

Disconnecting Places: Asian Carp and Other Aquatic Invasive Species of Concern for the Calumet Region



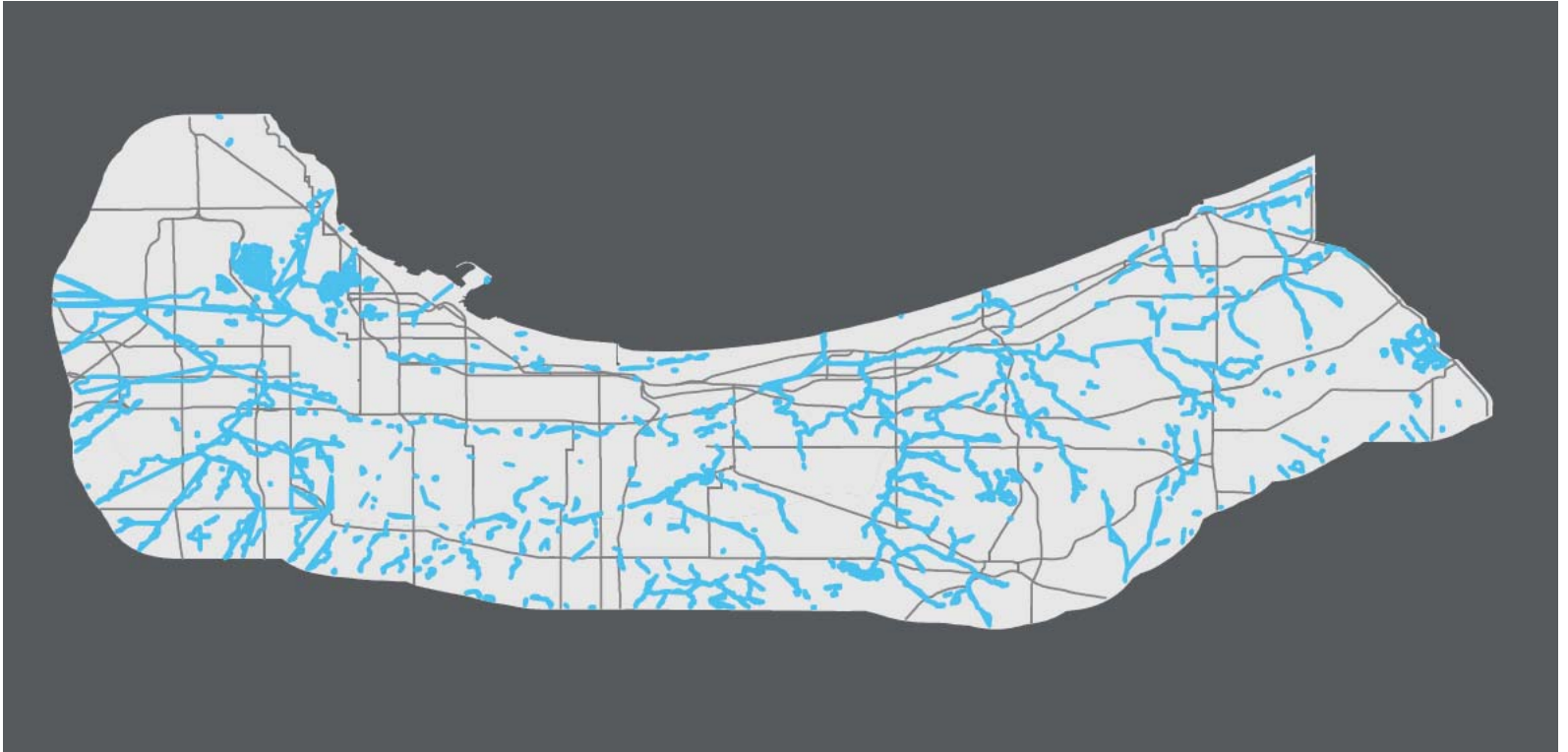
Reuben Keller

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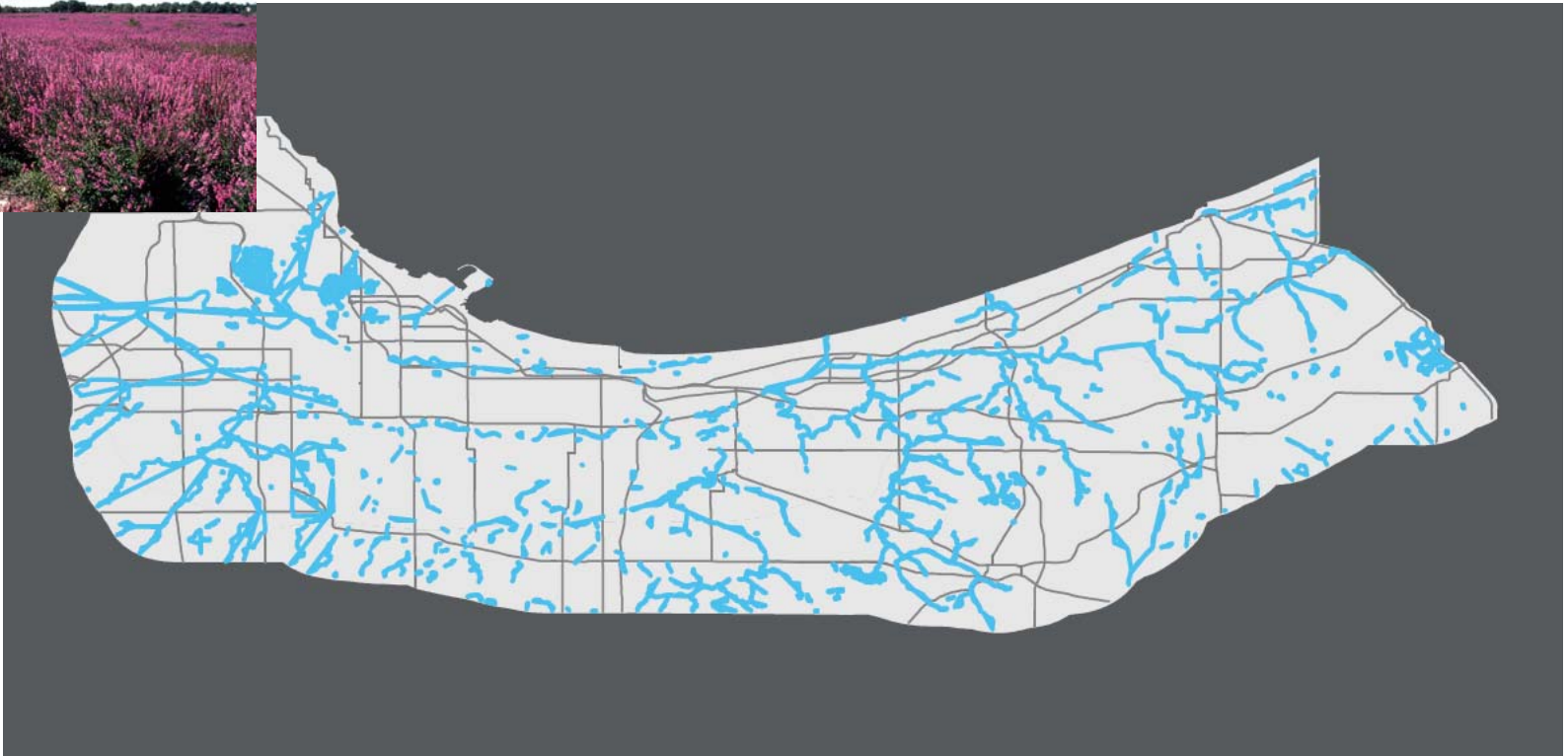
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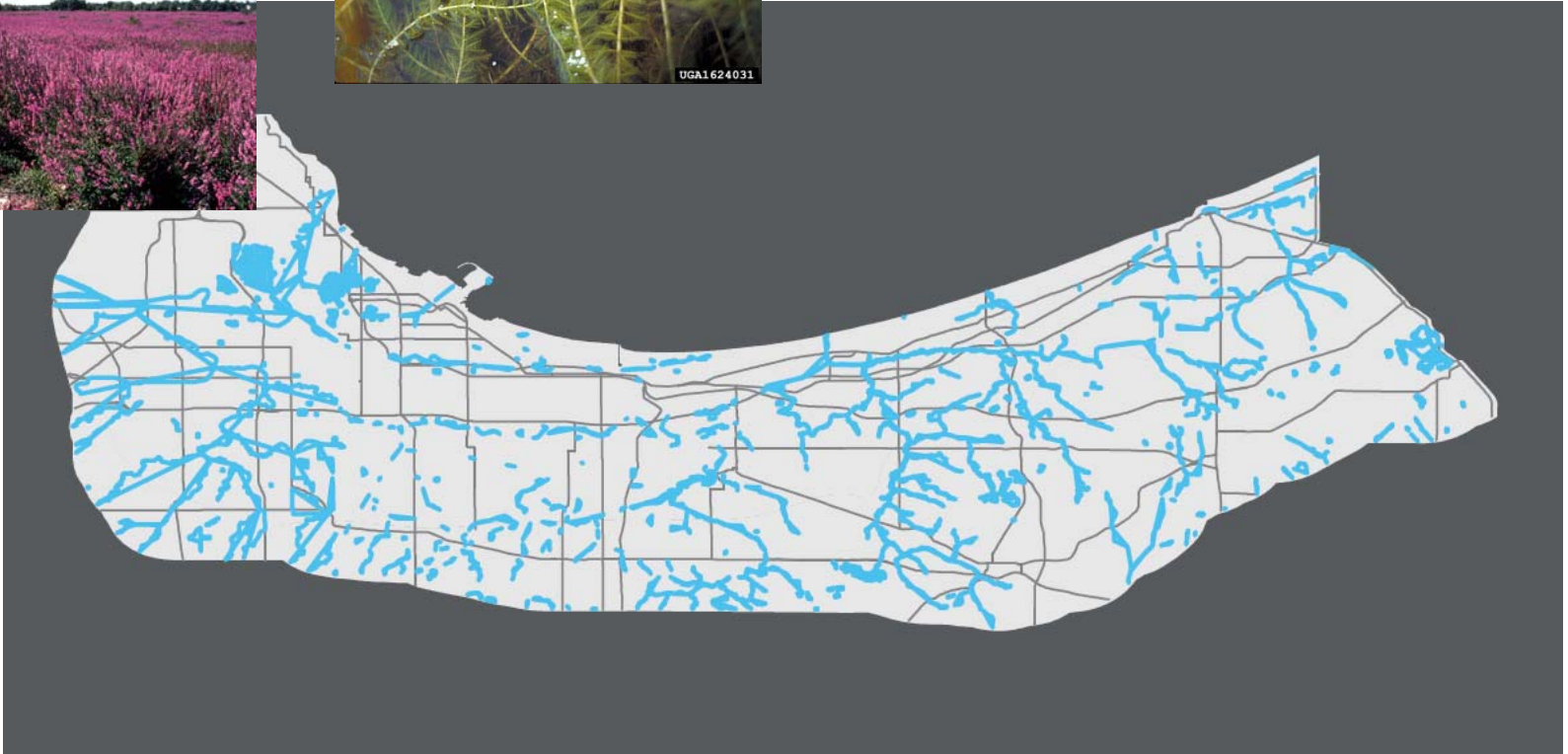
Invasive Aquatic Species in the Calumet Region



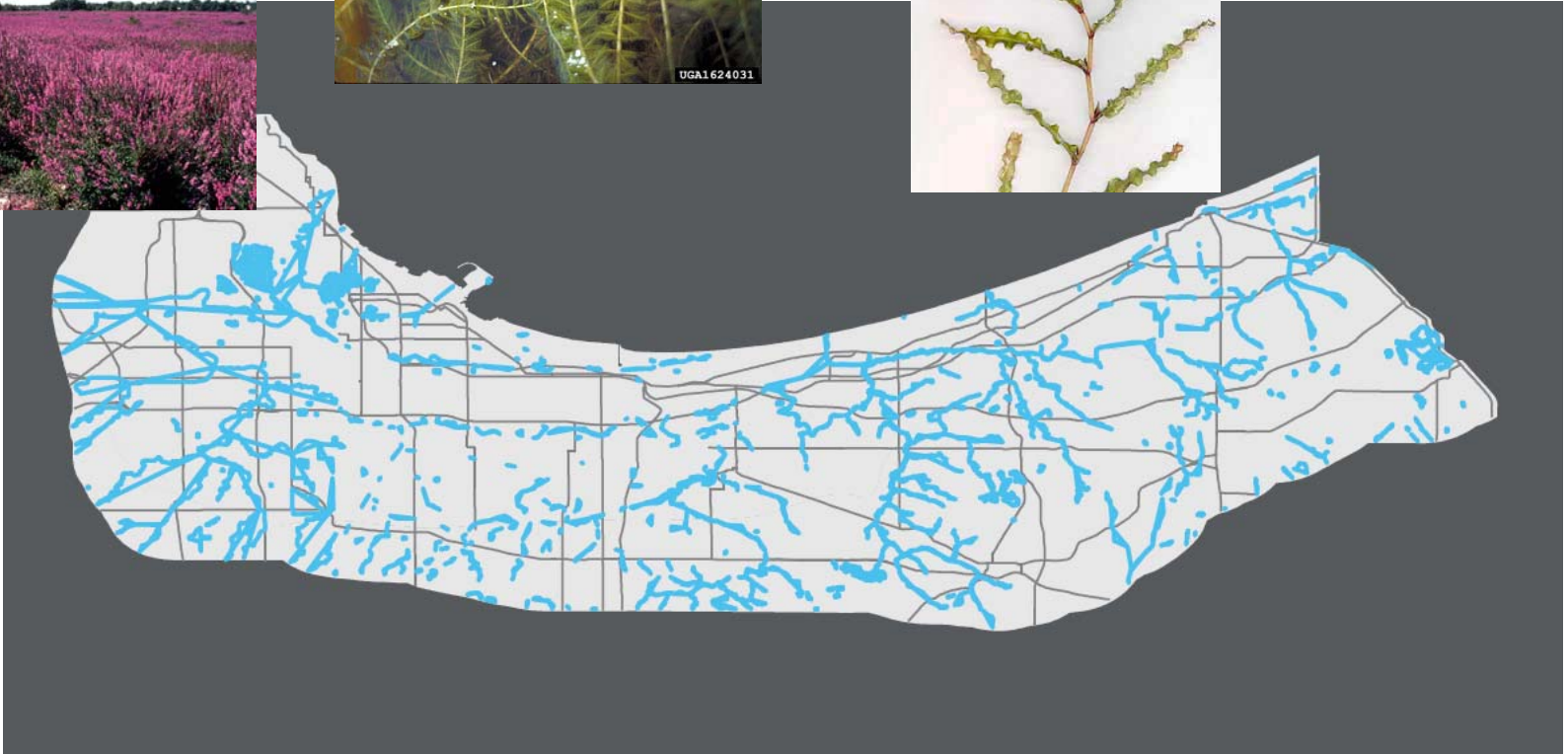
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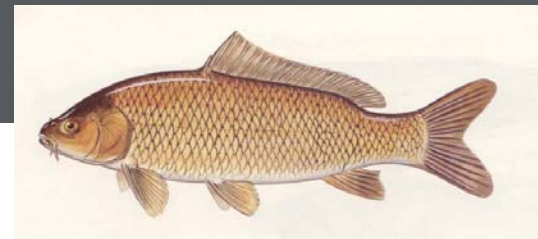
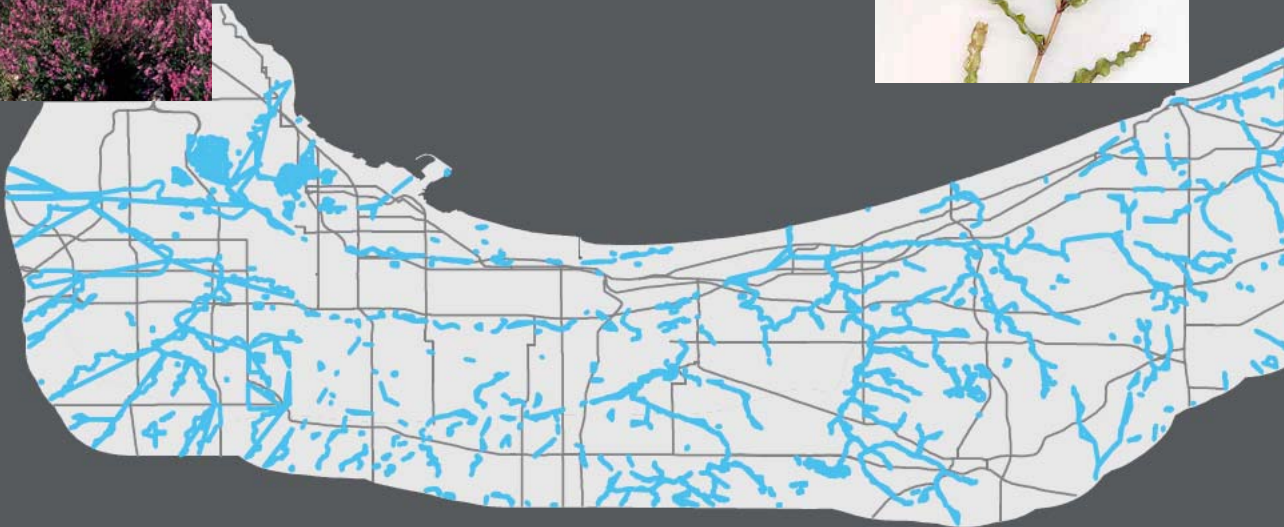
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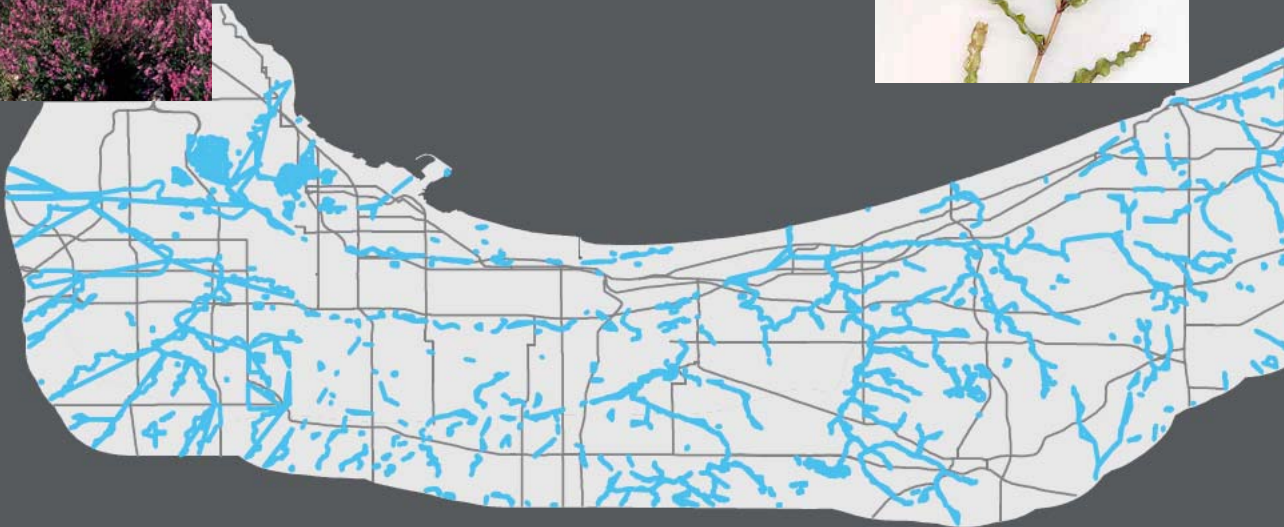
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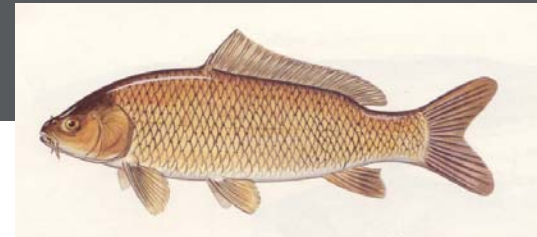
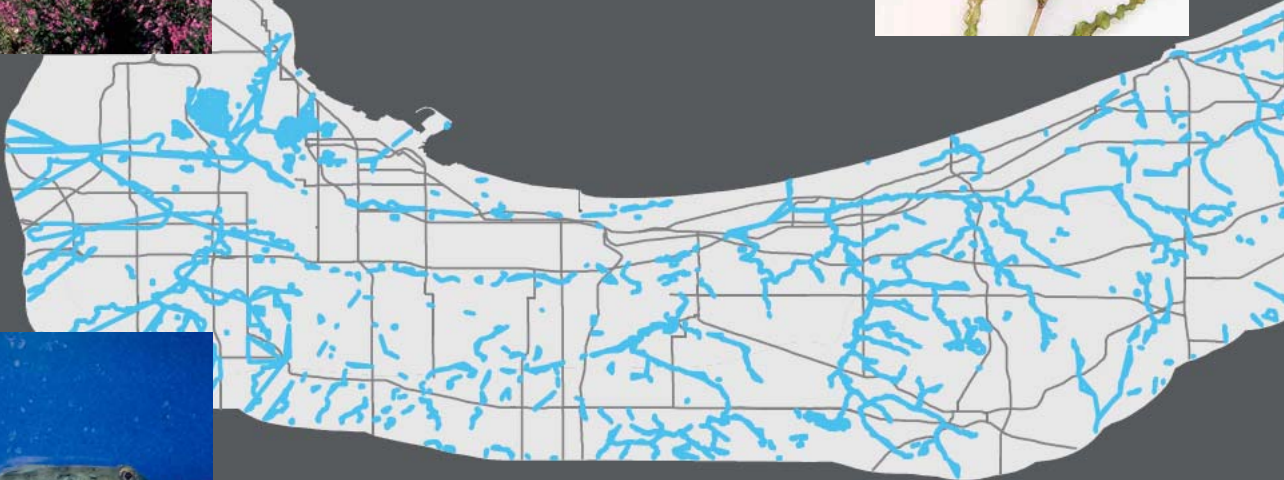
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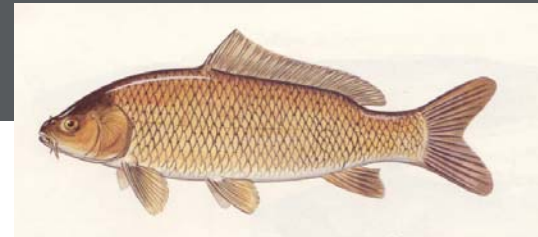
Invasive Aquatic Species in the Calumet Region



Future Invaders??



JasonLindsey.com



Future Invaders??



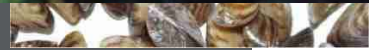
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Future Invaders??



Calumet Region is Globally Connected



1) Canals

3) Trades

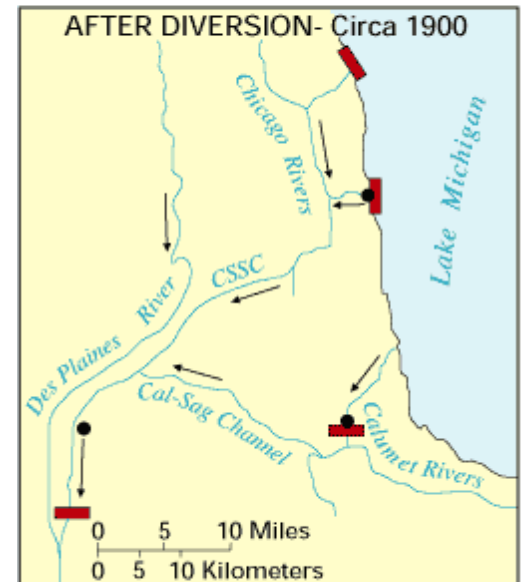
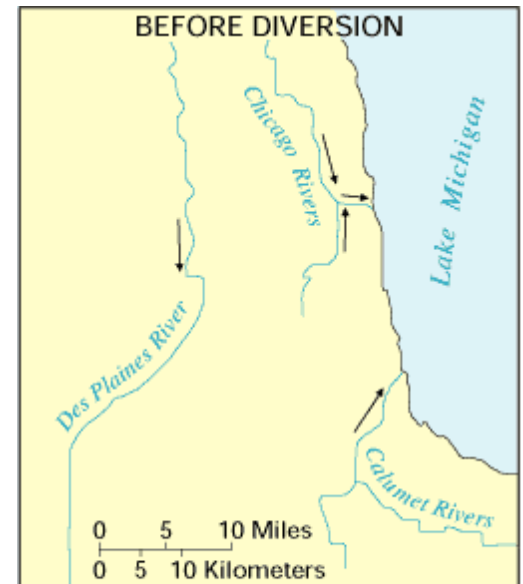
2) Shipping

Chicago Sanitary and Shipping Canal

- Opened in 1900
- Connects Great Lakes and Mississippi watersheds
- Originally too polluted, but now a pathway for species spread
- Zebra mussel, round goby; Asian carps? Others?



<http://en.wikipedia.org/wiki/File:Chicago-Sanitary-and-Ship-Canal.jpg>



EXPLANATION

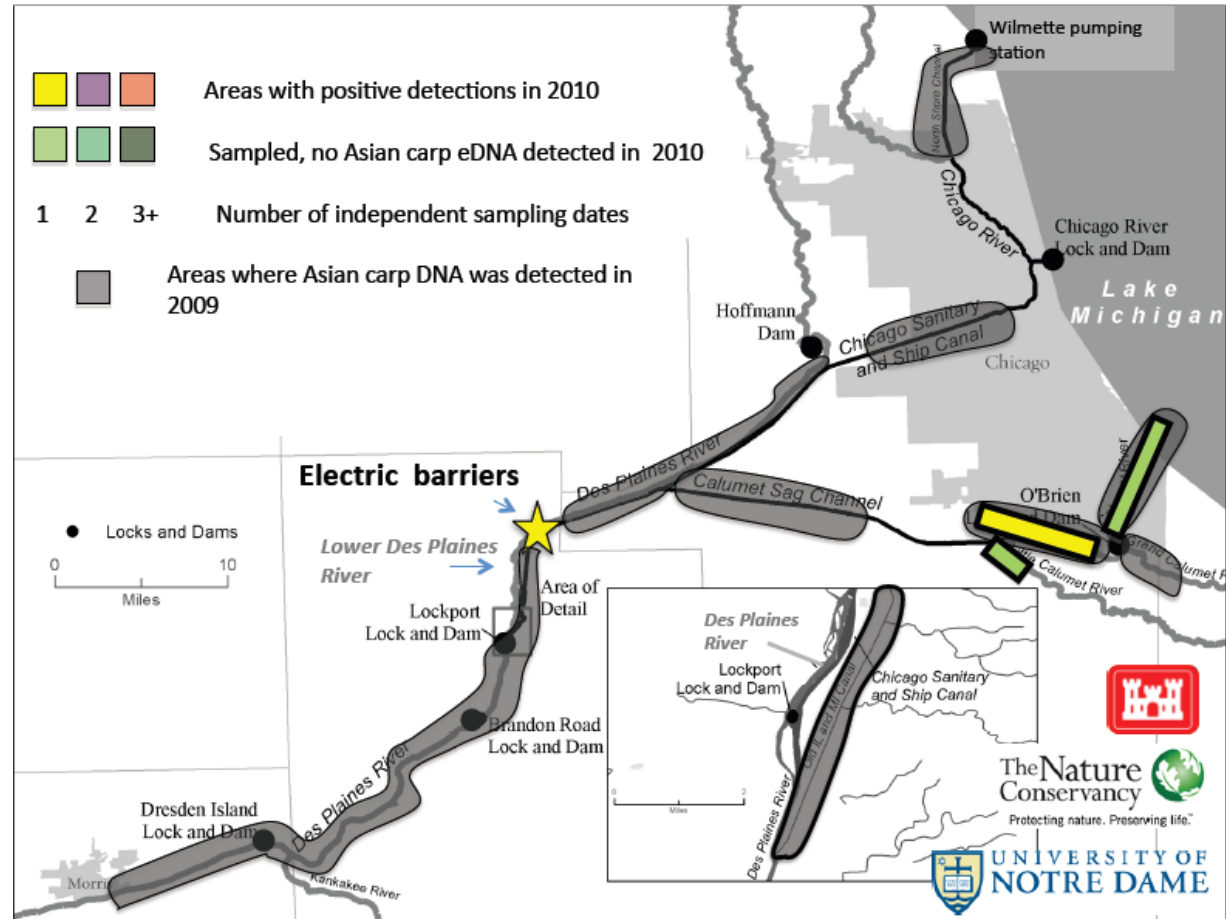
← Direction of Flow

■ Control structure

Asian Carp

- Native to East Asia
- Introduced to southern fish farms and water treatment plants
- Silver (1970s) and Bighead (1980s) carp populations found in the Mississippi River
- Rapid spread North, now in the Chicago Area Waterways

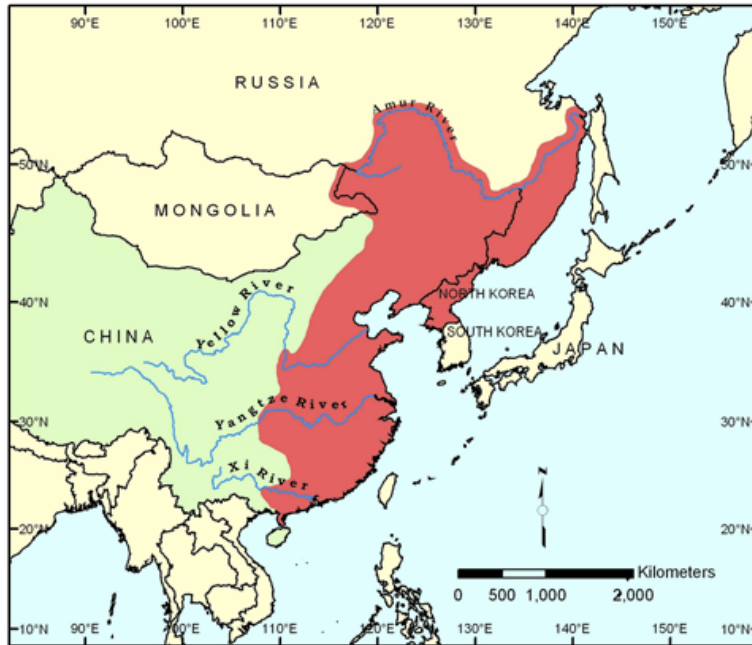
Fig. 1 Environmental DNA results as of April 16, 2010



http://www.lrc.usace.army.mil/pao/16April2010_eDNA_update.pdf

Asian Carps Are Here Because Calumet Waterways are Globally Connected

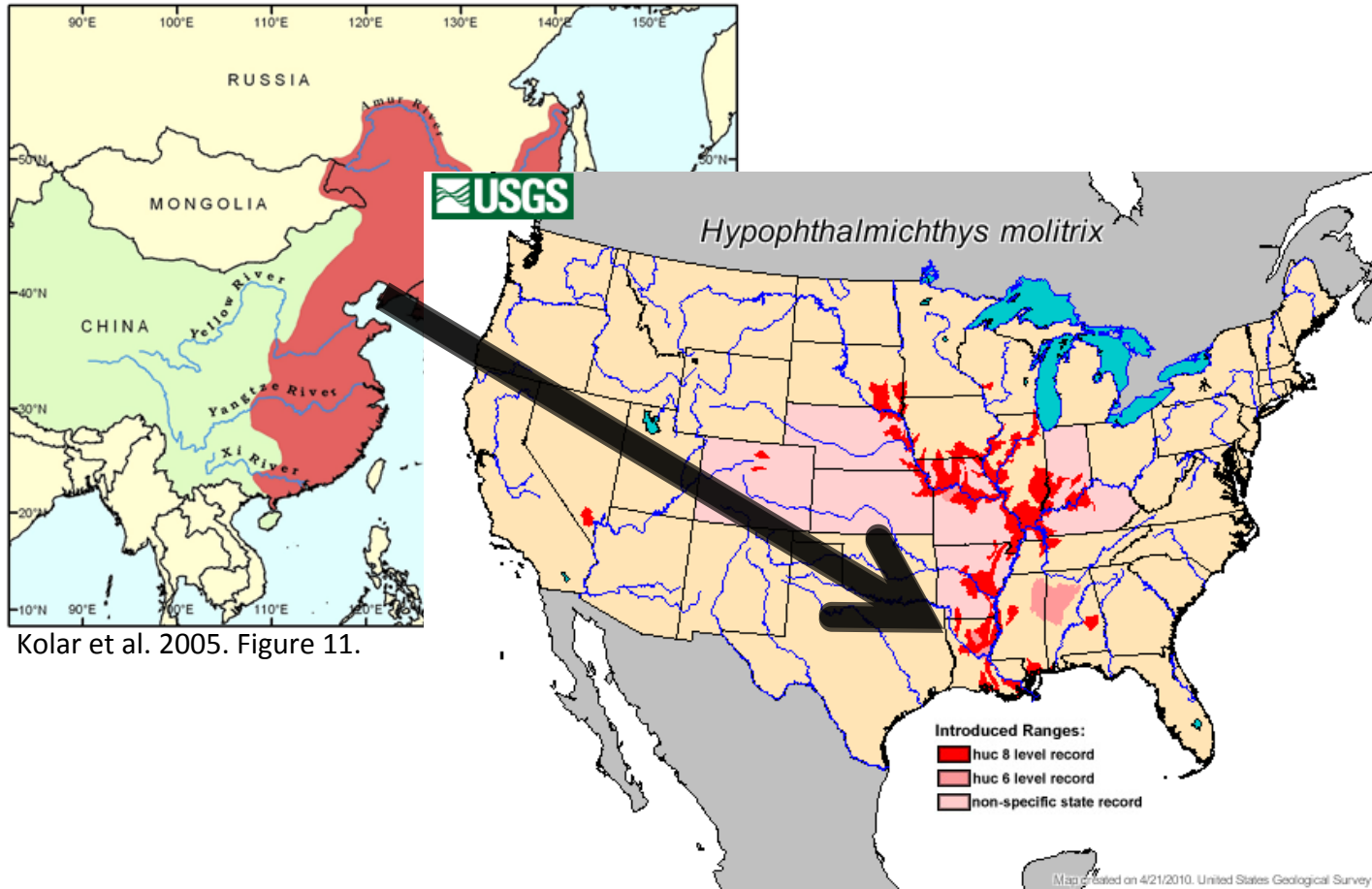
Silver carp native range



Kolar et al. 2005. Figure 11.

Asian Carps Are Here Because Calumet Waterways are Globally Connected

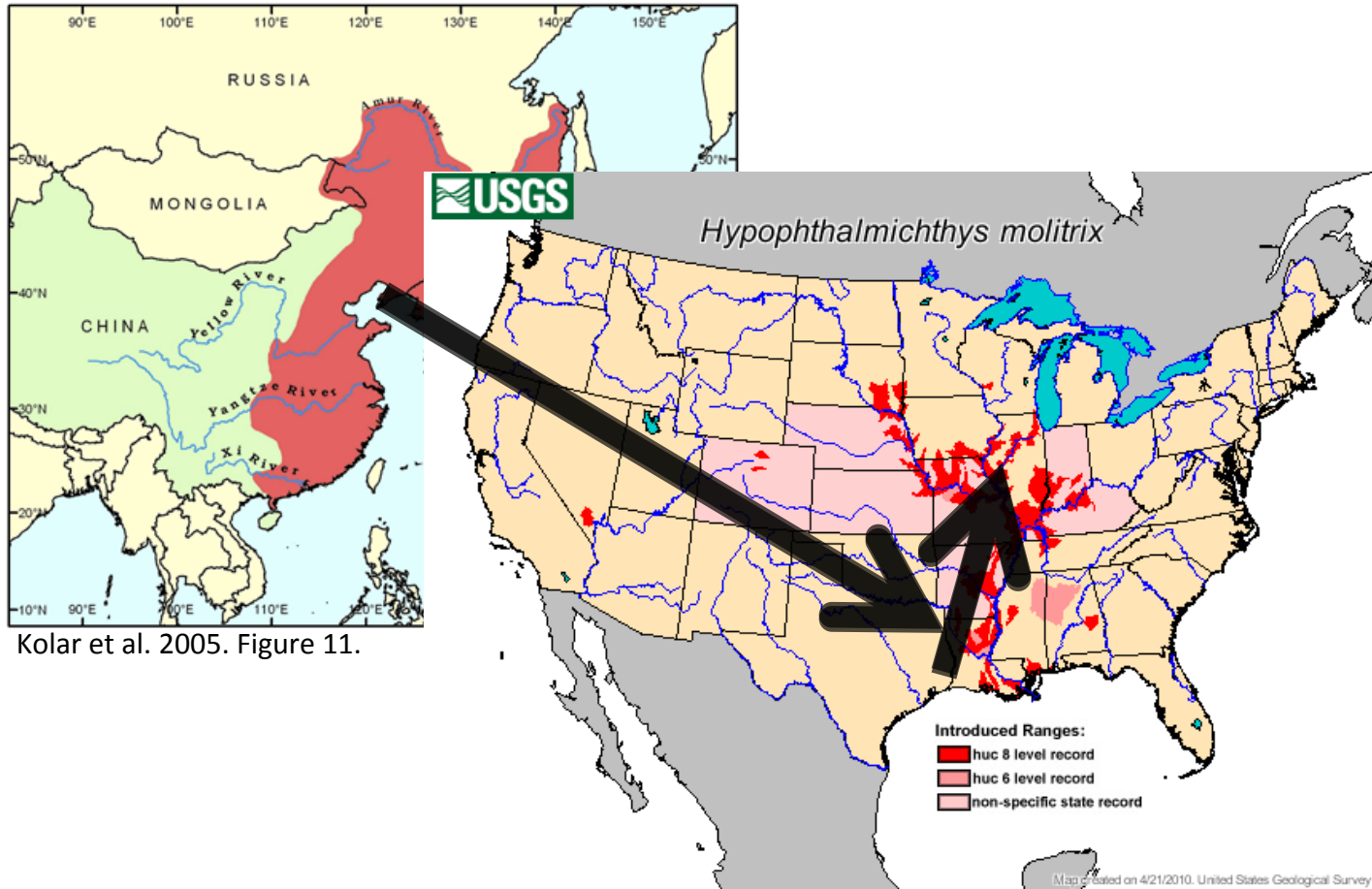
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Asian Carps Are Here Because Calumet Waterways are Globally Connected

Silver carp native range



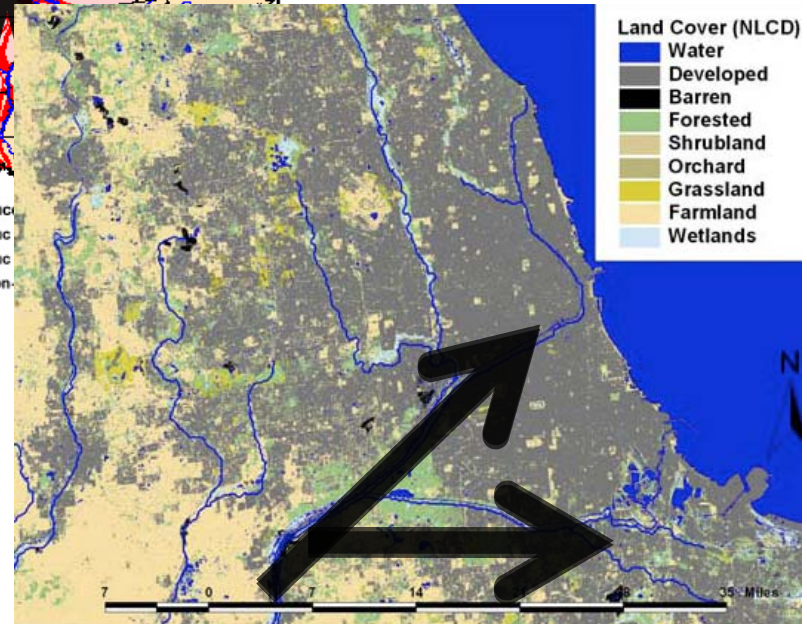
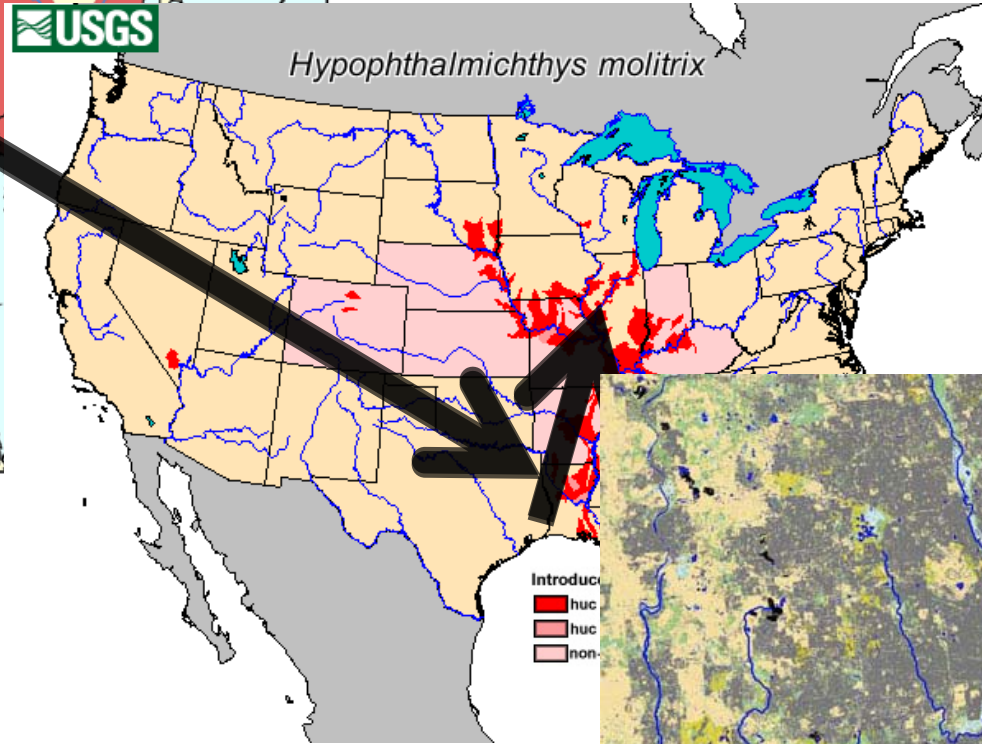
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Asian Carps Are Here Because Calumet Waterways are Globally Connected

Silver carp native range



Kolar et al. 2005. Figure 11.



Global Ecosystem Connectivity Via Shipping

- Ships carry ballast water to maintain trim and stability when not fully loaded
- Hull fouling organisms
- Strongest vector for aquatic species transfer among marine ecosystems, and among freshwater ecosystems with ports
- Risk varies by ship based on previous travel



1) What is the risk of Introduction and Spread of Invasive Species?

- Purchase and identify all species that could establish in Great Lakes region from:

Pet

Nursery plant

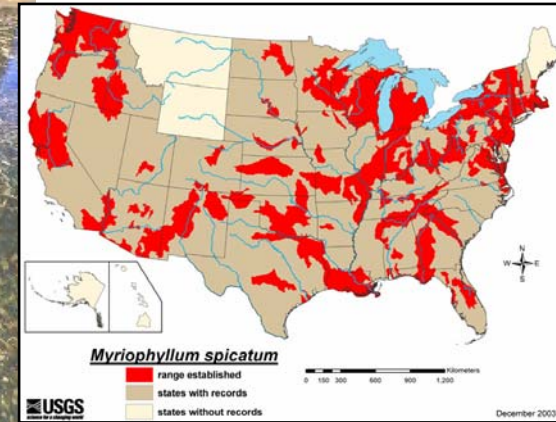
Live Food

Live Bait

Biological Supplies

Established Species

Taxa	Species
Plants	<i>Cabomba caroliniana</i> (Cabomba)
	<i>Egeria densa</i> (Brazilian waterweed)
	<i>Eichornia crassipes</i> (Water hyacinth)
	<i>Glyceria maxima</i> (Tall mannagrass)
	<i>Hydrocharis morsus-ranae</i> (European frog-bit)
	<i>Iris pseudocorus</i> (Yellow iris)
	<i>Lysimachia numularia</i> (Moneywort)
	<i>Marsilea quadrifolia</i> (Water shamrock)
	<i>Mentha aquatica</i> (Water mint)
	<i>Myosotis scorpioides</i> (Water forget-me-not)
	<i>Myriophyllum aquaticum</i> (Parrot feather)
	<i>Myriophyllum spicatum</i> (Eurasian watermilfoil)
	<i>Najas minor</i> (Lesser naiad)
	<i>Nymphoides peltata</i> (Yellow floating-heart)
	<i>Pistia stratiotes</i> (Water lettuce)
	<i>Potamogeton crispus</i> (Curly-leaved pondweed)
	<i>Trapa natans</i> (Water chestnut)
<i>Typha angustifolia</i> (Narrow-leaved cattail)	
Fish	<i>Ameiurus melas</i> (Black bullhead)
	<i>Cyprinus carpio</i> (Common carp, koi)
	<i>Carassius auratus</i> (Goldfish)
	<i>Gambusia affinis</i> (Mosquitofish)
	<i>Micropterus salmoides</i> (Largemouth bass)
	<i>Misgurnus anguillicaudatus</i> (Oriental weatherloach)
Molluscs	<i>Corbicula fluminea</i> (Asiatic clam)
	<i>Orconectes rusticus</i> (Rusty crayfish)



Rusty Crayfish



Potential Invaders

<u>Taxa</u>	<u>Species</u>
Plants	<i>Aponogeton distachyos</i> (Water hawthorne)
	<i>Houttuynia cordata</i> (Chameleon)
	<i>Marsilea mutica</i> (Water fern)
	<i>Ophiopogon japonicus</i> (Mondo grass)
	<i>Ranunculus lingua</i> (Greater spearwort)
	<i>Salvinia auriculata</i> (Eared watermoss)
Fish	<i>Aristichthys nobilis</i> (Bighead carp)
Amphibia	<i>Xenopus laevis</i> (African clawed frog)



Disconnecting the Calumet Region To Prevent New Invasions

Unintentional Connections

- Ballast water and hull fouling of ships
- Canals

Intentional Connections

- Introduction of Asian carps to North America
- Introduction of species through pet, watergarden, live food, bait and biological supplies trades

Disconnecting Unintentional Connections

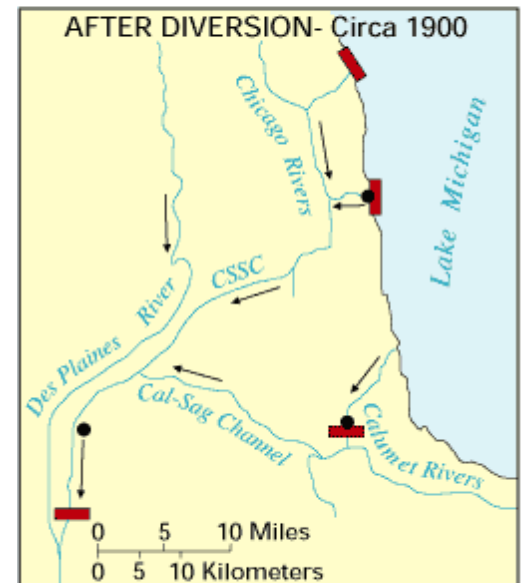
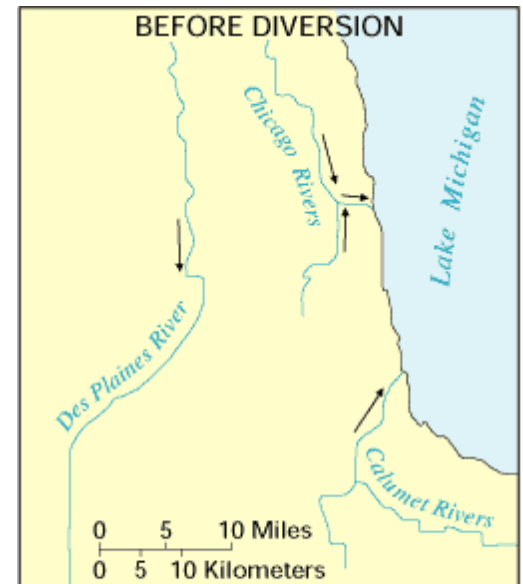
- Species arrive without any expectation of benefits, but with potential for large costs as invaders
- Try to prevent transport of all organisms

Disconnecting Shipping Invaders

- IMO and US Coast Guard have proposed treatment standards to reduce the number of organisms released from ballast
- Still a need to inspect ships for compliance, and possibly for additional treatment
- Hull fouling organisms are not currently addressed

Disconnecting Invaders from Canals

- Asian carps are currently moving along this waterway, but it may still be possible to stop them
- Other species have passed through, and many more are poised to pass
- Some form of ecological separation would be necessary in order to drastically reduce risk of future invasions



EXPLANATION

← Direction of Flow

■ Control structure

Disconnecting Intentional Connections

- Intentionally introduced species arrive with expectations of benefits, and with the potential for costs
- Identify the likely invaders and manage them appropriately, while not hindering commerce in species likely to cause no harm
- Risk assessment approach

Fecundity Predicts Invasiveness

Probability Invasive

$\text{Log}_{10}(\text{Annual Fecundity})$

Dreissena polymorpha



Pisidium henslowanum



Corbicula fluminea



Potamopyrgus antipodarum



Bithynia tentaculata

Fecundity Predicts Invasiveness

Probability Invasive



$\text{Log}_{10}(\text{Annual Fecundity})$

Consequences of a Connected World for the Calumet Region

- Invasive species are one of the largest problems for Calumet Region rivers, lakes and wetlands
- By definition, they come from outside the region
- Preventing future impacts relies largely on looking beyond the region
 - What happens in Southern fish farms, what gets imported for trade, and the ports that inter-continental ships visit, all affect conservation in this region