

Economic Issues of Marine Invasive Species in the Arctic

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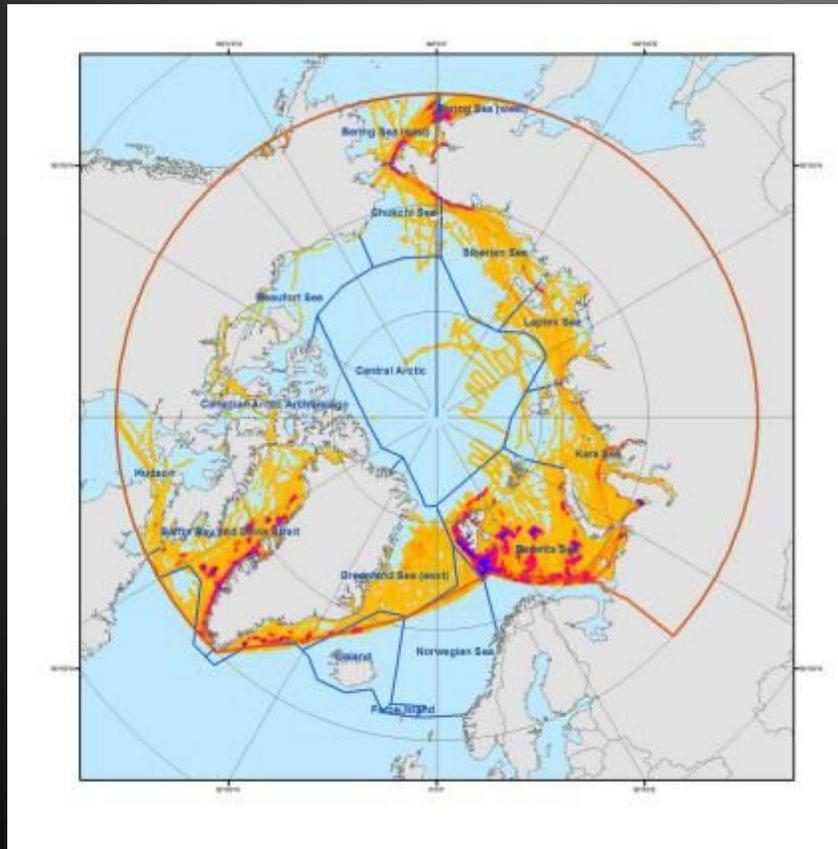
Marine Invasive Species in the Arctic, 2014, TemaNord, edited by L. Fernandez, B. Kaiser and N. Vestergaard

<http://www.norden.org/en/publications/publikationer/2014-547/>

Shipping vectors (pathways) of Arctic threat

Reeves et al compiled existing data on shipping (left), oil & gas

Ship noise and collision threat, ballast water, hull biofouling, dunnage can jeopardize Arctic (ecological, economic)



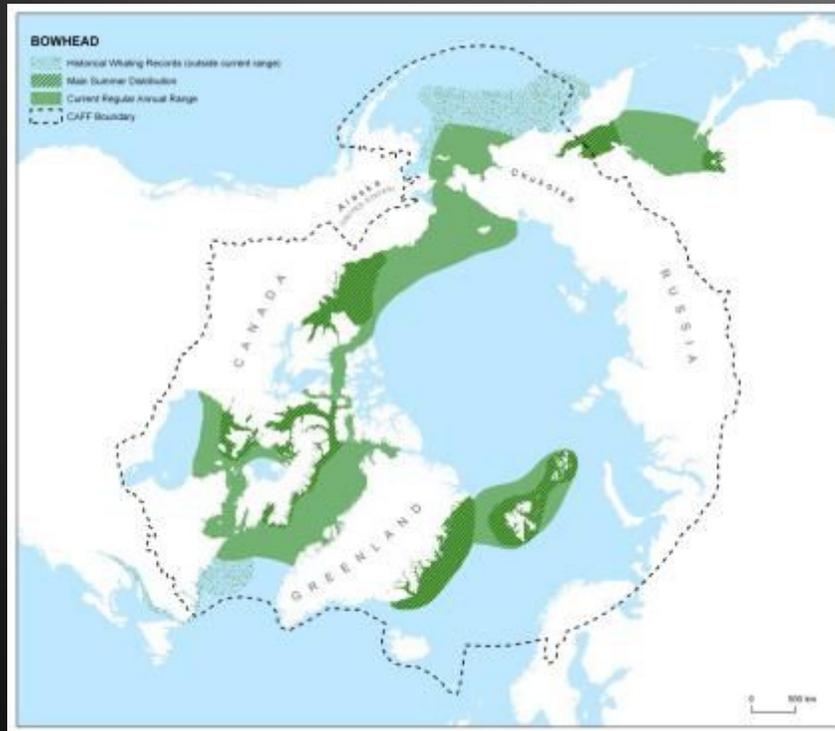
Reeves et al. 2014, Marine Policy

Marine Mammals, etc

Reeves et al compiled range maps (bowhead, left)

Spatial overlap of whale density and ship density distribution: noise and ship strike shows “risk” (mitigation) & opportunity site space (modify spatial overlap through traffic separation?)

Spatial overlap does not equal risk, but it’s a precursor



Reeves et al. 2014, Marine Policy

Marine Invasive Species, Noise, Ship Strikes

jeopardize Arctic (commercial, recreational, existence, subsistence values of marine resources), spatially correlated risk, benefits



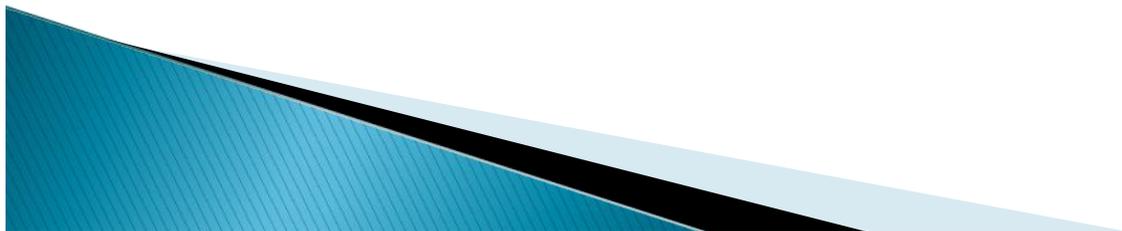
Vector (Pathway) Management

- ▶ Vector (pathway) direction and magnitude influences risk in a transport matrix with transfer coefficients between shipping source, interim and destination over space and time.
- ▶ Contagion for Artic Ports and Beyond
- ▶ Motivators for public management: Potential damage lowers benefits in shared space
- ▶ Motivators for ships: Speed and time saving, Weight, Cost, Fuel Savings from less biofouling of 30%, lost time in dry dock repair, lengthy insurance inspection, Avoidance of Potential physical damage.
- ▶ For both: Reduction in Piracy, Reciprocity for Addressing Shared Threat
- ▶ Can quantify these economic motivators



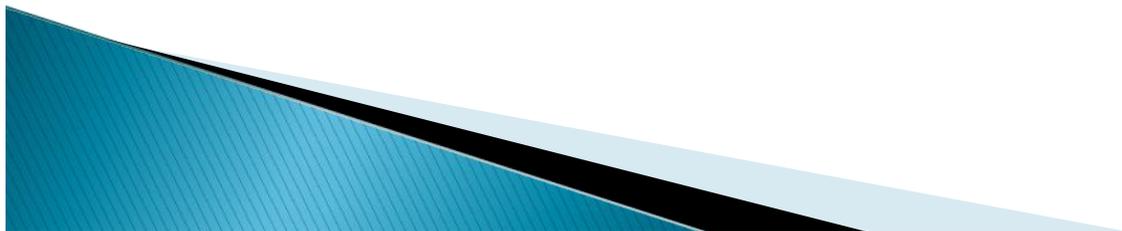
Incomplete and Uncertainty Policy?

- ▶ IMO and Arctic states are signatories to IMO conventions and Polar Code (10/14)
- ▶ MARPOL 73/78 and SOLAS 74 do not include vectors of marine invasive species, cetacean risk for Part I-A Safety and II-A-Pollution Prevention relates to Sewage and solid waste garbage on the ship.
- ▶ February 2004 IMO suggests numerical limit on invasive species in ballast water emissions (entering and exiting 200 mile EEZ) 5 of 8 states of Arctic Council have ratified this (Norway, Russia, Canada, and Denmark, and Sweden)
- ▶ United States, Finland, and Iceland have not.
- ▶ Aim: With the policy gap and no or mixed property rights, emphasize economic incentives for vigilance and abatement against marine invasive species



Shipping and Arctic ports with different information on risk and pollution control is similar to international trade between exporters and importers

- Asymmetric Information
 - shipper risk abatement to reduce biosecurity threat (hidden action)
 - shipper abatement cost (hidden characteristic)
- Instrument
 - Mechanism design contract to overcome information asymmetry, pollution externality
- ▶ Ports offer access for shippers so port access as basis of contract between port and shipper



Access to Arctic Ports, economic incentives

- ▶ Contract with incentives for ideal level of abatement of the shippers.
- ▶ If port (principle) knows shipper's production (timing and volume of ballast, cargo, hull), make contract spatial, tied to transport matrix. Monitoring would help if recommended abatement is not always visible (with remote surveillance).
- ▶ Performance/environmental bond



Environmental Bonds

- ▶ Pools costs for shippers
- ▶ Imposes a cost on potential damage that is forfeited if the damage occurs
- ▶ Cooperation increases with increased bonds and higher production value threatened



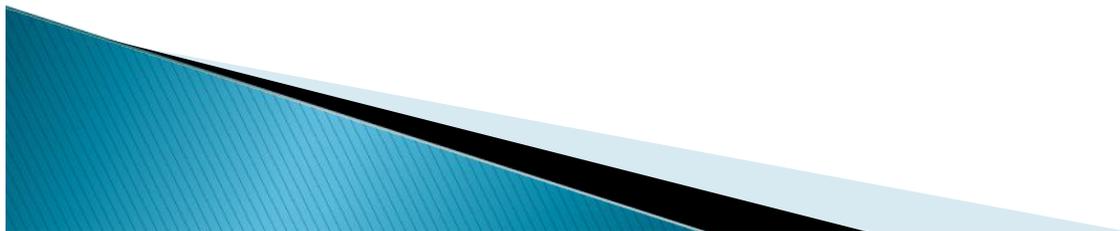
Leigh Johnson

Economic Modeling for >1 Decisionmaker

- ▶ Applied Spatial, Dynamic Game Model
- ▶ Asymmetric incentives across countries (different pollution control costs, flow and stock effects, ability to pay, damages), spatially varying costs

Integrated Model Components –with multiple decisionmakers acting simultaneously

- ▶ Minimize expected net costs of abatement and damages due to invasive species
- ▶ Taking into account spatial dynamics of marine invasive species, shipping and native habitat with transport matrix of invasive species and whale collision risk between ports



Tracking of ships spatial and dynamic movements episodically in Arctic:

- ▶ Monitoring capabilities in Vardo, Norway, Murmansk, Russia for VTS with remote surveillance monitoring for Barents area.
- ▶ IMO suggests same approach around Arctic requiring ships of 5,000 gross tons or more, tankers, hazardous cargos, ships longer than 200 meters and nonfunctioning vessels to notify either Vardo or Murmansk, VTS including automatic identification system, long range identification and tracking, web map service and satellite based synthetic aperture radar.
- ▶ Canada and U.S. Arctic area has radio call in to Coast Guard for ship counts
- ▶ Characterize dynamic (and spatial) risk values per vessel based on type of ship, cargo, age, flag of ship, water and sea conditions, traffic information, distance from shore, etc. wider than port