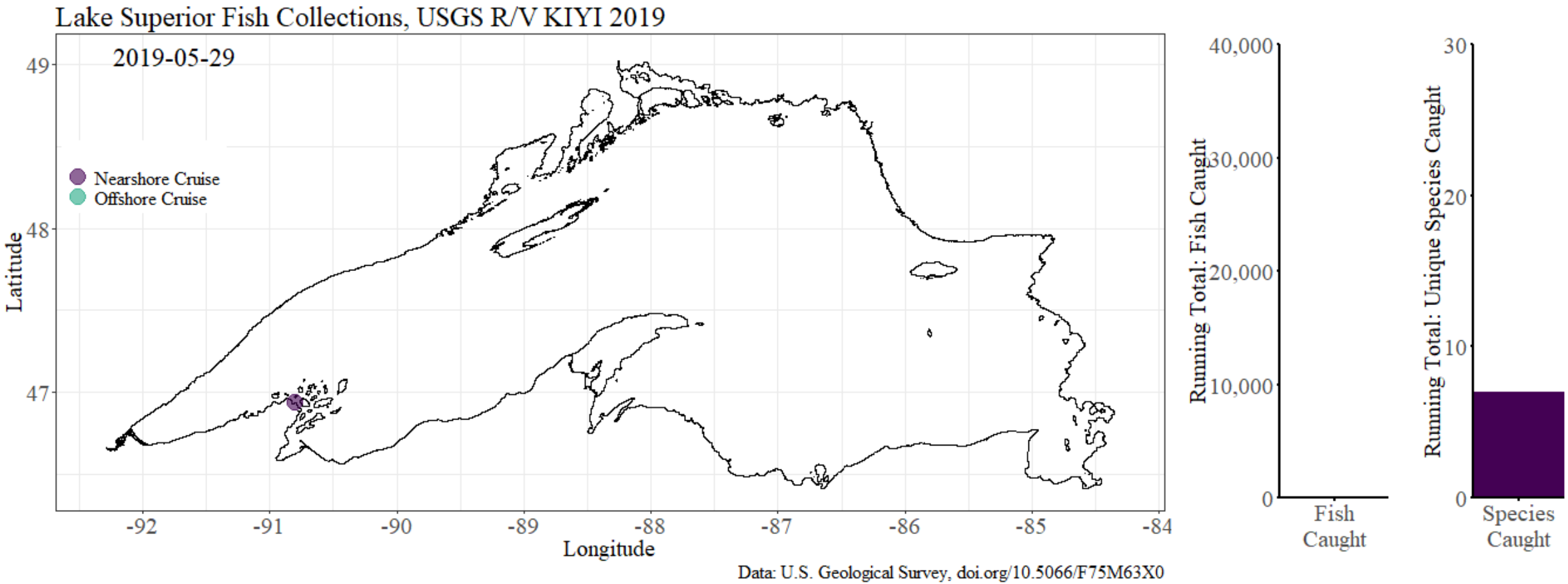
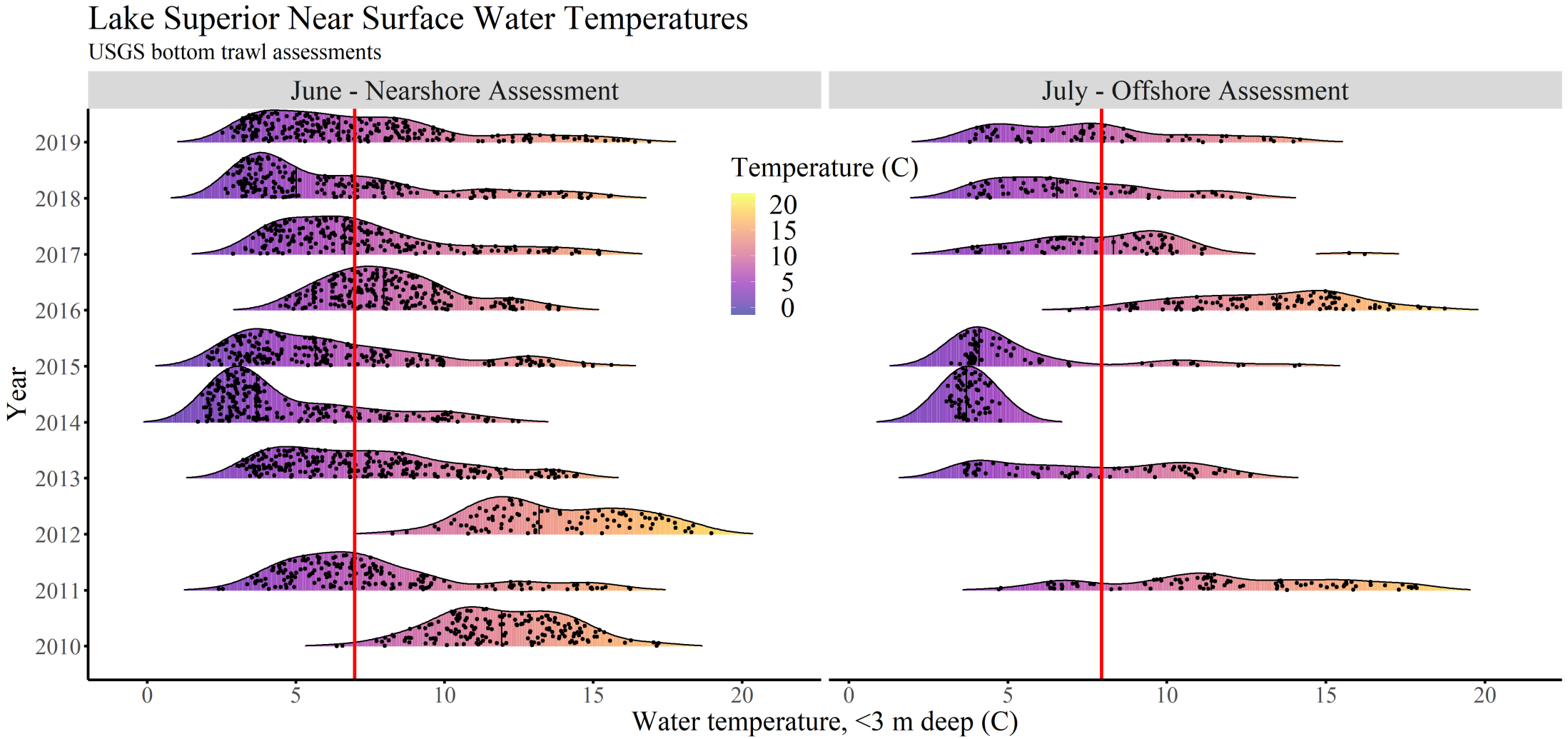
Lake Superior Annual Bottom Trawl Surveys 2019 Status and Trends Report



U.S. Geological Survey Lake Superior Biological Station
Ashland, Wisconsin

Water Temperatures

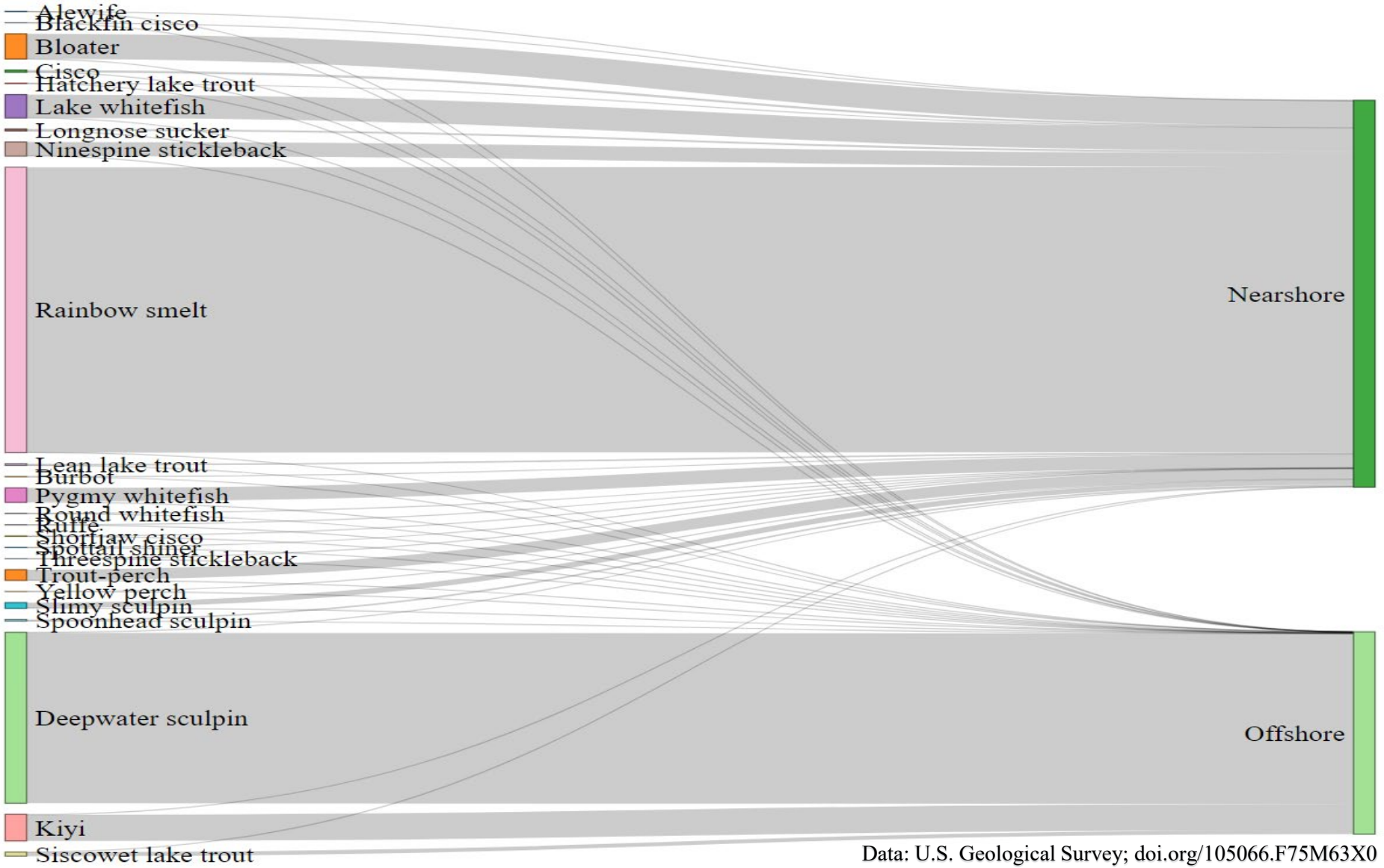


Data: U.S. Geological Survey, doi.org/10.5066/F75M63X0

Catch by Numbers

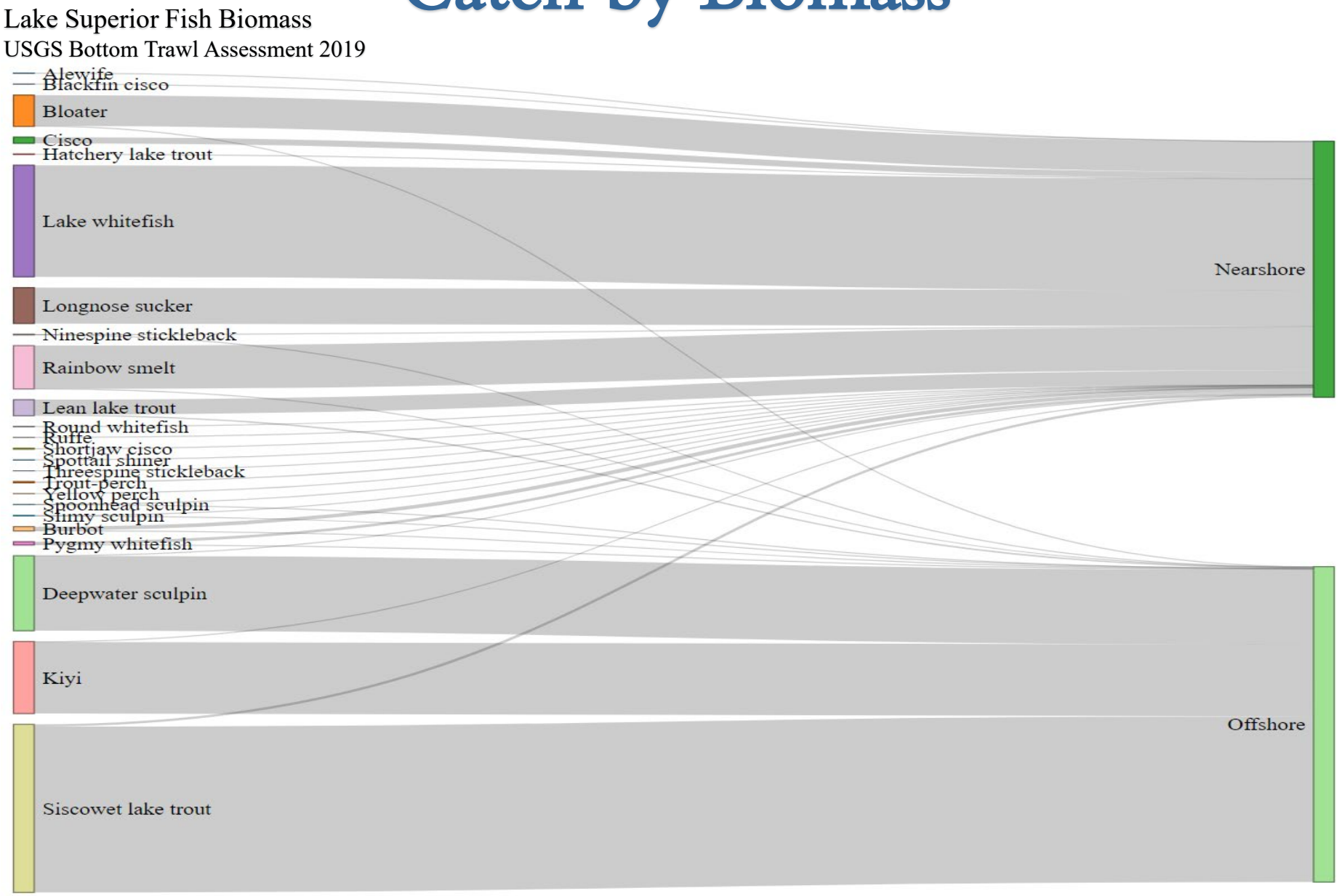
Lake Superior Fish Abundance

USGS Bottom Trawl Assessment 2019



Data: U.S. Geological Survey; doi.org/105066.F75M63X0

Catch by Biomass

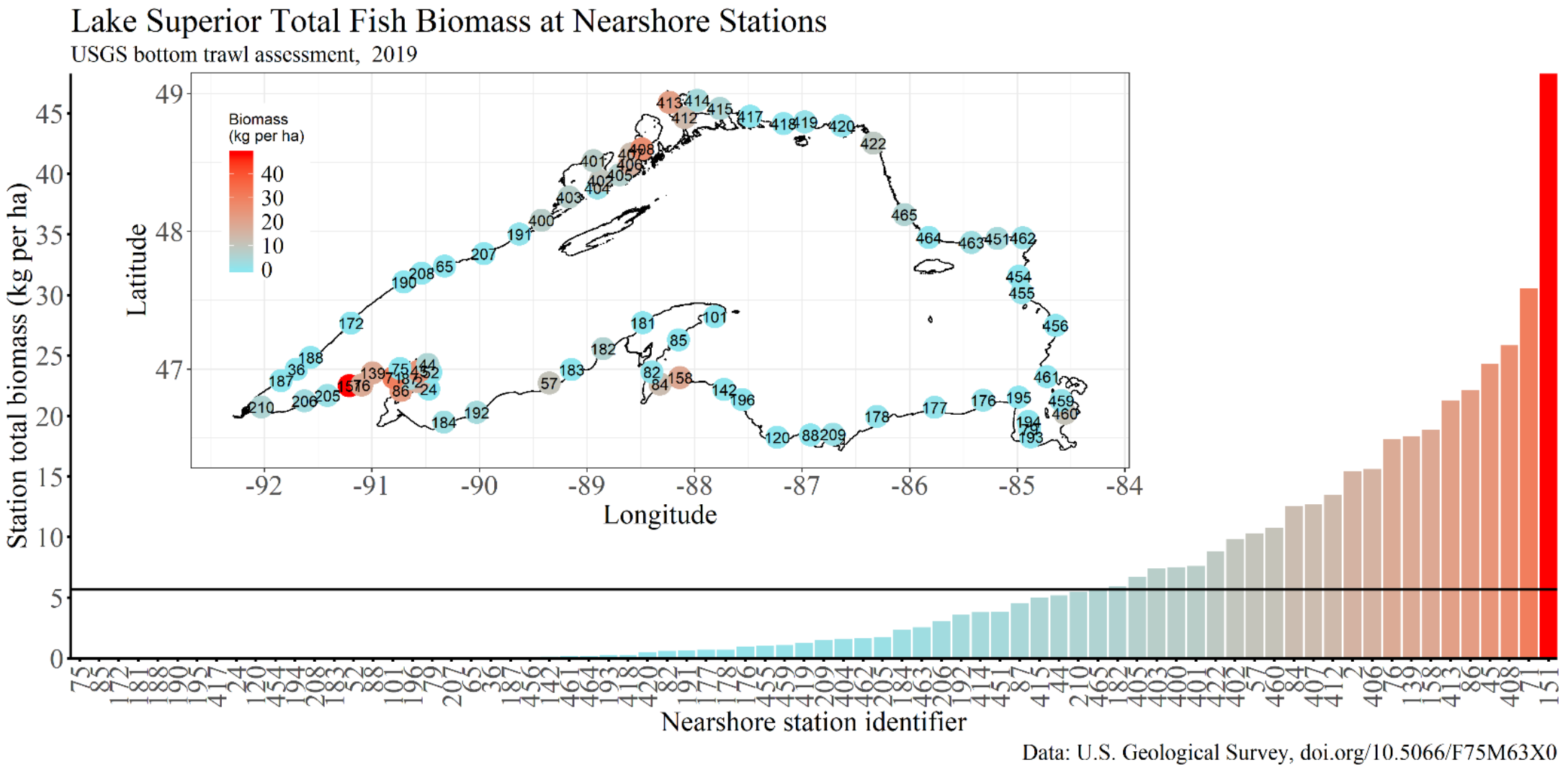


24 “species”
5.7 kg per ha

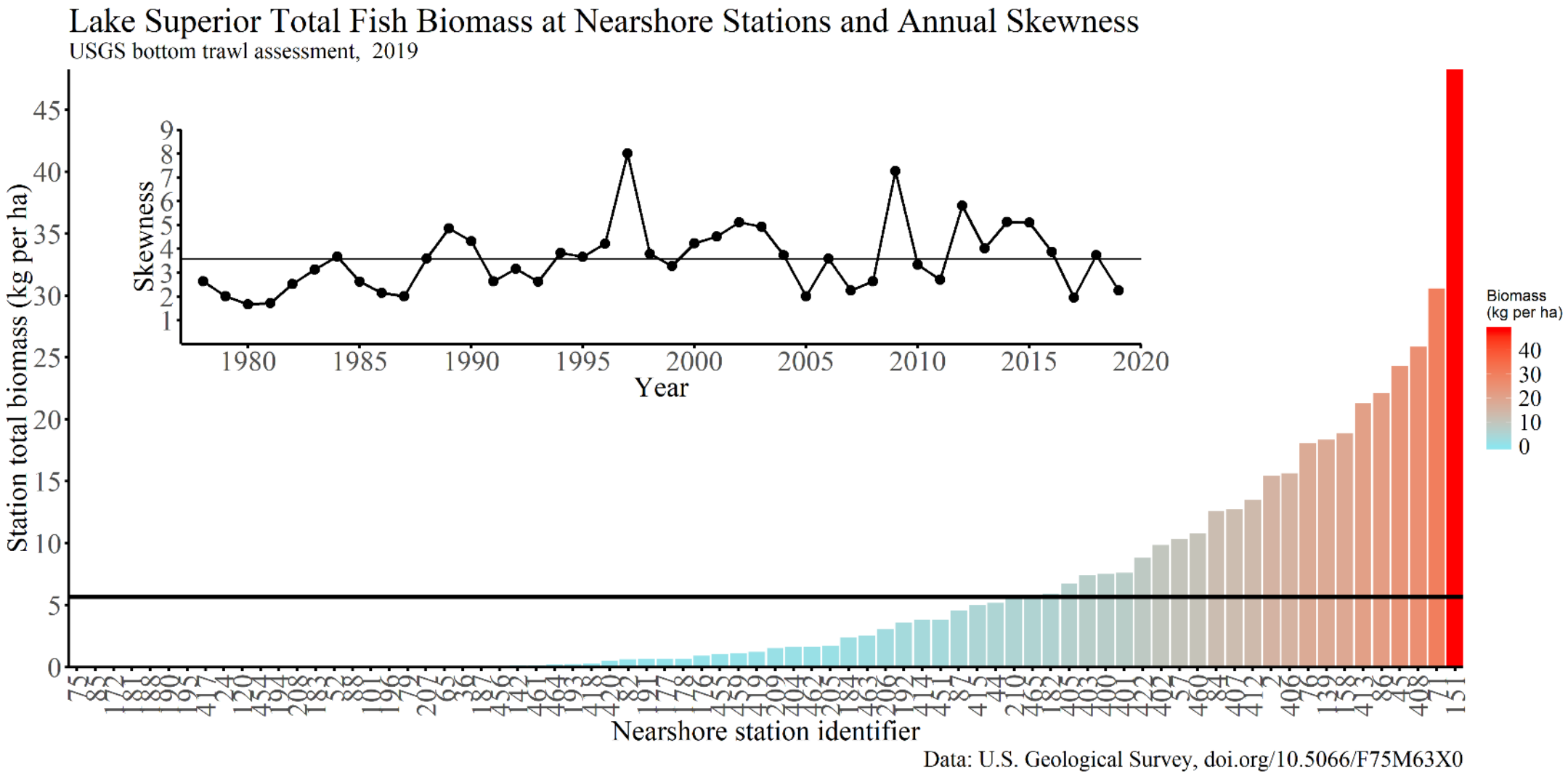
10 species
7 kg per ha

Data: U.S. Geological Survey; doi.org/105066.F75M63X0

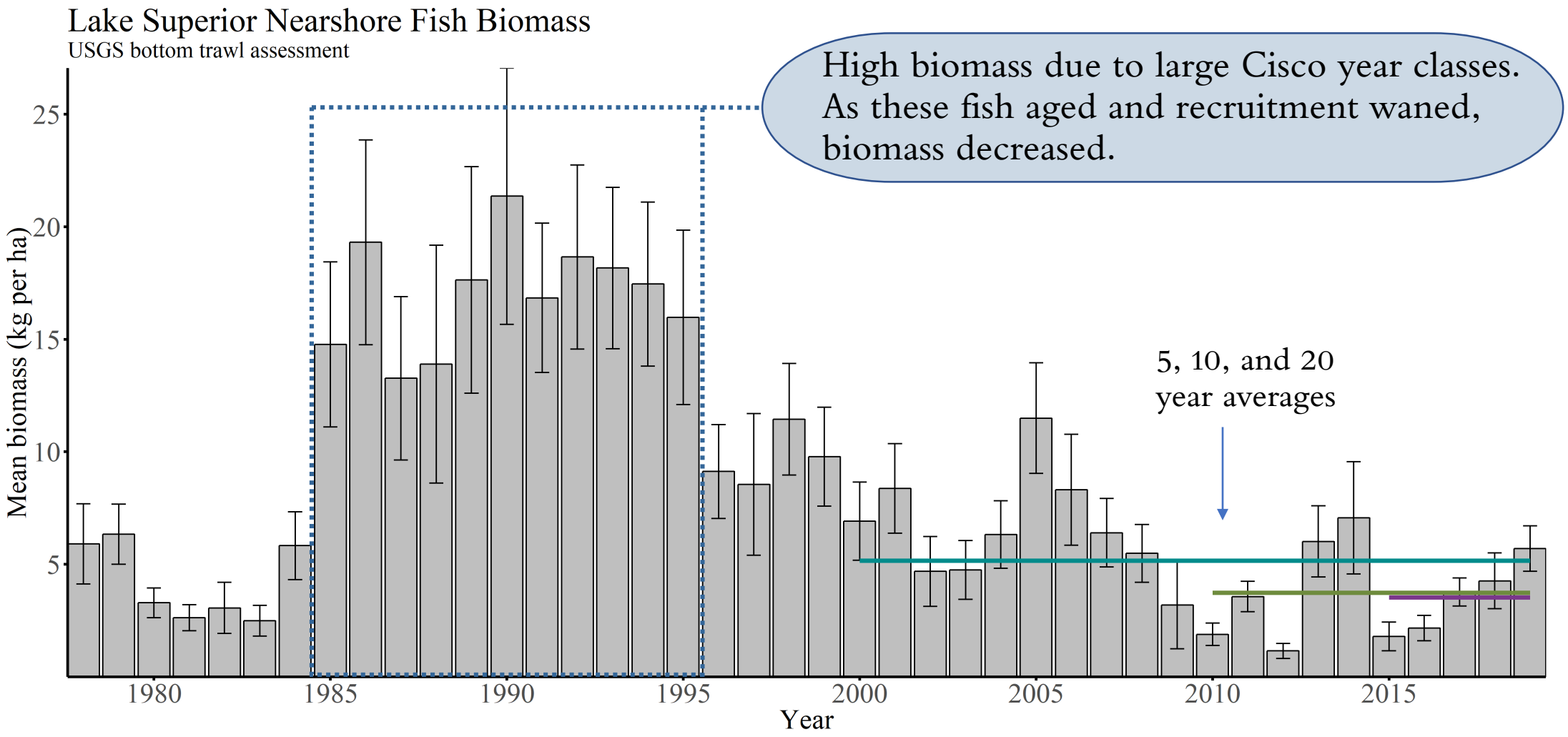
2019 Nearshore Station Biomass



2019 Nearshore Station Biomass

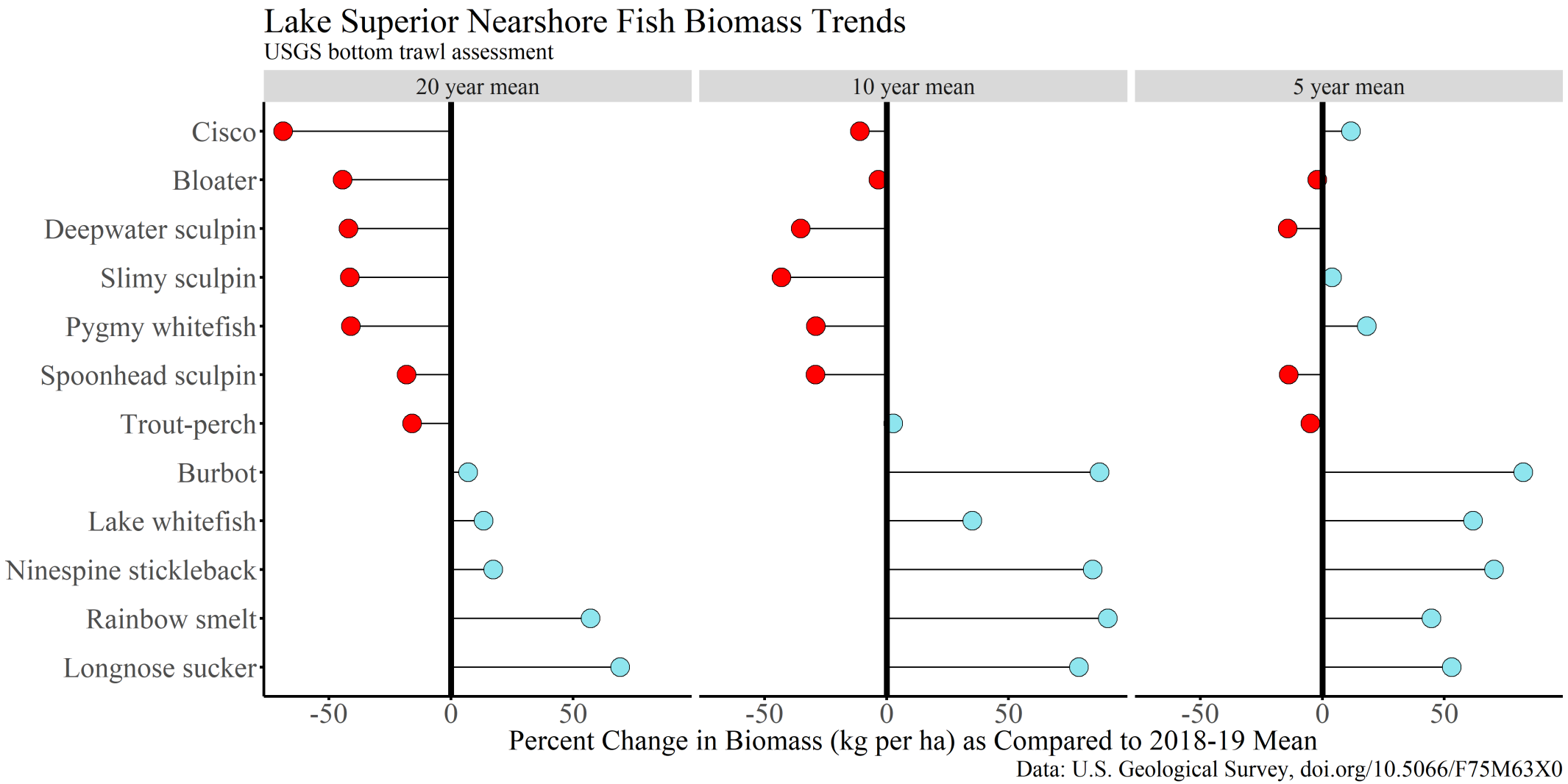


Annual Trends in Nearshore Biomass

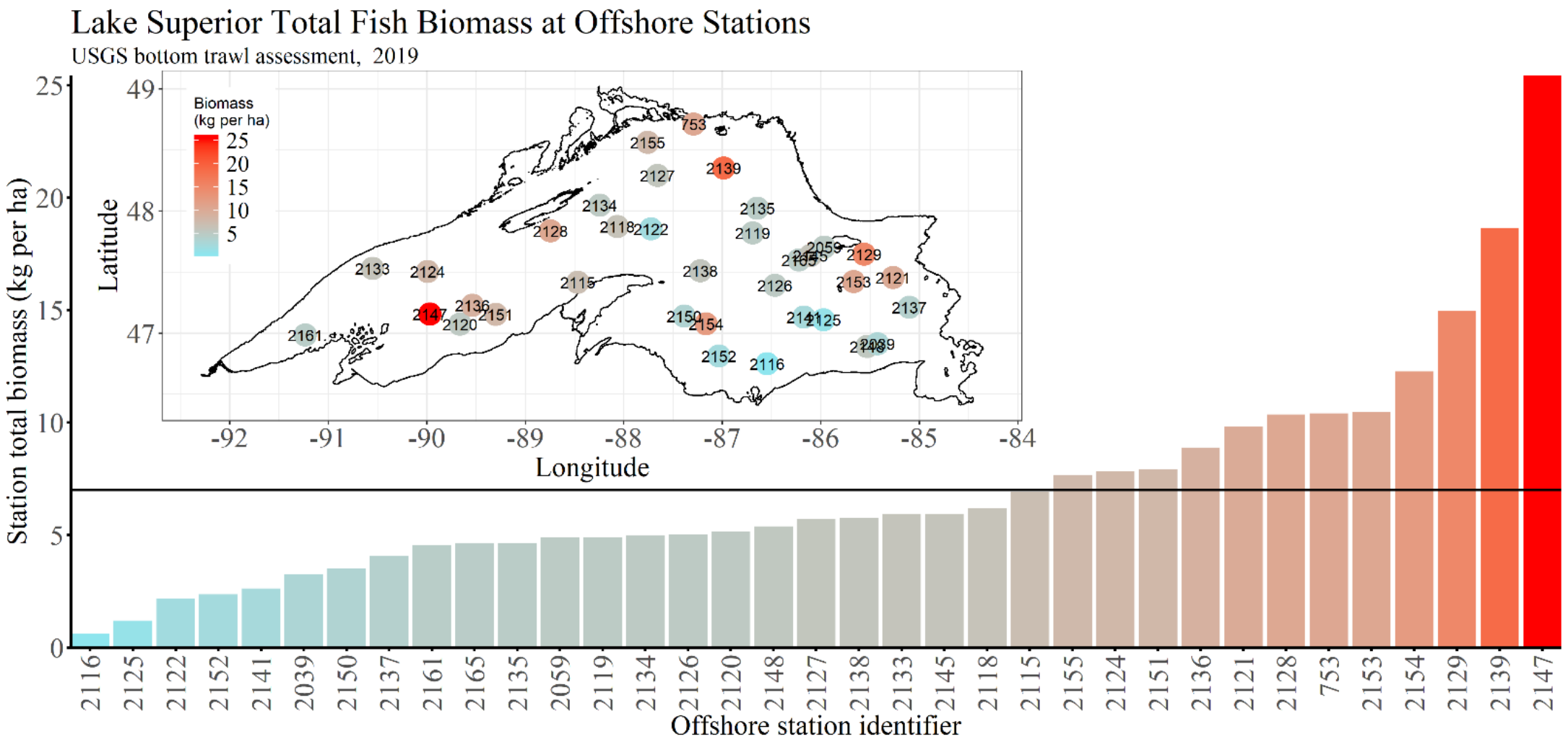


Data: U.S. Geological Survey, doi.org/10.5066/F75M63X0

Nearshore Species Temporal Trends

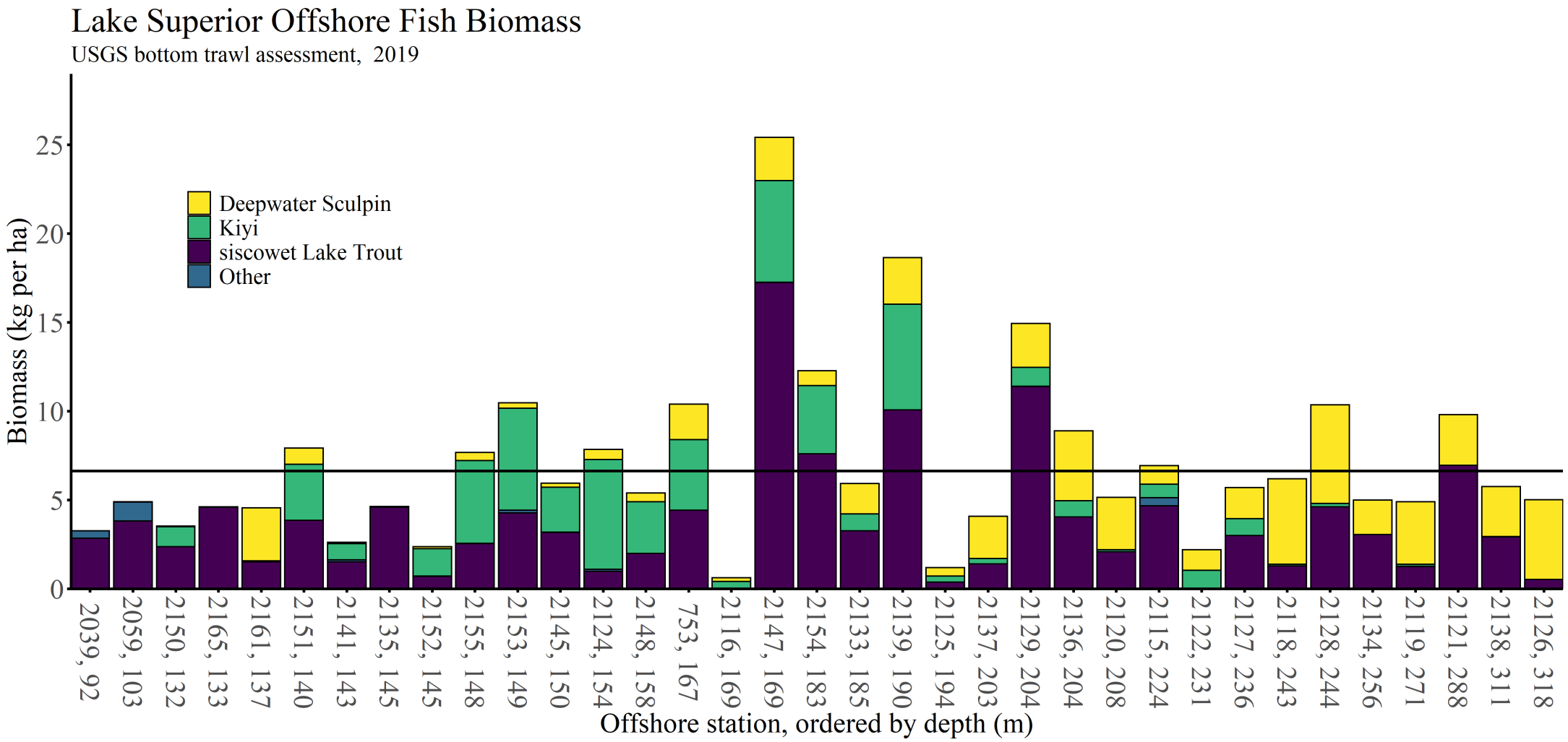


2019 Offshore Station Biomass



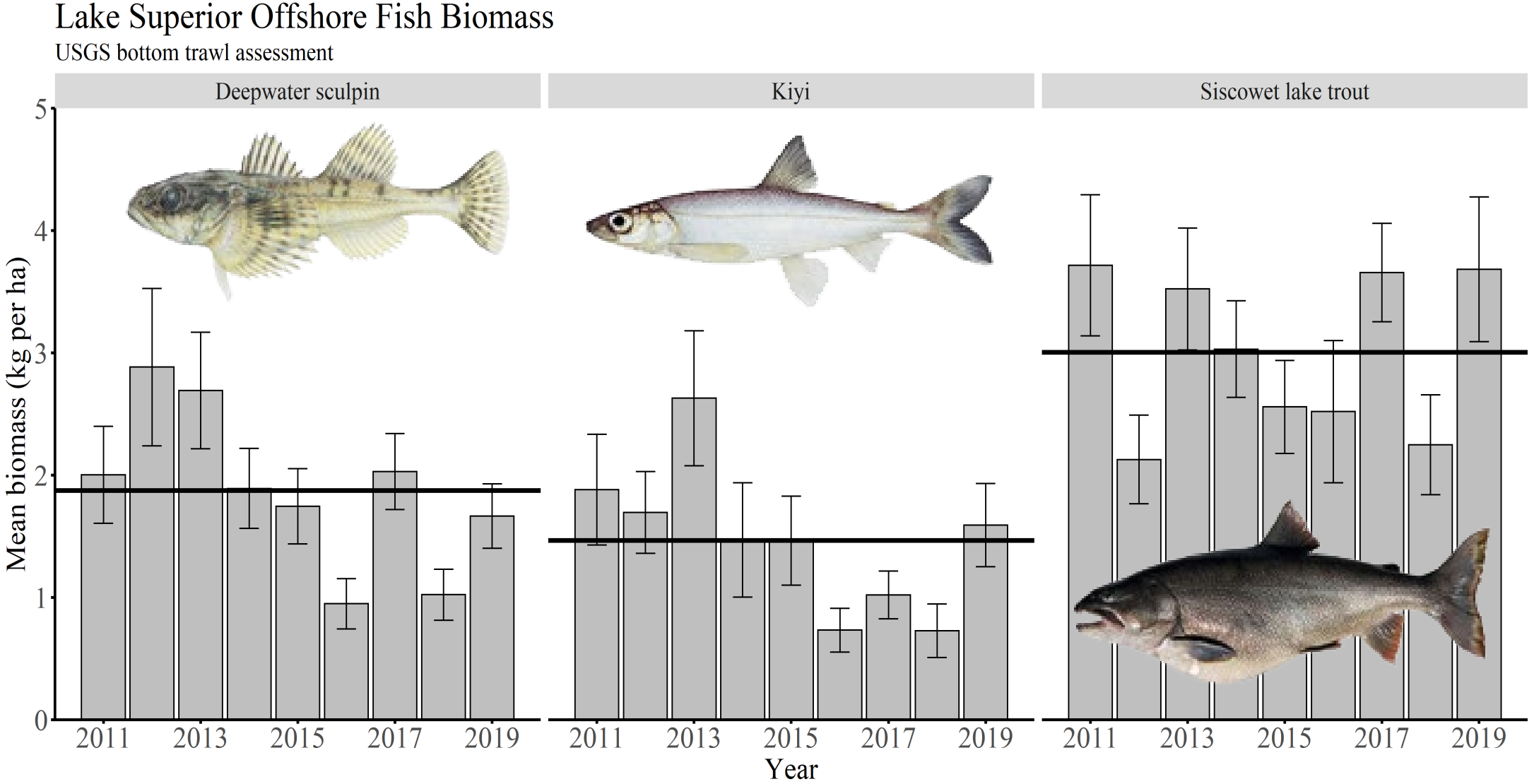
Data: U.S. Geological Survey, doi.org/10.5066/F75M63X0

2019 Offshore Station Biomass



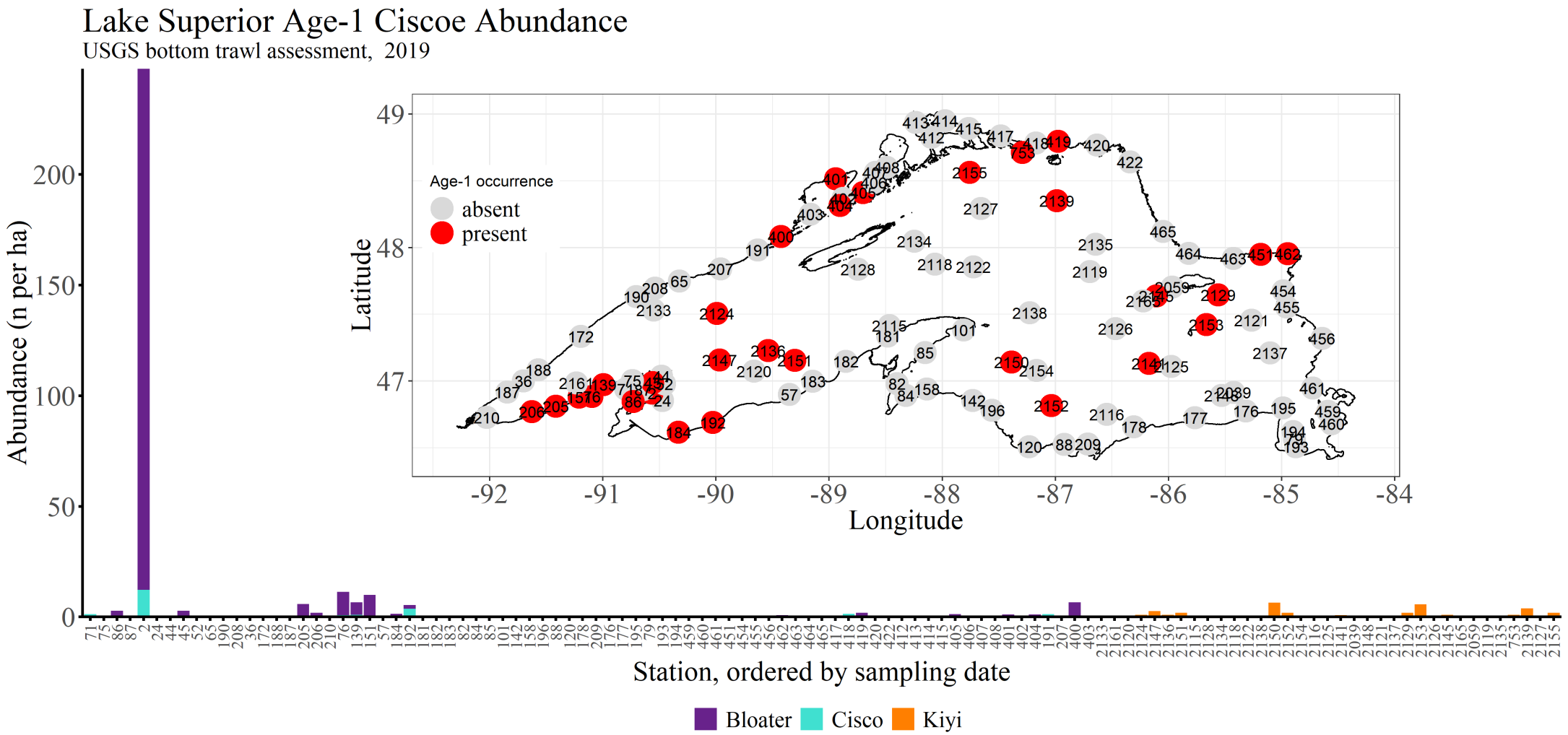
Data: U.S. Geological Survey, doi.org/10.5066/F75M63X0

Annual Trends in Offshore Biomass



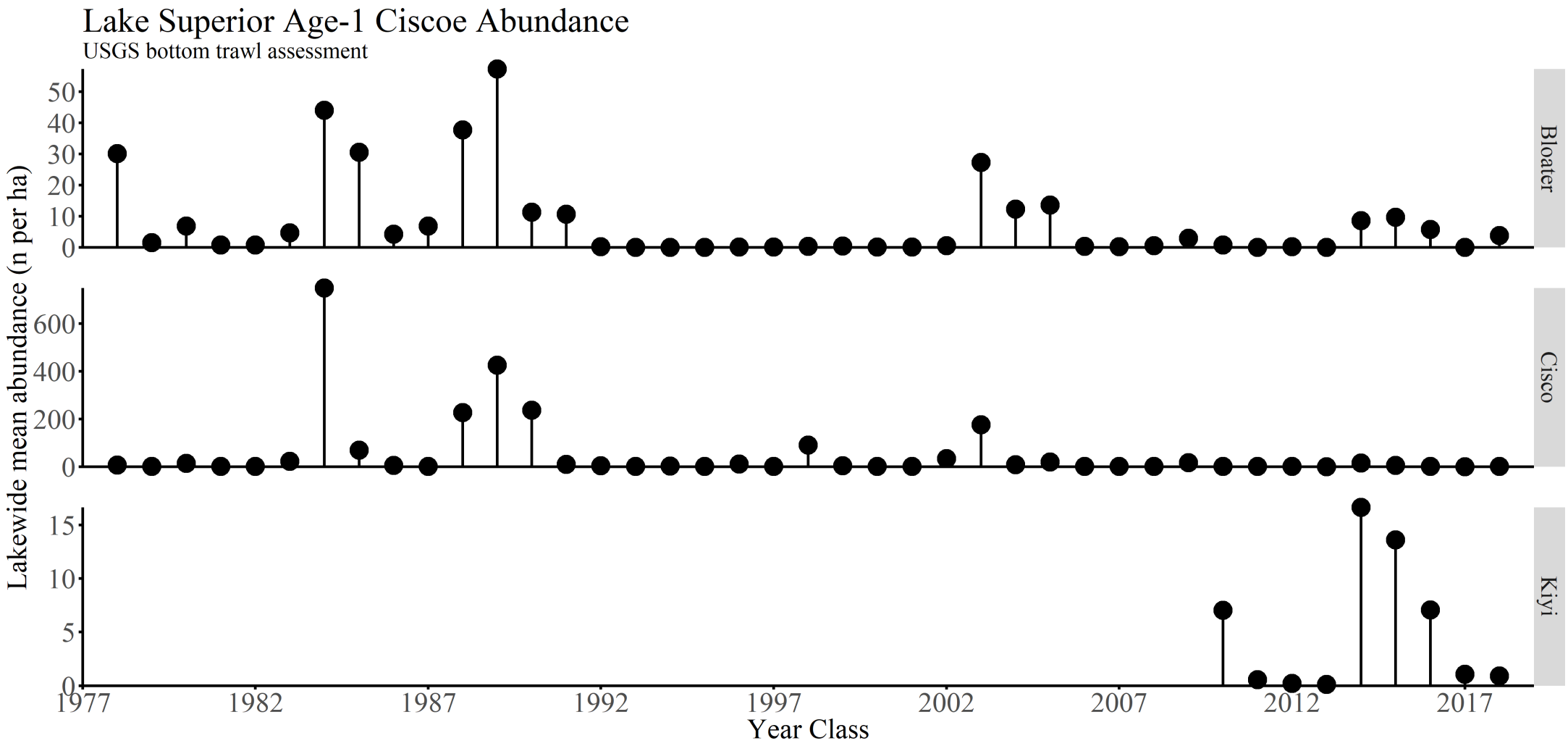
Data: U.S. Geological Survey, doi.org/10.5066/F75M63X0

2019 Age-1 Ciscoe Occurrences



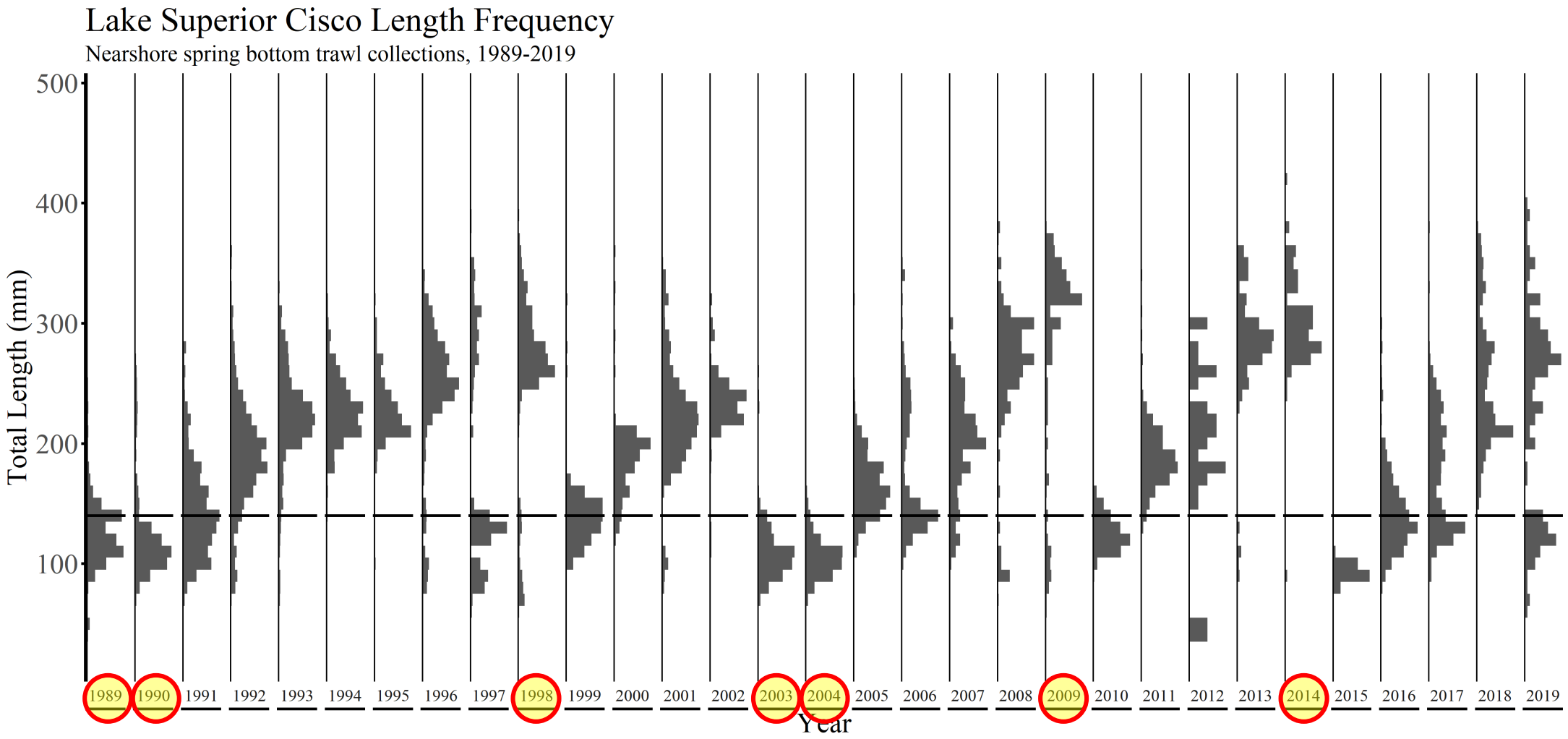
Data: U.S. Geological Survey, doi.org/10.5066/F75M63X0

Age-1 Ciscoe Trends



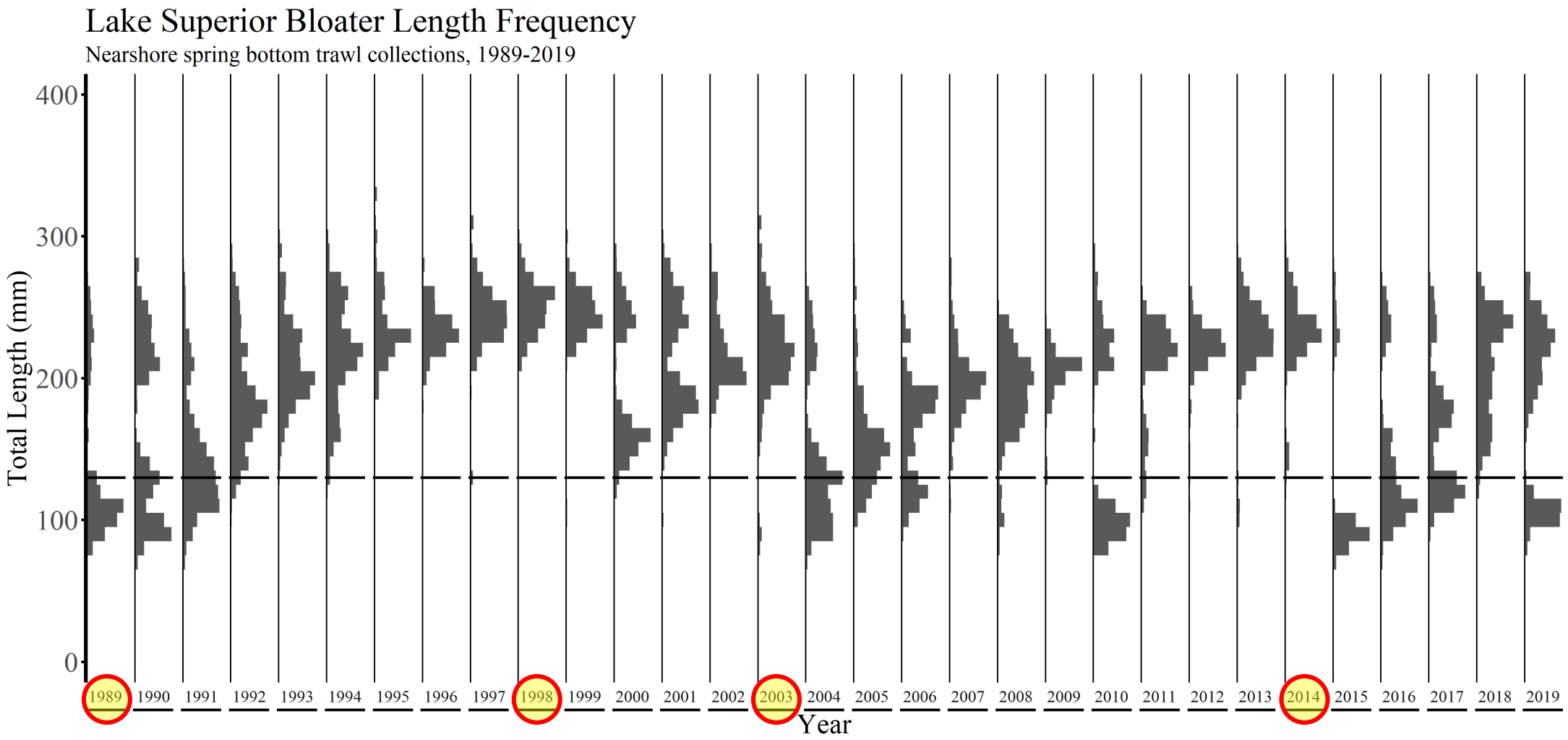
Data: U.S. Geological Survey, doi.org/10.5066/F75M63X0

Temporal Patterns in Cisco Length Frequency



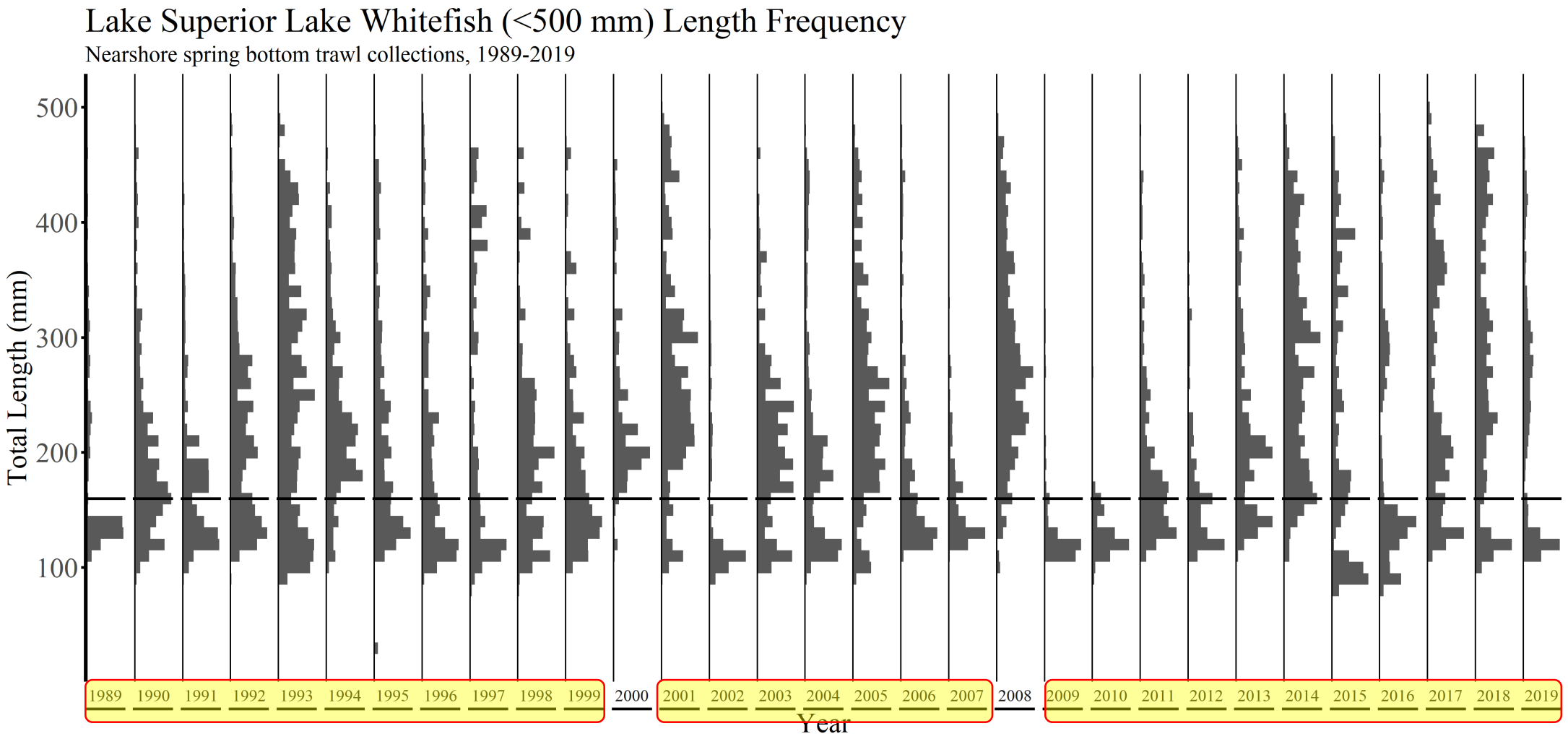
Data: U.S. Geological Survey, doi.org/10.5066/F75M63X0

Temporal Patterns in Bloater Length Frequency



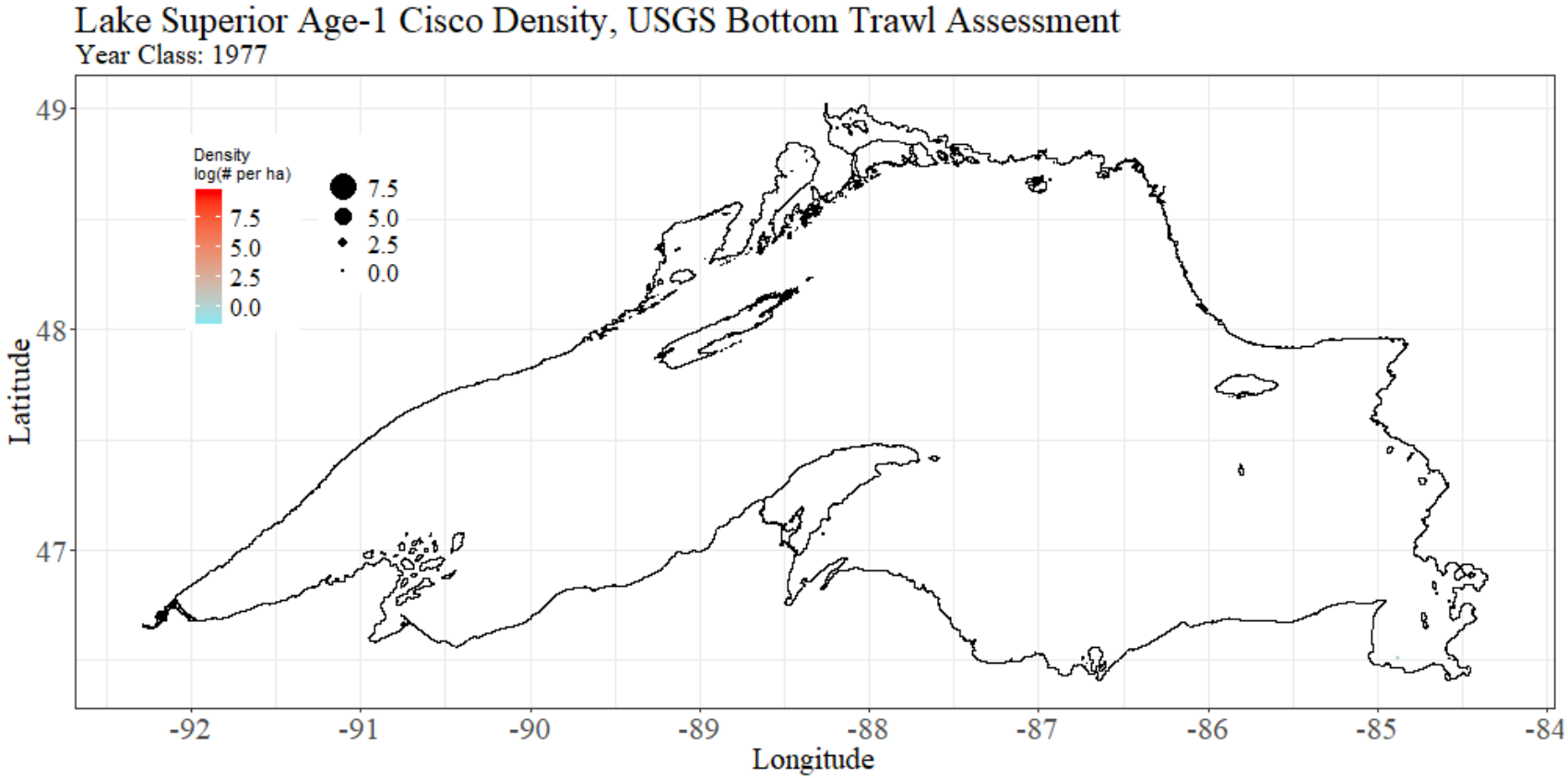
Data: U.S. Geological Survey, doi.org/10.5066/F75M63X0

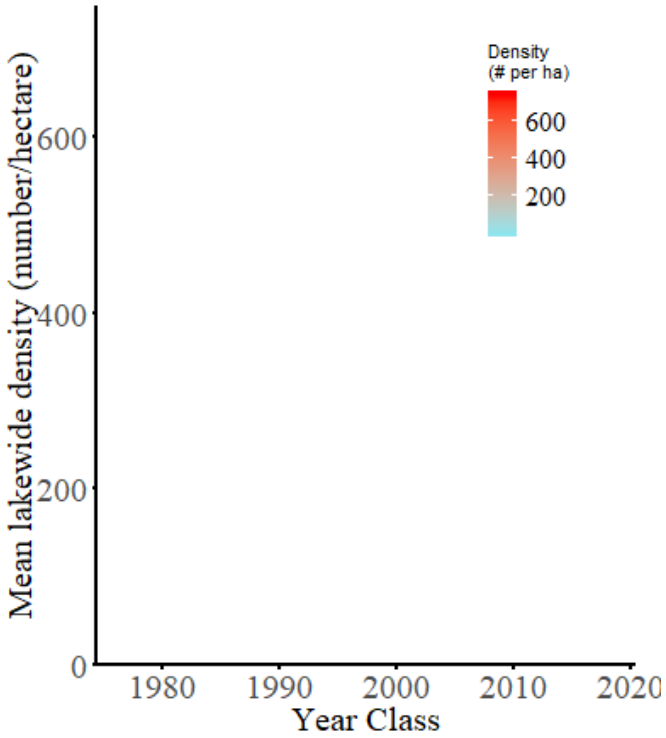
Temporal Patterns in Lake Whitefish Length Frequency



Data: U.S. Geological Survey, doi.org/10.5066/F75M63X0

Spatial Patterns in Age-1 Cisco and Bloater

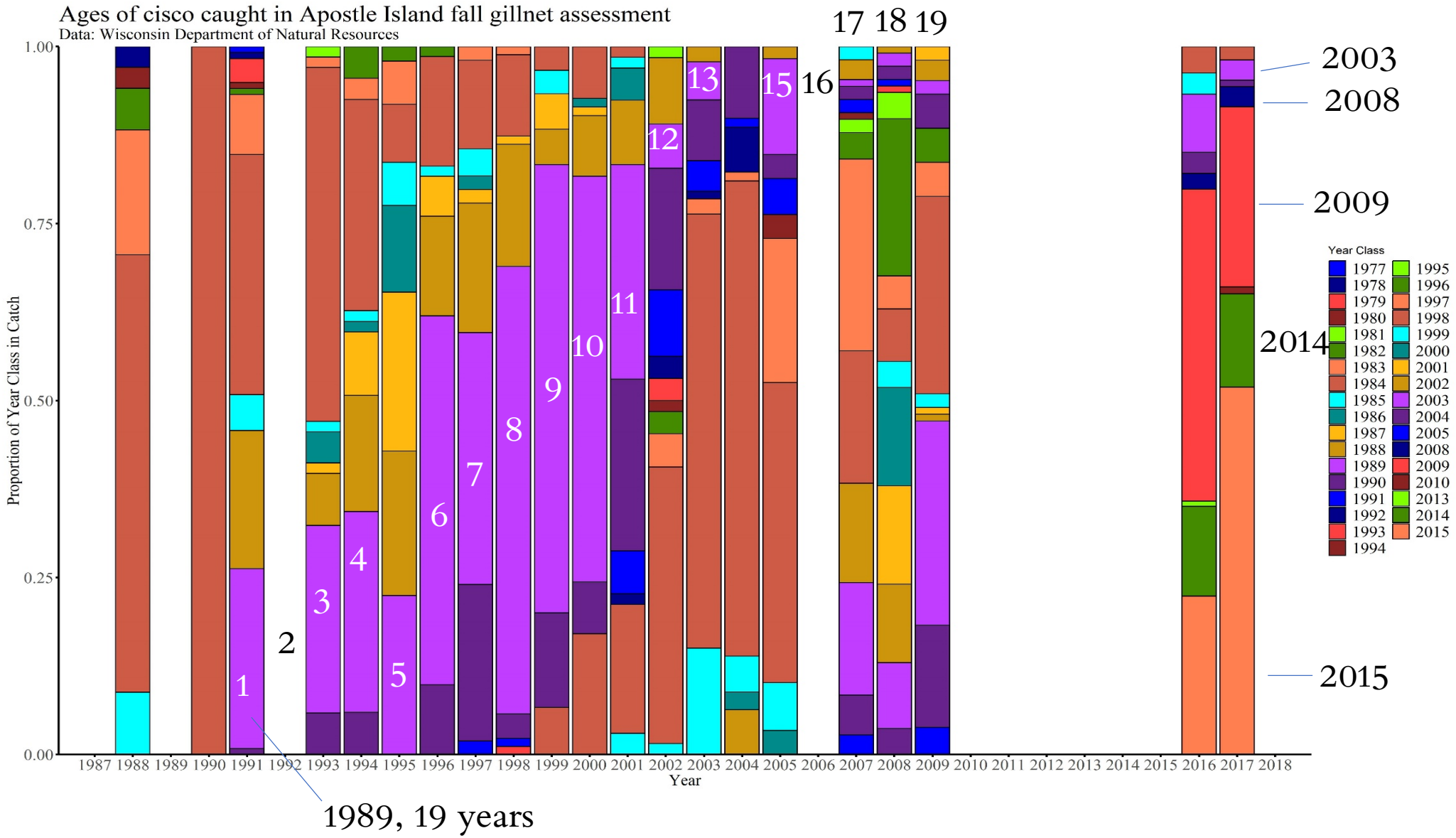




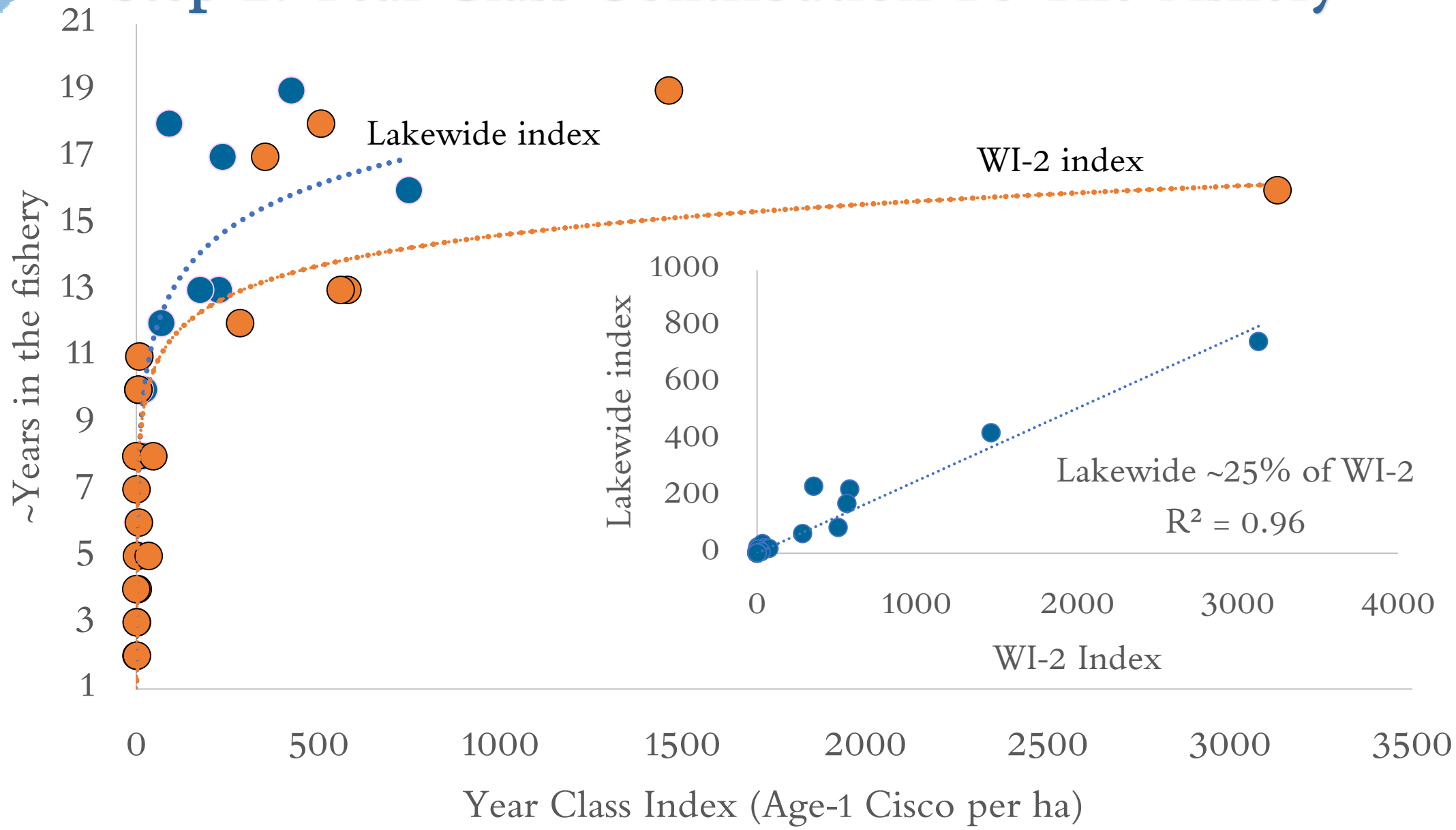
Data: U.S. Geological Survey, doi.org/10.5066/F75M63X0

How Many Age-1 Cisco Does It Take To See A Return To The Fishery?

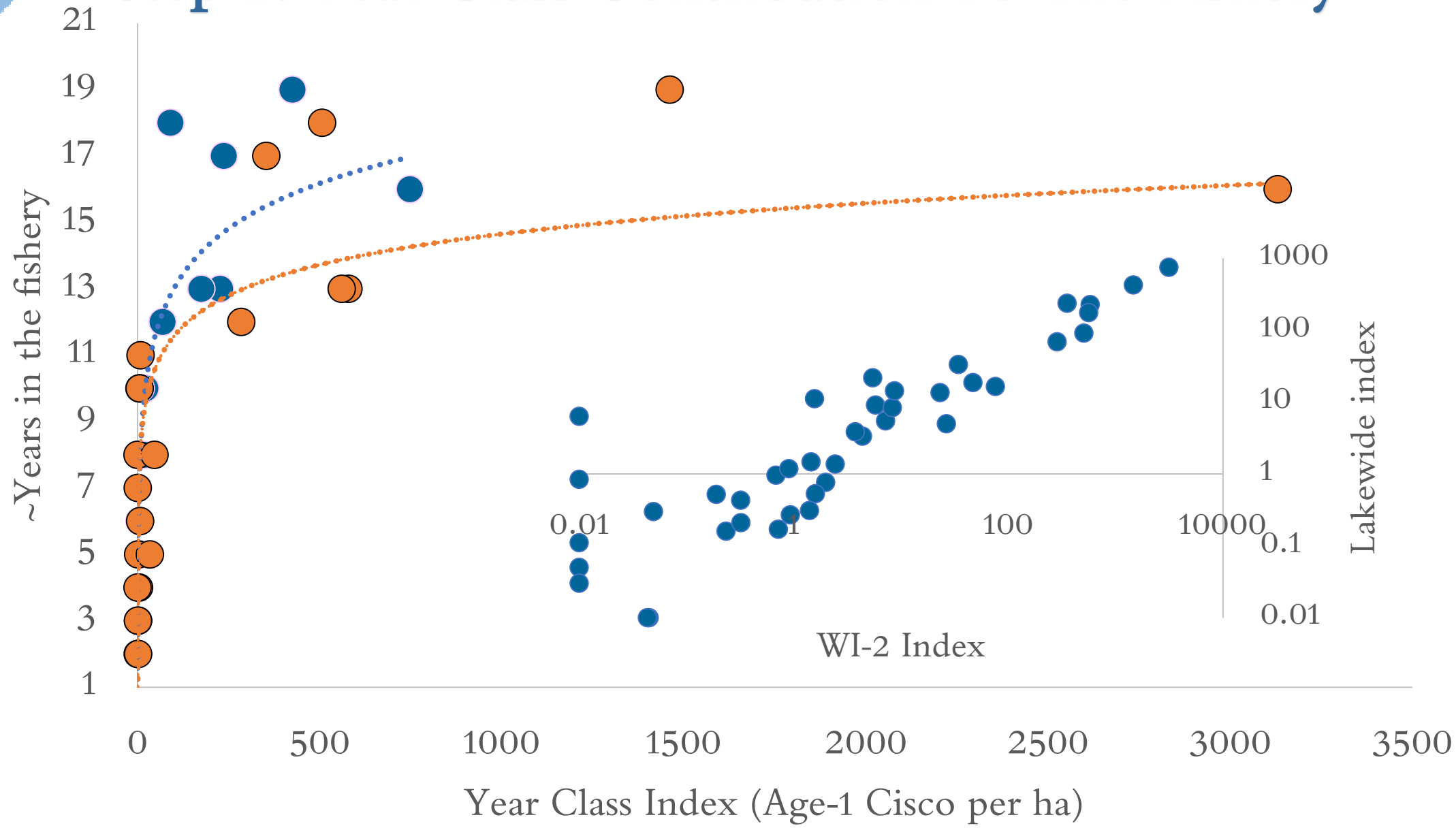
Step 1: Age Composition of the Wisconsin Fishery



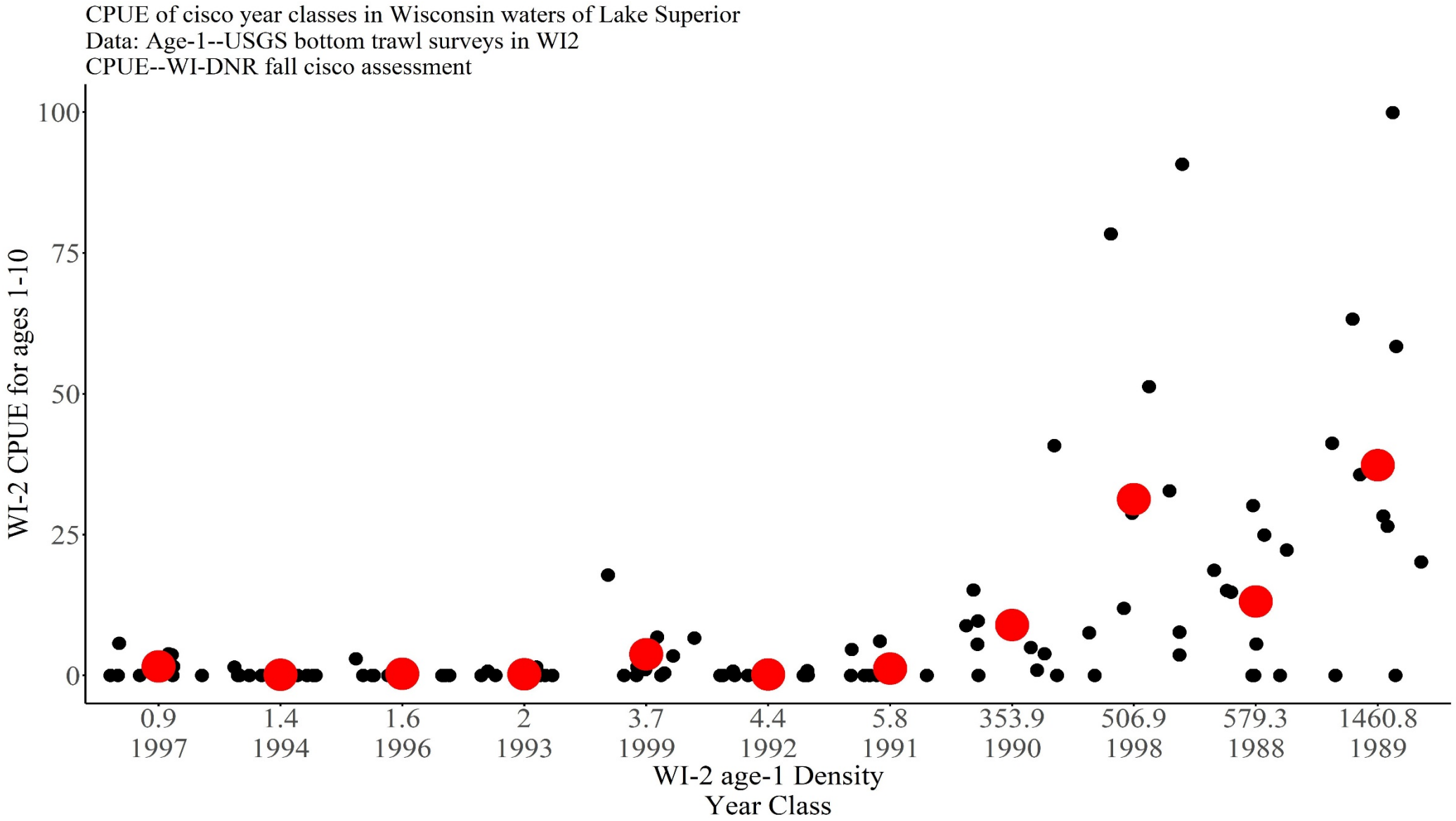
Step 2: Year Class Contribution To The Fishery



Step 2: Year Class Contribution To The Fishery

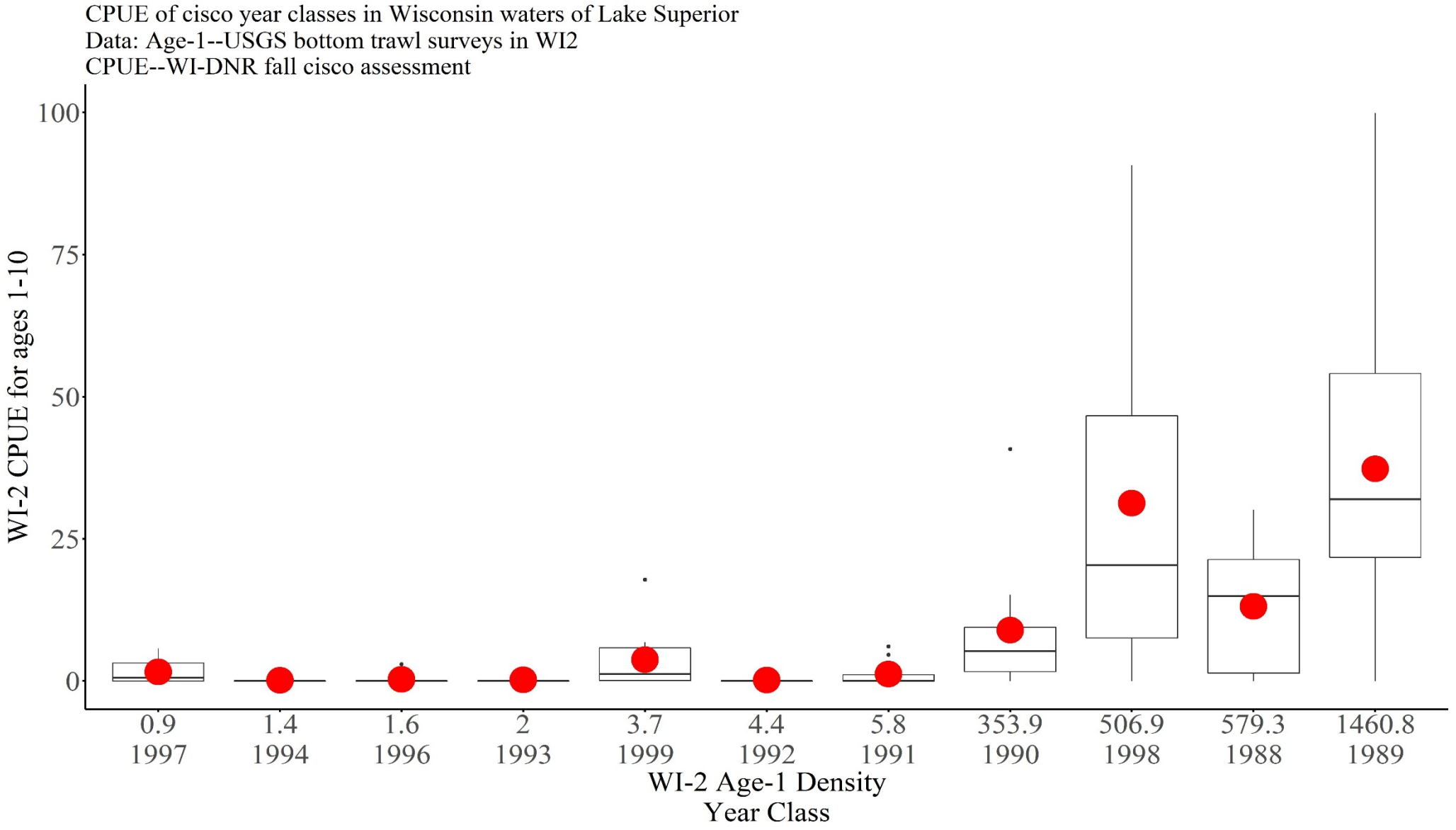


Step 2: Year Class Contribution To The Fishery



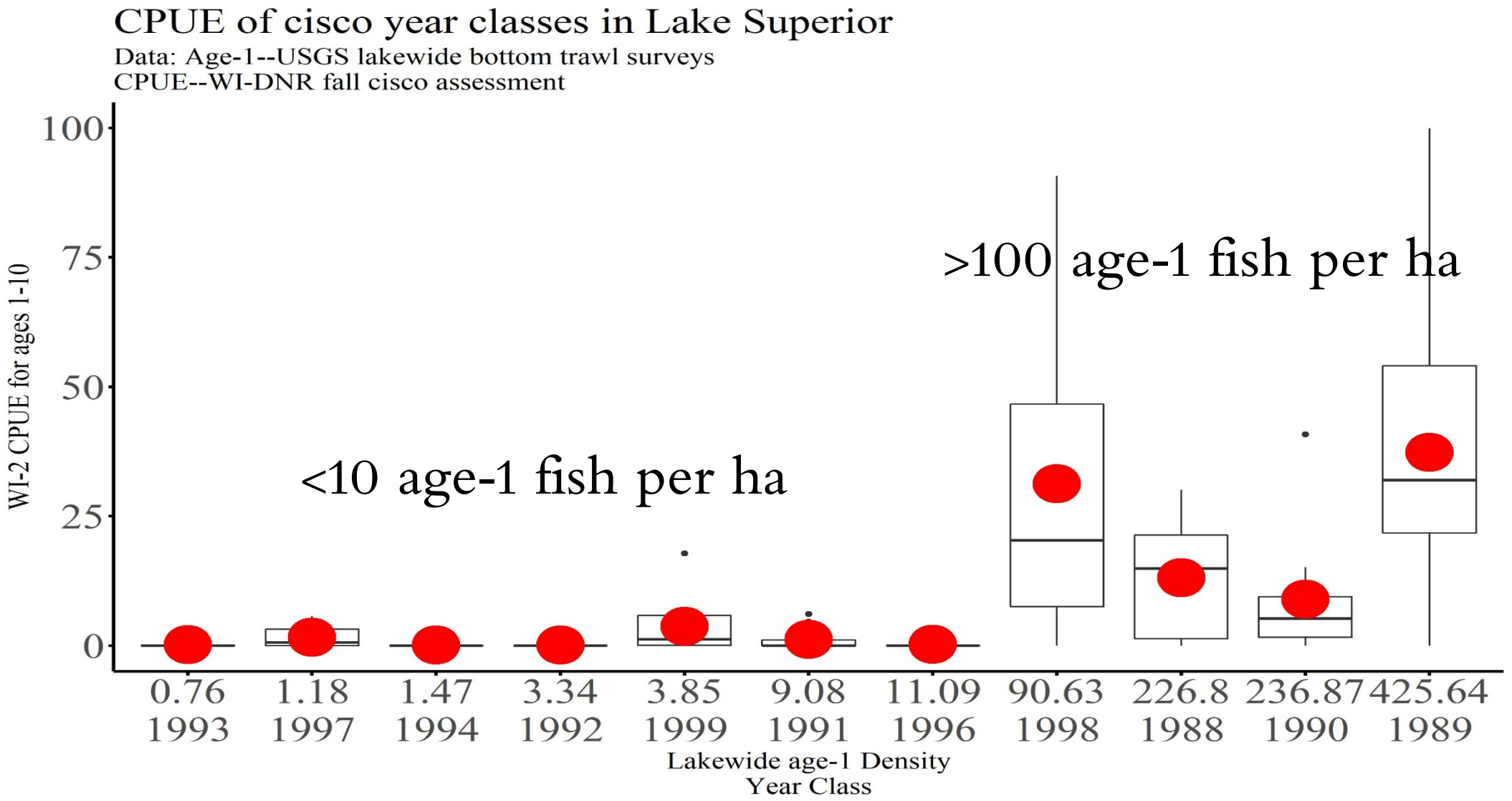
CPUE = Number of age 1-10 fish per 1200 feet of net per hour

Step 2: Year Class Contribution To The Fishery



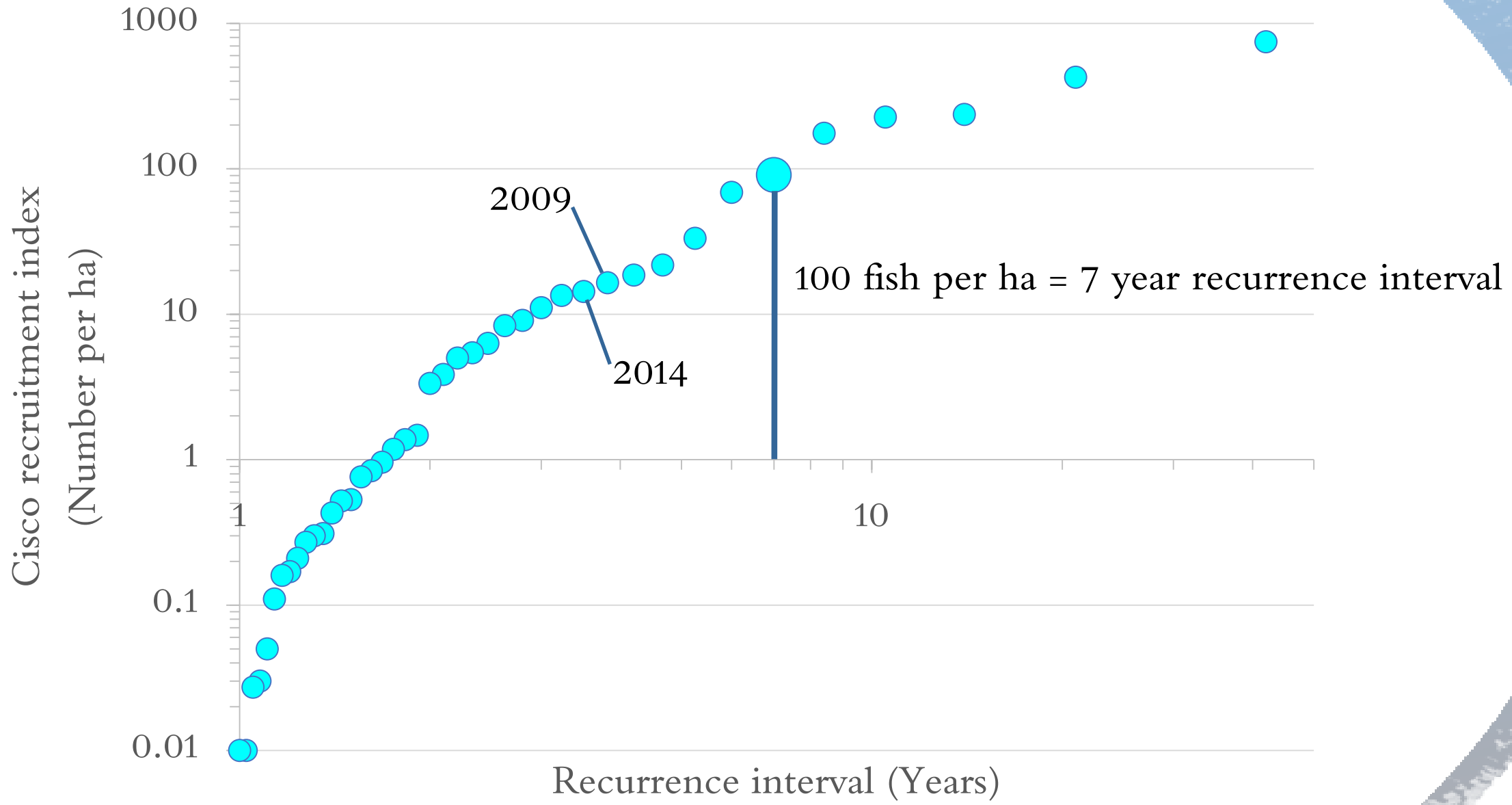
CPUE = Number of age 1-10 fish per 1200 feet of net per hour

Step 2: Year Class Contribution To The Fishery

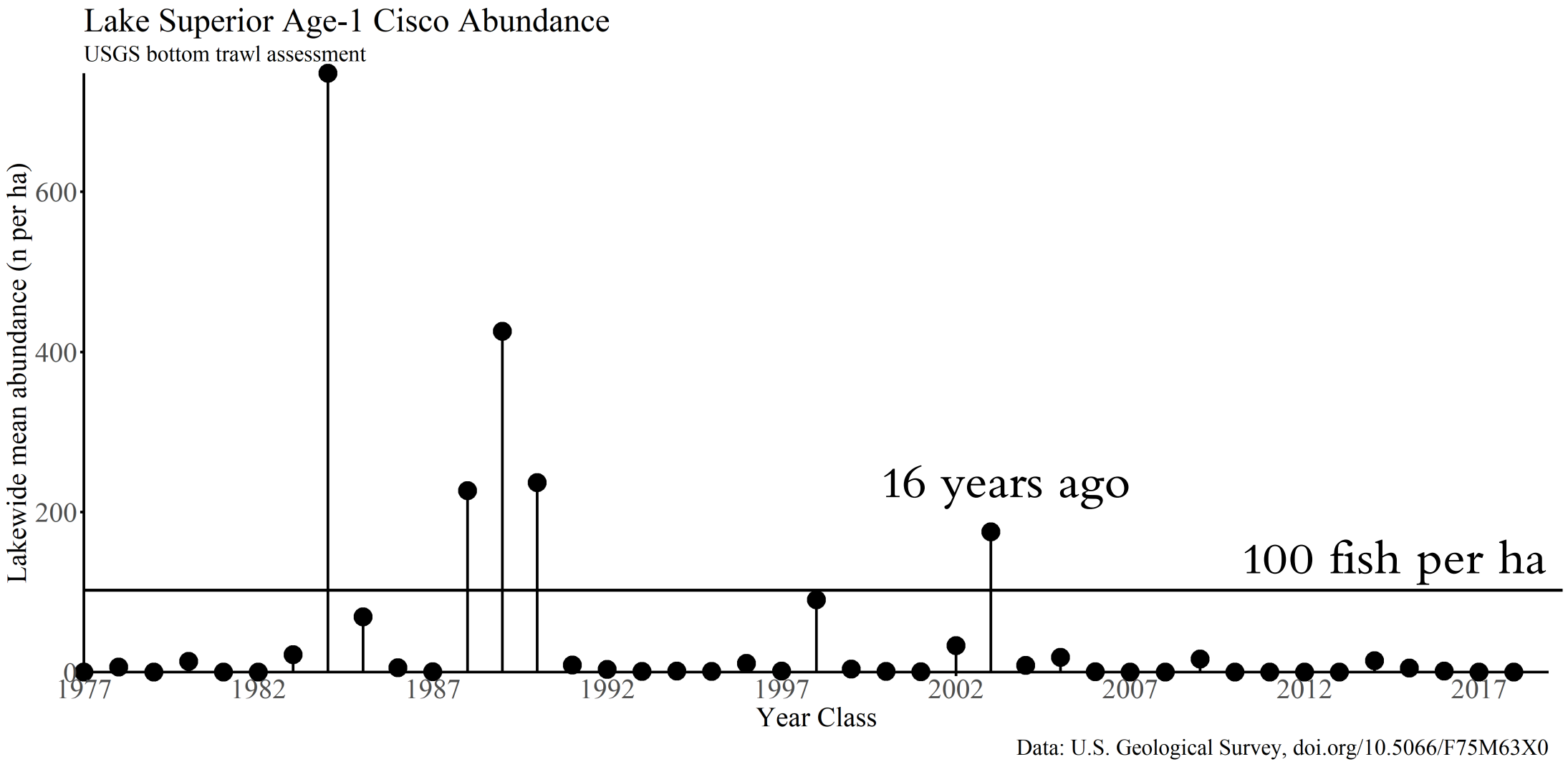


CPUE = Number of age 1-10 fish per 1200 feet of net per hour

Cisco Year Class Recurrence Interval



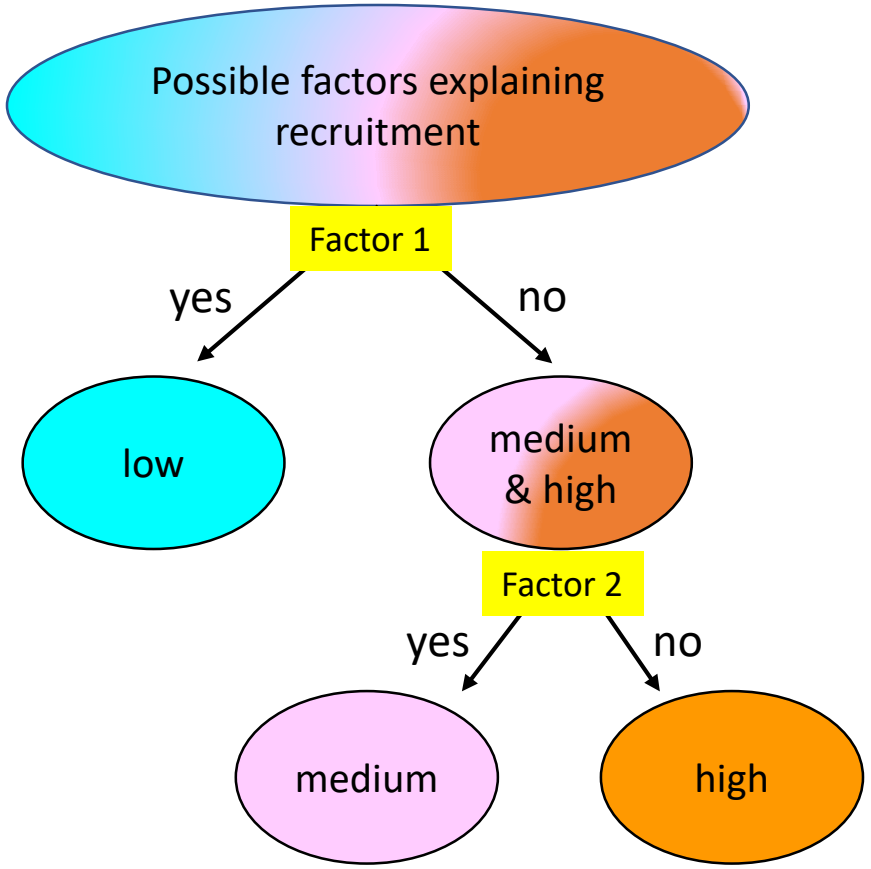
Cisco Year Class Strength



Data: U.S. Geological Survey, doi.org/10.5066/F75M63X0

Ciscoe age-1 Recruitment Predictive Model

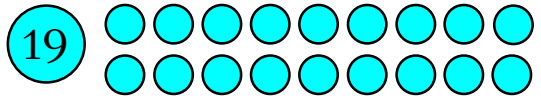
Recruitment group	Years	Index value
None-Low	19	<2 fish / ha
Measurable	12	3-33 fish / ha
High	7	68-750 fish / ha



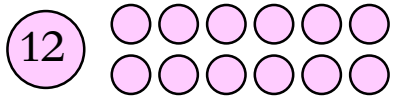
Data from USGS Lake Superior nearshore fish surveys

Ciscoe age-1 Recruitment Predictive Model

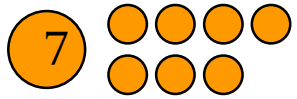
None-Low recruitment



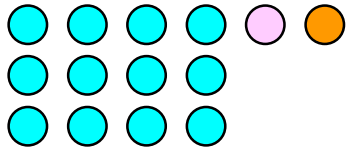
Low-moderate recruitment

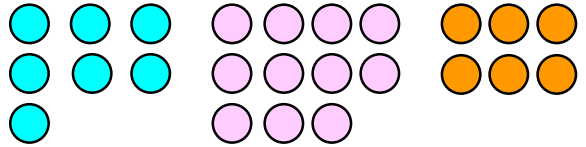


High recruitment

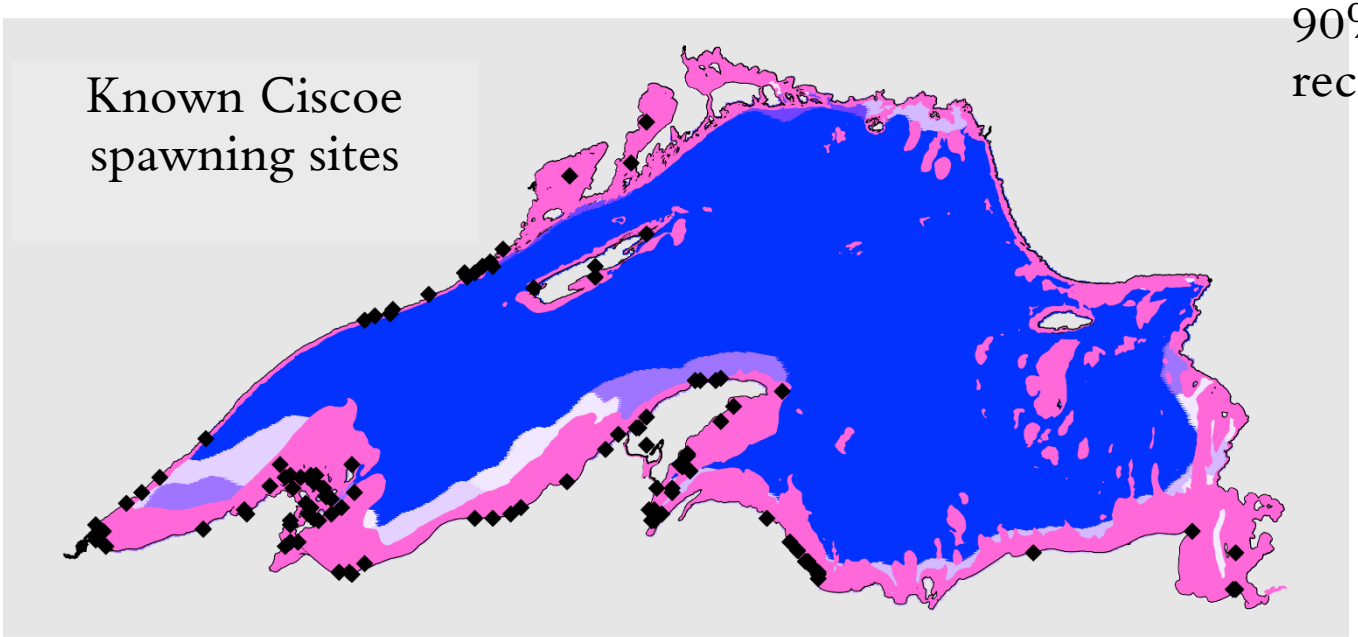


FACTOR 1: Early Ice January ice cover <15% | January ice cover >15%

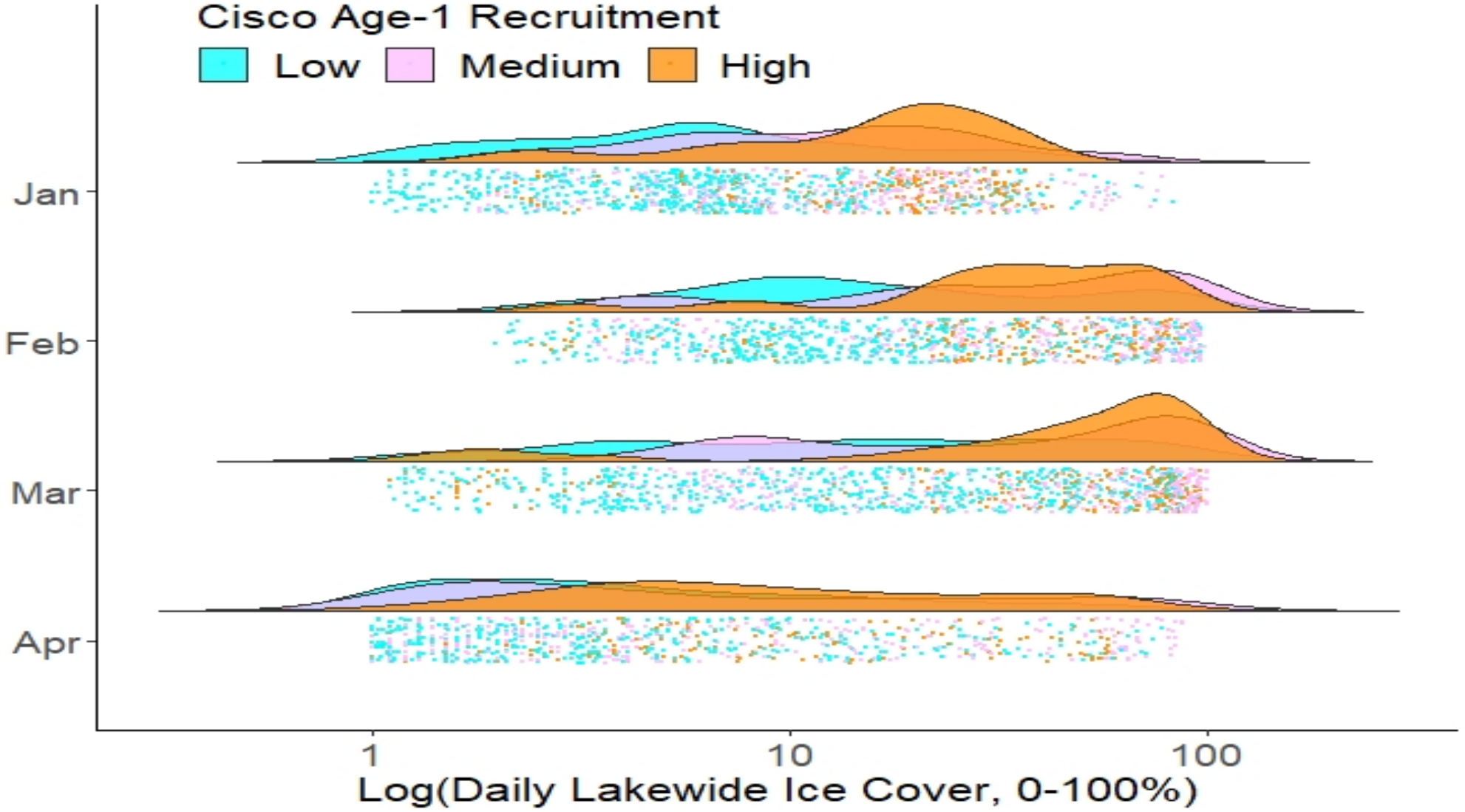




90% of measurable recruitment events



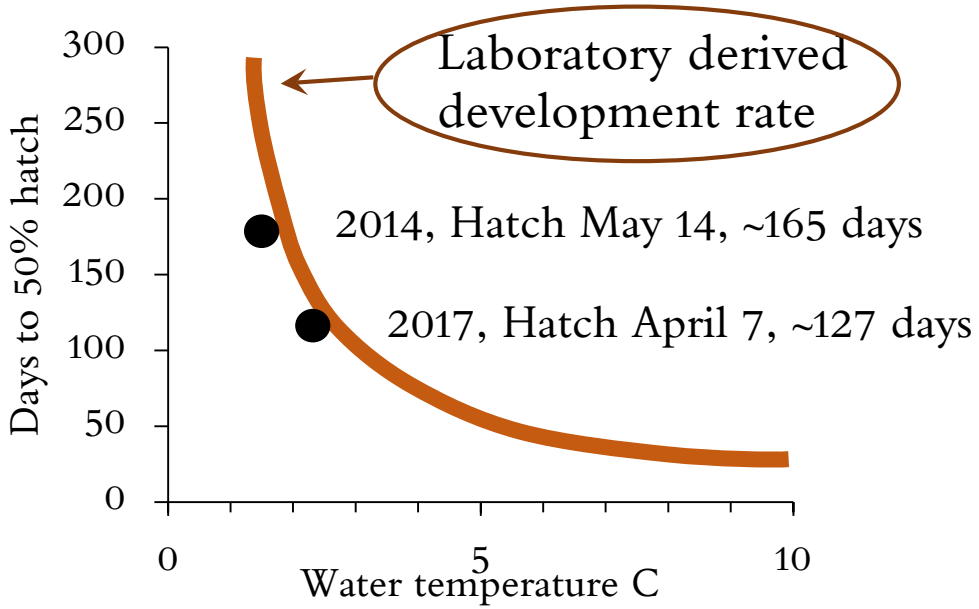
Cisco age-1 Recruitment and Ice Cover



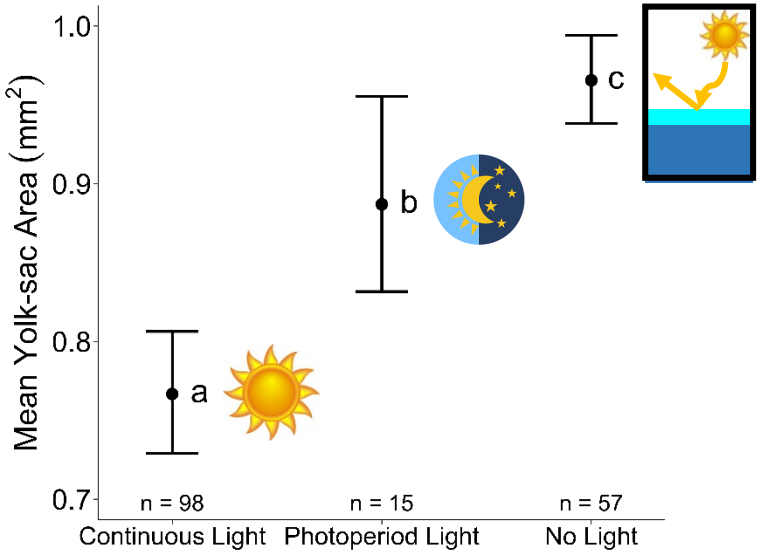
Data: Ice, NOAA GLERL. Fish, USGS

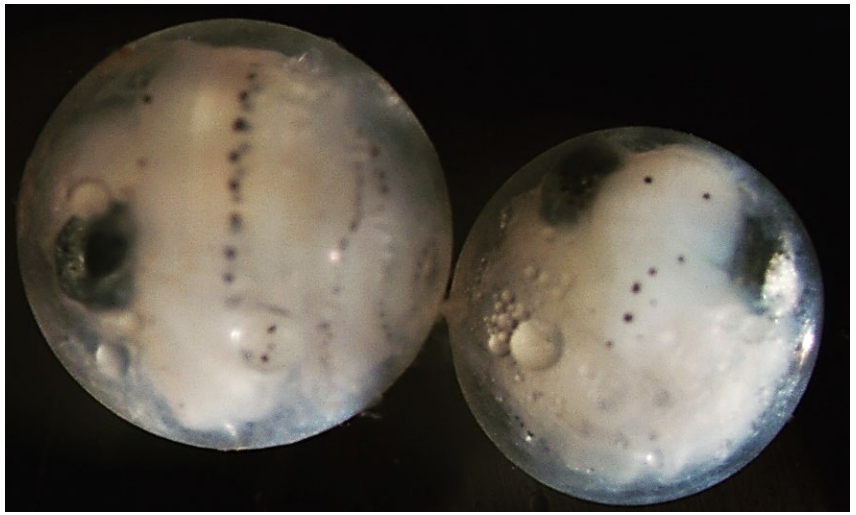
Potential Mechanism Between Early Ice and Recruitment

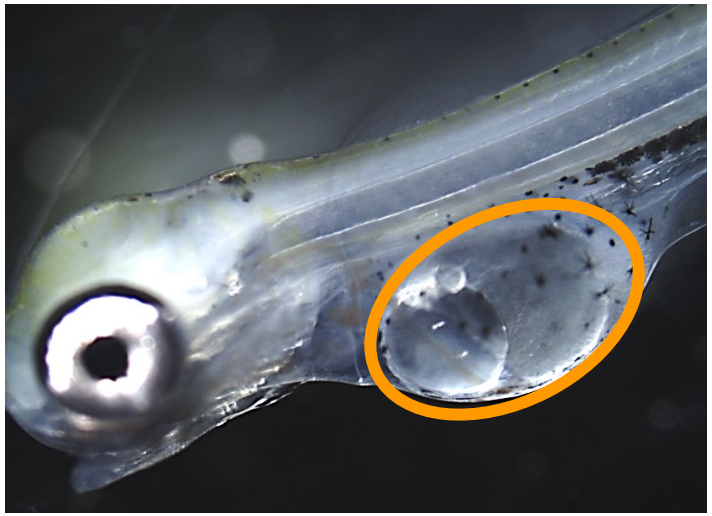
Lower Temperature – Slower development rate



Less Light – Slower development rate
Higher energy stores







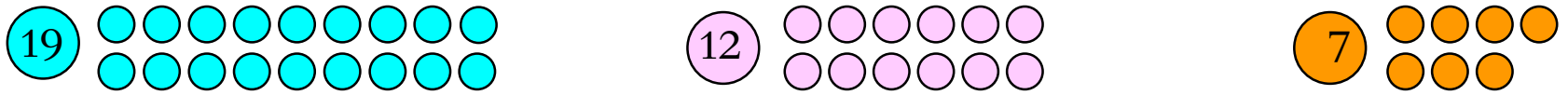
Egg development curve from Colby and Brooke 1973. Yolk-sac area and images from Taylor Stewart, University of Vermont

Ciscoe age-1 Recruitment Predictive Model

None-Low recruitment

Low-moderate recruitment

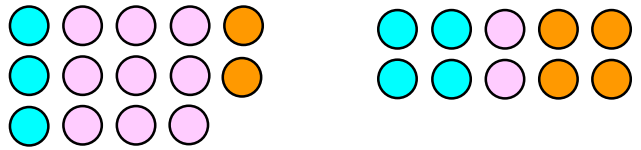
High recruitment



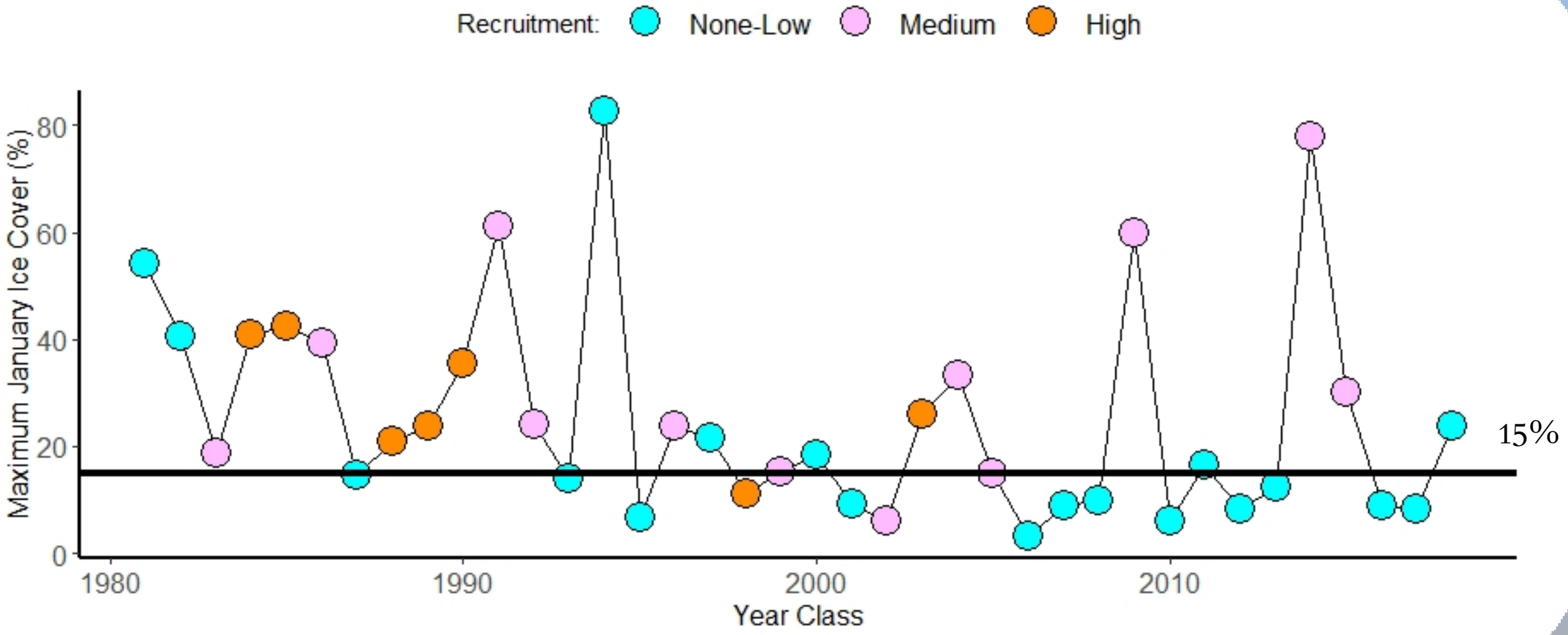
FACTOR 1: Early Ice January ice cover <15% January ice cover >15%

90% of measurable recruitment events

FACTOR 2: Spring warming July >7°C July <7°C

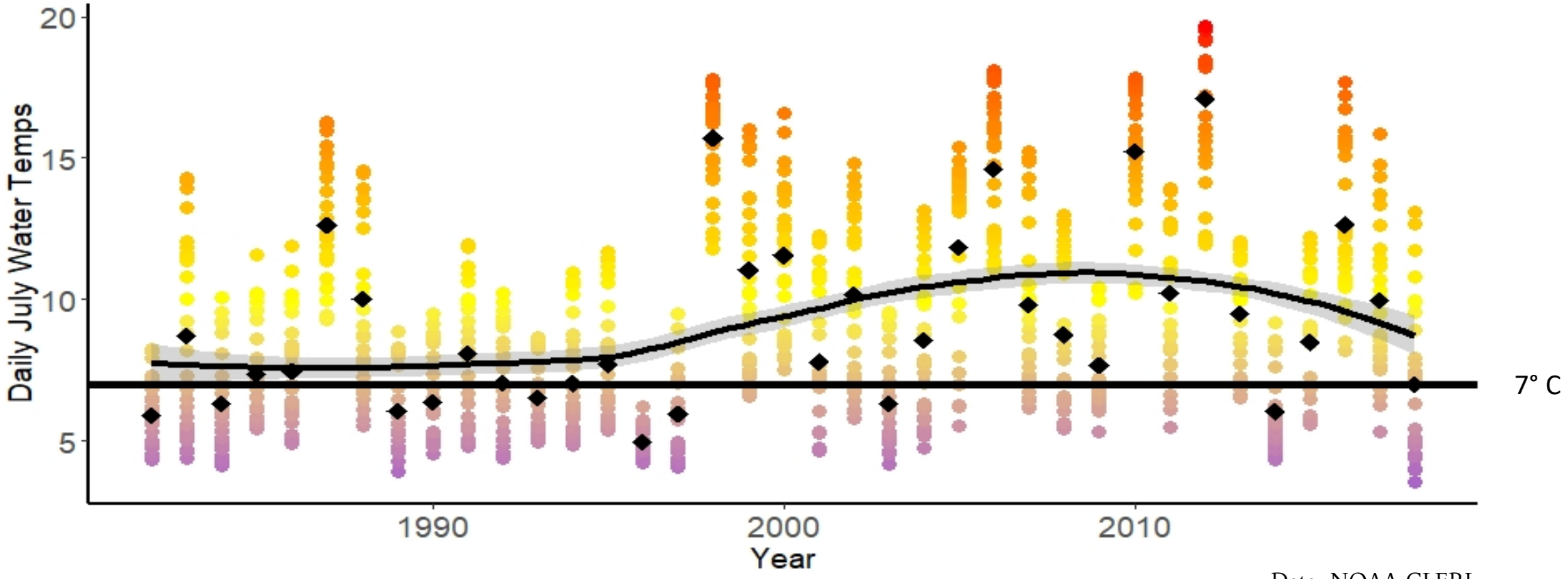


Trend in January Ice Cover



Data: Ice, NOAA GLERL. Fish, USGS

Trend in July Water Temperature



Data: NOAA GLERL