

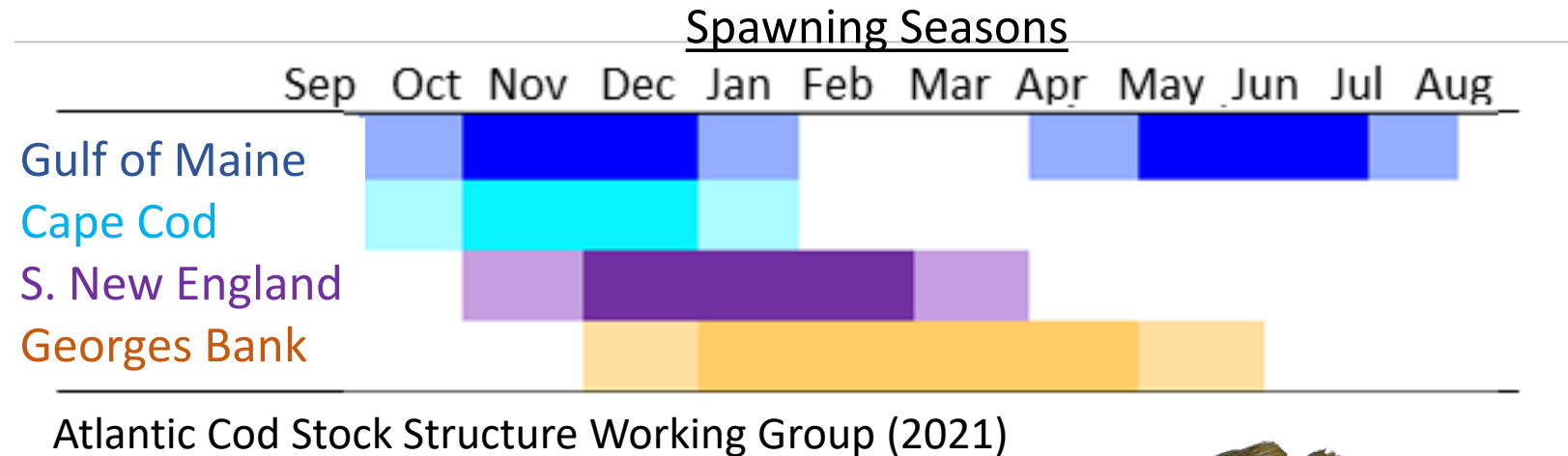
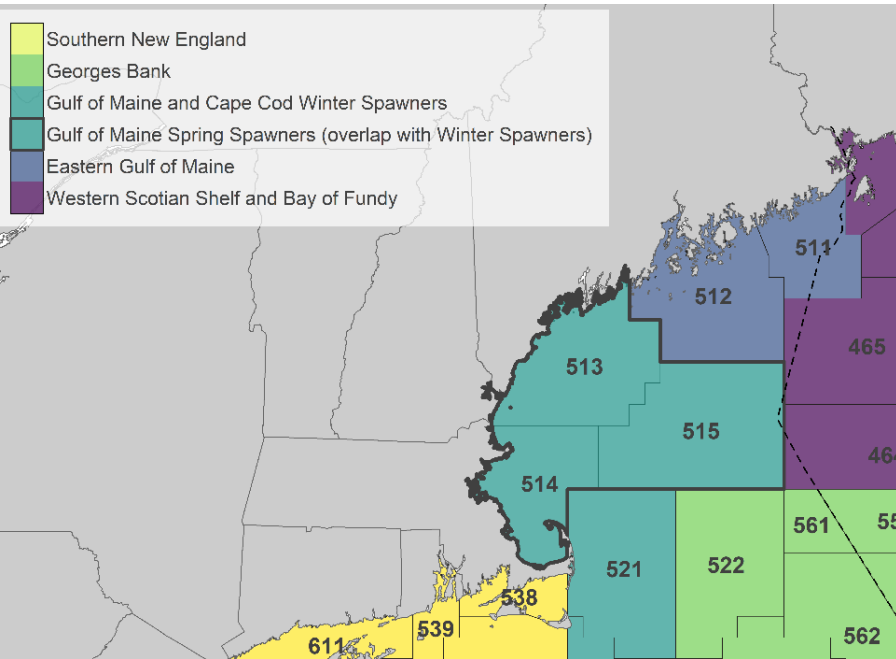
# Winter & Spring Spawning Cod in the Gulf of Maine



Steve Cadrin, UMass School for Marine Science & Technology

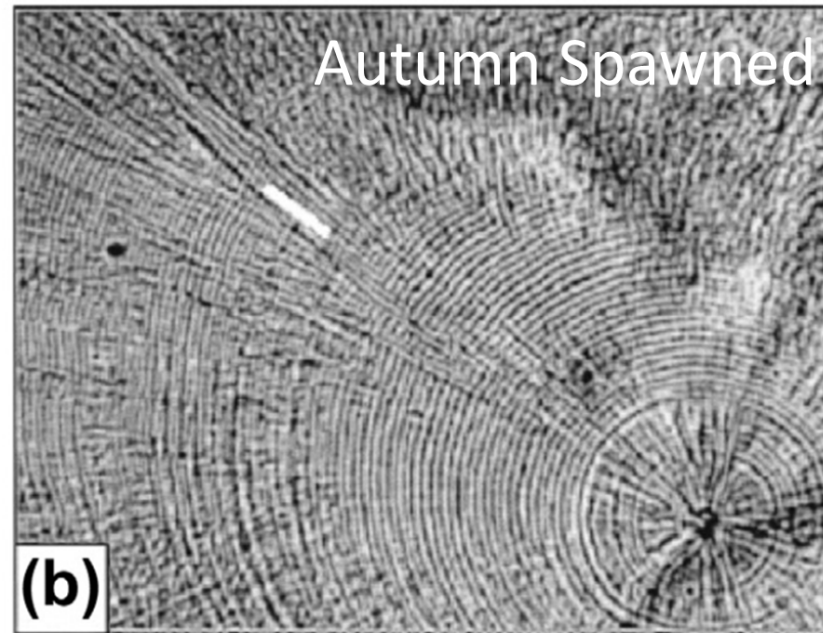
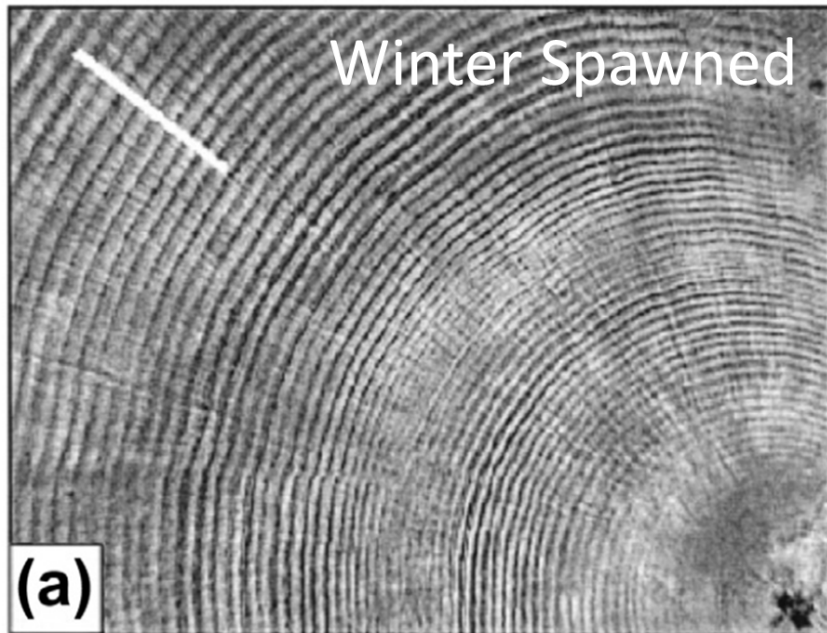
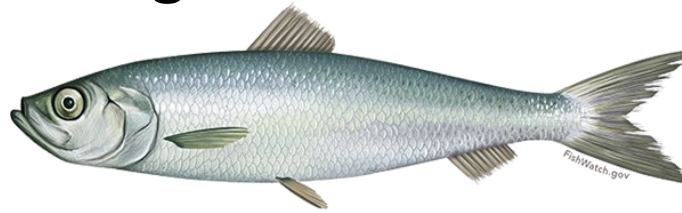
# Winter & Spring Spawners

- There are two **distinct spawning seasons** for cod in **the western Gulf of Maine**.
- Winter spawners are separate genetic population than spring spawners.
- Ignoring population structure played a role in the collapse of northern cod off Newfoundland and the lack of rebuilding of cod fisheries in the North Sea.
- To rebuild the Gulf of Maine cod fishery, we need to rebuild both populations.
- How can we account for this population structure in fishery management?



# Managing Mixed Stock Fisheries

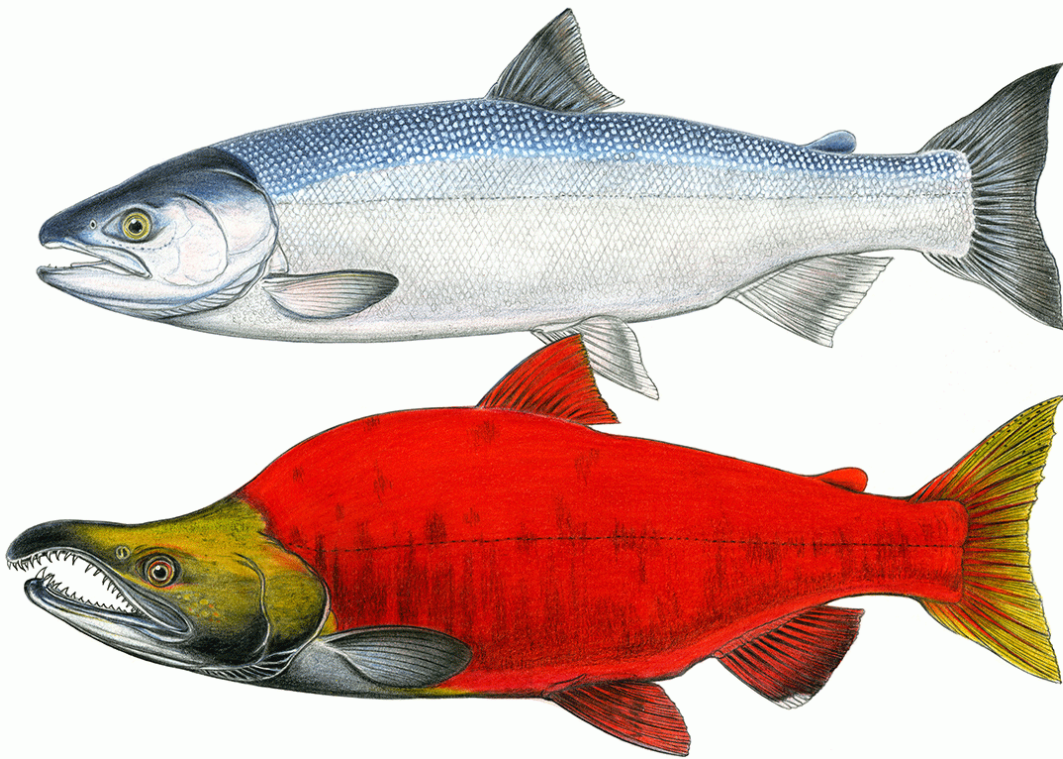
- Europeans rebuilt autumn spawning North Sea herring and spring spawning Baltic herring by sampling otoliths, determining spawning season, estimating stock composition, and allocating national catches to each spawning group.



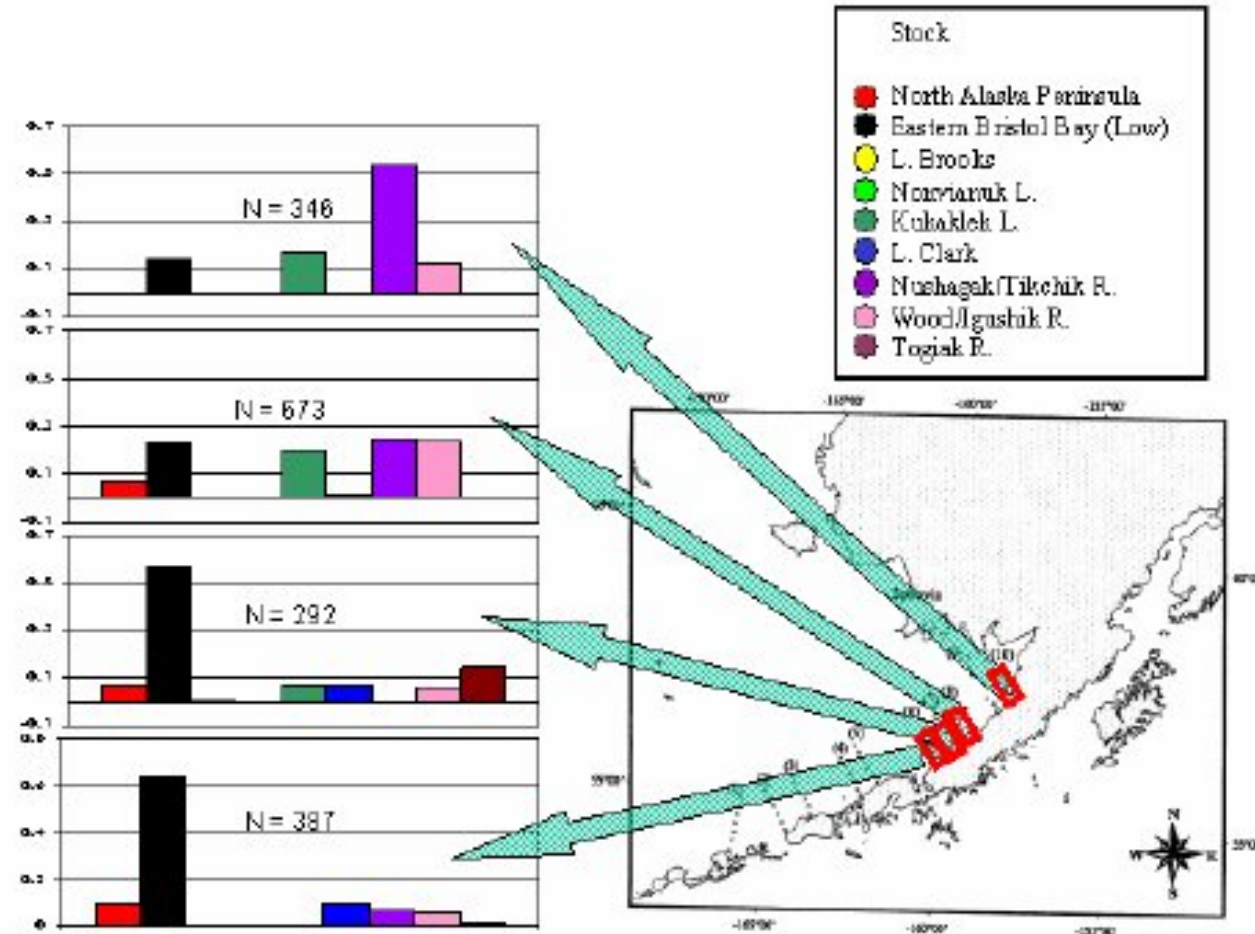
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# Managing Mixed Stock Fisheries

- The primary reason Alaskan salmon fisheries are more productive than other west coast salmon fisheries is effective conservation of population structure.
- Alaskan fisheries are routinely sampled for stock composition and managed to conserve each population separately.



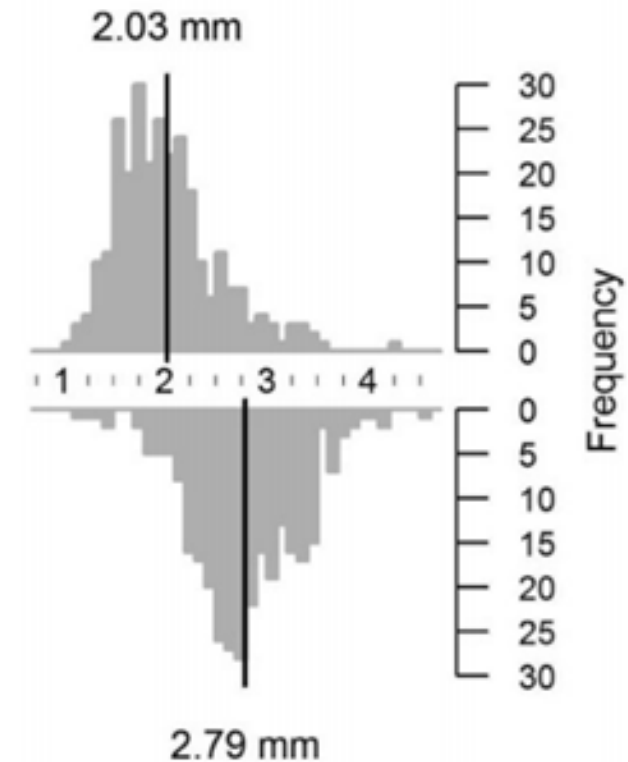
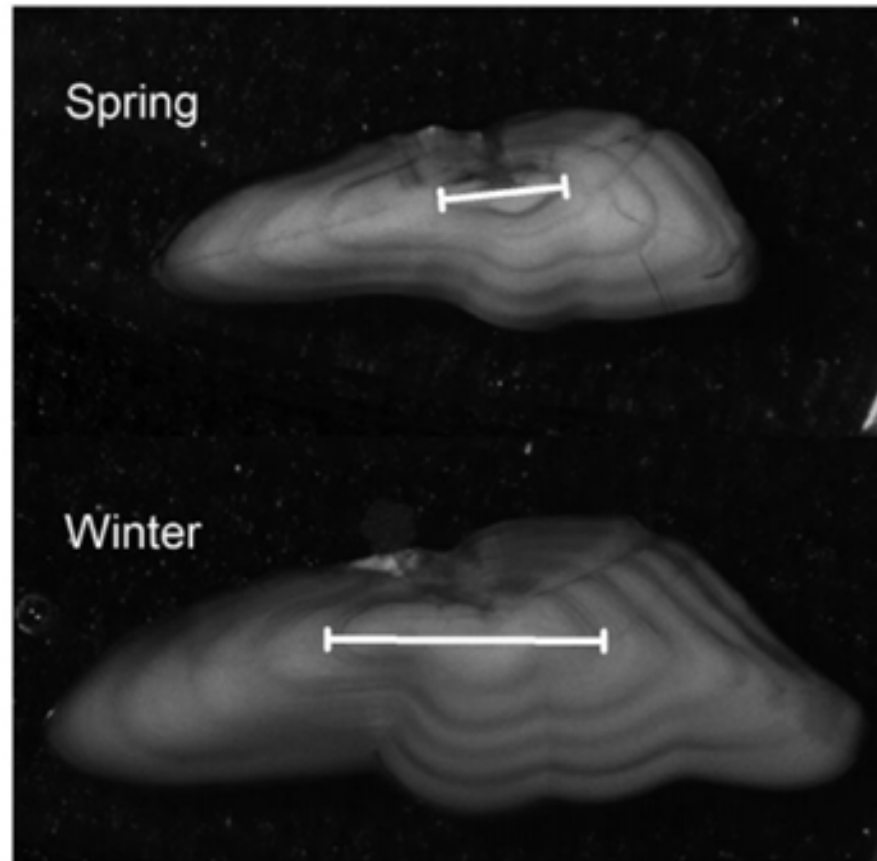
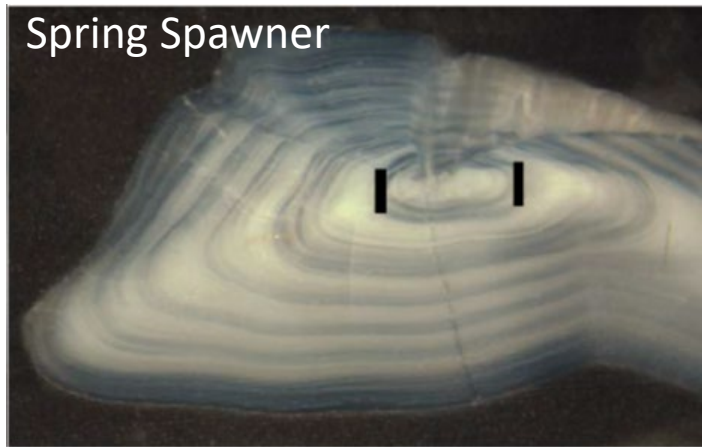
*Deerwhitlock*



# Classifying Winter & Spring Spawning Cod



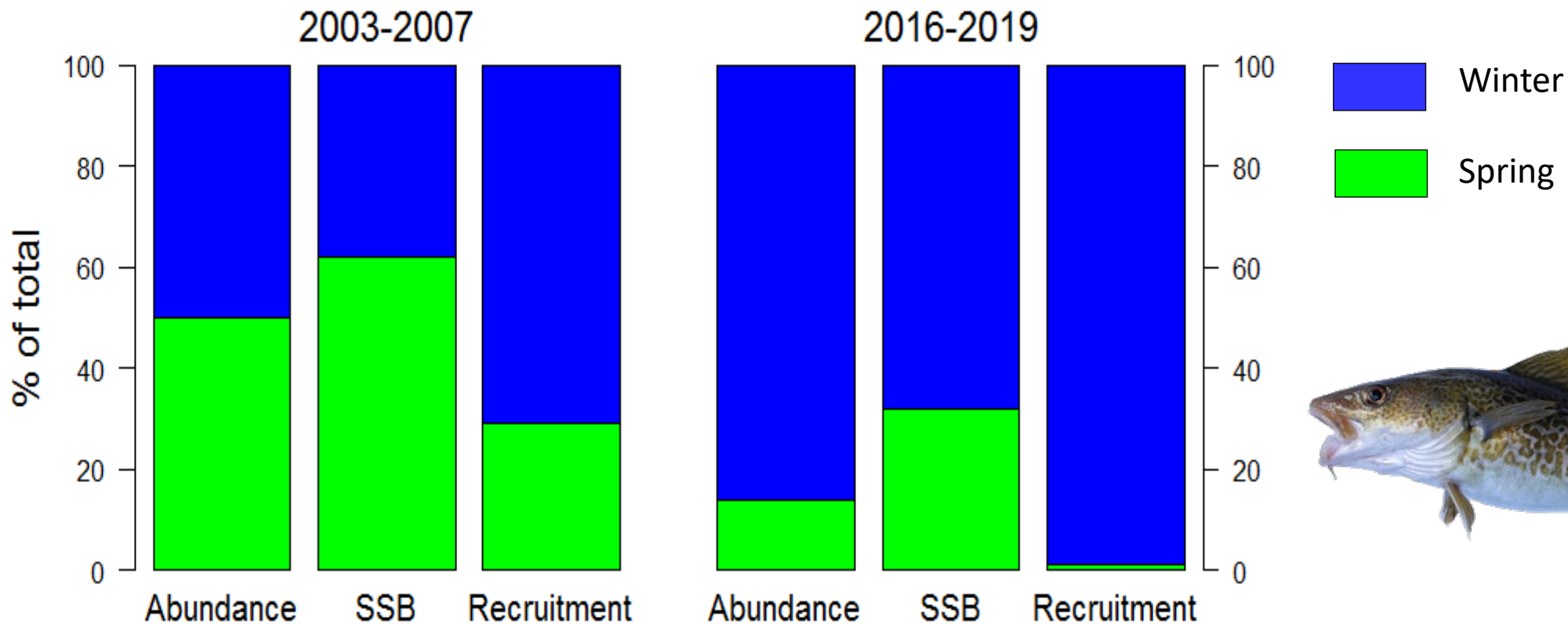
- The same otoliths sampled to estimate cod age composition can be used to determine stock composition using either genetics or growth rings.
- Spring spawners have a smaller first growth ring than winter spawners.



Dean et al. 2019

# Classifying Winter & Spring Spawning Cod

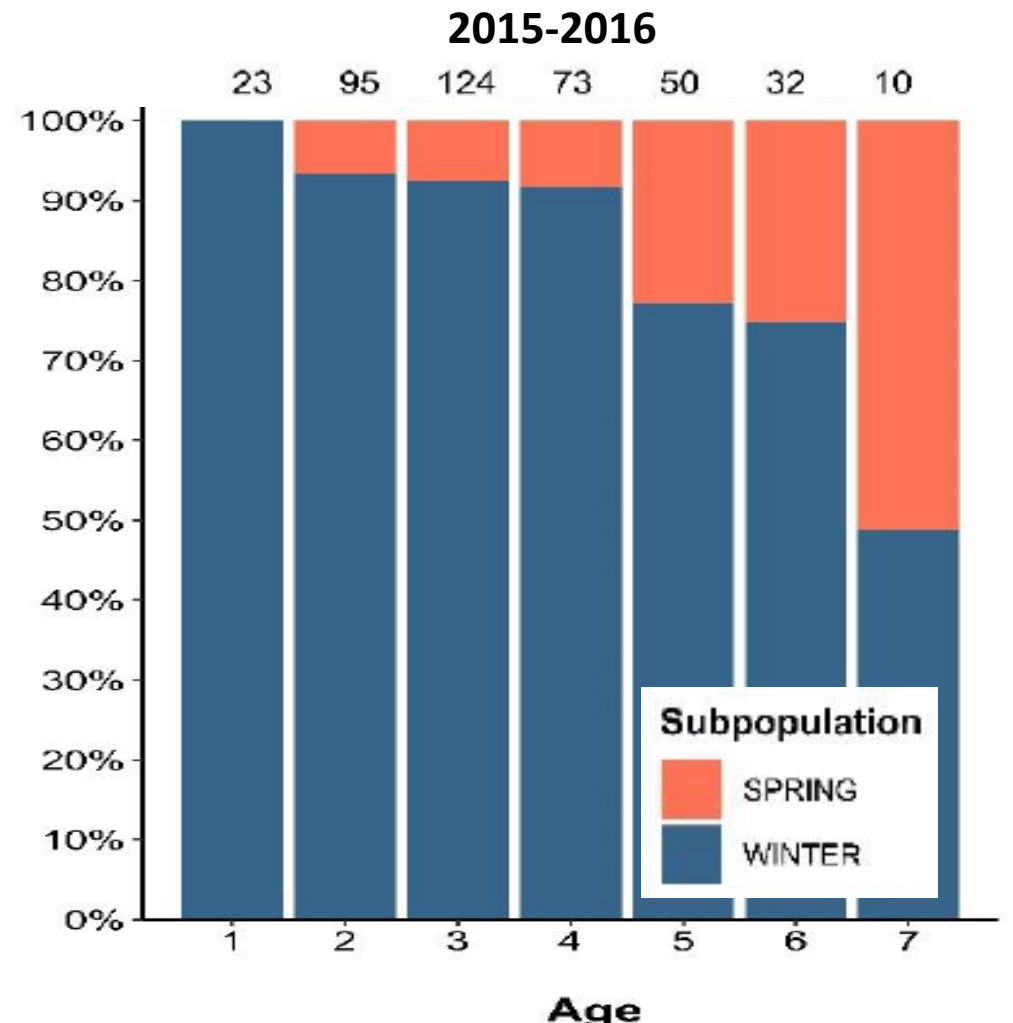
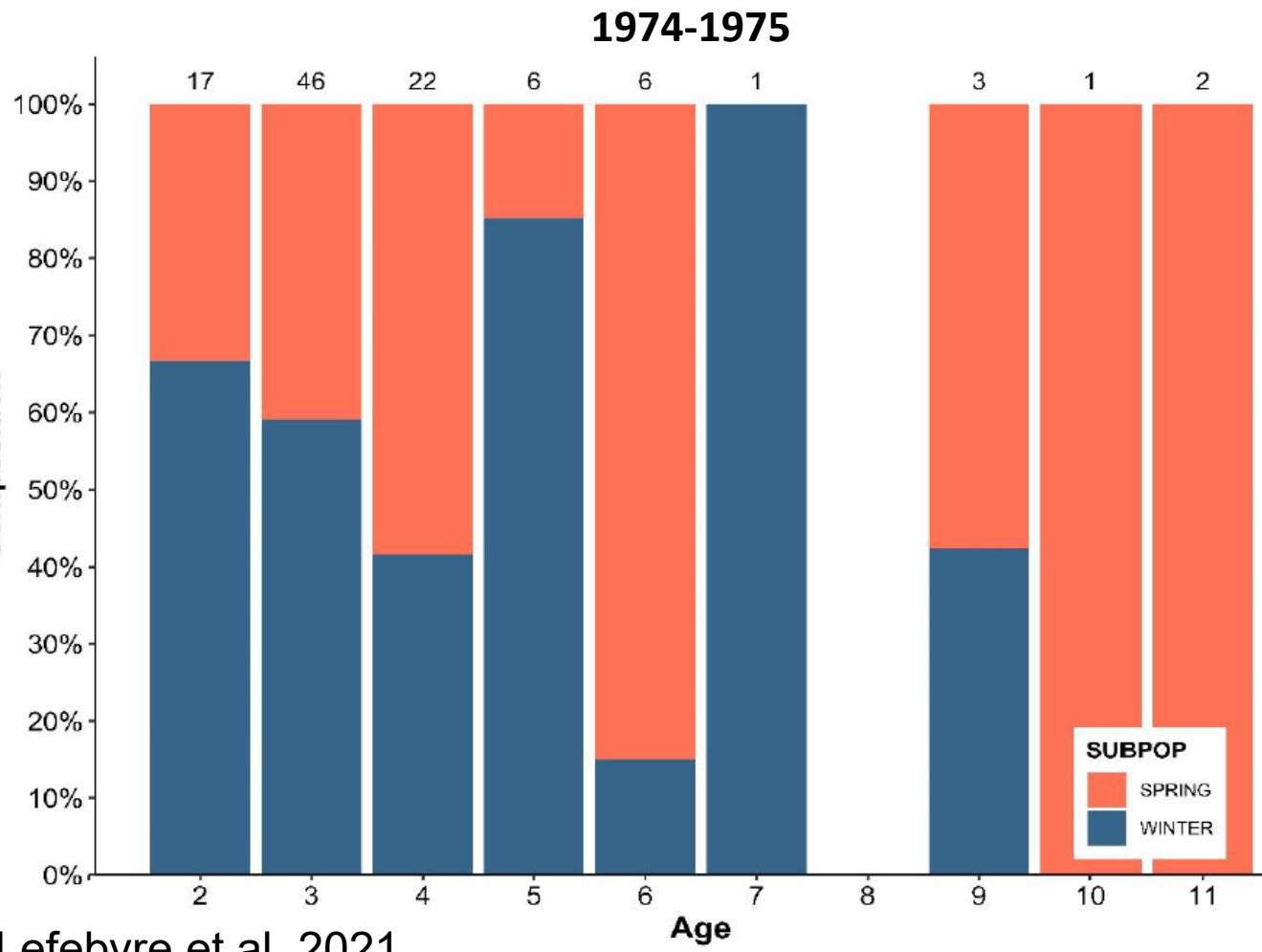
- Otoliths samples can be used to estimate current stock composition, and archived otoliths can be used to estimate historical stock composition.
- Otoliths from the MADMF cod industry-based survey showed a decrease in the proportion of **spring spawners**.



# Classifying Winter & Spring Spawning Cod



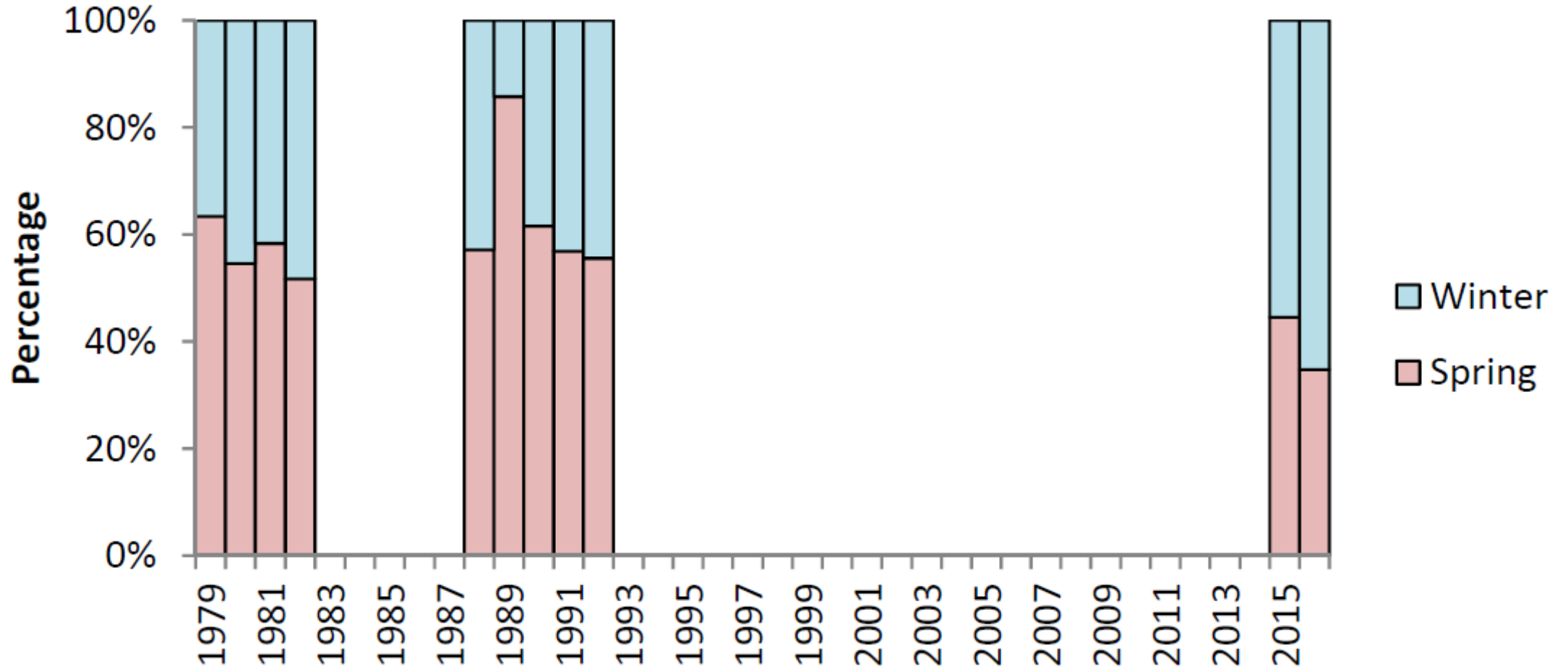
- The Northeast Fisheries Science Center assessed the feasibility of classifying winter vs. spring spawners using otolith samples from trawl surveys.



# Classifying Winter & Spring Spawning Cod



- Analysis of genetics from archived otoliths also showed a decrease in the contribution of **spring spawners**.





# Options for Managing Gulf of Maine Cod Fisheries

1. The two seasonal spawning populations can continue to be assessed and managed as a single stock with seasonal spawning closures.
2. Information on stock composition can be used to monitor the two spawning populations separately, with a combined catch allocation based on the current stock composition.
3. The two spawning populations can be assessed separately and have separate allocations.

