

Building Sustainable Solutions to the Issue of Ballast Water Treatment: Testing Relationships Between Propagule Pressure and Colonization Success of Invasive Species.

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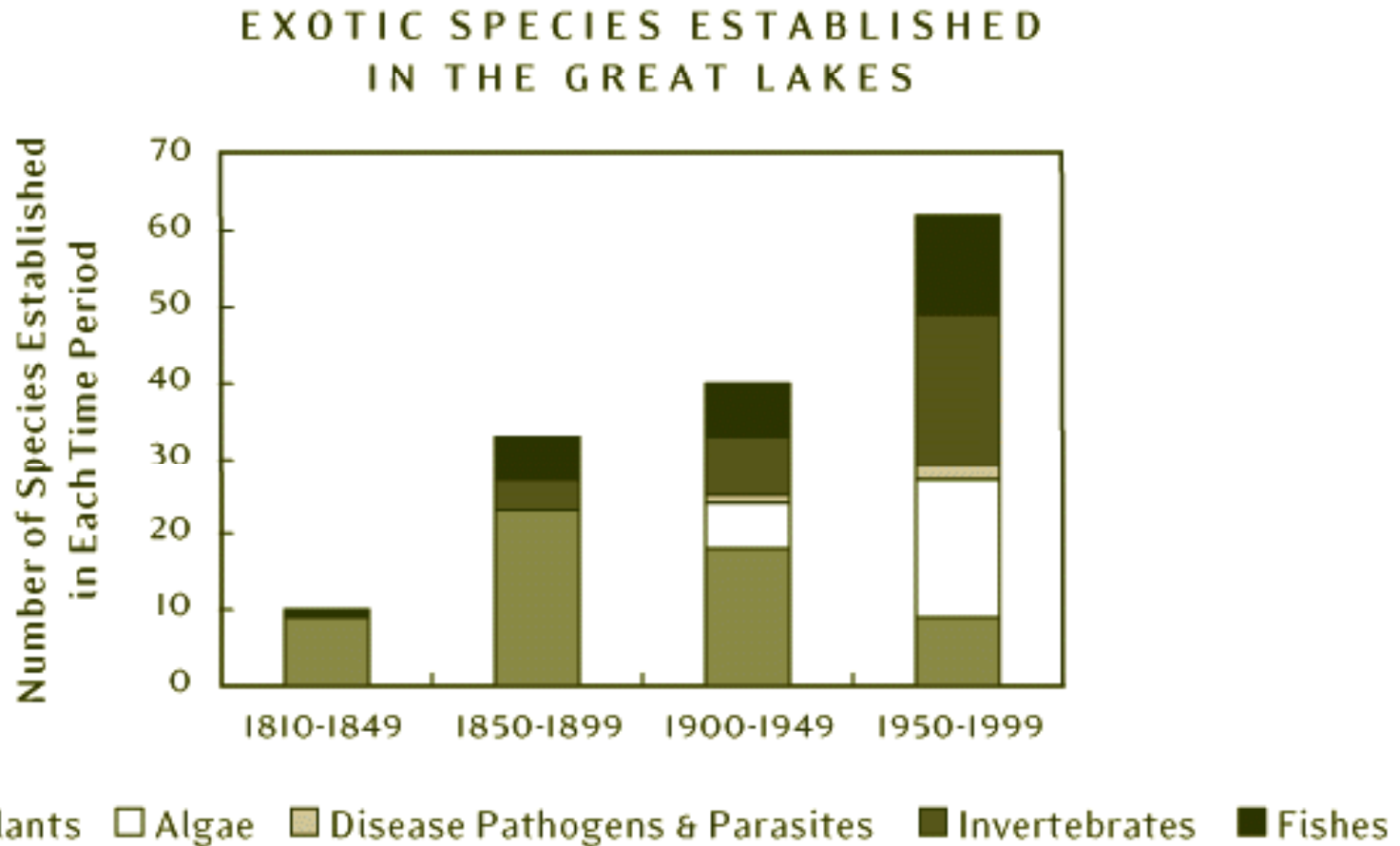
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Research Institute**

Invasive Species are non-native organism perceived or demonstrated to cause economic or environmental harm.



Source: Mills, et al, 1993; Edsall, et al, 1995; Mills, et al 1994

3) Propagule Pressure :

The size and frequency of invading populations

BWT

**SUCCESSFUL
COLONIZATION BY A
NON-NATIVE SPECIES**

1) Resident Diversity

2) Abiotic Conditions

Over-arching Question :

What are the ecological and empirical relationships between **Propagule Pressure** and **Colonization Success** of invasive organisms?



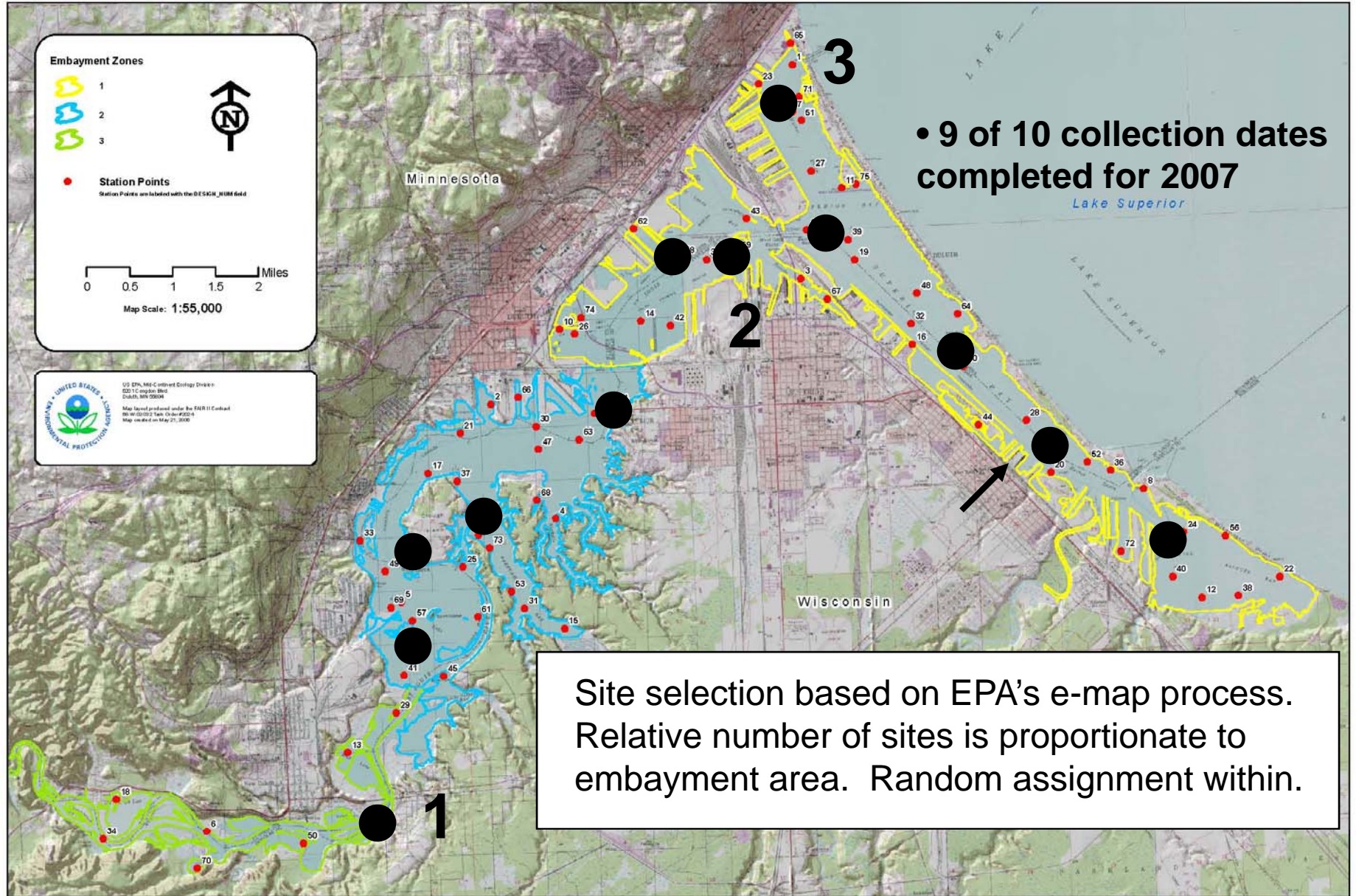
***Crustacean
Zooplankton***

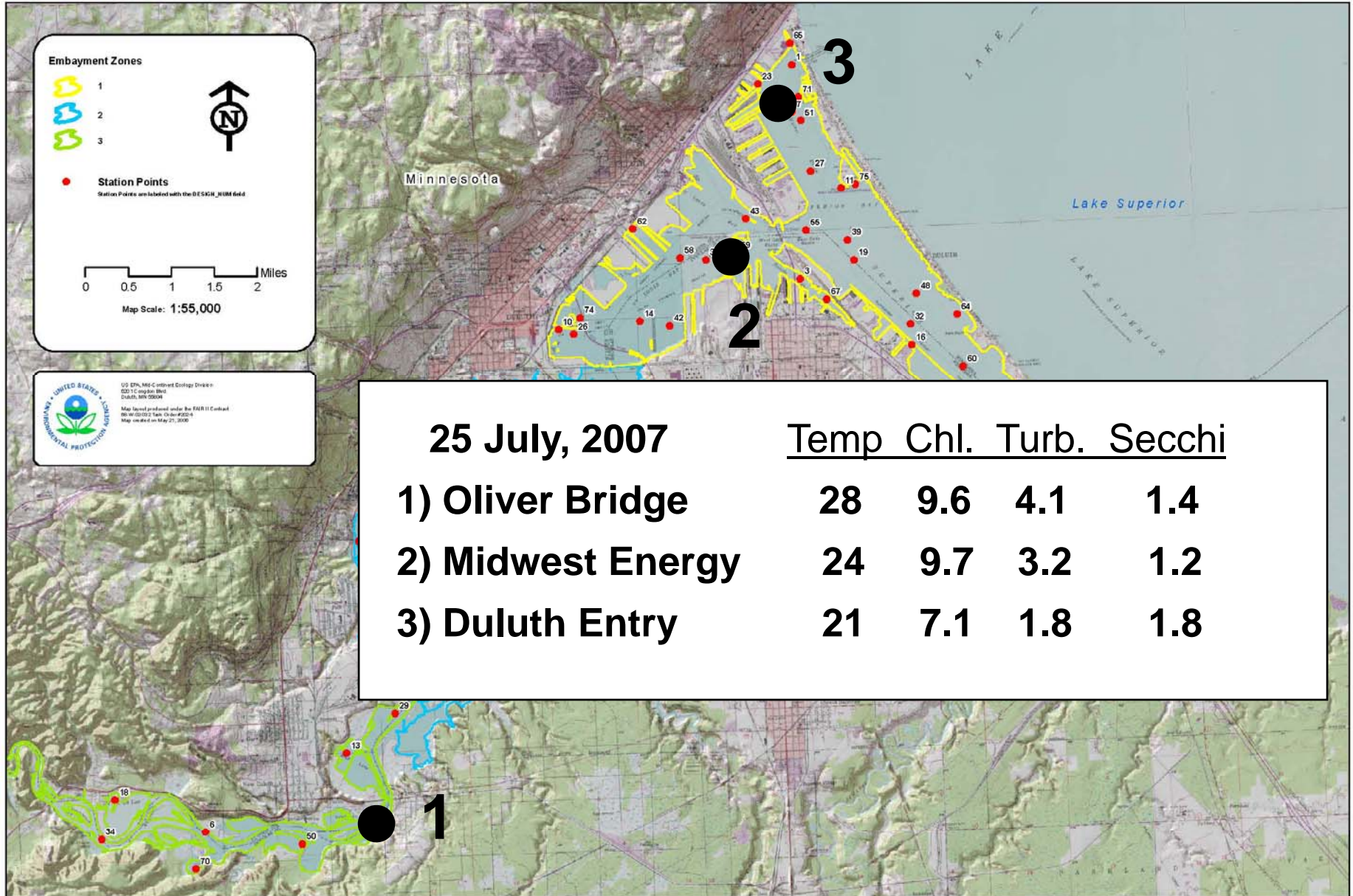
Objectives of this Project:

- 1) Identify resident diversity of zooplankton & the abiotic conditions at 12 locations bi-weekly (May – September) in the Duluth-Superior Harbor & St. Louis Estuary.
- 2) Conduct propagule pressure experiments in land-based mesocosms that bracket IMO proposed standards & that employ different natural assemblages of plankton (based on Objective 1).
- 3) Test for relationships between zooplankton diversity in the Harbor/Estuary (based on Objective 1) & seasonal shipping traffic.

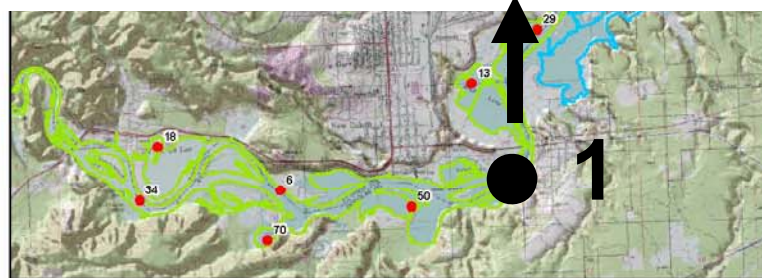
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Date	20-Apr-07	9-May-07	1-Jun-07	14Jun	5-Jul-07	29-Jul-07	16-Aug-07	29-Aug-07
Bosmina longirostrus	70.9	44.2	67.0	165.8	348.6	1403.1	527.2	7602.0
Chydorus sp.	240.9	10.2	63.8	25.5				
Alona sp.	14.2	20.4	44.6	63.8	8.5			25.5
Ceriodaphnia sp				63.8	11.9	95.7	807.8	357.1
Diaphansoma sp.		23.8		17.0	149.7	561.2	646.3	535.7
D. retrocurva						31.9	280.6	1275.5
D. g. mendota						6.4	34.0	
D. thomasi male	42.5							
D. thomasi female	34.0							
A. vernalis male	8.5			4.3				
A. vernalis female	2.8							
E. agilis male				8.5				
E. agilis female	5.7	10.2		8.5				
T. mexicanus male								
T. mexicanus female	19.8	3.4						
D. sicillodites male	11.3							
D. sicillodites female	2.8							
D. orgenensis male	2.8							
D. orgenensis female								
D. sicilis male		3.4						
D. sicilis female								
Eurytemora male								
Eurytemora female								
Epischura male								
Epischura female								
Harpacticoid male								
Harpacticoid female	2.8	6.8		4.3				
Leptodora				4.3		12.8	110.5	
N auplii	522.0	602.0	172.2	761.1	352.0	548.5	8044.2	6326.5
Cyclop copepids	272.1	224.5	95.7	250.9	35.7		3979.6	2959.2
Mesocyclop copepids	11.3	3.4					8.5	
Tropocyclop copepids	11.3							
Diaptomus copepids	5.7	6.8		4.3	98.6		8.5	25.5
Harpactacoid copepids	62.4	47.6	3.2					
Eury copepids						25.5		
Epischura copepids								



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Bosmina longirostrus	111.0	336.2	2039.7	4726.1	15095.5	59872.6	12314.2	5573.2	
Chydorus sp.	252.1	47.8	28.3						
Alona sp.	16.2	55.7	61.4	51.0	42.5				
Ceriodaphnia sp		15.9		12.7	31.8		1141.2	159.2	
Diaphansoma sp.		8.0	4.7	12.7	382.2	4670.9	9660.3	3980.9	
D. retrocurva				51.0	244.2	1114.6	5520.2	4140.1	
D. thomasi male	44.0	55.7	37.8	25.5	31.8	53.1	238.9	716.6	
D. thomasi female	37.0	79.6	80.3		31.8	212.3	132.7	79.6	
A. vernalis male	4.6								
A. vernalis female	11.6								
E. agilis male	6.9				21.2		159.2	398.1	
E. agilis female	9.3				21.2		159.2	477.7	
T. mexicanus male									
T. mexicanus female		8.0							
M. edax male							106.2	636.9	
M. edax female	2.3					53.1		238.9	
D. sicillodites male		31.8		25.5					
D. sicillodites female	2.3	8.0							
D. orgenensis male					21.2	159.2			
D. orgenensis female					21.2		132.7		
D. sicilis male	32.4	15.9						79.6	
D. sicilis female	2.3							79.6	
Eurytemora male			14.2	89.2	21.2	159.2	159.2		
Eurytemora female			28.3	165.6	21.2			79.6	
Epischura male				12.7			53.1	79.6	
Epischura female				51.0			79.6	79.6	
Harpacticoid male	4.6								
Harpacticoid female	18.5	15.9						79.6	
Lepto				25.5	31.8	159.2	79.6		
Holopedium							26.5	79.6	
N auplii	1192.7	3837.6	2285.2	3535.0	4203.8	3343.9	4617.8	16879.0	
Cyclop copepids	508.9	4808.9	1383.4	777.1	3620.0	4564.8	5838.6	6767.5	
Mesocyclop copepids	48.6	39.8			42.5	159.2	106.2	79.6	
Tropocyclop copepids	9.3								
Diaptomus copepids	6.9	167.2	42.5	51.0	276.0	424.6	1512.7	1751.6	
Harpactacoid copepids	101.8	31.8	28.3						
Eury copepids			75.5	815.3	350.3	265.4	212.3	238.9	
Epischura copepids				993.6	658.2	1857.7	1035.0	3025.5	
Veligers							16135.9	5944.8	5812.1

