



Invasive Species: Asian Carp Invasion Updates

Dan O'Keefe, Ph.D.

Michigan Sea Grant
MSU Extension

Ottawa Co. Water Quality Forum

November 1, 2010



Rainbow smelt



Purple loosestrife



Zebra mussels



Eurasian ruffe



American eel



Common carp



Alewife



White perch



Round Goby



Threespine stickleback



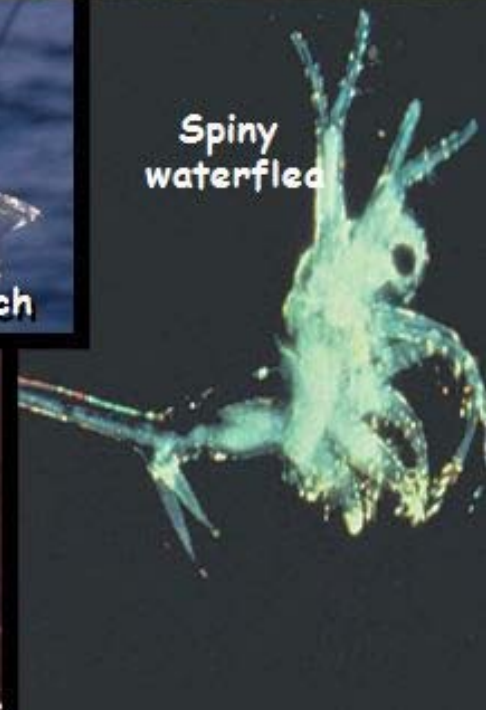
Rusty crayfish



Sea lamprey



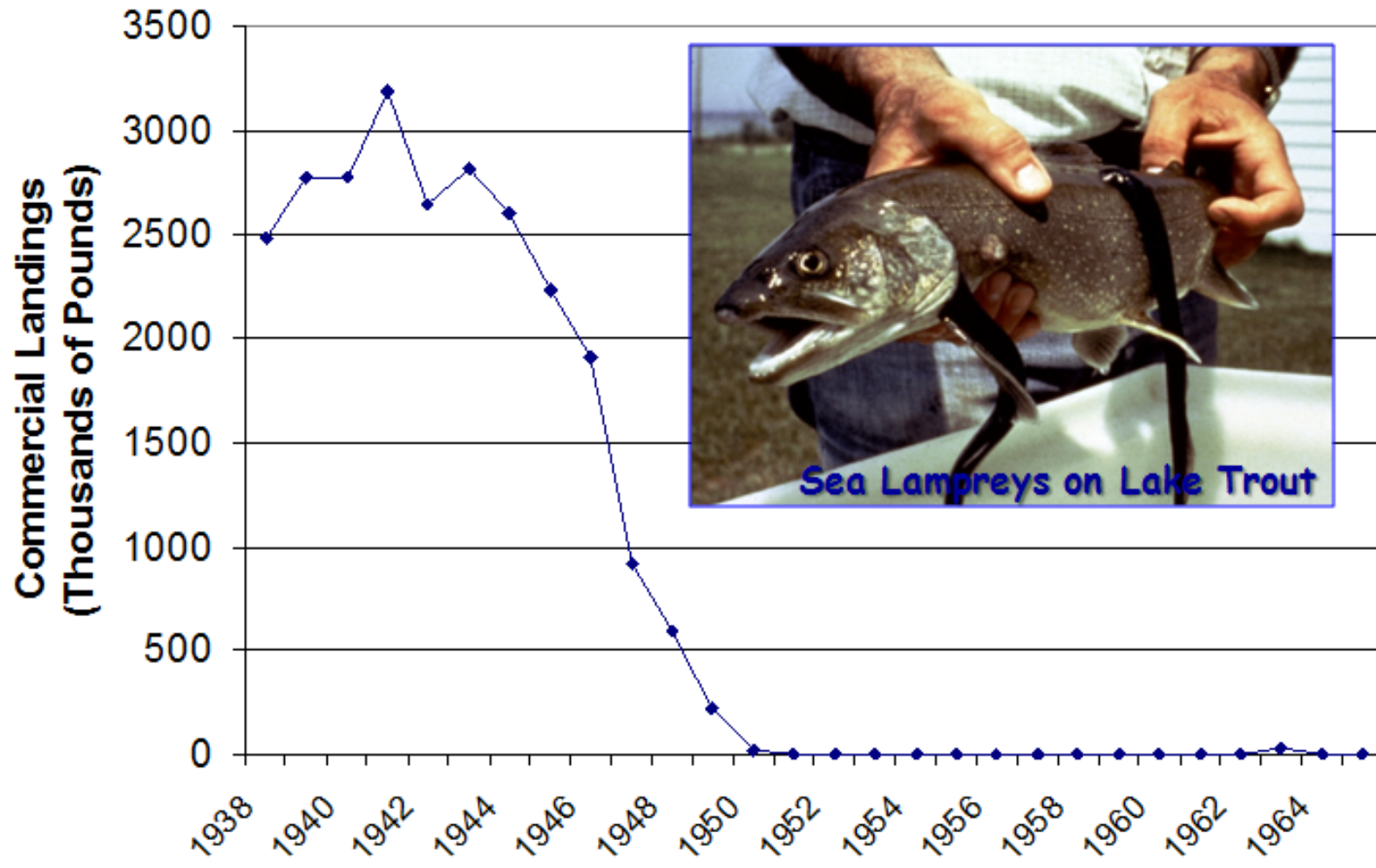
Corbicula



Spiny waterflea

“SLOW MOTION DISASTER”

Sea Lamprey First Entered Lake Michigan in 1936





Zebra Mussel

- Estimated \$1.5 to \$2 billion in damage 1989-2001
- \$125 million annually split between MS and GL
- Initial estimates of fishery impact were too high

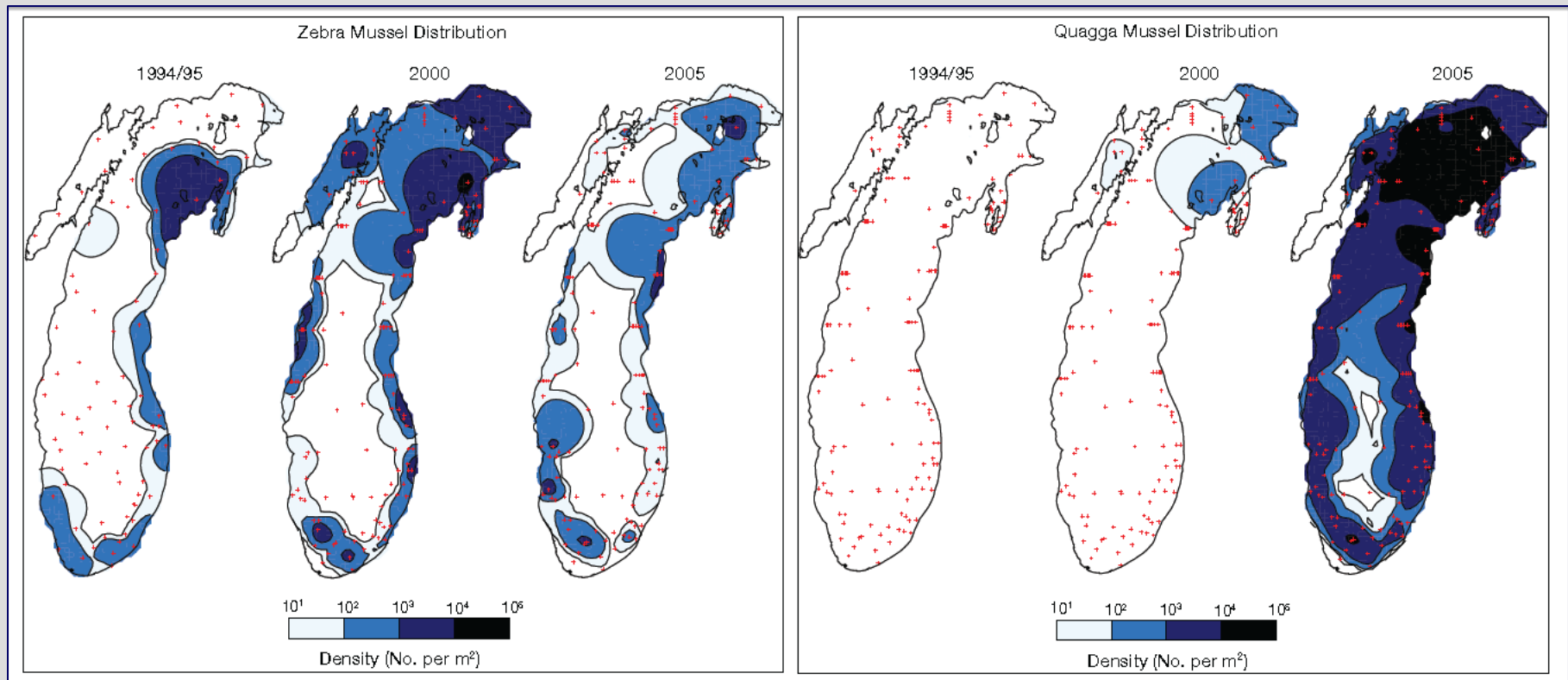
Effects of Invasive Species are Inherently Unpredictable



OCT 25 2004

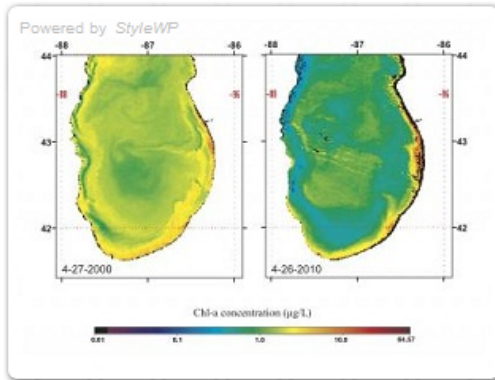
Zebra Mussels

Quagga Mussels



In Great Lakes, 'the sky really IS falling'

Published Tuesday, 7th September 2010



How should we react to news that the world's fourth largest lake is rapidly dying before our eyes and that practically nothing is being done to stop it?

Horror and outrage seem appropriate. However, the lead researcher tracking this particular slow-motion death says the response he's gotten is more of a shrug because "people are getting tired of hearing that the sky is falling."

The lake in question is Lake Michigan, the second-largest (by volume) of the US-Canadian Great Lakes. (It's actually the second-largest lake in the world, after the Caspian Sea, if you consider that it and Lake Huron are physically a single body of water.)

is in its biological death throes, just 12 short years after scientists first described the unique large-scale "river of phytoplankton" that forms the foundation of

Siphon of quagga mussel



Mar 16, 2009 11:00 AM in [Basic Science](#) | [1 comments](#)

Quagga terror: Alien mussels in U.S. waters cause problems for other species

By [John Platt](#)



Individually, the quagga mussel (*Dreissena rostriformis bugensis*) doesn't look like much.

Barely the size of a human thumbnail, with a non-descript shell, most people probably wouldn't give a quagga mussel a second glance if they saw one in a lake or river.

Unfortunately, quagga mussels don't appear individually, or in pairs, or in tens, but in tens of thousands. This invasive species, native to the Ukraine, has found a home in the United States, causing ecological damage wherever it spreads, and according to experts, it isn't going away any time soon.

E-MAIL

PRINT

COMMENT

Submit to digg



Like it? Thumbs-



DECLINING FISH HEALTH

While many species of fish will readily eat *Diporeia* (see right), few species can use zebra and quagga mussels efficiently for food. Moreover, even if a fish species does eat these mussels, the loss of *Diporeia* has left many of them with food choices much lower in nutrition than *Diporeia*. In Lake Erie, a severe decrease in smelt stocks was seen in the 1990s. Estimates of the slimy sculpin and lake trout populations in Lake Ontario showed a 95% decline between the late 1980s and 1996. In Lake Michigan, many fish populations are now sacrificing health to feed off zebra mussels. Whitefish, for example, shifted from a diet of 25-75% *Diporeia* to a diet of zebra mussels. During their first 2 weeks of life, larval bluegill reared in the presence of mussels grew 24% slower than fish reared alone. Alewife energy density was 23% lower during 2002-2004 (post zebra mussel invasion) compared to 1979-1981 (pre zebra mussel invasion). As a result, a Chinook salmon now needs to eat 22% more alewives to attain an ideal body weight by age 4.

DIPOREIA DECLINES

Diporeia, a tiny shrimp-like organism, was the dominant benthic invertebrate in most offshore areas of the Great Lakes since the glaciers receded ~10,000 years ago. *Diporeia* have a high lipid (fat) content, with lipids often exceeding 30% of its total weight. As a result, it is rich in calories and a good source of energy for fish. Since the early 1990s population densities of *Diporeia* in all the lower Great Lakes have dropped dramatically. "Exact mechanisms are unclear, but the decline of *Diporeia* is related to the introduction and expansion of the zebra and quagga mussels," says Tom Nalepa, a GLERL biologist who has been sampling Lake Michigan sediments since the early 1980s.



Diporeia

Actual Size 7.8 mm

Will Asian carp take over the Great Lakes?

- Can they survive and reproduce here?
- How are they getting into Great Lakes and how can this be prevented?
- What is the potential for ecological and economic harm?



Siamese Giant Carp



Goldfish



Jullien's Golden Carp



Predatory Carp

Asian Carp

Two planktivorous species in Chicago





Grass Carp

- Eats huge quantities of vegetation
- Can severely impact fish and wildlife habitat

Can Asian carp survive in the Great Lakes?



Fig. B: Craig Blackie and Dylan Weese are holding a very large carp, the bighead carp *Hypophthalmichthys* sp, which a fisherman had caught in his trap, in Lake Erie, and which an Axelrod Institute of Ichthyology collaborator, Bruce Morrison, brought to the Institute to be identified

Feeding Requirements

- At 63°F, small bighead carp (<6") lost weight at plankton density similar to Lake Michigan (Cooke *et al.* 2009)
- Optimal feeding at 68-80°F
- Bays, backwaters of large rivers, drowned rivermouths, and western Lake Erie more vulnerable

Can Asian carp reproduce in Great Lakes?

- Bighead, silver, and grass carp are reproducing in Illinois R.
- Temperature: $>64^{\circ}$ F
- Rise in water level or turbidity
- >60 miles of free-flowing river upstream of lake/bayou
- Further study needed, some exceptions noted



Silver carp ~ 240 hours



Large, warm rivers with abundant backwaters and few dams provide habitat for all life stages of carp.



Figure 29. Map of Lakes Erie, Huron, St Clair, Michigan, and Superior indicating rivers lacking dams and having a minimum length of 100 km that may be suitable for spawning by Bighead (*Hypophthalmichthys nobilis*) and Silver (*H. molitrix*) carps. Map developed by C. Lowenburg, U.S. Geological Survey.

How could Asian carp be introduced to Great Lakes?

- Direct hydrologic connections (e.g., Chicago canals)
- Live release (ceremonial, mischievous, or bait fish)
- Ballast or bilge water? Other?

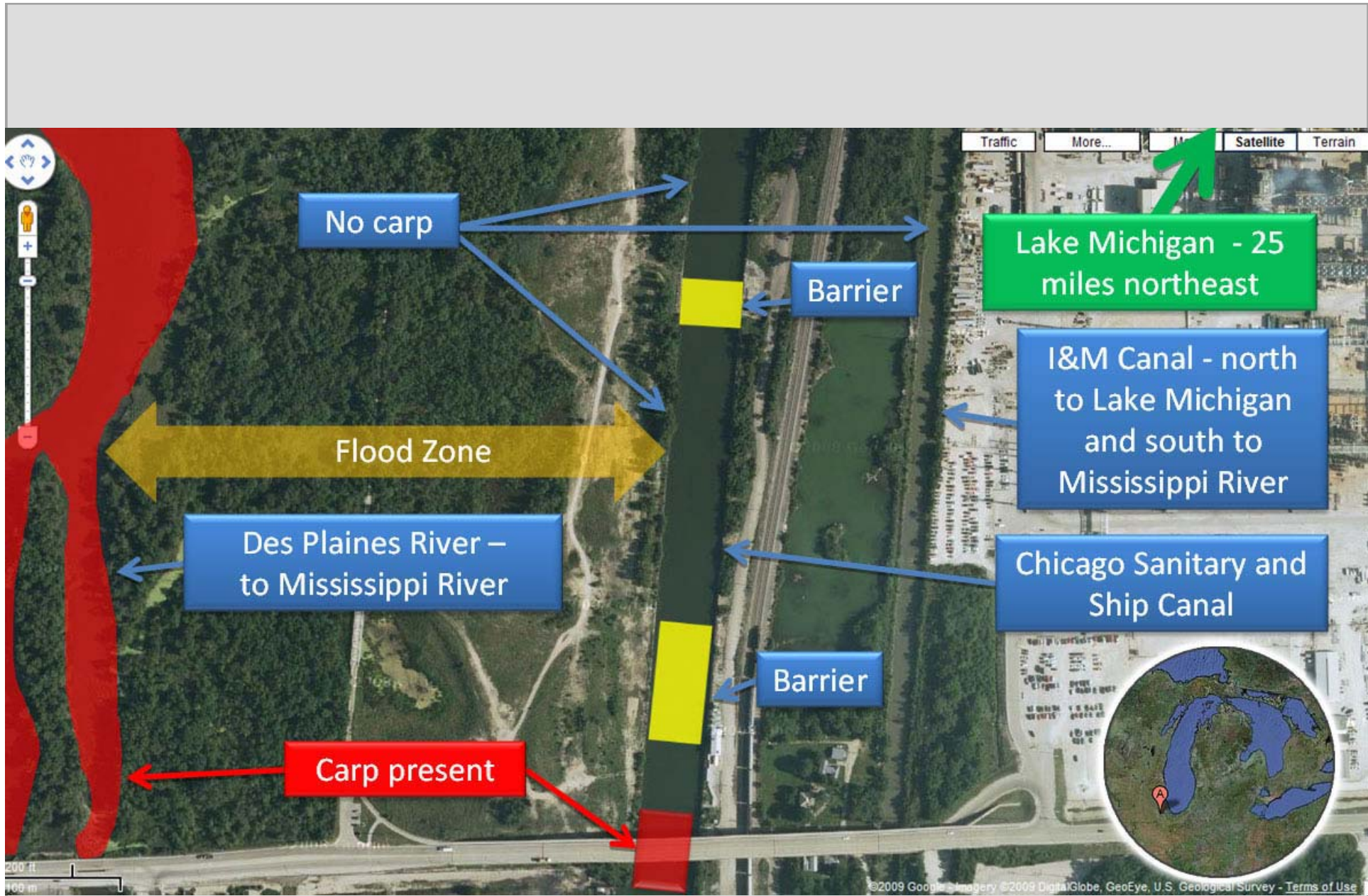


Image from Alliance for the Great Lakes



Bighead carp taken June 22, 2010 in Calumet River.



Twenty-one grass carp were captured during sampling near O'Brien Lock.



Silver carp eDNA was found in Lake Michigan at Calumet Harbor.

Chicago SSC and Cal-Sag

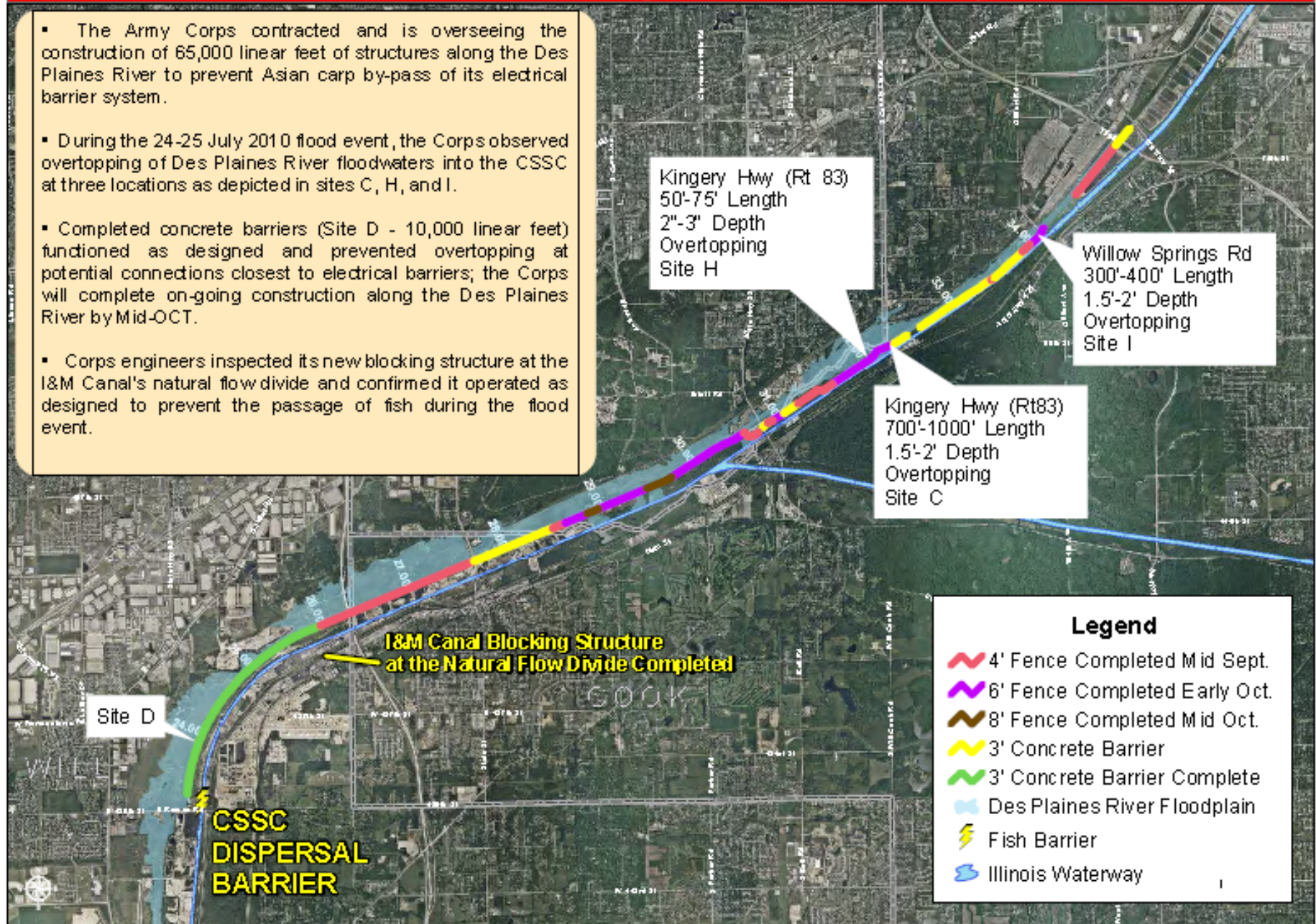
- Barrier IIB – December completion?
- Federal court case on lock closure
- Inter-basin feasibility study (USACE)

Progress on Hydrologic Connections

- Des Plaines River, IL
 - Floods into CSSC above barrier
- Old I&M Canal, IL
 - Culverts connect to CSSC
- Maumee/Wabash watersheds, IN
 - Connect in high water
- Erie/Ohio River watersheds, OH
 - Several possible connections in high water

Des Plaines River July 24-25 2010 Flood Map

- The Army Corps contracted and is overseeing the construction of 65,000 linear feet of structures along the Des Plaines River to prevent Asian carp by-pass of its electrical barrier system.
- During the 24-25 July 2010 flood event, the Corps observed overtopping of Des Plaines River floodwaters into the CSSC at three locations as depicted in sites C, H, and I.
- Completed concrete barriers (Site D - 10,000 linear feet) functioned as designed and prevented overtopping at potential connections closest to electrical barriers; the Corps will complete on-going construction along the Des Plaines River by Mid-OCT.
- Corps engineers inspected its new blocking structure at the I&M Canal's natural flow divide and confirmed it operated as designed to prevent the passage of fish during the flood event.



Kingery Hwy (Rt 83)
50'-75' Length
2"-3" Depth
Overtopping
Site H

Willow Springs Rd
300'-400' Length
1.5'-2' Depth
Overtopping
Site I

Kingery Hwy (Rt83)
700'-1000' Length
1.5'-2' Depth
Overtopping
Site C

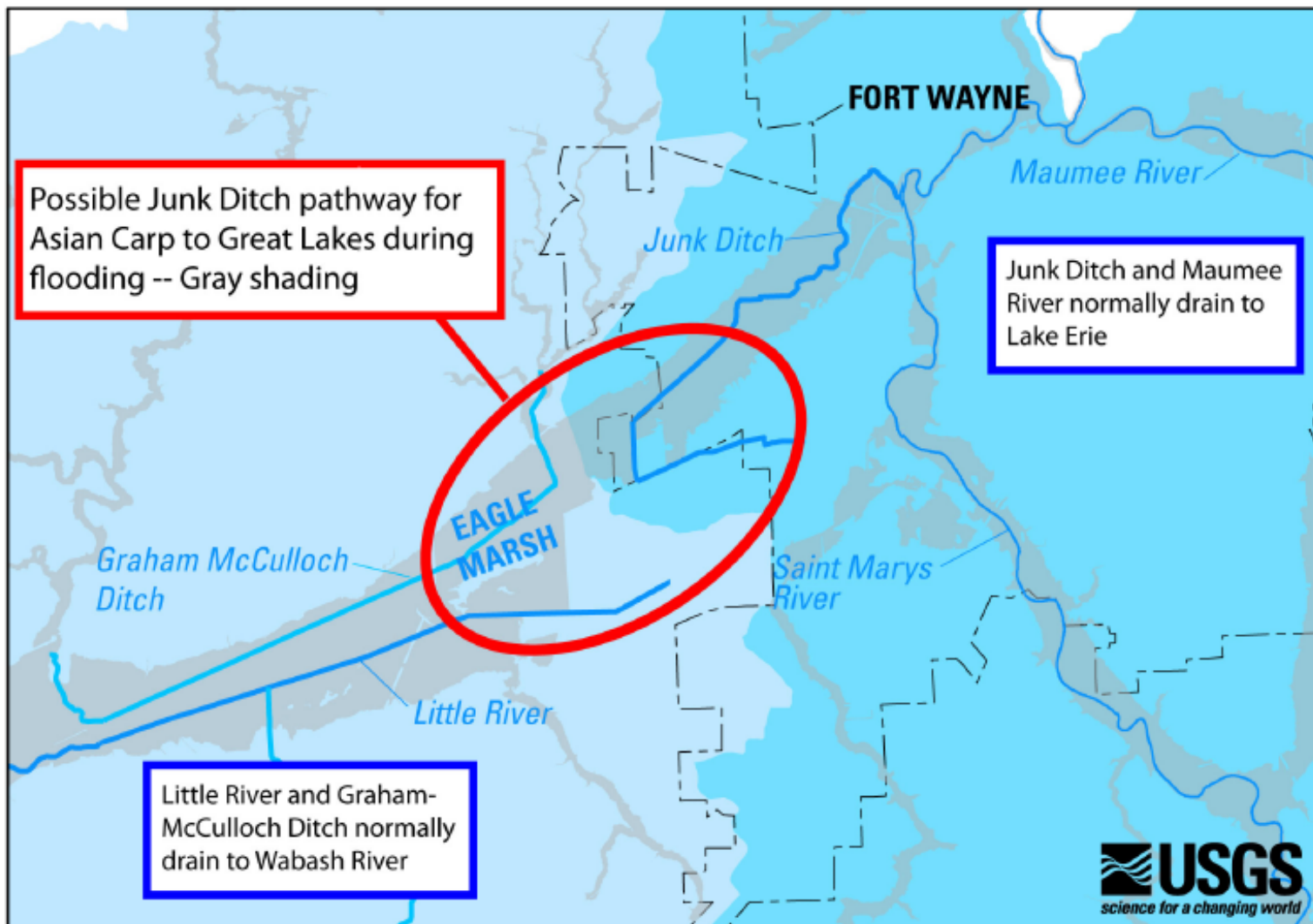
**I&M Canal Blocking Structure
at the Natural Flow Divide Completed**

Site D

**CSSC
DISPERSAL
BARRIER**

Legend

- ~ 4' Fence Completed Mid Sept.
- ~ 6' Fence Completed Early Oct.
- ~ 8' Fence Completed Mid Oct.
- ~ 3' Concrete Barrier
- ~ 3' Concrete Barrier Complete
- ~ Des Plaines River Floodplain
- ⚡ Fish Barrier
- ~ Illinois Waterway



EXPLANATION

- FLOOD PLAIN -- approximate
- DRAINS TO LAKE ERIE
- DRAINS TO LAKE MICHIGAN



Barrier fence from Rail Road
south pedestrian opening
with LRWP Executive Director
Betsy Yankowiak



WALLEYE BAIT??



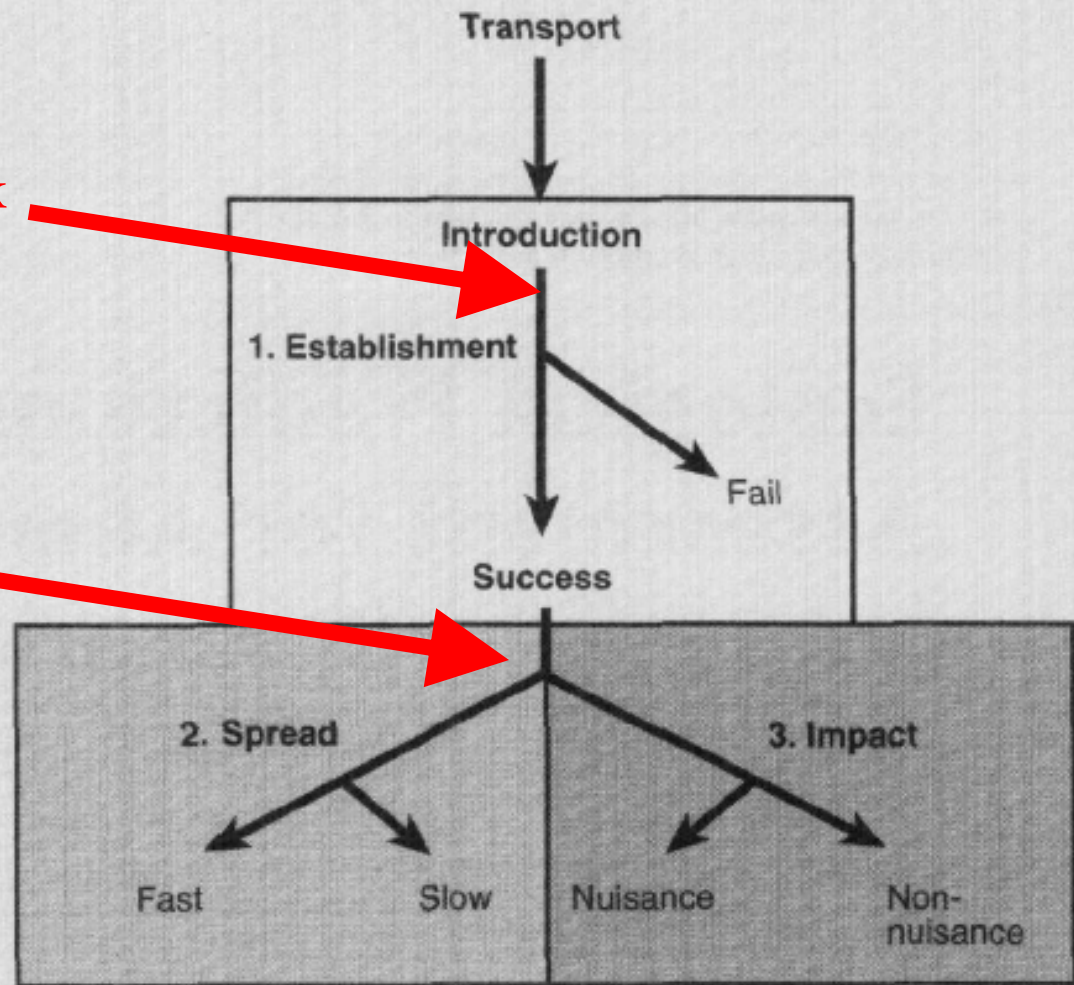
Illinois Natural History Survey Photo

Pathway approach to invasive species prevention

- Different pathways call for different strategies
- Multi-faceted approach needed for prevention
- Critical to reduce risk of establishment by reducing the number of fish introduced

More Carp = More Risk

Control is Often the Only Option After Successful Establishment



Monitoring and Removal

- Barrier defense project
 - Marseilles Pool – 1,078 carp in Sept.
 - Brandon Road and Lockport pools
 - Low density = Ineffective netting
- Chinese markets
 - Big River Fish & Zuochen
 - \$2 million from IL
 - 30 million pounds by 2012



Big River Fish Co. photo

Lake Michigan

ANS Threats to Mississippi Basin

- Zebra mussels: >\$62 million per year in MS Basin
- Round goby invaded via Chicago canals ~1999
- Current threats include VHS, New Zealand mudsnail, bloody red shrimp, and Eurasian ruffe



Will Asian carp have ecological and economic impacts?

- Risk of establishment unknown, but additional introductions will increase risk
- Ecological effects very difficult to predict; potential for disaster exists
- Great Lakes fishing and boating important to Michigan

WHAT IS AT STAKE FOR GREAT LAKES REGION???

- 5% hit to Great Lakes fishing?
 - 2,914 jobs; 414 in Michigan alone
- 1% hit to Great Lakes boating?
 - 2,461 jobs; 513 in Michigan alone
- DePaul University study on lock closure economic impacts => \$4.7 B over 20 years
 - Equivalent to 3.3% of Great Lakes sportfishing



Charter Fishing Party Expenditures

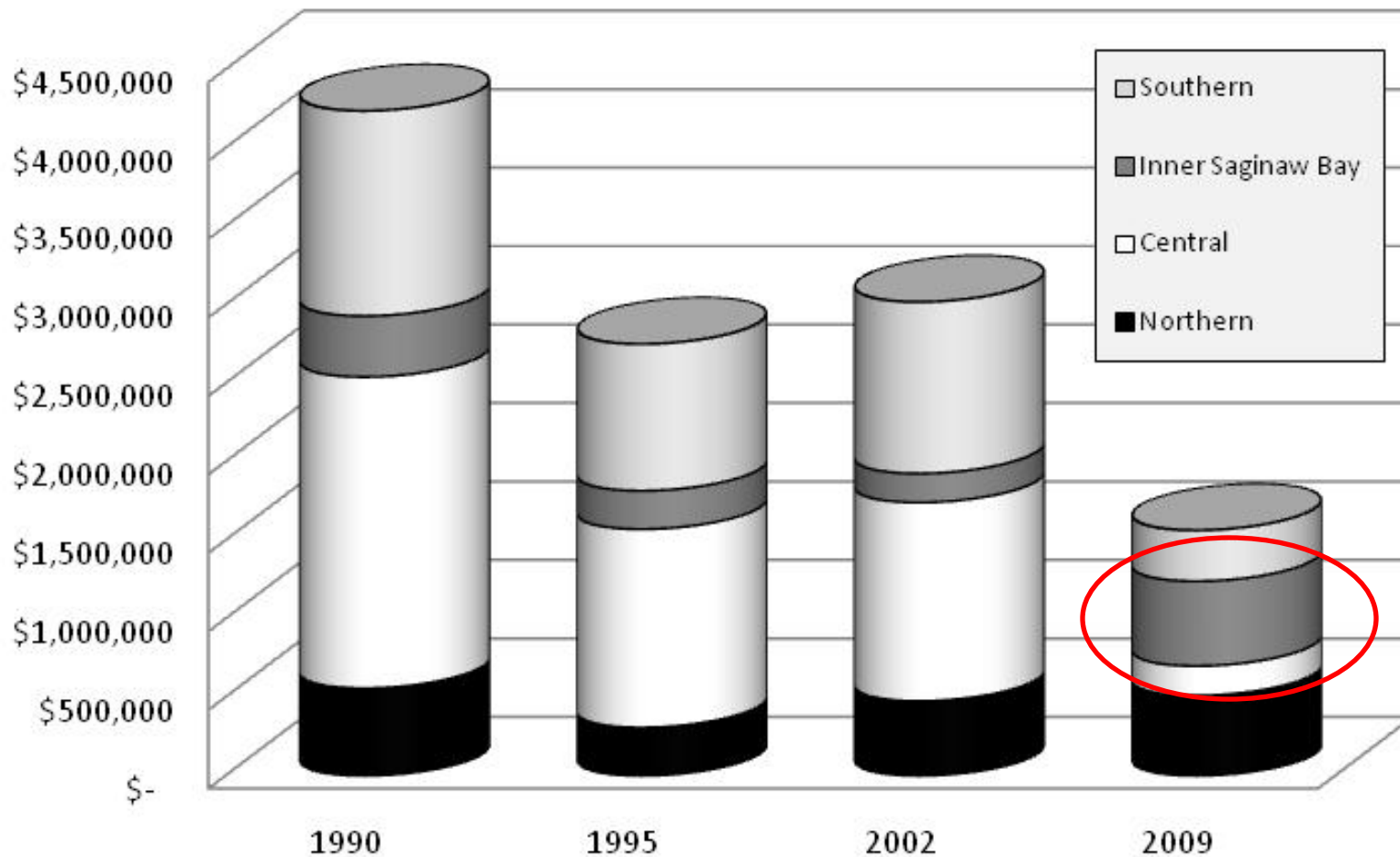
| | Local Spending per Party (2009 \$s) | |
|---|-------------------------------------|-------------------|
| | 1985 | 2009 |
| Charter fees and tips | \$454.08 | \$613.02 |
| Hotels, motels, B&Bs, camping | \$249.48 | \$213.08 |
| Restaurants and taverns | \$239.24 | \$119.37 |
| Groceries and liquor stores | \$107.80 | \$75.81 |
| Fuel for automobiles and trucks | \$9.44 | \$93.29 |
| Entertainment | \$47.20 | \$23.29 |
| Souvenirs and shopping* | \$77.12 | \$37.61 |
| Auto/truck expenditures other than fuel | - | \$14.31 |
| Fishing licenses | - | \$50.71 |
| Fishing equipment | - | \$5.60 |
| Other | - | \$16.84 |
| TOTAL | \$1,181.36 | \$1,262.96 |

* Included all other expenditures in 1985

Charter Fishing Economic Impacts to Coastal Communities in 2009

| | Total Expenditures | Output | Personal Income | Employment Hours |
|--------------------------------|---------------------|---------------------|--------------------|------------------|
| Lake Erie and St. Clair System | \$1,032,329 | \$1,427,230 | \$538,115 | 25,468 |
| Lake Huron | \$1,364,680 | \$1,563,551 | \$574,493 | 50,002 |
| Lake Michigan | \$9,051,449 | \$11,605,165 | \$4,989,910 | 259,756 |
| Lake Superior | \$226,518 | \$276,027 | \$102,021 | 8,573 |
| TOTAL | \$11,674,976 | \$14,871,972 | \$6,204,539 | 343,799 |

Economic Impact (Output) of Charter Fishing Lake Huron Regions - 1990-2009



What should we do if Asian carp are found in Michigan?

- Testing for eDNA already underway
- MDNRE released draft management plan
- Comments can be submitted to Dave Clapp clappd@michigan.gov

MICHIGAN DEPARTMENT OF NATURAL RESOURCES
AND ENVIRONMENT

PROPOSED PLAN FOR THE PREVENTION, DETECTION, ASSESSMENT, AND
MANAGEMENT OF ASIAN CARPS IN MICHIGAN WATERS



(Bighead carp)



(Black carp)



(Grass carp)



(Silver carp)

DAVID CLAPP, JESSICA MISTAK, KREGG SMITH, and MARK TONELLO

FISHERIES DIVISION

OCTOBER 2010



<http://www.michigan.gov/dnr>
⇒ Fishing Tab
⇒ Asian Carp



Acknowledgements

- Dr. Steve Miller, MSU CEA
- Dr. Chi-Ok Oh, MSU CARRS
- Kevin Irons, INHS
- Big River Fish Co.
- Phil Moy, WISG
- Donna Wesander, MDRNE
- Tracy Kolb, MDNRE
- Lynn Vaccaro, MISG

