Stocked and naturalized Steelhead in Lake Michigan

September 8, 2022

NRC Meeting

Lansing

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Rationale for stocking:

Benefits

1) Create fishing opportunities
2) Reestablish declining or extirpated populations

Costs

1) Financial cost to rear and transport fish
2) Potential genetic concerns
3) Ecological concerns
    - Competition (for food and spawning habitat)

Rationale for naturalized fish:

Benefits

1) Natural selection and local adaptations.
2) Better acclimated to environment (lower predation losses, better at feeding)
3) No cost to produce

Costs

1) All rivers aren't suitable for reproduction
2) More variability

History of steelhead in the Great Lakes (Part 1)

- Steelhead are not native to the Great Lakes.
- 1st introduced in 1876

- Even subspecies designation requires time and reproductive isolation.
- Rapid evolution in Great Lakes as steelhead adapted to fresh water.

Willoughby, J.R., Harder, A.M., Tennessen, J.A., Scribner, K.T., Christie, M.R., 2018. Rapid genetic adaptation to a novel environment despite a genome-wide reduction in genetic diversity. Mol. Ecol. 2018, 1–11.

History of steelhead in the Great Lakes (Part 2)

- Little Manistee River likely one of the first colonized by introduced trout
- Multiple hatchery strains with evolved tendencies to enter rivers at different times of the year have been stocked to extend the duration of once seasonal fisheries.

  Summer steelhead

  - Four strains (Rogue, **Skamania**, Siletz, and Umpqua)

  Winter steelhead (varying spawn times)

  - Michigan, Little Manistee River (McCloud River, CA)
  - Chambers Creek, Washington
  - Ganaraska, Ontario
  - Kamloops, British Columbia

Genetic stock considerations:

- Genetic differences highest between hatchery strains in Lake Michigan steelhead (Bartron et al.).
- Changes in hatchery management practices increased relative contributions of hatchery steelhead to naturalized populations.
- Hatchery fish are contributing genetically even to non-stocked systems:
  - Increased numbers of genes in spawning adults from populations can be attributed to genes specific to recently introduced hatchery strains.
  - Higher than expected straying rates
    - The % of hatchery fish returning to the four rivers with naturalized populations ranged from 13% to 31% of total spawning runs.

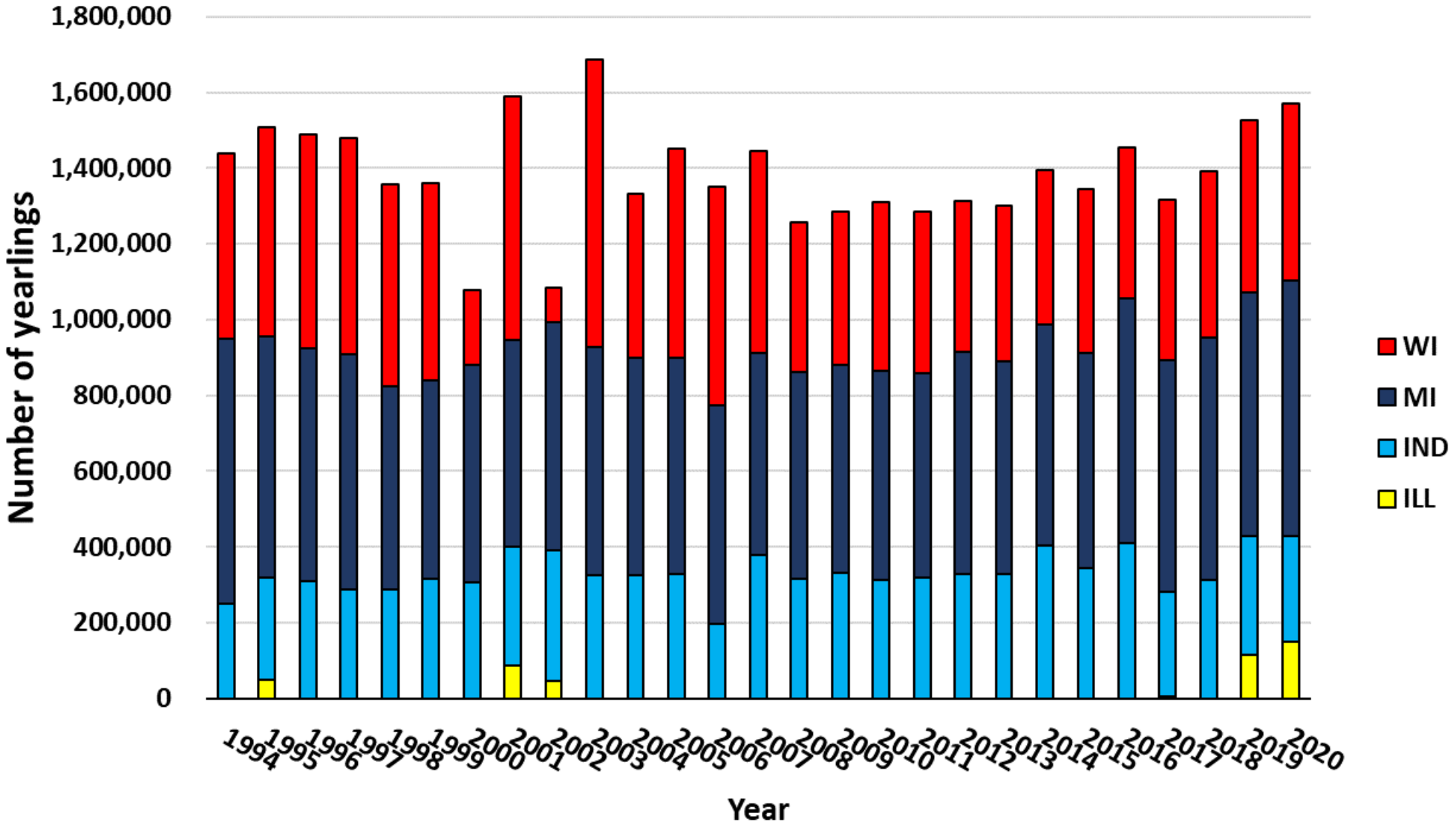
Bartron, M.L., Scribner, K.T., 2004. Temporal comparisons of genetic diversity in Lake Michigan steelhead, Oncorhynchus mykiss, populations: effects of hatchery supplementation. Environ. Biol. Fishes 69, 395–407.

Bartron, M.L., Swank, D.R., Rutherford, E.S., Scribner, K.T., 2004. Methodological bias in estimates of strain composition and straying of hatchery-produced steelhead in Lake Michigan tributaries. North Am. J. Fish. Manag. 24, 1288–1299.

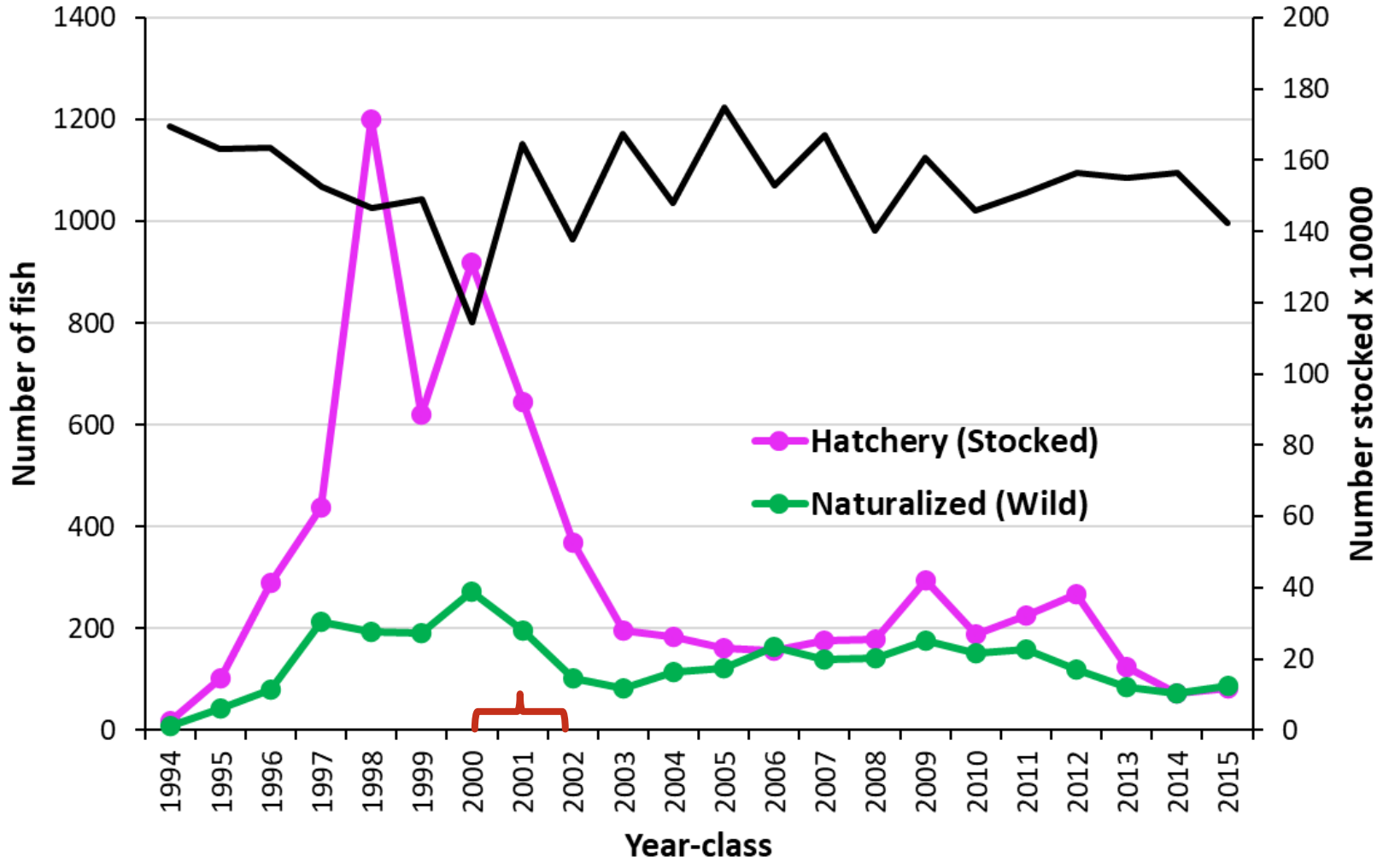
Other considerations:

- Hatchery fish lower survival vs. naturalized fish
- Hatchery fish can be less effective spawners (lower fitness)
  - Fitness = “ability to contribute to future generations”
- Hatchery fish and alter adaptations due to natural selection (outbreeding depression)

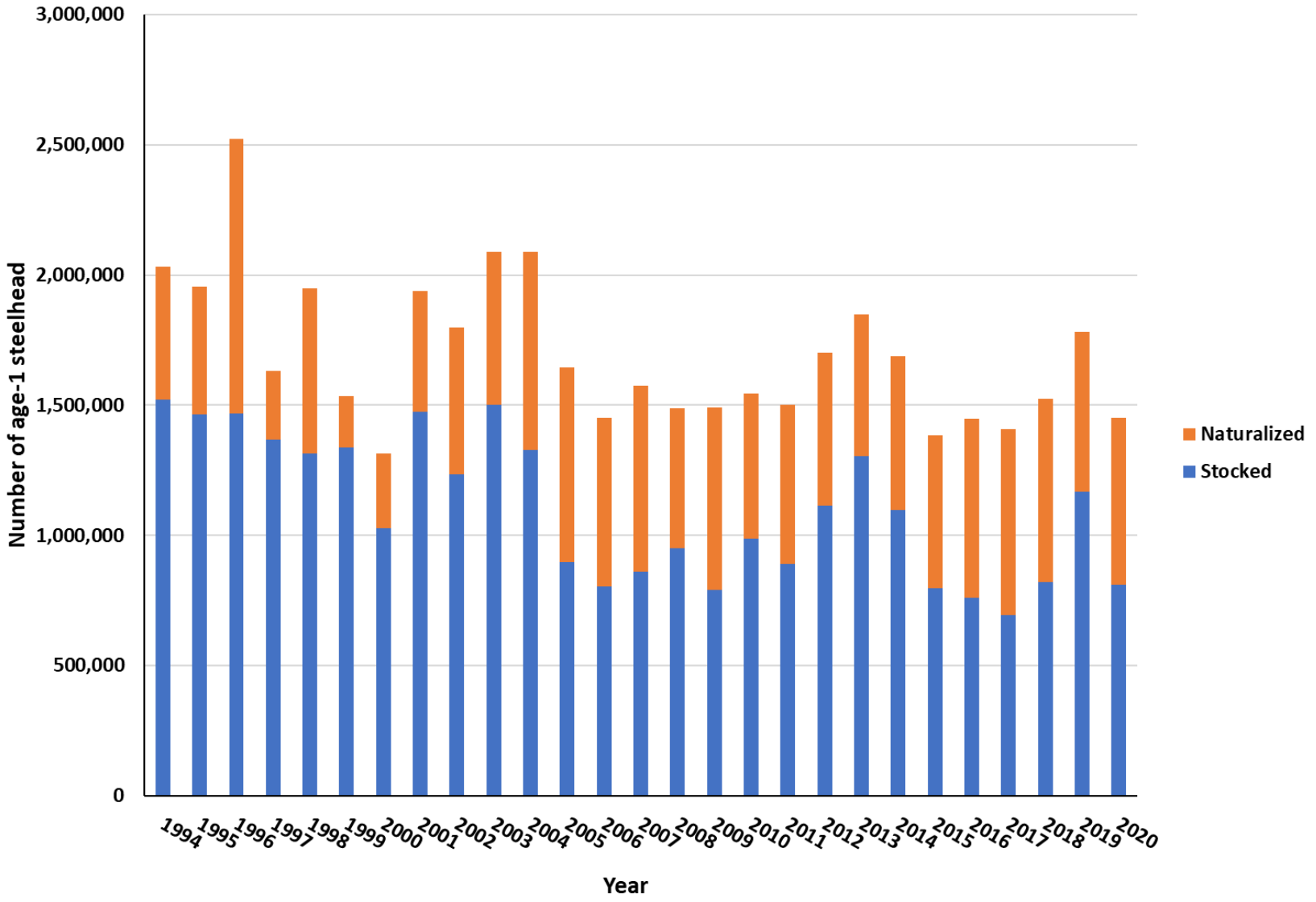
Current stocking practices for steelhead



Decreased survival of stocked steelhead



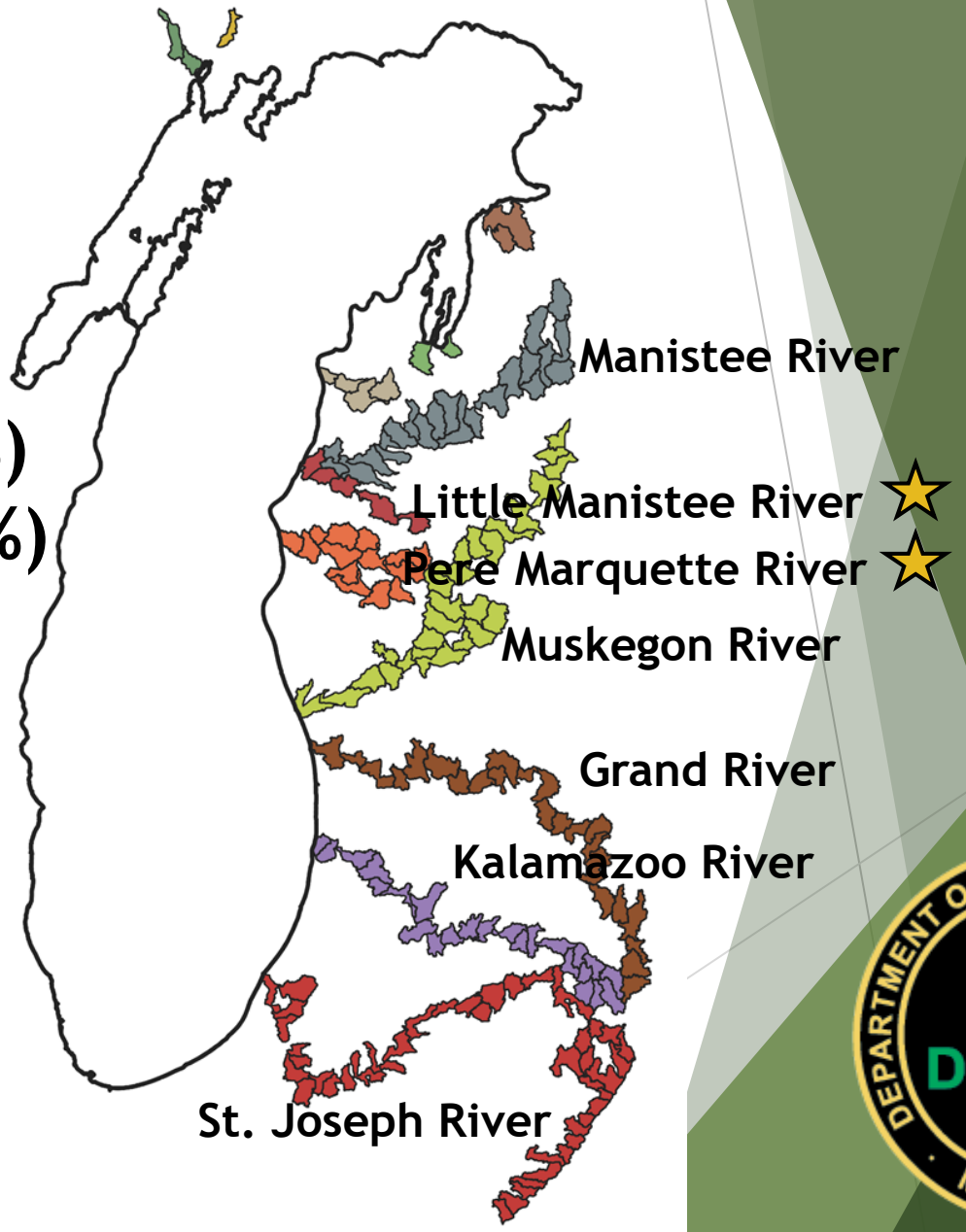
Proportion of stocked vs naturalized fish



Sources of Wild Steelhead Caught in Lake Michigan

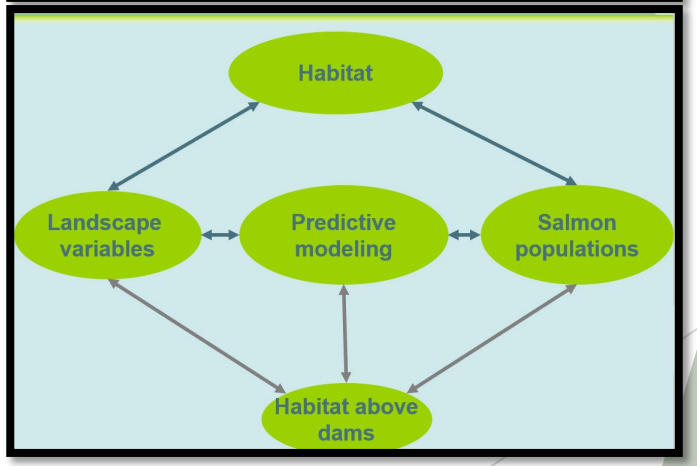
80%

Little Manistee River (25%)
Pere Marquette River (18%)
Kalamazoo River (17%)
Muskegon River (11%)
St. Joseph River (9%)

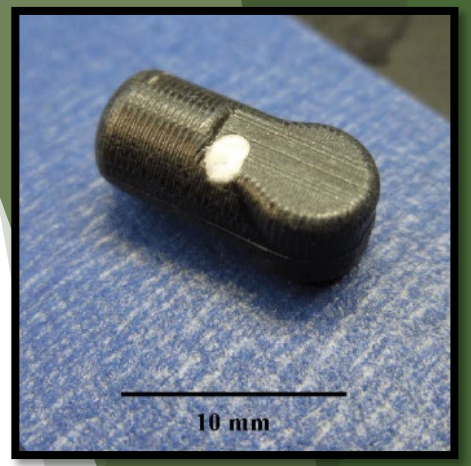


Ongoing and Future research:

- Mortality sources for young stocked and wild steelhead.
- Recruitment bottlenecks. (predation on young steelhead)
- Evaluation of time spent in river prior to smolting



New study: Movement patterns and survival of out-migrating steelhead smolts in tributaries to Lake Michigan



Hypothesis 1: Stocked young steelhead will out-migrate earlier and during a shorter-time span than naturalized fish.

Hypothesis 2: Naturalized steelhead are less likely to be consumed by predators than stocked fish.

Hypothesis 3: The numbers of predators influence predation rates on young steelhead.

Preliminary investigation complete:

- Test survival of young steelhead after:
  - Surgeries
  - Tag insertion
  - Holding for 2 months
- Zero mortalities!!

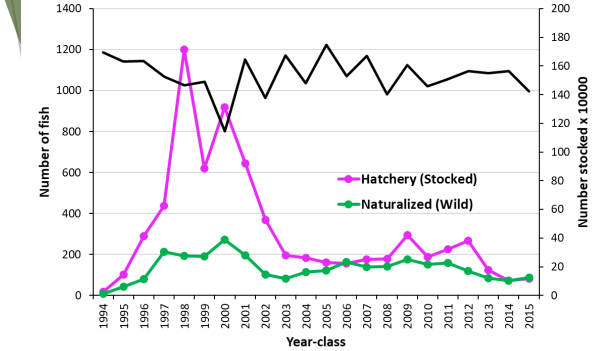
Proposed project timeline:

Year	2023			2024		2025		2026	
Season	Winter	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
Purchase/maintain tags and recievers	■		■		■		■		
North-Jordan River: Marking and monitoring*		■		■		■			
Mid-Manistee River: Marking and monitoring				■		■		■	
South-St. Joseph River: Marking and monitoring				■		■		■	
Hire graduate student-technician				■	■	■	■	■	
Data summary-reports, manuscript writing			■	■	■	■	■	■	■

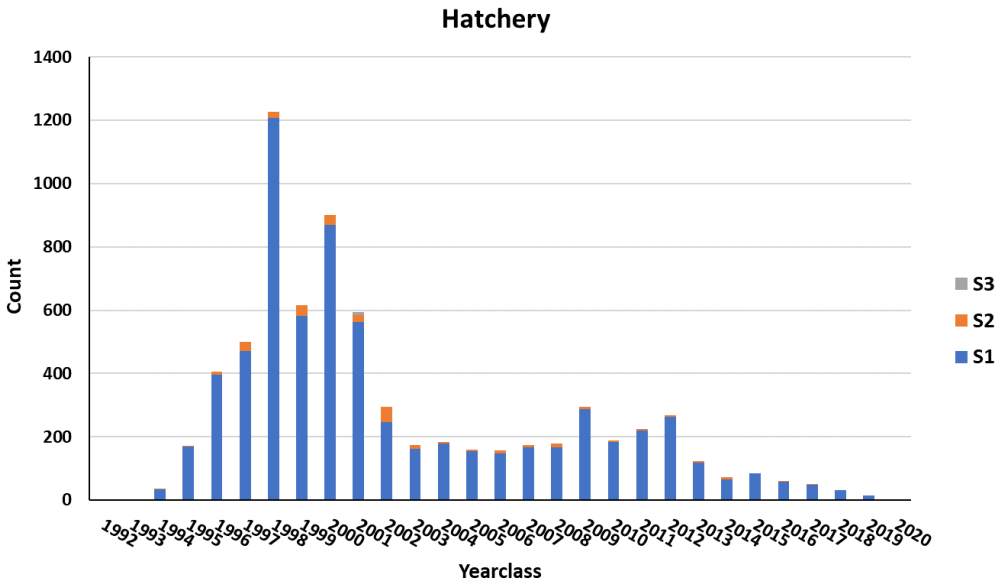
*1st year is less expensive location only tag on Jordan River

New finding, Smolt residency time for naturalized steelhead in streams is changing

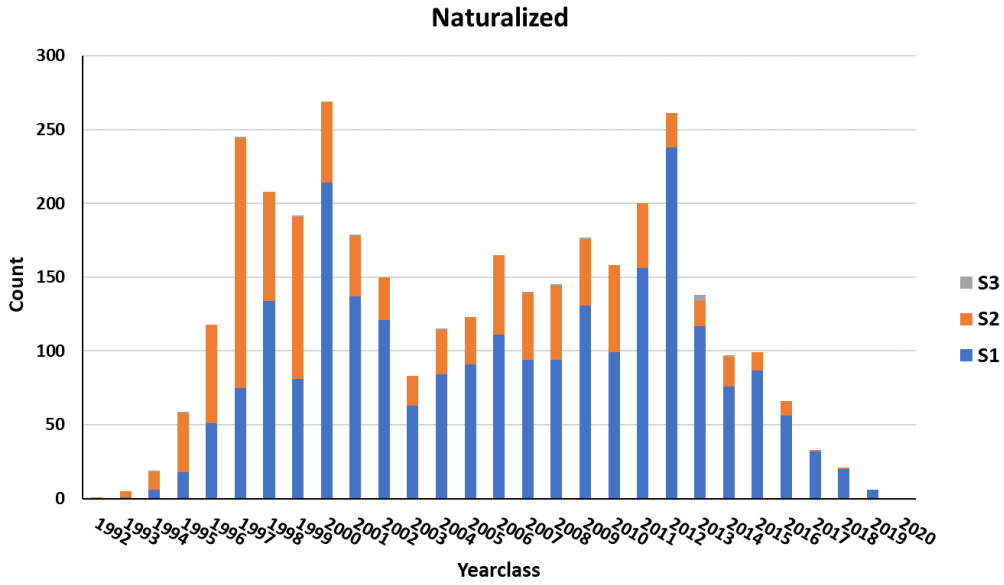
Stocked vs naturalized fish:



Recreational fishery

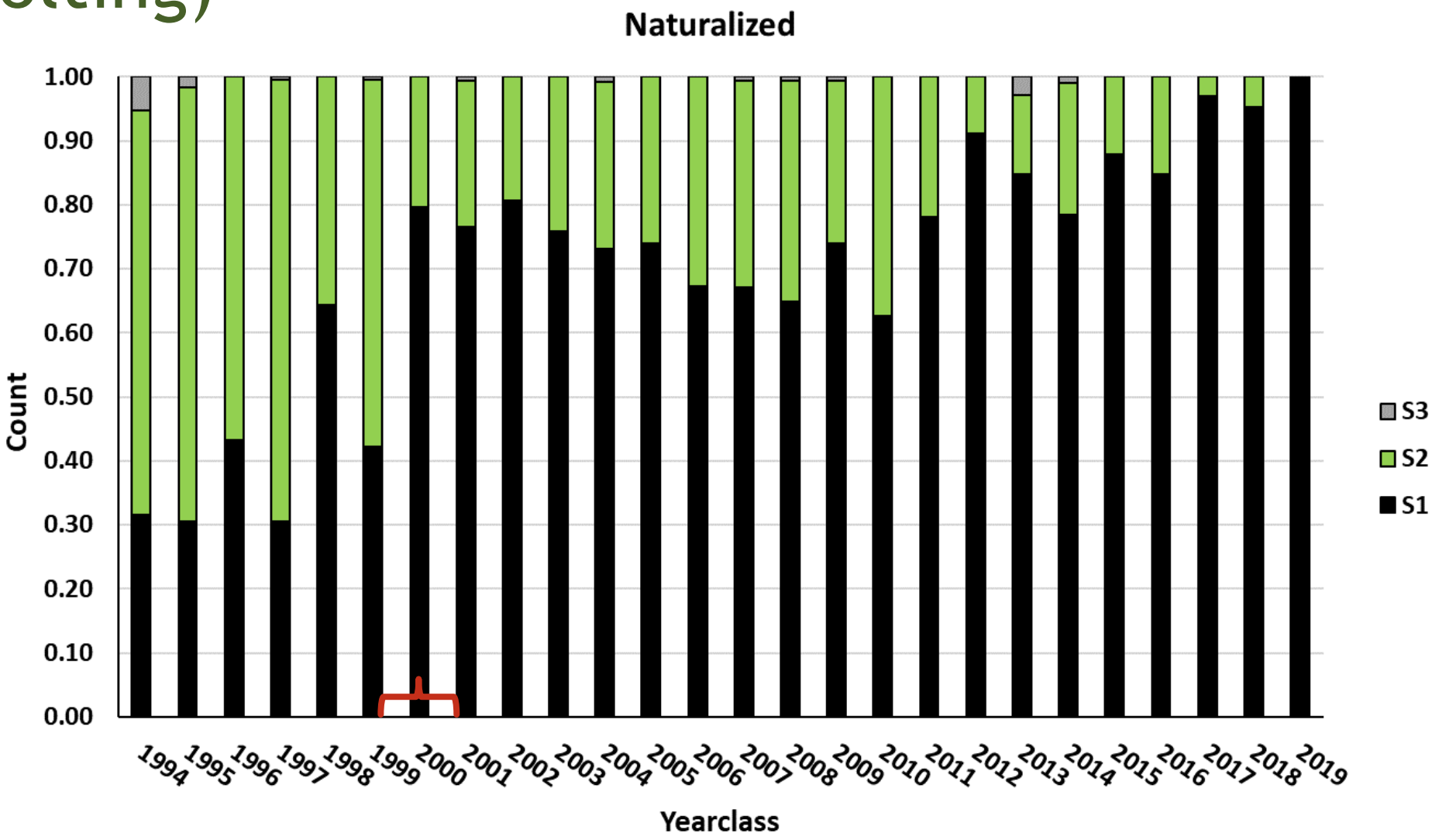


Average 96% S1



Average 71% S1

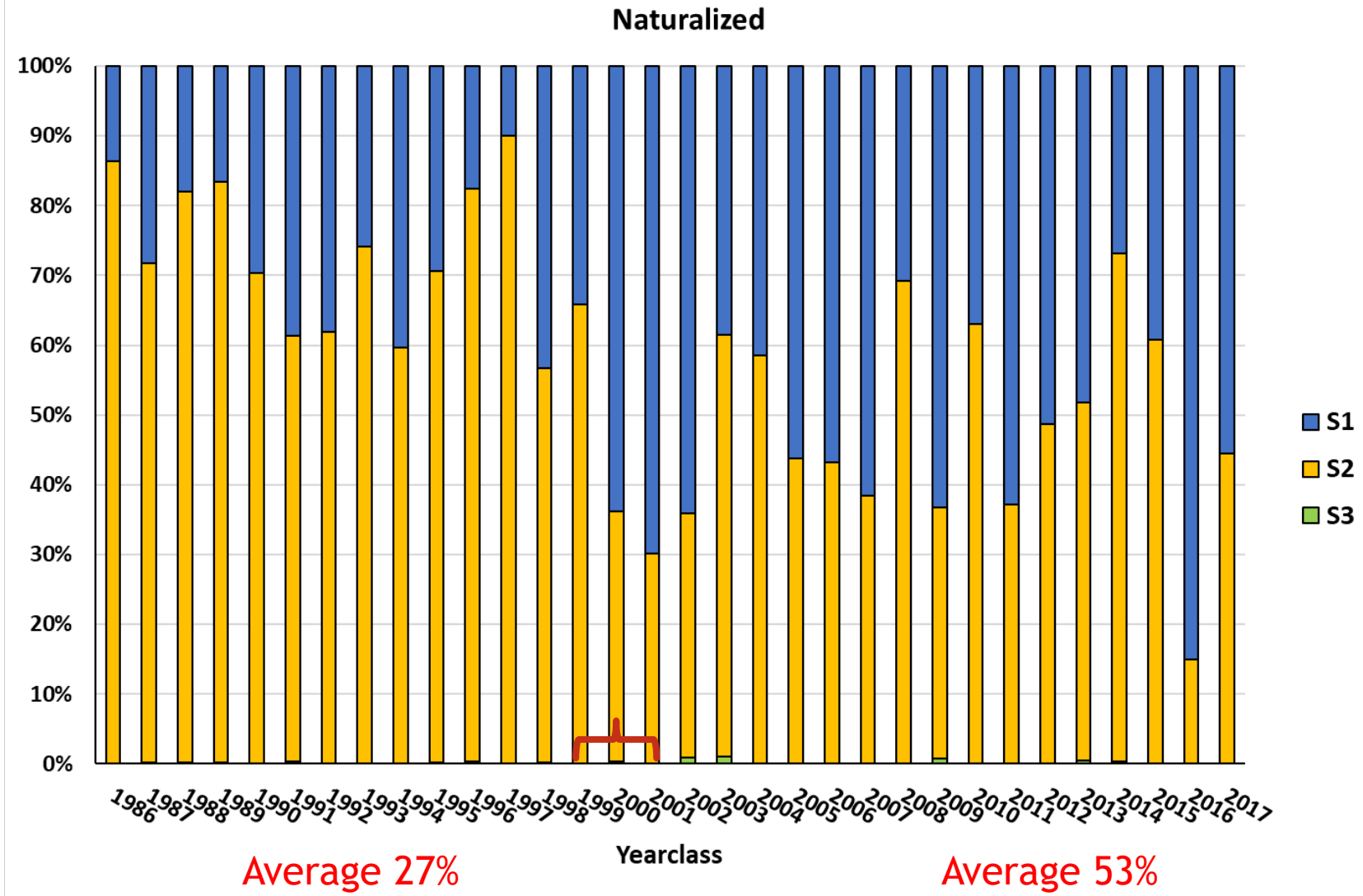
Recreational fishery age at out-migration (smolting)



Average 40%

Average 80%

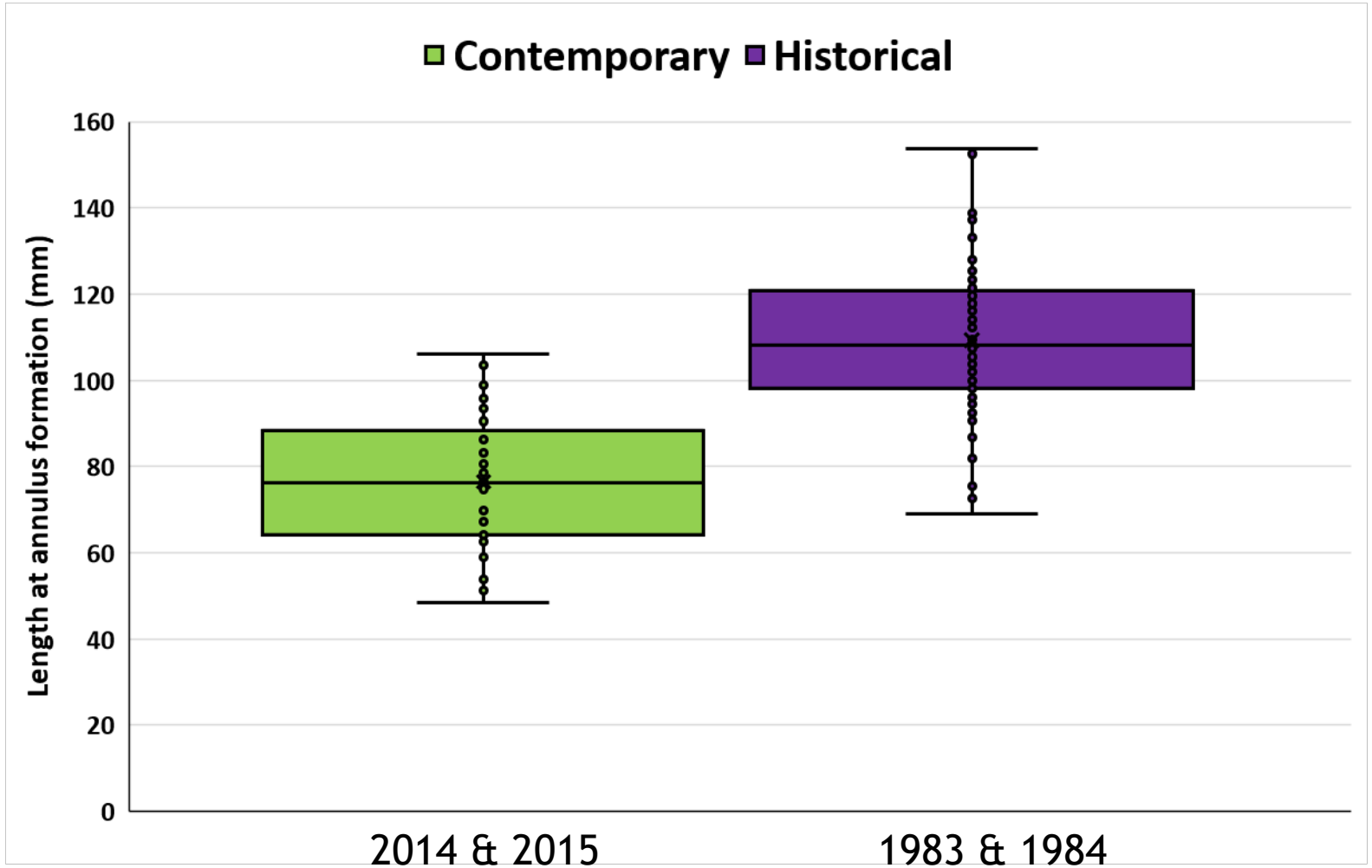
Little Manistee River age at out-migration (smolting)



Given what you now know, what are your expectations for growth of young steelhead?

Pre-2020 vs post-2020

Summary from Little Manistee River Age-1 steelhead



Next steps: Similar analysis on adults from open lake fishery.

Thank you

Questions?