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Proceedings of the regional peer review of the risk assessment of Alternate Ballast Water Exchange Zones for vessel traffic to the eastern Canadian Arctic

November 20-21, 2013
Winnipeg, Manitoba

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Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

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SUMMARY

A regional Science peer-review meeting was held on 20-21 November 2013 in Winnipeg, Manitoba. The purpose of the meeting was to provide advice on Alternate Ballast Water Exchange Zones (ABWEZs) in the eastern Canadian Arctic. The Science Advisory Report from the meeting will provide the information and scientific advice that may be used by Transport Canada Marine Safety (TCMS) to determine if changes are needed to the designated alternate exchange zones in the eastern Canadian Arctic.

Ballast water exchange is undertaken to minimize the ecological risk of nonindigenous species introductions. Current regulations under the *Canada Shipping Act* require all transoceanic ships entering Canadian waters to exchange ballast water outside the Canadian Exclusive Economic Zone (EEZ). If offshore exchange is not feasible for safety reasons such as heavy seas or storms, current Transport Canada regulations could allow for exchange in a designated alternate exchange zone. ABWEZs for vessel traffic to the Eastern Canadian Arctic are currently located in Lancaster Sound and Hudson Strait.

Meeting participants included experts from DFO Science, Transport Canada, Environment Canada, Parks Canada Agency, academia, the shipping industry, Nunavut Wildlife Management Board, Nunavut Tunngavik Inc., and a biological consultant from Winnipeg.

This proceedings report summarizes the relevant discussions from the peer-review and presents revisions to be made to the research document. It will be published in the Canadian Science Advisory Secretariat (CSAS) Proceedings Series on the CSAS website. One CSAS Research Document will be produced from this meeting and advice from the meeting will be published as a CSAS Science Advisory Report.

Compte rendu de l'examen par les pairs régional sur l'Évaluation des risques pour le trafic maritime des zones de renouvellement des eaux de ballast dans l'est de l'Arctique canadien

SOMMAIRE

Une réunion régionale d'examen scientifique par les pairs s'est tenue les 20 et 21 novembre 2013 à Winnipeg, au Manitoba. L'objectif de la réunion était de fournir des avis sur les zones de renouvellement des eaux de ballast dans l'est de l'Arctique canadien. L'avis scientifique découlant de la rencontre contiendra des renseignements et des recommandations que pourra utiliser Sécurité maritime de Transports Canada pour déterminer si des changements doivent être apportés aux zones de renouvellement des eaux de ballast dans l'est de l'Arctique canadien.

L'eau de ballast est renouvelée pour réduire le risque écologique que représente l'introduction d'espèces non indigènes. Le règlement actuel en application de la *Loi sur la marine marchande du Canada* exige que tous les navires transocéaniques renouvellent leur eau de ballast à l'extérieur de la zone économique exclusive (ZEE) du Canada avant d'entrer en eaux canadiennes. S'ils ne peuvent le faire en haute mer pour des raisons de sécurité, par exemple à cause de la forte mer ou d'une tempête, ils peuvent, conformément au règlement de Transport Canada en vigueur, le faire dans une autre zone désignée. Les zones de renouvellement des eaux de ballast pour les routes maritimes vers l'est de l'Arctique canadien sont présentement situées dans le détroit de Lancaster et dans le détroit d'Hudson.

Ont participé à la réunion des experts du ministère des Pêches et des Océans (secteur des sciences), de Transports Canada, d'Environnement Canada, de l'Agence Parcs Canada, des universités, de l'industrie maritime, du Conseil de gestion des ressources fauniques du Nunavut, de Nunavut Tunngavik Inc., ainsi qu'un expert-conseil en biologie de Winnipeg.

Le présent compte rendu résume les discussions pertinentes de l'examen par les pairs et présente les modifications qui seront apportées au document de recherche. Ce document sera publié dans la série des comptes rendus du Secrétariat canadien de consultation scientifique (SCCS) sur le site Web du SCCS. Un document de recherche du Secrétariat canadien de consultation scientifique sera produit après cette réunion et l'avis découlant de la réunion sera publié comme un avis scientifique du SCCS.

INTRODUCTION

Alternate Ballast Water Exchange Zones (ABWEZs) have been designated in Hudson Strait and Lancaster Sound for foreign ships in ballast destined for ports in waters of the eastern Canadian Arctic. In 2009, the Hudson Strait ABWEZ was assessed by Fisheries and Oceans Canada (DFO) Science. Several recommendations resulted from that assessment including the need to assess a broader geographical area of the Labrador Sea to the east of Hudson Strait, and to incorporate oceanographic modelling of dispersion patterns. DFO Science has responded to these recommendations by evaluating the relative risks of ballast exchange along major shipping routes within the eastern Canadian Arctic, including both the Hudson Strait and Lancaster Sound ABWEZs. This assessment will be considered by Transport Canada Marine Safety (TCMS) to determine whether modifications to their regulatory program are needed to reduce the risk of ship-mediated transfer of invasive species in the eastern Canadian Arctic.

The purpose of the meeting, as described in the Terms of Reference (Appendix 1), was to provide advice on alternative ballast water exchange zones in the eastern Canadian Arctic. This was done by evaluating the risks that the identified zones may pose to fisheries resources and to the marine ecosystem, and identifying and rationalizing other zones that may pose a lower risk.

Meeting participants (Appendix 2) included DFO Science sector and Oceans program, Transport Canada, Environment Canada, Parks Canada Agency, Université du Québec à Rimouski, Fednav Canada, Shipping Federation of Canada, Nunavut Wildlife Management Board, Nunavut Tunngavik Inc., and an independent biological consultant from Winnipeg. A working paper was circulated to participants in advance of the meeting and served as the basis for discussions.

OVERVIEW, OBJECTIVES AND PURPOSE OF MEETING

Presenter: Kimberly Howland

Presentation summary

Shipping is the main means of transporting cargo worldwide and of particular importance in Canadian Arctic locations where there is limited land-based access. Commercial shipping provides an effective mechanism for the transfer of biota among regions, allowing them to move far beyond their natural ranges, and has been responsible for a high proportion of nonindigenous species (NIS) introductions globally. This has occurred both through transfer of organisms carried in ballast and through those carried on the hulls as well as other underwater parts of ships (e.g., sea chests, anchor chains, propellers).

NIS that are introduced through ballast water exchange are typically of coastal or estuarine origin and are either pelagic species, or benthic species with pelagic larval stages. Those that become invasive can have severe impacts on receiving ecosystems through various means (e.g., competition for resources, direct predation, altering habitats).

Canada has developed regulations under the *Canada Shipping Act* (2006) to reduce risks for transfer of NIS. These regulations require transoceanic and coastal vessels coming from outside the Canadian Exclusive Economic Zone (EEZ) to conduct mid-ocean exchange (if ballast on board) or tank flushing (if no-ballast-on-board). In cases when mid-ocean exchange cannot be completed, emergency exchange may be conducted in designated ABWEZs within the Canadian EEZ (located in Lancaster Sound and Hudson Strait for the eastern Arctic region).

Upon ratification of the International Maritime Organization's International Convention for the Control and Management of Ships' Ballast Water and Sediments (expected 2016), vessels will be required to conduct treatment or in some cases, mid-ocean exchange and treatment.

The meeting objectives were to;

1. peer review the working paper (Stewart et al.),
2. assess the relative risks of ballast exchange for introduction of NIS along major vessel tracks in the eastern Arctic, and
3. identify optimal areas for exchange (i.e., those that are least likely to result in ecological damage through species introductions).

Discussion

Participants pointed out that ratification of the International Maritime Organization's International Convention for the Control and Management of Ships' Ballast Water and Sediments might occur before 2016.

OCEANOGRAPHY AND SHIPPING PATTERNS IN THE EASTERN ARCTIC

Presenter: Bruce Stewart

Presentation summary

A description of the oceanographic characteristics of the eastern Canadian Arctic was provided. Water depth, surface temperature, surface salinity, circulation/current patterns, and ice patterns/cover were used in the drift models to predict relative risk of establishment of NIS. These characteristics are expected to affect probability of survival and establishment of self-sustaining populations of NIS in the event of introductions.

An explanation of ballast water exchange was provided, in addition to how, why, and where exchange is carried out.

Currently, most of the ships discharging ballast water in the eastern Canadian Arctic originate from Western Europe, with the majority of traffic going to Churchill, MB. Shipping patterns are predicted to change dramatically within the next decade due to an increase in resource extraction and climate change, with more ships transiting into Canadian Arctic waters.

Discussion

Participants noted that the main concern is for ballast discharged when a ship arrives at a port empty to pick up resources compared to ships transporting goods from community to community which discharge much smaller amounts of ballast. Seasonality will affect the amount of ballast water taken up by a ship. Icebreakers will need more ballast in the winter due to the need for more weight when breaking ice.

ABWEZs are only to be used when ships are not able to conduct a mid-ocean ballast exchange due to inclement weather. It was noted that even though there will be an increase in shipping in the Canadian Arctic in the next decade, it does not mean that there will be a similar increase in ballast discharge in the ABWEZs. There could be more ships that encounter bad weather and needs to use the ABWEZs but this increase will not necessarily be systematic.

There was a request to increase the size of numbers in figures to make them easier to read.

FEDNAV ARCTIC SHIPPING

Presenter: Jared Gardner

Presentation summary

Fednav is the largest dry cargo shipping group in Canada, with business in the Great Lakes and the Arctic. The company has three vessels (Canadian flagged *MV Arctic*, *Umiak 1* and the foreign flagged *MV Nunavik*) that transit to various locations in the Arctic, including mines with ports located in Deception Bay, QC and Voisey's Bay, NL. Fednav also plans to start shipping ore from the Mary River (Baffinland) mine out of Milne Inlet in 2015. Fednav owns and operates 41 ships, most of which have an ice class designation that which allows them to travel through some thickness of sea ice.

Although not required by federal regulations, currently, water from the ballast tanks of the *MV Arctic* and the *Umiak 1* is voluntarily exchanged before entering Deception Bay (Nunavik) and Voisey's Bay (Labrador), respectively. In the case of the *Umiak 1*, exchange is a requirement of FedNav's shipping contract and must be completed before entering Labrador Inuit Claim waters along the Labrador coast. Ballast water discharge then occurs in Deception Bay and Voisey's Bay as the ships are loaded with cargo at these ports. The amount of ballast carried by these vessels varies with the ship design, cargo load and season.

Discussion

Participants asked for clarification as to where specifically the *Umiak 1* conducts exchange. With the *Umiak 1* exchange usually begins close to Anticosti Island and must be completed in the area north of the Strait of Bell Isle before reaching the Labrador Inuit Claim waters. In winter, warm saline water from the Labrador Sea is also typically taken up into the ballast tanks from deeper waters to the east of the sill/shelf along the Labrador coast to prevent freezing.

Participants expressed concern over the potential for ballast-mediated introduction of NIS into the Canadian Arctic via domestic (Canadian flagged) ships travelling from southern Canadian waters into the Canadian Arctic. It was noted that some species that may be native in southern Canadian waters, do not currently occur in the Arctic and would therefore be considered NIS in this region. Of particular concern are cold tolerant NIS picked up during voluntary exchange that could be transported into the Canadian Arctic in ballast water. Use of the Strait of Belle Isle area for voluntary exchange was a concern to some participants because the conditions at the exchange site would be very similar to discharge sites in the Arctic and several cold tolerant invasive species including green crab are already established there. This might limit the effectiveness of exchange in preventing the introduction and establishment of NIS in the Arctic.

Participants noted that there are operational considerations for ballast exchange including ensuring there is sufficient time to do a ballast exchange and whether or not areas designated for exchange are accessible. Participants indicated it is important to consider feasibility by considering the perspectives of those with shipping experience. The importance of having good dialogue between scientists, industry, and ship operators to develop procedures to prevent the ballast mediated spread of NIS was noted.

It was noted that although investigation of alternate areas for voluntary exchange by domestic vessels was beyond the scope of this study, that it could be included in a research recommendations section within the science advisory report and research document.

OVERVIEW OF RISK ASSESSMENT AND GENERAL METHODS

Presenter: Kimberly Howland

Presentation summary

In this study the relative risks of ballast exchange along major vessel tracks was assessed to identify optimal areas for exchange (i.e., those that are least likely to result in ecological damage through species introductions). Risk is defined as the product of the probability (or likelihood) of an event occurring and the impact or magnitude of consequence if that event occurs. In the context of invasion biology, these risk elements are typically the likelihood of introduction of NIS and the magnitude of ecological consequences to the receiving habitat should NIS be introduced.

A brief overview of the approach and the various steps involved in the risk assessment was provided. Since empirical information for the different risk elements was lacking for the eastern Canadian Arctic, the relative risks of exchange at different locations were considered using mathematical modelling of particle transport to quantitatively assess the relative likelihood of exposure if ballast were exchanged or released along a given vessel track. Likelihood of exposure (based on metrics of arrival time and frequency of occurrence in receiving habitats determined through particle dispersion modelling) and likelihood of establishment (based on physical and chemical variables expected to affect survival and establishment of introduced NIS in receiving habitats) were used to determine likelihood of introduction. Habitat sensitivity based on areas of biological importance, risk intolerance, and human use was used as a proxy for magnitude of ecological consequence. The exposure, establishment, and habitat sensitivity variables were then combined to assess the relative risk from ballast water exchange along each ship track. Since the relationship between establishment of NIS and various environmental parameters has not been empirically demonstrated in this region, different weighting schemes were used to test the sensitivity of the model to these parameters.

ICE-OCEAN CIRCULATION MODELS AND SHIPPING ROUTES

Presenter: Shannon Nudds

Presentation summary

Ocean circulation models for Baffin Bay – Labrador Sea and Lancaster Sound were used to model the distribution of particles released into the surface layer (upper 5 m) along major historical vessel tracks (i.e., 2004 data from Transport Canada) during the open water period, May to September. This season was chosen since currents are stronger and dispersion of particles would be expected to be greatest in open water (thus representing the worst case scenario). Particle tracking techniques were used to simulate the movement of ballast water from the ship tracks over a 30-day period. The primary circulation model used was CECOM (Canadian East Coast Ocean Model) with meteorological forcing data from 2009 and 2010. These two years were chosen since they were the most recent data available at the time the risk assessment was initiated in 2010. Additional simulations were also done with a second model, an Arctic model based on NEMO (Nucleus for European Modelling of the Ocean) with forcing data from 2003 and 2004. These years were chosen because simulations showed the highest correlation with real observations during this period. This second model was used to validate the results from the CECOM model at open boundaries in the CECOM domain since there were concerns about the quality of the model solutions in these areas. Dispersion results with both models were presented.

Discussion

Participants discussed the model and inputs into the model.

There was a question about the information underpinning the modelled shipping routes. Shipping routes used in the model were based on historical/past international shipping routes. In the future, shipping routes probably won't change, but the frequency will. Timing may also change from open water to year-round. The modelling was based on open water shipping, and doesn't address year-round shipping. There is uncertainty in the potential risks of ballast release from year-round shipping. The uncertainties section should mention our limited understanding of the species that may be found in ballast and the lack of information on where the ballast water was picked up.

Justification for using the upper 5 m of the water column as the surface current layer in the model should be included in the research document.

There were some questions as to why ship route 4 was modeled as most ships going to this area would be bringing in supplies and not in ballast. A participant noted that it may be due to the fish plant in Pangnirtung which ships out fish as cargo. The recently constructed port raises concerns about increased traffic.

Participants noted that the explanation of the model provided in the presentation was better than the explanation provided in the document. A clearer explanation of the Canadian East Coast Ocean Model (CECOM) used in the risk assessment, in particular particle dispersal, should be provided in the research document.

Participants noted there was no explanation in the research document for why a 30 day period was chosen for the simulation. A comment was made that the 30 day limit may have a biological basis as certain invertebrate species would not survive beyond 30 days unless they had suitable habitat (coastal areas). It was also noted that model results progressively lose more reliability as results extend beyond 30 days. A justification of the choice for the 30 day limit should be included in the research document.

The slide from the presentation comparing CECOM and NEMO dispersion field results should be included in the research document as this would help demonstrate the differences between the two models. Information should be included on how representative the years 2003 and 2004 used in the NEMO model were.

PARTICLE TRACKING, LIKELIHOOD OF EXPOSURE AND FINAL RISK CALCULATION

Presenter: Shannon Nudds

Presentation summary

The relative overall risk of ballast mediated introduction of NIS at points along a ship track was determined using likelihood of introduction (product of likelihood of exposure and establishment of NIS) multiplied by impact of introduction (relative habitat sensitivity). The relative likelihood of introduction of NIS was determined using Arrival Time and Frequency of Occurrence multiplied by a weighting factor which considered the depth, temperature, salinity, and period of ice cover along the track. Several examples of the calculations were provided.

Discussion

Much of the discussion focused on the terminology used to describe the risk assessment. For modelling purposes, the receiving habitats along the ship tracks were differentiated into zones

that were weighted based on physical and chemical oceanographic parameters, areas of biological importance, and risk intolerance, which were expected to influence the risk of NIS introductions. Participants had problems with the use of the term ‘zone’, such as depth zones, weighting zones as it implied a contiguous geographic location. It was suggested that ‘weight zones’ be replaced by ‘weight categories’.

A participant was unsure how the particle dispersion was included in the model and the presenter advised the group that it was nested within the likelihood of exposure calculation. Some of this confusion may be related to efforts to relate this assessment to single species risk assessments. It was recommended that the authors avoid trying to fit what they did into a single species conceptual framework. The documents would be clearer if the authors simply describe what they did without reference to the single species assessment framework.

Participants were confused with the description of the relative risk calculations in the research document, and suggested the text be revised to reflect what was in the presentation.

WEIGHTINGS, DEFINITIONS AND SENSITIVITY ANALYSIS

Presenter: Bruce Stewart

Presentation summary

The physical and chemical oceanographic variables expected to influence the likelihood of establishment of introduced NIS were used to provide a measure of the relative likelihood of NIS establishment. Information on the variables used (depth, salinity, water temperature, and period of ice cover), their relative weightings, and the sensitivity of the model to different weighting schemes were provided. Rationale for use of different approaches to presentation of risk results (delineation of risk levels based on natural breaks, even breaks on a linear scale or a continuous scale without breaks) was also provided.

Relative habitat sensitivity was used as a measure of the magnitude of the impact of NIS establishment. Areas identified as particularly important biologically, risk intolerant, and/or valuable to humans were used as a proxy for relative habitat sensitivity. Details describing the approach taken in this study were provided.

Likelihood of establishment, exposure and habitat sensitivity (magnitude of impact) was combined to calculate the relative risk of NIS establishment associated with ballast release from different points along each ship track.

Discussion

The model variables and weightings were discussed. Participants questioned whether salinity should be used as one of the variables that could influence the likelihood of establishment of NIS in the model. Some felt that the overall salinity range used in the model was too narrow to be of consequence (i.e., to have an effect on the likelihood of establishment) and therefore may not be useful for this purpose. Minimum salinity values instead of maximum salinity values may be more informative although it may be difficult to obtain minimum salinity values since it usually occurs during ice melt, a period when there is high variability and when it is difficult to obtain measurements. However, minimum salinity may be what determines survivability. Participants discussed the possibility of weighting the salinity differently than the other variables (depth, temperature, and ice cover). After discussion it was generally concluded that weighting salinity differently or using minimum instead of maximum would not likely change results much since;

a) annual salinity likely has a similar pattern to minimum and maximum salinity and data were normalized, and

b) climate has a relatively low weighting overall, and salinity only contributes to one third of that weighting (with temperature and ice cover contributing to the other two thirds).

Nevertheless, some participants still felt minimum salinity could be important and authors were asked to look at the raw salinity data and consider how it could be used/whether or not it should be used in the model. One participant pointed out that the relative importance of using minimum salinity versus annual or maximum salinity depends on the ports of origin and their salinities. A participant asked how we could use salinity to assess the risk in the receiving region if we don't have data from the port of origin. The authors indicated that there are published data on salinities in ports of origin (DFO Arctic Shipping Risk Assessment); ports tend to be coastal and estuarine and generally be of lower salinity.

It was pointed out that there are some instances in the document where the "likelihood of establishment" and the "likelihood of introduction" were used interchangeably, and this should be corrected. Participants questioned the use of "important harvesting areas" or "areas valuable to humans" in determining the relative habitat sensitivity of an area in the model because socio-economic issues are not supposed to be considered in developing the science advice. Authors indicated that they are used as proxies for habitat sensitivity. Humans tend to settle in areas of high biological productivity, and areas with high human use may be more likely to be exposed to new species due to transport into the area. The research document needs to be revised to clarify that areas of human use are being used as proxies for habitat sensitivity and not as socio economic indicators.

Participants were confused by two of the variables used to determine habitat sensitivity; areas of high biological importance, and risk intolerance. A participant asked, how these variables were defined and how did they differ from one another? Authors explained that biological importance refers to areas where high numbers of species congregate, and as a result they may be more exposed to and impacted by NIS. Risk intolerance refers to the characteristics of individual species and how these characteristics would make them more vulnerable to the introduction of NIS. For example, certain species may be more vulnerable due to low population numbers; or may tend to congregate in areas where they would be more vulnerable to impacts. Participants felt that these explanations should be provided in the research document and that clearer terminology be used to describe the concept of risk intolerance. The mega-fauna habitat use was used as proxies for the presence of micro-fauna.

It was suggested that the model domain boxes be shown on the figures.

Participants questioned why deepwater turbot and shrimp areas were considered to have a high ranking for risk intolerance. The authors noted that the intent was to highlight the potential impact if there were an NIS that could be released that would impact this deepwater habitat. However, this study focused on the impacts on coastal species and not on deeper water species, and does not consider harmful phytoplankton, algae, zooplankton, and cysts that could be introduced by ballast water. Harmful phytoplankton and algae in particular may increase with temperature increases associated with climate change and could be harmful to species such as seabirds and walrus that consume shellfish. This is a data limitation that should be mentioned in the documents.

A participant pointed out that the maps showing the weighting scheme reflected the particle tracking and shows that the highest risk lies in the coastal areas.

A participant felt that the 2004 shipping dataset from Transport Canada used in the risk assessment may not accurately reflect the shipping patterns that currently occur within the eastern Arctic. There is also not a clear distinction in the dataset between vessels that fall under the ballast water regulations and those that do not. It was suggested that Northern Canada

Vessel Traffic Services Zone Regulations (NORDREG) data be used since ship declarations have been mandatory in this zone beginning in 2009. It was also suggested that data from the shipping risk assessment for ship-mediated introductions of aquatic NIS (Chan et al. 2012, DFO 2012, Casas-Monroy et al. 2014, and DFO 2014) could contribute to the ABWEZ assessment. Participants indicated that there are not many different routes that can be used within the eastern Arctic, so there is little chance that major shipping routes have been overlooked.

Discussion continued on the weighting schemes for depth, climate (temperature, salinity and ice cover), and habitat sensitivity (biological importance, risk intolerance and important harvesting areas) variables. Participants discussed how they should be weighted, and whether they should be represented by a linear or geometric regression. Some participants indicated that the weightings that were assigned to the variables affecting habitat sensitivity should be reconsidered. It was pointed out that there are a variety of variables that drive habitat sensitivity and these can be different in coastal or deep offshore areas. It was noted that a geometric relationship may be better at describing the relationship.

It was suggested that it would be helpful in better understanding the risk assessment if the graphs that show the natural breaks in the model outputs were included in the research document.

RISK ASSESSMENT RESULTS

Presenter: Bruce Stewart

Presentation summary

The modelling results were robust to different weightings and consistently identified the same regions as having higher relative risk. The results indicate that existing ABWEZs in and around Lancaster Sound and Hudson Strait have the highest relative risk for establishment of NIS. Lower risk portions of major vessel tracks should be considered as alternatives, including the Labrador Sea portion of all vessel tracks, and the Baffin Bay deep offshore vessel track at depths greater than 1000 m. Foreign coastal biota released along these tracks are least likely to reach shallow coastal habitats that offer favourable conditions for their survival and establishment.

Knowledge gaps were described and recommendations (conclusions and advice) were presented.

Discussion

Ensure latitudes and longitudes are correctly identified on the figures (e.g., Figure 15 and study area figure). Ship track maps from the presentation should be in the report.

There was a comment that the recommendations were too general. Meeting participants agreed that there should be two ABWEZs described; one in Baffin Bay and the other in the Labrador Sea. Each would have the 1000 m contour lines, latitudes and longitudes marked. A map with the Canadian EEZ included and labelled would be helpful. The EEZ should be labelled Canadian EEZ.

The term “international ships” should not be used. There are no ships that are considered international but there are ships that enter into Canadian waters from outside Canadian jurisdiction.

The research document recommends that sediment be flushed out of ballast tanks, however it was noted that if domestic ships were required to do this as well, then sealifts would be required

to flush their ballast tanks. Participants suggested that if recommendations are made regarding ballast flushing then supporting text regarding known risks associated with residual sediments needs to be included in the research document.

Participants pointed out that ballast water treatment is not effective for some species such as dinoflagellates and cautioned against wording in the recommendations implying that once implemented it would negate the need for exchange or use of ABWEZs.

The research document recommended that a precautionary approach be adopted with respect to ships operating within the EEZ that would require these vessels to exchange their ballast water or flush their tanks before reaching the ABWEZ. One participant noted that it was not clear if the ABWEZs could also be used by vessels operating within the EEZ. From some participant's perspectives, the research document didn't include sufficient information to support this recommendation. Another participant pointed out that ships coming from Northeastern U.S. may go to Canadian ports in the Arctic and have the potential to carry NIS and thereby also pose a risk. It was suggested that the recommendation should reflect the need for more information concerning ballast water exchange for vessels operating within the EEZ.

A participant asked why ships operating in the EEZ that take up ballast in fresh water ports couldn't simply discharge their ballast in a salt water port – why should they need to conduct exchange? One of the authors indicated that there is the potential that freshwater invertebrates may be able to establish in some of the estuarine ports with freshwater inputs, whereas there would be less risk of this in a strictly marine ABWEZ. It was suggested that if there is science to support this it should be included in the research document. Another participant indicated that the whole basis and science behind mid-ocean exchange is built on this premise.

Participants pointed out that we don't have data on all of the ports from which the ships originate and without this we cannot precisely identify which areas would be the best for an ABWEZ. However, we can say which areas have the lowest risk for introduction of NIS species.

A participant was concerned about lumping international and domestic ships together because their operational requirements are different. Another participant suggested that although there is no regulatory requirement for ballast exchange by vessels operating in the EEZ, if they choose to conduct voluntary exchange then the identified ABWEZs would offer an appropriate location for this.

Recommendations found in the research document should be replaced with those agreed to during the meeting.

MEETING WRAP-UP

Participants developed summary bullets for the Science Advisory Report to address the terms of reference. Sources of uncertainty and recommendations for further research to improve understanding of the risks of ballast water exchange in the Eastern Canadian Arctic were identified. The Chair concluded the meeting with thanks to all participants.

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APPENDIX 1: TERMS OF REFERENCE

Risk Assessment of Alternate Ballast Water Exchange Zones for vessel traffic to the Eastern Canadian Arctic

Regional Peer Review – Central and Arctic Region

November 20-21, 2013

Freshwater Institute, Winnipeg, MB

Context

Transport Canada Marine Safety (TCMS) is tasked with managing a regulatory program to set ships' procedures to reduce the risk of ship-mediated transfer of invasive species. TCMS has requested scientifically defensible advice as the basis for national ballast water regulations regarding Alternate Ballast Water Exchange Zones (ABWEZs) for ships in ballast destined for ports in waters of the eastern Canadian Arctic. Under current regulations, ABWEZs have been designated in the Hudson Strait and Lancaster Sound regions of the eastern Canadian Arctic for foreign vessels travelling to the Port of Churchill or the Northwest Passage, respectively, in the event that foreign vessels bound for Arctic ports need to conduct emergency ballast water exchange within the Canadian Exclusive Economic Zone (EEZ). Hudson Strait receives the largest volume of shipping activity in the eastern Canadian Arctic. This ABWEZ was assessed by Fisheries and Oceans Canada (DFO) in 2009. Several recommendations resulted from this assessment including the need to assess a broader geographic area to the east of Hudson Strait, including the Labrador Sea, and incorporate oceanographic modelling of dispersion patterns. The Lancaster Sound ABWEZ was not considered in the 2009 review.

DFO responded to these recommendations by developing a working paper that evaluates the relative risks of ballast exchange along major shipping routes within the eastern Canadian Arctic, including both the Hudson Strait and Lancaster Sound ABWEZs. This assessment is based on oceanographic modelling of particle dispersion in relation to climate and depth, together with the identification of areas of ecological, economic and/or cultural significance. TCMS will consider the results of this assessment to determine whether and how a regulatory program needs to be modified to reduce the risk of ship-mediated transfer of invasive species in the eastern Canadian Arctic.

Objectives

The objective of this meeting is to peer review the working paper and to provide advice on alternative ballast water exchange sites in the eastern Canadian Arctic by…

- evaluating the risks that the identified zones may pose to fisheries resources and to the marine ecosystem; and
- Identifying and rationalizing other zones that may pose a lower risk to fisheries resources and to the marine ecosystem.

Invited participants will receive copies of the working paper along with relevant published background documents by November 11, 2013.

Expected Publications

- Science Advisory Report
- Proceedings
- Research Document

Participation

- Fisheries and Oceans Canada (DFO) (Science, and Ecosystems and Fisheries Management sectors)
- Transport Canada, Environment Canada, Parks Canada Agency
- Government of Nunavut, Nunavut Wildlife Management Board, Nunavik Marine Region Wildlife Board, Nunavut Tunngavik Inc. and Makivik Inc.
- Academia
- Industry (Shipping Industry)
- Other invited experts

APPENDIX 2: MEETING PARTICIPANTS

Name		Affiliation
Kristen	Adair	DFO, Science, C&A Region
Dave	Brickman	DFO, Science, Maritimes Region
Leah	Brown	DFO, Oceans program, C&A Region
Charles	Hannah	DFO, Science, Pacific Region
Kimberly	Howland	DFO, Science, C&A Region
Kathleen	Martin	DFO, Science, C&A Region
Cynthia	McKenzie	DFO, Science, Newfoundland and Labrador Region
Chris	McKindsey	DFO, Science, Quebec Region
Christine	Michel	DFO, Science, C&A Region
Shannon	Nudds	DFO, Science, Maritimes Region
Tim	Siferd	DFO, Science, C&A Region
Nathalie	Simard	DFO, Science, Quebec Region
Rob	Stewart	DFO, Science, C&A Region
Ross	Tallman	DFO, Science, C&A Region
Tom	Therriault	DFO, Science, Pacific Region
Margaret	Treble	DFO, Science, C&A Region
Chris	Wiley	DFO, Transport Canada
Philippe	Archambault	Université du Québec à Rimouski
Katherine	Cumming	Parks Canada Agency
Mark	Dahl	Environment Canada
Jared	Gardner	Fednav Canada
Caroline	Gravel	Shipping Federation of Canada
Jesica	Goldsmit	Université du Québec à Rimouski
Karla	Letto	Nunavut Wildlife Management Board
Gabe	Nirlungayuk	Nunavut Tunngavik Inc.
Andre	Rochon	Université du Québec à Rimouski
Bruce	Stewart	Arctic Biological Consultants

APPENDIX 3: MEETING AGENDA

Risk Assessment of Alternate Ballast Water Exchange Zones for vessel traffic to the Eastern Canadian Arctic

Regional Advisory Meeting – Central and Arctic Region
Freshwater Institute, Winnipeg, MB
November 20-21, 2013

Wednesday November 20

9:00 Welcome, Introductions, CSAS Guidelines and code of conduct (Chair: Margaret Treble, Kathleen Martin)

9:20 General overview, objectives and purpose of meeting (Kim Howland)

9:30 Background: oceanography and shipping patterns in the Eastern Arctic (Bruce Stewart)

10:35 Coffee Break

11:00 Background: domestic shipping - perspectives on operational requirements and needs for ballast water exchange in the Arctic (Jared Gardner, FedNav)

11:25 Overview of risk assessment and general methods (Kim Howland)

11:30 Ice-ocean circulation models and shipping routes (Shannon Nudds)

12:15 *Lunch*

1:25 Particle tracking and likelihood of exposure (Shannon Nudds)

Calculation of final risk (Shannon Nudds)

2:05 Zone weightings, definitions and sensitivity analysis (Bruce Stewart)

- Likelihood of establishment (depth and climate)
- Habitat sensitivity

3:45 *Coffee Break*

4:00 Results (Bruce Stewart)

- Sensitivity analyses
    - Likelihood of establishment
    - Habitat sensitivity
    - Relative risk

4:55 Discussion (Bruce Stewart)

5:00 Wrap-up, concluding remarks day 1

5:15 Meeting adjourned, day 1

Thursday November 21

9:10 Review of Day 1 and begin discussion on recommendations (Margaret Treble/Kim Howland)

10:20 *Coffee Break*

10:45 Drafting/revision of Science Advisory Report

12:00 *Lunch*

1:00 Drafting/revision of Science Advisory Report

2:30 Closing remarks, wrap-up day 2

3:00 Meeting Adjourned