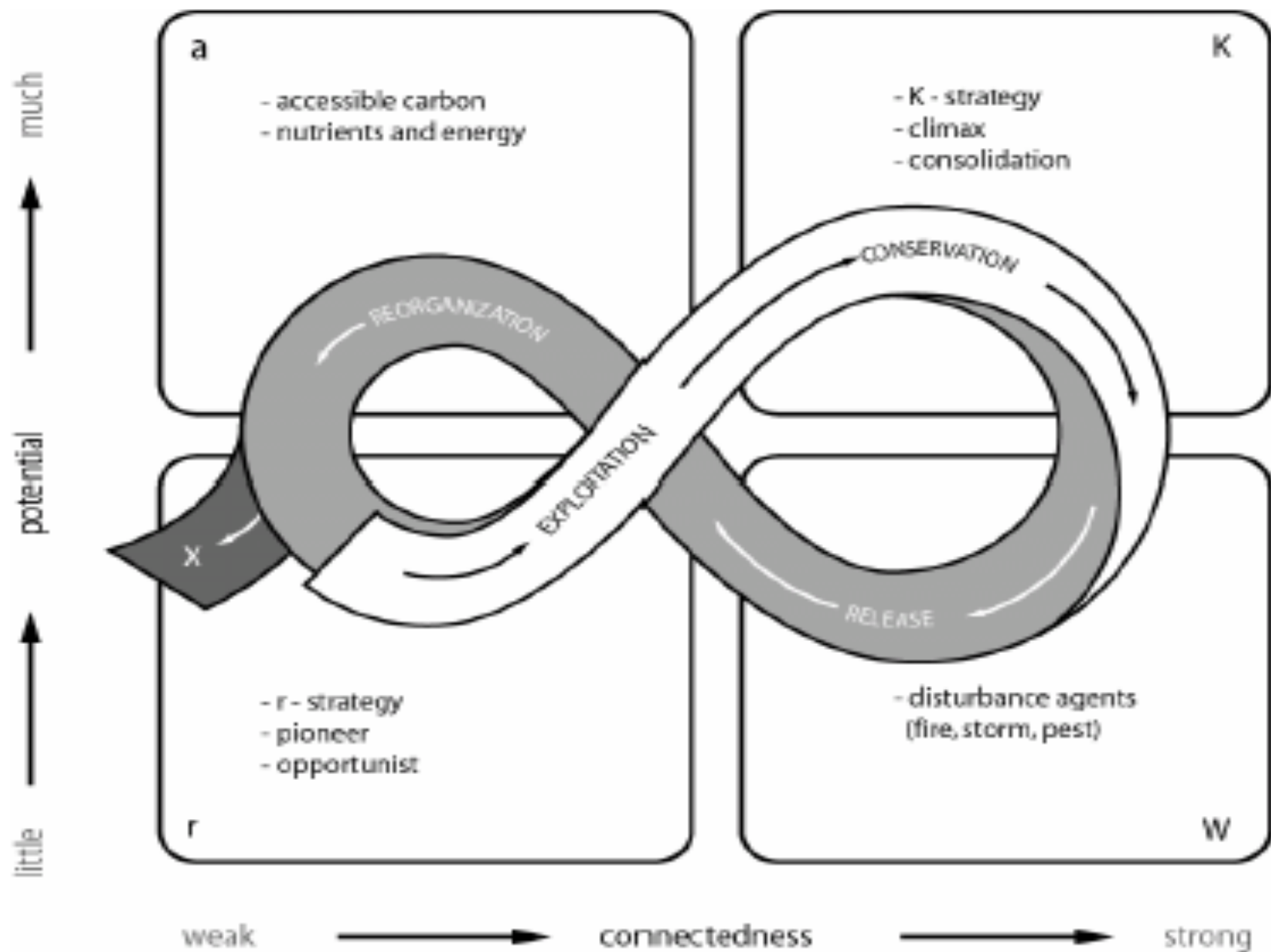


# **Chapter 3: Ecosystems are Dynamic**



# Changing Ecosystems

- ***Gaia hypothesis***: claims that the ecosphere is a self-regulating homeostatic system in which the biotic and abiotic components interact to produce a balanced, constant state; that it is a highly integrated system with strong internal interactions.
  - BUT: Not all ecosystems are equal in their ability to withstand disturbances
- **Inertia** is the ability of an ecosystem to withstand change, while **resilience** refers to the ability to recover to the original state following disturbance



Source: Holling, various; Navigating Social-Ecological Systems (2003)

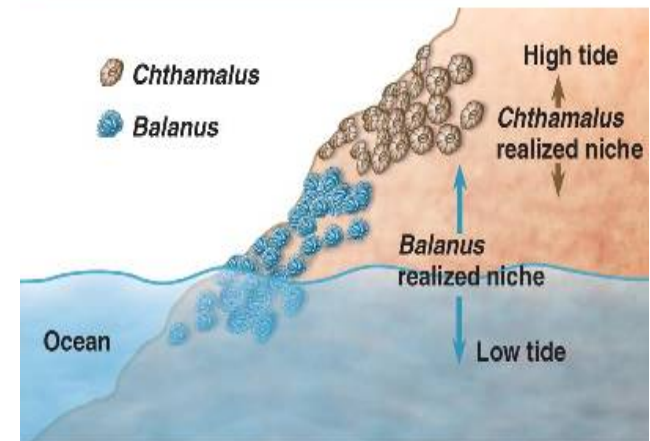
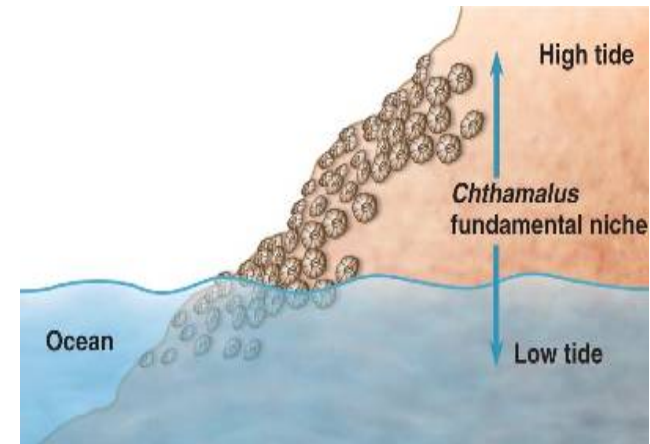
# Changing Ecosystems

## Invasive Alien Species

- Organisms found in an area outside their normal range are considered **alien species**
  - e.g., Purple Loosestrife and Eurasian Water Milfoil
- Species that multiply quickly, out-compete native species, and change native habitats are considered to be **invasive** alien species
- Invasive alien species are often fast-growing generalists that can alter growth form, reproduce quickly both sexually and asexually, disperse readily, and associate with humans.

# Effects on Native Species

- Invading species often compete with native ones for the same resources
- Can lead to ousting of native species
- Native and invading species can share a niche
- fundamental to realized niche
  - e.g. barnacles



# Asian Carp History



- Native to China and other parts of Southeast Asia
- Have been cultivated for aquaculture for more than 1,000 years
- Catfish farmers in the U.S. imported Asian carp to eat up algae
  - were also imported into the southern United States to keep aquaculture clean and to provide fresh fish for fish markets
- Now, the fish have slowly escaped into the wild and have been making their way up the Mississippi River.
- They are eating machines that can decimate entire ecosystems.

**Bighead carp** (*Hypophthalmichthys nobilis*)

**Black carp** (*Mylopharyngodon piceus*)

**Grass carp** (*Ctenopharyngodon idella*)

**Silver carp** (*Hypophthalmichthys molitrix*)



# Asian Carp's Effects on Other Fauna

- Harmful to many types of animals because of the Asian carps consumption of low level food chain organisms such as plankton
  - Birds
  - Insects
  - turtles
  - etc.
- Consumption of macrophytes and macroinvertebrates



# Asian Carp Risks

## **Ecological Risks:**

- can decrease of native mussels and other invertebrates
- can reduce recruitment and abundance of native fish
- black carp reduce abundance of mussels and snails
- silver carp tend to jump out at people and hurt them severely

## **Threats to Great Lake:**

Some believe that if invasive species of carp enter the Great Lakes, the multi-billion dollar recreational fishing, hunting and tourism industry will be devastated

- can hurt Great Lake communities that depend on fisheries for its economy (fisheries are valued at 4.5 billion dollars annually)
- can decrease economic value to communities that benefit from hunting



# Response Efforts

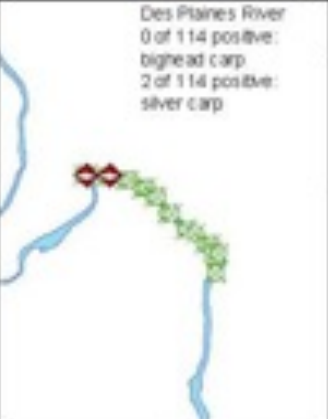
- Increased eDNA (Environmental DNA) monitoring
- An electrical barrier system
- Chemical controls
- Fish harvesting



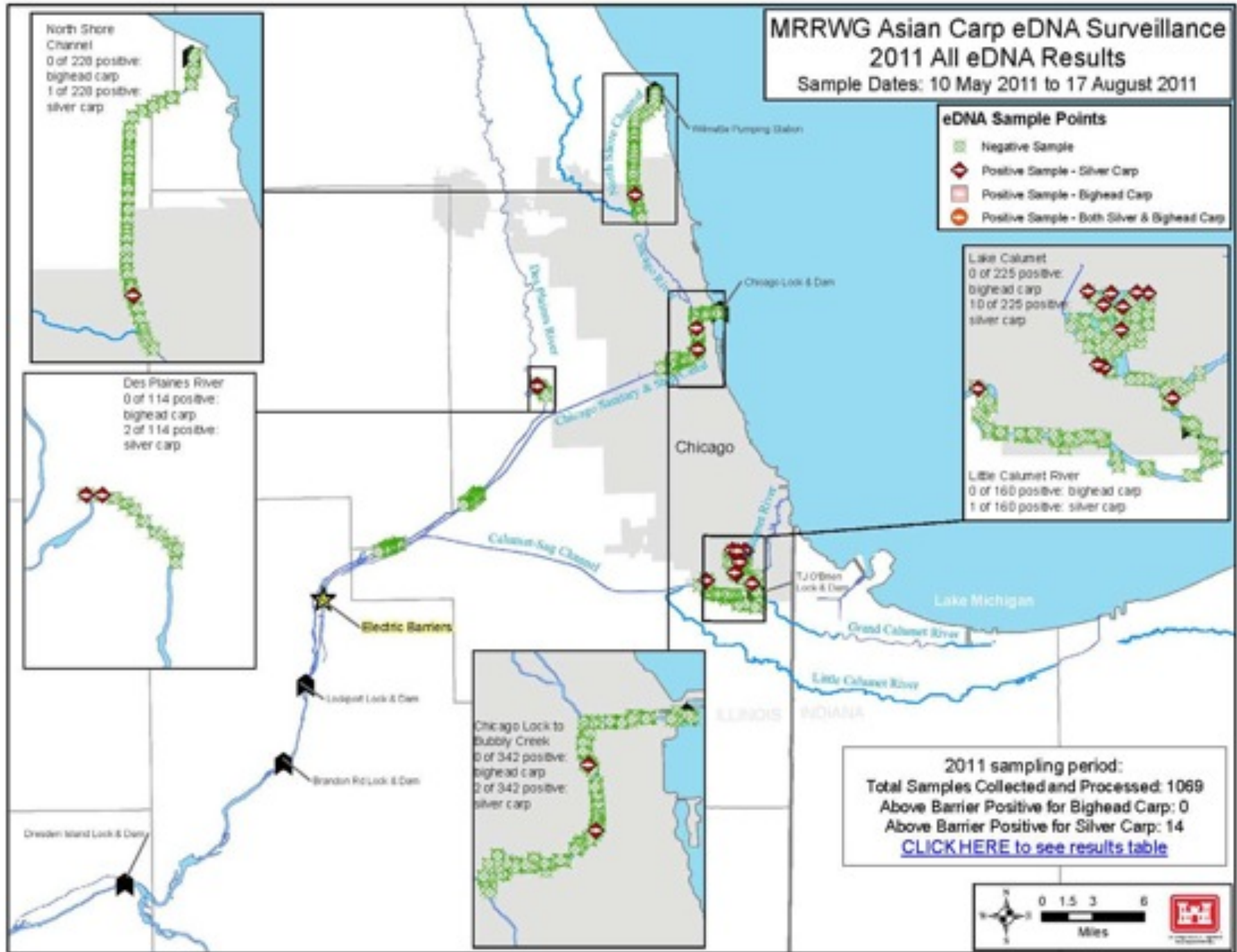
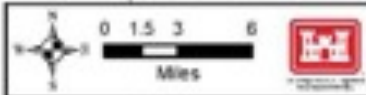
# MRRWG Asian Carp eDNA Surveillance 2011 All eDNA Results

Sample Dates: 10 May 2011 to 17 August 2011

- eDNA Sample Points**
- Negative Sample
  - ◆ Positive Sample - Silver Carp
  - Positive Sample - Bighead Carp
  - Positive Sample - Both Silver & Bighead Carp

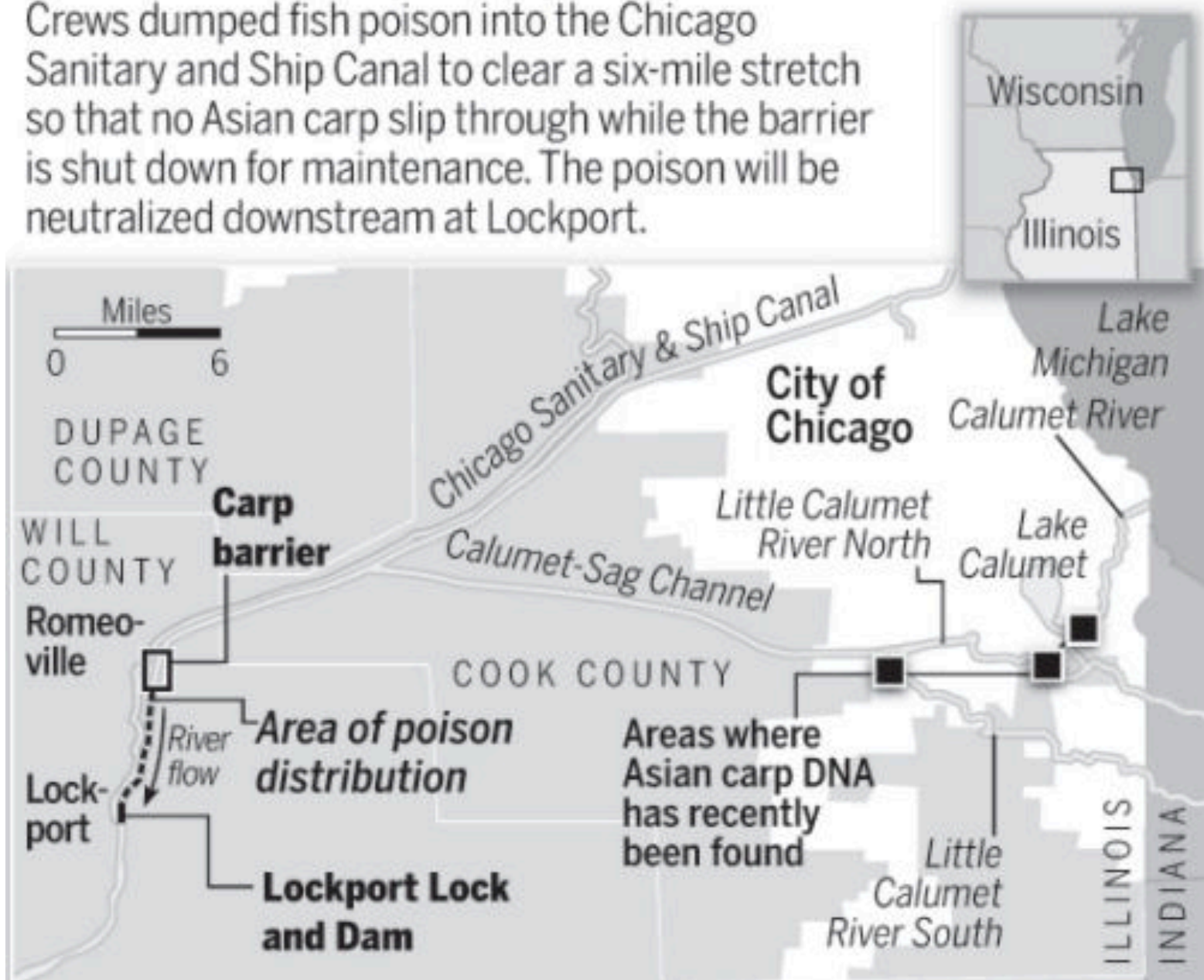


**2011 sampling period:**  
**Total Samples Collected and Processed: 1069**  
**Above Barrier Positive for Bighead Carp: 0**  
**Above Barrier Positive for Silver Carp: 14**  
[CLICK HERE to see results table](#)



# Poison goes to work on Asian carp

Crews dumped fish poison into the Chicago Sanitary and Ship Canal to clear a six-mile stretch so that no Asian carp slip through while the barrier is shut down for maintenance. The poison will be neutralized downstream at Lockport.



# Why Should We Care?



## Economics:

- Impacts infrastructure
- Organisms (such as the Zebra Mussel) can cause direct damage to industry
- Decrease of Fishing and Tourism industries
- Billions Spent in Remediation and Prevention

## Quality of Life:

- Simply put, if invasive species continue to infiltrate and impact our ecosystems, the quality of nature and living in the surrounding areas will decrease.

## Ethics:

- Is the preservation of property rights and free trade worth the destruction of our ecosystems
- Politicians from both sides of the political spectrum criticize the use of tax-payer money for something they falsely perceive as threat-less.

# Changing Ecosystems

## Hyperabundance

- Native species can become pest species when their populations increase to undesirable numbers
  - Where natural habitats have been disturbed
  - When predatory species are removed
- Species culls are often used to control these population explosions

# Changing Ecosystems

## Species Removal

- Removal of species from food webs can disturb the ecosystem
- The reduction of keystone species may be particularly disruptive

# Changing Ecosystems

## Feedback

- Feedback initiates responses that may exacerbate (**positive feedback**) or moderate (**negative feedback**) the change
  - Positive feedback loop: the effect of increased temperatures in the North (**polar amplification**)
  - Negative feedback loop: the possible role of phytoplankton in global warming

# Changing Ecosystems

## Synergism

- Synergism is another important characteristic that may influence change in ecosystems
- A synergistic relationship occurs when the effect of two or more separate entities together is greater than the sum of the individual entities
  - e.g., the effects of acid deposition

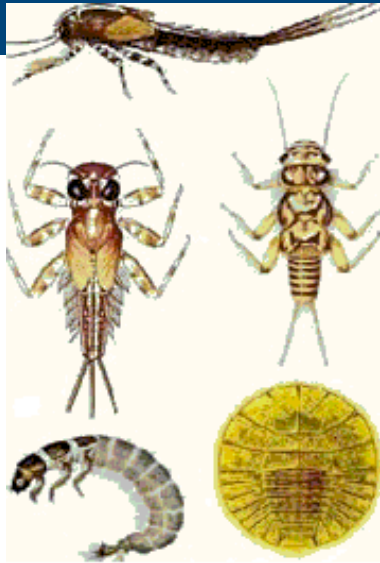


# Changing Ecosystems

## Ecological Restoration

- Restoration ecology developed as a field of study, and practice, to help repair environmental damage
- Examples:
  - Remediation of Sydney Tar Ponds
  - Reclamation of treeless areas around Sudbury
  - Efforts to reintroduce endangered species into national parks
- Ecological restoration is very challenging and very costly, and there is widespread agreement that it is better to avoid ruining ecosystems in the first place rather than trying to restore them afterwards

# Sediment Remediation and Fish Habitat Restoration

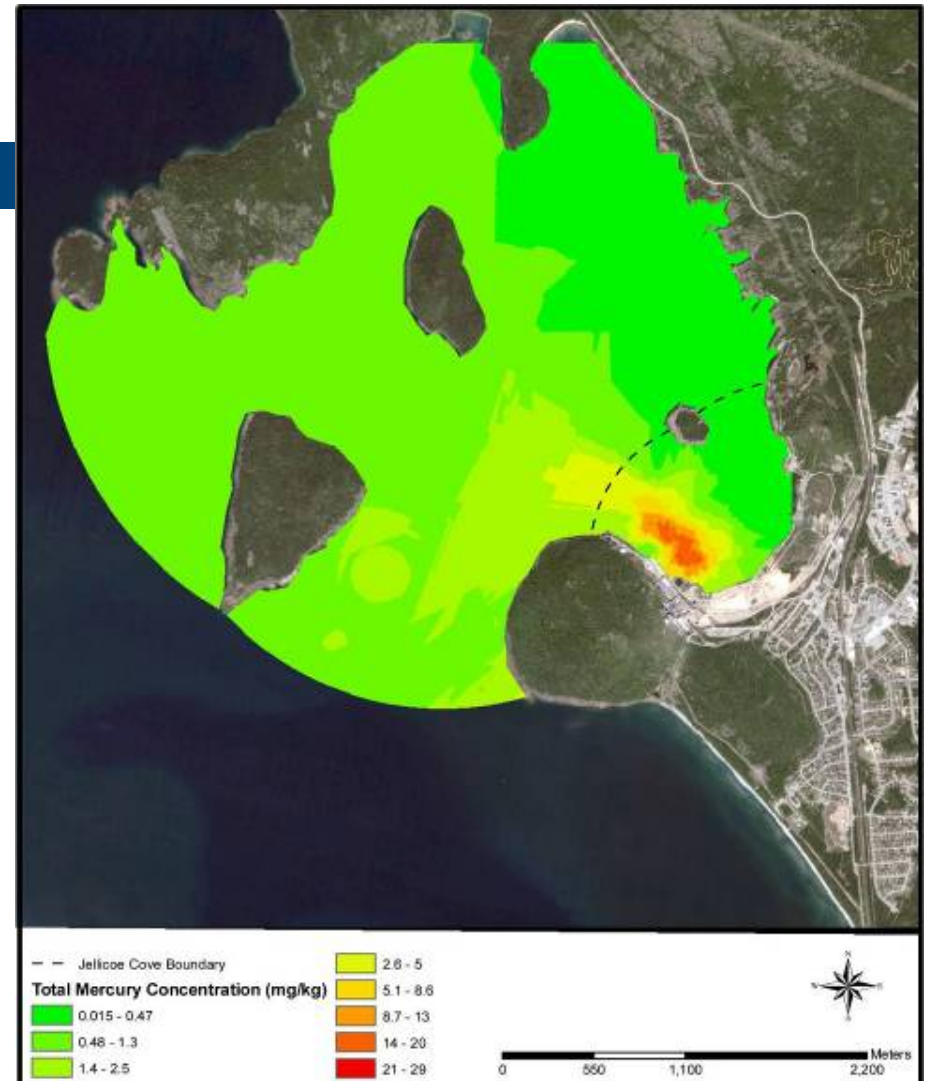
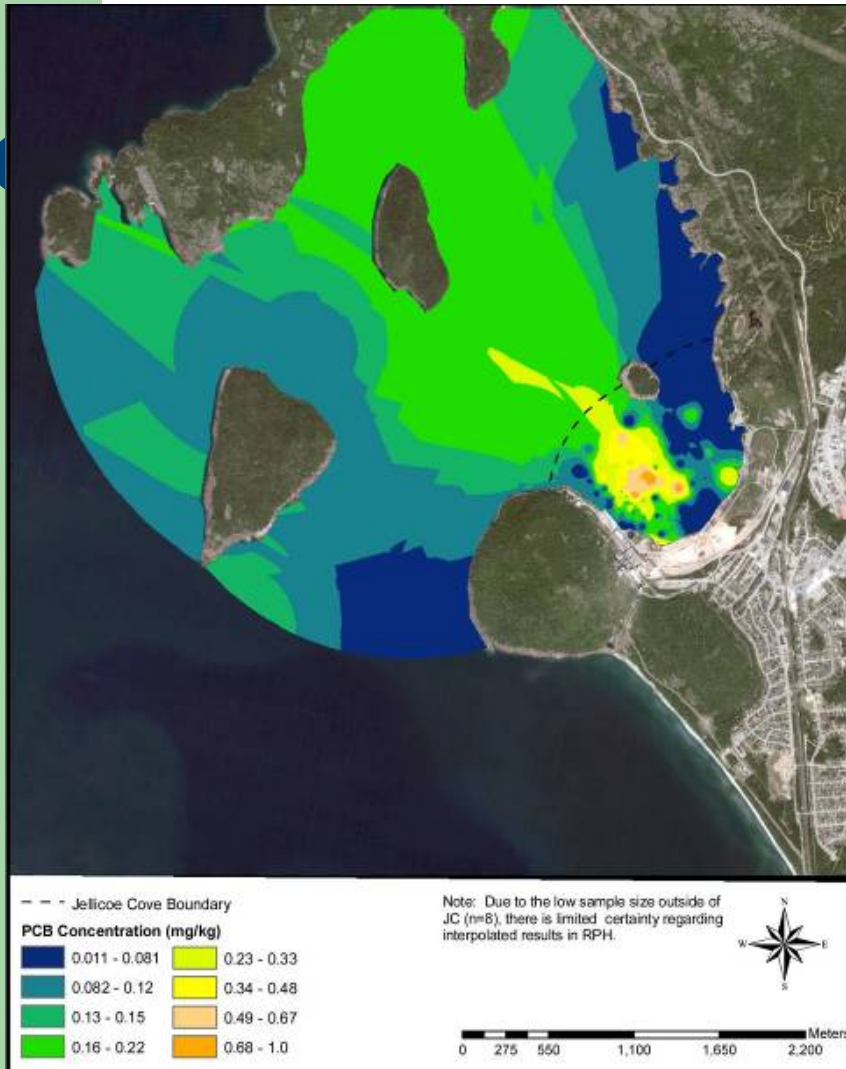


Lake Trout

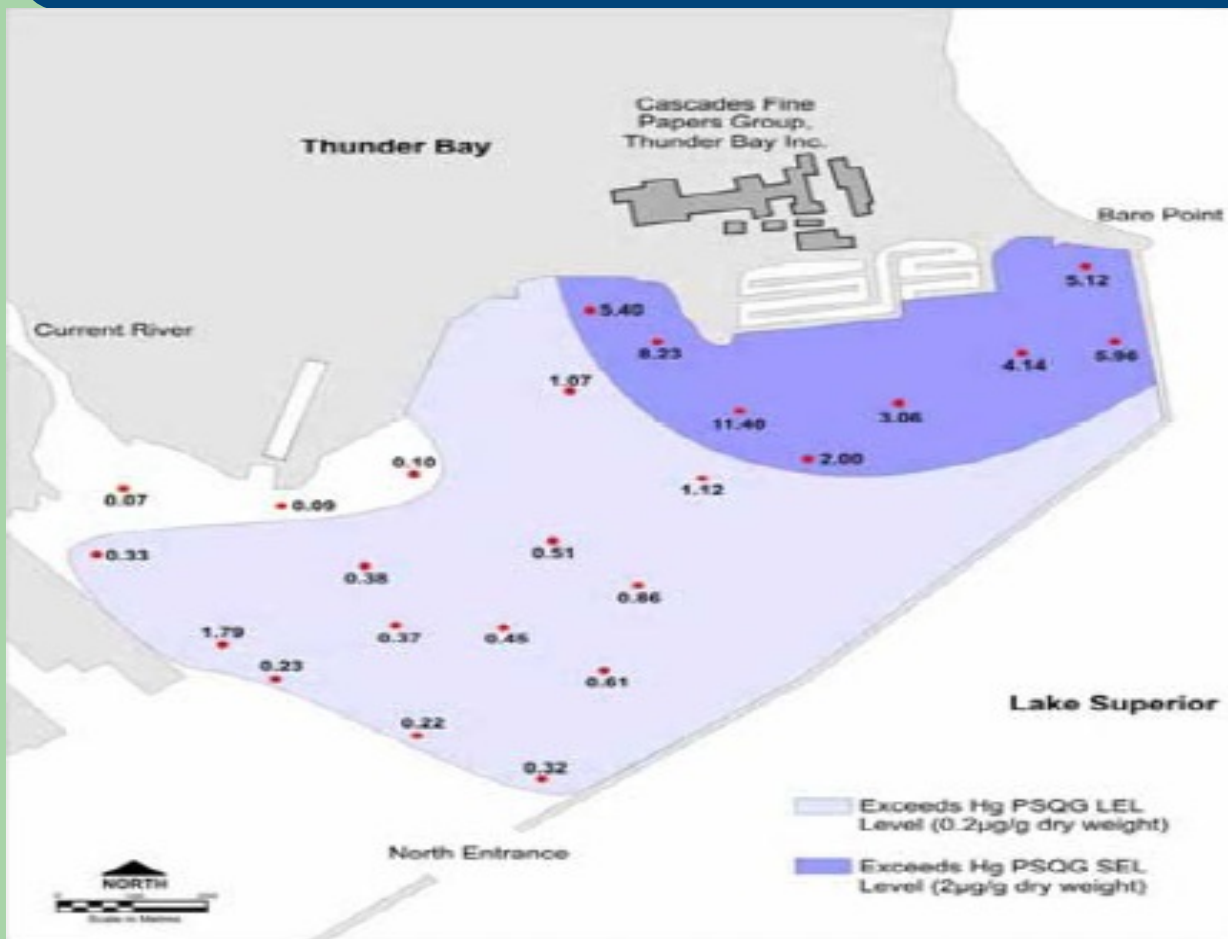


\$20 million

# Peninsula Harbour Area of Concern



# Thunder Bay Area of Concern

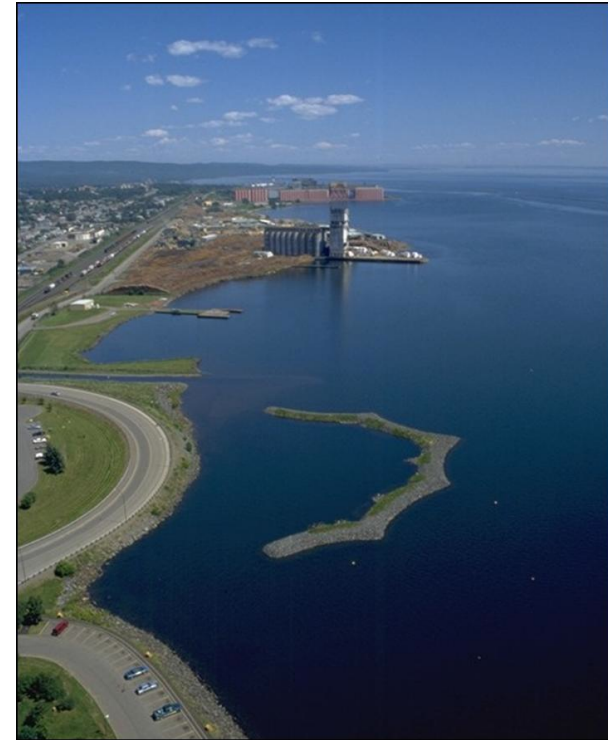


# Fish and Wildlife Habitat Improvement Projects



Photo courtesy of Ron Lacey-[www.borealphotography.com](http://www.borealphotography.com)

- Embayment McKellar (Construction; \$607,800)
- *McVicar Creek Habitat Rehabilitation* (Cost; \$595,000)



# Redesign Water Park to Protect and Enhance Shoreline of the Kaministiquia River

- Kaministiquia River Heritage Park designed to enhance aquatic habitat
- Scenic Value
- Promenade
- Boardwalk

