

Retrospective on the Zebra Mussel Invasion of the Great Lakes



Brent Gibson, Great Lakes United

DREISSENIDS IN NORTH AMERICA: TWENTY YEARS OF CONSEQUENCES

Retrospective examination of significance and impacts of the Dreissenid invasion of North America related to:

- *National Policy in the U.S.*
- *Development of Invasion Ecology*
- *Economic Costs*
- *Public Awareness*

→ TWENTY YEARS OF CONSEQUENCES

*Retrospective
impacts on
America re*

*ance and
f North*

- *Natio*
- *Deve*
- *Econ*
- *Publ*

gy



Brent Gibson, Great Lakes United

~~TWENTY~~ TWENTY-TWO(+??) YEARS OF CONSEQUENCES

Carlton, J. *(In press, Jour. Grt. Lks. Res. Quoted with permission)*

- ❑ *Detected in Lake Erie in 1986 and 1987*
- ❑ *“Likely spread from Lake Erie to Lake St. Clair, where it was then discovered on June 1, 1988.”*

THE ZEBRA MUSSEL: CATALYST FOR U.S. NATIONAL POLICY ON AQUATIC INVASIVE SPECIES



U.S. National (Pest Species) Policy 1800s-1990

Primary focus on terrestrial and agricultural pests:

- **1884 - first federal animal quarantine law**
- **1890 - Meat Inspection Act**
- **1900 - Lacey Act**
- **1912 - Plant Quarantine Act**
- **1939 - Federal Seed Act**
- **1957 - Federal Plant Pest Act**
- **1975 - Federal Noxious Weed Act**

Aquatic species slowly enter the picture

- ❑ **River and Harbor Act (1899)**
- ❑ **Water Resource and Development Act (1958)**
- ❑ **Convention on Great Lakes Fisheries (1955)**
 - **Created Great Lakes Fishery Commission**
 - **Established sea lamprey research and control program**
- ❑ **Lacey Act Revisions (1960s and 1980s)**
 - **Mollusks, crustaceans, reptiles, amphibians**
 - **Fish**
- ❑ **Executive Order 11987 (J. Carter, 1977)**
 - **Recognized exotic species as ecosystem-level problem**
 - **Terrestrial AND aquatic ecosystems**
 - **Precautionary policy – but NOT successful in effecting change**

National policy was reactive (vs. proactive) and took a species by species approach.

Aquatic species come into focus . . . and the zebra mussel shows up

- **Late 1980s: International Joint Commission and the Great Lakes Fishery Commission**
 - Concern about recurring appearance of nonindigenous species in the Great Lakes
 - Spiny water flea (*Bythotrephes longimanus*) – 1982, Eurasian ruffe (*Gymnocephalus cernuus*) – 1986
 - Identified ballast water as likely source

May 1988 - stakeholder meeting in Toledo, Ohio

- Jim Carlton - “biology of ballast water”
- Recommendation for ballast water exchange for ocean-going vessels before they enter the Great Lakes
- June 1988 - *Dreissena polymorpha* “officially” found
- “Zebra mussels” added to letters to governments; sent August 1988

Aquatic species come into focus . . . and the zebra mussel shows up

- Late 1980s: International Joint Commission and the Great Lakes Fishery Commission
 - Concern about recurring appearance of nonindigenous species in the Great Lakes
 - Spiny water flea (*Bythotrephes longimanus*) – 1982, Eurasian ruffe (*Gymnocephalus cernuus*) – 1986
 - Identified ballast water as likely source

May 1988 - stakeholder meeting in Toledo, Ohio

- Jim Carlton - “biology of ballast water”
- Recommendation for ballast water exchange for ocean-going vessels before they enter the Great Lakes
- June 1988 - *Dreissena polymorpha* “officially” found
- “Zebra mussels” added to letters to governments; sent August 1988

Nonindigenous Aquatic Nuisance Prevention and Control Act, 1990 (NANPCA, U.S. Public Law 101-646)

- ❑ Late 1989 - drafting of new legislation began**
- ❑ September & December 1989 – Monroe, Michigan water supply fails**
- ❑ November 1989 – Jon Stanley (USFWS) estimates potential cost of zebra mussel could be \$5B by 1999**
- ❑ Introduced in various forms to House and Senate in March 1990**
- ❑ Signed into law November 29, 1990.**

Nonindigenous Aquatic Nuisance Prevention and Control Act, 1990 (NANPCA, U.S. Public Law 101-646)

- ❑ **Late 1989 - drafting of new legislation began**
- ❑ **September & December 1989 – Monroe, Michigan water supply fails**
- ❑ **November 1989 – Jon Stanley (USFWS) estimates potential cost of zebra mussel could be \$5B by 1999**
- ❑ **Introduced in various forms to House and Senate in March 1990**
- ❑ **Signed into law November 29, 1990.**

Nonindigenous Aquatic Nuisance Prevention and Control Act, 1990 (NANPCA, U.S. Public Law 101-646)

Jim Carlton (email to D. Reid dated March 31, 2008)

“The immediate catalysts for . . . NANPCA were (zebra mussel-related) events such as the closing of the water plant at Monroe, but the real driver - and I believe the major reason NANPCA passed -- was Jon Stanley's estimate that the cost of zebra mussels would be about \$5B between 1989 and 1999. Without that number, NANPCA would not exist.”

Nonindigenous Aquatic Nuisance Prevention and Control Act, 1990

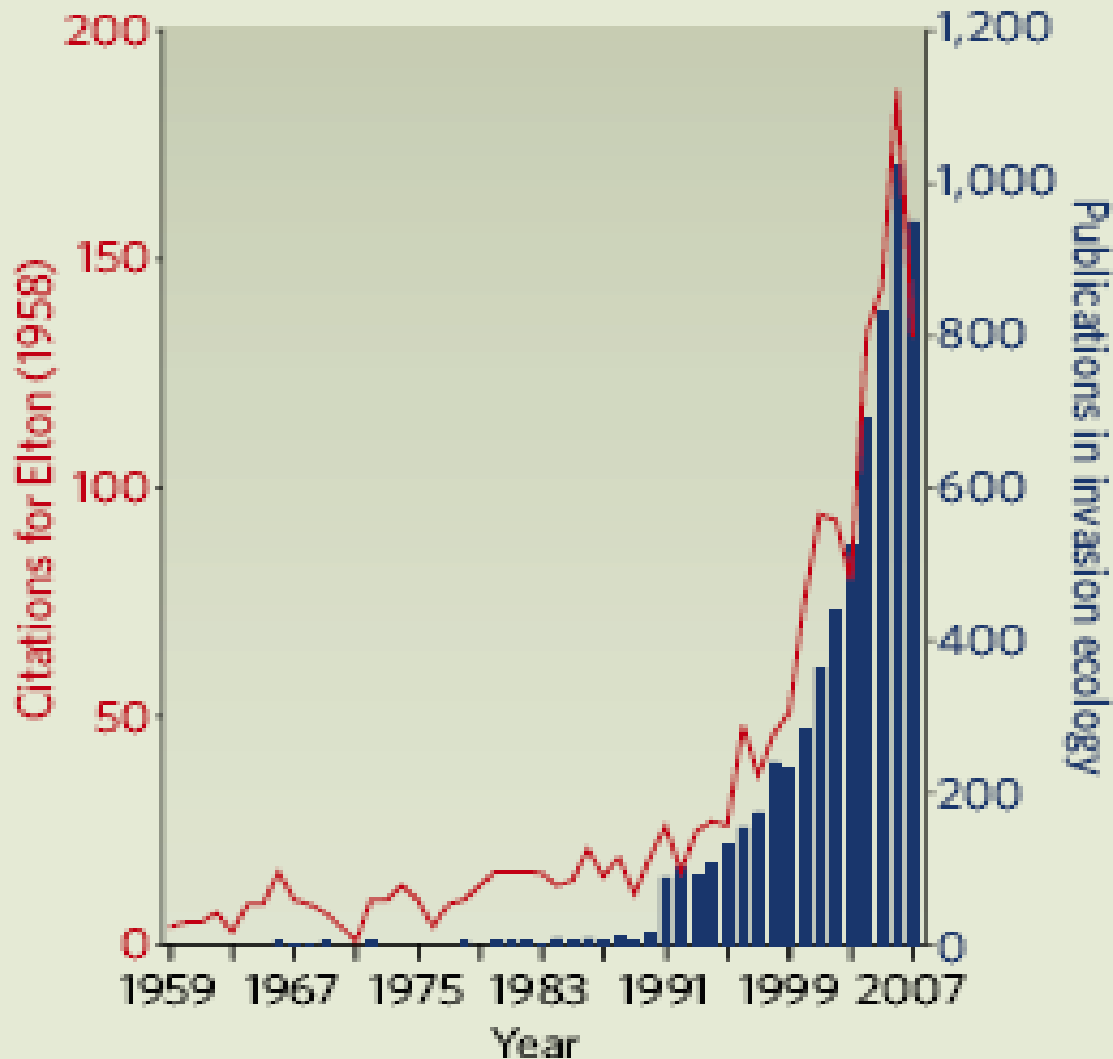
- **Significant shift in U.S. national policy/approach to “invasive” species**
 - *(Purpose) “. . . prevent and control infestations in coastal inland waters . . . by the zebra mussel and other nonindigenous aquatic nuisance species”*
 - *Established definitions of “aquatic nuisance species” and “nonindigenous species”*
 - *Not just a “zebra mussel” bill – NANPCA mandated sweeping changes to national policy*

THE ZEBRA MUSSEL: CATALYST FOR GROWTH OF INVASION SCIENCE



(Presentation by Hugh MacIsaac, University of Windsor)

Invasion studies



Invasion-related scientific literature has exploded since 1990

Red line = citations of Elton, 1958

Dark blue bars = synonyms (7) for invasive species

Ricciardi & Maclsaac, 2008 (Nature)

**THE ZEBRA MUSSEL: CATALYST FOR
ANS (AIS) AWARENESS
(GROWTH OF OUTREACH AND EDUCATION)**



(Presentation by Carol Swinehart, MI Sea Grant)

Public outreach and involvement has changed since the discovery of zebra mussels in the Great Lakes

- ❑ **ANS not on radar screen pre-1989**
 - Except for sea lamprey
- ❑ **NANPCA authorized grants for research and education programs through Sea Grant**
 - Availability of funds sparked interest of Sea Grant programs nationwide, leading to rapid expansion of ANS outreach
- ❑ **ZM rapidly affected traditional stakeholders**
 - Anglers, Boaters, Commercial fishing operations, Commercial shippers, Aquaculture and Baitfish operations, Riparians, Great Lakes coastal communities, News media
- ❑ **Brought new stakeholders, especially Industries and municipalities**

Public outreach and involvement has changed since the discovery of zebra mussels in the Great Lakes

- ❑ **Growth of ANS issues and widespread impacts on wide range of stakeholders led to extensive need for new information**
- ❑ **1st zebra mussel conferences circa 1990/1991; later morphed into ICAIS**
- ❑ **Significant partnering among education, outreach, and scientific communities and stakeholders**
 - **Pet Industry and Habitattitude™**
 - **Best Management Practices for Ballast Water**

THE ZEBRA MUSSEL: ECONOMIC COSTS UPDATED



(Presentation by Chuck O'Neill, NY Sea Grant)



Impact by Major Categories



Expenses by sector during period 1989-2004

Industrial Facilities

Min: \$2,000 Max: \$1.6 million

Water Treatment Plants

Min: \$1,000 Max: \$3.66 million

Electric Power Generation

Min: \$1,000 Max: \$5.95 million



Actual and Extrapolated Impacts



Electric Generation + Water Treatment

	<u>1995 Study</u>	<u>2005 Study</u>
1989-1995	\$56.7 million	\$146 million
1989-2004	\$550+ million*	\$267 million

Best Estimate, All Categories

1989-2004 **\$1 – 1.5 billion***

Various problems make data set incomplete and statistically limited.

* *Extrapolated for additional years & range*

Summary

- ❑ **U.S. Pest/Invasive Species Policy predominantly agricultural/terrestrial**
- ❑ **Great Lakes invasions of 1980s significantly shifted focus to aquatic ecosystems**
- ❑ **Invasion of the zebra mussel catalyzed**
 - **Congressional action – change national policy**
 - **Major changes in science – growth of invasion ecology and biology**
 - **Rapid increase in demand for information, expansion of public awareness and involvement, incorporation of stakeholders as partners**
- ❑ **We still don't have a good model for economic costs**

Finis