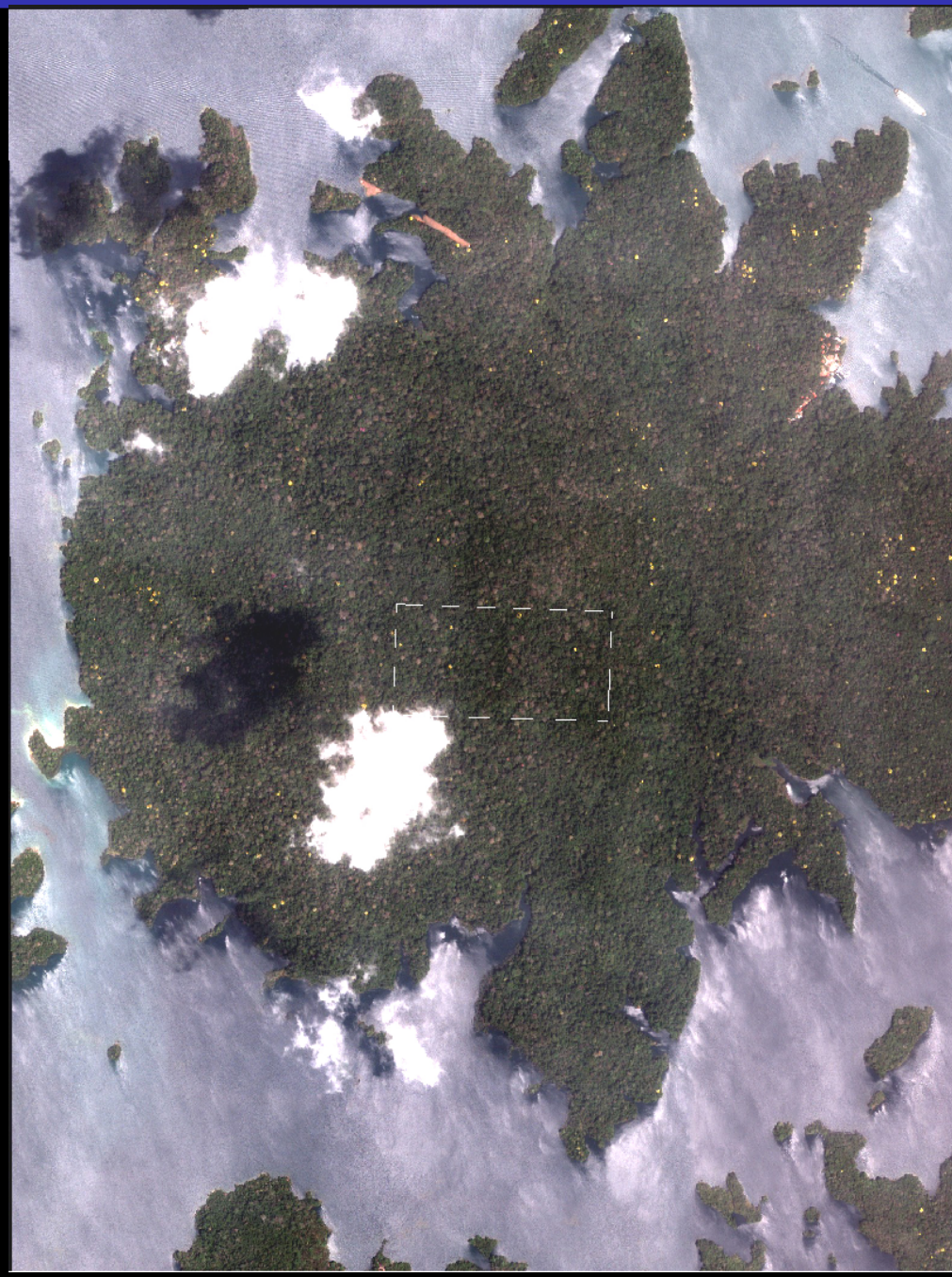
Lake Michigan Fish and Ecosystems

Epidemiology of Fisheries and Invasions

Richard Condit

Rare Nest Gallery
Alan Sue Exhibition
7 August 2019

Curious entities reduced to counts



Outline

Fragile ecosystems

Contributing characteristics

- Islands
  - Small area
  - Recent
  - Isolated and dispersal-limited
  - Few species
  - Simplified ecosystems
- Fresh water ecosystems

Fragile Hawaii

Fragile Hawaii

Recently formed ecosystem

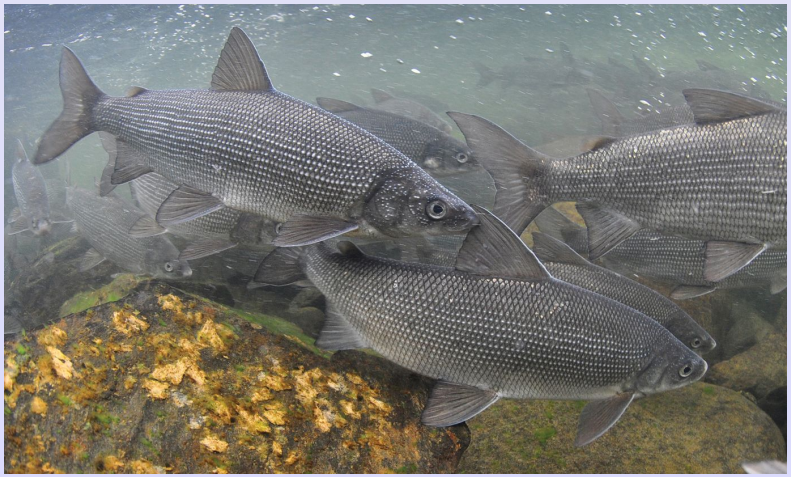
Lake whitefish

Lake whitefish

Lake whitefish

The important native fishery

- Bottom feeder
- Deep water spawner
- Persists despite the ecosystem alterations
- Commercial fishery
  - Sustainable for over a century
  - $6 million current annual value (Lake Michigan)

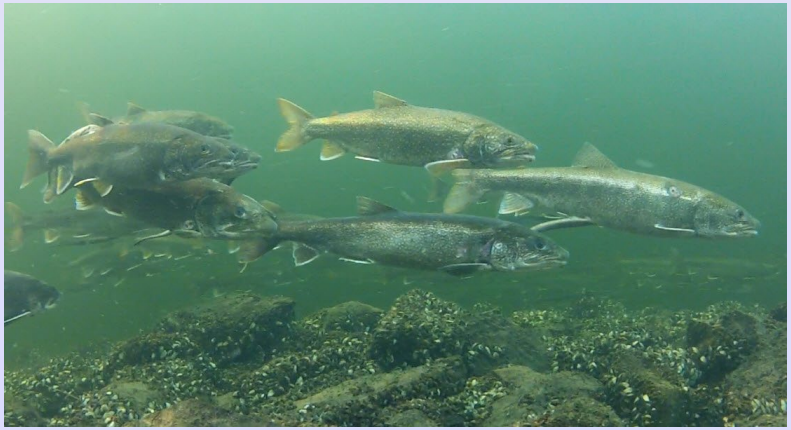


Lake trout

Lake trout

The native great lakes prize

- Top predator of open water
- Stream or shore spawner
- Dominated commercial fishery 1870s-1940s
- Favored prey of the lamprey
- No longer reproducing but restoration is intended

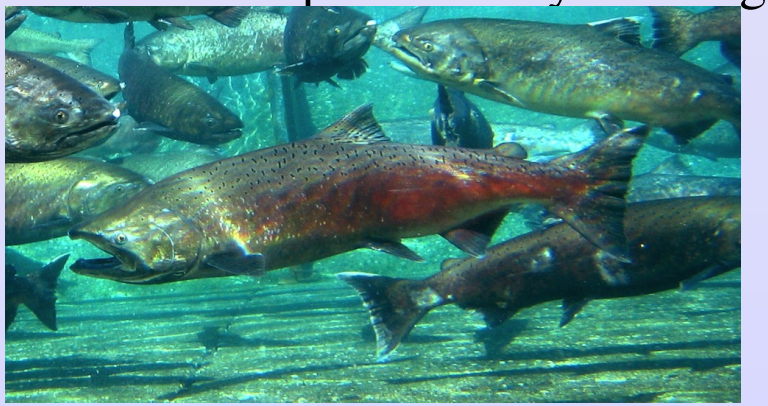


Chinook salmon

Chinook salmon

A Pacific salmon part of huge marine fishery

- Top predator of open water
- Stream spawner
- Stocked in Great Lakes from 1970
  - Chinook is the cost effective of several stocked species
  - Some reproduction but not viable without stocking
- Control alewife via predation
- The industry
  - $\sim$ 10 million young fish per year in L. Michigan
  - $\sim$ \$6 million cost
  - $\sim$ \$1 billion value of sports fishery across great lakes



Sea lamprey

Sea lamprey

Sea lamprey


GREAT LAKES
(LAURENTIAN) BASIN
Drainage Basin Boundary
International Boundary
State Boundary
River
Lake
Selected City
0
200 km
N
The Ogoki River sub-basin and the Long Lake sub-basin are diverted into the Great Lakes Basin by human intervention.
Ogoki R.
Lake Nipigon
Long Lake
Dog R.
Pic R.
White R.
Magpie R.
CANADA
USA
Minnesota
Thunder Bay
Ontario
Lake Superior
St. Louis R.
Duluth
CANADA
USA
Montreal R.
Spanish R.
Wanapitei R.
Mississagi R.
Lake Nipissing
Escanaba R.
Menominee R.
Michigan
Magnetawan R.
Georgian Bay
CANADA
St. Lawrence R.
USA
Straits of Mackinac
Wisconsin
Green Bay
Green Bay
Wolf R.
Fox R.
Lake Michigan
Lake Huron
Manistee R.
Au Sable R.
Saginaw Bay
Lake Simcoe
Saugeen R.
Black R.
Toronto
Lake Ontario
Grand R.
Muskegon R.
Michigan
Saginaw R.
Rochester
Niagara Falls
Finger Lakes
Genessee R.
Milwaukee
Buffalo
Grand R.
Lake St. Clair
Thames R.
New York
Detroit
Illinois
Lake Erie
St. Joseph R.
Chicago
Toledo
Cleveland
Grand R.
Maumee R.
Cuyahoga R.
Pennsylvania
The flow of the Chicago River was diverted out of the Great Lakes Basin in 1900 with the construction

Sea lamprey

Primitive North Atlantic fish that ascends rivers to breed

- Parasite that decimated trout
- Stream spawner
- Invaded lower great lakes in 1930s
  - Welland Canal
  - Always native to Lake Ontario?
- Controlled by poisoning of larvae
  - Reduced by 1970
  - Ongoing poisoning costs $\sim$ \$20 million per year

Alewife

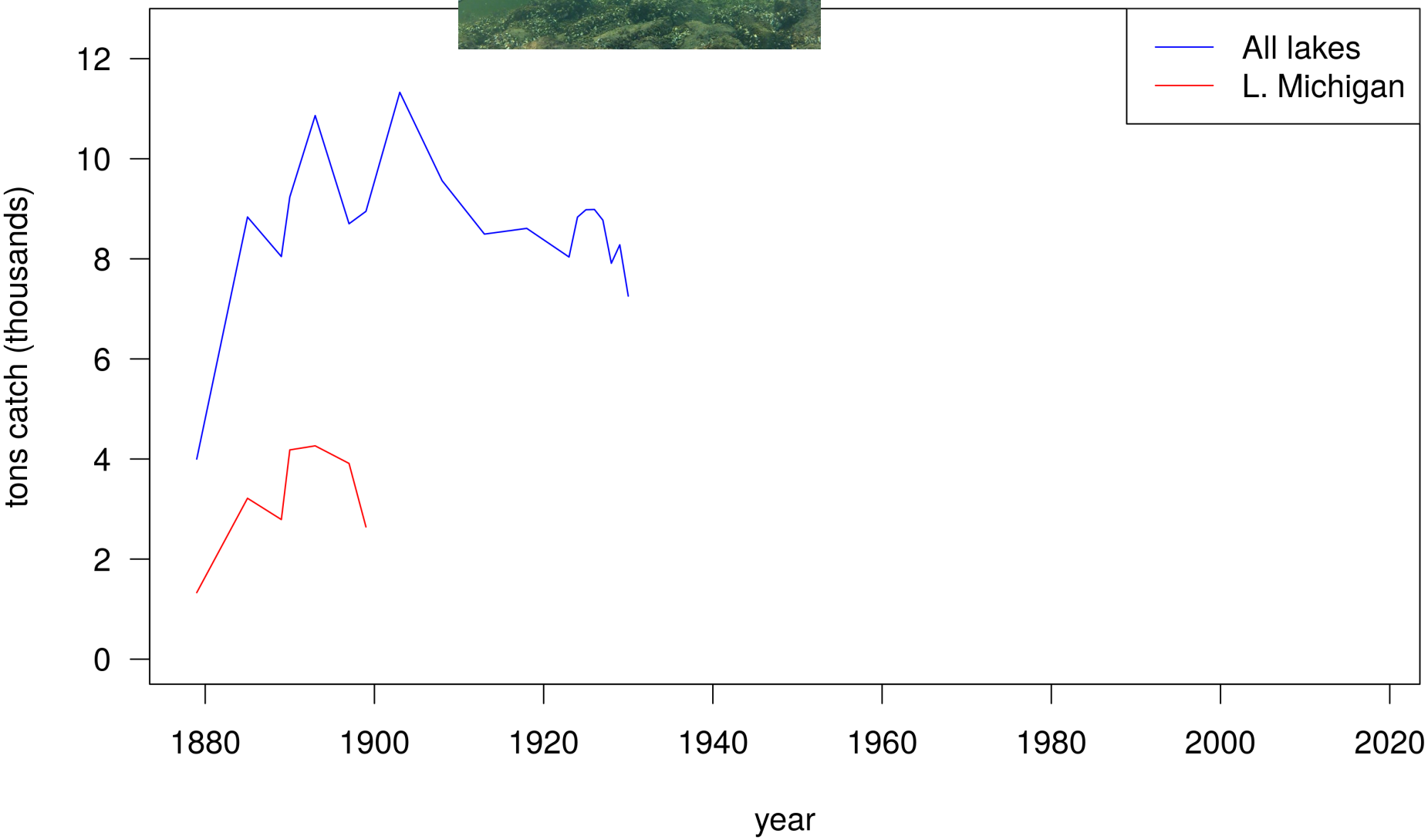
Alewife

Alewife

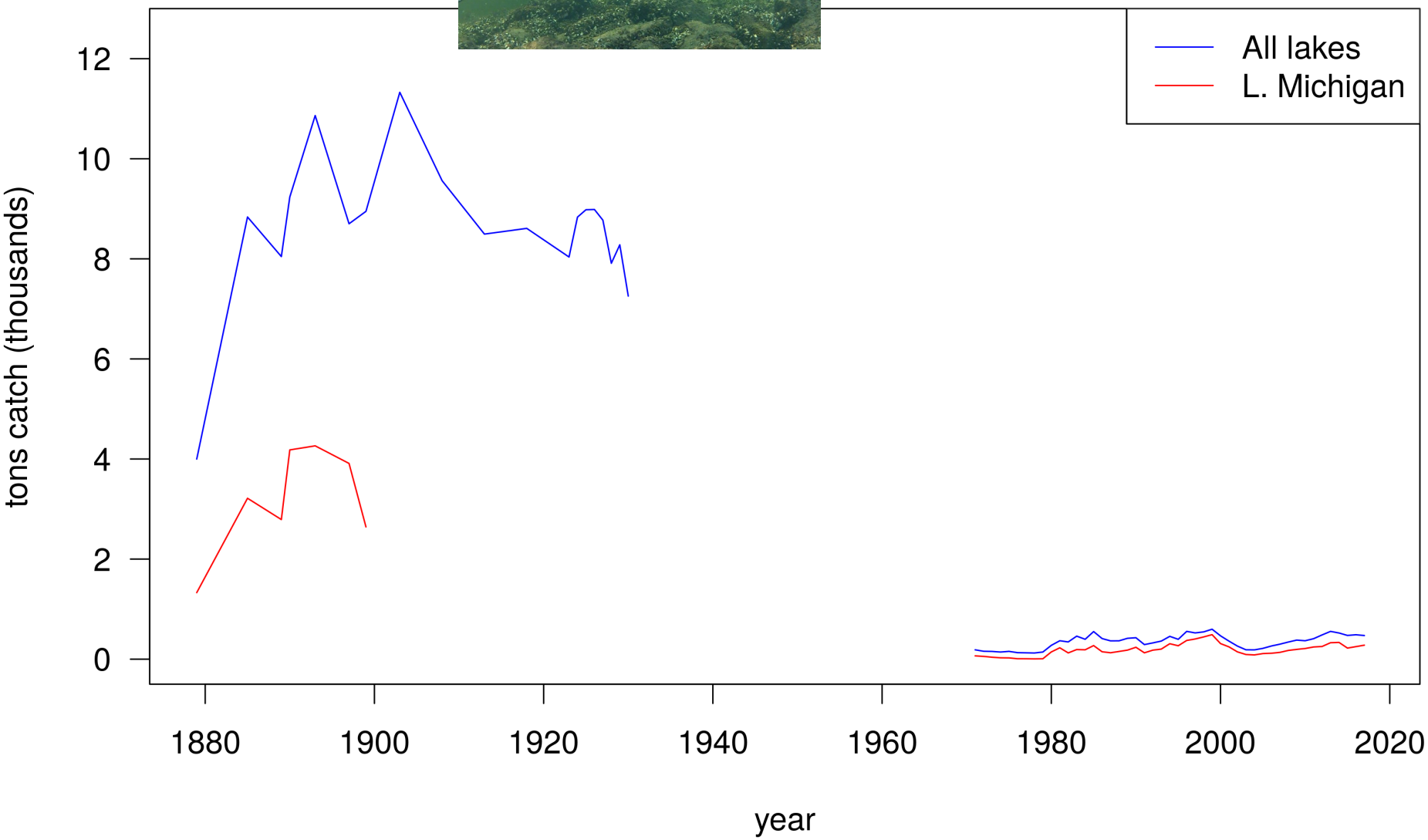
Coastal North Atlantic fish that enters rivers

- Plankton feeder of open water
- Invaded lower great lakes in 1950s
  - Welland Canal
  - After trout were reduced by lamprey?
- Spread rapidly then a die-back littered beaches in 1960s
- Controlled by Pacific salmon after 1970
  - Predator on young trout and salmon
  - Favored food of large trout and salmon

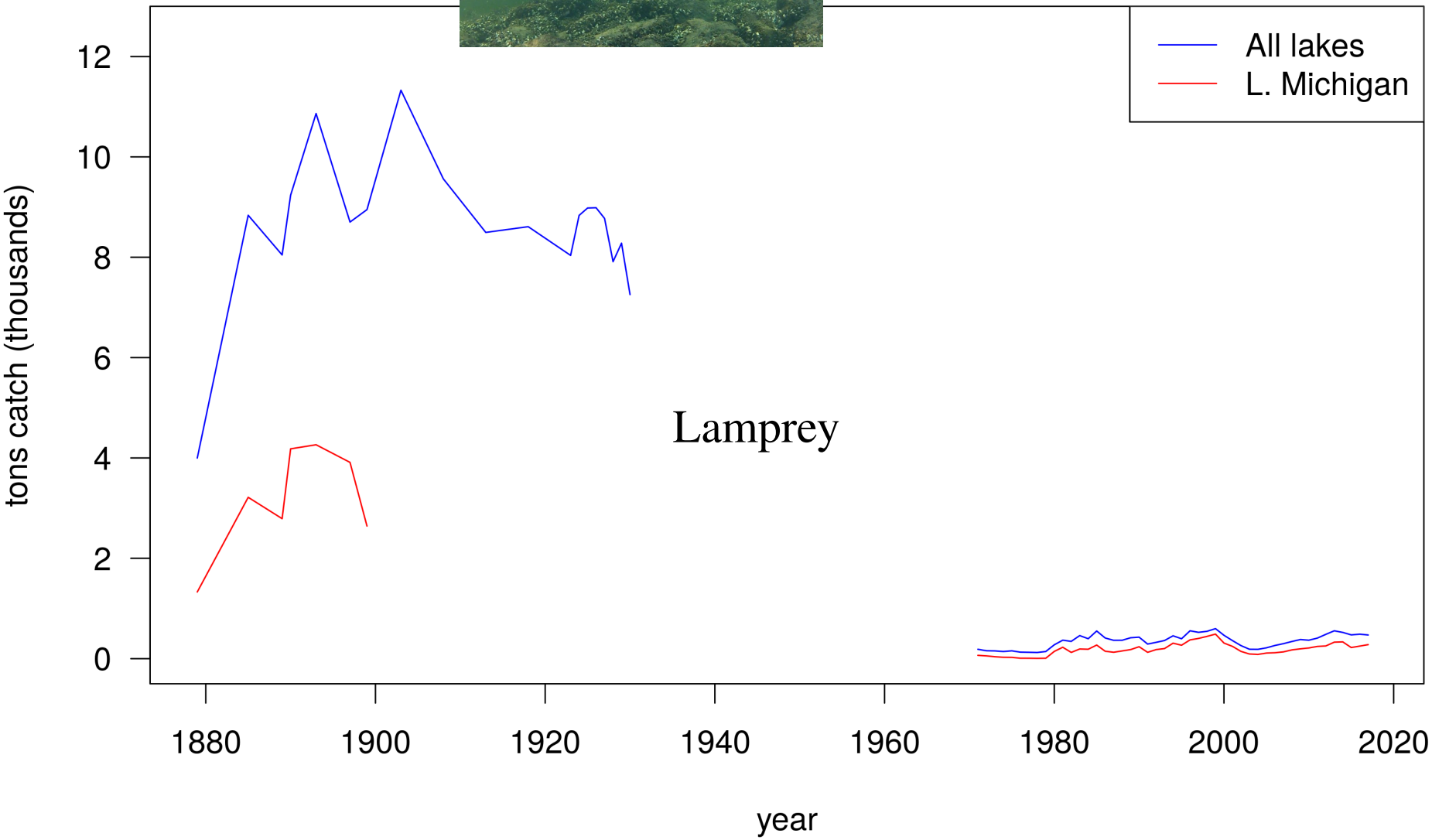
Lake trout commerial catch



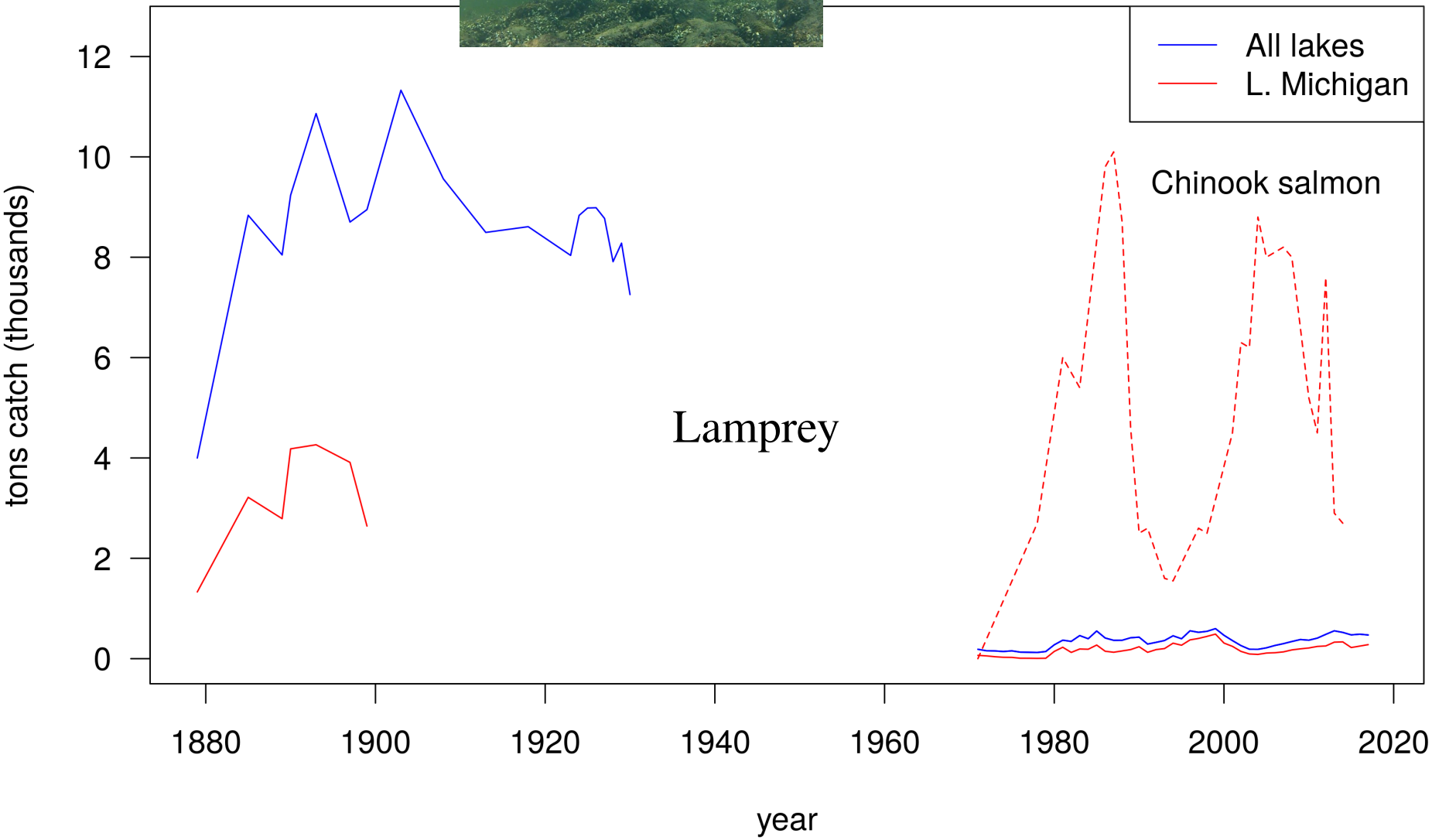
Lake trout commerial catch



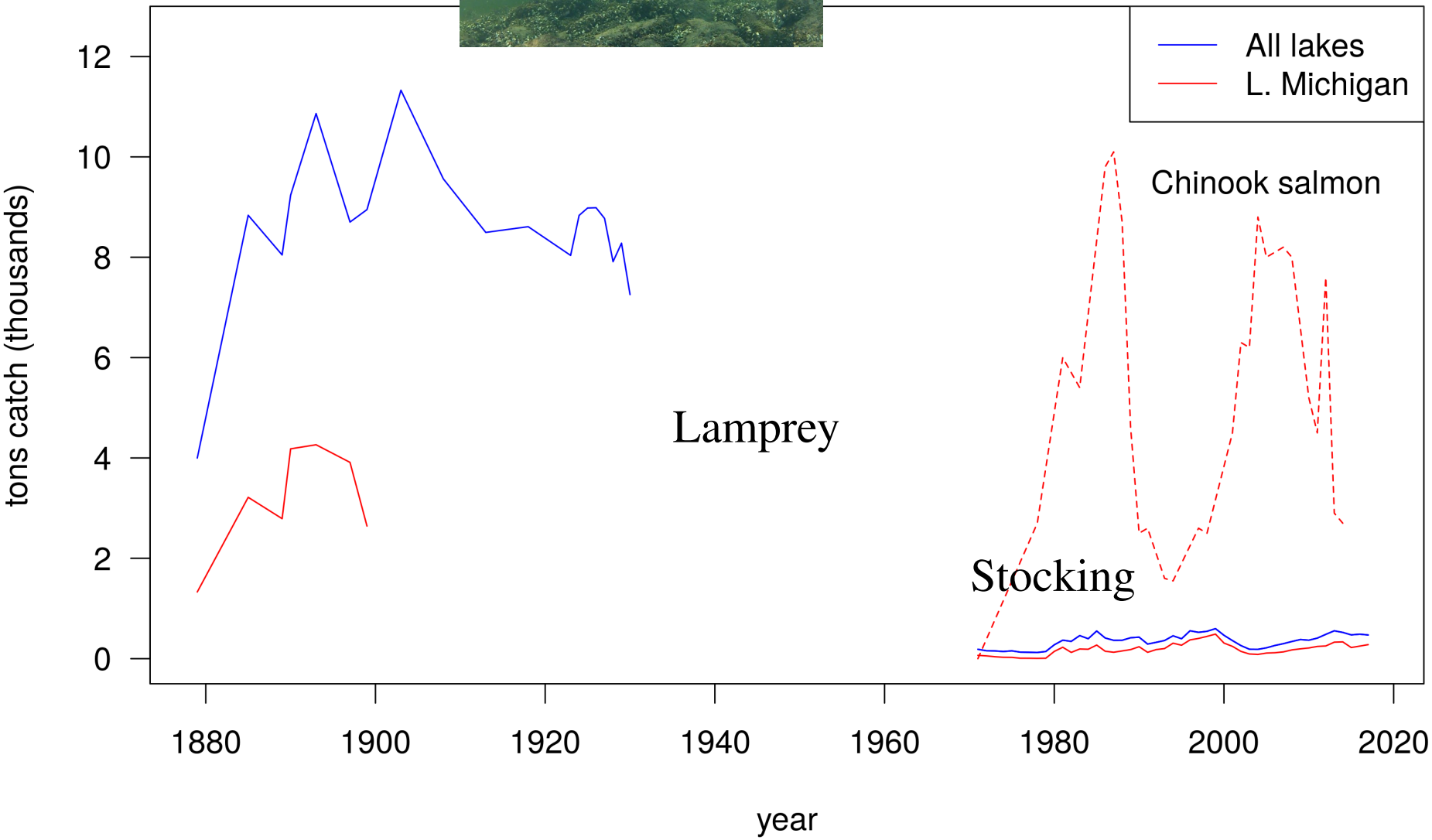
Lake trout commerial catch



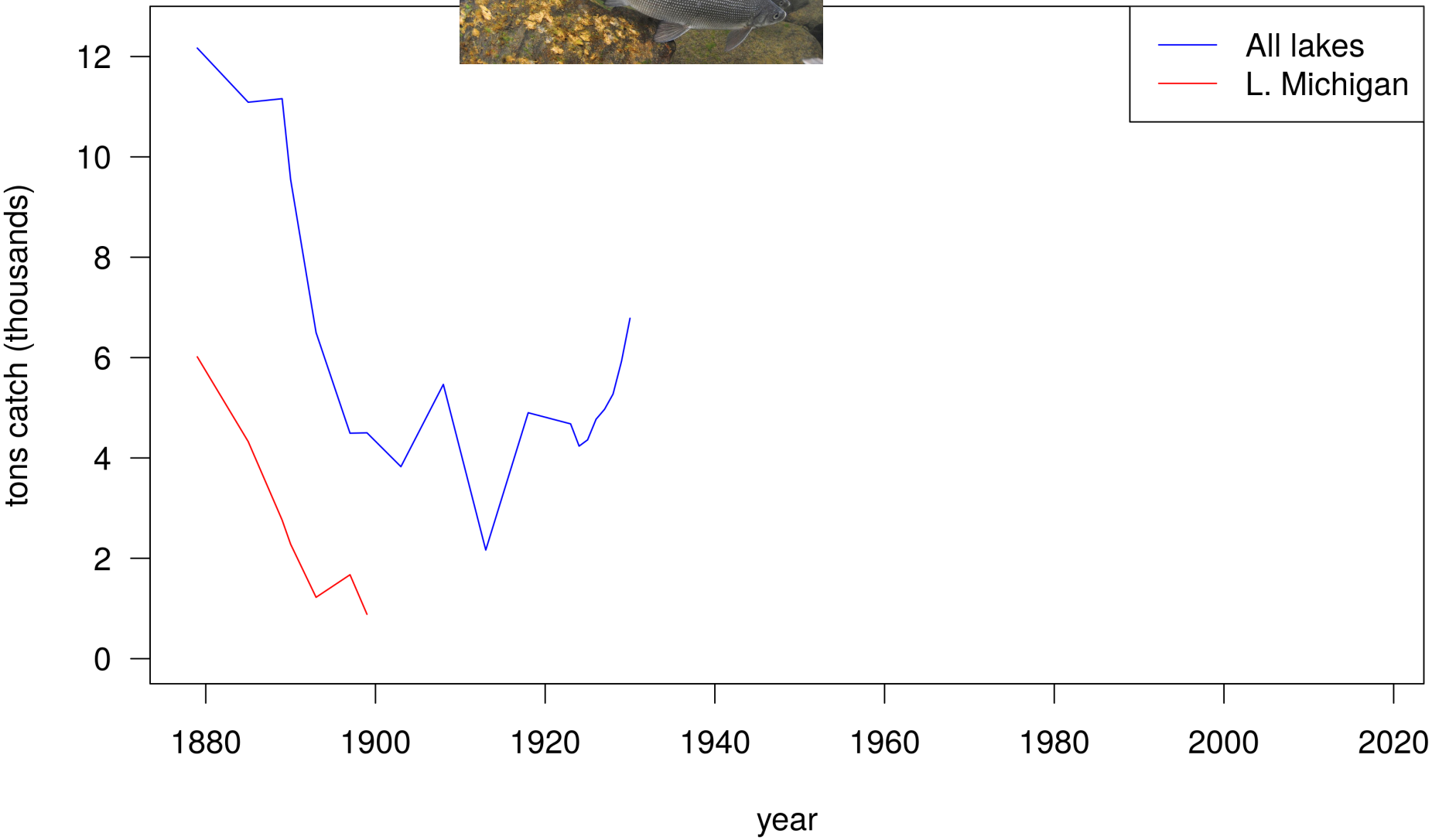
Lake trout commerial catch



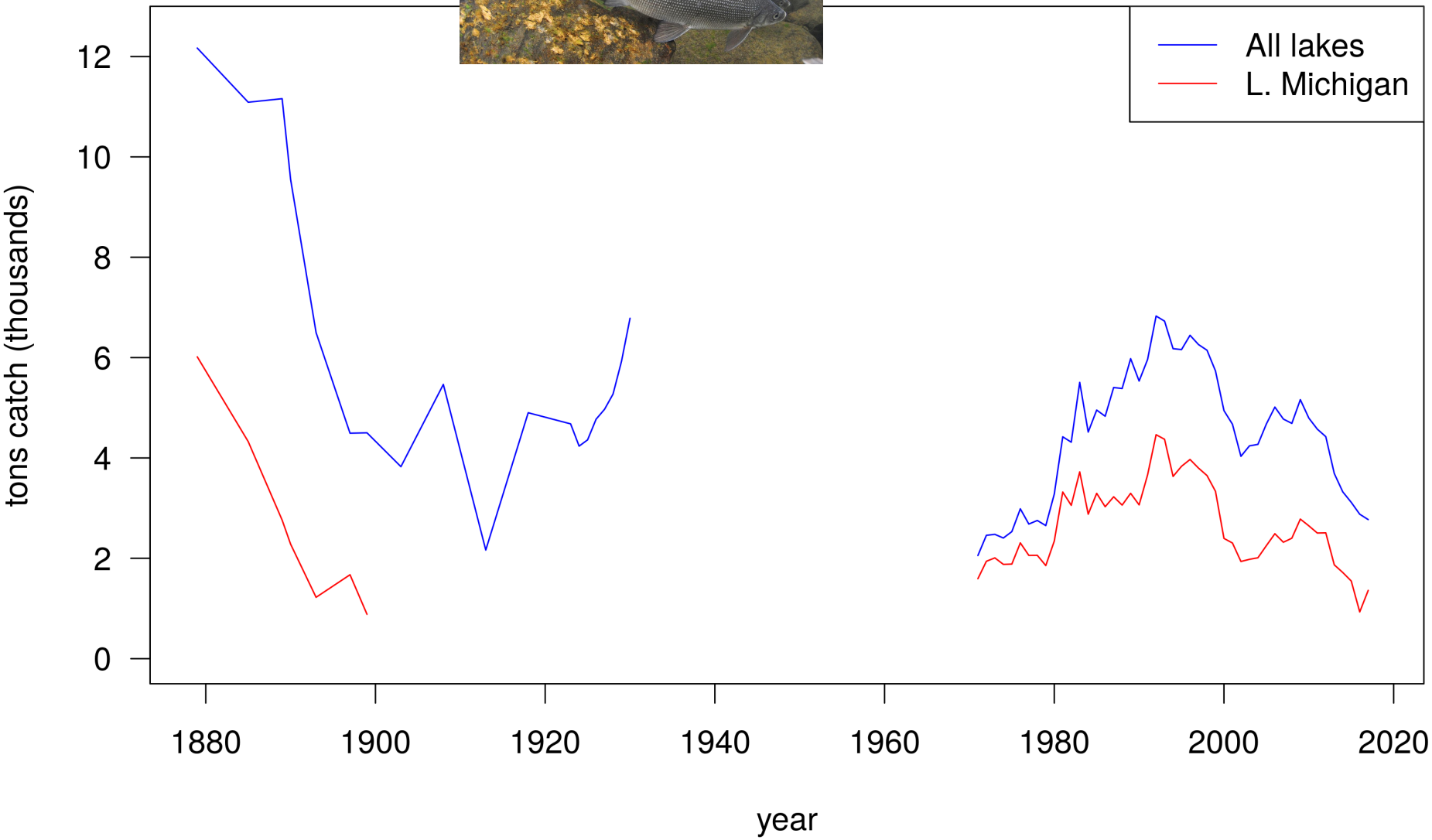
Lake trout commerial catch



Lake whitefish commercial catch



Lake whitefish commercial catch



Dreissenids

Zebra and Quagga mussels

- Invaders from Europe
  - Ship ballast
  - Lake St. Clair 1988
- Enormous increase through L. Michigan 2004-2010
- Great changes to food web
  - Clearer water, less plankton in food column
  - More production at bottom
- No great impact on fish populations thus far

Economics of fisheries

- Cost of management much below perceived economic payoff
  - $6 million stocking salmon (L. Michigan only)
  - $20 million poisoning lamprey (Great Lakes)
  - $18 million commercial value (Great Lakes)
  - $1 billion sports value (Great Lakes)
- Value is mostly recreational

Conclusions

Fragile ecosystem of Lake Michigan

- Managed by poison and stocking
- Impacted by agriculture, mussels
- Invasive species are both feared and valued
- Simple and vulnerable system

    Salmon-alewife interaction: few species and easy to manage
    Enormous invasion of mussels alters entire food web
    Missing species so lakes are exceedingly invasible?