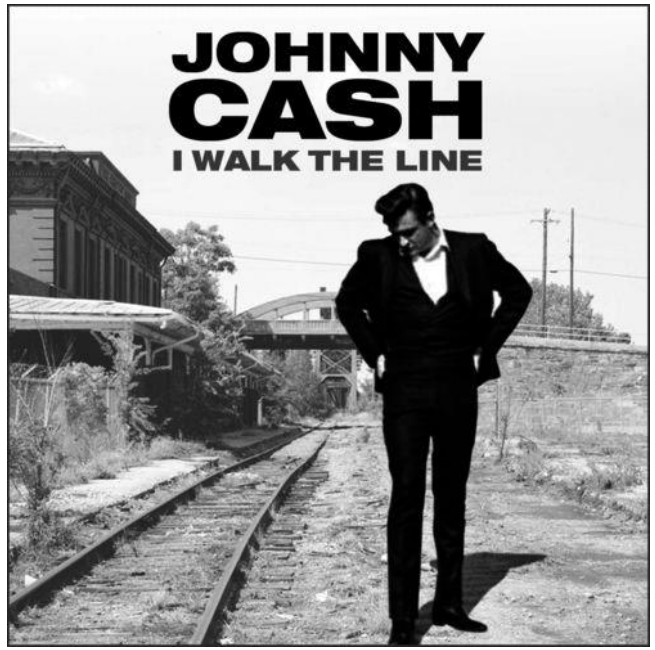
Walking the Line: Managing Alewife Morality in Lake Michigan

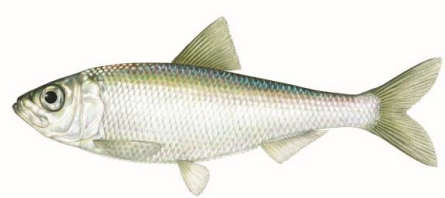


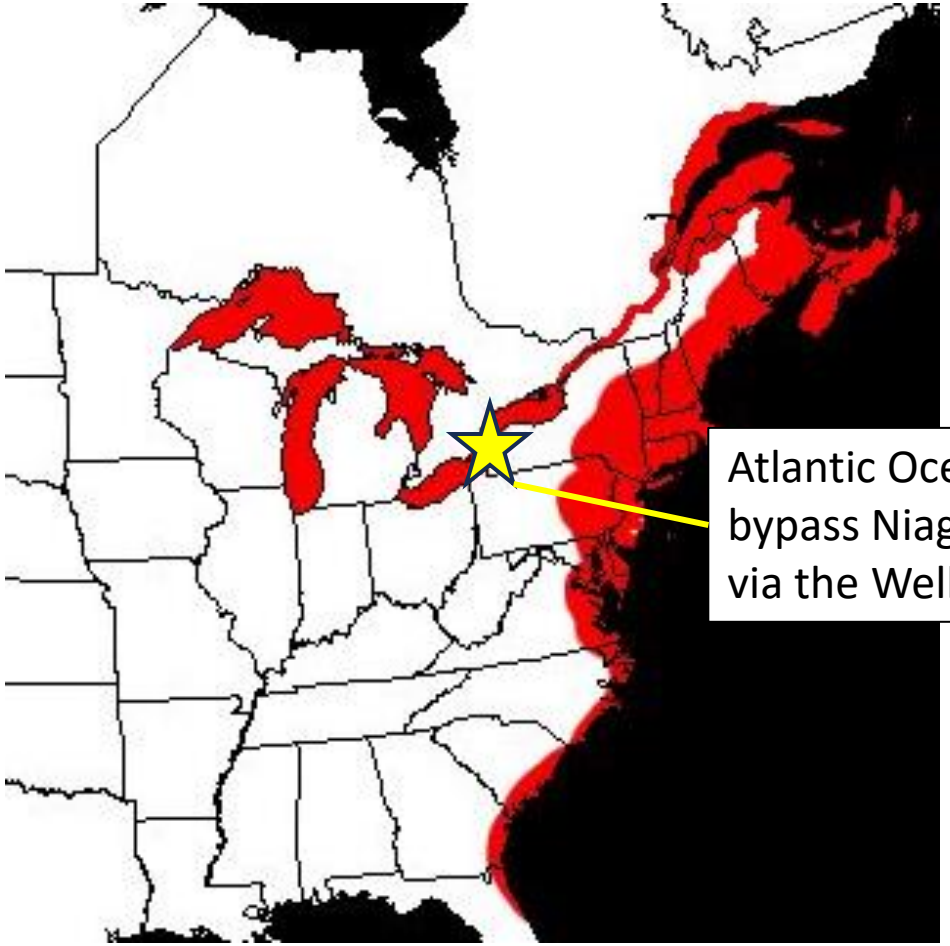
Ben Turschak and Dave Clapp

Michigan Department of Natural Resource

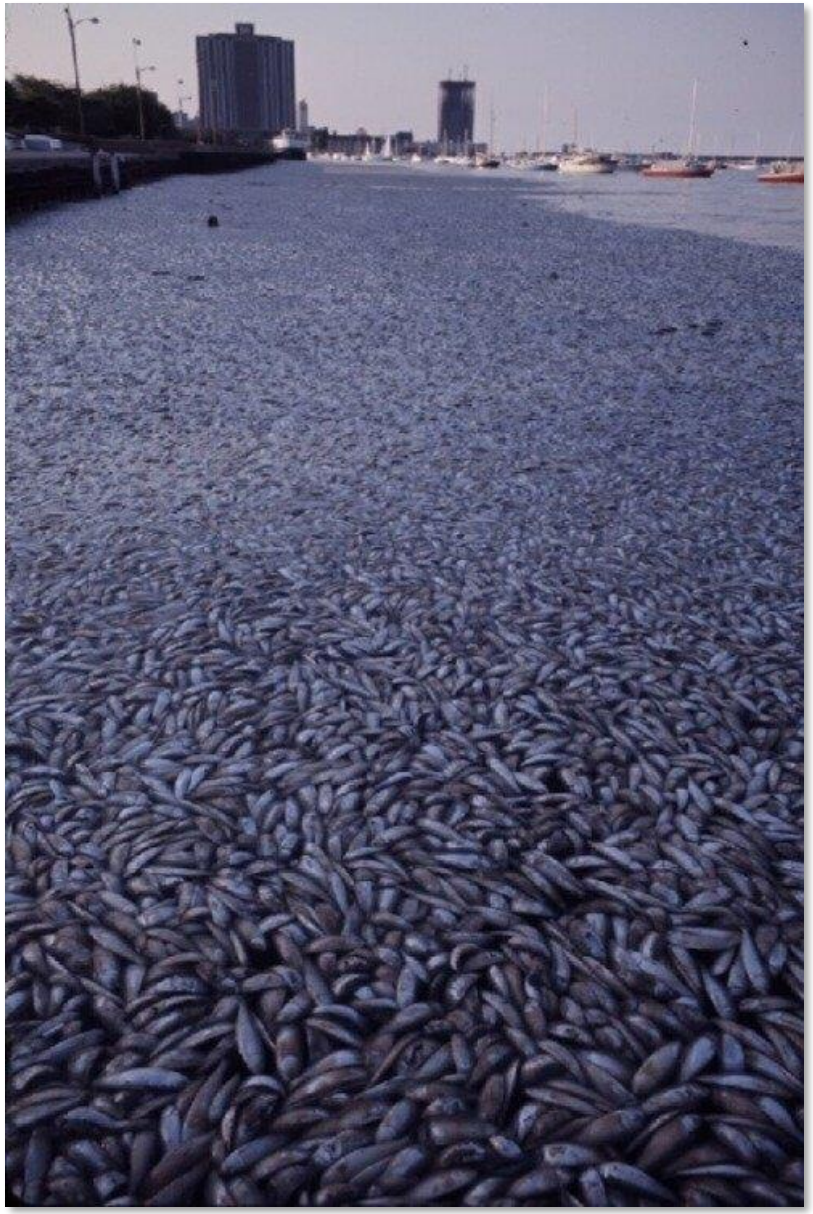
Charlevoix Fisheries Research Station

Meet the Alewife





Chicago - 1967



Illustrations by Joseph R. Tomelleri ©

A Nuisance - Die offs

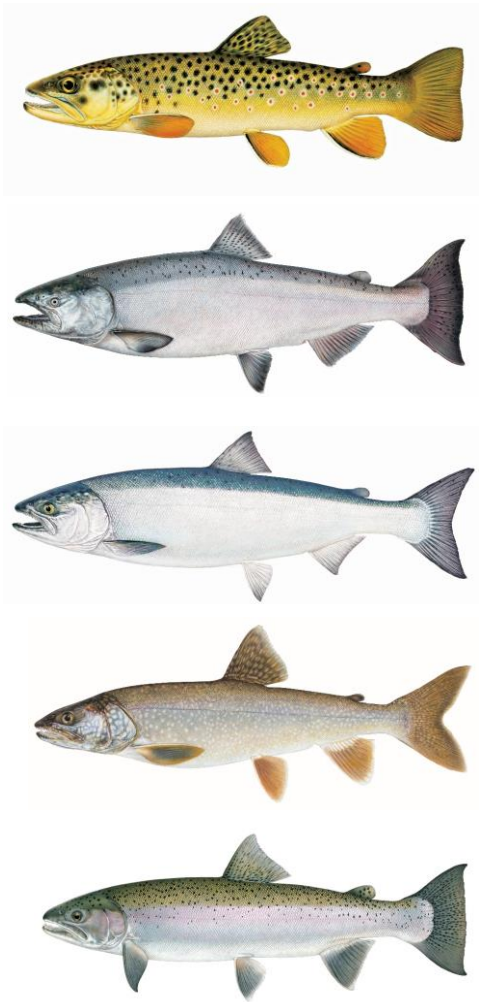
Muskegon - 1967

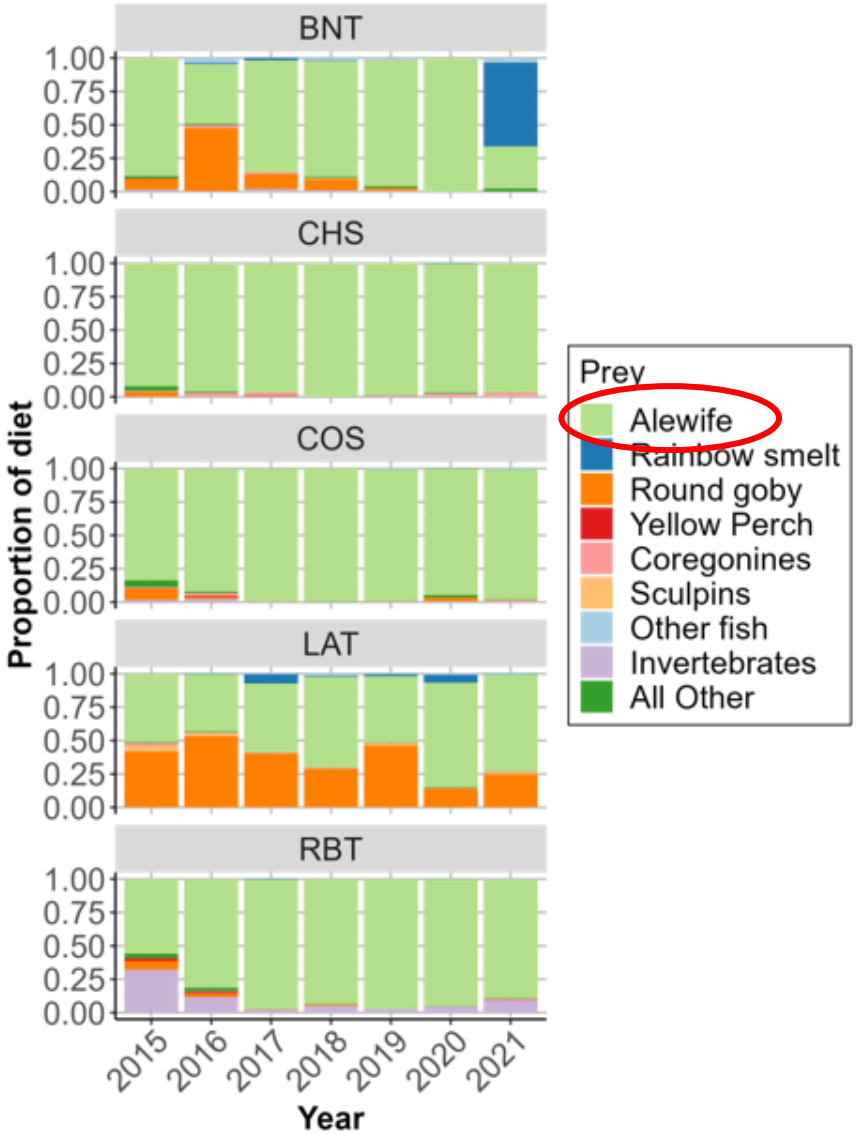
Benzie Co. - 2022

An Opportunity - Birth the of Great Lakes Salmonine Fishery (ca. 1966)

Milwaukee Journal Sentinel-Matthew Dae Smith

Alewife Management – The Salmonine Fishery





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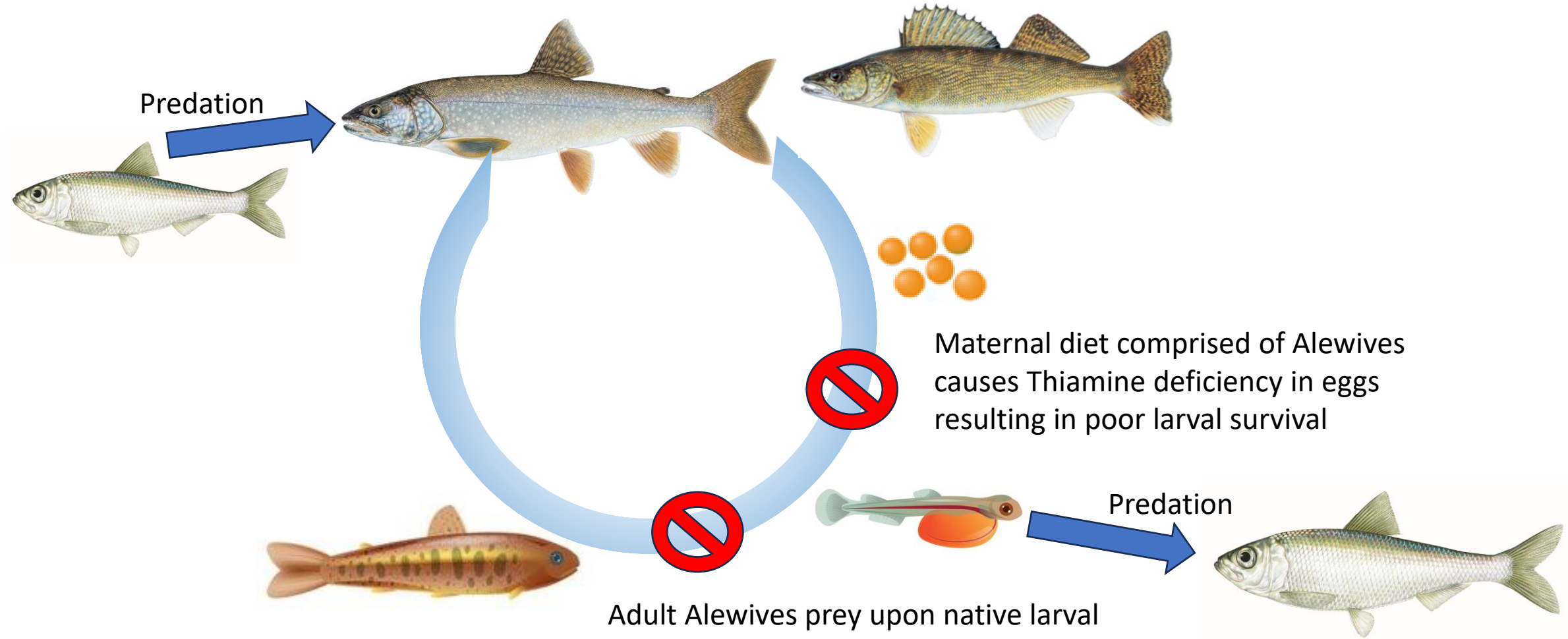
Alewife Management - Challenges for Native Fish



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Managing Alewife Mortality - Balance

Alewife Biomass	Alewife Mortality Rate	Potential Outcomes
Too High	Low	1. Low survival/recruitment of native fishes 2. High abundance of introduced salmon 3. Large size of introduced salmon
Intermediate	Intermediate	1. Better survival/recruitment of native fishes 2. Moderate Abundance of introduced salmon 3. Large size of introduced salmon
Too Low	High	1. High survival/recruitment of native fishes 2. Low Abundance of introduced salmon 3. Low size of introduced salmon

Sources of Alewife Mortality

- **<u>Natural Mortality</u>**

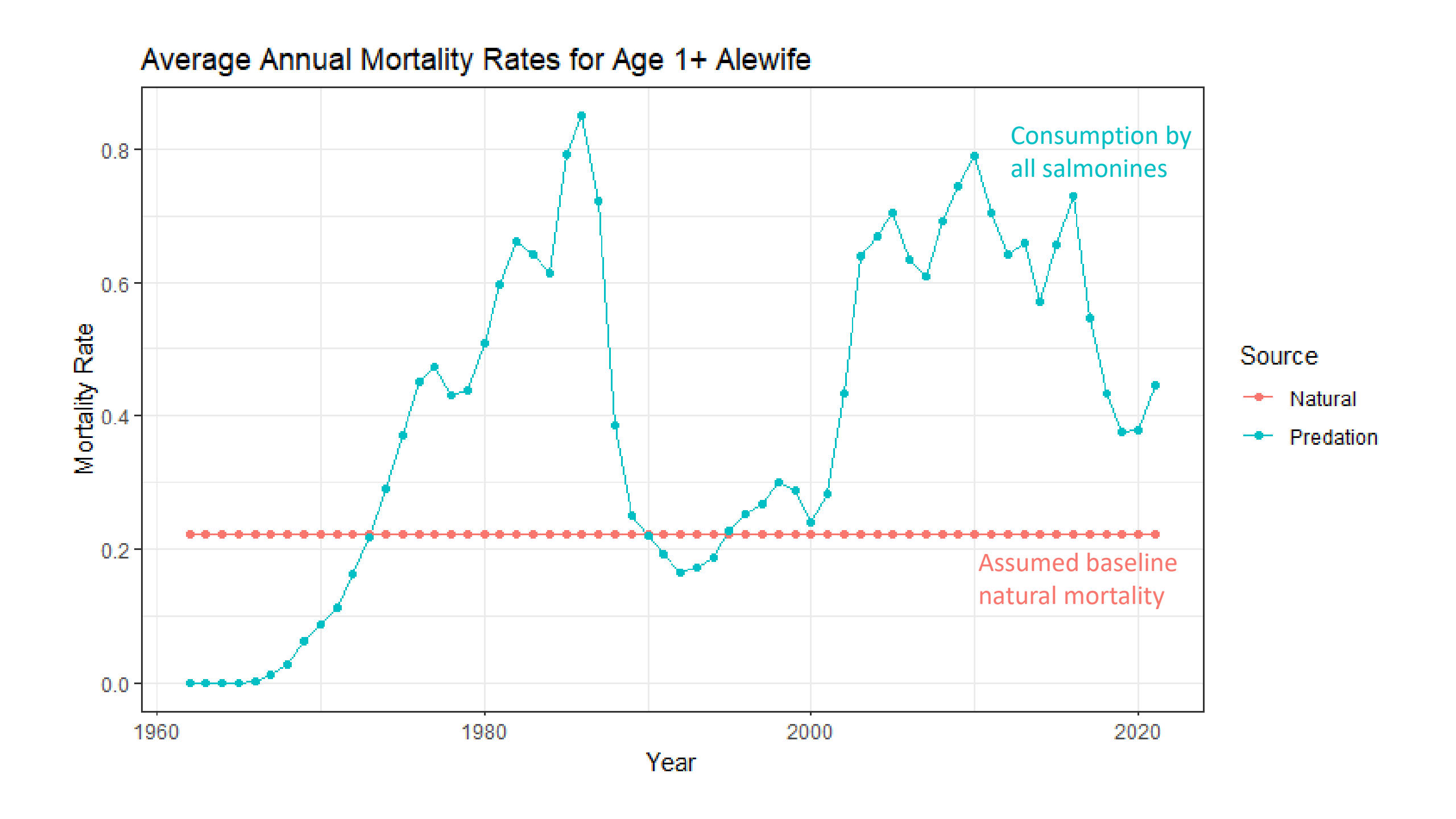
(difficult to estimate and manage)

  - Senescence
  - Spring die-offs

- **<u>Predation Mortality</u>**

(managed by adjusting salmonine stocking and harvest policies)

  - Consumption by salmonine predators


Average Annual Mortality Rates for Age 1+ Alewife
Mortality Rate
0.0
0.2
0.4
0.6
0.8
1960
1980
2000
2020
Year
Consumption by all salmonines
Assumed baseline natural mortality
Source
Natural
Predation

Alewife Natural Mortality – Die-offs

Popular Theories for Seasonal Die-Offs

1. Spawning Stress
2. Osmoregulation (marine fish living in freshwater)
3. Die-offs proportional to population size (more alewife = larger die-offs)
4. Disease
5. Water Temperature Fluctuations or Cold-Water Exposure

THE TRUTH IS WE DON'T KNOW!

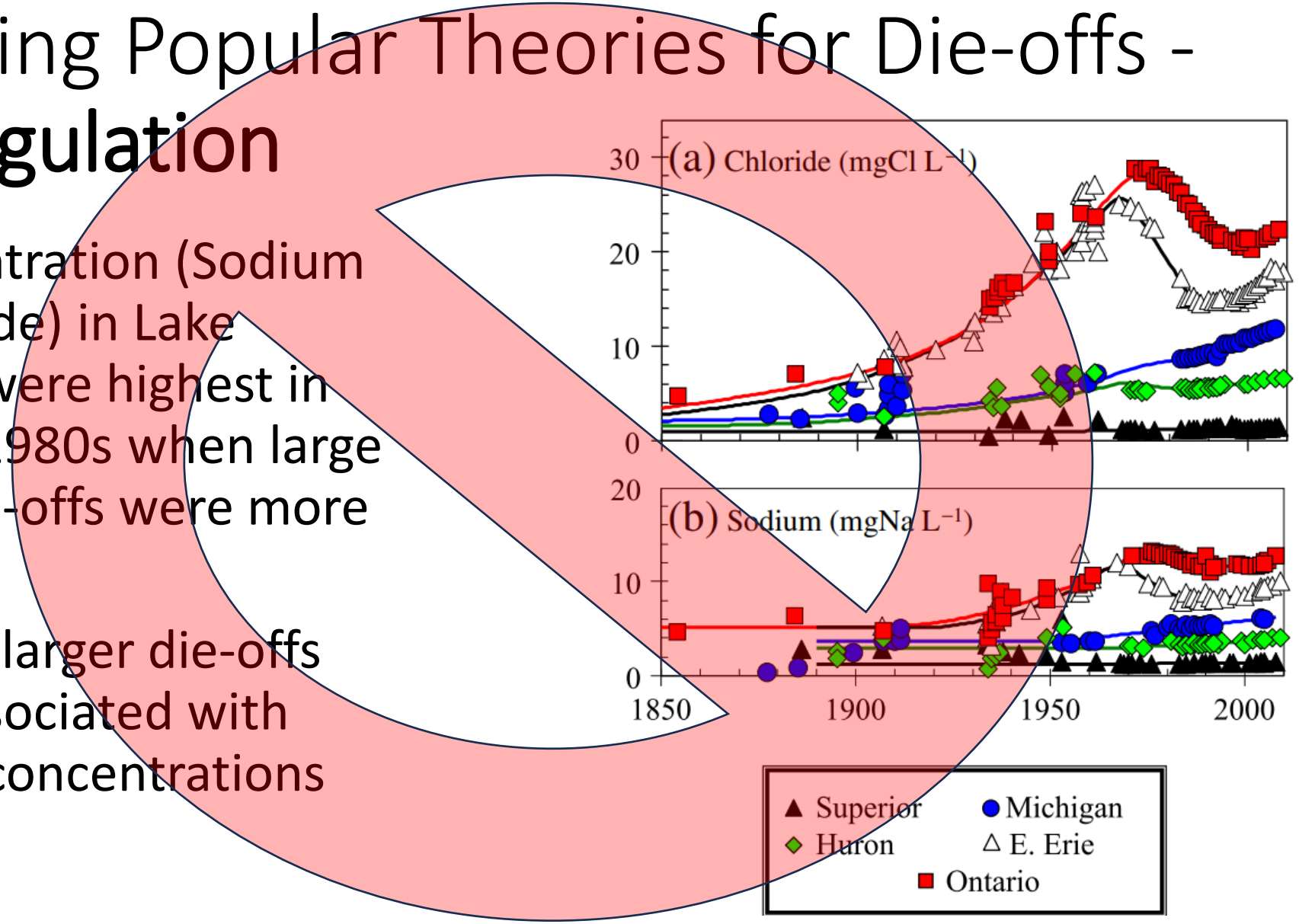
Debunking Popular Theories for Die-offs - **Spawning Stress**

- Many dead alewives are young immature age-1 fish (< 5”) that can’t spawn

- Alewives don’t typically reach maturity until age-2 or 3 (> 5” – 6.5”)

Debunking Popular Theories for Die-offs - **Osmoregulation**

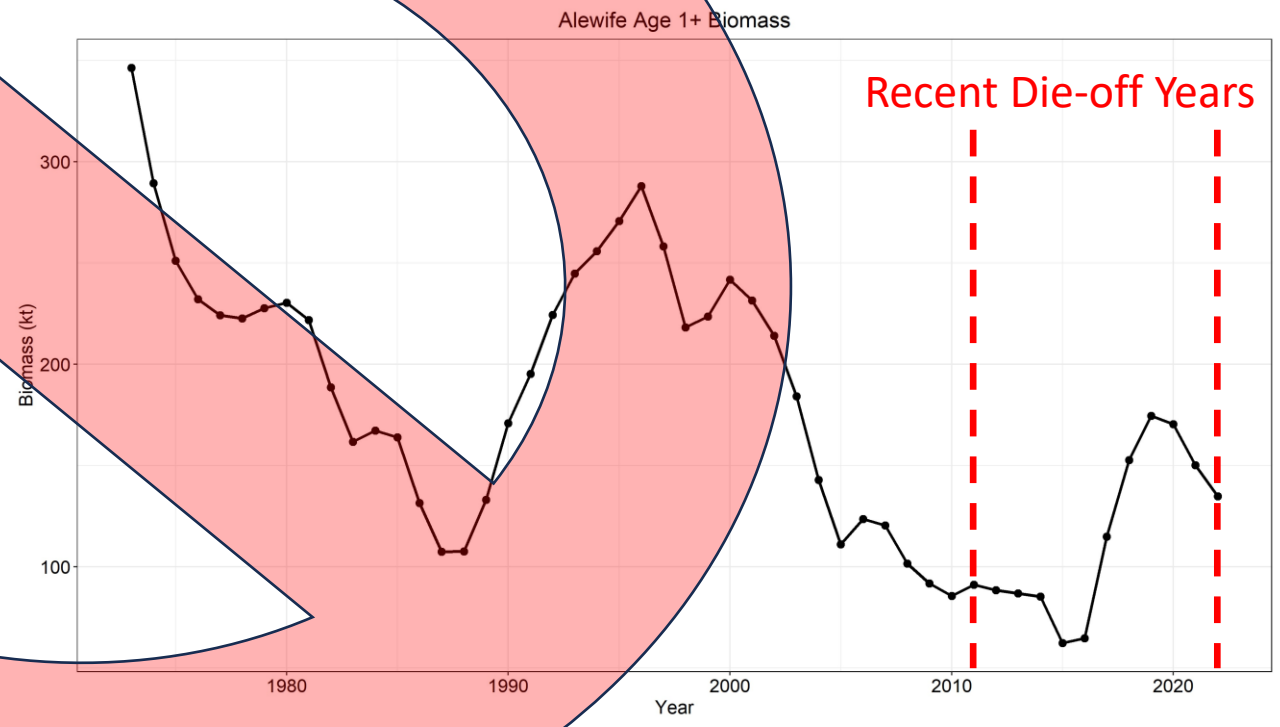
- Ion concentration (Sodium and Chloride) in Lake Michigan were highest in the 1960-1980s when large alewife die-offs were more common
- Years with larger die-offs are not associated with lower ion concentrations



S.C. Chapra et al. / Journal of Great Lakes Research 38 (2012) 550–560

Debunking Popular Theories for Die-offs - **Die-offs proportional to population size**

- Large die-offs are episodic and occur only on certain years (e.g. 2011, 2022)
- If they were proportional to population size, die-offs would be expected to occur at varying levels every year



Debunking Popular Theories for Die-offs - **Disease**

- Dead and dying Alewives collected in 2022 were tested for a suite of common fish diseases (including VHS)
- Fish showed no outward signs of disease and tested negative for diseases

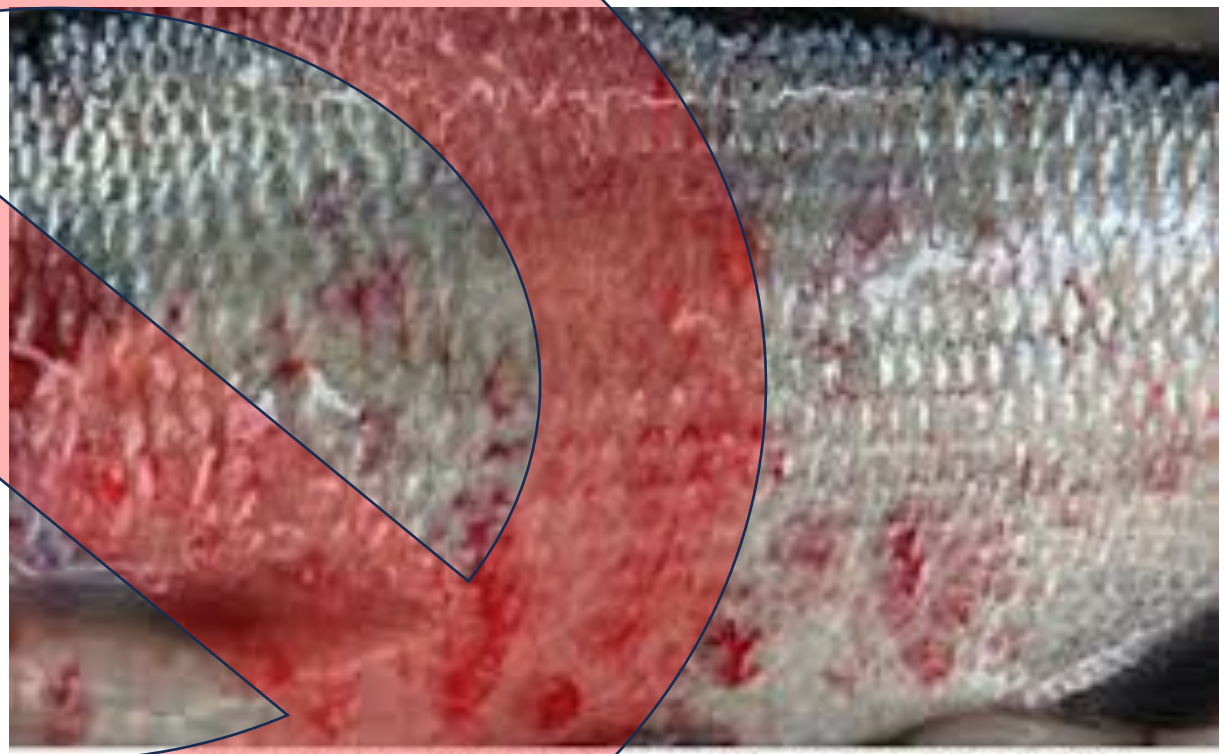


Photo courtesy of Dr. Mohamed Faisal

Debunking Popular Theories for Die-offs - **Water Temperature Fluctuations or Cold-Water**

- Differences in temperature between the lake and harbor areas greatly exceeds maximum temperature differences within Lake Michigan proper during early spring
- Many fish readily move between these Lake Michigan and lakes / harbors
- Die-offs often occur in Lake Michigan proper where temperatures are ubiquitous

Alewife Die-offs – It's complicated (probably)

Homeoviscous Adaptation

Homeoviscous Adaptation - the process that regulates the viscosity of cell membranes which is a critical step to thermal acclimation in fish

- Cell membrane viscosity can decrease at colder temperature
- Membrane viscosity can be regulated by increasing polyunsaturated fatty acids (think about oil vs. fat; oil hardens at much colder temperature than fat)
- Seasonal energy density (i.e., % lipid) in Alewife is lowest in spring which can make homeoviscous adaption more difficult
- Polyunsaturated fatty acids are derived from diet; diets lacking important fatty acids can make homeoviscous adaption more difficult

Fish Physiology and Biochemistry **29:** 117–126, 2003.
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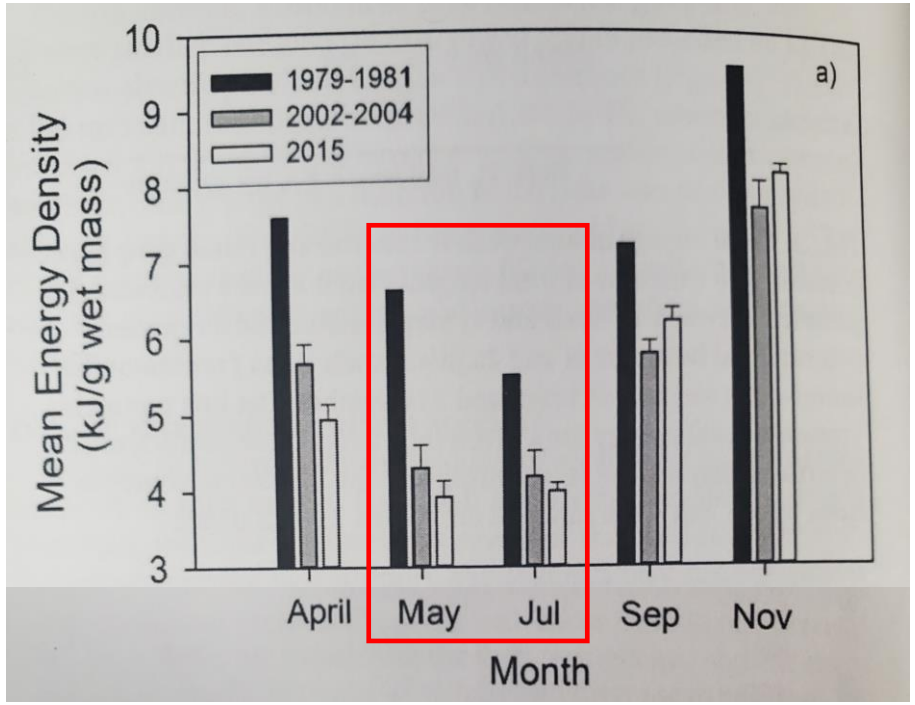
Cold tolerance and homeoviscous adaptation in freshwater alewives (*Alosa pseudoharengus*)

Randal J. Snyder[1] and Todd M. Hennessey[2]
[1]*Department of Biology, SUNY College at Buffalo, 1300 Elmwood Avenue, Buffalo, NY 14222, USA (Phone: 716-878-5225; Fax: 716-878-4028; E-mail: snyderrj@buffalostate.edu);*
[2]*Department of Biological Sciences, SUNY Buffalo, Buffalo, NY 14260, USA*

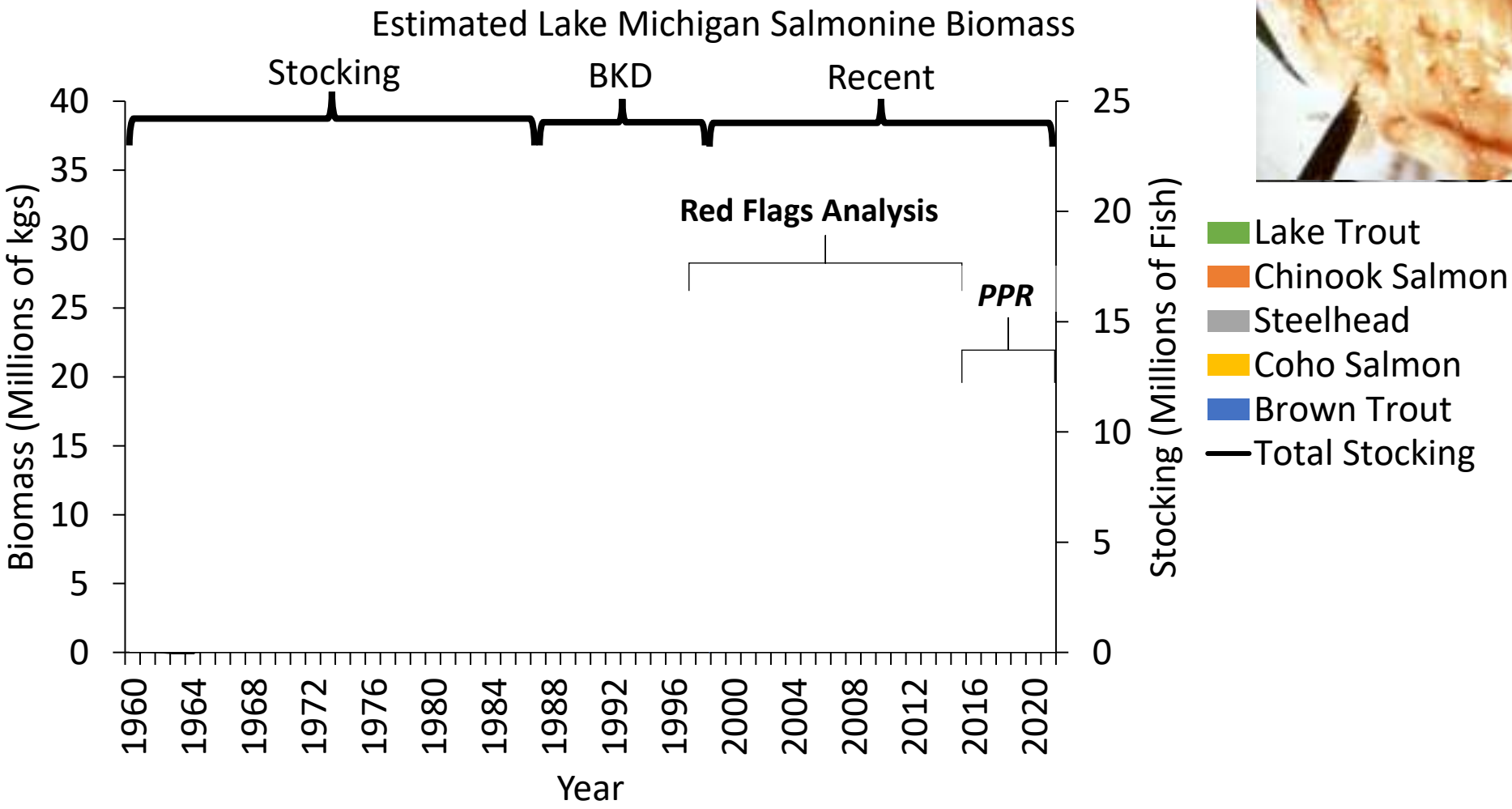
Spatiotemporal variability in energetic condition of alewife and round goby in Lake Michigan

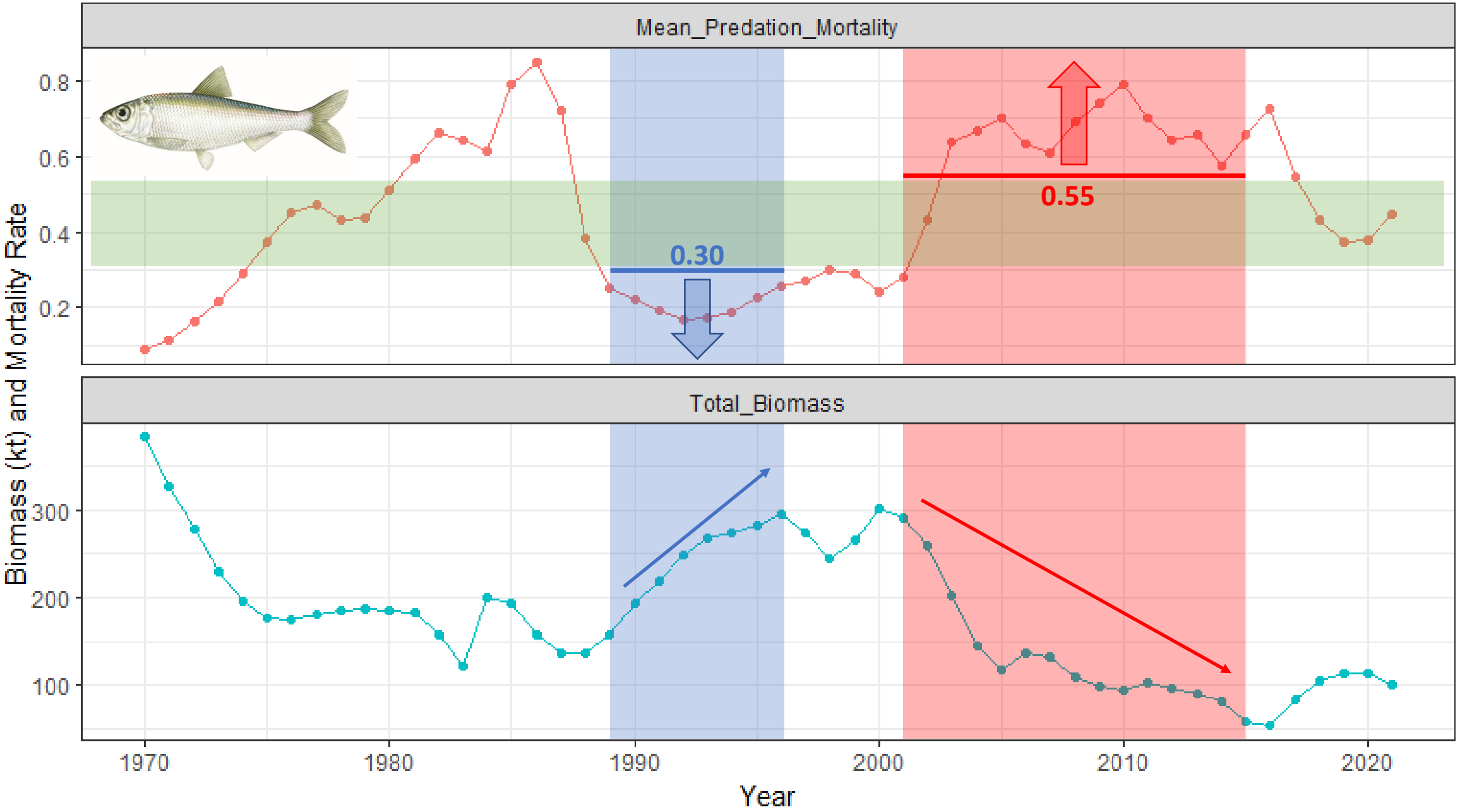
Authors: David B. Bunnell, Steven A. Pothoven, Patricia M. Armenio, Lauren Eaton, David M. Warner, Ashley K. Elgin, Lyuba E. Burlakova, and Alexander Y. Karatayev | AUTHORS INFO & AFFILIATIONS

Publication: Canadian Journal of Fisheries and Aquatic Sciences • 12 July 2019 • https://doi.org/10.1139/cjfas-2018-0391

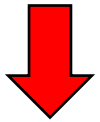


Beyond Die-Offs – Managing Alewife Mortality




Mean_Predation_Mortality
0.8
0.6
0.4
0.2
0.30
0.55
Total_Biomass
300
200
100
Biomass (kt) and Mortality Rate
1970
1980
1990
2000
2010
2020
Year

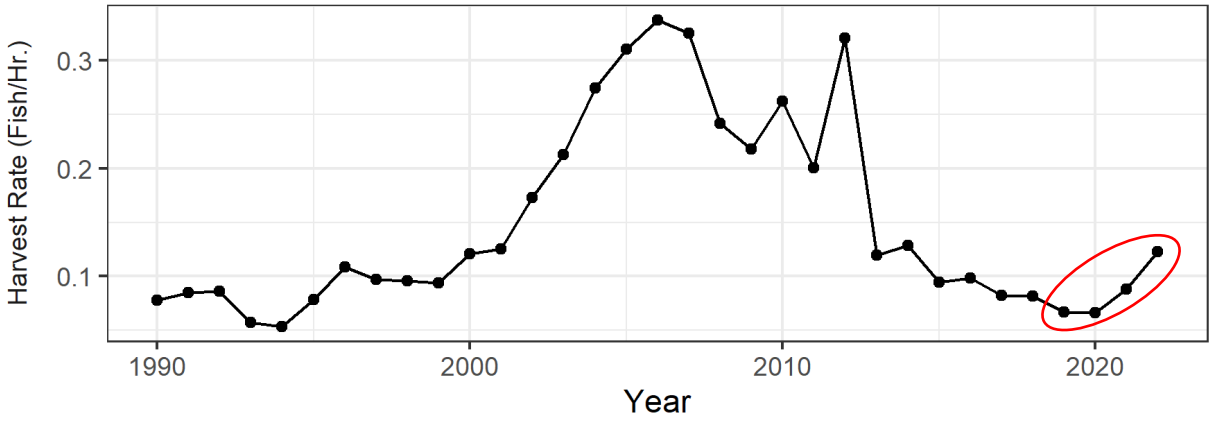
Managing Alewife Predation Mortality

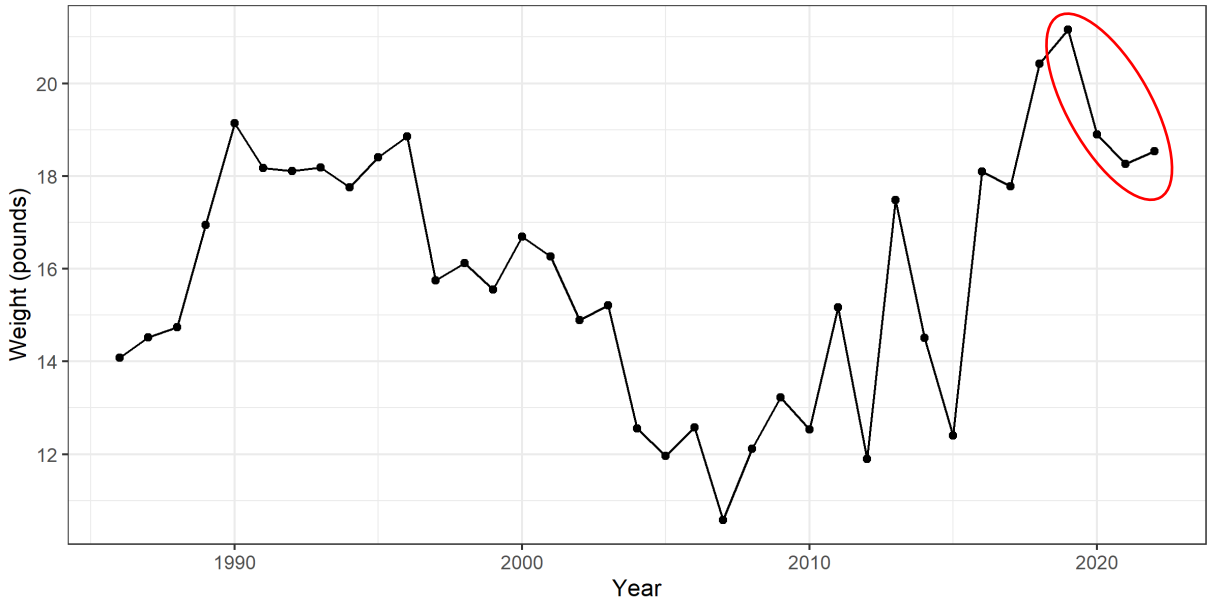
Management Goal: Alewife Biomass	Predation Mortality Target Rate
 Increase	< 0.3
 Stable	0.3 – 0.55
 Decrease	> 0.55

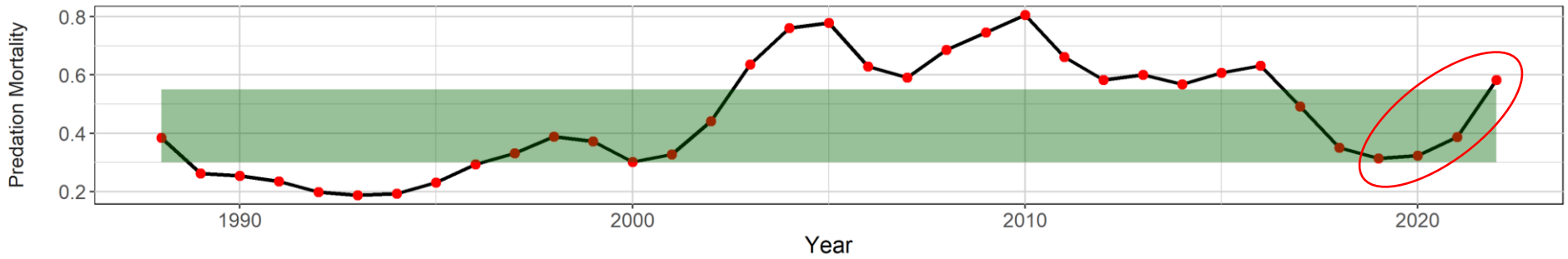
Where are we today?

Stocking of salmon increased in 2023 but unclear whether these stocking rates can be sustained given:

- Charter catch rates increasing
- Size of salmon decreasing
- Alewife mortality increasing (*next slide*)







Questions

- Ben Turschak (turschakb1@michigan.gov)
- Dave Clapp (clappd@michgan.gov)