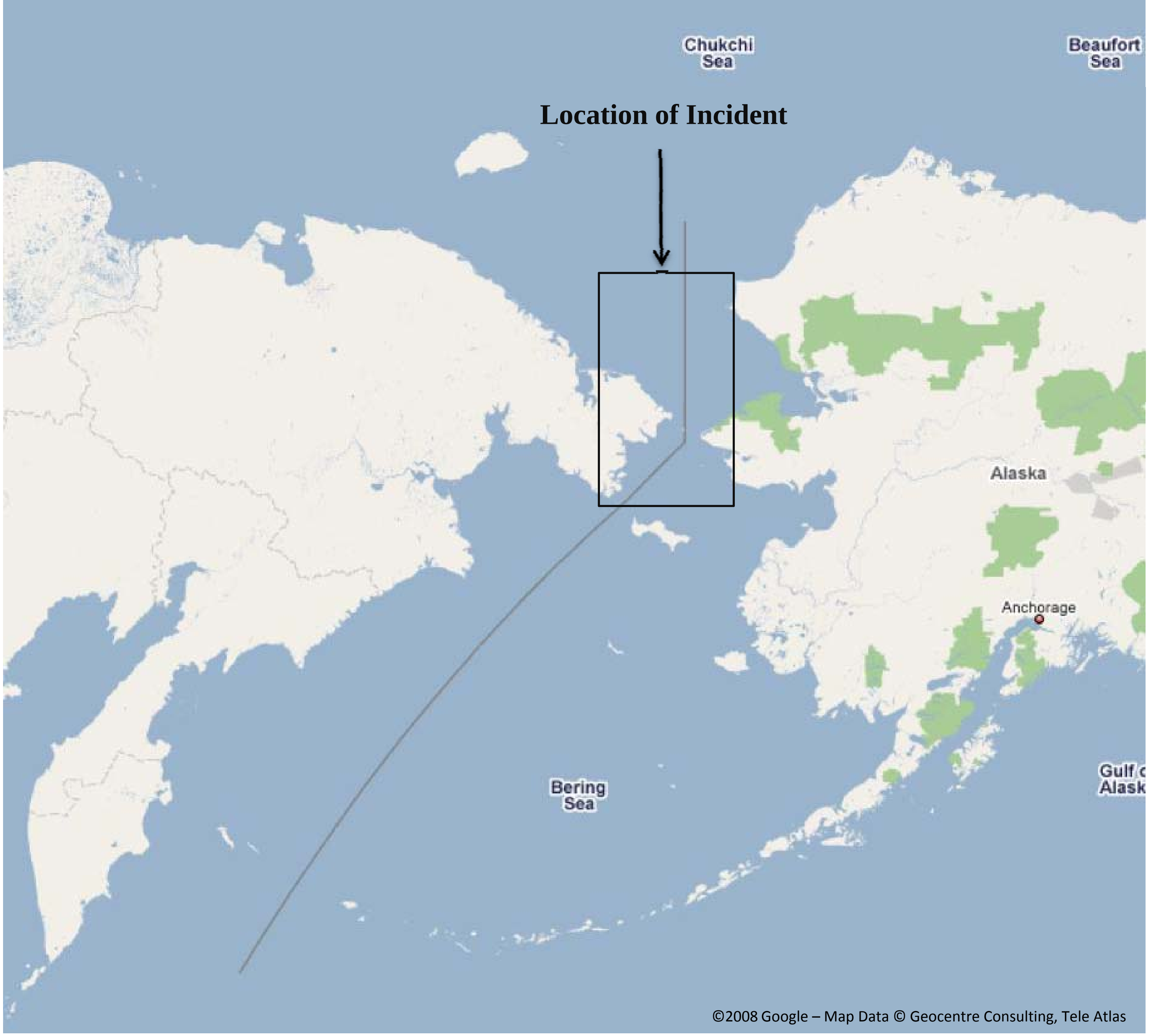
Chukchi Sea
Beaufort Sea
Location of Incident
Alaska
Anchorage
Bering Sea
©2008 Google – Map Data © Geocentre Consulting, Tele Atlas

FIGURE 3


Location of Incident
Herschel Island
Ivvavik
National Park
United States
Canada
Vuntut
National Park
©2008 Google – Map Data © Geocentre Consulting, Tele Atlas

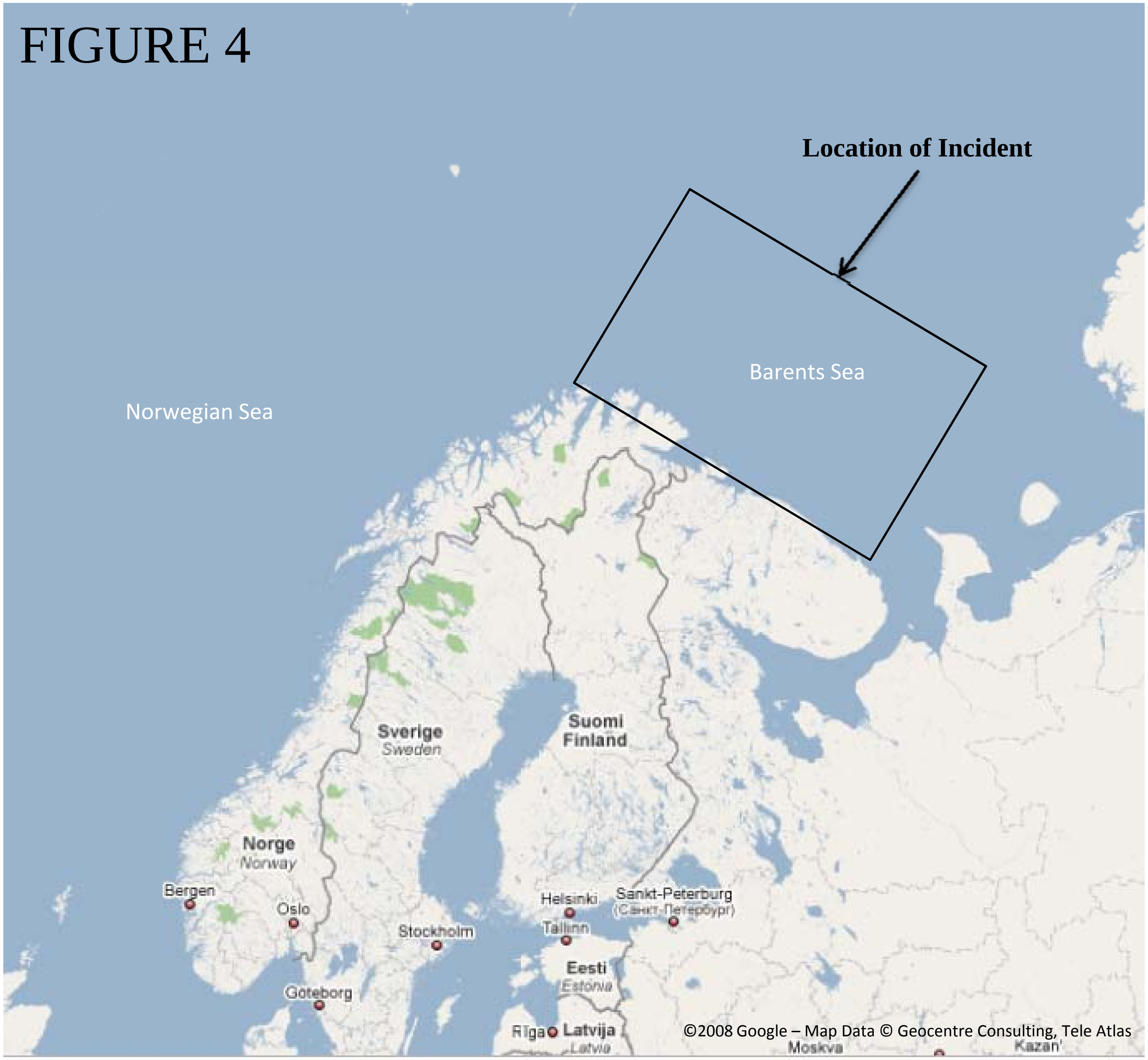
FIGURE 4
Location of Incident
Barents Sea
Norwegian Sea
Sverige
Sweden
Suomi
Finland
Norge
Norway
Bergen
Oslo
Stockholm
Helsinki
Sankt-Peterburg
Tallinn
Eesti
Estonia
Göteborg
Riga
Latvija
Latvia
Moskva
Kazan'
©2008 Google – Map Data © Geocentre Consulting, Tele Atlas

FIGURE 5


Russia
Location of Incident
Nome
St. Lawrence Island
United States
Bering Sea
©2008 Google – Map Data © Geocentre Consulting, Tele Atlas

Figure 6


Approximate Locations of Incidents
Incident A
Incident B
Incident C
Incident D
Incident E
RUSSIA / RUSSIE
CANADA
KALAALLIT NUNAAT
(GRØNLAND)
DK
ALASKA
US
ARCTIC OCEAN
OCÉAN ARCTIQUE
PACIFIC OCEAN
OCÉAN PACIFIQUE
ATLANTIC OCEAN
OCÉAN ATLANTIQUE
North Pole / Pôle nord
Arctic Circle
Cercle arctique
International Date Line
Ligne internationale de changement de date
International Meridian
Méridien international
Mongolia / Mongolie
CHINA
CHINE
Japan
Japon
KAZAKHSTAN
Turkey
Turquie
Ukraine
Romania
Roumanie
Belarus
Bélarus
Poland
Pologne
Finland
Finlande
Sweden / Suède
Germany
Allemagne
Norway
Norvège
United Kingdom
Royaume-Uni
Iceland
Islande
Ireland
Irlande
USA / É-U d'A
NORTH
CIRCUMPOLAR REGION
LA RÉGION
CIRCUMPOLAIRE-NORD
Reproduced with the permission of Natural Resources Canada 2008
Courtesy of the Atlas of Canada
0 500 1000 km

APPENDIX A

Opening the Arctic Seas

ENVISIONING DISASTERS AND FRAMING SOLUTIONS

March 18 – 20, 2008
The New England Center
University of New Hampshire
Durham, NH USA

Monday, March 17 Arrival and Check-in at the New England Center Hotel

Tuesday, March 18

08:00 *Continental Breakfast in the Great Bay Room*

08:45 **Welcome and Introductions**
Nancy E. Kinner, UNH Co-Director, CRRC
Amy A. Merten, NOAA Co-Director, CRRC
Taylor Eighmy, Vice President, Research, UNH
David Westerholm, Director, Office of Response & Restoration, NOAA
Christopher Hall, Captain, U.S. Coast Guard
Lawson W. Brigham, Alaska Office Director, U.S. Arctic Research Commission

09:15 **Background and Goals of the Workshop**
Peter J. Hughes, Workshop Facilitator

09:30 **Participant Introductions**
Peter J. Hughes, Workshop Facilitator

10:00 **Plenary Talk: Arctic Shipping**
Lawson Brigham

10:15 *Break*

10:30 **Plenary Talk: Arctic Peoples**
Gun-Britt Retter, SAAMI Council
Charles Johnson, Alaska Nanuuq Commission

11:00 **Workshop Structure, Logistics & Outcomes Participant Operating Principles**
Peter J. Hughes & Organizing Committee

11:30 **Breakout Session I: Envisioning the Incidents**
Breakout Discussion Groups

Working Lunch (in Breakout Groups)

15:30 **Plenary Talk: Arctic Tourism**
John Snyder, Polar Tourism

15:45 **Plenary Talk: Arctic Search and Rescue**
Larry Trigatti, Dept of Fisheries & Oceans, Canada

16:00 **Wrap-Up**
Peter J. Hughes & Organizing Committee

18:00 Shuttle to *Dinner at The Three Chimney Inn in Durham, NH*

Wednesday, March 19

08:00 *Continental Breakfast in the Great Bay Room*

08:45 **Overview and Review**
Peter J. Hughes & Organizing Committee

09:00 **Plenary Session: Breakout Group Reports (20 minutes each)**

10:45 *Break*

11:00 **Plenary Talk: Biological Consequences or Implications**
Jeep Rice, NOAA Fisheries

11:15 **Plenary Talk: Arctic Oil and Gas Exploration**
Dennis Thurston, US Minerals Management Service

11:30 **Breakout Session II: Framing the Solutions**
Breakout Discussion Groups

Working Lunch (Breakout Groups)

15:00 **Plenary Session**

15:30 Shuttle from the New England Center to the Seacoast Science Center in Rye, NH

16:00 **Plenary Session: Breakout Group Reports (10 minutes each)**

17:00 **Wrap-Up**
Peter J. Hughes & Organizing Committee

17:30 *Dinner at the Seacoast Science Center in Rye, NH*

Shuttle return to the New England Center

Thursday, March 20

08:30 *Continental Breakfast in the Great Bay Room*

09:15 **Overview and Review**
Peter J. Hughes & Organizing Committee

09:30 **Breakout Session III: The Way Forward**
Breakout Discussion Groups

11:00 **Plenary Session: Breakout Group Reports (10 minutes each)**

12:00 *Lunch*

13:00 **Plenary Session: Synthesis and Next Steps**
Peter J. Hughes & Organizing Committee

14:00 **Closing Remarks**
Peter J. Hughes & Organizing Committee

APPENDIX B

Breakout Discussion Groups

Group A **Cruise Ship** **Greenland** **Great Bay Room, Left** Leader: John Falkingham Recorder: Tyler Crowe OC: Lawson Brigham I. Ertmann F. Grant-Suttie J. Holst-Andersen N. Kinner, Recorder J. Snyder Cruise Contact/Industry	**Group B** **Ore Carrier/IFO Spill** **Central Arctic Ocean** **Great Bay Room, Right** Leader: Pablo Clemente Colón Recorders: Joseph Cunningham/ Sarah Lilley OC: Tom Laughlin D. Edwards M. Druckenmiller D. Kirby D. Main R. MacDonald A. Mäkinen A. Mikhailov	**Group C** **Explosion Drill Rig** **Beaufort Sea** **Penobscot Room** Leader: Bruce Hollebone Recorders: Heather Ballestero/ Kim Newman OC: Doug Bancroft P. Bergmann V. Broje C. Johnson D. Thurston L. Trigatti D. Westerholm M. Williams
Group D **Collision Tanker & Fishing Vessel** **Norway/Russia** **Kennebec Room** Leader: Ron Morris Recorder: Steve Morgan OC: Ole Bjerkemo A. Bambulyak W. Blanchard, Recorder K. Juurmaa A. Merten, OC S. Pak G. Retter J. Weatherly	**Group E** **Barge with Explosives** **Bering Sea** **Narragansett Room** Leader: Vera Metcalf Recorder: Zachary Magdol OC: Drew Tucci L. Furgione L. Littlejohn, Recorder J. LoScuito J. Rice K. Schwehr J. Whitney	

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APPENDIX C

Arctic Incidents

Incident A

The M/V A, with 1400 passengers on board, runs aground while exiting a fjord on the West Coast of Greenland in mid September. Progressive flooding makes the ship unstable, and all must abandon ship. Some passengers and crew were injured in the grounding, requiring special medical attention.

Primary Objective: Explore issues associated with mass Search and Rescue (SAR) and salvage in a situation where self-rescue, or quick rescue by a maritime "good Sam" is unlikely.

- The response will involve SAR, salvage, and towing. Medical concerns for some passengers, approaching darkness, and less than ideal weather outlook require this be treated as an urgent SAR case.
- The response will have to identify temporary accommodations for the rescued persons, and transportation back to "civilization".
- The response will consider the possibility that other cruise ships may be in a position to assist within certain timeframes. It is likely that other such vessels would be available within 24 hours or less, but poor weather might reduce their ability to respond.
- The vessel has on board several hundred thousand gallons of intermediate fuel oil, as well as smaller amounts of lube oil, diesel fuel, and various hazardous materials associated with refrigeration, dry cleaning, and other ship services. The initial discharge may be relatively minor, but if the ship is not stabilized within 48 hours, heavy seas may destroy the vessel. Therefore, pollution response equipment must be mobilized and staged as a contingency.
- The ship is operated by a major cruise line, but under the flag of convenience.

Arctic Incidents

Incident B

The Bulk Ore Carrier B becomes trapped in the ice while attempting a late season crossing of the Arctic en route to the Bering Sea. Ice damages the rudder and/or prop shaft, making it unable to maneuver. The vessel's hull is initially undamaged, but at risk (vessel is sub-standard with questionable integrity even in the best of conditions) if forced to winter over. It carries copper ore, approximately 2,000 m3 (12,500 bbls) of heavy fuel oil, and 25 crew members.

Primary Objective: Explore legal and logistic issues associated with a potential SAR/pollution incident in the central Arctic Ocean

- Vessel is on the high seas at the time of distress, raising questions about what nation(s) has the authority to direct the vessel's owner/operator to take action, or to coordinate rescue and response operations.
- The response has a brief (~1 week) window where rescue/break out by ice breaker is possible.
- Ice strengthened salvage tugs will be needed to tow the vessel to port.
- If forced to winter over, will the crew be forced to stay onboard, or the vessel "temporarily" abandoned? As it is owned by single ship company and under a flag of convenience, there are significant doubts about the responsible party.
- If forced to winter over, who will support and supply the ship and crew? What if water intakes needed to run machinery become ice clogged, or vital systems fail?
- In-situ cargo unloading might be needed to access and inspect damaged areas of the cargo hold to determine the vessel's watertight integrity and make temporary repairs.
- A high viscosity pumping system may be needed to remove fuel, particularly if the fuel preheating system fails.

Incident C - revised

A drill ship and three support vessels (two oil spill response and one ice management) are involved in drilling an exploratory well 20 miles offshore and in 50 meters of water on the U.S.-Canada border. A fire in the engine room of the ice management support vessel leads the loss of control and causes the vessel to ram the drill ship rupturing the drill ships ballast tank. In an effort to right the drill ship, the operator vacates fuel wing tanks containing Arctic grade diesel fuel resulting in a spill of 700 barrels. The support vessel fire results in injuries as does the collision, with additional diesel spilled. Operations occur during mid-May under broken-ice conditions.

Primary Objective: Explore the technical challenges associated with fire fighting, evacuation, search and rescue, small oil spill response, and salvage of the platform.

- SAR issues should include burn and trauma victims.
- This scenario will involve evacuation, fire fighting, small spill response, and salvage of the platform.
- Proposed spill volume is 1000 bbls.
- Issues to be addressed include:
    - Responsible parties for SAR, firefighting and salvage operations
    - Emergency communications capability and protocols
    - Availability and use of fire fighting systems, personnel and equipment
    - Availability of responders and rescue assets
    - Response measures and capabilities for small spills
    - International Cooperation between the U.S. and Canada
    - The industry standard safety systems associated with these platforms and the need for redundant systems, operating restrictions (based on time of year/WX conditions), and oversight
- Canada and the United States have a Joint Contingency Plan that covers spills in this area. U.S. and Canadian participants should use this plan as a reference, and participants from other nations could evaluate the value of similar plans for their nations.

Arctic Incidents

Incident D

In near-zero visibility conditions, the tanker D maneuvers to avoid fishing vessel E near the boundary between Russian and Norway in their disputed region of the Barents. The last minute maneuver is not entirely successful, a collision occurs with damage to both vessels. The tanker releases ~ 4,000 m3 (25,000 bbls) of cargo (multiple tanks) ~48hr into the incident. The tanker should be towed to a Port-of-Refuge to avoid sinking; the F/V sinks or is damaged beyond salvage.

Primary Objective: Explore issues associated with a large (100,000 bbl+) oil spill in the Arctic region

The proximate cause of this incident is heavy icing/sleet causing near-zero visibility (March, early spring). Issues should be addressed concerning navigation standards in the Arctic (prevention) as well as complicating assessment and response efforts.

The fishing vessel will require a SAR effort, and the presence of sister vessels and the no visibility conditions will cause confusion as to how many persons or vessels are involved.

The fishing vessel will be part of a non-Arctic nation fishing fleet. The role of that Flag State M as a responsible party and stakeholder will be explored.

The environmental effects caused by the spill will impact commercial fishing and natural resources in both nations' EEZ.

A spill of this size will include in-situ burn as a response tool. Both nations (and vessels fishing or in innocent passage) will be involved in the logistics, approval, and monitoring.

Arctic Incidents

Incident E

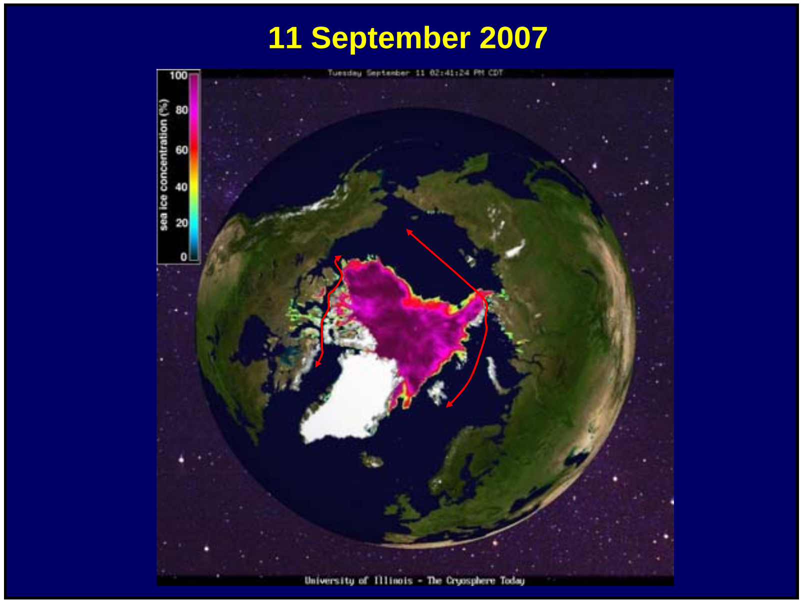
The tug F, towing a barge with explosives for a mining operation and other containerized cargo for Arctic communities looses power, is pushed by storms, and grounds on St. Lawrence Island (this is an environmentally sensitive area and haul out region for Steller sea lions and other endangered species.).

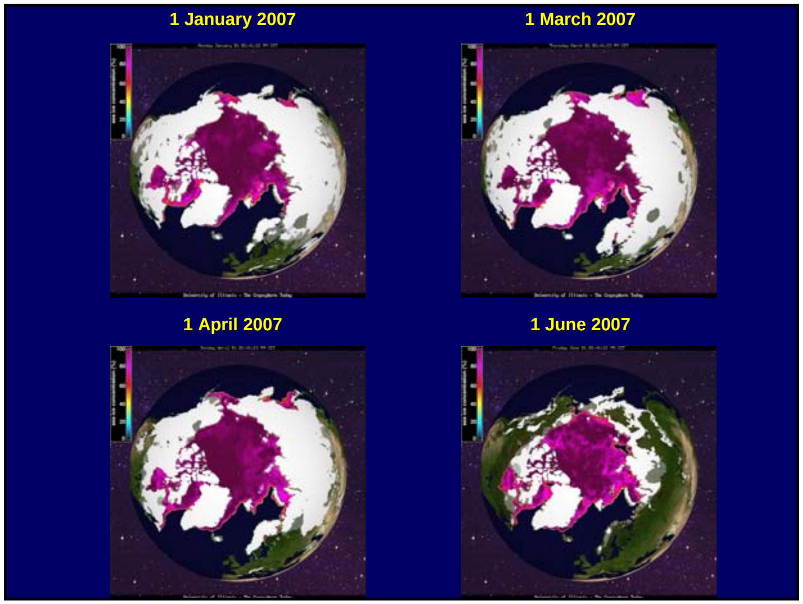
Primary Objective: Explore response issues in the Bering Sea near the Bering Strait chokepoint

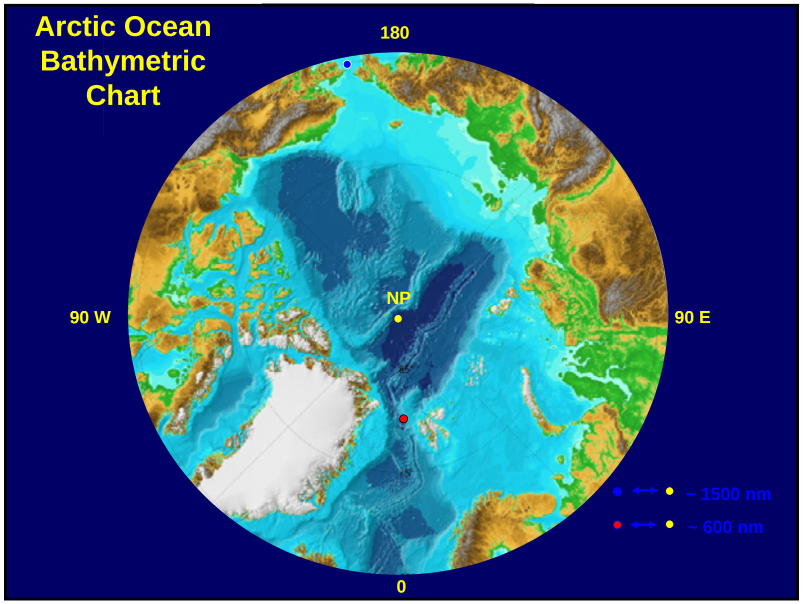
- The presence of explosives would significantly complicate the response efforts. The "no smoking" section of the site safety plan will be strictly enforced.
- Tugs in this type of operation carry large volumes of fuel, typically diesel
- The United States and the Russian Federation have a Joint Contingency Plan covering these waters
- As with the container ship NAPOLI (English Channel, January 2007), the response issues associated with hundreds of poorly marked cargo containers, many containing hazardous materials, are complex.
- The Bering Sea is a shallow sea, heavily used by both Great Circle transits between Asia and North America, and by a large international fishing fleet.

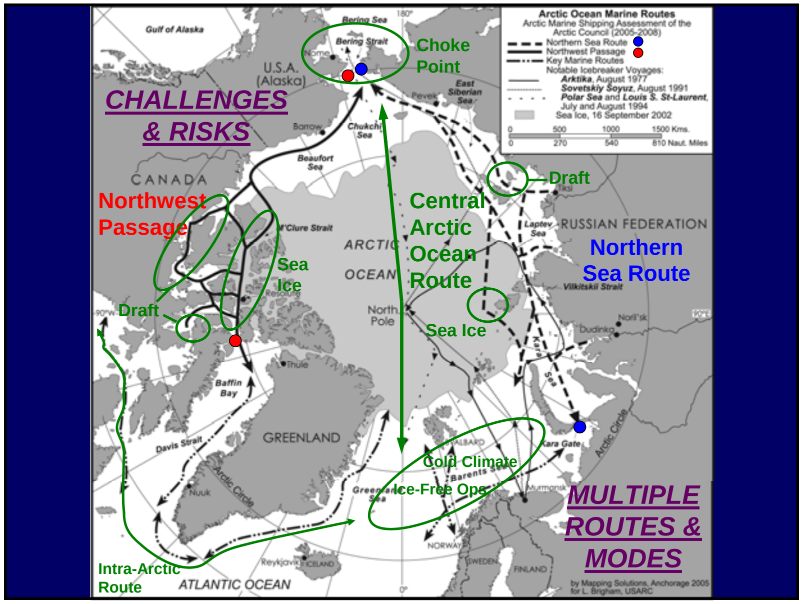
APPENDIX D


Arctic Marine Shipping Assessment:
What Is Driving Arctic Marine Use??
Opening the Arctic Seas: Envisioning Disasters & Framing Solutions
New England Center, UNH ~ Coastal Response Research Center
18 March 2008
Lawson W. Brigham, PhD
Vice Chair, PAME & Chair, AMSA
U.S. Arctic Research Commission ~ Anchorage

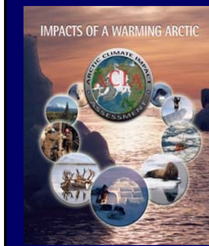

11 September 2007
Tuesday September 11 02:41:24 PM CDT
sea ice concentration (%)
100
80
60
40
20
0
University of Illinois - The Cryosphere Today


1 January 2007
1 March 2007
1 April 2007
1 June 2007

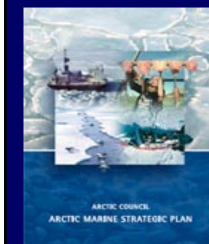

Arctic Ocean
Bathymetric
Chart
180
NP
90 W
90 E
0
~ 1500 nm
~ 600 nm



Arctic Marine Shipping Assessment (AMSA) Key Points



www.amap.no

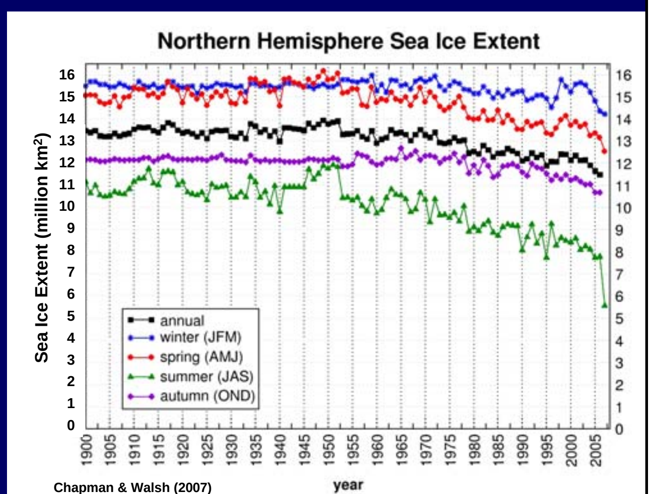


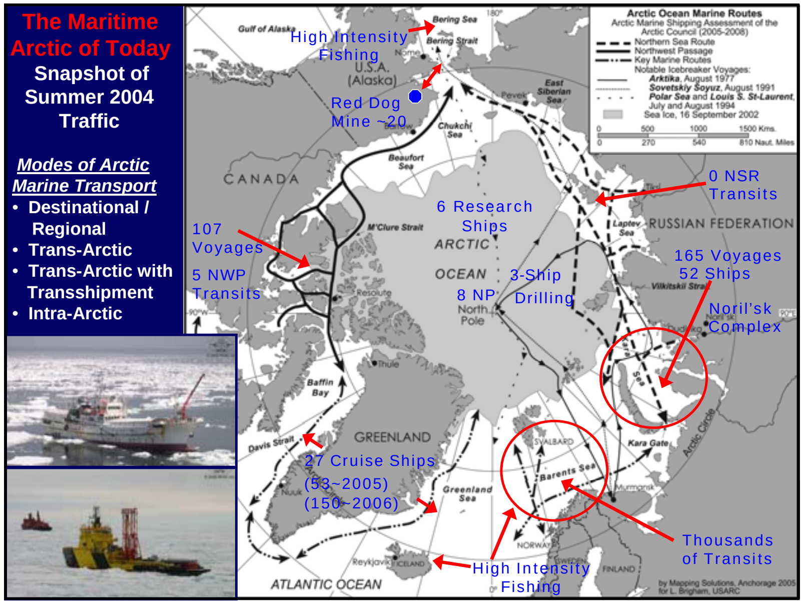
www.pame.is

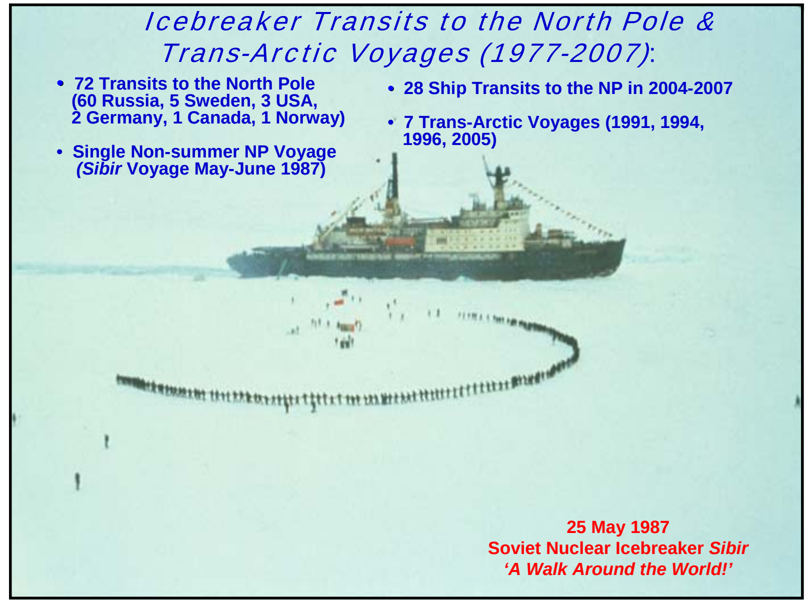
- AMSA Natural Follow-on to:
  - Arctic Climate Impact Assessment (ACIA)
  - Arctic Marine Strategic Plan (AMSP)
- Circumpolar, *yet* Regional *and* Local Focus
- Use Large Marine Ecosystems (LMEs) Concept
- Global Maritime Industry ~ Many Non-Arctic Actors
- Marine Safety & Marine Environmental Protection
- AMSA Leads ~ Canada, Finland & USA
- Member State Commitment & Support with Data Collection Effort (to Senior Arctic Officials)

Sea Ice

- Extent decrease is largest during summer
- Extent decrease is largest since late 1980s
- Extent seasonal decreases since 1950s







20 Key AMSA Uncertainties

- Stable legal climate
- Radical change in global trade dynamics
- Climate change is more disruptive sooner
- Safety of other routes
- Socio-economic impact of global weather changes
- Oil prices (55-60 to 100-150 USD?)
- Major Arctic shipping disasters**
- Limited windows of operation (economics)
- New Ice Age ~ Atlantic Changes
- Maritime Insurance Industry
- China and Japan become Arctic maritime nations
- Transit fees
- Conflict between indigenous & commercial use
- Arctic enforcers (police force)
- Escalation of Arctic maritime disputes
- Shift to nuclear energy
- New resource discovery
- World trade patterns
- Catastrophic loss of Suez or Panama Canals
- Global agreements on construction rules and standards.

"Stricken cruise ship off Antarctica evacuated" MSNBC- 11/23/07

Lawson Brigham, PhD
Chair, AMSA

Scenarios on the Future of Arctic Marine Navigation in 2050

more demand

Arctic Race

High demand and unstable governance set the stage for a "no holds barred" rush for Arctic wealth and resources.

Arctic Saga

High demand and stable governance lead to a healthy rate of development, includes concern for preservation of Arctic ecosystems & cultures.

RESOURCES & TRADE

unstable & ad-hoc — GOVERNANCE — stable & rules-based

Polar Lows

Low demand and unstable governance bring a murky and under-developed future for the Arctic.

Polar Preserve

Low demand & stable governance slow development in the region while introducing an extensive eco-preserve with stringent "no-shipping zones".

less demand

AMSA/GBN Scenarios Workshops ~ April & July 2007
The Future of Arctic Marine Navigation in 2050

AMSA Regional Case Studies ~ 2020

Russian Arctic ~ NSR Linkages

Distance (Nautical Miles) Hamburg to Yokohama

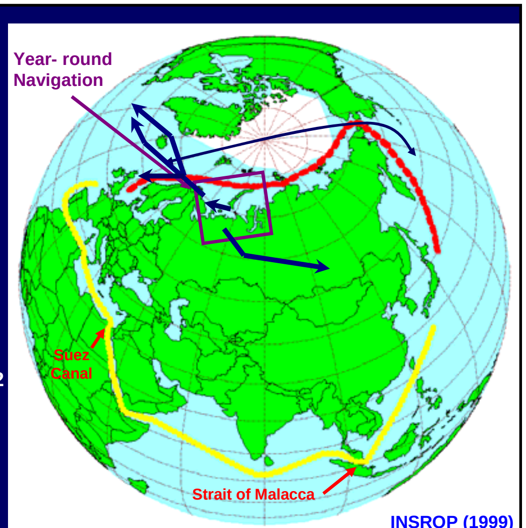
Northern Sea Route ~ 6,920

Suez Canal ~ 11,073

Panama Canal ~ 12,420

Cape of Good Hope ~ 14,542

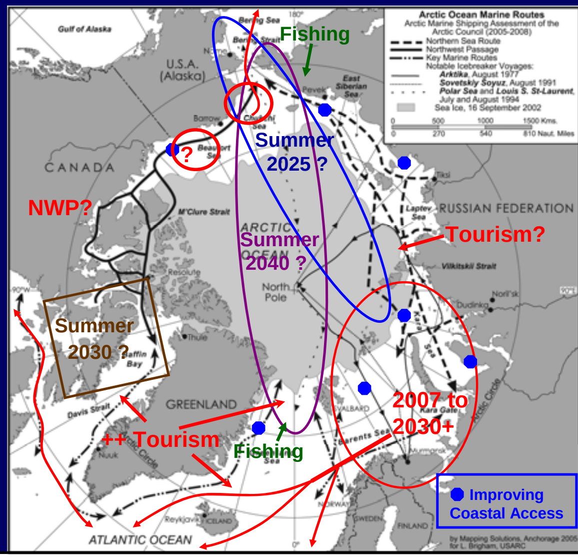
Pipelines vs. Arctic Tankers



Potential AMSA Findings

Primary Driver ~ Regional & Global Natural Resource Development
Lack of Integrated Governance-Regulatory Framework
Continued Sea Ice Retreat ~ Increased Access
Winter Arctic Sea Ice Cover Remains
New Ship Technologies ~ Allow Greater Access & Independent Operations (No Convoys)
Global Maritime Industry ~ Key Stakeholders
Minimal Arctic Infrastructure to Support Expanded Marine Activity & Provide Adequate Safety Net
Sectors: Oil & Gas, Hard Minerals, Tourism, Fishing & Water
Greatly Enhanced Monitoring Required
Intense Development ~ NW Russia & Norwegian-Barents-Kara Seas
Balance ~ Freedom of Navigation with Coastal State Marine Safety & Environmental Protection Interests
Lack of Experienced Mariners

The Maritime Arctic of the Future?



AMSA Final Report Structure

Chapter Outline

Chapters

1: **Introduction & Geography (US)**

2: **History of Arctic Marine Transport & Governance (US, CAN)**

'Governance Team' Ocean Policy Experts from Dalhousie U.

Review of Arctic Marine Technology (Finland)

3: **AMSA Marine Activity Data, Sea Ice & Accidents (2004) (CAN)**

2004 Snapshot Survey ~ All Ship Types

4: **The Human Dimension: Town Hall Meetings & Impacts (US & DEN)**

Town Hall Meetings in Canada, Iceland, Norway, US

More Planned in Canada, US, Greenland, Norway

Survey in the Russian Arctic (RAIPON)

Social & Economic Impacts

Current Marine Uses ~ Arctic Communities

5: **Scenarios & Futures (2020/2050) (US)**

Scenarios Workshops San Francisco (4/07) & Helsinki (7/07)

Drafting Scenario Narratives (Stories)

3 Regional (2020) Case Studies : Bering Strait, Canadian Arctic, Barents Region

6: **Environmental Impacts ~ Current & Future (NOR, RU)**

Scenarios Workshop & Arctic Ship Emissions Workshop

7: **Arctic Marine Infrastructure & Anticipated Needs (US, Iceland, EPPR)**

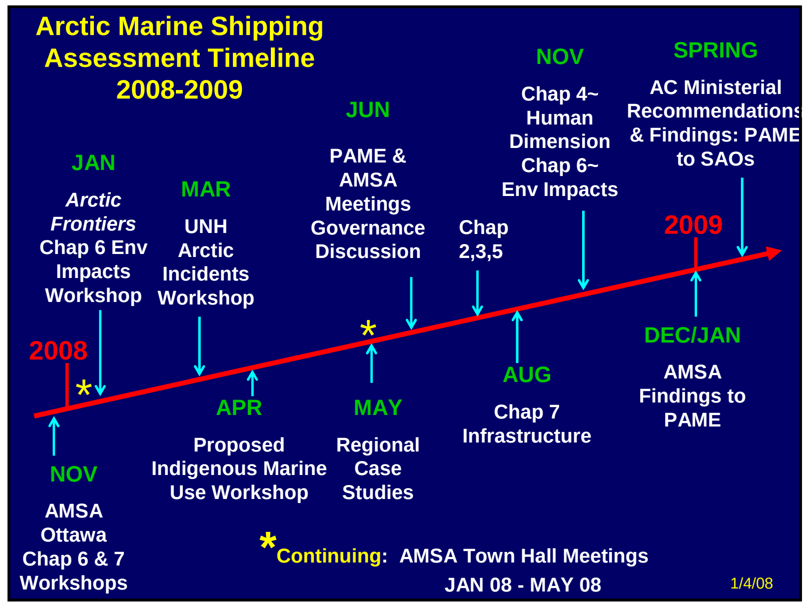
Infrastructure ~ SAR, Ports, Monitoring, Incident Response, Sea Ice Forecasts, Charting, Aids to Navigation, Vessel Traffic Systems, Oil Spills in Ice, & More

Baltic Case Study Underway (Finland)

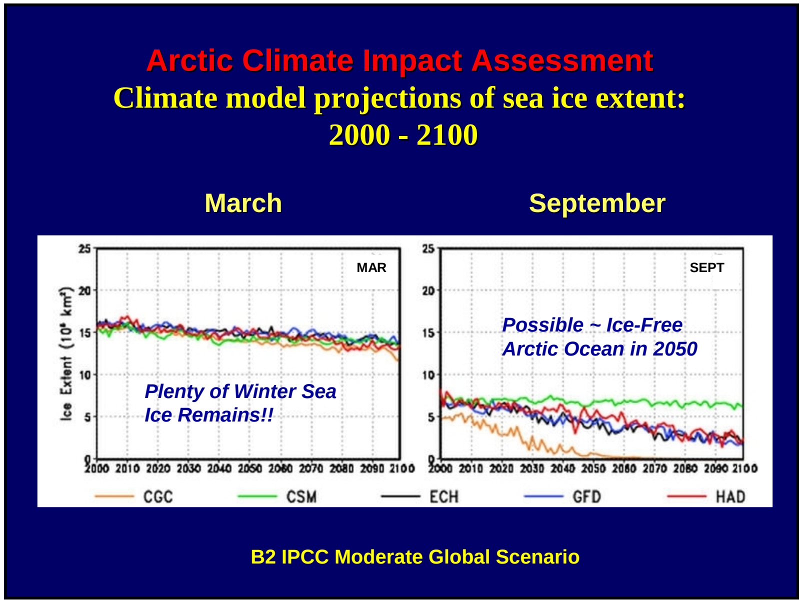
*Arctic Incidents Workshop ~ 18-20 MAR 08 (US-NOAA) ******

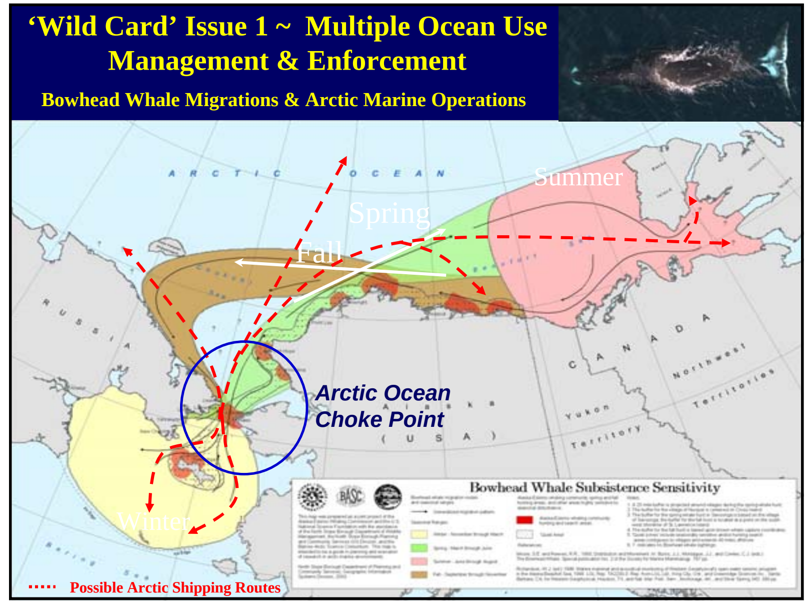
8: **Findings of the Assessment (All Authors)**

AMSA Research Agenda, Appendices



Lawson Brigham, PhD
Chair, AMSA





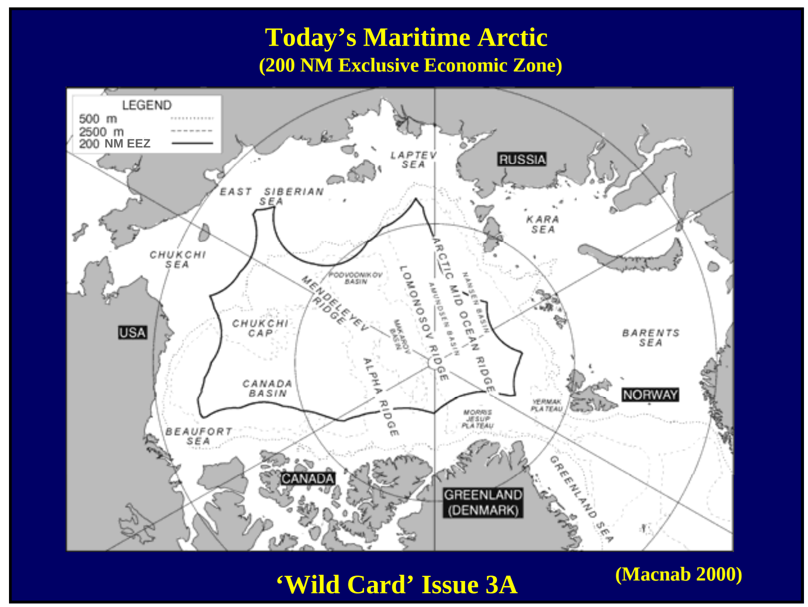
New pathway to pollution in Arctic

ONE of the bonuses of global warming is the potential for new shipping routes to open up through the Arctic as ice retreats, shortening journeys by many thousands of miles. There is a downside, however. New northern passages could significantly boost levels of low-lying ozone as ship exhausts pump pollutants into the pristine environment.

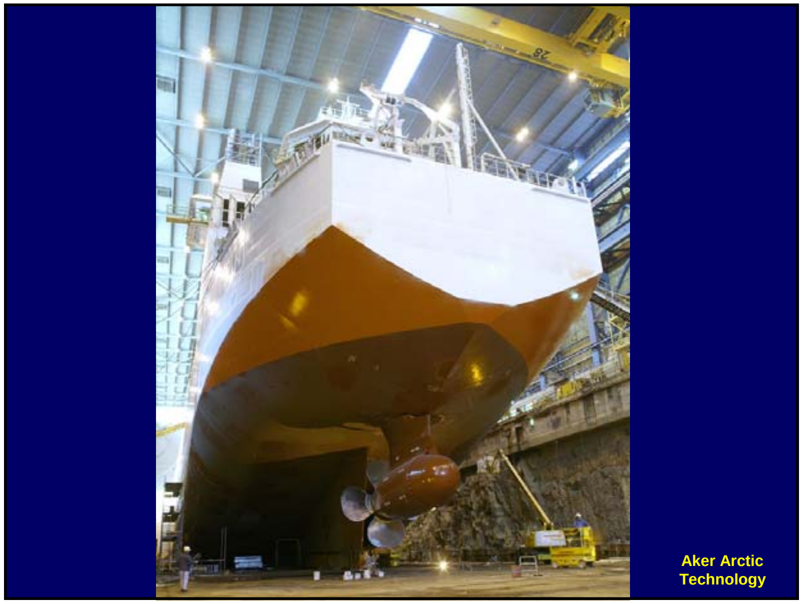
Climate models indicate that the northern passages – the north-east coast of Siberia, northern Alaska and around the Canadian archipelago – may be open to shipping during the summer months from around 2050 onwards. Claire Granier, from the University of Pierre and Marie Curie in Paris, France, and her colleagues calculated the likely ozone emissions associated with such a scenario, assuming that the routes would be accessible for six months of the year.

Emissions of nitrogen oxides and carbon monoxide from ships could triple ozone levels, making them comparable to those in industrialised regions today (*Geophysical Research Letters*, DOI: 10.1029/2006GL026180).

"The Arctic is a very sensitive region and these very high ozone levels are likely to have a serious impact on plant life," says Ulrike Niemeier, a co-author from the Max Plank Institute for Meteorology in Hamburg, Germany.



'Wild Card' Issue 4 ~ Technology
Future Convoy Requirements?
ARCTIC EXPRESS
Icebreaking (Double Acting) Container Ship
Norilskiy Nickel in the Kara Sea
March 2006
Aker Arctic



Aker Arctic
Technology

LNG
Aker Arctic Technology

Opening the Arctic Seas
Arctic Peoples – the Saami

By Gunn-Britt Retter
Head of Arctic and Environmental Unit
Saami Council

One People in Four Countries

- The Saami live in four national states
- Common language, culture and traditions
- Common Saami flag, national day and national anthem

Varangersaami

Ceavccegeađgi – Mortensnes:

- Settlements through 10,000 years
- one step on the ground is a step of 1000 years in history

Arctic Visions and Interests

- Land of discovery
- Storehouse of Resources
- Environemental linchpin
- The scientific Arctic

Arctic Council Arctic Human Development Report, 2004

Arctic Peoples' Homeland

Do you take any risks of ruining you home?

5

Climate Change – Arctic race

- More access
- More exploitation of resources
- More shipping
- More burning of oil and gas
- Excellerate Cliamte Change

6

The United Nations
INTERNATIONAL COVENANT ON CIVIL AND POLITICAL RIGHTS

Article 27

"In those States in which ethnic, religious or linguistic minorities exist, persons belonging to such minorities shall not be denied the right, in community with the other members of their group, to enjoy their own culture, to profess and practice their own religion, or to use their own language."

7

Free, prior and informed consent

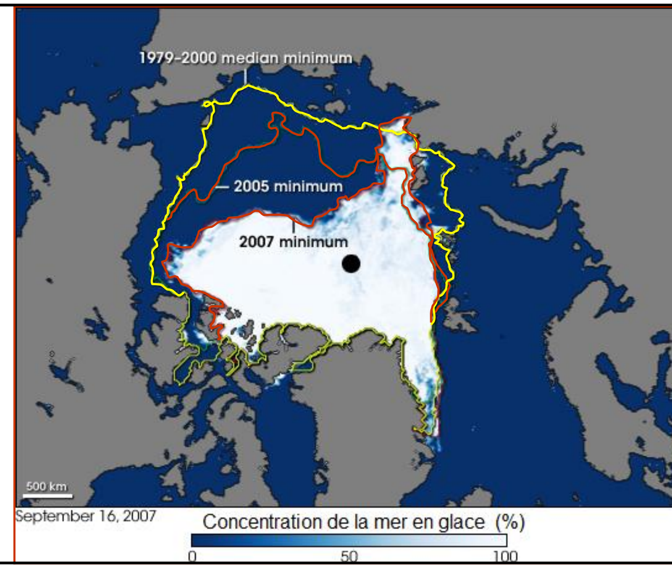
- direct and binding negotiations with Indigenous Peoples

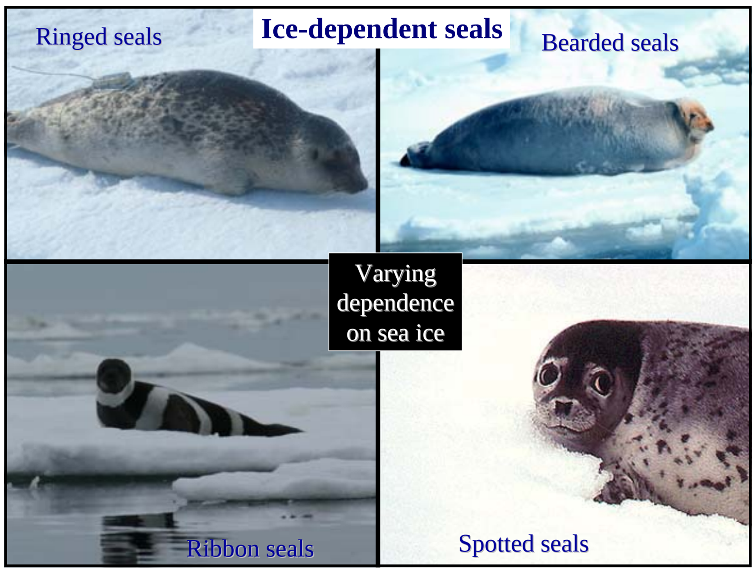
8


Do you take any risks of
ruining you home?

Biological Perspectives---
Outline

- Biology problems without ICE
- Most Vulnerable species types with OIL
- Most vulnerable habitats with oil





Species at High Risk: Ice-Dependent Marine Mammals

Forage—

Reproduction—

Candidates for ESA listings

Baselines???

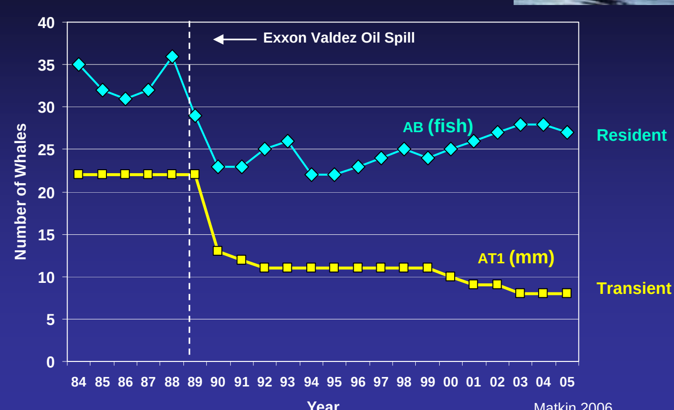
Add oil spill to the Arctic-

What species are most vulnerable?

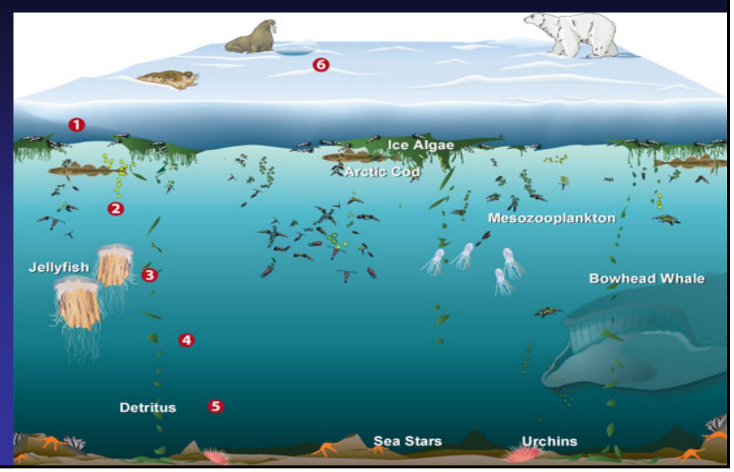
Air Breathers are **most vulnerable** to spilled oil

PWS Orca Survival After the *Exxon Valdez* Oil Spill

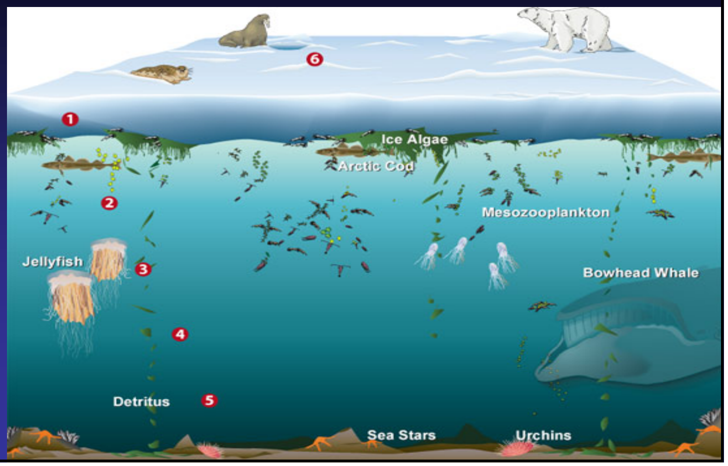
Residents / Transients



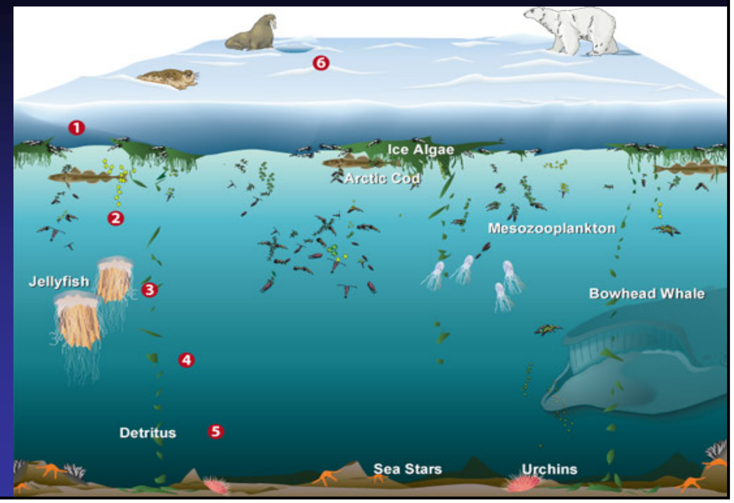
Where is the OIL? **On top (easier to recover?)**



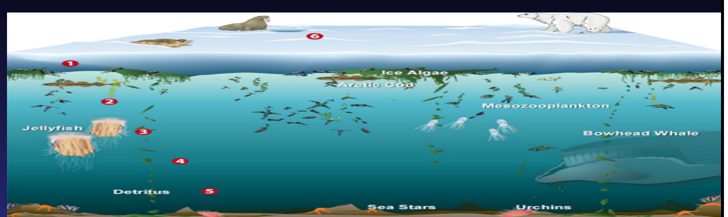
Where is the OIL? **"In the ICE? (persistence?)**



Where is the OIL? **Under the ICE?**



Where is the OIL? **On the bottom?**



Will the shallow Benthic habitat be affected?
Benthic habitat over shallow shelves
Is Important

Arctic Tourism: Past, Present and Future

Opening the Arctic Seas:
Envisioning Disasters and Framing Solutions

Dr. John Snyder
Strategic Studies, Inc.
Centennial, Colorado

Two Centuries of Arctic Tourism

1807 Arctic travel guides and journals are published for:

- Mountaineers
- Anglers
- Hunters
- “Knapsack” Adventurers

1850’s Mass tourism enabled by:

- Steamships
- Railroads
- Increased personal wealth
- More leisure time

Arctic Tourism Industry Now Very Diverse

- Mass Tourism
- Sport Fishing & Hunting
- Nature Tourism
- Adventure Tourism
- Cultural Tourism

Economic Importance of Arctic Tourism

- **Arctic economies rely on tourism for sales revenue, jobs, personal income, and public finance revenues.**
  - Norway: 370,000 cruise passengers visited Norway in 2007, double the number that arrived in 2000. Svalbard had 45 cruise calls, 17 more than in 2006.
  - Iceland: tourism is nation's second largest industry with annual growth of 9 % since 1990
  - Canada: Cruise ships doubled in 2006, from 11 to 22. Inuit-owned Cruise North Expeditions will enter market with 2008 trips to Ellesmere Island.
  - Russia: Northern Sea Route, White and Barents Seas now have cruise tourism. Kamchatka and Kola Peninsulas offer wildlife tours.
  - Alaska: 2007 cruise visitor volume was 1,029,800. This is an increase of 7.3 percent to between 2006 and 2007.
- Tourism development is goal for Greenland, Nunavut, Manitoba, Yukon, Sami, Russian Federation, and Native Alaskan economies.

Human Impacts of Arctic Tourism

Magnitude
- The single largest human presence in the Arctic are tourists.
- Tourists now exceed their host populations at ALL destinations.
- Majority travel by ship.

Social Issues
- Communities seasonally transformed
- Emergency and law enforcement resources strained.
- Social institutions often overwhelmed

Tourist Perceptions
- No terror threats in the Arctic
- Climate change publicity is priceless advertising.
- Response to scarcity – see the Arctic and its wildlife before it is "lost".

Cultural Resource Conservation: A Difficult Challenge

Economic Benefits
- Provides jobs, income, government revenues.
- Provides on-site market for numerous Native products.
- Cultural preservation of native arts, language and practices.
- Participation in the market economy.

Cultural Impacts
- Additional tourists further stress increasingly scarce natural resources.
- Stressed resources results in stressed ways of life.

The Future: "Reduced Barriers to Entry"

Improved Access
- **Reduced amount and duration of Arctic sea ice**
- **Weather conditions becoming more tolerable**
- **Improved transport technologies**
- **New and expanding infrastructure**

Cost of Travel
- **Increasingly affordable**
- **More personal wealth to facilitate travel**

Time to Travel
- **More leisure time**
- **Large population now entering retirement.**

Jurisdictional Constraints Removed
- **Allowable entry replacing prohibited access**
- **Closure of military bases and reduced security restrictions.**

Allowable Entry Replaces Prohibited / Difficult Access

Allowable tourism entry, primarily motivated by economic development, strongly promotes Arctic regions that were previously inaccessible.

New entrants include:
- Russia
- Greenland
- Nunavut

Future Impacts Of Reduced "Barriers To Entry"

- **Growing number of Arctic destinations.**
- **Length of seasons expanding.**
- **Duration of the tourist visit increasing.**
- **Collectively, the result will be**
  - **larger numbers of tourists**
  - **spending more time**
  - **in more locations.**

New Destinations: North Pole, Northwest Passage, Northern Sea Route, Wildlife Habitats, and Heritage Sites

- 1984 the *Lindblad Explorer* pioneered tourism through the Northwest Passage.
- Since then, new polar routes transited by ice breakers, private yachts, charter vessels, and even submersibles.

Transits well documented in publications by Brigham, Armstrong, and Ellis.

Polar Tourism Marine Incidents

2007 *Explorer* sinks during Antarctic polar tourism cruise.

Marine Incidents Involving Polar Cruise Ships

MARINE INCIDENT	TOTAL EVENTS	EVENTS SINCE 2000	PERCENT SINCE 2000
Polar Cruise Ships Sunk, 1979 – 2007	8	5	63 %
Polar Cruise Ships Running Aground, 1972 – 2007	27	16	59 %
Pollution and Environmental Violations, 1992 – 2007	40	18	45 %
Disabling by Collisions, Fires, Propulsion Loss, 1979 - 2007	28	22	79 %

SOURCES: Public Media Sources, Ross A. Klein, Ph.D., and www.cruisejunkie.com

Summary of Cruise Ship Illness Outbreaks, 2002 - 2007

Year	# of Reports	Total Sick
2002	43	3530
2003	44	3556
2004	42	3675
2005	35	4674
2006	54	6815
2007	33 (7 Polar Cruises)	4166

Can Arctic infrastructure respond to this incident?

SOURCE: United States Center for Disease Control (CDC).

Arctic Environmental Contaminants: New Human Exposures

Tourist exposure to Arctic environmental contaminants is an issue receiving little attention. Examples include:

- **Cold War Legacy:** Numerous contaminants, often located in isolated caches. Leakage is a serious environmental threat and exposure to those toxins is hazardous.
- **Historic Structures:** Abandoned canneries, whaling and sealing stations, and explorers' huts are simultaneously tourist attractions and health threats.
- **Soviet Union's Environmental Pollution:** Tourists potentially exposed to contaminants now that the Arctic's largest land mass seeks to attract tourism.

Navigating the Future

SOLUTIONS TO PREVENT HARM

- **Information for Safe Operations**
  - Ice Conditions
  - Weather
  - Hydrographic Charts
  - LRIT Long Range Identification and Tracking
- **Guidelines for Safe Operations**
  - IMO Guidelines for ships operating in Arctic ice covered waters (Govt.)
  - Association of Arctic Expedition Cruise Operators Guidelines (Industry)
  - WWF Arctic: Ten Principles for Arctic Tourism (NGO)
- **Infrastructure**
  - Environmental Incidence Response
  - Ports
  - Search and Rescue
  - Medical Evacuation & Care
  - Navigational Aids
  - Salvage
  - Waste Disposal
- **Human Resources**
  - Mariners
  - Ice Navigators
  - Emergency Service Providers
  - Maintenance Personnel
  - Environmental Managers and Monitors

ARCTIC TOURISM: THE FUTURE IS NOW

GREENLAND CRUISE TOURISM: 2006

No. of calls = 157
No. different ships = 28
Total Cruise Tourists = 22,051
Greenland's Population: 56,901

"Tourism is growing – and a feeling of optimism generally pervades the tourist industry. However, this optimism is not shared at all places along the coast. A political decision needs to be made on the future of the country's infrastructure and thereby under which conditions the tourist industry can expect to be able to develop within the coming years."

Sources: Greenland Port Statistics for 2006;
Greenland Tourism & Business Council, 2006 Annual Report

Oil and Gas Activities in the Arctic

From an Assessment of the Arctic Council

Co-Leaders

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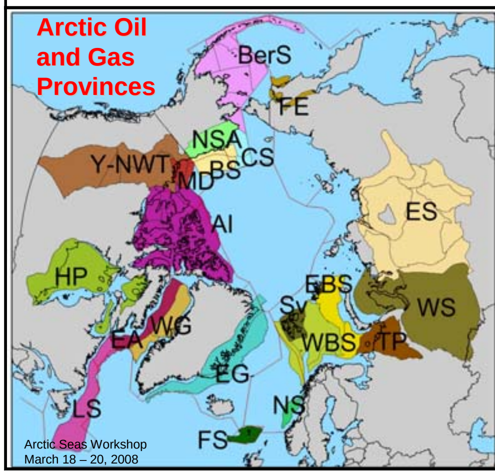
www.amap.no

Scope of the Assessment

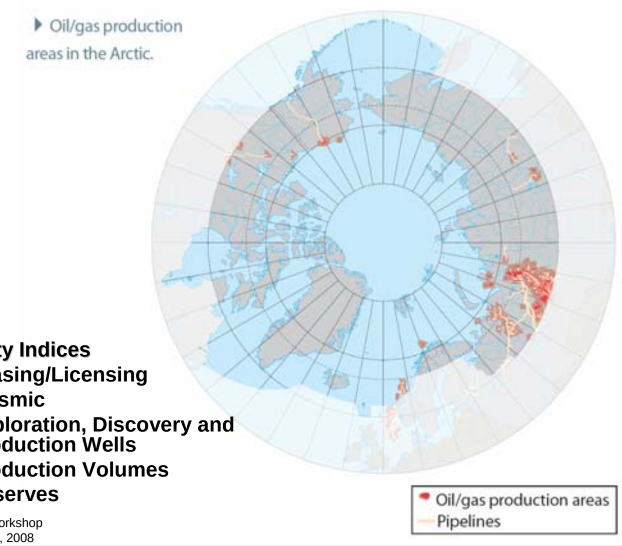
- **Detailed evaluation of activities**
- **Social and economic effects**
- **Environmental effects from pollution**
- **Environmental effects from physical disturbances**
- **Effects on human health**
- **Status and Vulnerability of Ecosystems**

Oil and Gas Activities

***Robert P. Crandall**, State of Alaska AOGCC (retired)*
***Dennis K. Thurston**, MMS*



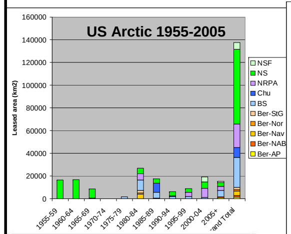
FE	**Far East Russia**
ES	**East Siberia**
WS	**West Siberia**
TP	**Timan-Pechora**
EBS	**East Barents Sea**
WBS	**West Barents Sea**
Sv	**Svalbard**
NS	**Norwegian Sea**
FS	**Faroes Shelf**
EG	**East Greenland**
WG	**West Greenland**
EA	**Eastern Arctic Canada**
LS	**Labrador Shelf**
AI	**Arctic Islands**
HP	**Hudson Platform**
MD	**Mackenzie Delta**
Y-NWT	**Yukon-Northwest Territories**
BS	**Beaufort Sea**
CS	**Chukchi Sea**
NSA	**North Slope Alaska**
BerS	**Bering Sea**

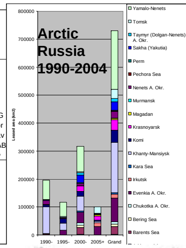


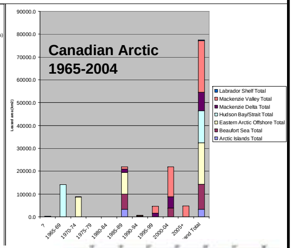
Activity Indices

- **Leasing/Licensing**
- **Seismic**
- **Exploration, Discovery and Production Wells**
- **Production Volumes**
- **Reserves**

Leasing and Licensing

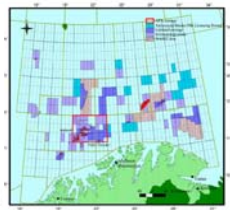






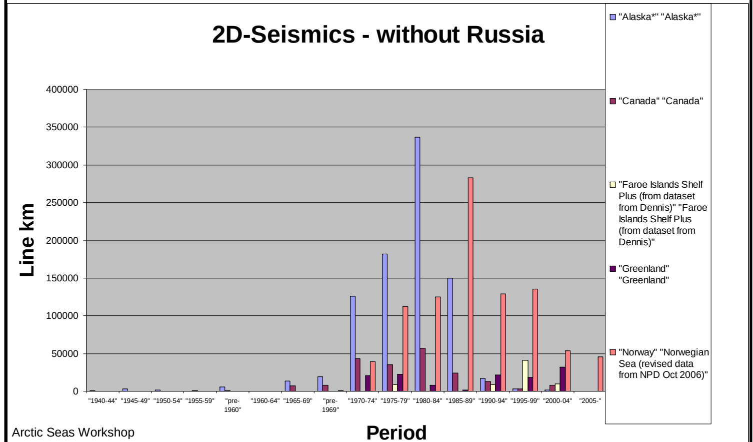
Offshore Alaska Lease Areas 2007-2012

Russian Barents Sea Area Tenders



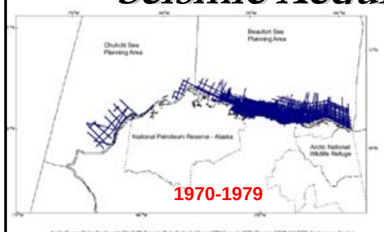
Norway Licenses and 19th Round

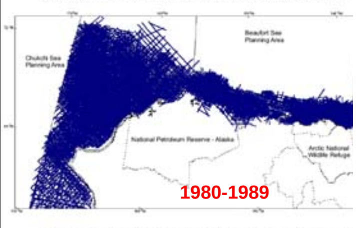
Seismic Data Acquisition

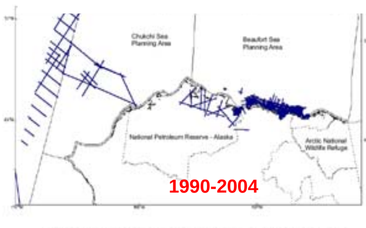


Seismic Acquisition Alaska

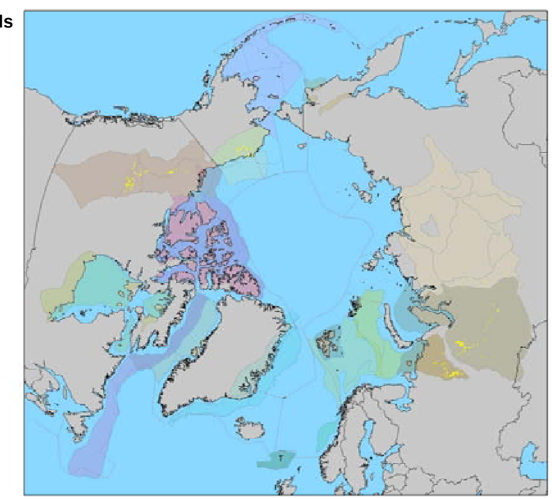
Offshore and over ice seismic Surveys from 1970-2004



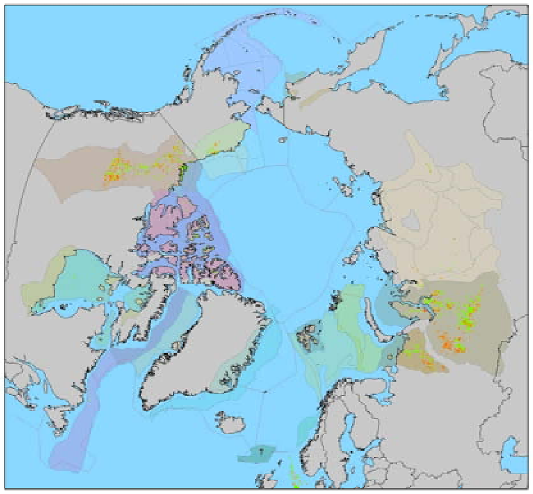




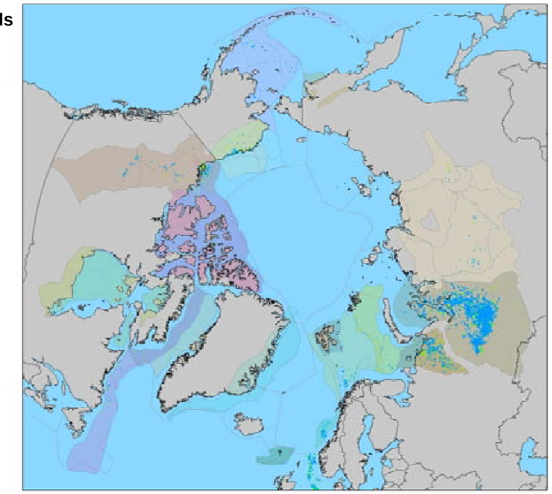
Arctic Wells drilled
pre-1960



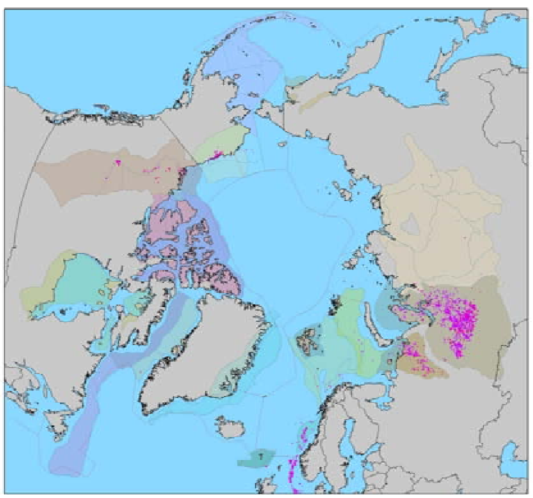
Arctic Wells drilled
1960-1975



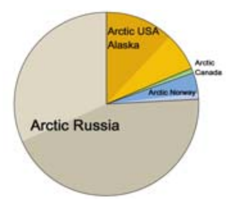
Arctic Wells drilled
1976-1989



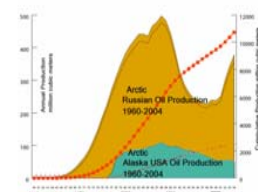
Arctic Wells drilled
1990-2004

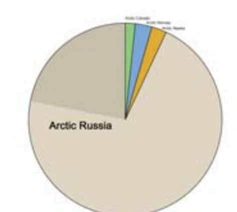


Arctic Oil and Gas Production

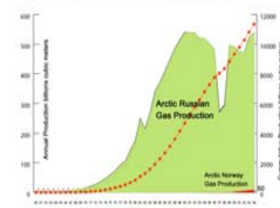


Oil



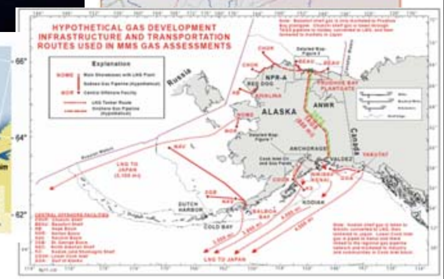


Gas



Oil and Gas activity is likely to expand into new Arctic areas

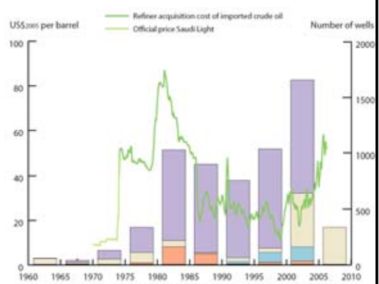
Arctic oil and gas transportation systems will expand

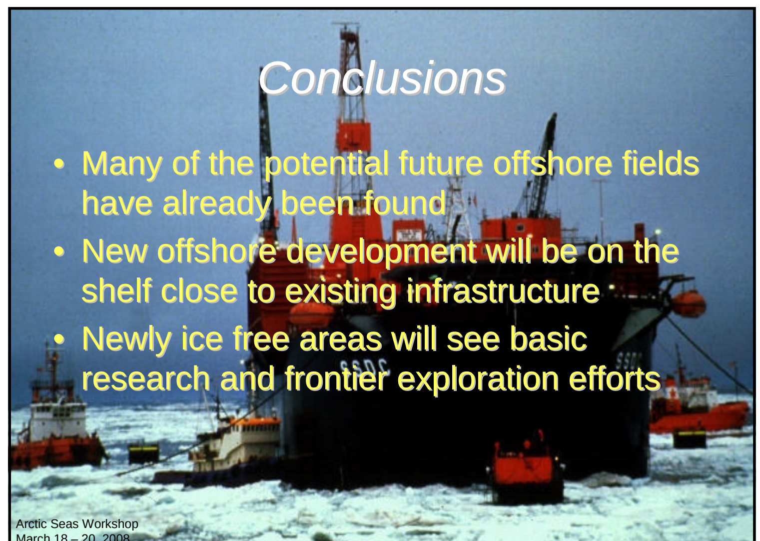


Levels of activities in the Arctic are affected by many factors

Areas Leased or Licensed for Petroleum

Production wells drilled

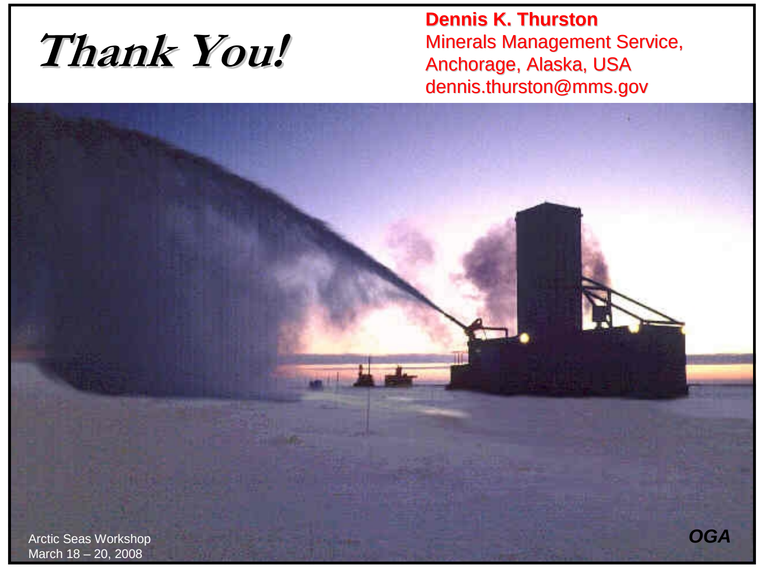




Conclusions

- Many of the potential future offshore fields have already been found
- New offshore development will be on the shelf close to existing infrastructure
- Newly ice free areas will see basic research and frontier exploration efforts


Recommendation
Prevent oil spills
• It's harder to clean it up than it is to prevent it from happening.
• It's easier to get money to clean it up than it is to fund prevention measures


Thank You!
Dennis K. Thurston
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Arctic Seas Workshop
March 18 – 20, 2008
OGA

Fisheries and Oceans Canada / Pêches et Océans Canada
Canadian Coast Guard / Garde côtière canadienne

Arctic Search & Rescue

Envisioning Disasters and Framing Solutions
Plenary Session

Larry Trigatti
C&A Region

18-20 March, 2008

Canada

Fisheries and Oceans Canada / Pêches et Océans Canada
Canadian Coast Guard / Garde côtière canadienne

Discussion Points

- Activity/Interaction
- Legislation
- Prevention, Preparedness & Response
- Arctic Conditions

Canada

Fisheries and Oceans Canada / Pêches et Océans Canada
Canadian Coast Guard / Garde côtière canadienne

- Seaborne Activities
  - Vessel transits
  - Production Rigs
  - Coastal Facilities
  - Air transit
  - Small Craft
- Legislation
  - Requires preparedness

Canada

Fisheries and Oceans Canada / Pêches et Océans Canada
Canadian Coast Guard / Garde côtière canadienne

Prevention – Prep & Response

- 28.35 g = 0.4536 kg
- SAR – National Coordination through DND
- ER – Division of Mandates/Labour

Canada

Fisheries and Oceans Canada / Pêches et Océans Canada
Canadian Coast Guard / Garde côtière canadienne

Arctic (Remote) Conditions

- Physical Properties (weather, geography, natural resources)
- Human & Social Properties (density, infrastructure)
- Relativity/Availability (D/S/T: magnitude between availability and application)

Canada

Basic Response Model

- Alerting & Detection
- Response
- Re-set/Recovery

Canada

Major Marine Disaster Contingency Plan *DND*

Canada

SAR Organizations

- NFLD – 43 /0.5 M
- NU – 7 /30,000
- NT – 17 /43,000
- YK – 19 /30,000
- BC – 133 /3.7M

Canada

Pollution

- Vessels – Canadian Coast Guard
- Oil/Gas – National Energy Board
- Coastal refineries and Facilities – Territorial Gov't
- Coordination/Overlap

Hi-Lights

- Focus remains on PREVENTION
- Legislated systems in place for Preparedness and Response
- Communications are critical
  (Alert, Detect, Response Phases)
- Location = Challenges
- Continuous Review/Improvement

Thank You – Questions?