Highlights of

Canadian Marine Shipping Risk Forum

WORKSHOP ON STATE OF THE ART IN SHIPPING RISK AND MODELLING

"The broad representation in the room was a pleasant surprise and bringing these diverse perspectives together was beneficial."

Bryden Bone, Fisheries and Oceans Canada, December 2, 2019

ABOUT THIS REPORT

This report summarizes highlights of the one-day workshop, "State of the Art in Shipping Risk and Modelling" convened by the Canadian Marine Shipping Risk Forum (CMSRF) in Halifax, NS, Canada on December 2, 2019.

This workshop was held adjacent to, and with the support of, the 15th ArcticNet Annual Scientific Meeting in Halifax, NS. The workshop aimed to engage a broad community of practitioners in shipping research and application, considering risks to and from ships in Canada.

The CMSRF is a MEOPAR-funded Community of Practice providing an ongoing forum for communicating about and identifying potential collaborations on shipping risk in Canada.

The focus of this workshop is on 'state of the art' in modelling which can help build a point of reference in terms of contemporary works, from which the Community of Practice will continue to evolve and grow, keeping members engaged as new developments and approaches arise.

The workshop hosted speakers on topics such as "Multidisciplinary Approaches to Shipping Risk", "Data and Modelling for Shipping Risk" and "Qualitative vs. Quantitative Risk Assessments", followed by roundtable discussions on these issues.

The workshop was structured to explore the topics of interest and relevance identified by participants in an October 2019 webinar as worthy of knowledge sharing and further investigation and discussion.

The interest in the workshop's topics was indicated by the engaged participation of 80 representatives from academia, industry, government, non-governmental organizations from across Canada.

The workshop structure combined informative presentations with interactive group discussion to address topics ranging from practical applications to policy making, from multi-stakeholder engagement to data sharing.

The members of the organizing committee would like to extend special thanks to ArcticNet for its support in providing a venue for this workshop to take place.

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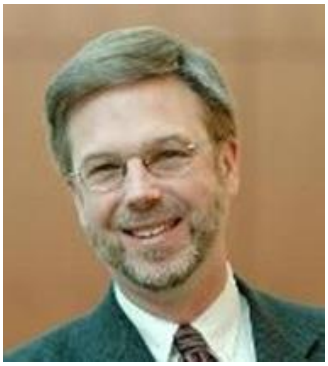
MESSAGE FROM STEERING COMMITTEE

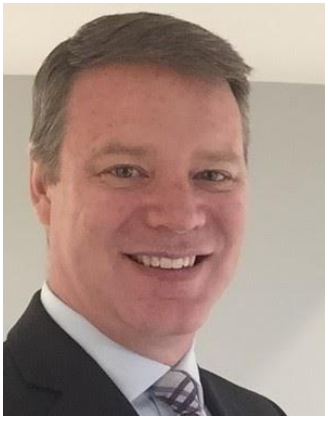
Paul Blomerus
Executive Director
Clear Seas

On behalf of Clear Seas, I would like to thank all the speakers and participants for sharing their insights, knowledge and collaborative spirit during this shipping risk workshop. This event confirmed the need for a forum to share best practices, exchange resources and collaboratively develop new approaches for the assessment and management of shipping risk in Canada. Working together to create standardised approaches using the most up to date data will help us to achieve our goals of the highest standards for safe and sustainable marine shipping.



Dr. Ronald Pelot
Assoc. Scientific Director
MEOPAR

MEOPAR was pleased to co-sponsor this event, which was successful on many fronts. The multi-sectoral participation from different levels of government, NGOs, industry and academia was instrumental in addressing the broad range of issues surrounding marine traffic management. A very useful feature was that the presentations ran the gamut from observations (data), to modelling, to decision support and risk management issues, an integrative approach which forms the backbone of MEOPAR's approach to tackling complex marine issues. The outcomes from the workshop will help prioritize and focus efforts to advance this important topic, bolstered by new relationships facilitated by the workshop.



Peter Dorcas
Vice President, Business Development
exactEarth Ltd.

At exactEarth we were very happy with the wide breadth of topics covered by the presenters and panelists, and the enthusiastic participation by attendees as evidenced through their questions after every presentation and during the networking breaks. We now have a much better understanding of the challenges faced by maritime authorities, and the type of information that researchers require. The insights collected were extremely useful, and exactEarth was thrilled to have partnered with Clear Seas & MEOPAR in conducting a successful workshop.

WORKSHOP OVERVIEW

MEOPAR, Clear Seas and exactEarth hosted an interactive workshop on December 2, 2019 in Halifax, NS on state of the art in shipping risk and modelling in Canadian waters.

This workshop was the first in a planned series of annual workshops over three years to explore related topics in shipping risk and modelling and provide a recurring forum for knowledge exchange.

This workshop series is in response to the need identified within the Community of Practice mandate, as established from prior workshops and consultation with the Steering Committee, that there exists a distinct lack of venues for discussing practical elements around shipping risk modelling.

Shipping risk modelling approaches encompass a wide variety of interdisciplinary fields. The purpose of this one-day workshop was to share developments and best practices for shipping risk, considering multidisciplinary approaches, data sources and modelling approaches, and qualitative vs. quantitative assessments.

With the focus of this workshop on 'state of the art' in modelling, the Community of Practice seeks to help build a point of reference in terms of contemporary works, from which to evolve and grow, keeping members informed and engaged as new developments and approaches arise.

Additional desired outcomes from this workshop included seeking interested participants to join the Community of Practice or contribute their perspectives and expertise through online platforms and future workshops.

Further, we anticipated potential research collaborations, knowledge sharing and communication among participants, including calls for proposals and new initiatives that fall within our scope. This information will also be communicated through our Community of Practice website. The identification of applied and research projects among different groups in this domain is a valuable means of ensuring that approaches, techniques and knowledge are effectively coordinated.

ABOUT THE CMSRF COMMUNITY OF PRACTICE

This Community of Practice was formed in response to an identified need in Canada for an on-going forum to discuss developments in marine shipping modelling and risk assessment. The MEOPAR Research Network, in collaboration with the Clear Seas Centre for Responsible Marine Shipping and exactEarth Ltd, launched this Community of Practice to be open to, and supportive of, people and organizations working and doing research in these fields, and to network and share knowledge on these topics.

This Community of Practice – focused on modelling and risk assessment for marine shipping – is one of eight such communities supported by the MEOPAR Research Network to:

- Help to mobilize knowledge, enrich research and identify knowledge gaps, and encourage collaboration between academics, practitioners, policy-makers and community groups.
- Provide a way for practitioners to share best practices, ask questions of their colleagues, and provide support for each other.

The Canadian Marine Shipping Risk Forum Community of Practice will focus on the exploration of risks from – and to – shipping within Canadian waters, with three primary interest areas:

- Shipping movement data
- Shipping traffic modelling
- Shipping risk quantification and assessment

The anticipated outcomes of this Community of Practice and its activities include:

- Identifying best practices for shipping modelling and shipping risk analysis
- Maintaining active discussion on new developments in marine shipping data sources
- Identifying gaps in marine shipping risk assessment and sharing knowledge to address them
- Engaging with stakeholders and highly qualified personnel to develop further knowledge on approaches for considering shipping risk as well as techniques on shipping data handling through the inclusion of training components within each of the year 2 and 3 workshops.

Ultimately, this Community of Practice will provide a focal event for identifying, discussing and furthering application of best practices for shipping modelling and shipping risk analysis, topics inherently interdisciplinary in nature.

WORKSHOP OBJECTIVES

1. Introduce the Community of Practice and establish its purpose and potential uses
2. Communicate current and upcoming issues and recent developments
3. Share knowledge for marine shipping risk research and practice

WORKSHOP HIGHLIGHTS

Welcome and Context Setting

Andy Smith, Deputy Commissioner, Strategy & Shipbuilding, Canadian Coast Guard

The Canadian Coast Guard's motto is "Safety First, Service Always" and an understanding of shipping risk is essential to achieve that goal. Deputy Commissioner Smith welcomed workshop participants and provided his valuable insights and perspective on the topic of marine shipping risk.

The invention of the microscope changed the way we see the world and work with facts and data. The Coast Guard has always relied on people to identify and plan for risks. However, times are changing and people need to incorporate technology, data, and community perspectives to gain a full understanding of the issues.

The introduction of the Automatic Identification System (AIS) was a game-changer for the Canadian Coast Guard as AIS provided a full picture of ship activity. This level of detail allows for study of past activity to support better future decisions and service.

An example of a shipping risk issue the Canadian Coast Guard is addressing with a multidisciplinary approach is the provision of icebreaking services in Canadian waters. Icebreaking requires situation awareness, using a combination of satellite and surveillance technology as well as communications with ship operators to maintain traffic flow. The Coast Guard fleet is finite; bringing ships to one area risks leaving another area exposed.

Canada requires icebreaking services both north and south of 60 degrees, which places significant demands on a finite and aging fleet, as the nearly year-round schedule of icebreaking in the Great Lakes, Atlantic, and Arctic regions allows for little maintenance time. One technological mitigation measure the Coast Guard is assessing is the concept of a "digital twin" to support proactive maintenance.

The Canadian Coast Guard is focused on marine traffic safety in all waters, but the Arctic in particular requires active shipping risk assessment and mitigation, from the

perspectives of both environmental response and search and rescue response. The Arctic is seeing an explosion of interest: ships are coming earlier and staying later. To be ready for increased search and rescue requirements in the north, the Coast Guard has to reconcile shipping needs, environmental concerns, and work effectively with Indigenous partners to effectively prepare.

Approach

The workshop provided a series of presentations on relevant topics, with a breakout discussion session amongst participants following each topic area.

The discussion sessions were guided by a series of questions intended to gather knowledge and identify gaps for future research on that topic area, and supported by a facilitator/scribe at each of the tables.

The discussion questions included:

1. Are you aware of any other related works on this topic?
2. What are the challenges or gaps on this topic? Where is more work or research needed?
3. What key data sources would benefit work on this topic?
4. How would you prioritize the challenges or gaps in this topic area? What is most important and/or needs to be tackled first?
5. How can the Community of Practice help address the challenges or close the gaps you've identified?
6. Are there any other comments on this topic area that you would like to share?

Session 1: Multidisciplinary Approaches to Shipping Risk

Speaker	Jackie Dawson, University of Ottawa
Topic:	Arctic Corridors and Northern Voices: An example of a multidisciplinary approach to shipping risk assessment in the Arctic
Highlights	Shipping risk assessment needs to consider culturally, environmentally, and commercially important areas for corridors. For example, ice in the north is changing, which changes risks:

- Risks to ships include pressured ice and mobile ice, especially with a decreasing number of ice-class ships operating in the Arctic.
- Risks from ships include ship-source noise and impacts to communities and traditional ways of life from broken ice.

Once you identify risks, you can start to mitigate them.

Speaker	Paula Doucette, Transport Canada
Topic	A Broader Approach to Regional Assessments of the Cumulative Effects of Marine Shipping
Highlights	The Cumulative Effects program was launched in response to heightened concern from communities about the impacts of marine shipping activity. Transport Canada is preparing a national framework to assess cumulative effects by running six pilot studies around Canada to gather data and a range of perspectives. Once data has been gathered and amalgamated, mitigation options will be identified for each pilot site. This program began by establishing agreements and governance structures with the pilot communities. The program sought to identify what vessel activities were of concern and which components were of value to communities, to understand the regional context. Each area required different terms of reference in response to the different issues raised by the communities involved. To date, the program has held workshops, technical sessions, and bilateral meetings, and delivered a series of "What We Heard" reports, with additional feedback sought online.

Speaker	Ron Pelot, MEOPAR / Dalhousie University
Topic	Shipping risks: science models → system models → management tools → governance

Highlights

In collaboration with the Ocean Frontier Institute and other Dalhousie researchers, leading 'Module N: Safe Navigation and Environmental Protection', a project to identify how ocean change in the northwest Atlantic and Arctic gateway shapes our understanding of marine shipping risks.

Areas of concern include changing and increasing traffic patterns, limited chart coverage, and distance from search and rescue resources.

The multidisciplinary data and outcomes of this study are expected to feed into maritime law and policy, social sciences, natural sciences, and risk mitigation measures.

Summary of Breakout Discussion on Multidisciplinary Approaches to Shipping Risk

Any other related works on this topic?

- TC studies in Cambridge Bay
- Safe Harbours
- Beaufort Sea Partnership
- Martin Robards, Wildlife Conservation Society
- Inuvialuit Settlement Region (ISR) did a shipping assessment similar to that in Cambridge Bay with TC
- Studies with and about indigenous communities and cultures
- Ice risk; vessel noise risk; oil spill risk; vessel/mammal strike risk
- Transport of non-native species
- Species at risk
- Ongoing mapping by CHS (Canadian Hydrographic Services)
- Mariner's Guides (Best Practices): Western/Eastern/Hudson Strait
- Prior and future CCG capability in the Arctic
- POLAR Code
- Abandoned vessels regs (but not yet tested in court)

- CATZOC – on ECDIS (Electronic Chart Display and Information System), the CATZOC information is displayed as CATZOC symbols, representing a particular "zone of confidence" category.
- MIDOSS (Model of Impact of Dilbit and Oil Spills in the Salish Sea) project
- Open Risk (platform, models, training academy)
- Transmountain Pipeline risk studies (including marine)
- There seems to be a abundance of studies, but little is communicated to industry stakeholder groups.

What are the challenges or gaps on this topic?

- Vast area
- Class A vs Class B AIS transponders: lack of rules surrounding Class B can make some things unclear (ex. fishing vessel vs fishing gear)
- Data sharing restrictions
- Communications in remote regions
- Data collection in remote regions
- Limited historical data sets (ex. AIS coverage)
- Inclusion of small vessels in impact studies
- More bathymetric mapping needed
- Need better inclusion of coastal Communities, fisheries, and others with traditional knowledge (while this consideration was in the original Area Risk Assessment, it was eventually dropped)
- Concern over erosion from vessel wakes
- Impacts on various mammals; cumulative vs short-term
- Human safety
- There is a shortage of experienced ship officers, especially ofr Arctic/ice-covered waters
- Need to repair old facilities
- What are the emerging areas of science in a dynamically changing environment
- Existing data is not available to the marine industry.

- New sensors, and methodology for using/analyzing (plus cyber-security)
- "Black Box" perception of Risk Assessment tools (e.x. DNV's MARCS – Marine Accident Risk Calculation System)
- Information-sharing between projects
- Including all stakeholders; reaching out; language barriers

What key data sources would benefit work on this topic?

- Satellite images (Synthetic-Aperture Radar)
- Use/disseminate more existing data : e.x. East Coast risk assessment data
- Social science data
- Coastal Communities (traditional knowledge; sacred sites, etc.)
- Fisheries (traditional knowledge)
- Indigenous communities ((traditional knowledge; sacred sites, etc.)
- Industry and Response organizations' information
- A risk assessment done a few years ago generated a lot of data, which has not been made available (ref to Donovan Case from ALERT). Many agencies, industry, indigenous groups, etc. were involved.
- Many groups/agencies have conducted multi-faceted shipping studies, such as: RQM (Reseau Quebec Maritime); Gulf of Maine; ECHO Program (Enhancing Cetacean Habitat and Observation) by VFPA (Vancouver Fraser Port Authority); Clear Seas Vessel Traffic Analysis; TC Innovation Centre; many universities (Dalhousie, UVic, U Ottawa, UBC, etc.)
- Information and data on non-AIS-carrying vessels
- More information on oil and other potential pollutants (i.e. HNS) for both cargo and bulkers (e.g. type, volume)

How would you prioritize the challenges or gaps in this topic area?

- Balancing needs of stakeholders
- Great need for training and recruitment of trained personnel for northern shipping
- Training is a provincial responsibility; it needs a national focus

- Relevant designs for new Coast Guard vessels for the next 50 years
- Relatively large percentage of non ice-strengthened vessels
- Restart TC's ARP (Area Risk Planning) on the East Coast
- Appoint a ministry to collect and catalogue data
- Re-engage stakeholders in risk assessments

How can the Community of Practice help address the challenges or close the gaps you've identified?

- Involve groups related to mariner training and recruitment issues
- Engage with Pre- and Post- Arctic conferences hosted by the CCG
- Engage with Commanding Officers Conferences by the CCG
- Identify knowledge gaps and possible solutions
- TC, CCG, ECCC should lead the CoP

Are there any other comments on this topic?

- Foreign crews may exacerbate the risk in the north

Session 2: Data and Modelling for Shipping Risk

Speaker	David Creber, Dillon Consulting
Topic	Data Quality, Lack of Systematic Reporting of Marine Accidents, and Other Limitations of Ship Accident Models
Highlights	What is risk? The likelihood and consequence of an event. Data to apply to understanding marine shipping risk is subject to variation in consistency, subjectivity, and reliability. For example, ship accident models, of which there are multiple types, each with their own pros and cons, are based on data sources that vary among jurisdictions.

For hazardous and noxious substances, data on what is shipped in bulk and in containers is collected differently and often held securely in different countries and even regions.

There is no universal definition of a shipping accident or incident. Databases recording marine shipping incidents and accidents are not usually designed to provide statistically meaningful data.

Achieving corroboration from different databases is another challenge, and using AIS data as an independent check is difficult due to a lack of complete coverage (fishing vessels are not usually included in AIS data, yet account for more than half of all incidents and accidents).

Speaker	Meg Carr & Casey Hilliard, WHaLE Lab
Topic	Analysing Vessel-Strike Risk to NARWs: Benefits and challenges of working with AIS
Highlights	Encountered the usual challenges with using AIS data – AIS was not originally intended for tracking and data gathering about marine shipping vessel activity. AIS was intended to improve navigational safety.

Speaker	Norma Serra, University of Victoria on behalf of Peter Dorcas, exactEarth
Topic	Data Collection: Leveraging AIS to track small vessels and to relay additional ship sensor data
Highlights	Satellite AIS is a complex system and detection of an AIS device in Space will depend on a combination of transmission power, background RF noise, and the local density of AIS-equipped shipping. Detection for Class B devices can be problematic in space due to the weak nature of the signal. This means that tracking of small vessels outside terrestrial AIS range can be problematic. exactTrax is a special service designed to address these issues and gaps.

exactTrax works extremely well in Australia, Africa and Latin America. Unfortunately, Canada is a real challenge – mostly because the Canadian Coast Guard broadcasts weather data on ASM frequencies at a very high power.

Speaker	Mark Stoddard, Dalhousie University / DRDC
Topic	Estimating Risk-Based Ship Transit Times in Ice using POLARIS
Highlights	The POLARIS Risk Index Outcome considers ice regime, polar class, and risk index values to generate the outcome of green to red for operational go/no-go information. The system takes information from Canadian Ice Services to show operational and non-operational areas in the Arctic. The time it will take a given ship to get from point A to B in ice conditions varies. In addition to ice data, factors that influence the outcomes include the ship's ice class and the time of year. Ships can often go faster by waiting a few weeks.

Summary of Breakout Discussion on Data and Modelling for Shipping Risk

Any other related works on this topic?

- Transport Canada study on the social and economic impacts of new regulations to protect NARW & SRKW. More modelling and next steps for long-terms solutions are needed.

What are the challenges or gaps on this topic?

- The human factor, including training and experiences
- Data gathered from front-line experiences (ship master, surveyor)
- Data safety: use complicates access
- Proprietary data (e.g., soundings, cargo carriage)

- Data quality, including incomplete or missing data (e.g., fishing vessel and tug and barge carriage of AIS).
- Non-relevant data (e.g., SAMSON model incorporates ship classes used in the North Sea)
- Impact of climate change on data and trends
- Data held by Indigenous groups

What key data sources would benefit work on this topic?

- Real human impacts
- Vessel monitoring system
- Accident rates

How would you prioritize the challenges or gaps in this topic area?

- Urgent. Mariner experience in Arctic/ice operations is rapidly diminishing.

How can the Community of Practice help address the challenges or close the gaps you've identified?

- Strip identifying information from proprietary data – for security and privacy considerations.
- Identify the issue!

Are there any other comments on this topic?

- Listen to people with experience

Session 3: Funding Overview

Speaker	Gordon Deveau, Deputy Director, NSERC-Atlantic
Topic	Alliance Grant: NSERC's new program to support collaborative R&D projects
Highlights	NSERC is focused on providing funding for academics, students, and youth in the areas of natural sciences and engineering, with the

goal of connecting academics to industry. Industry particularly wants access to students to fill their talent pipeline.

The Alliance Grant is flexible to provide for a simpler process and faster decisions. No topic restrictions allow for more options. Collaboration is encouraged by allowing 30% of the funds to be dedicated to another discipline and researchers are permitted multiple applications with durations of 1-5 years. The grant value ranges from $20,000 to $1,000,000 per year.

Applications are evaluated equally on relevance and outcomes, partnerships, quality and appropriateness of research, and training outcomes.

The application is available on the NSERC website, providing a single point of entry for research partnerships.

Speaker	Ron Pelot, Associate Scientific Director, MEOPAR
Topic	MEOPAR/RQM joint initiatives
Highlights	Focus on St. Lawrence System for collaboration between Quebec and non-Quebec researchers. Usually seek to fund a two-year project. Potential topics include regarding shipping include vessel noise, whale strikes, marine spills, and accident analysis.

Session 4: Qualitative vs. Quantitative Risk Assessments

Speaker	Daniel Reid, Transport Canada
Topic	Update on the Regional Risk Assessment for the Northern Shelf Bioregion
Highlights	The Regional Risk Assessment (RRA) was proposed under the Tanker Safety Expert Panel to acquire tools for ongoing risk assessment within Transport Canada. The RRA assessed the consequences associated with an oil spill event by creating scenarios and modelling oil trajectories. The model incorporated met-ocean conditions, considered existing

mitigating measures, and used national and international incident statistics as well as different types of marine traffic.

The scenarios were developed with input from stakeholders. Early involvement from stakeholders is necessary for support of the outputs. Understanding of data inputs and how they are used is also important for stakeholder buy-in.

The outcome was relative risk scores, with smaller scale risks deemed more likely to occur (e.g., spills from fishing vessels, pleasure craft, and mid-size tank barges).

Challenges included the availability and quality of data, when attempting to do a quantitative assessment of a qualitative issue.

Speaker Norma Serra, University of Victoria

Topic Investigating Whale-watching Activities using Quantitative and Qualitative Approaches

Highlights The study aimed to answer two questions:

1. What are whale-watching vessels doing?
2. Can AIS inform policies to improve whale-watching activities?

The guidelines for the whale-watching industry were developed by industry in the 1990s. Fisheries and Oceans Canada released new regulations in 2018, requiring AIS for vessels carrying 12 or more people or 8 m or more in length.

The study included industry participants (volunteers) from Tofino, Victoria, and Cowichan Bay, BC who provided their Class B AIS data.

Challenges included poor AIS data quality, as the available satellite Class B data was often masked by terrestrial AIS data, held by the Canadian Coast Guard and more difficult to access.

Measures to overcome challenges included conducting interviews with industry participants about their operations, navigational equipment, and tracking needs to support compliance with new regulations.

Anticipated outcomes from this study include informing policy and practices for improved safety measures to reduce occurrences of whale strikes and underwater noise.

Speaker Weishan Wang, Dalhousie University

Topic Evaluating Institutional Arrangements for Marine Shipping Management within the Northern Marine Transportation Corridors Using Multiple Criteria Decision Analysis

Highlights This study was posed to respond to the problem of increased shipping in sensitive areas and a lack of appropriate institutional approach to integrate different stakeholders.

Key questions included: what can be managed (e.g., shipping operations), who can manage it, how can it be managed, and how to evaluate the results (e.g., through attributes and other criteria).

The study applied a multi decision criteria analysis (MCDA) matrix to consider the concerns of seven stakeholders on three factors.

The outcome was incorporation of different perspectives with weighting of the different criteria. Also developed guidelines for using the MCDA effectively.

Speaker Meghan Mathieson, Clear Seas

Topic Combining risk assessment approaches in the Marine Transportation Corridors Initiative to support marine spatial planning efforts

Highlights Overview of Clear Seas' research on how different approaches to risk assessments can be applied to support marine spatial planning efforts for the Pacific region.

Two examples from Marine Transportation Corridors Initiative to illustrate qualitative and quantitative risk assessments:

1. Assessing sensitivity of coastal areas to oil spills (qualitative, considering potential consequences only)

2. Vessel drift and response analysis (quantitative, considering probability of rescue of a drifting ship under 7 scenarios)

The initiative is intended to support better decision-making by identifying priorities and associated mitigation measures, then layering different data sets to identify areas of sensitivity that may be at risk from commercial marine traffic activities

The results will be reviewed and discussed in a workshop that brings together a range of perspectives - including First Nations, government, academics, and industry.

Summary of Breakout Discussion on Qualitative vs. Quantitative Risk Assessments

Any other related works on this topic?

- WWF Canada's Mariners Guides to Western and Eastern Arctic for a) route planning and b) where there are cultural and environmental risks (qualitative resource)
- Canadian Coast Guard → Vessels of concern (qualitative resource)

What are the challenges or gaps on this topic?

- Human aspect:
    - Managing expectations when gathering input; qualitative struggles to compete with quantitative (i.e. numbers)
    - Overcoming individual interests (e.g. monetary) toward an overall good output
    - How to balance different interests
    - Linking dissemination of data to policies to effects on communities (also: linking academic works to policy to ship operators and decision makers)
    - Cost of doing research – need more public engagement and education
    - More funding needed for Science and Social Science research

    - Overall supply chain risk assessment -- how decisions are made re: pipelines or rail affecting shipping & vice versa
    - Research on public perception / acceptance
- Data collection and management:
    - Keeping and managing data, both inter- and intra-organizational
    - Data reuse and structuring data for reuse is a challenge (can include metadata – how/when/who captured data – to aid reuse
    - For qualitative data, bias / lack of objectivity and expert challenge of collected data are issues
    - Verifying validity of qualitative data
    - Using AIS data for quantitative risk planning
    - Spatial data for analysis are difficult to access across different agencies / jurisdictions / locations / scales / resolutions
- Qualitative vs. Quantitative:
    - Qualitative approaches can work where data is not available
    - Need more qualitative research to drive the focus of some of the quantitative research

What key data sources would benefit work on this topic?

- An Arctic Coast Guard Auxiliary could potentially help in Arctic; however, range of community configurations and issues could make an auxiliary difficult to implement
- More environmental data would have wide benefit; also access to metadata is needed
- Expansion of AIS requirements to smaller vessels (including tug and barge)
- Access to CCG AIS data to incorporate into research

How would you prioritize the challenges or gaps in this topic area?

- More funding is needed to keep pace with escalating needs and concerns
- Transparency of model assumptions and underpinnings

- New models? Transport Canada push for full model (risk) rather than piecemeal
- Narrow scope of risk assessment tools to better meet requirements and specifications
- TERMPOL is project specific; specific studies for certain areas or targeted geographies
- Quantitative and qualitative work on "Places of Refuge" issue
- Access to AIS and other data is a problem
- Risk assessment in moving from Pilotage Authority
- That which is most relevant to a wide range of sectors

How can the Community of Practice help address the challenges or close the gaps identified?

- Getting people together to discuss these topics, focusing on cooperation between diverse group of stakeholders and identifying what does each participating group focus on
- Identify resources for coordinating data and best practices, including a consolidated list of models with metadata
- Identify research areas in which to develop open-source models
- Consider weather impact on incidents and response to incidents; climate change effects on risk (e.g., high water / fluctuations in Great Lakes)
- More public education to understand how decisions (e.g., whale watching, cruise ship itineraries, etc.) impact outcomes on shipping risk

Are there any other comments on this topic?

- More work on qualitative vs. quantitative needed
- Ensuring representativeness in qualitative works is important
- Documenting conditions around qualitative input is important to avoiding misunderstanding in use
- Using data (e.g. AIS, incidents, spills) for purposes which it was not intended can be problematic. Assess what data are being used for vs. intended uses and assess if sufficient for purpose

- Standardize incident reporting and update data collection guidelines re: usage / purpose

Next Steps for CMSRF Community of Practice

The inaugural workshop provided a valuable opportunity to begin a conversation on how marine shipping risk is currently identified, assessed, and mitigated in Canada.

The Community of Practice intends to continue the discussion through fora such as additional workshops and webinar presentations on relevant topics by a wide range of people and organizations involved in understanding and addressing shipping risk.

APPENDIX 1 – WORKSHOP PROGRAM

CANADIAN MARINE SHIPPING RISK FORUM

Workshop: State of the Art in Shipping Risk and Modelling

Monday December 2, 2019

Halifax Convention Centre: Room 612/613

8:00 to 8:15	Welcome	**About the Community of Practice**
8:15 to 8:45	Context Setting	**Canadian Coast Guard** • Andy Smith, Deputy Commissioner, Strategy & Shipbuilding

8:45 to 10:15	Session 1	**Multidisciplinary Approaches to Shipping Risk**
		Speakers:
		• Jackie Dawson, University of Ottawa
		  ○ Arctic Corridors and Northern Voices: An example of a multidisciplinary approach to shipping risk assessment in the Arctic.
		• Paula Doucette, Transport Canada
		  ○ A Broader Approach to Regional Assessments of the Cumulative Effects of Marine Shipping
		• Ron Pelot, MEOPAR / Dalhousie University
		  ○ Shipping risks: science models → system models → management tools → governance
		Breakout Groups

10:15 to 10:30	**Break**	

10:30 to 12:00	Session 2	**Data and Modelling for Shipping Risk**
		Speakers:
		• David Creber, Dillon Consulting
		  ○ Data Quality, Lack of Systematic Reporting of Marine Accidents, and Other Limitations of Ship Accident Models
		• Meg Carr & Casey Hilliard, WHaLE Lab
		  ○ Analysing Vessel-Strike Risk to NARWs: Benefits and challenges of working with AIS

		• Peter Dorcas, exactEarth
		  o Data Collection: Leveraging AIS to track small vessels and to relay additional ship sensor data
		• Mark Stoddard, Dalhousie University / DRDC
		  o Estimating Risk-Based Ship Transit Times in Ice using POLARIS
		Breakout Groups

12:00 to 1:00	**Lunch in Convention Hall C1-C2-C3** (note: conference badge required)	

1:00 to 2:15	Session 3	**Funding Overview**
		• Gordon Deveau, Deputy Director, NSERC-Atlantic
		  o Alliance Grant: NSERC's new program to support collaborative R&D projects
		• Ron Pelot, Associate Scientific Director, MEOPAR
		  o MEOPAR/RQM joint initiatives

2:15 to 3:00	Session 4 (Part 1)	**Qualitative vs. Quantitative Risk Assessments**
		Speakers:
		• Daniel Reid, Transport Canada
		  o Update on the Regional Risk Assessment for the Northern Shelf Bioregion
		• Norma Serra, University of Victoria
		  o Investigating Whale-watching Activities using Quantitative and Qualitative Approaches
		• Weishan Wang, Dalhousie University
		  o Evaluating Institutional Arrangements for Marine Shipping Management within the Northern Marine Transportation Corridors Using Multiple Criteria Decision Analysis
		• Meghan Mathieson, Clear Seas
		  o Combining risk assessment approaches in the Marine Transportation Corridors Initiative to support marine spatial planning efforts

3:00 to 3:15	**Break**	
3:15 to 4:00	Session 4 (Part 2)	**Qualitative vs. Quantitative Risk Assessments** Breakout Groups
4:00 to 4:30	Closing	**Summary and Next Steps**

APPENDIX 2 – SPEAKER BIOS

Speaker biographies are presented in the order of the workshop program

Andy Smith is the Deputy Commissioner of Strategy and Shipbuilding for the Canadian Coast Guard since August 28, 2017. Andy joined Fisheries and Oceans Canada (DFO) from Public Services and Procurement Canada (PSPC) where he was Associate Assistant Deputy Minister, Real Property. In this capacity, he provided strategic leadership and operational level direction related to the management of the Public Services and Procurement portfolio of buildings and engineering assets. Previously, Andy held the rank of Rear Admiral as the Chief of Military Personnel at the Department of National Defence (DND). In his career at DND, he held positions of increasing responsibility, including Commanding Officer of Fleet Maintenance at Maritime Atlantic Headquarters and Director General, Maritime Personnel and Readiness at National Defence Headquarters in Ottawa.

Dr. Jackie Dawson is the Canada Research Chair in Environment, Society, and Policy and is an Associate Professor in the Department of Geography, Environment, and Geomatics at the University of Ottawa. She is an Applied Scientist working on the human and policy dimensions of environmental change in ocean and coastal regions and is considered an expert in Arctic shipping, Arctic tourism, and Arctic oceans governance. She has served on two Canadian Council of Academies' Expert Panels, is an elected member of the College of the Royal Society of Canada and is a Fellow of the Royal Canadian Geographic Society. She led the drafting of the 2018 G7 science statement focused on Arctic oceans and resilient communities and is currently the Co-Scientific Director of the NCE ArcticNet.

Paula Doucette is a Senior Environmental Assessment Advisor under Transport Canada's Oceans Protection Plan. Paula has been responsible for conducting regional engagement activities as part of the Cumulative Effects of Marine Shipping Initiative since July 2017. Prior to this, Ms. Doucette worked as a Senior Environmental Officer, conducting environmental assessments on behalf of Transport Canada's Pacific region since 2004. Paula has a BSc in Natural Sciences from the University of Western Ontario and a Master's degree from Dalhousie University.

Ronald Pelot has been a Professor in the Department of Industrial Engineering at Dalhousie University since 1994. Over the past two decades, he and his team have developed new software tools and analysis methods applied to maritime traffic safety (accidents), coastal zone security, and marine spills. Research methods encompass spatial risk analysis, vessel traffic modelling, data processing and pattern analysis, location models for response resource allocation, and safety analyses. One study concerns shipping in the Arctic, including a network model of feasible routes accounting for ice, land and bathymetry and a forecast of northern traffic in the future based on a wide range of drivers. Dr. Pelot has published over 50 journal articles and produced more than 100 technical reports.

David Creber, P.Eng. is the Marine Risk Management Lead with Dillon Consulting Limited and is a biologist and environmental engineer with over 15 years of experience in consulting for the government and private sector clients. He is an Associate at Dillon's office in Fredericton, New Brunswick but works all across Canada and internationally. David has extensive experience developing risk based assessments in the marine environment. This includes being the Technical Lead on the Transport Canada's Area and Regional Risk Assessment Projects as well as the HNS Risk Assessment Project. Furthermore, David has led the development of a risk-based methodology to assess and prioritize abandoned, wrecked and hazardous vessels in Canada for the Canadian Coast Guard. He has worked on multiple studies to assess the risk of oil seeping from sunken vessels and developing innovative oil spill clean-up techniques in the marine environment. David spent 25 years in the Royal Canadian Navy serving in a wide variety of roles both ashore and at sea.

Casey Hilliard is a data manager, splitting his time equally between MEOPAR (the Marine Environmental Prediction and Response NCE), and MERIDIAN (the Marine Environmental Research Infrastructure for Data Integration and Application Network), and operating from within the Institute for Big Data Analytics at Dalhousie University. He maintains large geospatial datasets for each of these organizations, primarily in the context of managing their respective AIS data assets. In this role, Casey provides support to these groups' associates, helping them make effective use of these data by providing advice and tools for marine traffic modeling and data interpretation. Casey is also the coordinator for the new Canadian Marine Shipping Risk Forum.

Meg Carr is a Biological Oceanography PhD student at Dalhousie University co-supervised by Dr. Chris Taggart and Dr. Angelia Vanderlaan. Her research focuses on vessel-strike risk to endangered North Atlantic right whales and Northwest Atlantic blue whales in Canadian waters. Her work assesses the effectiveness of past and potential future vessel-strike risk management strategies with the goal of informing marine policy decisions aimed at vessel-strike reduction.

Peter Dorcas has 18 years of experience supporting the introduction of new space-based products and services to the international market. Peter joined exactEarth in 2009 as the Director of Sales and Marketing and was promoted to his current role in 2016. Prior to joining exactEarth, Peter held systems engineering, project management and business development positions at COM DEV and MacDonald Dettwiler and Associates. Peter has a Degree in Mechanical Engineering from McMaster University and is a certified Professional Engineer.

Mark Stoddard is a PhD Candidate in the Department of Industrial Engineering at Dalhousie University. His current academic research is focused on Arctic maritime risk assessment. Past academic research has focused on the development and use of new operational research techniques for strategic and operational planning with uncertainty. In addition to his PhD studies at Dalhousie University, he is employed as a defence scientist with Defence Research and Development Canada (DRDC). Mr. Stoddard leads the Operational Analysis and System Integration Support (OASIS) Group at the DRDC Atlantic Research Centre in Halifax, Nova Scotia.

In February 2015, Gordon Deveau undertook the position of Deputy Director of the Natural Sciences and Engineering Research Council of Canada (NSERC) Atlantic Regional Office. Before joining NSERC, Gordon was the Manager of Innovation for the Atlantic Canada Opportunities Agency (ACOA) and he was directly involved in the management of the Agency's Atlantic Innovation Fund (AIF). Prior to joining ACOA, he worked for Fisheries and Oceans Canada, the Government of Newfoundland and Labrador, Memorial University and Parks Canada. Over the years, he has provided leadership and program direction in a number of policy and management positions related to science and technology for a variety of federal and provincial government organizations.

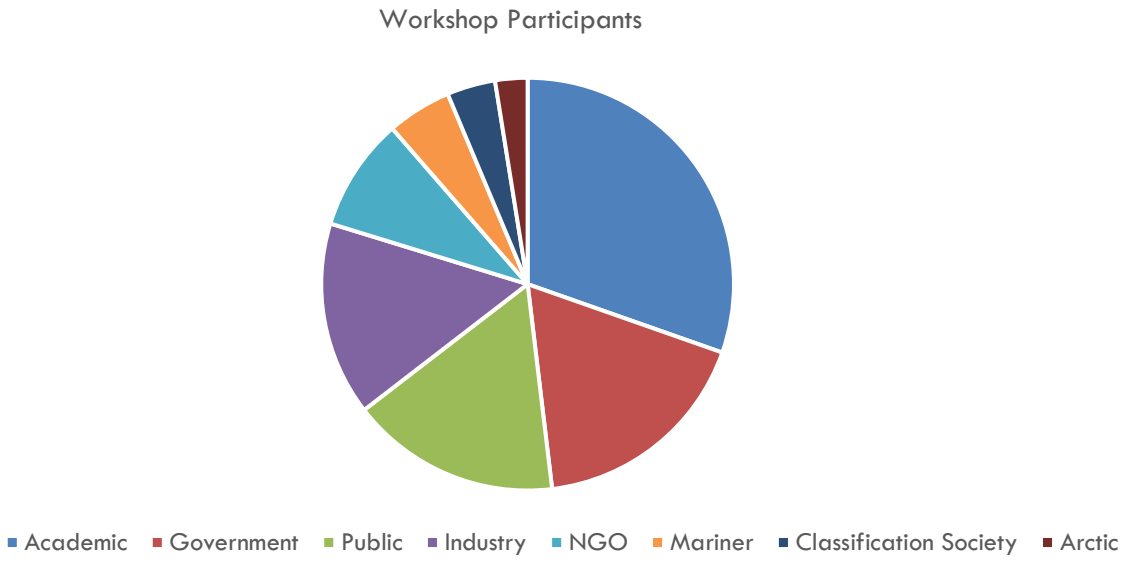
Daniel Reid is the Manager, Regional Environmental Response Program with Transport Canada. Daniel started his marine career as a teenager, working in fishing, aquaculture and commercial diving on northern Vancouver Island and BC's north coast. He worked with the Canadian Coast Guard for 15 years in both Search and Rescue and Environmental Response. Initially hired as a student deckhand with the Inshore Rescue Boat program Daniel went on to work as a public safety diver; a spill response specialist and regional training officer. Prior to leaving CCG Daniel was the area manager for the ER program on Vancouver Island. Daniel deployed to Transport Canada in 2014 and worked as a Marine Safety Inspector. He is now a manager in the Ocean's Protection Plan directorate working on several preparedness and response initiatives, including the Regional Risk Assessment that he will discuss today. Daniel lives in Victoria with his wife and two teenagers. They all enjoy spending time in, on and around the ocean.

Norma Serra Sogas is a Research Associate with the CORAL Research Group at the University of Victoria. Her research focuses on coastal planning and management, and environmental impact assessments. Recently her work involves developing systems and methods for collecting and analyzing vessel information to inform the assessment of vessel activities and their potential impacts to marine and coastal environments. Norma is also Program Manager and Lead Trainer for Pacific Marine Analysis and Research Association, a Canadian charity organization, delivering training on systematic conservation planning tools and processes. Norma holds an MSc from the University of Victoria. She is originally from Barcelona, Spain, but now lives in beautiful Victoria, British Columbia, with her husband and daughter.

Weishan Wang earned her Bachelor of Business Administration at Shanghai Maritime University in 2016. With strong interests in marine shipping industry, she moved to Halifax in pursuit of her master's degree in Marine Affairs Program, Dalhousie University, completed in 2018. Her Master's work focused on Arctic marine shipping governance. She used Multiple Criteria Decision Analysis (MCDA) as a quantitative approach for decision-makers to compare and evaluate different governance frameworks. Currently, she is an Interdisciplinary PhD student at Dalhousie University. The research of her doctoral studies will build on her previous research and studies about shipping in the Canadian Arctic. She is exploring how Marine Spatial Planning (MSP) could be applied as a process and a platform to support Arctic shipping governance, and in particular how Inuit's concepts of marine and coastal spaces could be integrated into ocean planning. Her current research interest is reinterpreting Indigenous knowledge through geographic and cartographic tools and applying them into decision support systems.

Meghan Mathieson is the Research Manager for Clear Seas Centre for Responsible Marine Shipping. Meghan is interested in all things maritime and has a passion for clarifying complex topics, analyzing risk and improving decision making through the use of evidence. As Research Manager at Clear Seas for the past three years, she has had the opportunity to work on a range of issues affecting commercial marine shipping in Canada, including vessel traffic patterns, drift rates, emergency towing, air emissions, and alternative marine fuels. Clear Seas' ongoing research efforts seek to provide a better understanding of the marine environment and support marine spatial planning efforts in Canada through the Marine Transportation Corridors Initiative.

APPENDIX 3 – WORKSHOP PARTICIPANTS



First Name	Last Name	Organization
Laura	Avery	MEOPAR
Cheryl	Bidgood	Canadian Marine Pilots Association
Bryden	Bone	Fisheries and Oceans Canada
Brian	Burden	Alfa Laval
Meg	Carr	Dalhousie University
Donovan	Case	Irving Oil
Rachel	Chang	Dalhousie University
Colin	Clark	Lloyd's Register
Christopher	Connor	Master Mariner
Murray	Coolican	Clear Seas
David	Creber	Dillon Consulting
Terry	Crosby	---
John	Dalziel	Dalhousie University
Sam	Davin	WWF-Canada

First Name	Last Name	Organization
Jackie	Dawson	University of Ottawa
Gordon	Deveau	NSERC
Claudio	DiBacco	Fisheries and Oceans Canada
Renata	Dividino	GSTS
Peter	Dorcas	exactEarth
Paula	Doucette	Transport Canada
Rob	Elliott	---
Peter	Ellis	Clear Seas
Mohammad	Etemad	Dalhousie University
Shayla	Fitzsimmons	Dalhousie University
Tom	Fredericks	---
Jack	Gallagher	Hammurabi
Alireza	Ghasemi	Dalhousie University
Chris	Hall	Saint John Port
William	Halliday	Wildlife Conservation Society
Hilary	Harron	Dalhousie University
Ines	Hessler	Dalhousie University
Casey	Hilliard	Dalhousie University
Sarah	Hughes	---
Stephen	Insley	Wildlife Conservation Society
Anthony	Isenor	Canadian Forces
Samsul	Islam	Dalhousie University
Paul	Kendrick	---
Scott	Kennedy	---
Ian	Kerr	Dalhousie University
Alan	Knight	Transport Canada
Zuzanna	Kochanowicz	University of Ottawa

First Name	Last Name	Organization
Tamunoiyala	Koko	Lloyd's Register
Ben	Lowen	Fisheries and Oceans Canada
Alex	Macintyre	HBR Pilot
Beverly	Maksagak	Kitikmeot Regional Wildlife Board
Cindy	Marven	MEOPAR
Meghan	Mathieson	Clear Seas
Adam	McLeod	Transport Canada
Elissama	Menezes	WWF-Canada
Christopher	Milley	Nexus Coastal
Sue	Molloy	Glas Ocean
Adrian	Nicoll	Transport Canada
Colleen	Parker	Nunavut Impact Review Board
Jim	Parsons	Memorial University
Ronald	Pelot	Dalhousie University
Andrew	Rae	---
Samith	Rathnayaka	Lloyd's Register
Daniel	Reid	Transport Canada
Ed	Ross	Trail Marksys
Kasia	Rozalska	Fisheries and Oceans Canada
Abu Md	Safiul Alam	---
Mahmud	Sazidy	---
Priscilla	Schmitz	---
Barry	Scott	Vela Marine
Norma	Serra	University of Victoria
Kazi	Shah Jalal	Transport Canada
Talah	Shark	Dalhousie University
Ian	Stewart	University of King's College

First Name	Last Name	Organization
Mark	Stoddard	Dalhousie University
Bud	Streeter	Clear Seas
Erin	Tretiak	Transport Canada
Brian	Tuomi	Nautical Consulting
Gary	Walsh	---
Weishan	Wang	Dalhousie University
Melissa	Weber	University of Ottawa
Aldona	Wiacek	St. Mary's University
Ramunas	Wierzbicki	Marine Labs
Pamela	Wong	Trail Marksys
Thomas	Zagon	Environment and Climate Change Canada