

Impacts of Aquatic Invasive Species on the Lake Superior Fishery

**by Jeff Gunderson
Minnesota Sea Grant Program**



Can humans really impact the fishery of such a large waterbody?



Lake Superior Fishery Change



- Invasive Species
cause of the greatest
fishery impacts

- Chemical Pollution
- Sedimentation
- Commercial Fishing
- Recreational Fishing
- Habitat Loss

55 Non-Native Species in Lake Superior

(Only 33 Native Fish Species)

FISH (n=21)

- Alewife
- American eel
- Brook silverside
- Common carp
- Eurasian ruffe
- Freshwater drum
- Goby, round
- Goby, tubenose
- Goldfish
- Rainbow smelt
- Sea lamprey
- Stickleback, fourspine
- Stickleback, threespine
- White perch
- 7 Trout/Salmon

INVERTEBRATES (n=21)

- Asian clam
- Bosmina coregoni* (zooplankton)
- Cyclops strenuus* (zooplankton)
- Echinogammarus ischuus* (shrimp)
- Eurytemora affinis* (zooplankton)
- Gammarus fasciatus* (shrimp)
- New Zealand mudsnail
- Spiny waterflea
- Ripistes parasita* (worm)
- Rusty crayfish
- Vejdovskyella intermedidia* (worm)
- Zebra and Quagga mussels

Other (n=13)

- 9 parasites and diseases
- 4 submerged/wetland plants

Environmental impact of two invasive species with the most demonstrable impacts

➤ Lamprey

Atlantic Ocean via canals



➤ Smelt

Atlantic Ocean via stocking



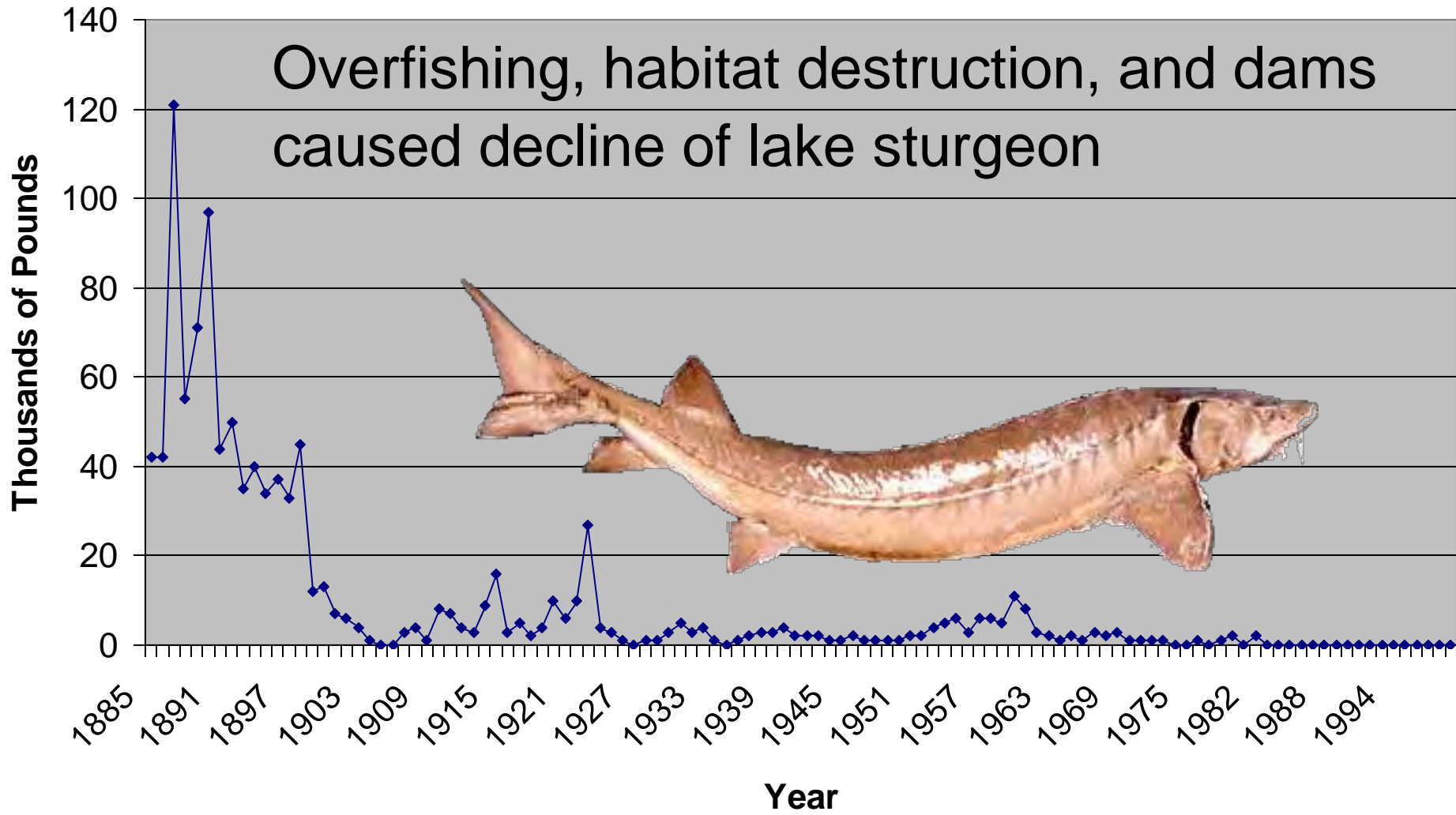
But first a description of two Lake Superior fish that endured precipitous declines **not** caused by invasive species – lake sturgeon and brook trout



Lake Sturgeon

- Unique fish
- Long lived
- Slow maturing

Lake Superior Lake Sturgeon Production

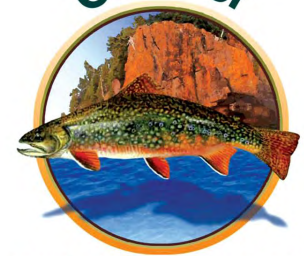


Dramatic declines already by 1900

Coaster Brook Trout



- Lake Superior brook trout remain close to shore and historically spawned in 118 tributaries
- Provided a great sport fishery



Causes of Decline?

Linked to the Lake, Tied to the Past

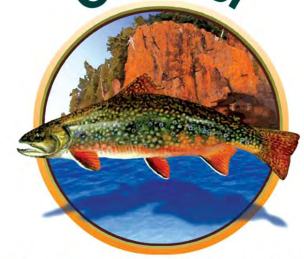
- **Overharvest**
 - Primarily sport fishing



Minnesota Historical Society
Brook Trout at Devils Track River -- Lake Sup. 1878



Significant declines already apparent by 1880



Linked to the Lake, Tied to the Past

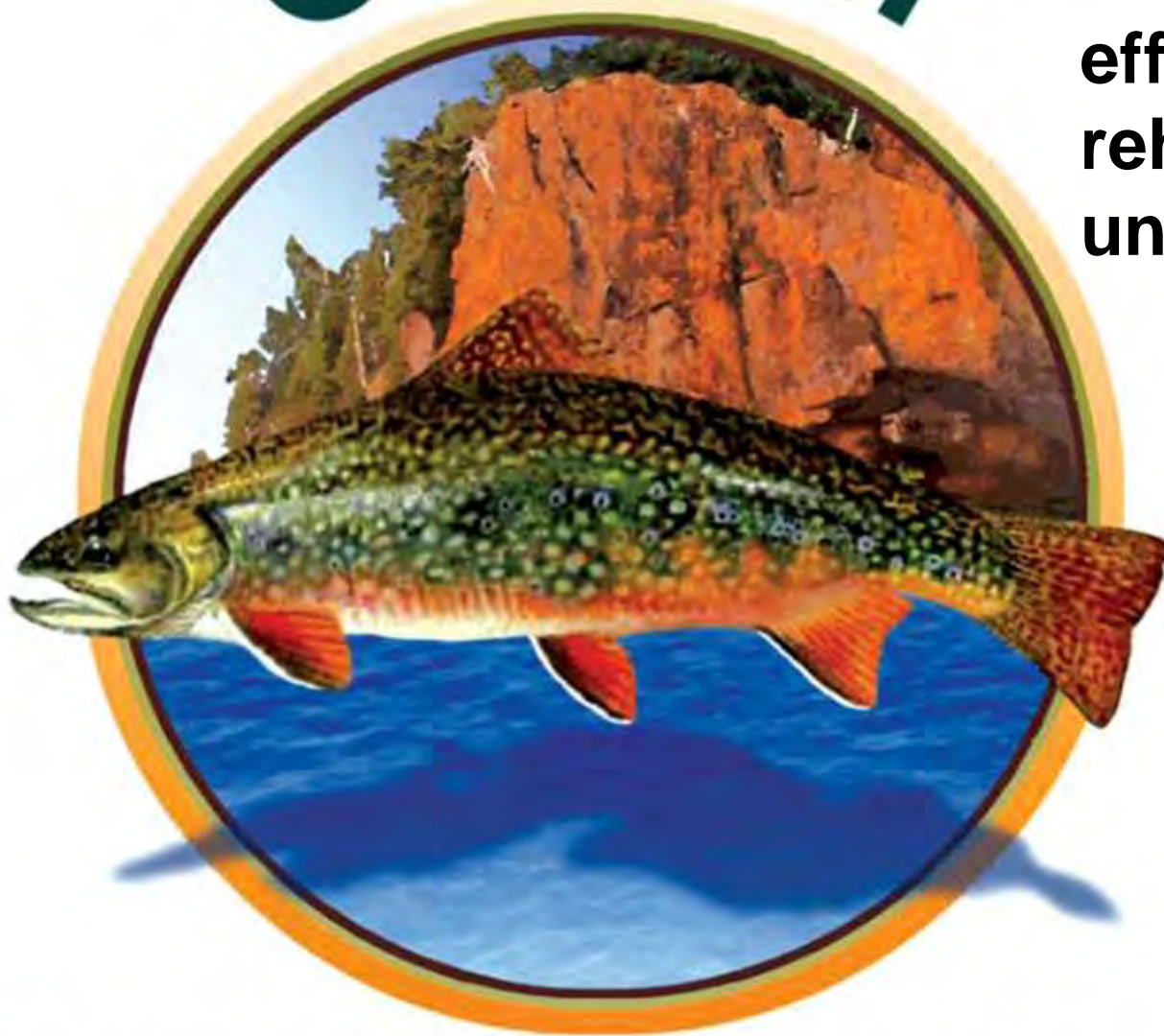
Causes of Decline?

- Overharvest
- Stream habitat degradation



Coaster

Research and management efforts toward rehabilitation are underway



Linked to the Lake, Tied to the Past

Now, Invasive Species Induced Impacts

SEA LAMPREY



- **Most devastating invader in Great Lakes**

What prevented lamprey from entering the upper Great Lakes?

Niagara Falls:



Welland Canal

Opened access to upper lakes

- Welland Canal was completed in 1829
- Welland Canal was deepened in 1919
- First sea lamprey in L. Erie 1921

Lake Trout a Valuable Fishery



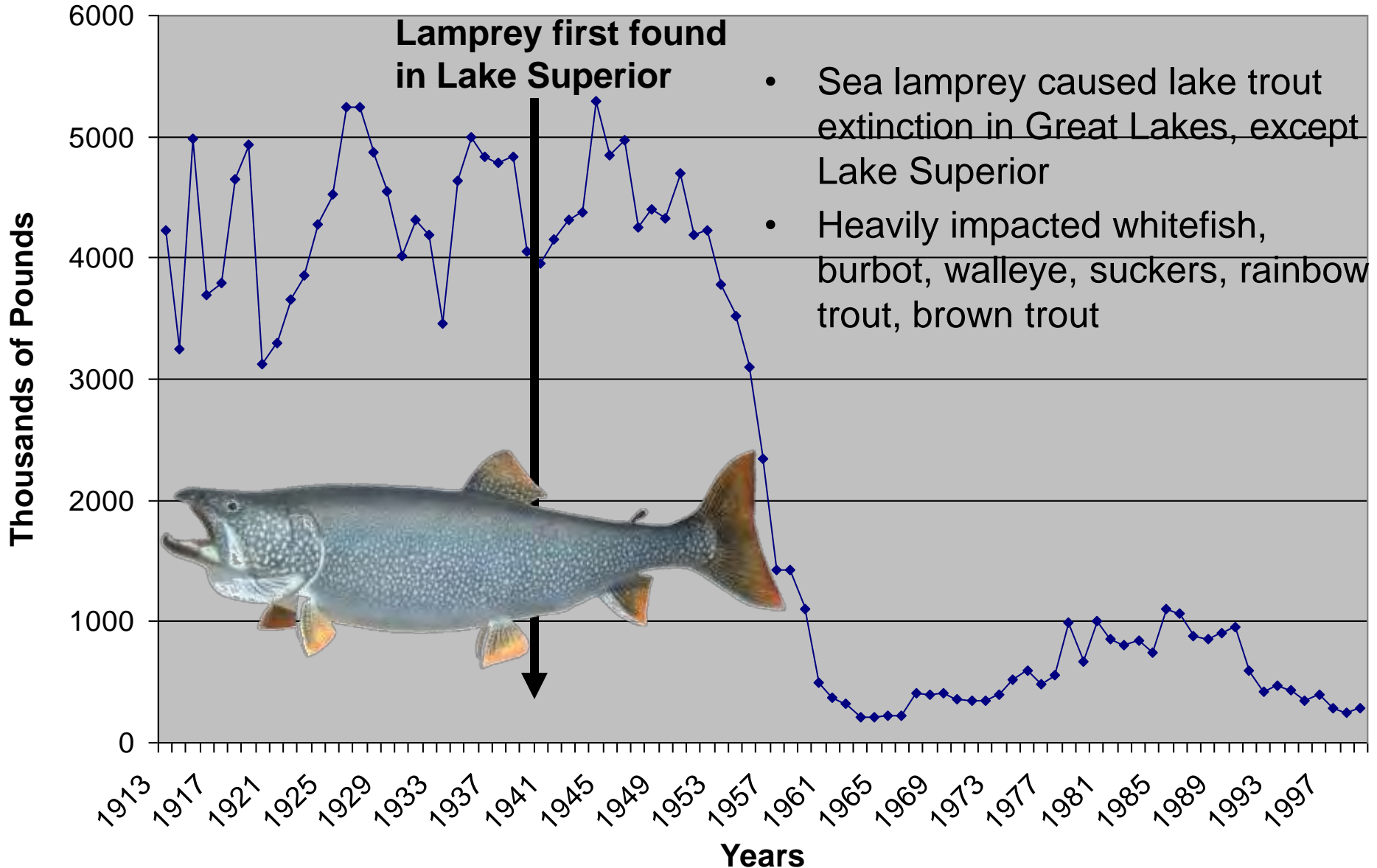
Wisconsin Historical Society



Minnesota Historical Society

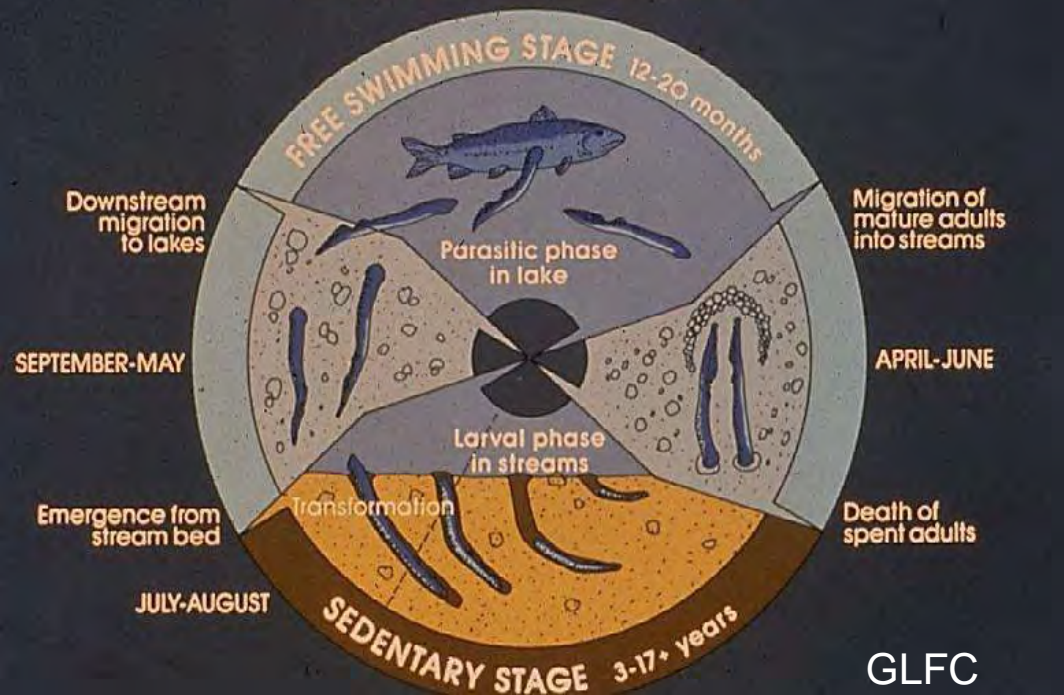
Lake trout were the top predator and provided a commercial harvest of 4 to 6 million lbs. annually

Lake Superior Lake Trout



Note: Commercial harvest data doesn't perfectly reflect changes in abundance because of changing net efficiencies, changing market demand, and changed regulations.

Life Cycle of the Sea Lamprey



Sea Lamprey Control

Based on life cycle, focused controls in streams

- **Prevent upstream spawning migration of adults – mechanical and electrical barriers, trapping**
- **Kill juveniles in streams with selective chemicals**
- **Sterile male releases to reduce viable eggs produced.**
- **Attractants and repellants**

Lamprey Chemical Control



First TFM application – Lake Superior, 1958

Lake Trout Rehabilitation after 50 Years

- Self-sustaining populations in most areas
- Stocking of hatchery reared fish has ceased in many areas
- Abundance is at or exceeds historical levels in many areas





Laker Recovery

Sea lampreys continue to kill as many or more lake trout than humans, but recovery has succeeded.

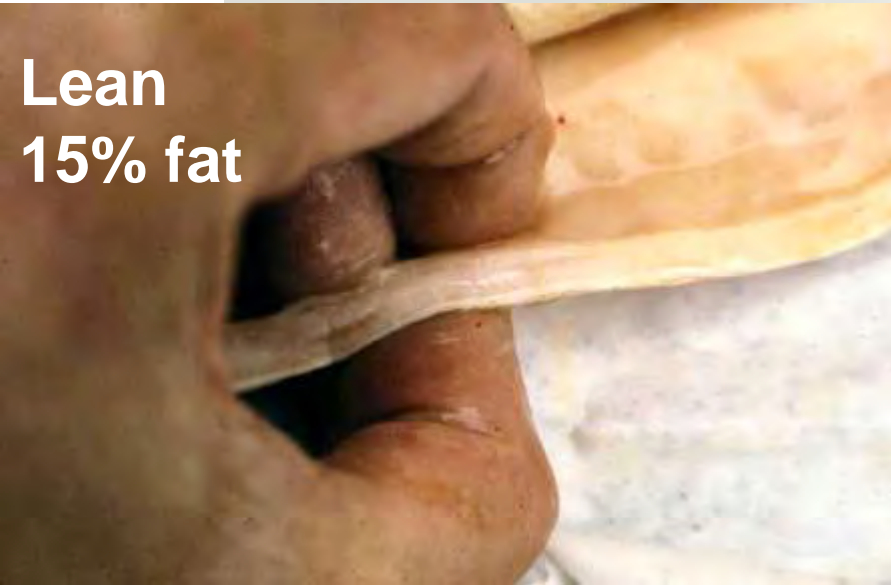
Siscowet

Fat Lake Trout

Not found in other Great Lakes



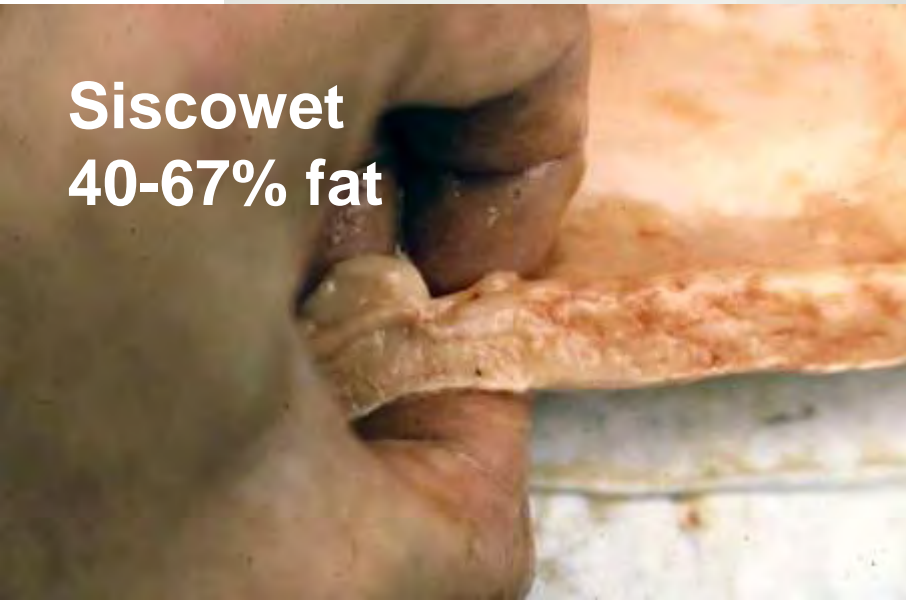
Lake Trout Forms



Lean
15% fat



Lean Lake Trout



Siscowet
40-67% fat



Siscowet Lake Trout

Siscowets are approximately 14 times more abundant than lean lake trout

The State of Lake Superior in 2000
http://www.glfc.org/pubs/SpecialPubs/Sp07_2.pdf

Siscowets also appear to have experienced a strong recovery from lamprey devastation



Lean lake trout

Siscowets



Lake Superior Cisco Fishery

- Ciscoes were formerly called lake herring
- Historically, most abundant native fish



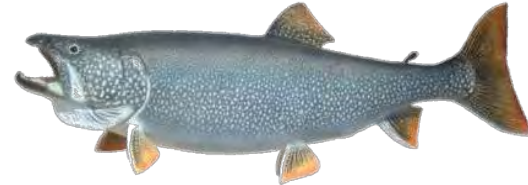
**Supported an annual
commercial harvest of
10 to 15 million pounds**



Lamprey ↑



Lake trout ↓



Lake trout ate cisco

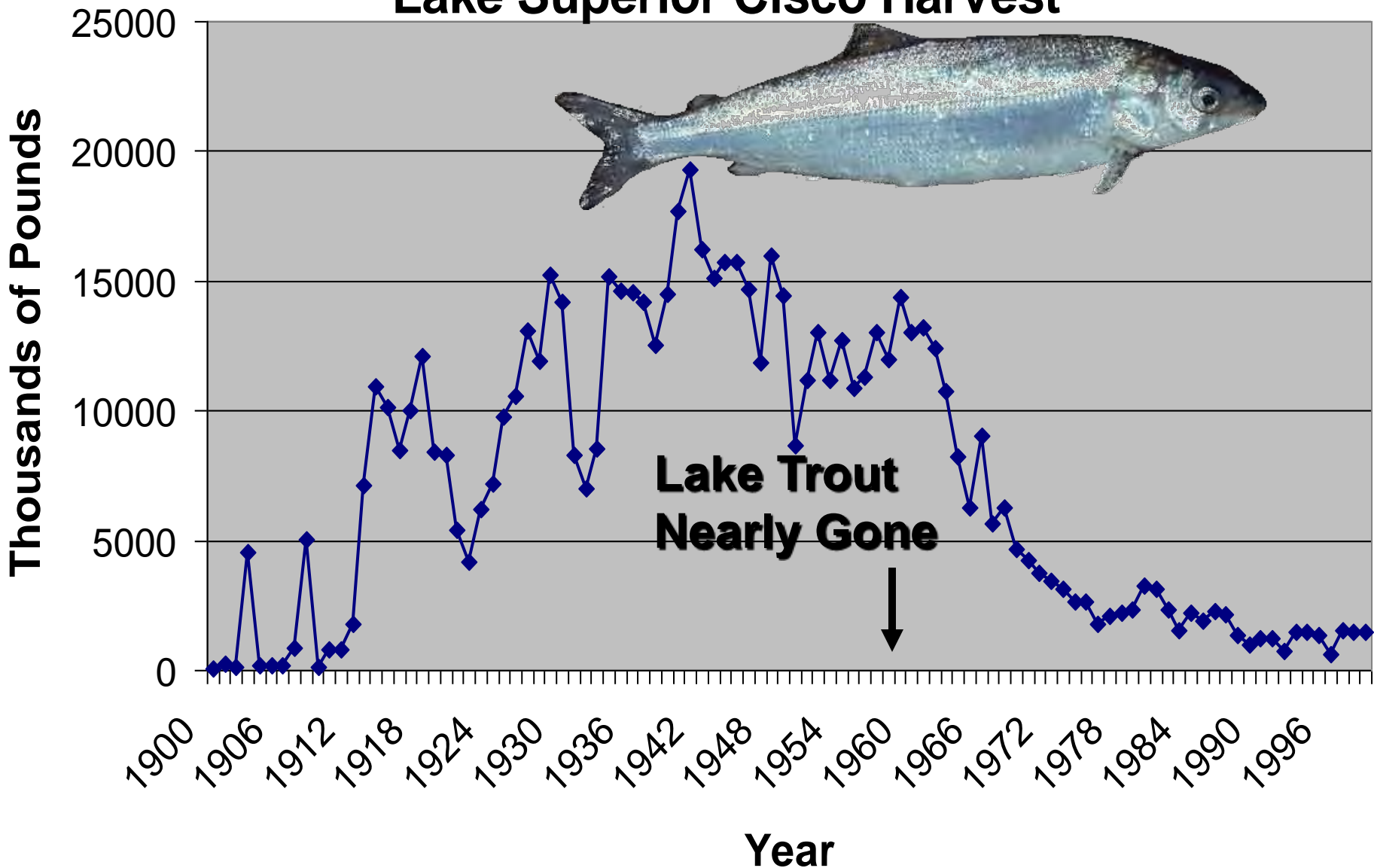
Therefore, Cisco should ↑



Millions of pounds of lake trout disappeared because of lamprey -- so many more millions of pounds of cisco were not be eaten by lake trout – therefore, cisco numbers were expected to dramatically increase

Instead, cisco numbers declined

Lake Superior Cisco Harvest



Rainbow Smelt Introduction



- Introduced into a MI inland lake in 1912
- Found in Lake Superior in 1930s
- Found along North Shore in 1946 after which populations exploded

Rainbow Smelt



- **Small coastal Atlantic Ocean fish**
- **Has had negative impacts on native species**

Smelt Impacts

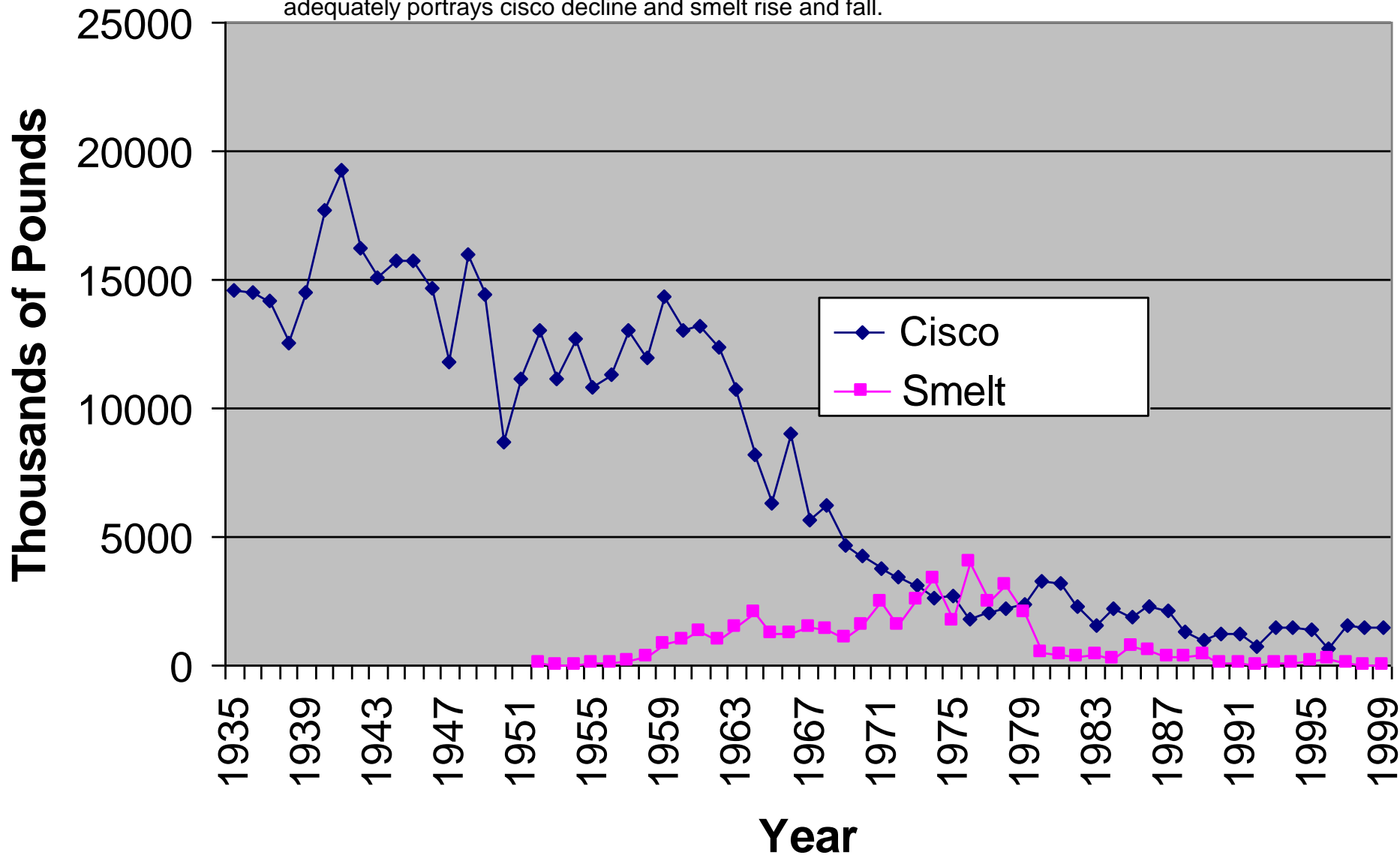


Contributed to declines in native fish populations such as cisco and lake whitefish

Herring
Fisherman

Cisco and Smelt Production

Note: Commercial harvest data doesn't perfectly reflect changes in abundance because of changing net efficiencies, changing market demand, and changed regulations, but I think it adequately portrays cisco decline and smelt rise and fall.



Pound net in Duluth-Superior Harbor



Unlike the invasion of lamprey, smelt at least created a commercial fishery

**It also created a party every spring
in the “good old days”**



**And more fun than anyone
should have!**



Photo: WI Historical Society



After 1979, smelt abundance declined and cisco increased.

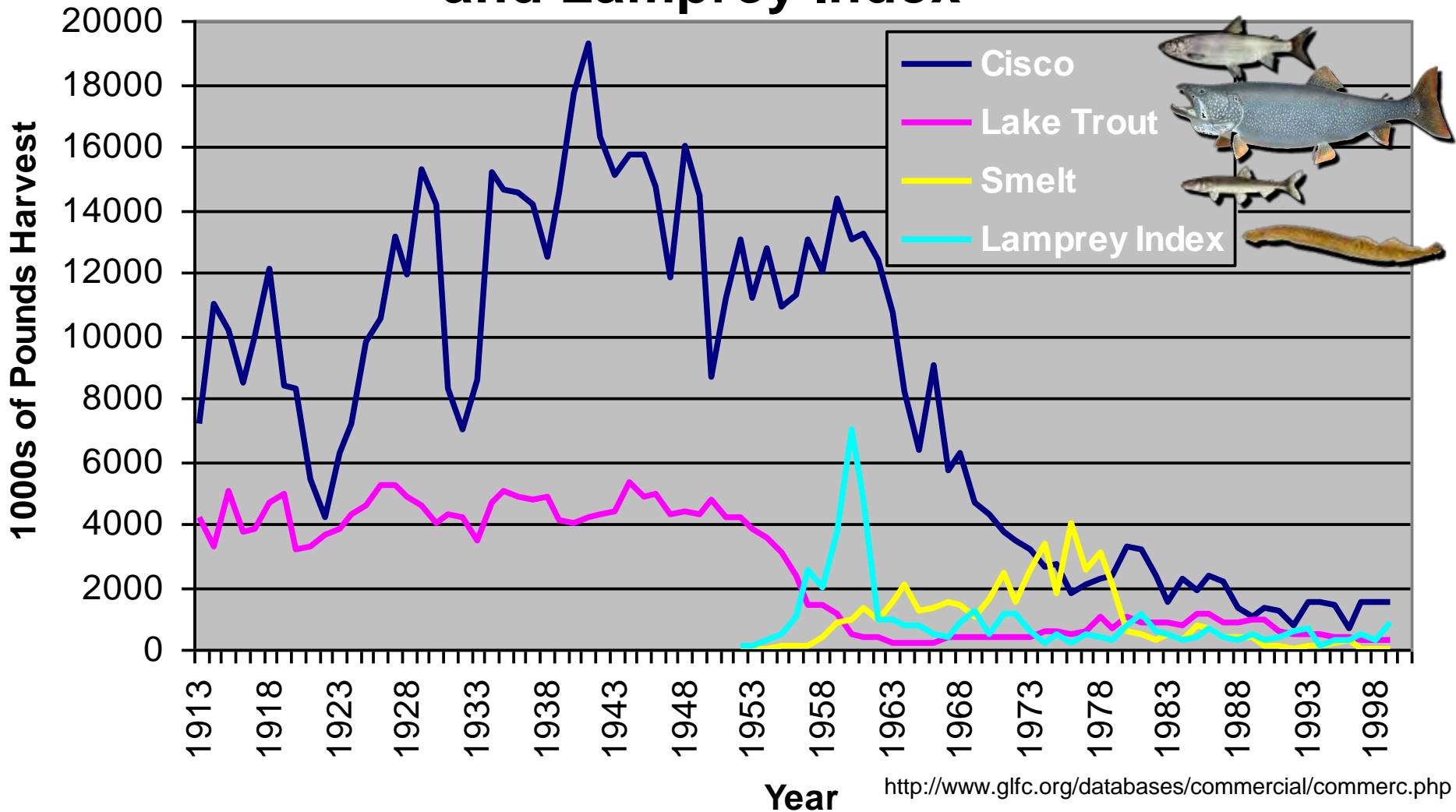
We're not sure why smelt crashed, but it was the increasing number of predators since the early 1980's that has kept them in check.

Cisco Recovery

- Several strong year classes since their population lows in the 1970s
- Greatest biomass of prey fish
- Cautiously optimistic about future



Cisco, Lake Trout, Smelt harvest and Lamprey Index



Less predators and less forage fish (food) available than prior to lamprey and smelt

The “Old” Invasive Species had Significant Environmental Impacts

- Lamprey

- Atlantic Ocean via canals



- Smelt

- Atlantic Ocean via stocking



A story of devastation and successful recovery.

We have had dramatic declines in the most abundant and valuable fish in Lake Superior – caused by the introduction of lamprey and smelt. These were both Atlantic Ocean fish that entered through canals (lamprey) or by intentional stocking (smelt). The impacts that they caused 40 – 50 years ago have largely been reversed.



There are many more recently introduced invasive species:

What will their legacy be?

Here already

- Ruffe – 1986
- Fourspine sticklebacks – 1986
- Threespine sticklebacks - 1987
- Spiny waterfleas - 1987
- Zebra mussels - 1989
- Round gobies - 1995
- New Zealand mudsnails – 2001
- Quagga mussels - 2005

Coming soon?

- Bloody red shrimp
- VHS virus
- Fishhook waterfleas
- Others?



Only time will tell



Thank you