TRANSFER OF AQUATIC NUISANCE SPECIES INTO THE GREAT LAKES FROM U.S. AND CANADIAN COASTAL AND INLAND PORTS

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INTRODUCTION

- Vessel-mediated transfer of ANS from:
  - Overseas
  - Inter-lake
  - Coastal and Inland
- Focus: Ballast water of commercial vessels
- Hull fouling and recreational vessels
- Risk of:
  - Introduction (BW as proxy for propagule pressure)
  - Survival (environmental similarities of source and discharge port pairs)
  - Consequence (select ANS of concern)

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GEOGRAPHIC SCOPE

- Great Lakes: Montreal & west
- SLS to mouth
- Coastal beyond
- Atlantic, Arctic, Gulf of Mexico
- Not Pacific
- Quebec City: fresh to marine transition

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DATA AND METHODS

- Ballast Water Volume:
  - 10 Years: 2007 – 2016
  - Source: NBIC
  - Coastwise
  - Tank Records for discharging BW > 0 MT
- Environmental Similarity
  - Salinity + Temperature
  - Source: Keller's Global Port Database

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RESULTS

	Average year (total 2007-2016/10 years)	Range (min-max)
#Voyages	76	41-122
BW Volume (million MT)	0.78	0.3 – 1.6

- *Voyages*: Bulkers (76%), Tankers (17%), General Cargo (4%)
- *Volume*: Bulkers (96%), Tankers (2%), General Cargo (0.7%)

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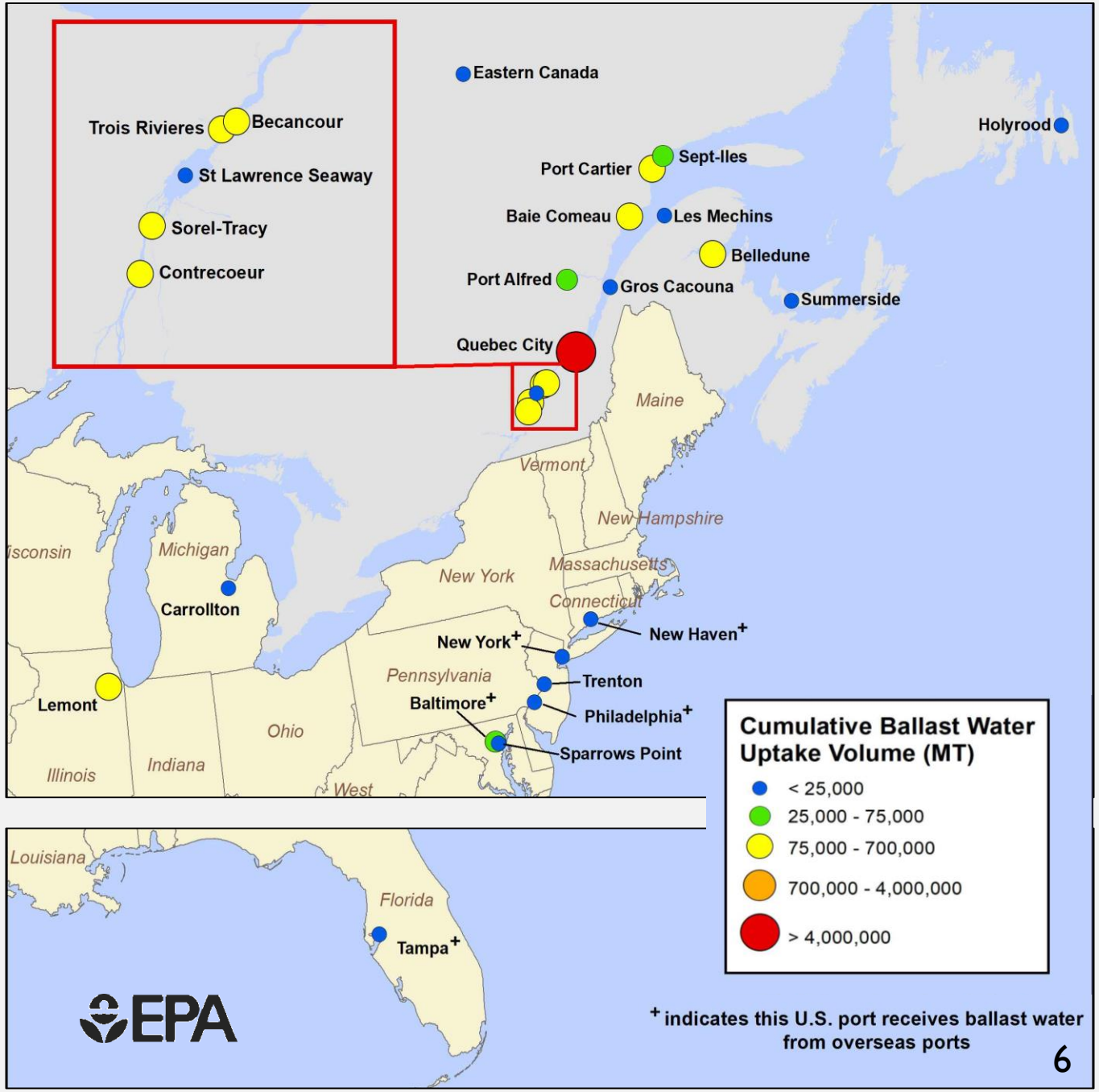
SOURCE PORTS TOP 15

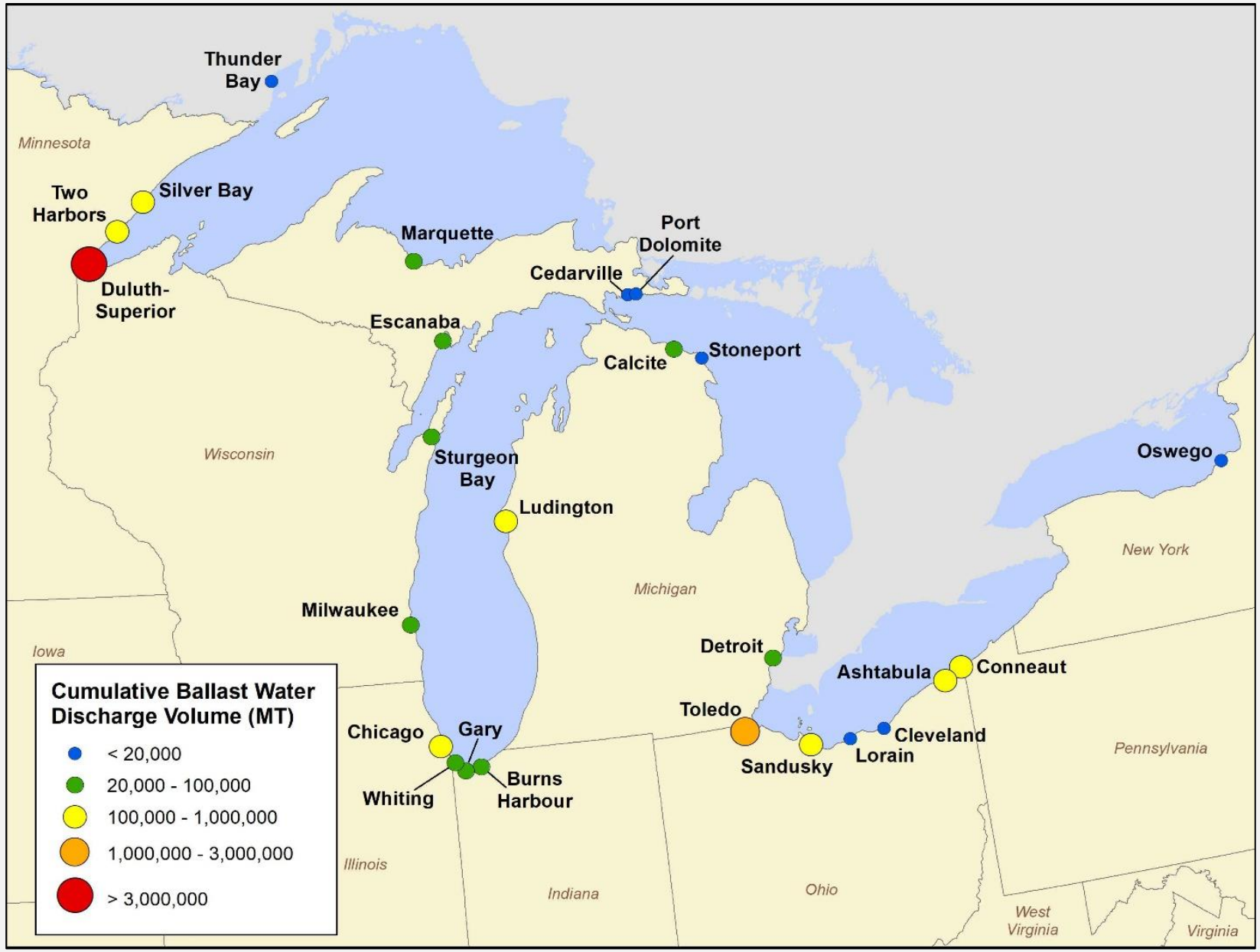
- **Quebec City**
- Sorel-Tracy
- Baie Comeau
- Contrecour
- Lemont, IL
- Belledune
- Sept-Illes
- Port Alfred
- Baltimore, MD+
- Philadelphia, PA+
- New Haven, CT+
- Tampa, FL+
- New York, NY+
- Les Mechins
- Trenton, NJ



DISCHARGE PORTS TOP 9/25

>100K MT

- **Duluth-Superior**
- Toledo
- Conneaut
- Silver Bay
- Ashtabula
- Sandusky
- Two Harbors
- Ludington
- Chicago



TOP 25 PORT PAIRS

- Majority from SLS to Lake Superior or Lake Erie
- 9 Source ports
  - All SLS ports Source to 94%
  - >5 source ports received overseas BW
- 10 Discharge ports
  - 80% of Discharge at 5 ports

    Quebec City – Duluth: 32%

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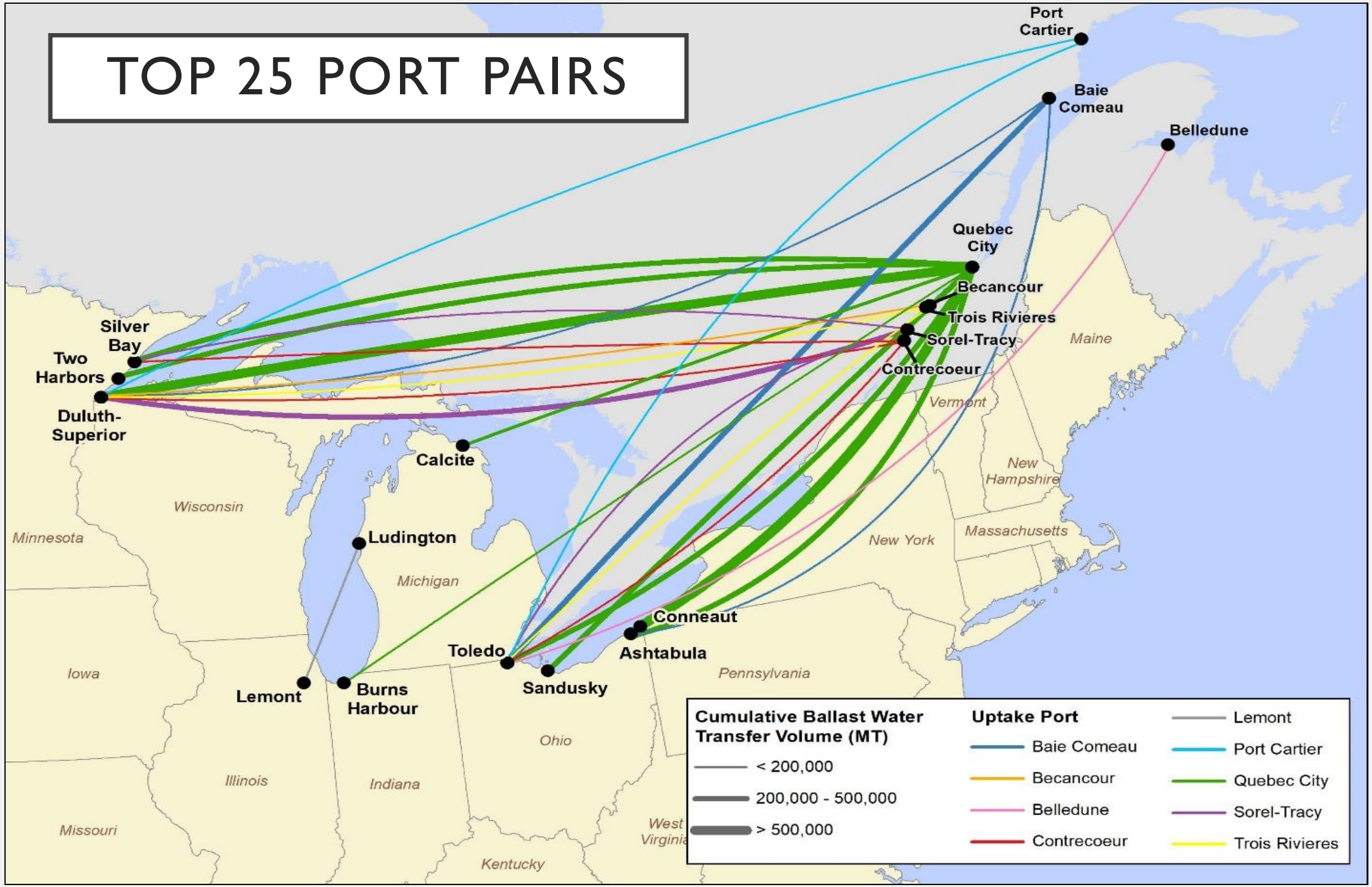
TOP 25 PORT PAIRS



ENVIRONMENTAL SIMILARITIES

- Range: 0.49 – 3.22
- Risk: High = 19, Medium = 4, Low = 2
- Distance < 1.0:
  - *Uptake*: Becancour, Trois Rivieres, Lemont, Sorel-Tracy, Contrecoeur
  - *Discharge*: Duluth-Superior, Ludington, Toledo, Silver Bay
- Quebec City (18 ppt) pairs: 1.4 to 1.6
- Salinity Dependence

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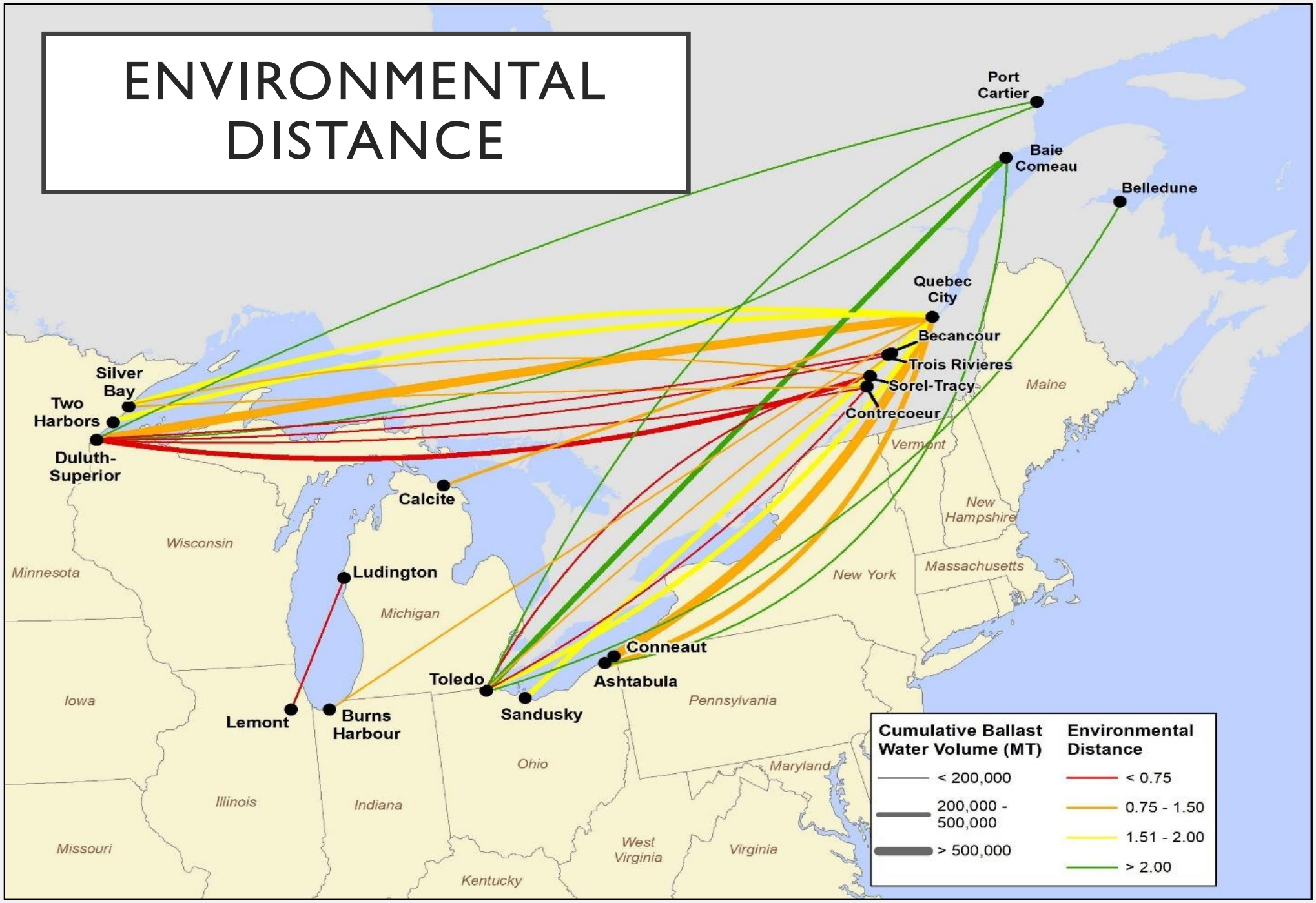
ENVIRONMENTAL DISTANCE



MANAGEMENT

- 91% reported Managed
  - 74% BWE
- Varies by route:
  - 1.5% - 100% Reported managed
- Quebec city-Duluth:
  - 19.1% managed (reported)

Water Overflowing from Deck Hatches and Ports During BWE; Photo courtesy of Smithsonian Environmental Research Center at: https://invasions.si.edu/nbic/managementpract.html

COMPARISON WITH OVERSEAS AND INTER-LAKE TRANSPORT

	Inter-lake	Coastal & Inland	Overseas
Average Year	52 MMT	0.78 MMT	0.27 MMT
4 Year Cumulative	209 MMT	4.5 MMT	1.1 MMT
Retention Times	1-3 days	7.6 days	30 days

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SUMMARY OF COASTAL RESULTS

- Coastal/inland transfers have greater volumes and shorter voyage times than overseas transfers
- Coastal/inland transfers have smaller volumes and longer voyage times that inter-lake transfers
- Majority of volume sourced from the SLS
- Limited number of high volume ports
- Majority of top port pairs are categorized as "high risk" according to environmental distance
- Reported BW management rates varied widely from route to route
- Majority Vessel Type: Bulkers (96% by volume)

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QUESTIONS

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U.S. Flagged Laker Paul R. Tregurtha in the St. Mary's River, courtesy of Boat Nerd, available at: http://www.boatnerd.com/pictures/fleet/prtrgrth.htm

SUMMARY COMPARISON WITH OVERSEAS AND INTER-LAKE TRANSPORT

Source Type	Ballast Water Discharge Volume (MT)			Retention time
	Annual Average (Averaging Period)	Cumulative for 2010-2013	Cumulative for 2011-2014	
Coastal and Inland	775,415 (2007-2016)	4,305,972	4,793,942	7.6 days
Overseas	270,234 (2010-2013)	1,080,934	-	30 days
Inter-lake	52,377,334 (2011-2014)	-	209,509,336	1-3 days

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