Applying lessons of the past to understand current poor Striped Bass year-class success

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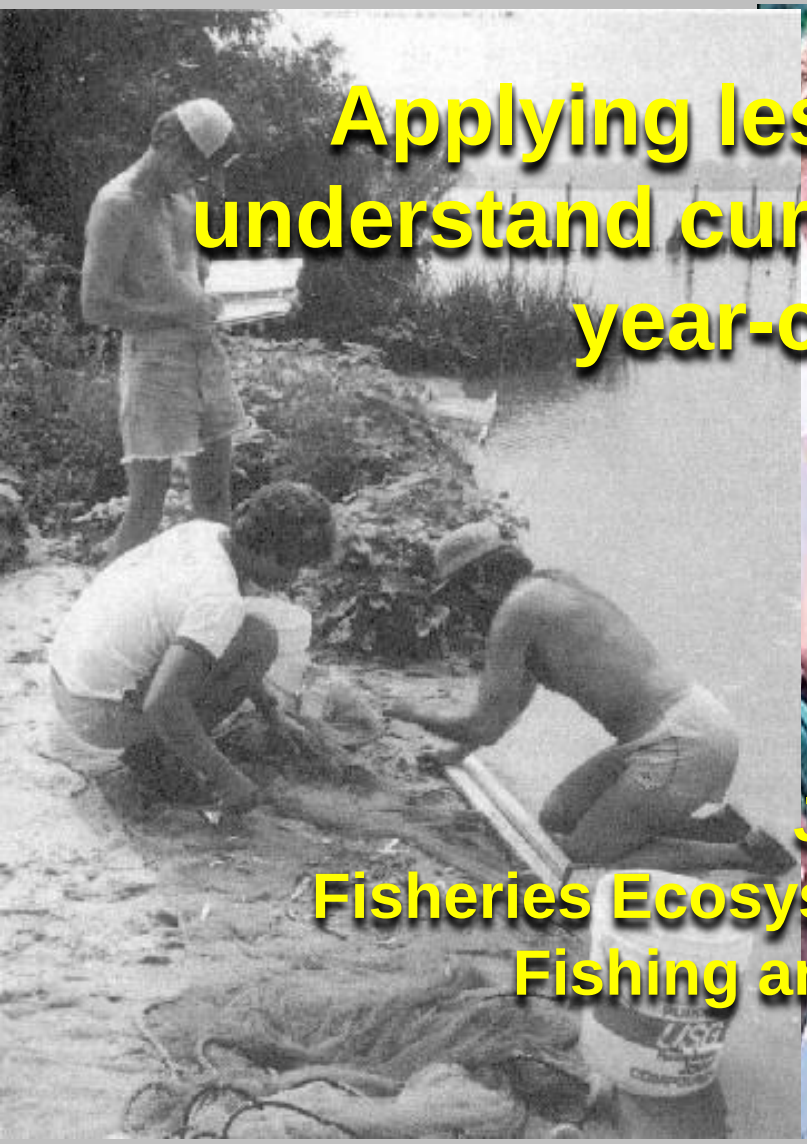
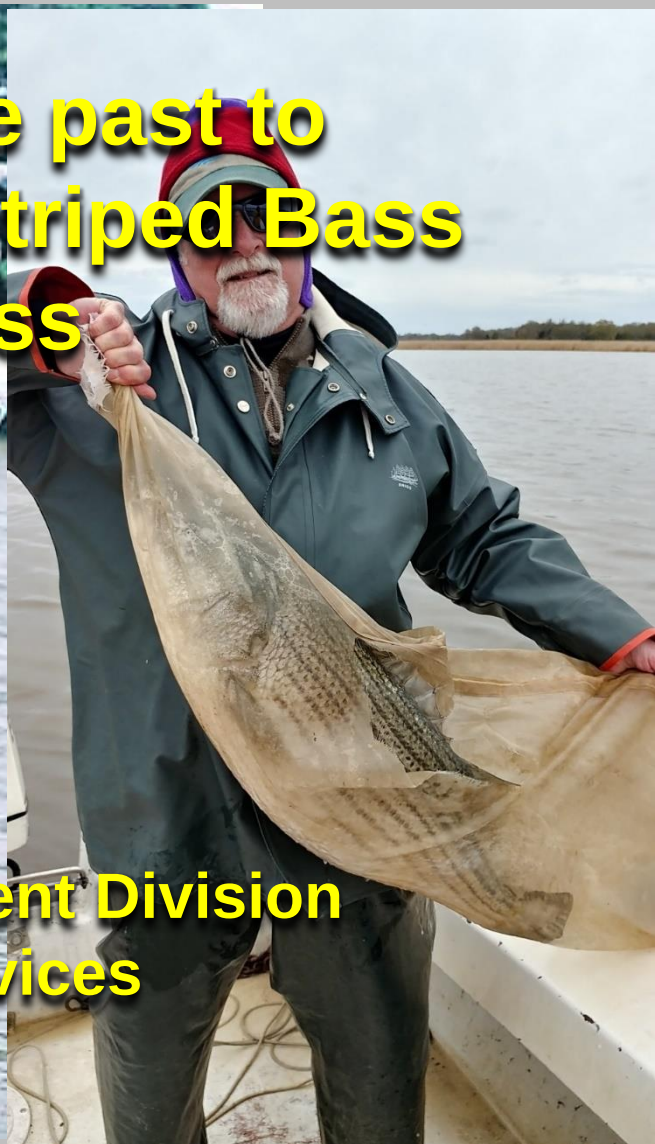


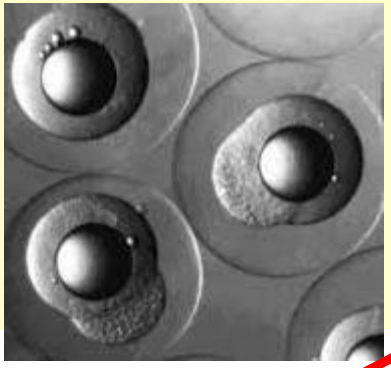


Chesapeake Bay Striped Bass

- Boom and bust dynamics back to colonial times
- 12 MD and 4 VA spawning areas (+ Hudson & Delaware rivers) support Atlantic coast fisheries
- Fishery depends on strong Bay year-classes
- Spawn in March-May, fresh-tidal & oligohaline
- Environment drives year-class success
  - Year-class determined in 1st 3 weeks of life
  - Flow and temperature important

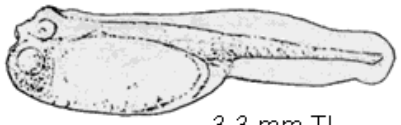
Early life stages and what influences them based on past studies

3 mm, egg



Temperature
Water quality
Flow

3 mm, prolarvae

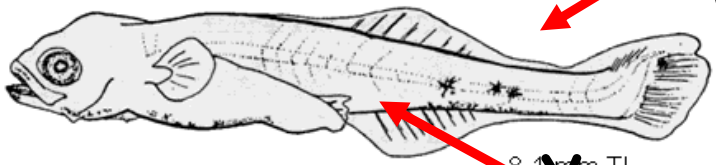


5 mm, prolarvae

6 mm, postlarvae

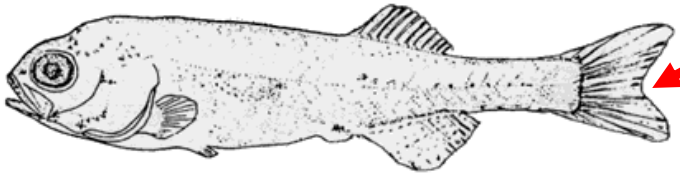
Food
Water quality
Flow

9 mm, postlarvae



Year-class set

12 mm, juvenile



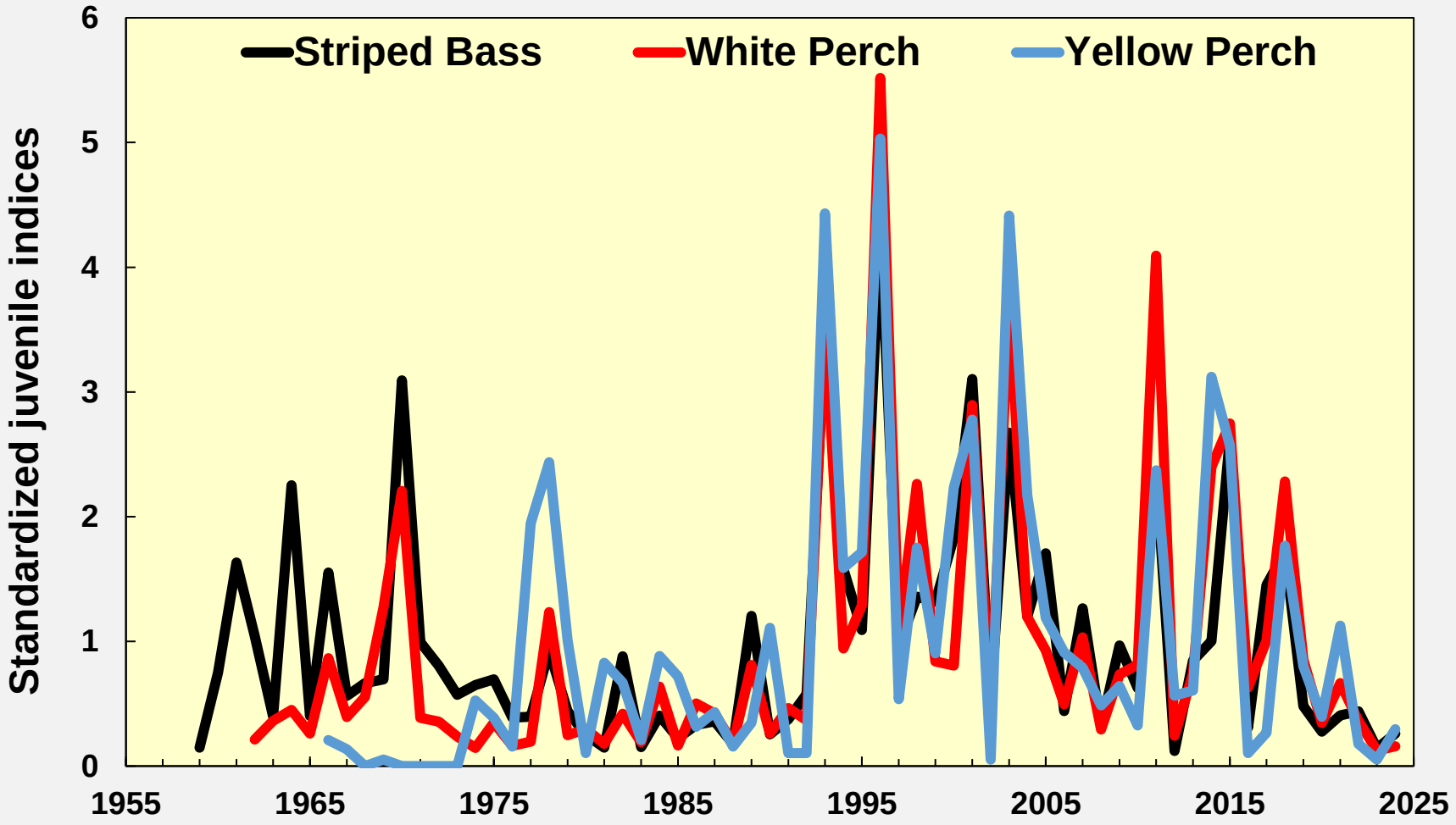
Data exist to contrast past conditions & current.

- Juvenile index: 1957-2024
- Flow: 1957-2024 (USGS)
- Spawning status & temperature: Egg-larvae surveys, 1954-2024
- Larval feeding, mortality: Choptank 1980s & 2023-2024
- Water quality: Choptank 1980s & 2013-2024

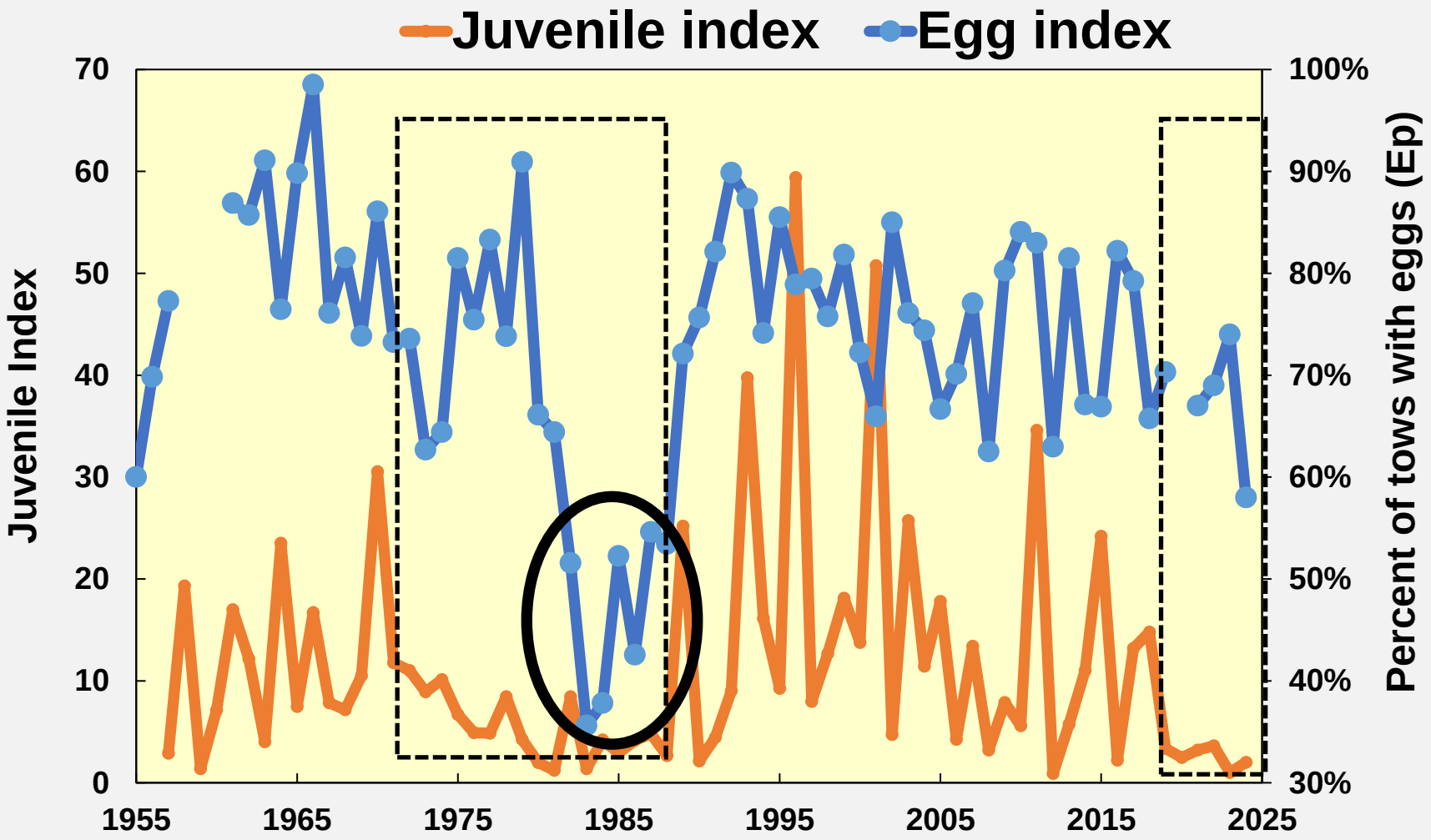
Created from old data sheets, datasets, & reports

MD JI trend not specific to Striped Bass.

Juvenile index trends of Striped Bass & 2 Bay panfish that share larval habitat standardized to years in common. Different adult life histories & fisheries.

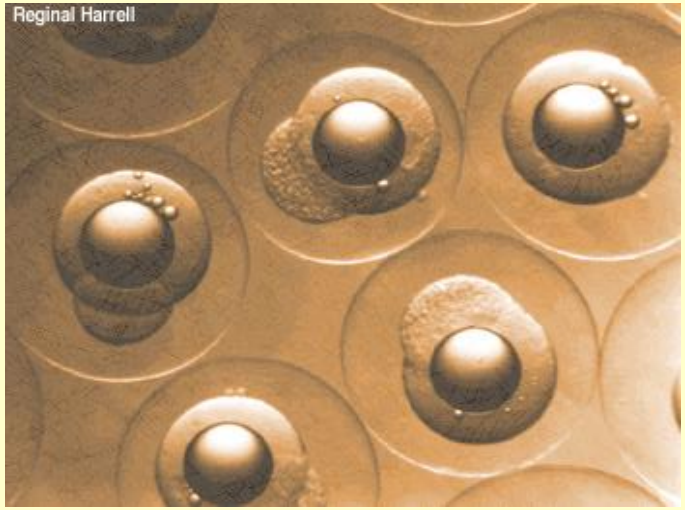


Juvenile index (orange) declines before egg presence index (blue). Indicates habitat issue. Oval indicates when low spawning stock affected JI.

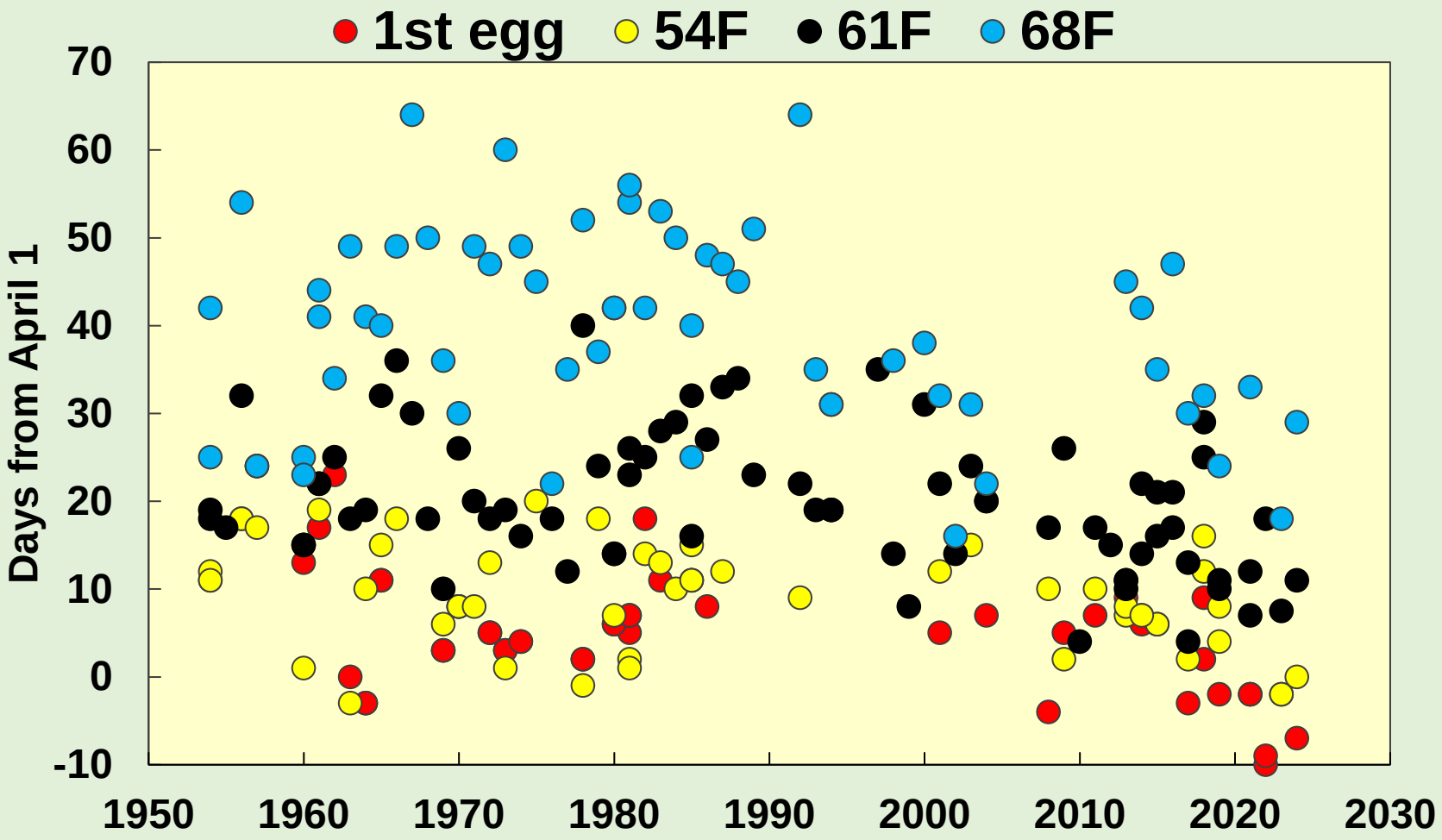


Spawning temperature: Have milestone dates for spawning changed?

- Dates expressed as days from April 1 (day 0)
- 1st egg = day first egg collected
- Day 54°F, 12°C met
  - Early spawning; high mortality
- Day 61°F, 16°C met
  - Peak spawn, low mortality
  - About 85% of eggs collected between 54° and 61˚F
- Day 68°F, 20°C met
  - End of spawning, high mortality



Days from April 1 (day = 0) that 1st egg was collected or 54ºF (12°C), 61ºF (16°C), and 68ºF (20°C), were reached during 1954-2024.
Nanticoke and Choptank Rivers combined.

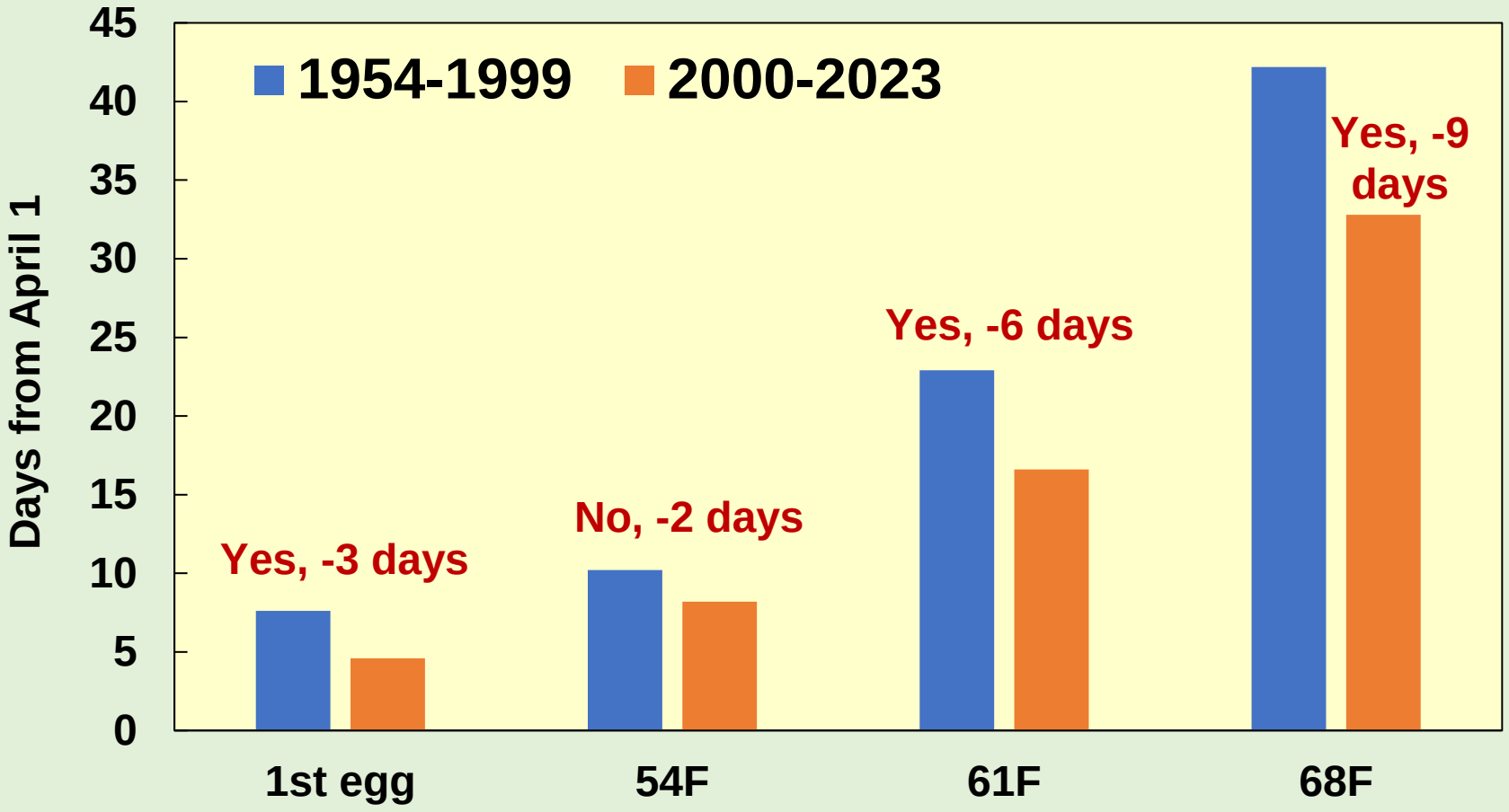


Are spawning milestones earlier since 2000?

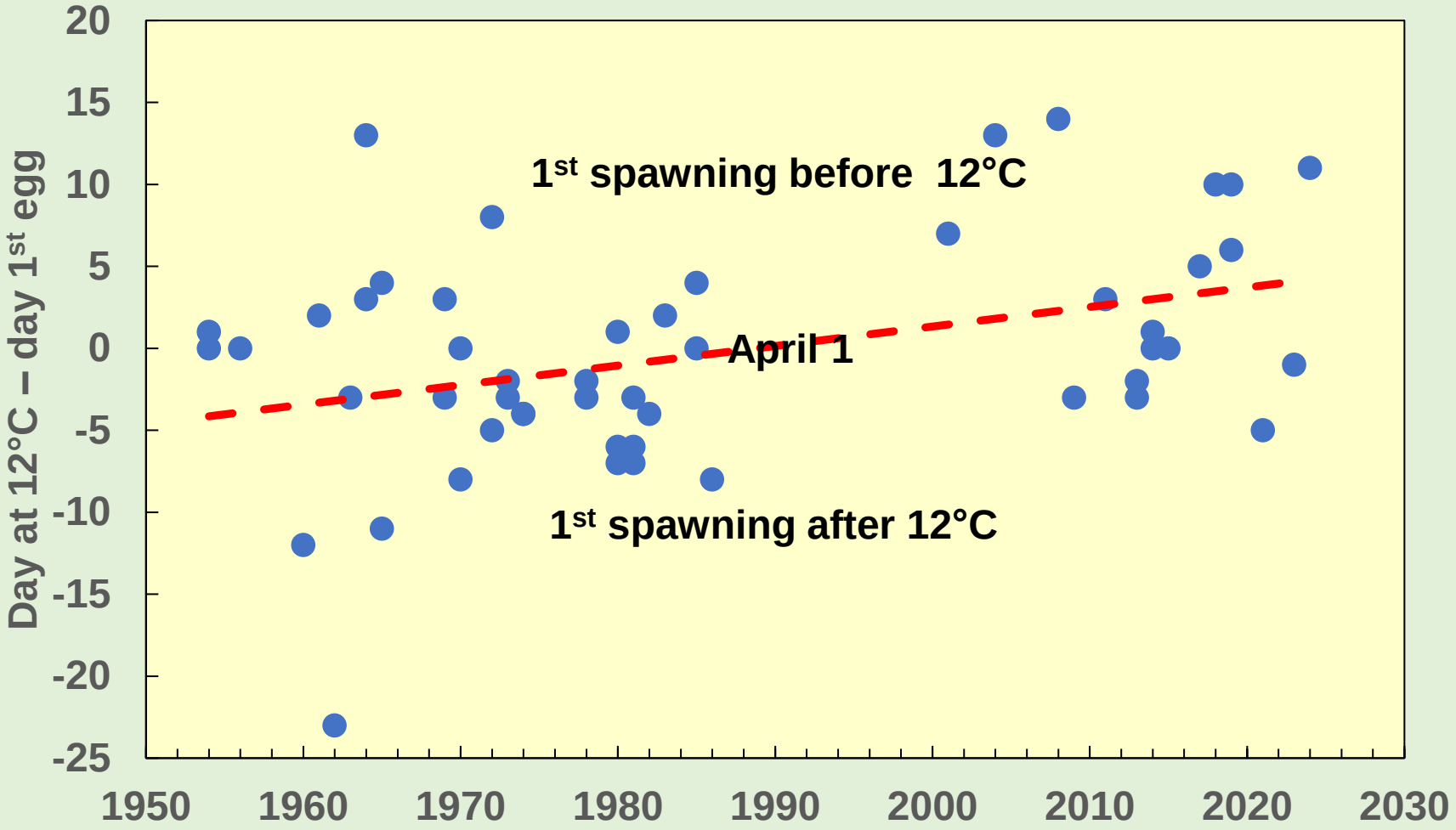
Average date from April 1 for milestones, by period.

Yes = statistical difference (t-test, P ≤ 0.05).

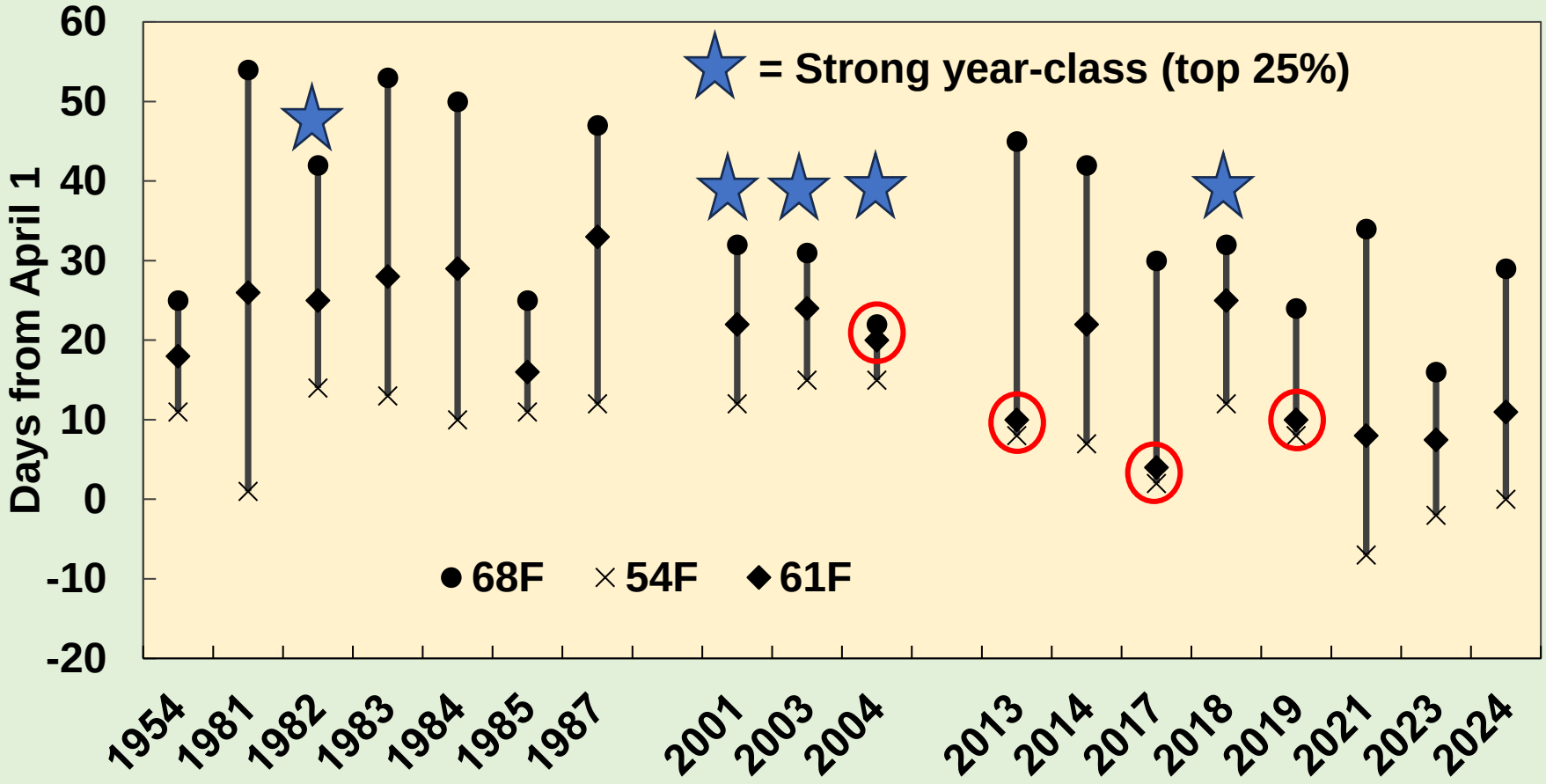
Similar results in Potomac and Head-of-Bay (Angela Giuliano, MCF, DNR spawning stock survey data).



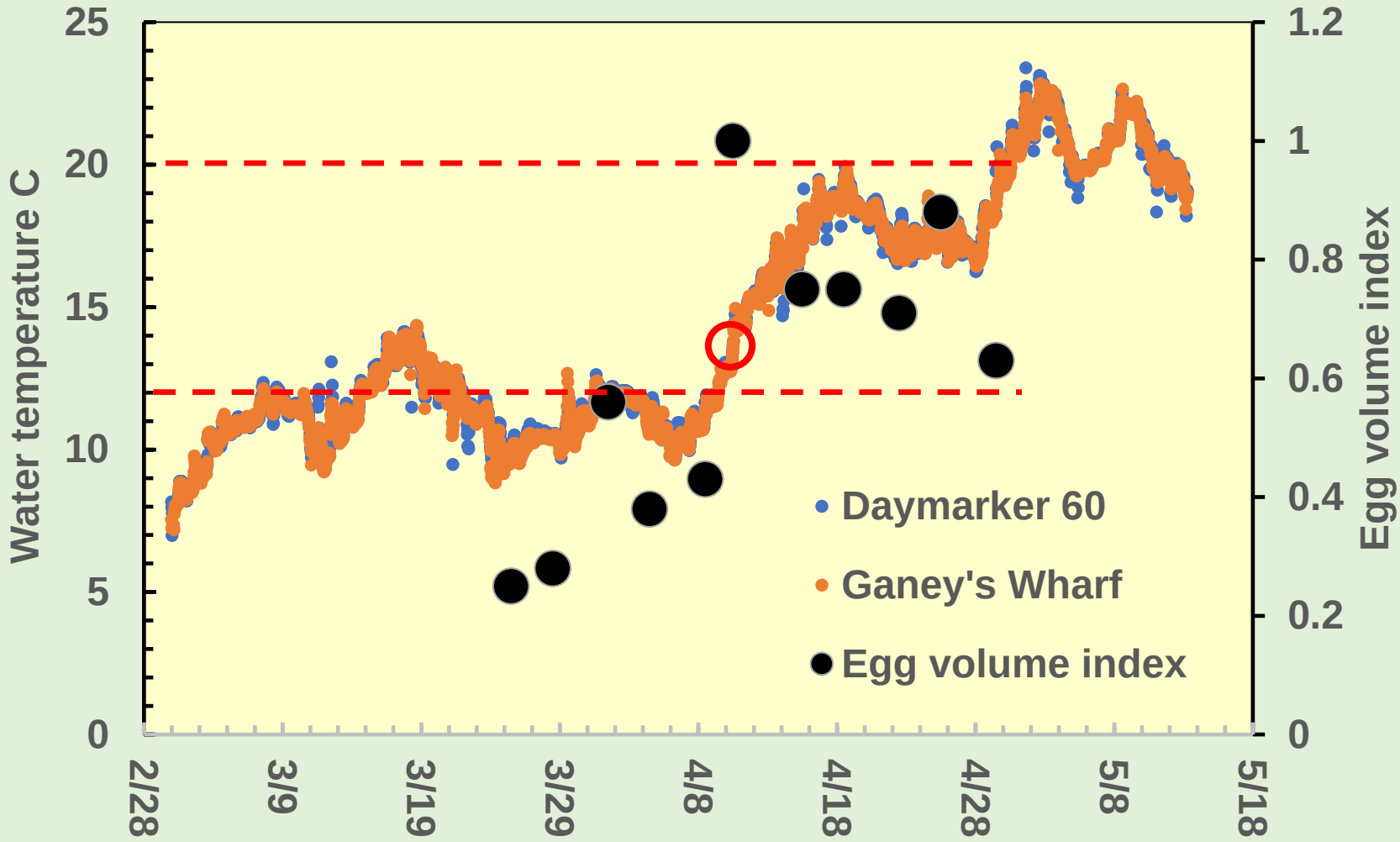
Day 54°F (12°C) was reached – day first egg was collected. April 1 = day 0. Dotted line = trend (r^2 = 0.14, P=0.0006). Early spawning mismatched with water temperature more often since 2000.
Nanticoke and Choptank Rivers



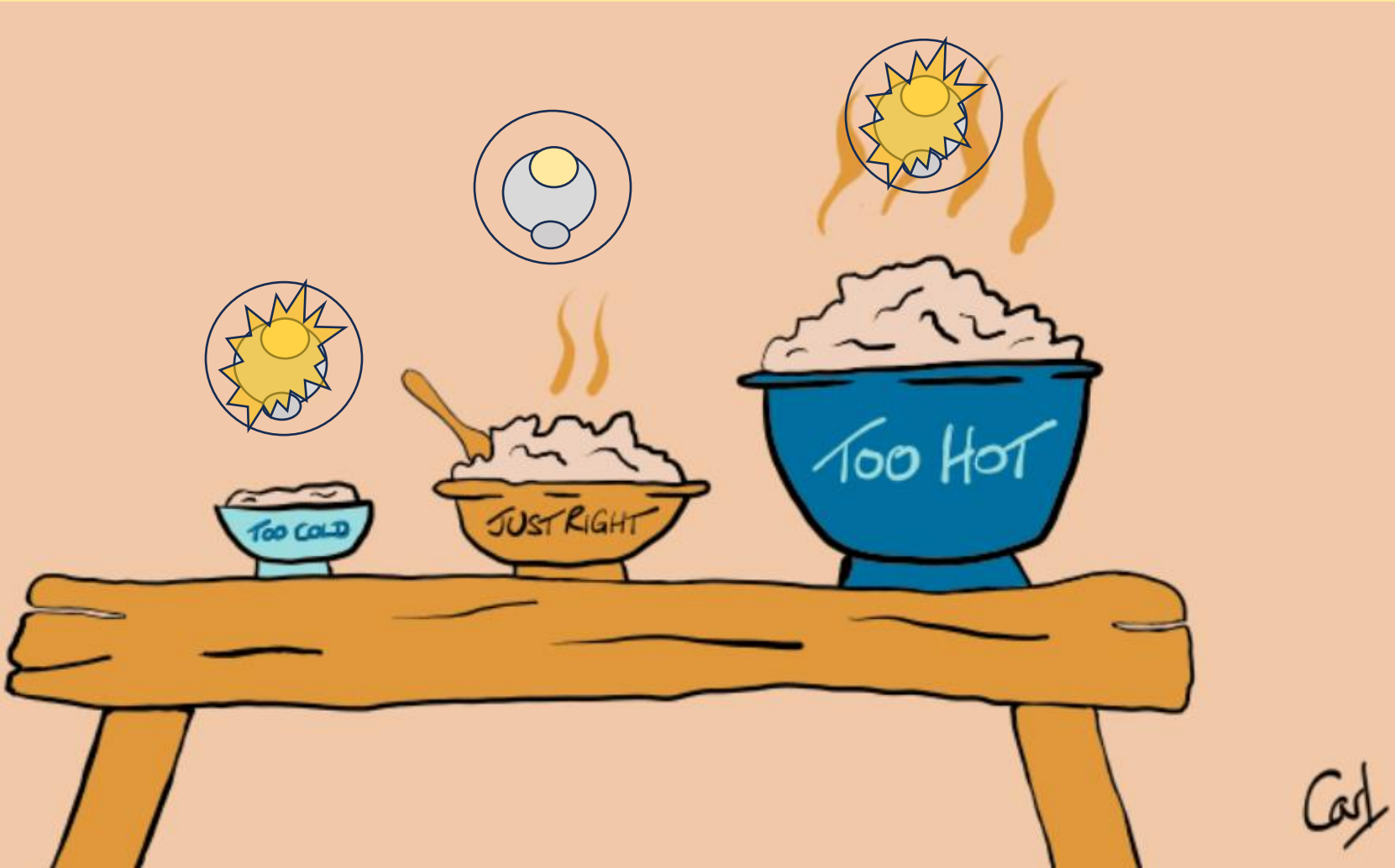
Days from April 1 (day = 0) that 54ºF (12°C), 61ºF (16°C), and 68ºF (20°C) were reached in Choptank River, 1954-2024. Red circles highlight very rapid warming. Peak spawning temperature since 2019 when spawning used to start.



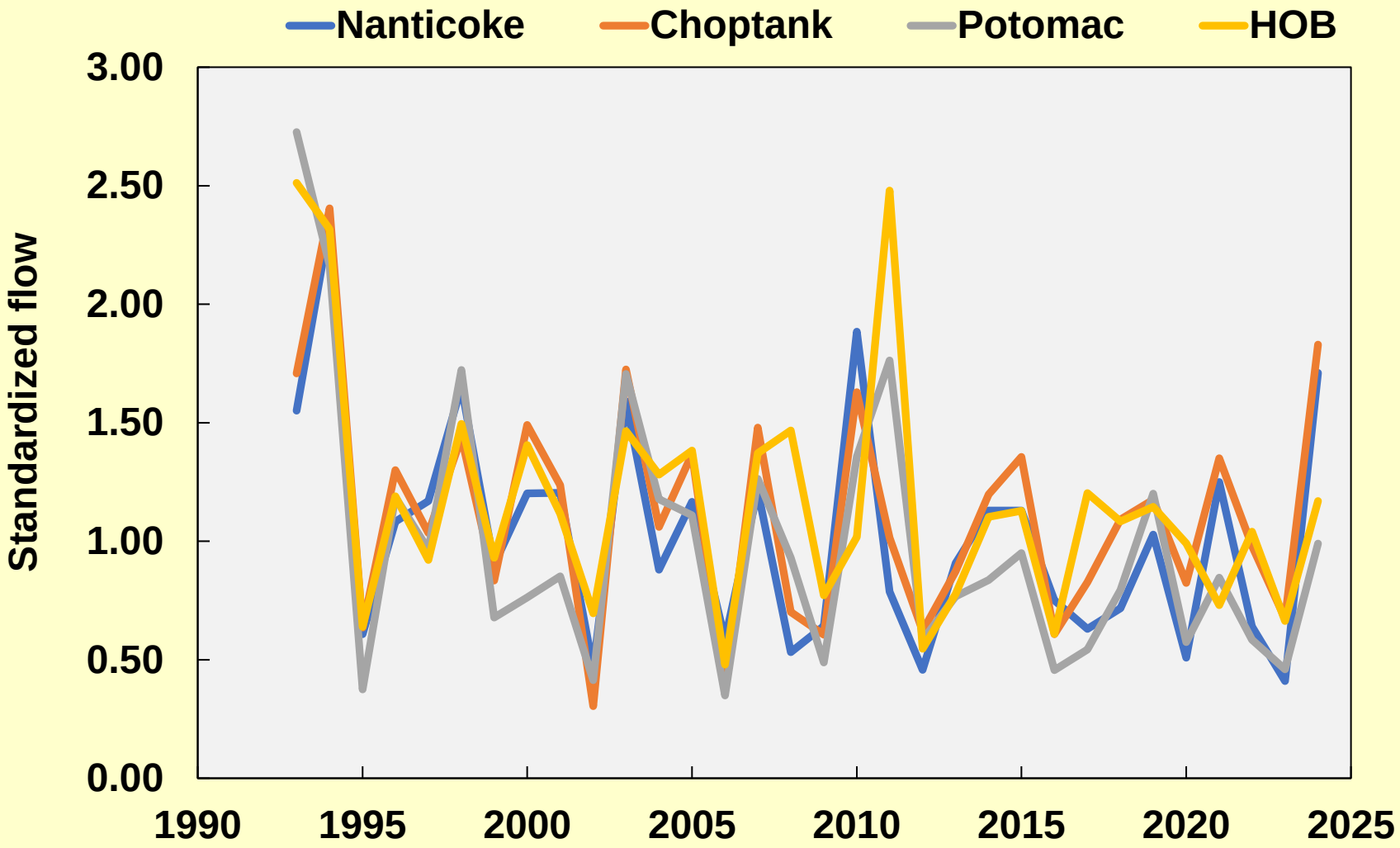
Mean egg volume index versus water temperature, Choptank River, 2024. Dave Secor described spawning as a gambler's bet for catching the warm-up.



Spawning temperature window is like Goldilocks's porridge, but "just right" is shrinking



Standardized spawning season flow, 1993-2024; after 2011 highs not as high & lows more frequent – higher odds of a poor year-class. 1.00 = 1957-2020 average.



Hypothesis: Flow & winter temperature drives match-mismatch of first-feeding larvae and copepods.

Larval fish were identified, guts dissected, and item presence recorded during 1980s and 2023-2024. Criteria for successful feeding developed from 1980s estimates of mortality and growth.

Choptank River

Striped Bass, 7-8 mm

White Perch, 7-8 mm

Copepod

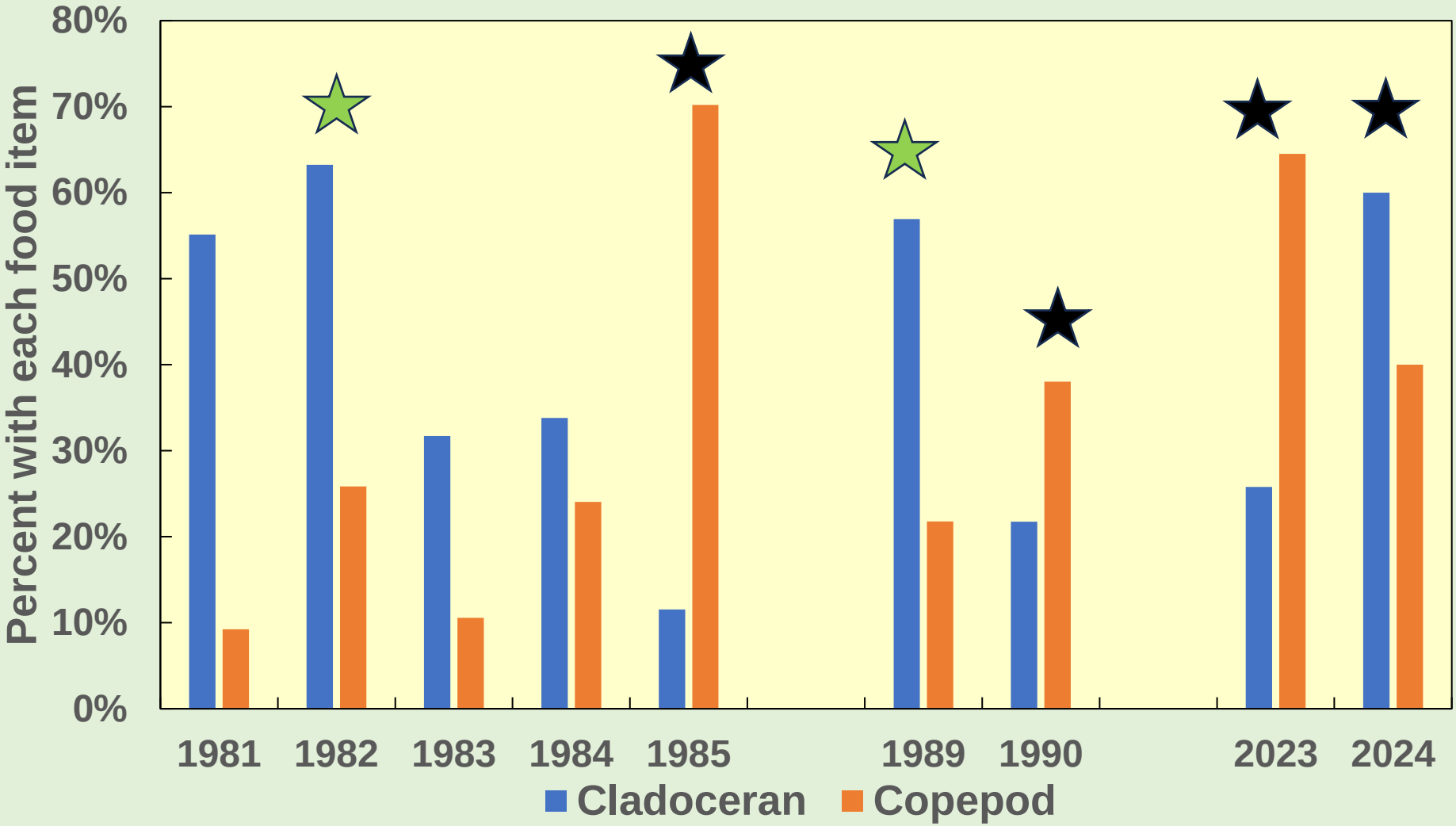
Cladocerans

Feeding incidence for cladocerans or copepods.

Striped Bass 5-7 mm TL postlarvae (first-feeding)

★ = good postlarval survival and poor year-class.

★ =good postlarval survival and good year-class.



High feeding incidence and low mortality did not always translate to better year-class success. Larvae fed well in low and high flow years. A prominent role of poor larval feeding success was not suggested for poor 2023-2024 year-classes preceded by very warm winters.

Water Quality: USFWS larval Striped Bass experiments, 1984-1990.

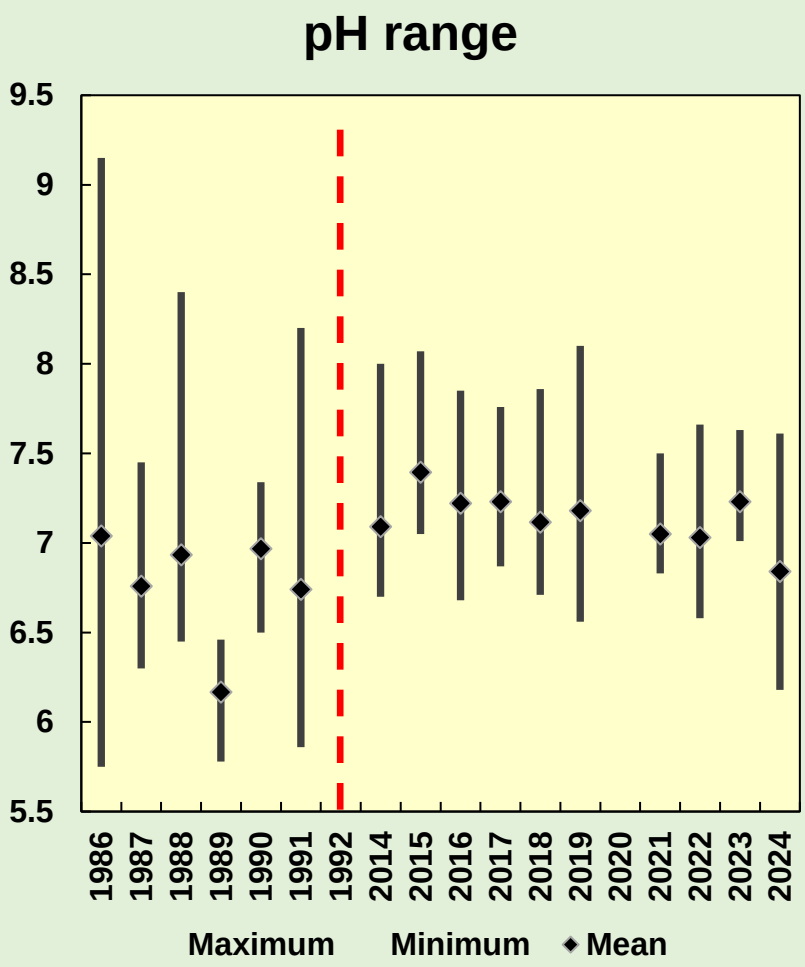
Metals, low pH, and low buffering (acid rain) were of concern in some spawning areas.

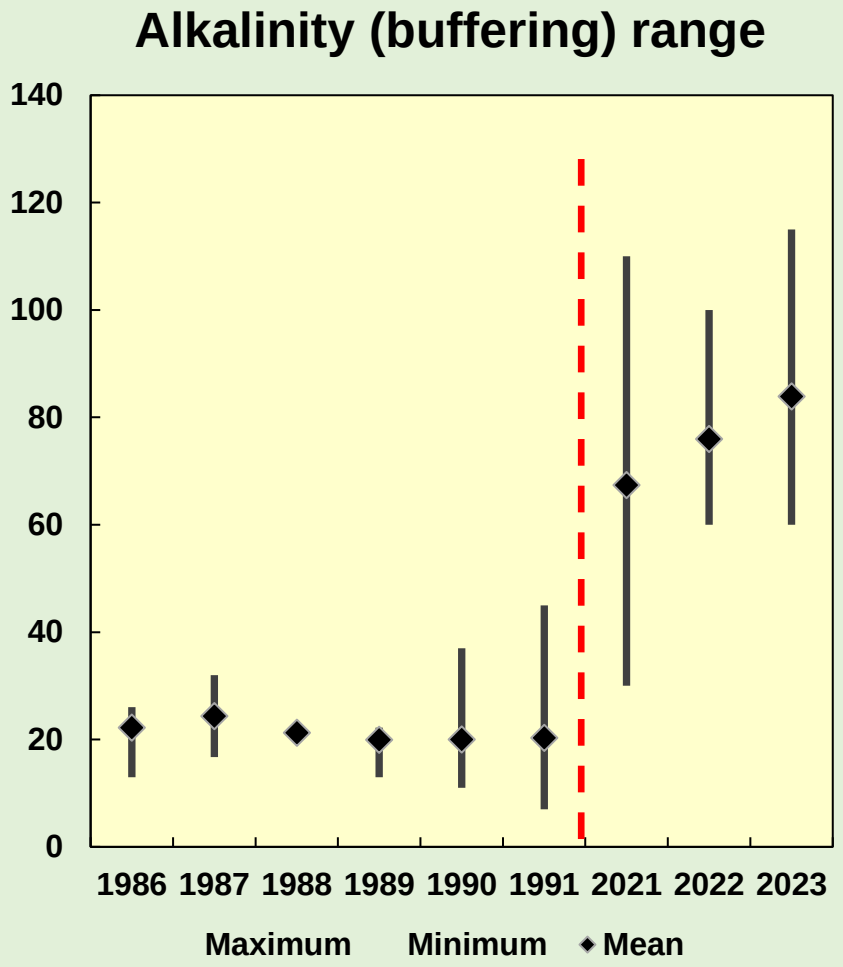
Yes indicates levels were of concern.

System	High Metals	Low pH	Low Buffer
Nanticoke	Yes	Yes	Yes
Choptank	Yes	Yes	Yes
Potomac	Yes	No	No
Head-of-Bay	No	No	No

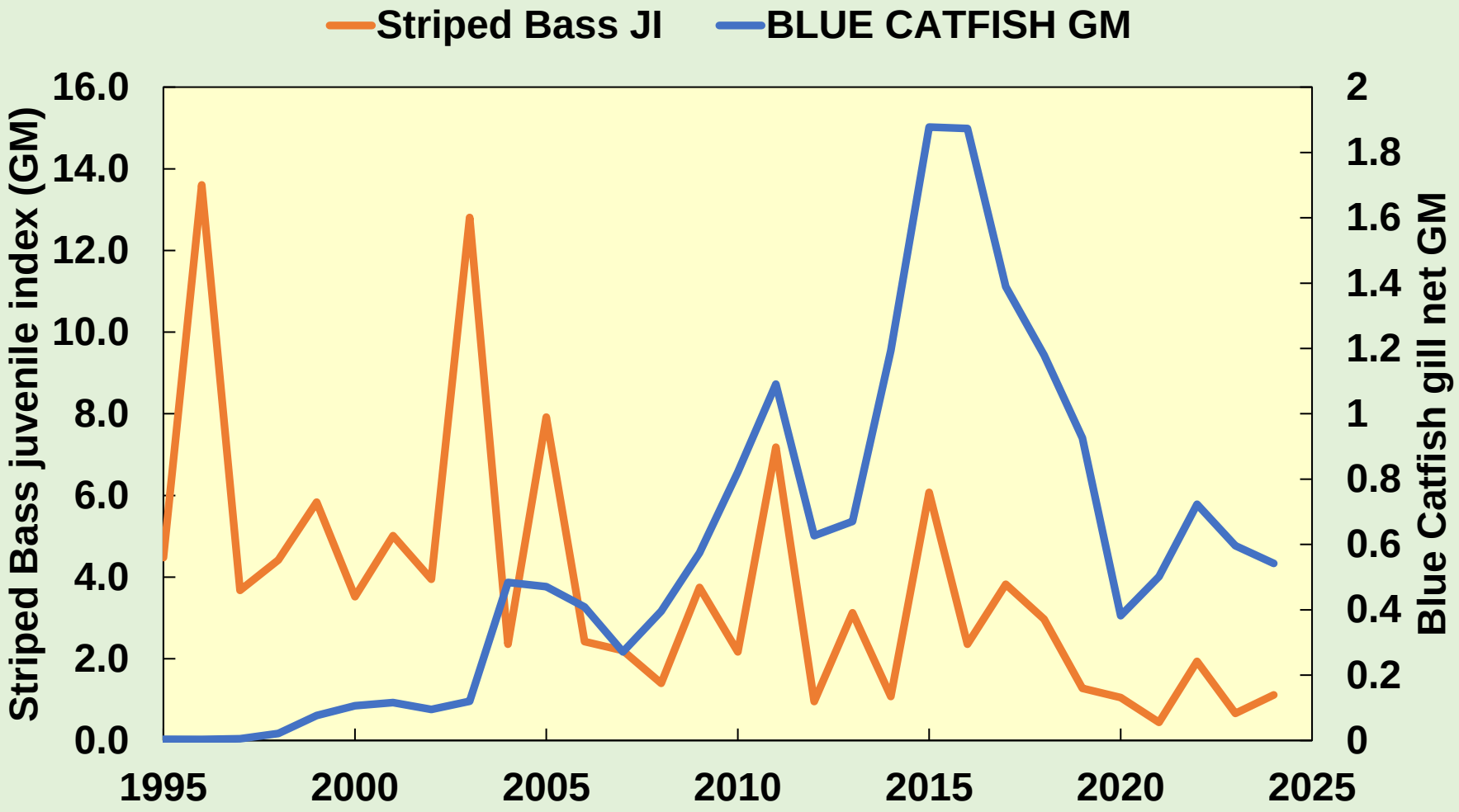
Choptank River pH and alkalinity mean and range during April 1 – May 7, 1986-1991 and 2014-2024.

Changes in recent years indicate lower toxicity potential





Blue Catfish Predation? Potomac River Striped Bass juvenile index vs gill net survey Blue Catfish geometric mean (Paul Piavis). Weakly correlated, r = -0.23, P = 0.21.



Stoplight summary of factors for recent poor year-classes. Colors indicate my level of concern

Factor	Stoplight
Spawning temperature	Shorter span, rapid warming
Climate & weather	Warm winters, climate patterns, climate warming
Eggs	Is 2024 drop real?
Flow	What mechanism?
Feeding	2023 & 2024 good
Toxic pH, buffering, metals	Clean Air Act, ag BMPs
Blue Catfish	Low Potomac JI correlation
Other?	New toxics, ????

Contact Jim Uphoff
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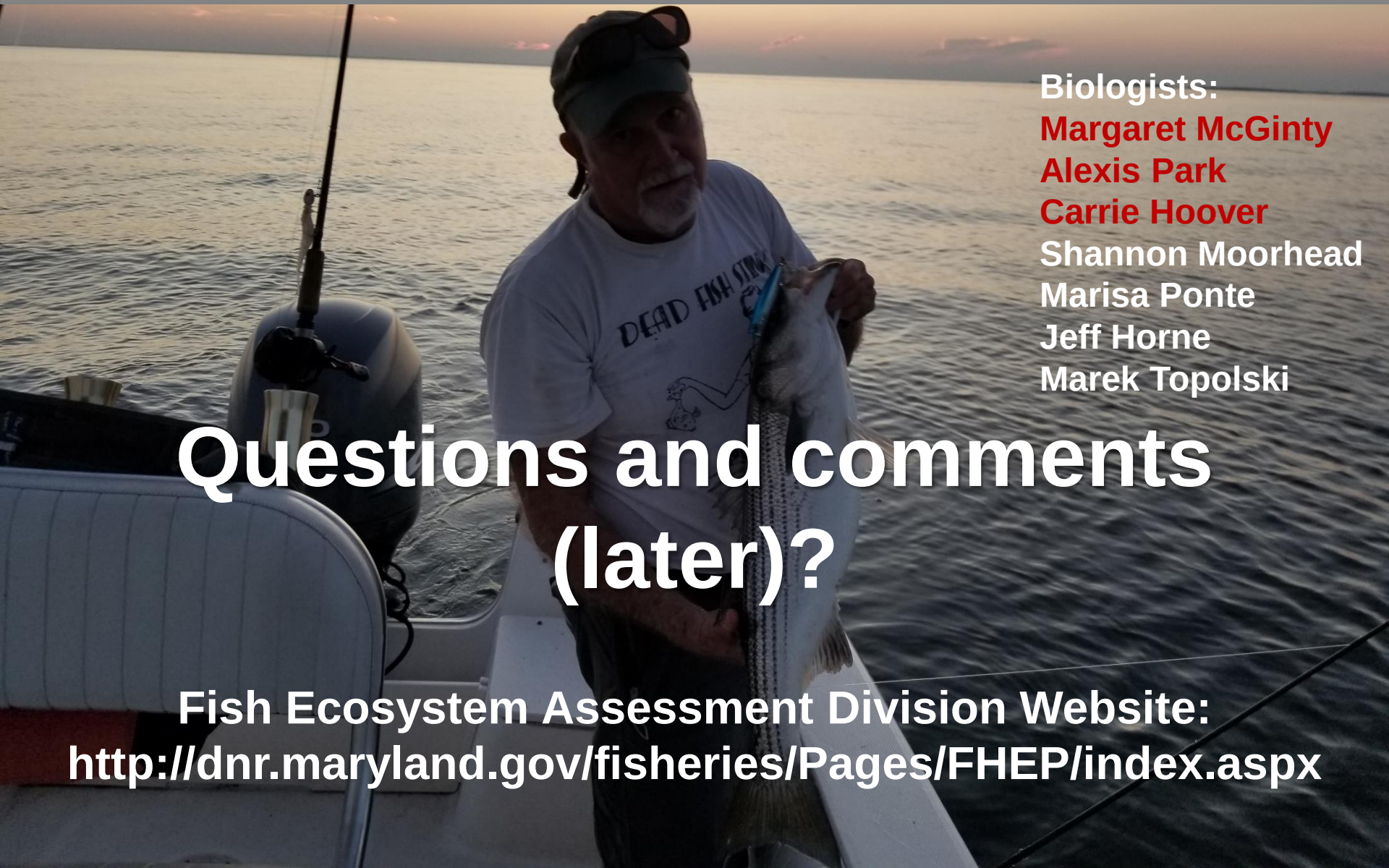

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Marek Topolski

Questions and comments (later)?

Fish Ecosystem Assessment Division Website:
http://dnr.maryland.gov/fisheries/Pages/FHEP/index.aspx