

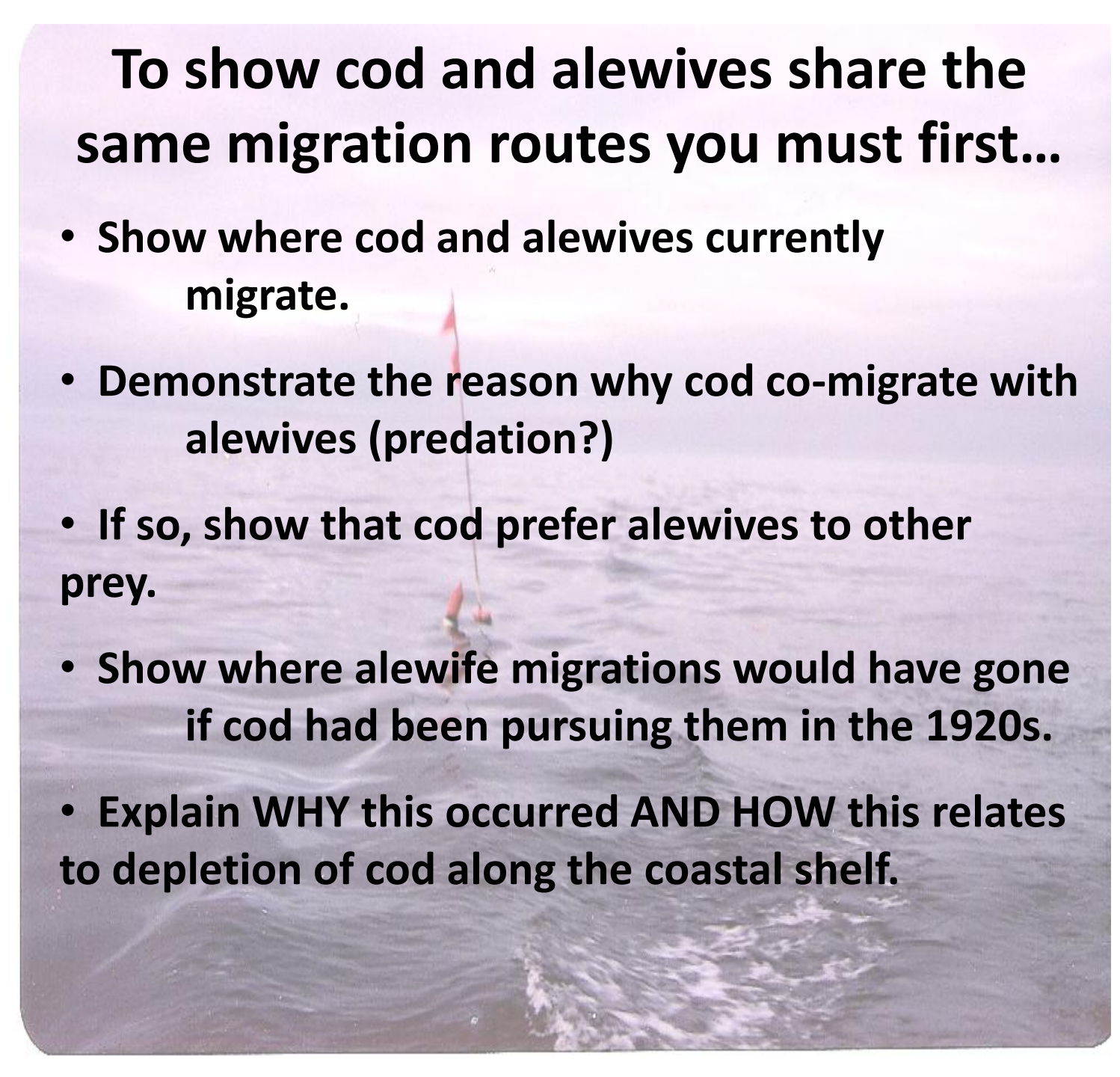
A bathymetric map of the Gulf of Maine, showing the seafloor topography. The map uses a color scale from light blue (shallow) to dark blue (deep). The Gulf of Maine is the large, deep basin on the right side of the map, and the continental shelf is visible on the left. The text is overlaid on a semi-transparent orange and red rectangular box.

MIGRATIONS: HISTORICAL COD & ALEWIVES IN THE GULF OF MAINE

DID THEY USE THE SAME ROUTES?

To show cod and alewives share the same migration routes you must first...

- Show where cod and alewives currently migrate.
- Demonstrate the reason why cod co-migrate with alewives (predation?)
- If so, show that cod prefer alewives to other prey.
- Show where alewife migrations would have gone if cod had been pursuing them in the 1920s.
- Explain WHY this occurred AND HOW this relates to depletion of cod along the coastal shelf.



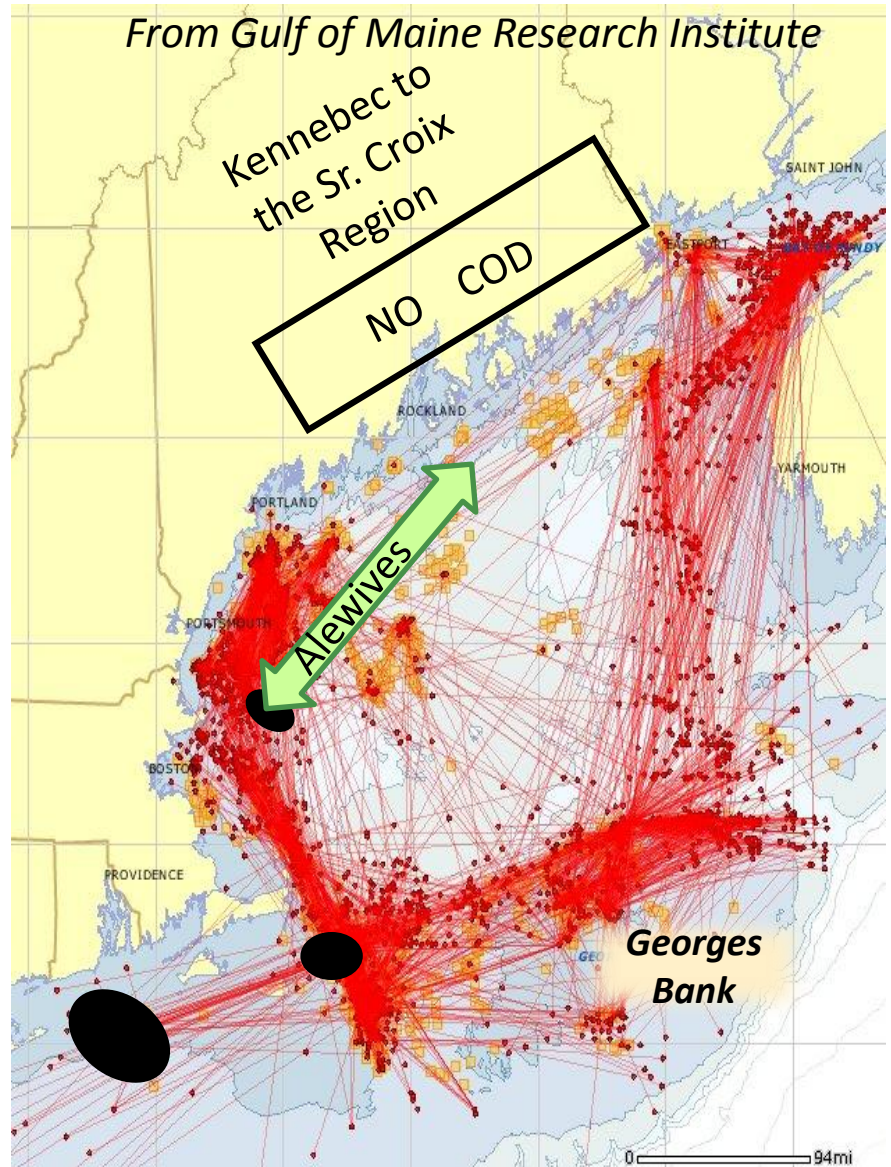
Cod Migrations And Overwintering Alewives

No cod tag returns within 150 miles of Canada.

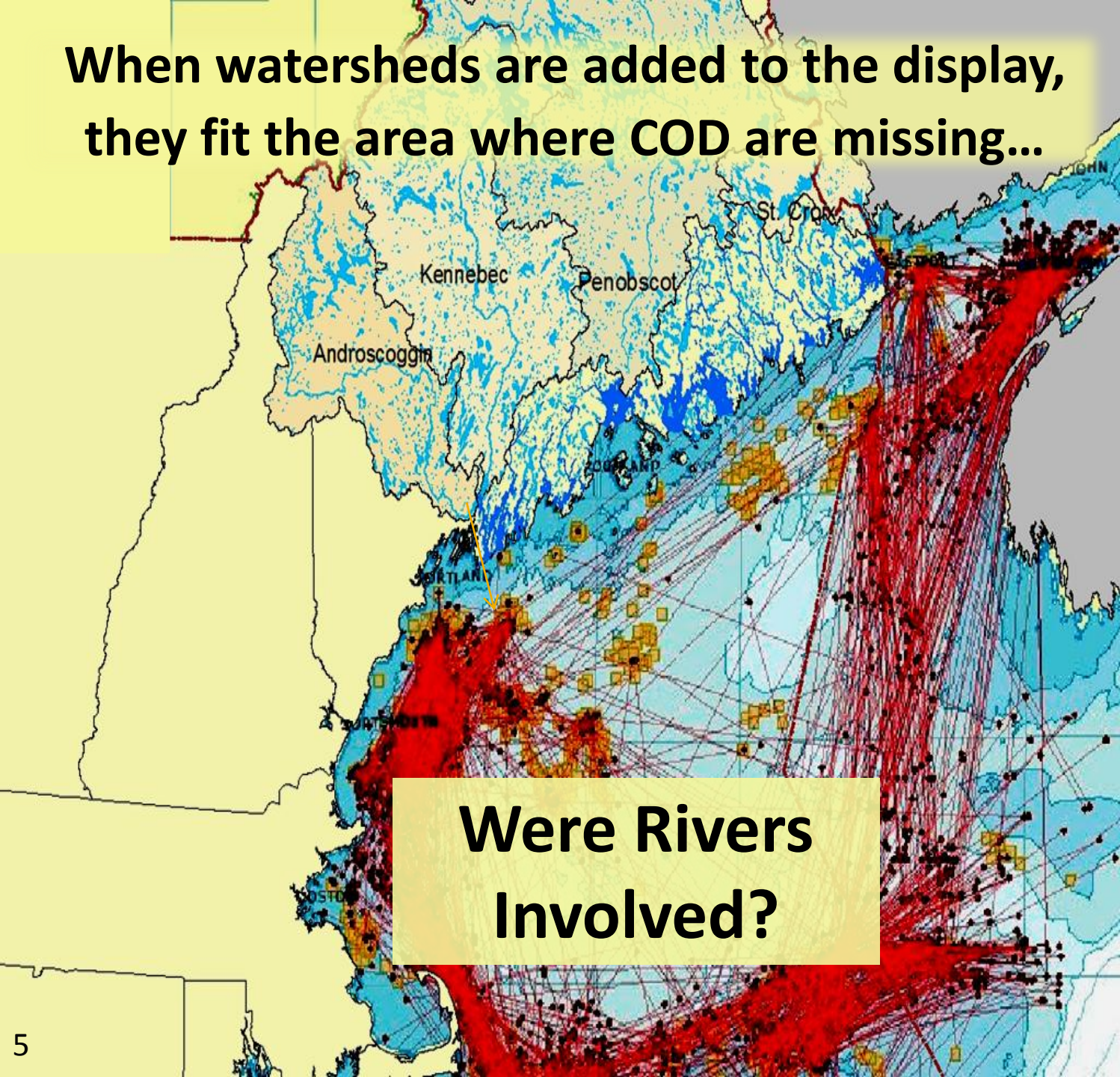
***Tan squares** are where **110,000 cod** were tagged.

***Red dots** were where tags were recovered. Red lines connect the two.

***Black areas** are winter locations of alewives.

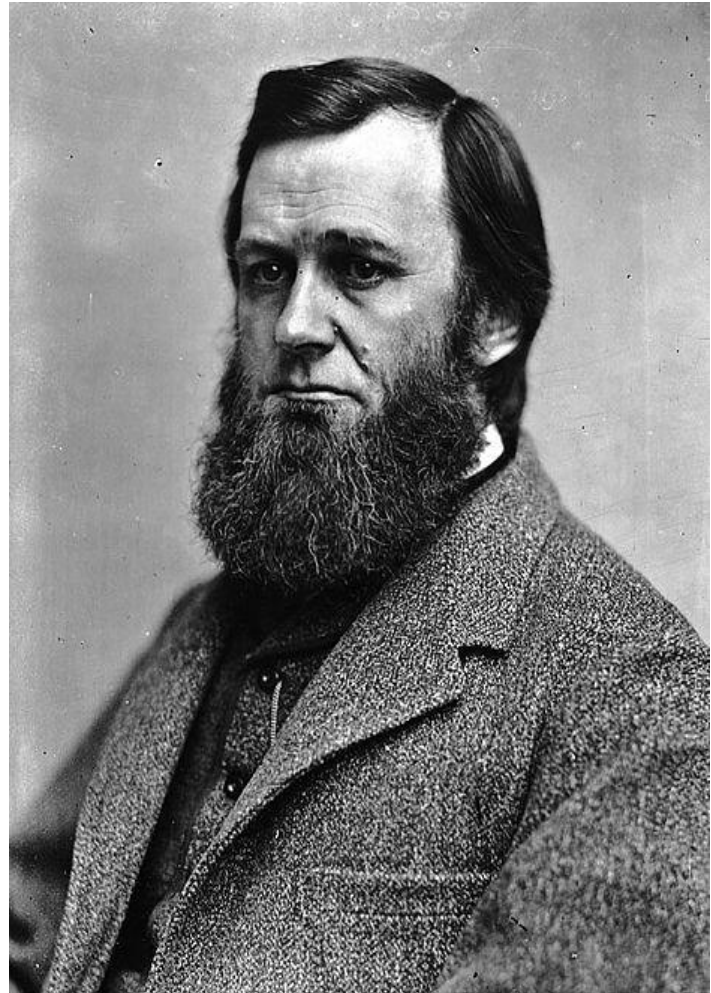


**When watersheds are added to the display,
they fit the area where COD are missing...**



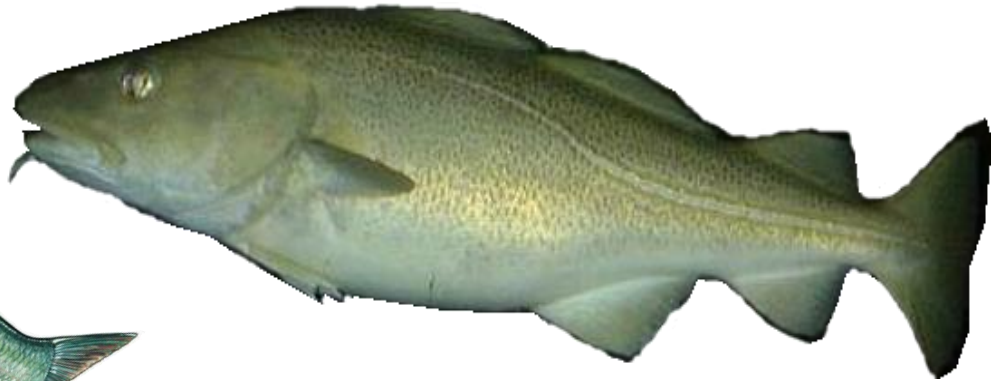
**Were Rivers
Involved?**

- In 1883, U.S. Commissioner Spencer Baird reported to Congress that the collapse of the coastal cod fishery after the Civil War was due to the collapse of alewife runs, caused by construction of dams at head-of-tide.



Had that happened again?

COD-ALWIFE CONNECTIONS IN THE 1860s and 1920s



Was Baird right?

Kennebec

Penobscot

MAINE

Androscoggin

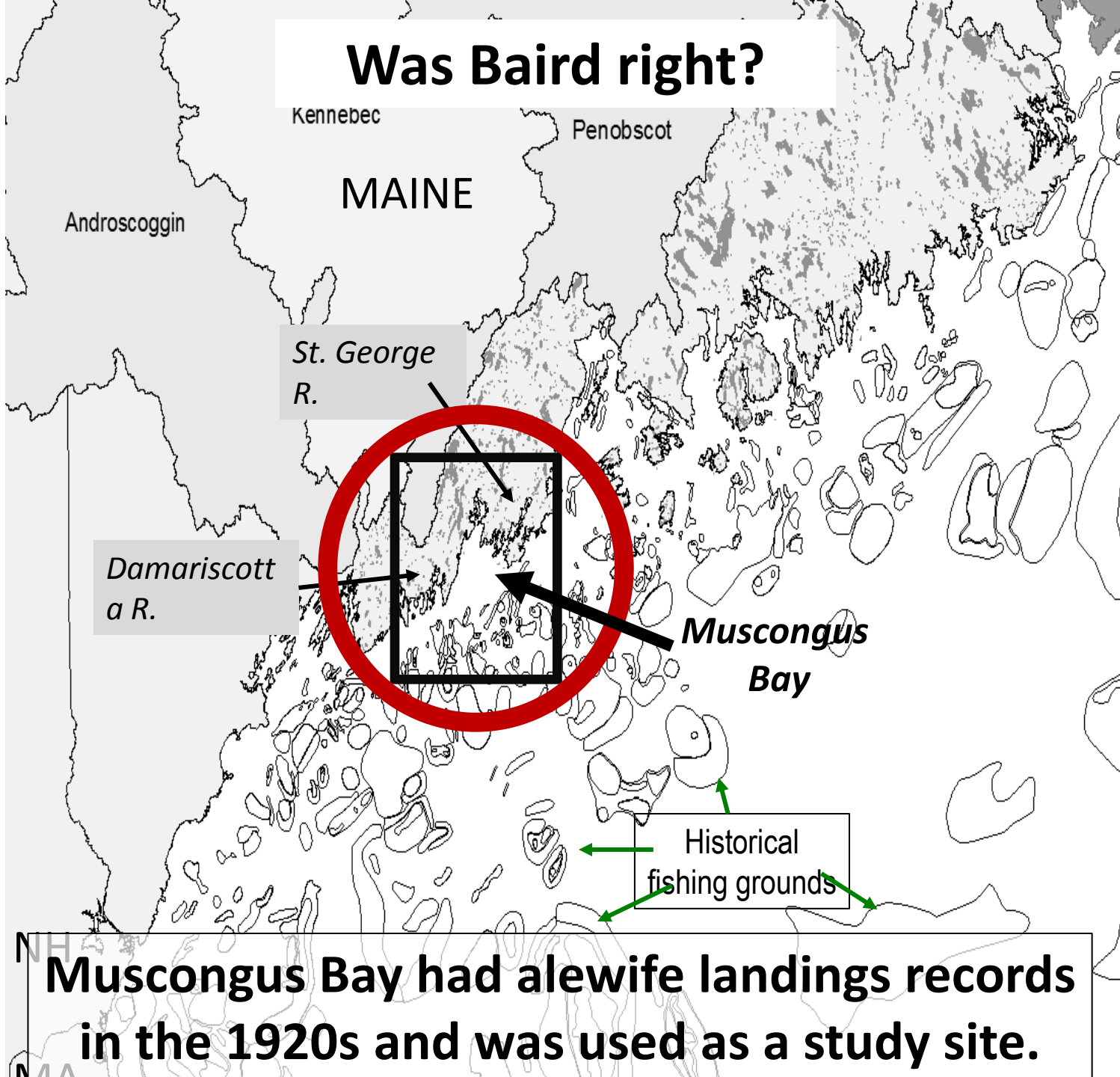
St. George
R.

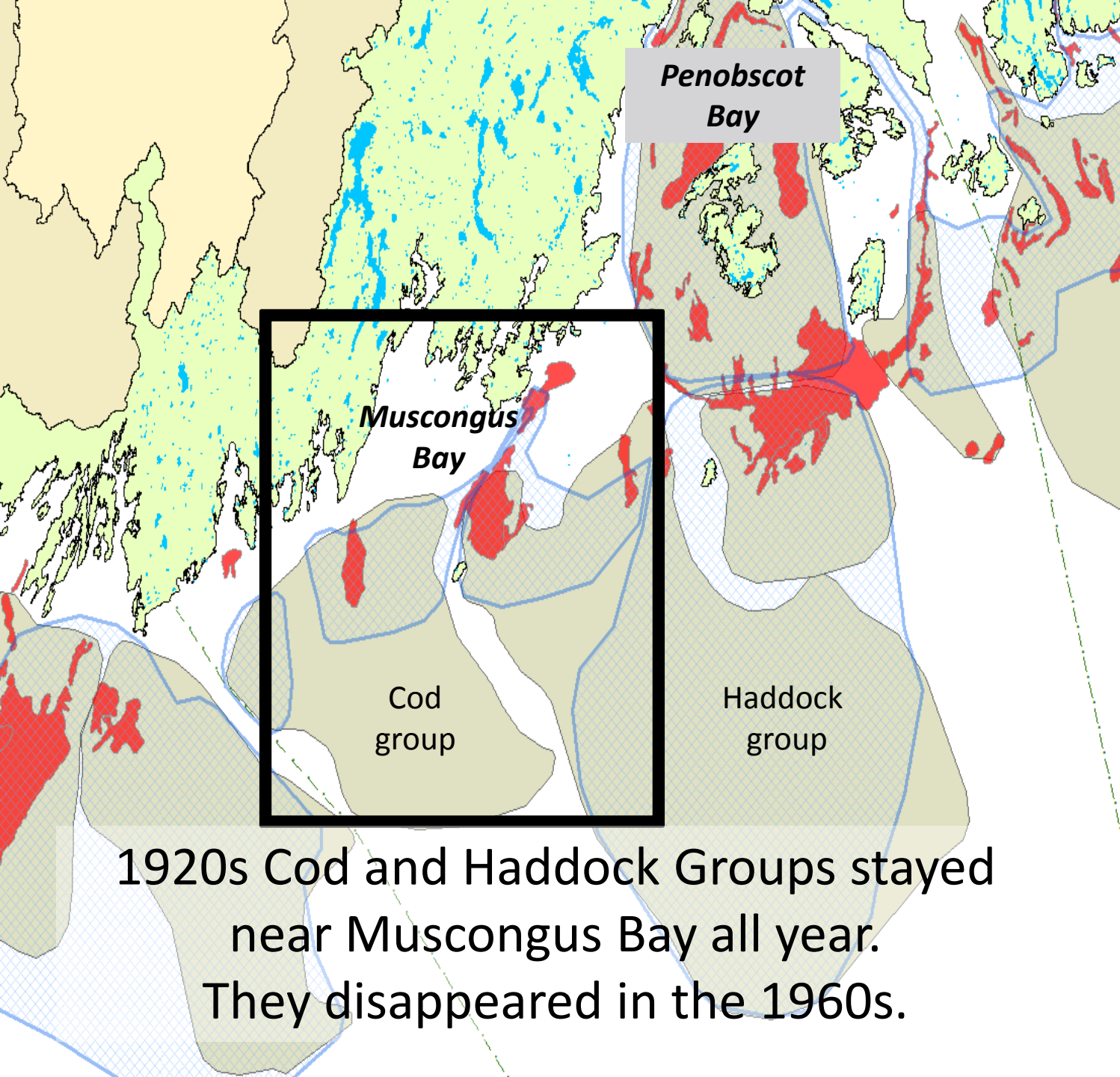
Damariscott
a R.

Muscongus
Bay

Historical
fishing grounds

Muscongus Bay had alewife landings records in the 1920s and was used as a study site.





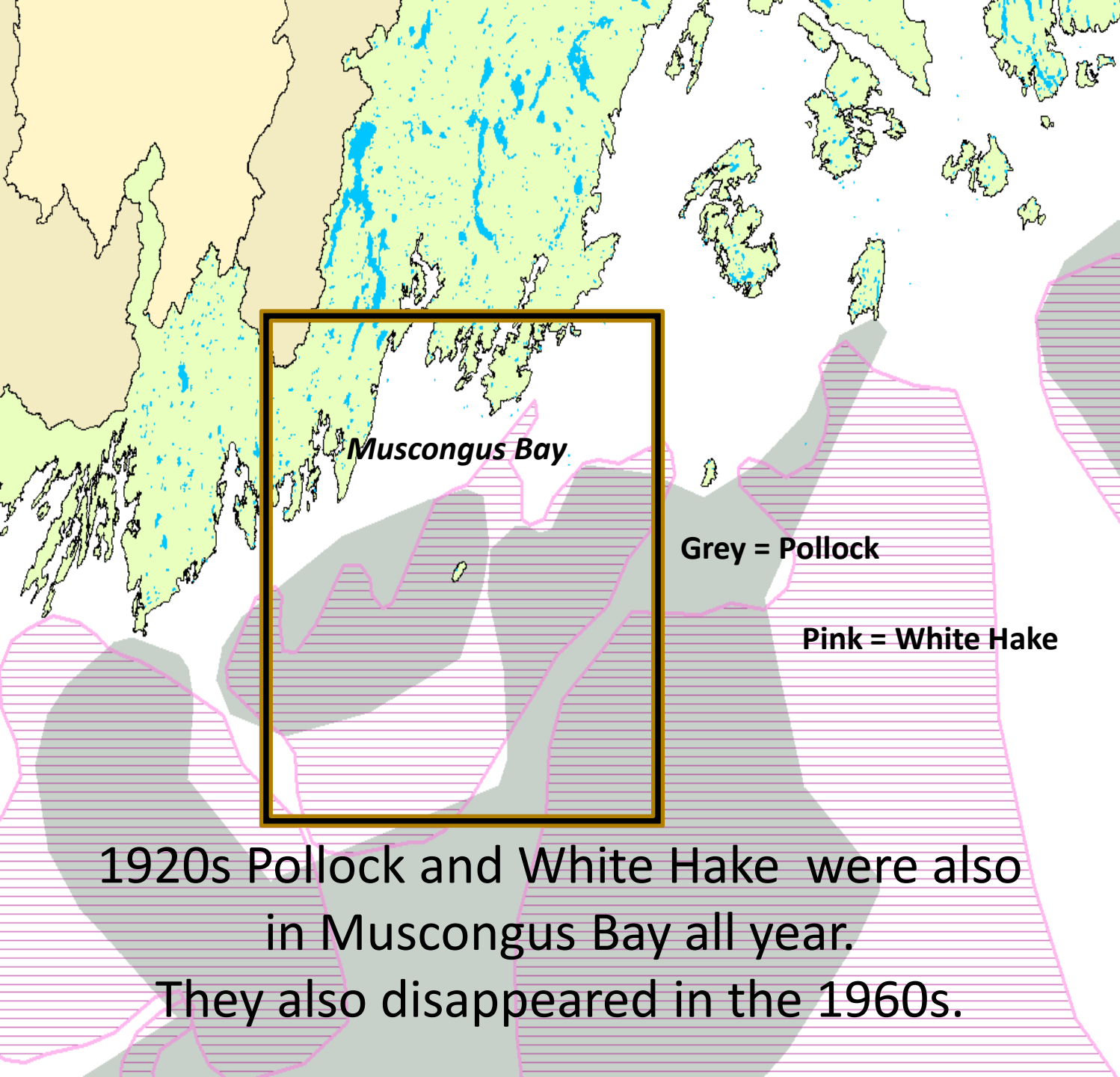
Penobscot Bay

Muscongus Bay

Cod group

Haddock group

1920s Cod and Haddock Groups stayed near Muscongus Bay all year. They disappeared in the 1960s.



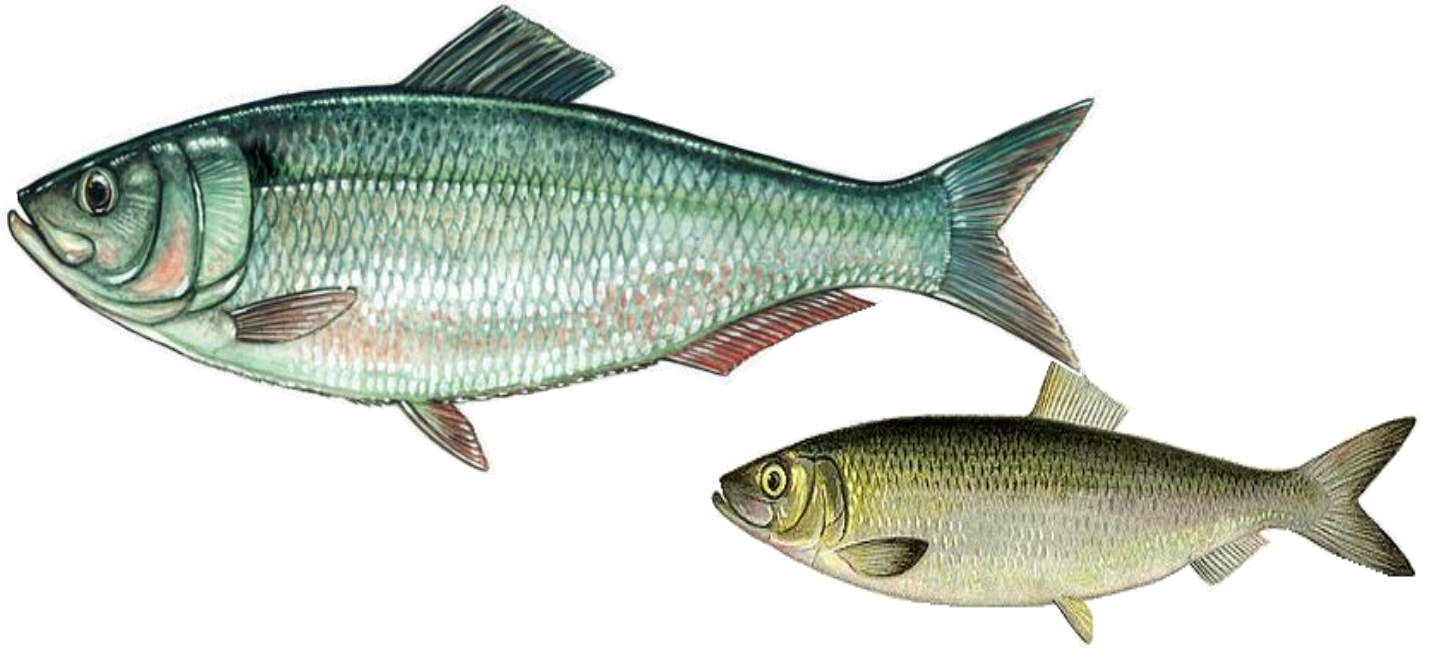
Muscongus Bay

Grey = Pollock

Pink = White Hake

1920s Pollock and White Hake were also in Muscongus Bay all year. They also disappeared in the 1960s.

Adult alewives and bluebacks co-migrate with Atlantic herring in the spring and fall...



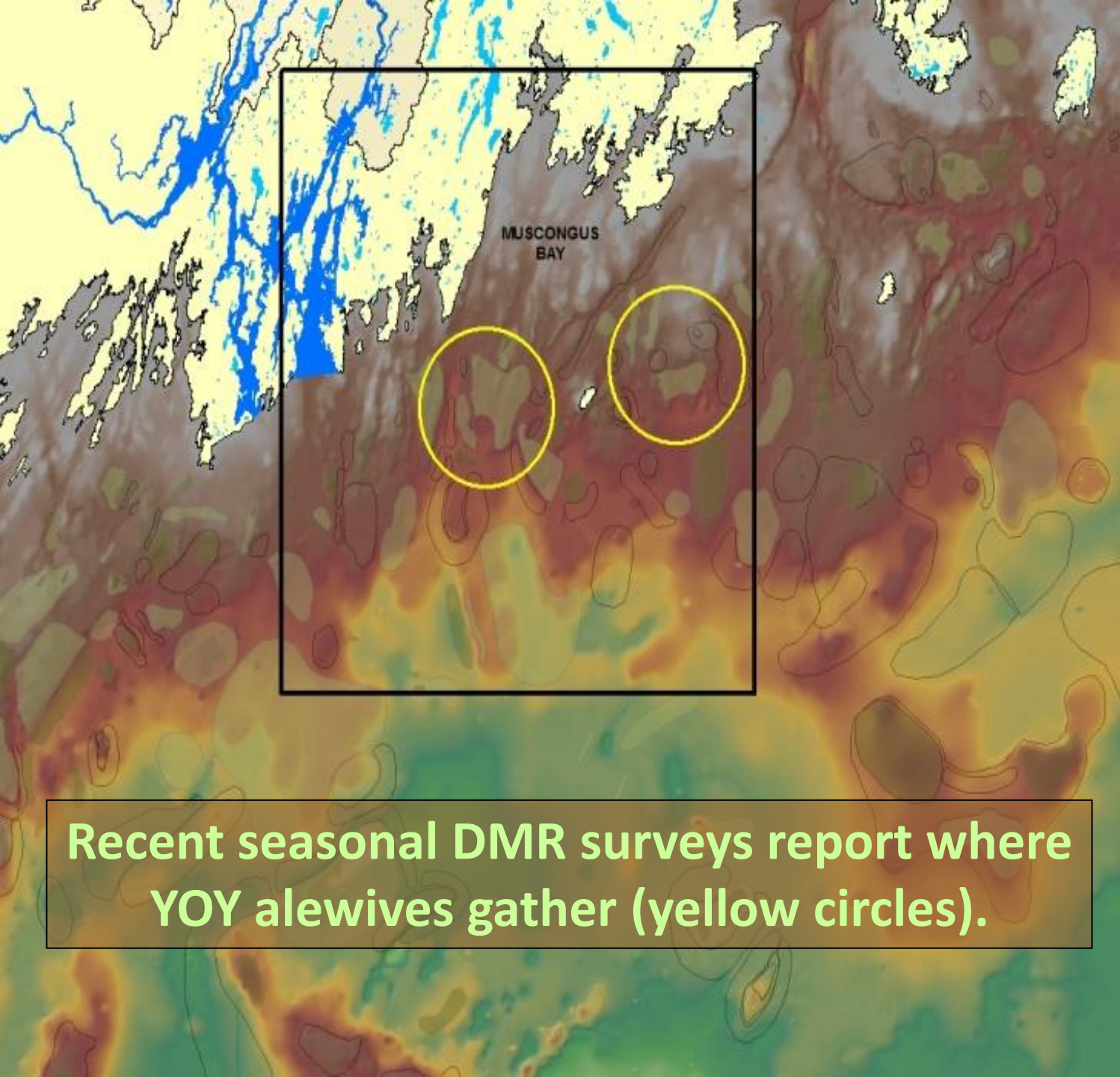
But YOY alewives remained in the area all year.



If local cod were actually preying on JV alewives...

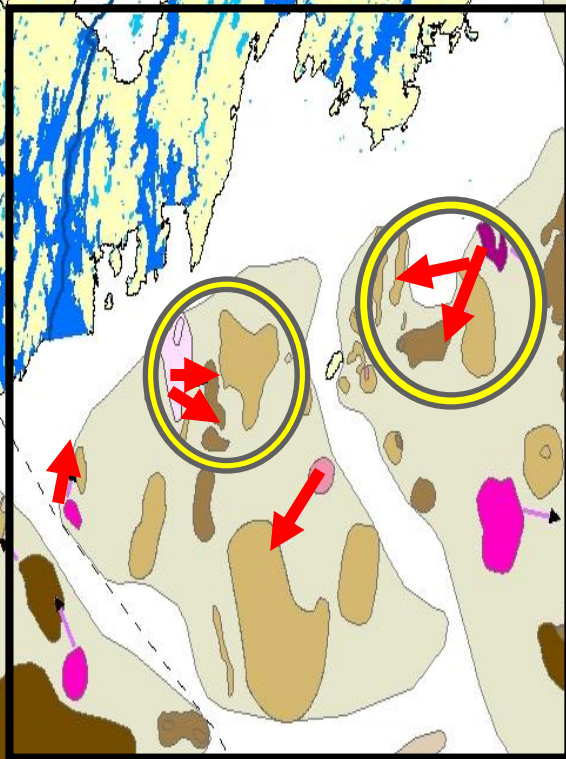
- **In fall, cod would come to inshore grounds** to prey on YOY alewives arriving there from natal rivers and pursue them through winter and the following spring.
- **If not, the cod would migrate away** from the area, indicating a minimal attraction for young alewives.

Let's look at this more closely...



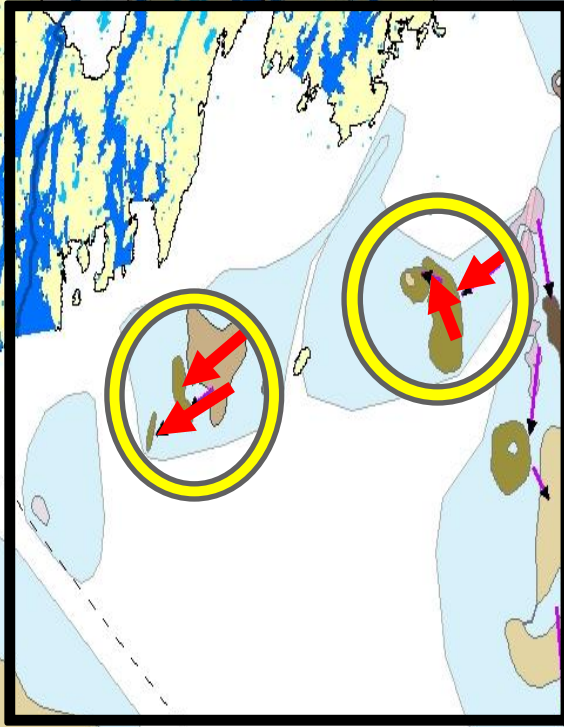
**Recent seasonal DMR surveys report where
YOY alewives gather (yellow circles).**

**Cod moved to the same grounds as
YOY alewives, rather than offshore!**



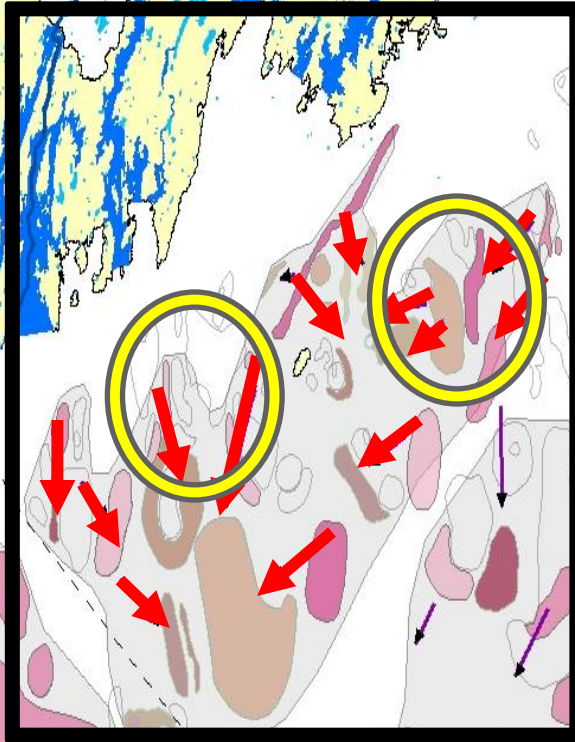
Cod moves from summer to fall

**Haddock also moved closer to YOY
alewives**



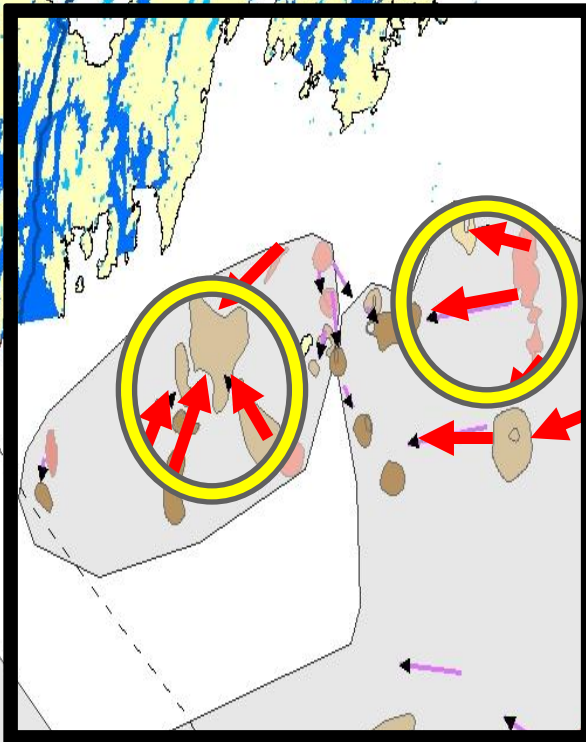
Haddock moves from summer to fall

So did white hake...



White Hake moves from summer to fall

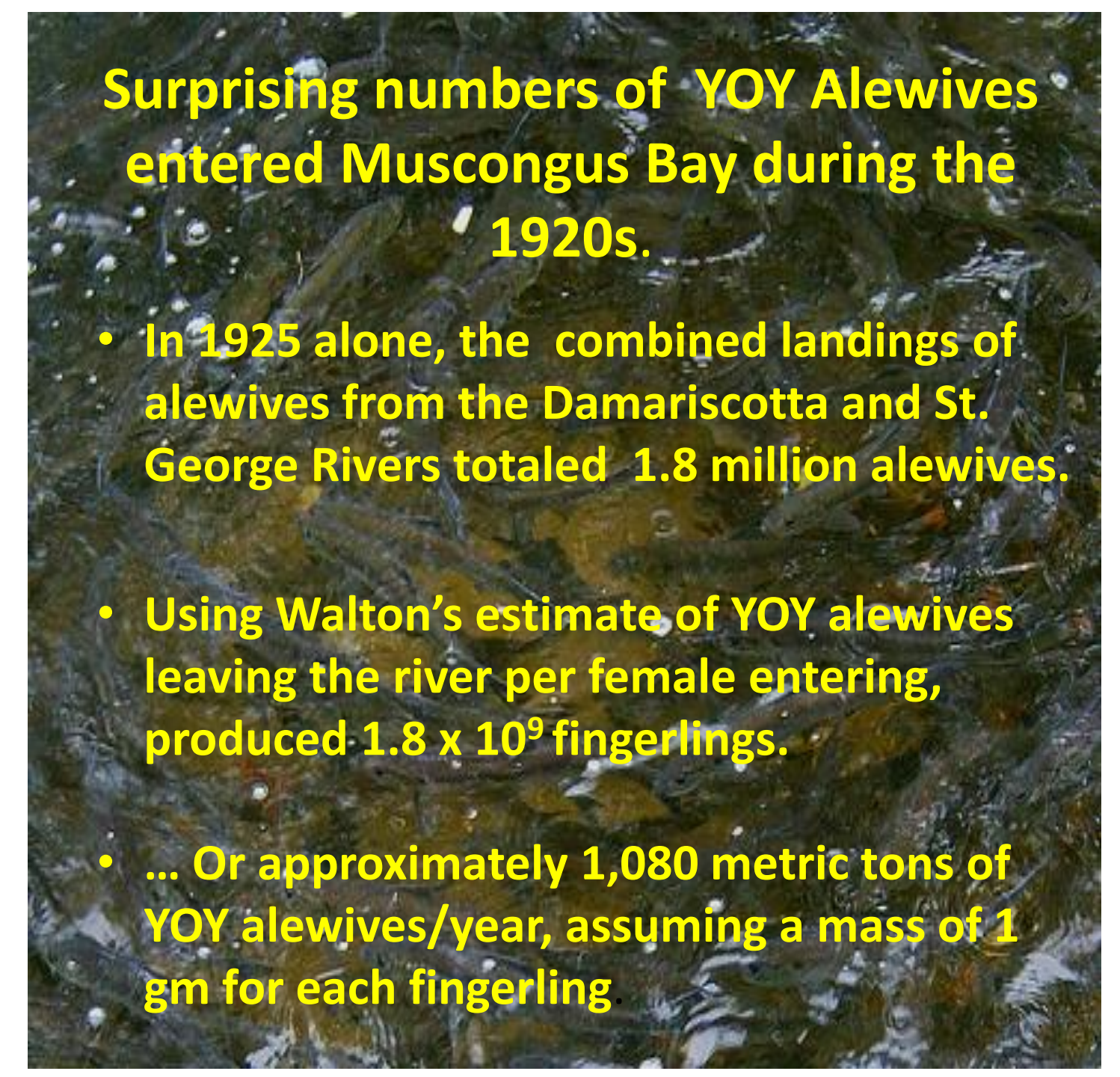
**Pollock also moved close to YOY
alewives**



Pollock moves from summer to fall

Cod left in the 1960s, even though invertebrates were still abundant...



A large number of young alewives (YOY) are seen swimming in a river, likely Muscongus Bay, during the 1920s. The fish are small and silvery, with some showing a slight yellowish tint. They are densely packed in the water, creating a shimmering effect. The background is dark and slightly out of focus, emphasizing the fish in the foreground.

Surprising numbers of YOY Alewives entered Muscongus Bay during the 1920s.

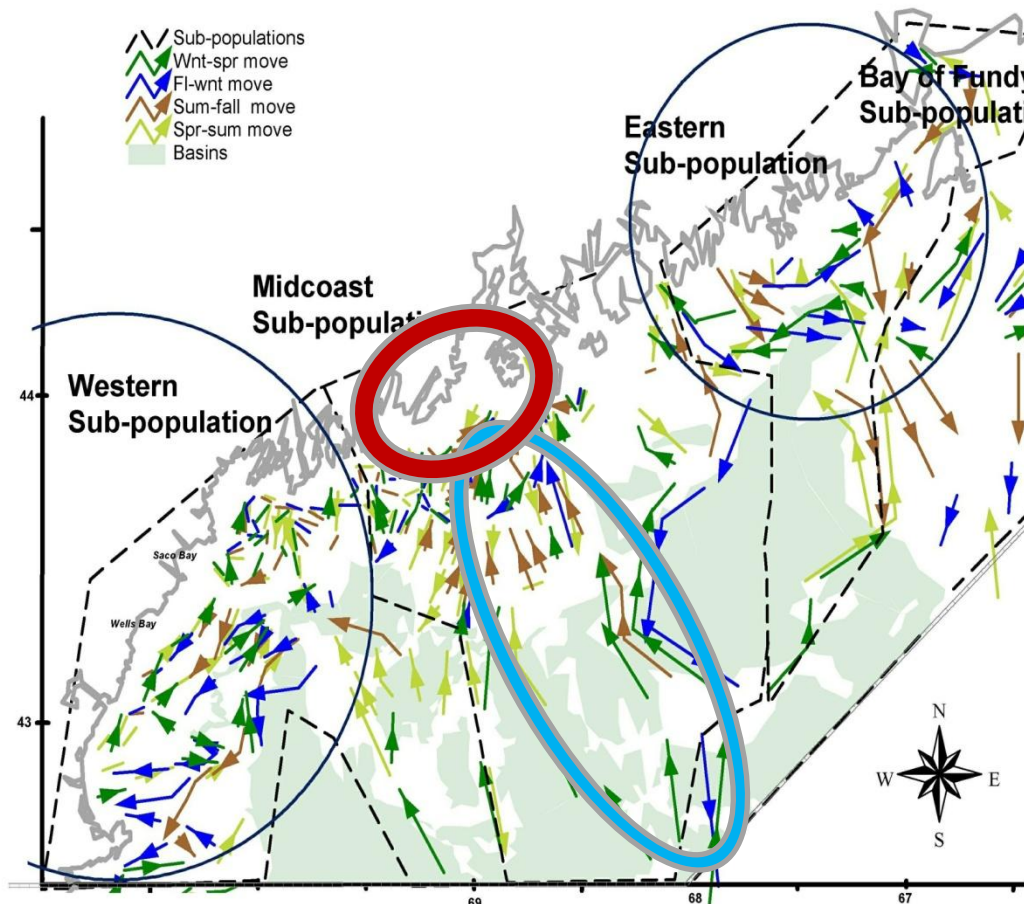
- In 1925 alone, the combined landings of alewives from the Damariscotta and St. George Rivers totaled 1.8 million alewives.
- Using Walton's estimate of YOY alewives leaving the river per female entering, produced 1.8×10^9 fingerlings.
- ... Or approximately 1,080 metric tons of YOY alewives/year, assuming a mass of 1 gm for each fingerling.

**1,100 mt fingerling alewives
would attract a lot of cod!**

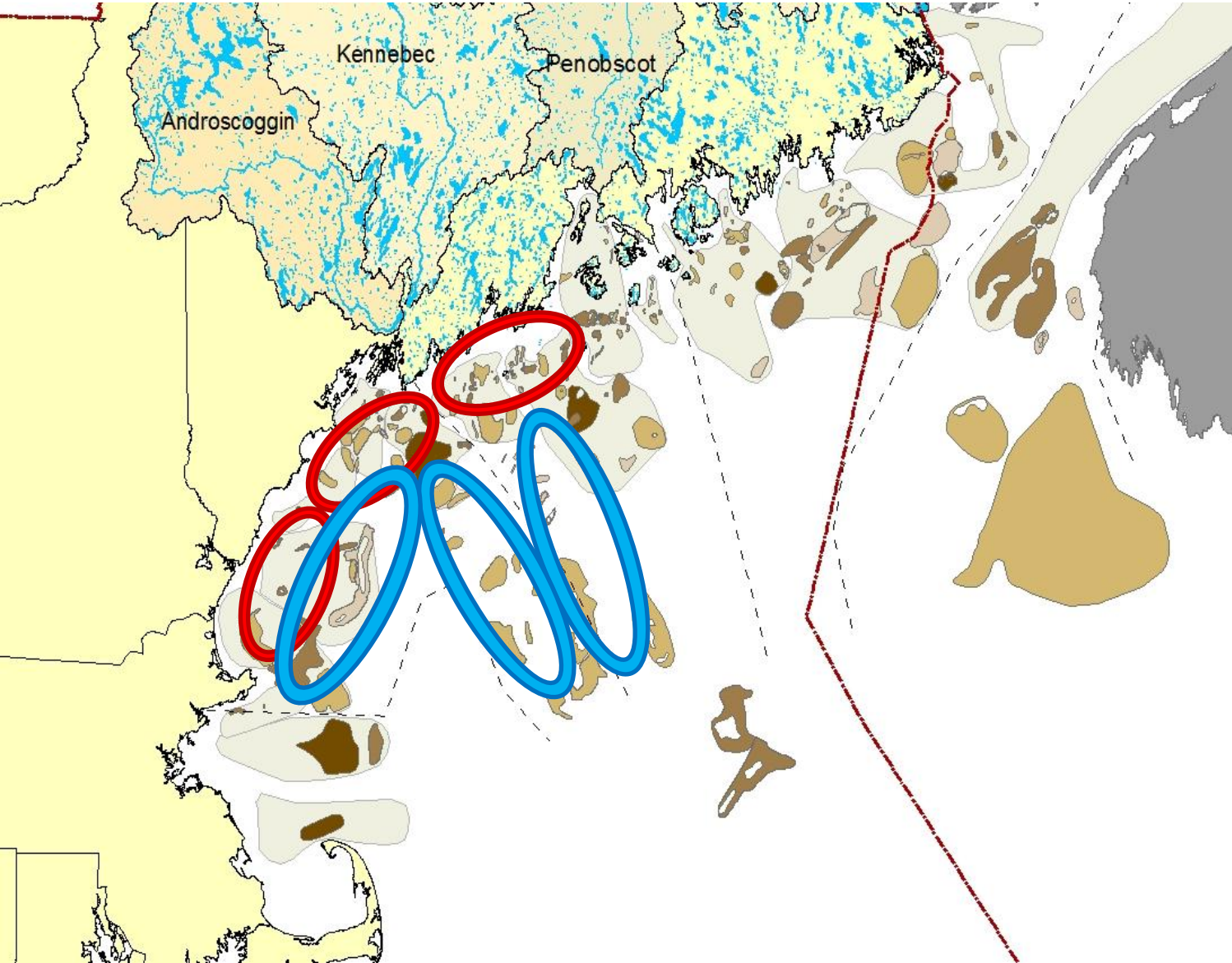


An Unexpected Connection

1920s Muscongus Bay alewives would have migrated south (blue), while their YOY (red) would have stayed near inshore grounds.



Alewife Migration Routes, Based On Historical Cod Migrations



Links between Cod and Alewives

- JV cod prey primarily on invertebrates and share the same estuaries with YOY alewives.
- At maturation their diet changes and YOY alewives as prey are the right size for JV cod.
- Cod had both resident and migrating groups near Muscongus Bay in the 1920s.
- Migrating alewives and cod arrived near Muscongus Bay in spring and left in the fall.
- Cod disappeared in the 1960s when alewives declined sharply, even though numerous other prey species were still present and abundant.
- The 1960s cod collapse parallels similar events in the 1860s and ~with herring in the 1990s.