

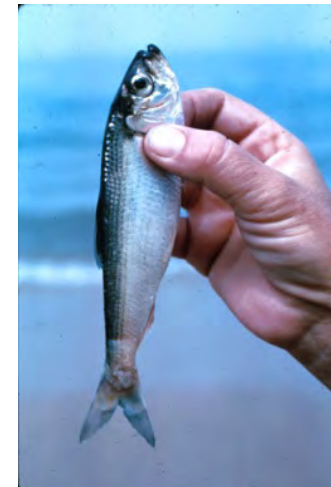
Predator-prey balance in fish communities of the Great Lakes infested with alewives

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- Kimberly Fitzpatrick and Suresh Sethi (Cornell University)
- Tim Johnson and Jeff Buckley (OMNRF)
- Mike Connerton and Chris Legard (NYDEC)
- Dave Warner and Brian Weidel (USGS)



Alewife

- A herring invader from the Atlantic Ocean
- Without predators, alewife populations in Lakes Michigan, Huron, and Ontario exploded
- Interferes with natural reproduction by certain native fishes, including yellow perch, deepwater sculpin, burbot, walleye, emerald shiner, lake trout, and Atlantic salmon





Dead alewives in Chicago harbor, June 1967. Great Lakes Science Center archive.

Major salmonine stocking programs begin in 1960s and 1970s



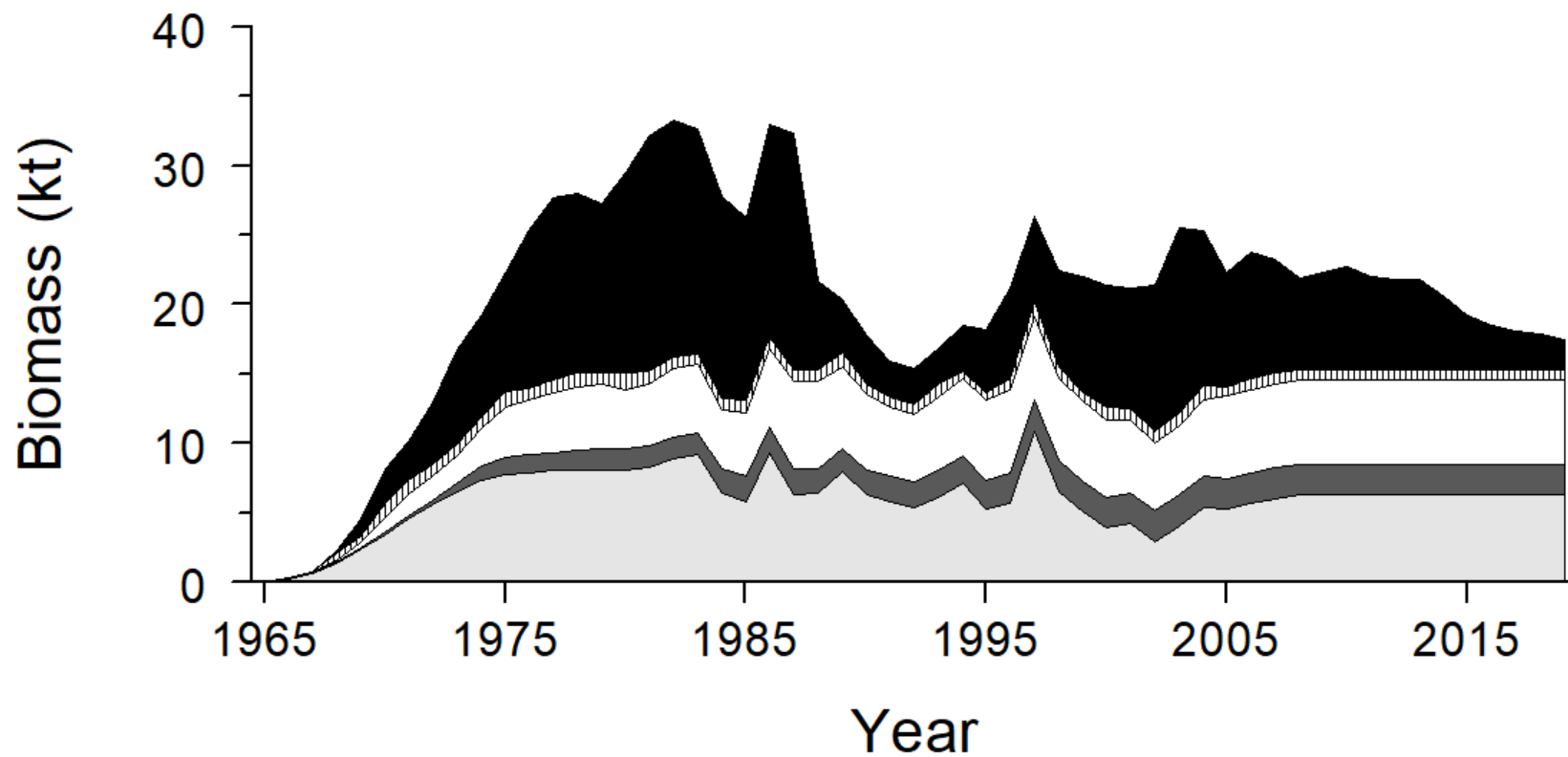
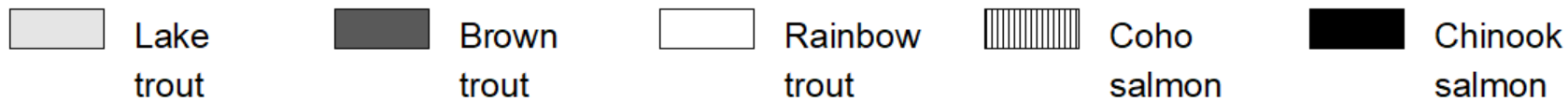
- Trout and salmon, including lake trout, brown trout, rainbow trout, coho salmon, and Chinook salmon
- To a lesser degree, some walleye stocking also is initiated

Predator-prey balance begins to become a concern as early as the 1980s in Lake Michigan

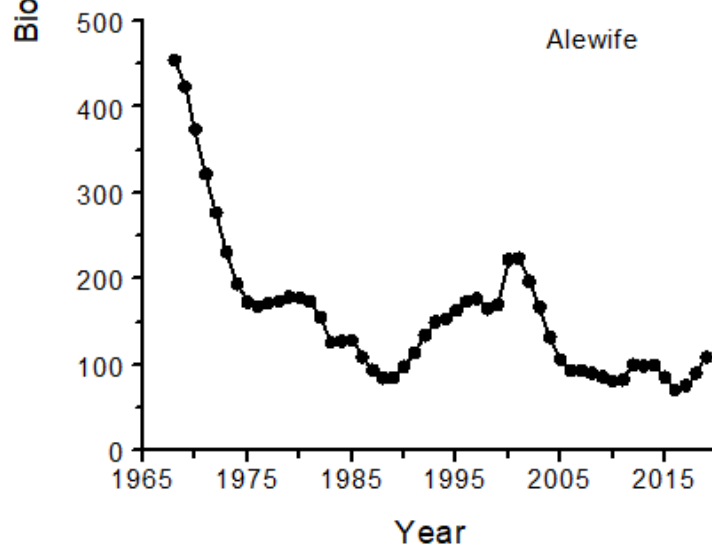
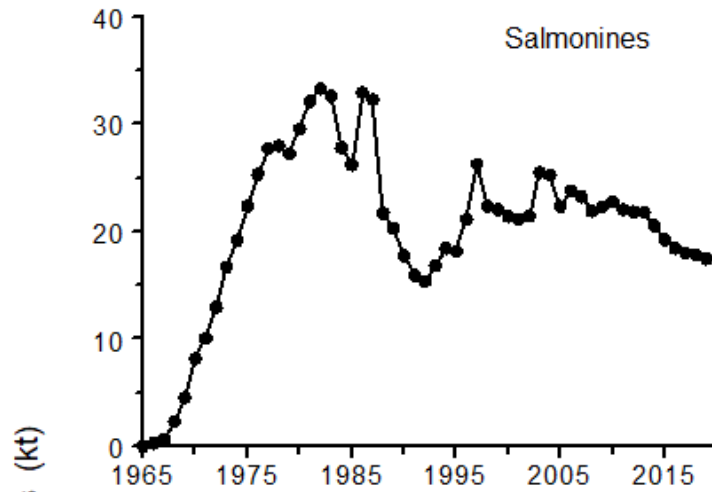
- Cuts in the stocking rate of Chinook salmon into Lake Michigan begin in the 1980s, and continue in 1990s, 2000s, and 2010s
- Similarly, cuts in stocking rate of Chinook salmon into Lake Ontario begin in the 1990s, and continue in 2010s
- Similarly, cuts in stocking rate of Chinook salmon into Lake Huron begin in the 1990s



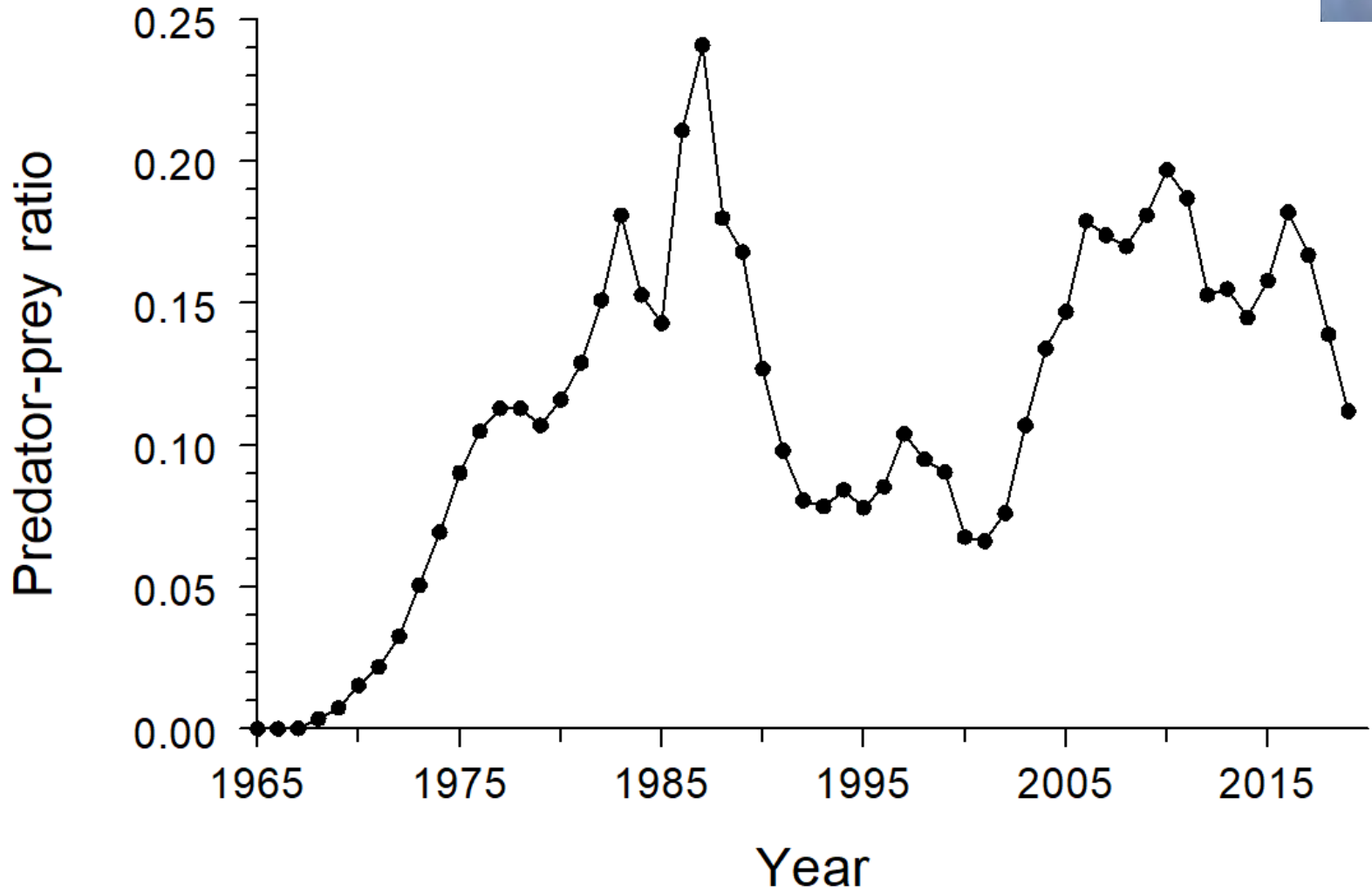
Lake Michigan



Lake Michigan



Lake Michigan

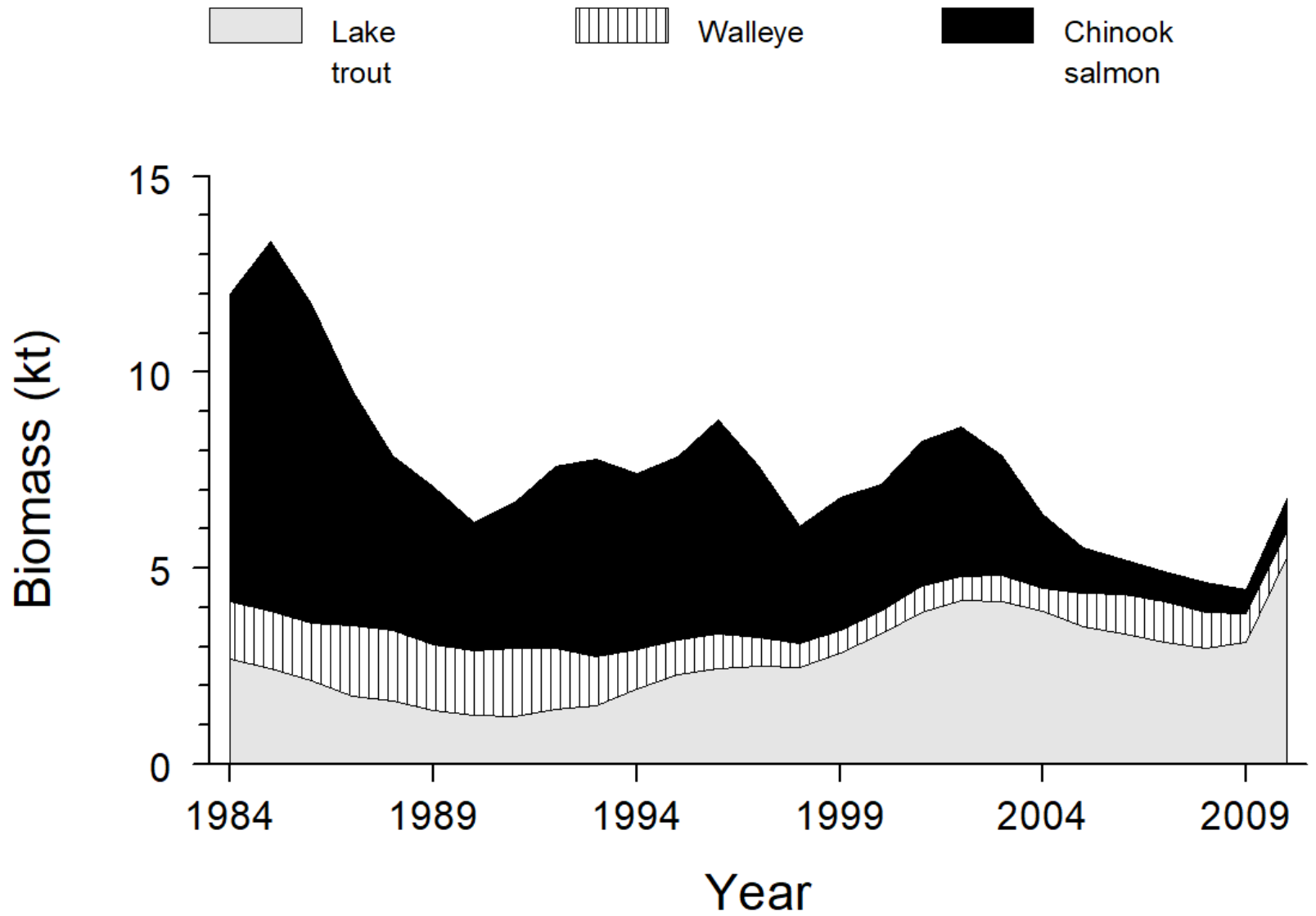


Apparently, alewife reproduction in Lake Michigan is resilient to food web changes induced by dreissenid mussels

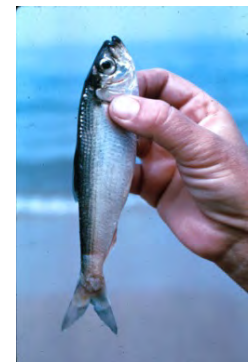
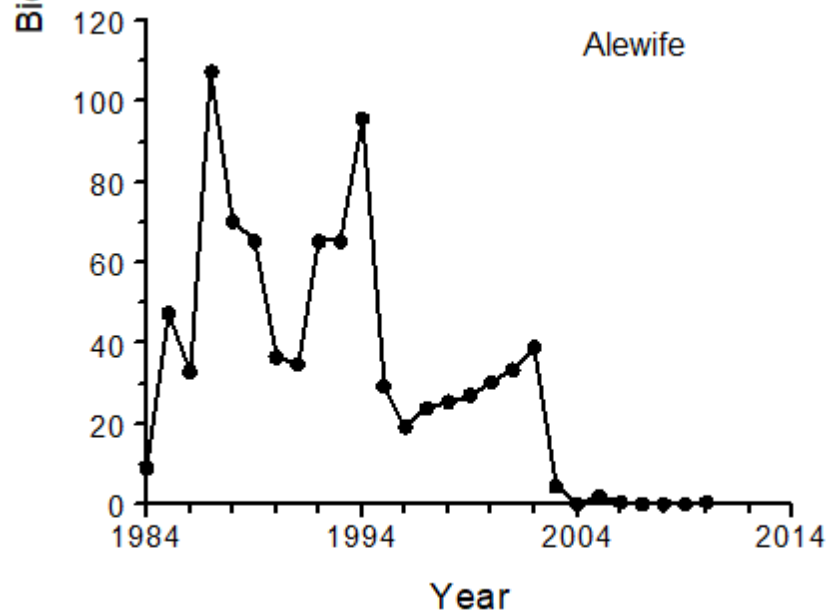
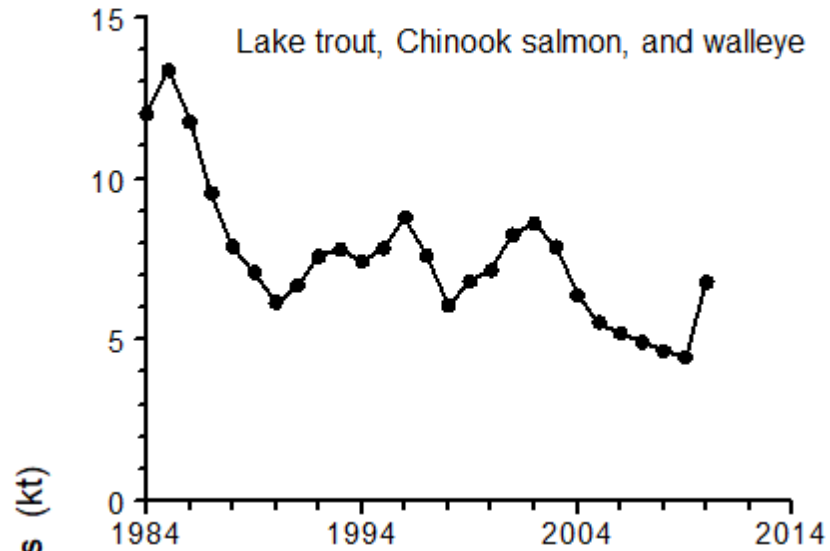
- Alewife year-class strength has trended neither upward nor downward during 1965-2019
- Biggest alewife year-class was produced in 1998 and third largest in 2010, both after mussels invaded Lake Michigan



Lake Huron

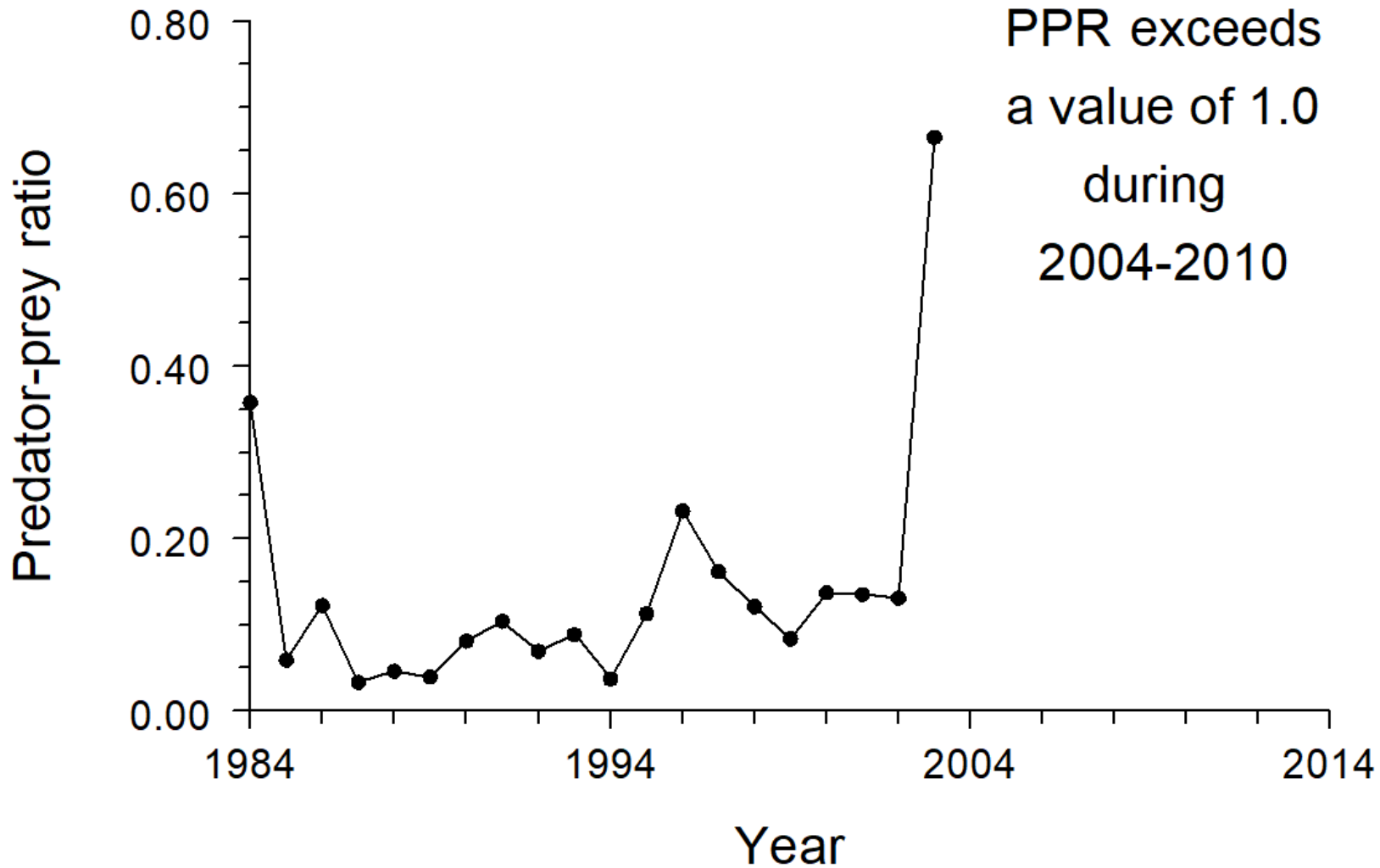


Lake Huron





Lake Huron



Alewife population in Lake Huron undergoes a complete collapse during 2002-2004

- Collapse occurred while lake trout population was relatively high in abundance
- “Tipping point” may have been reached
- After 2004, importance of alewives in Lake Huron food web greatly reduced; no longer a major player
- Predators switched diets after 2004
- Apparently, alewife population has remained in a “predator pit” since 2004 (last 17 years), with no signs of a recovery



Predator-prey ratio in Lake Ontario well below 0.15 in value

- Prior to 2016, predator-prey ratio in Lake Ontario was estimated to be 0.03 (includes just Chinook salmon and lake trout as predators, but this is bulk of predator biomass)
- After 2016, predator-prey ratio in Lake Ontario has averaged 0.09



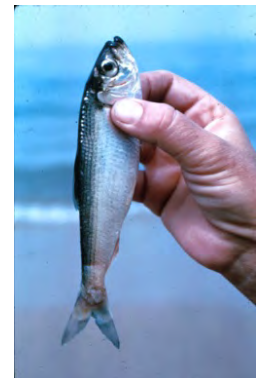
Is a predator-prey system consisting of Chinook salmon, lake trout (and other salmonines), and alewife sustainable in the Great Lakes in the long run?

- Maybe not, based on Lake Huron experience
- Eventually, a tipping point is reached, and the alewives undergo a complete collapse
- Predator-prey system undergoes a dramatic shift (regime shift)
- Alewife population remains in a “predator pit” until predator population size is substantially reduced



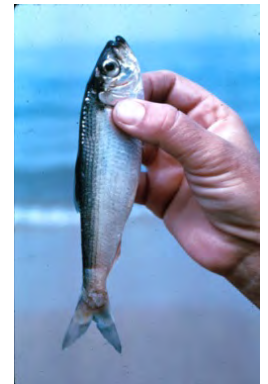
Summary and conclusions

- Predation, primarily by salmonines, has been very effective in reducing alewife abundance in the Great Lakes
- Predation effect has been substantially stronger in Lake Huron and Lake Michigan than in Lake Ontario
- Alewife population in Lake Huron underwent a complete collapse during 2002-2004, resulting in the alewife population playing a much less significant role in the Lake Huron food web

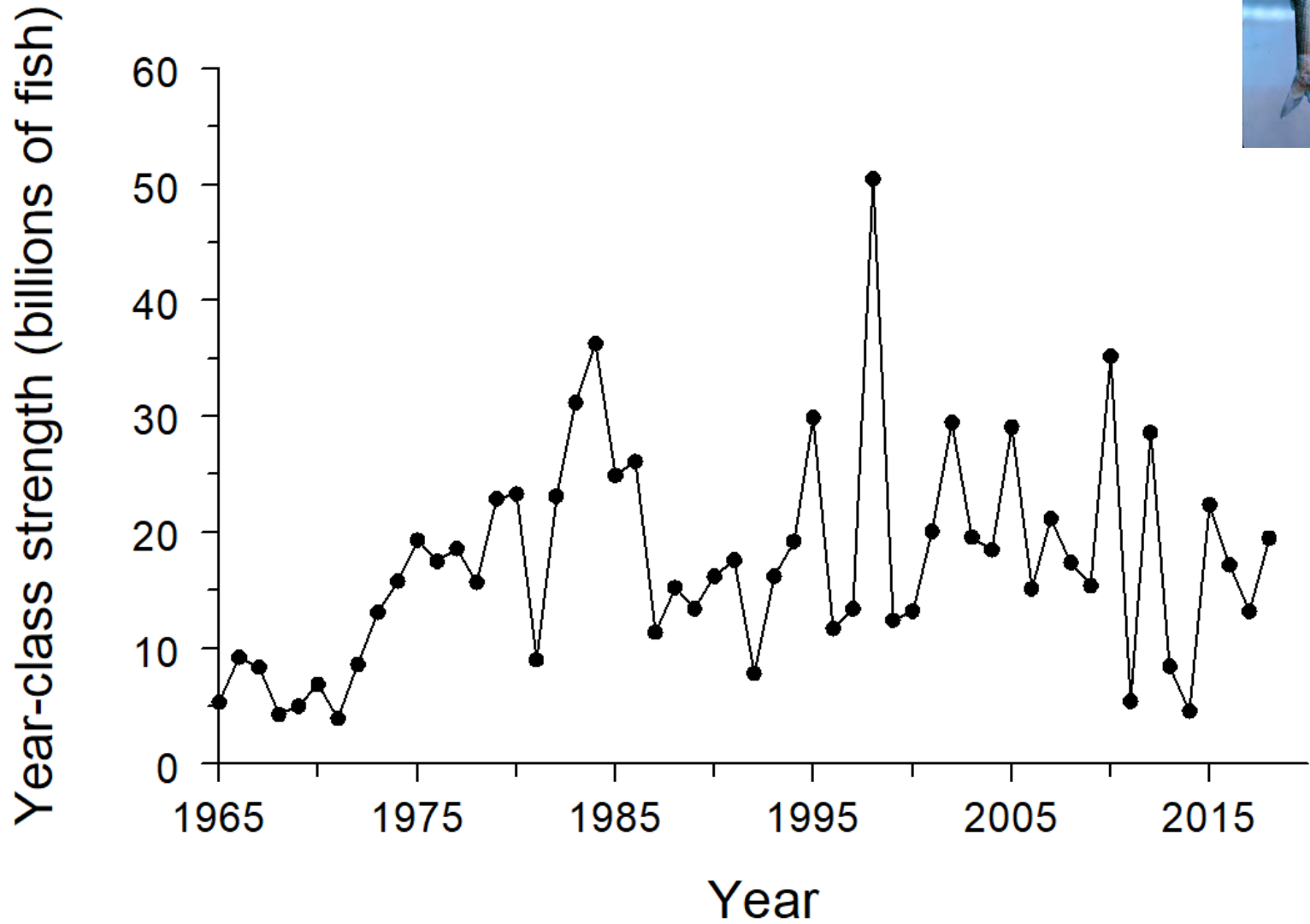


Summary and conclusions (continued)

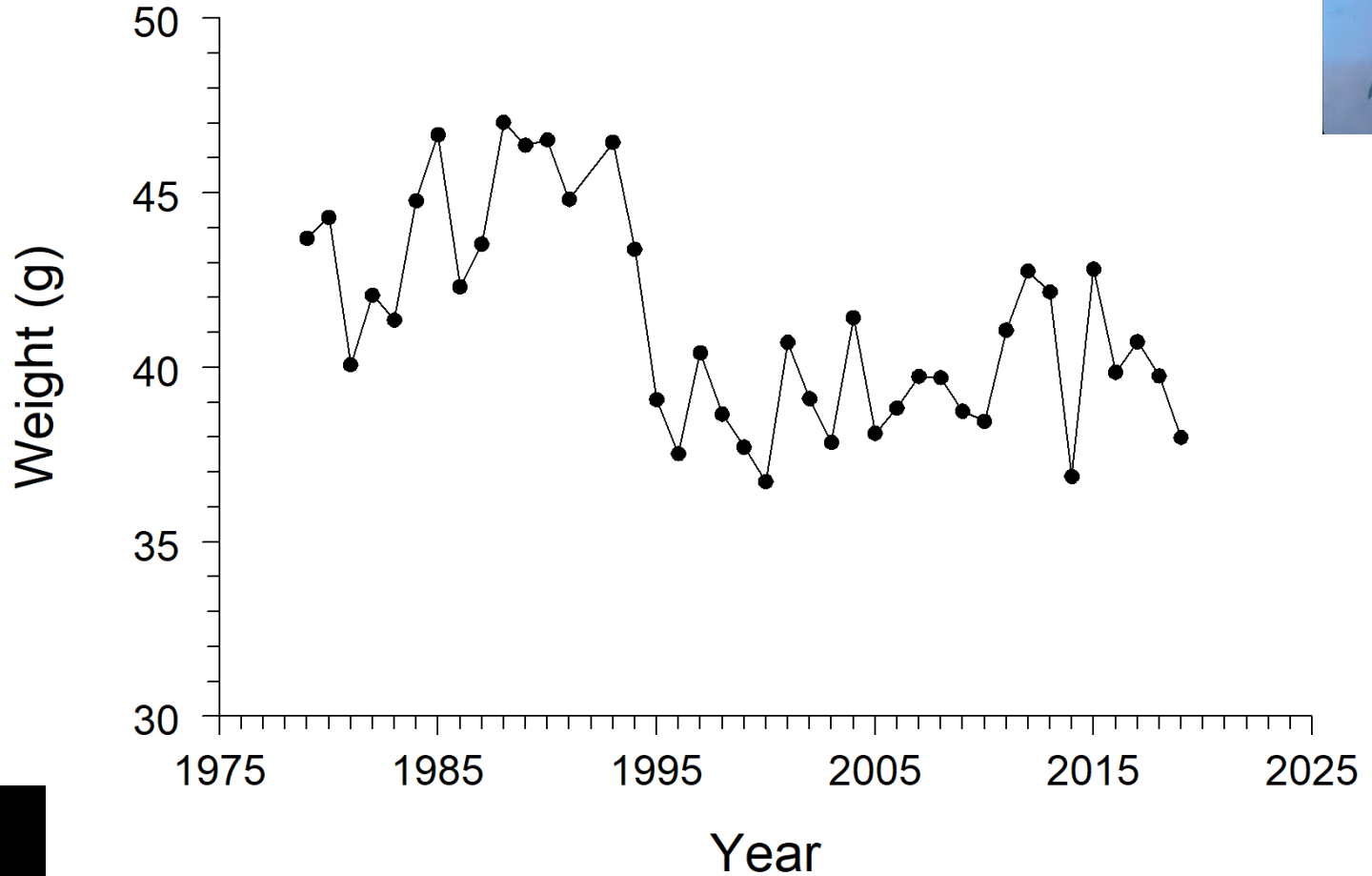
- Tipping point may have been reached in Lake Huron, and the fish community underwent a major shift in structure
- Alewife population in Lake Huron may now be in a predator pit
- Predator-prey system of Chinook salmon, lake trout (and other salmonines), and alewife may not be sustainable in the Great Lakes in the long run



Lake Michigan

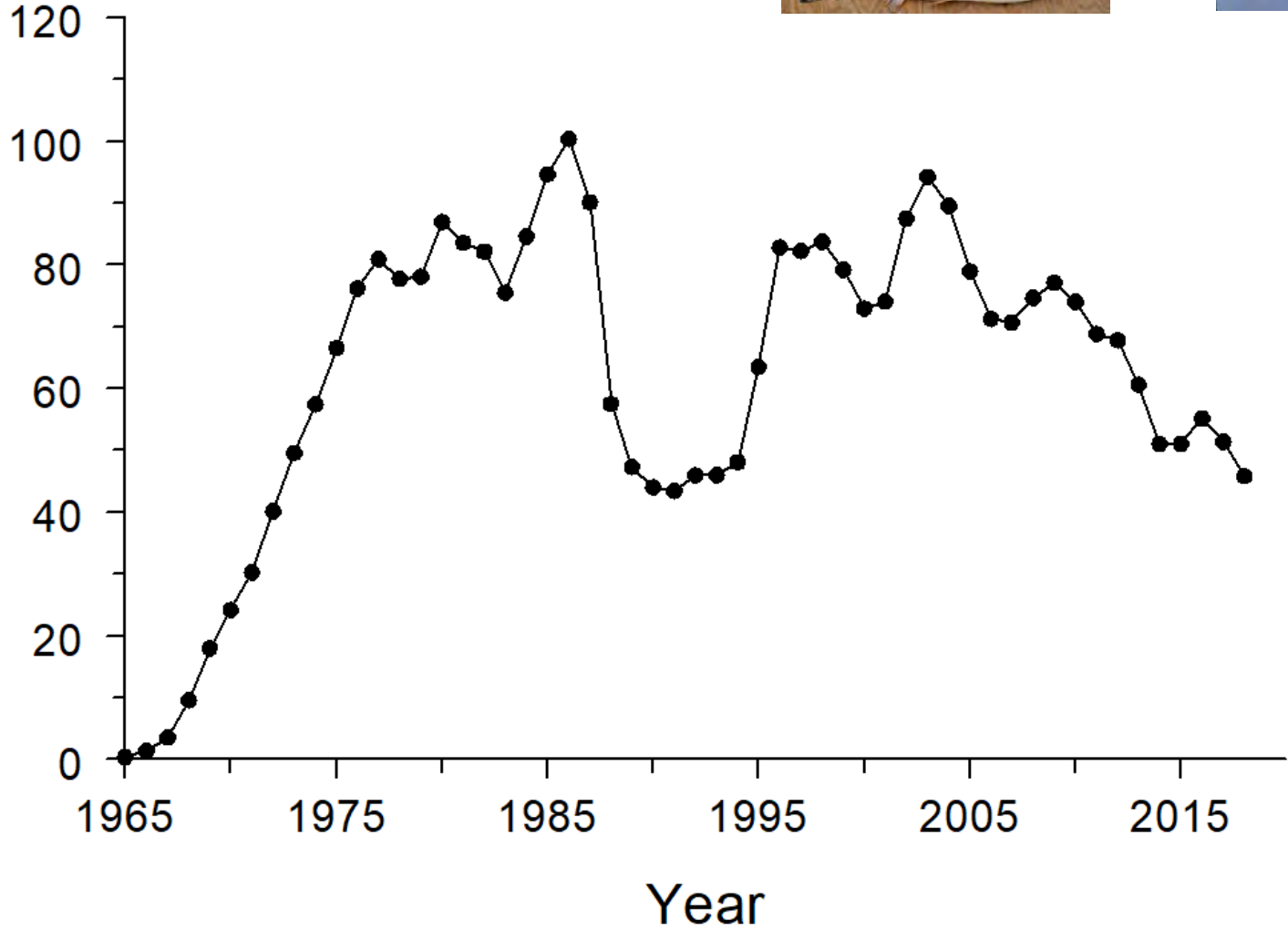


Weight of 175-mm alewife Lake Michigan



Consumption of alewives by salmonines (kt)

Lake Michigan



Lake Michigan

Biomass density of age-1 and older alewives, 1973-2019

