American Eel Supplemental Report to the 2022 Benchmark

American Eel Board Meeting

August 1, 2023

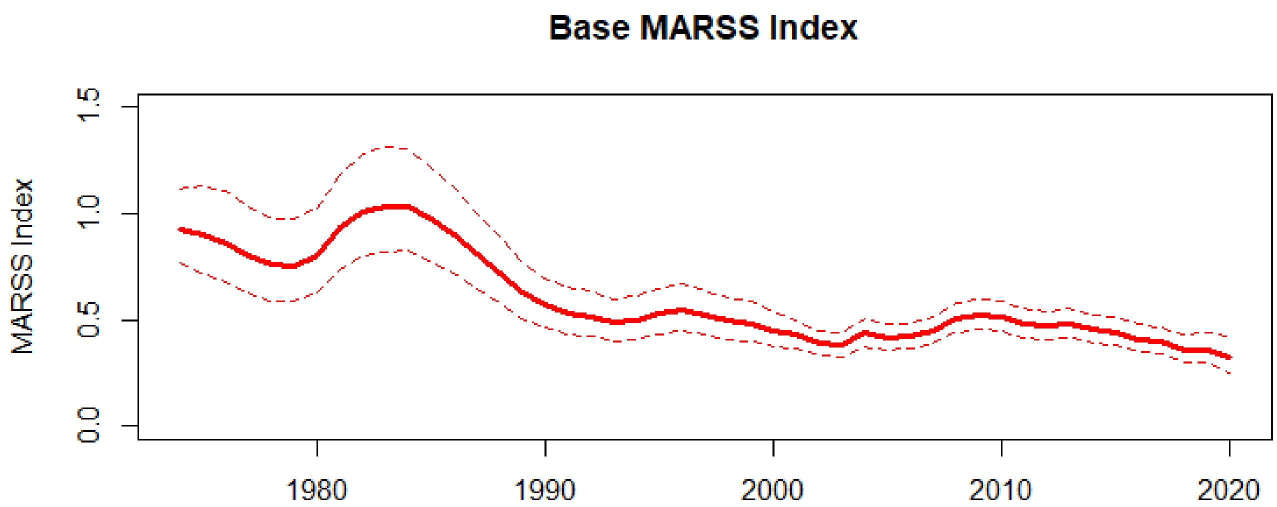
Background and SAS Tasks

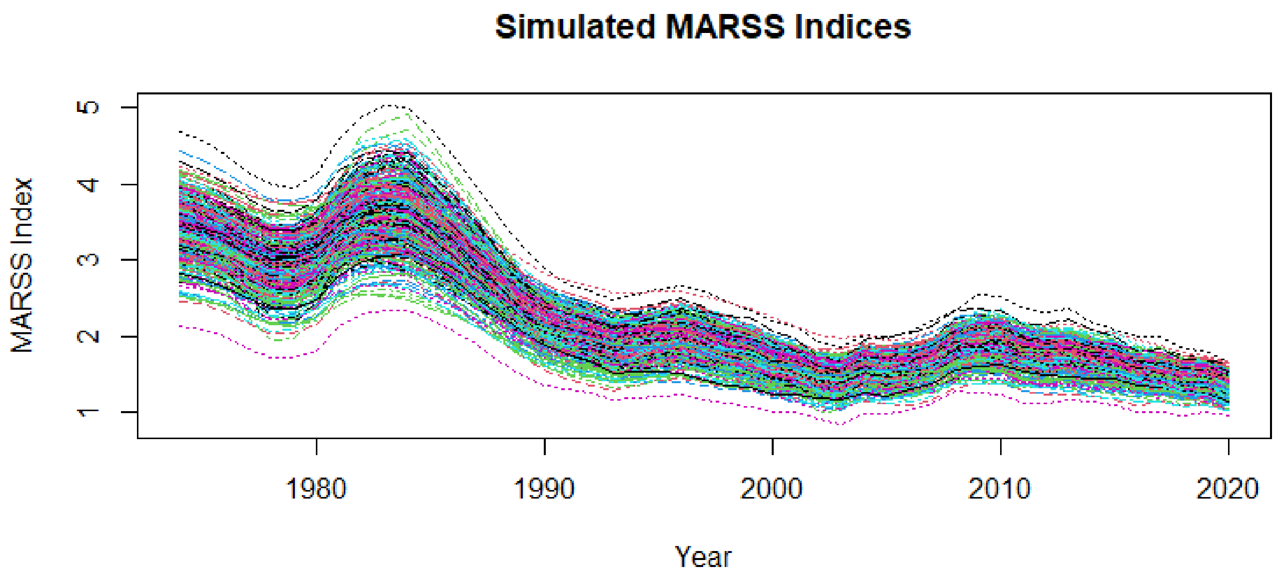
- Peer Review:
  - Additional work is needed to establish threshold reference points in I_{TARGET} (use of MSE)
  - Stock is depleted, not overfished with likely overfishing
- American Eel Board:
  - Evaluate influence of individual surveys on coast-wide yellow eel index
  - Consider reference period and other configurations for I_{TARGET}
  - Usefulness of habitat model for future assessments

Sensitivity Testing - MARSS Resampling

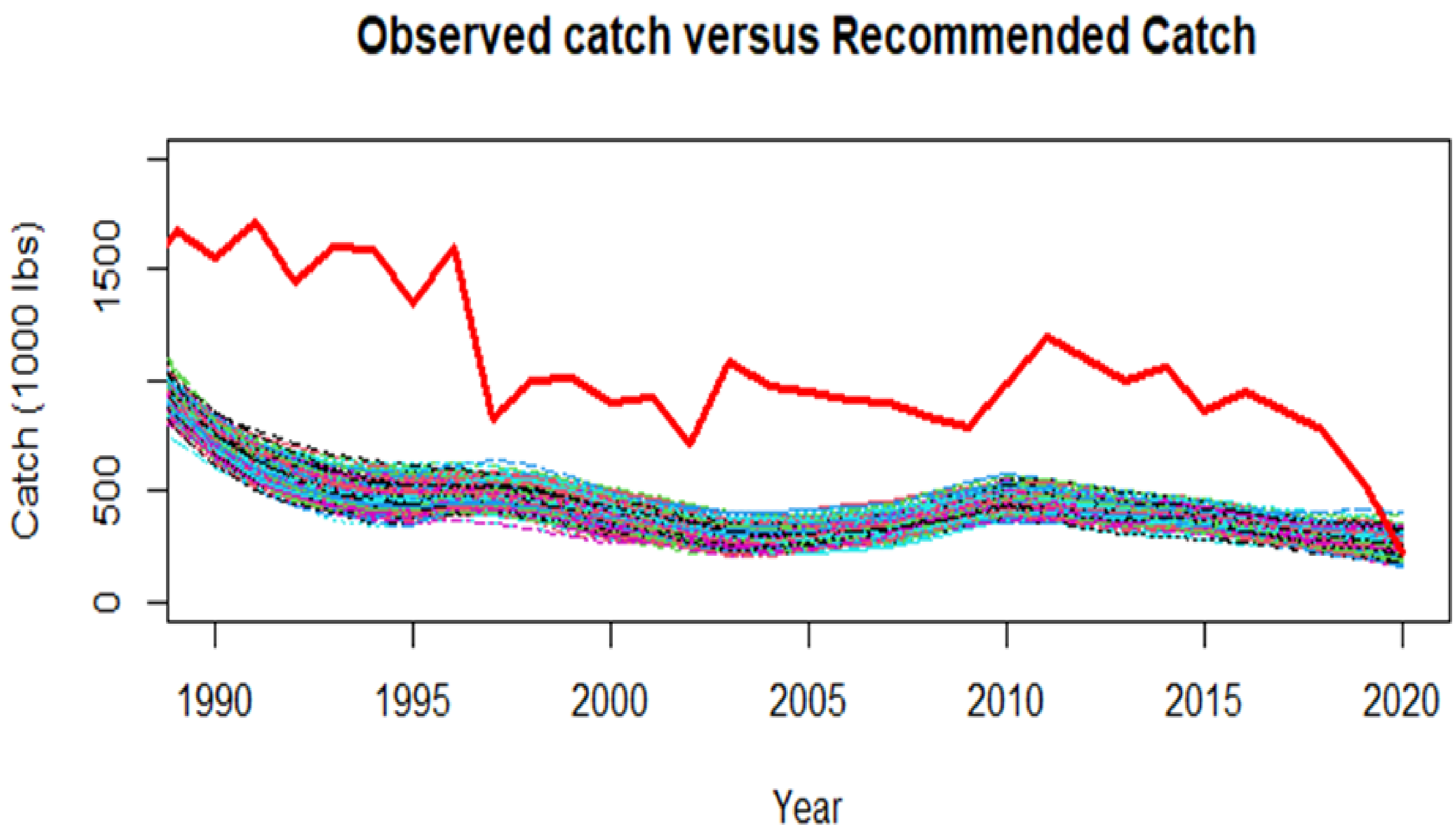
- Goal: Conduct simulations to determine how uncertainty in annual indices of abundance may influence the MARSS yellow eel index and how this may then influence recommended harvest by the I_{TARGET} method
- Method:
  - Simulations were conducted by randomly drawing a value for each fishery-independent survey for each year the survey was conducted from a normal distribution
  - MARSS index re-calculated, I_{TARGET} re-run

Sensitivity Testing - MARSS Resampling





Sensitivity Testing - MARSS Resampling

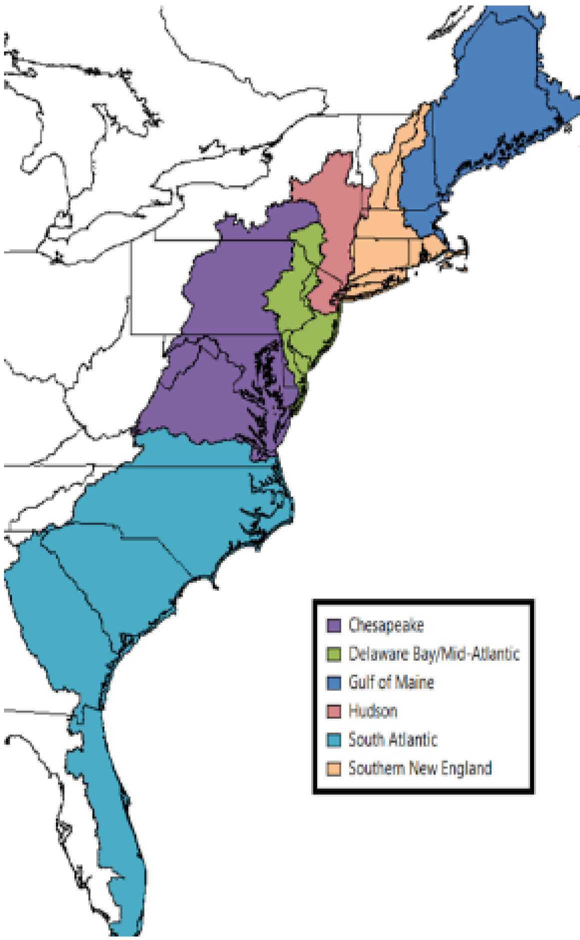


Sensitivity Testing - MARSS Resampling

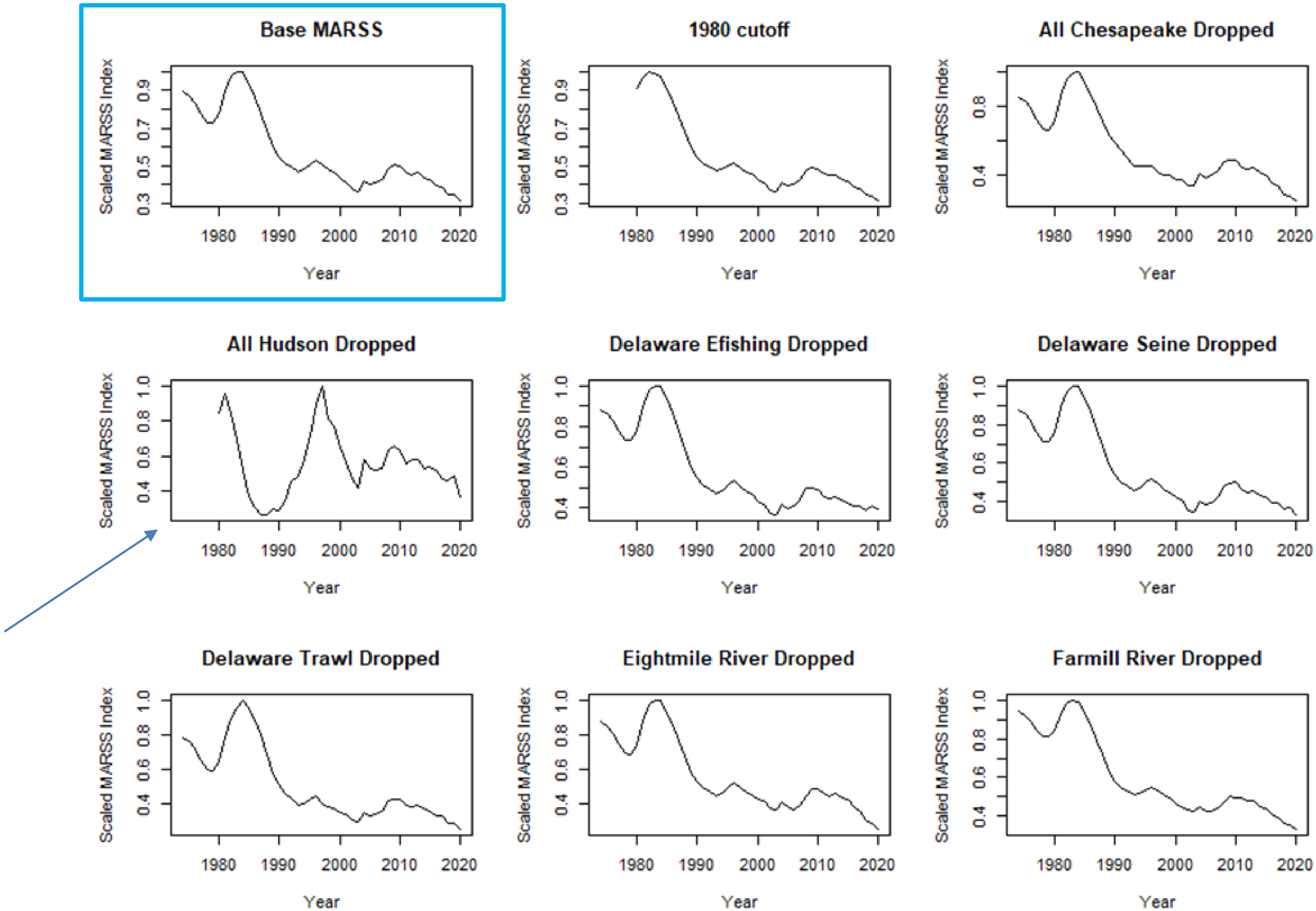
- <u>Conclusions:</u>
  - Resulting yellow eel trends very similar
  - Recommended catch from I_{TARGET} very similar
    - Base MARSS: 202,453
    - Simulated MARSS: 255,285 pounds (95th percentile range: 190,411 – 337,171 pounds)
  - Trends in the coastwide population of yellow eels based on the MARSS model and recommended catch of based on the I_{TARGET} method are robust to uncertainty in individual point estimates of relative abundance from fishery-independent surveys

Sensitivity Testing - Leave-One-Out

- Goal: To explore the influence of any one survey on the final MARSS model index (e.g., Hudson River)
- Methods: Conducted a sensitivity analysis in which each individual survey was omitted from the data one at a time and the MARSS model fit to the remaining surveys
  - Additional runs to drop entire regions (Hudson or CB) or include longest survey from each region



Sensitivity Testing - Leave-One-Out



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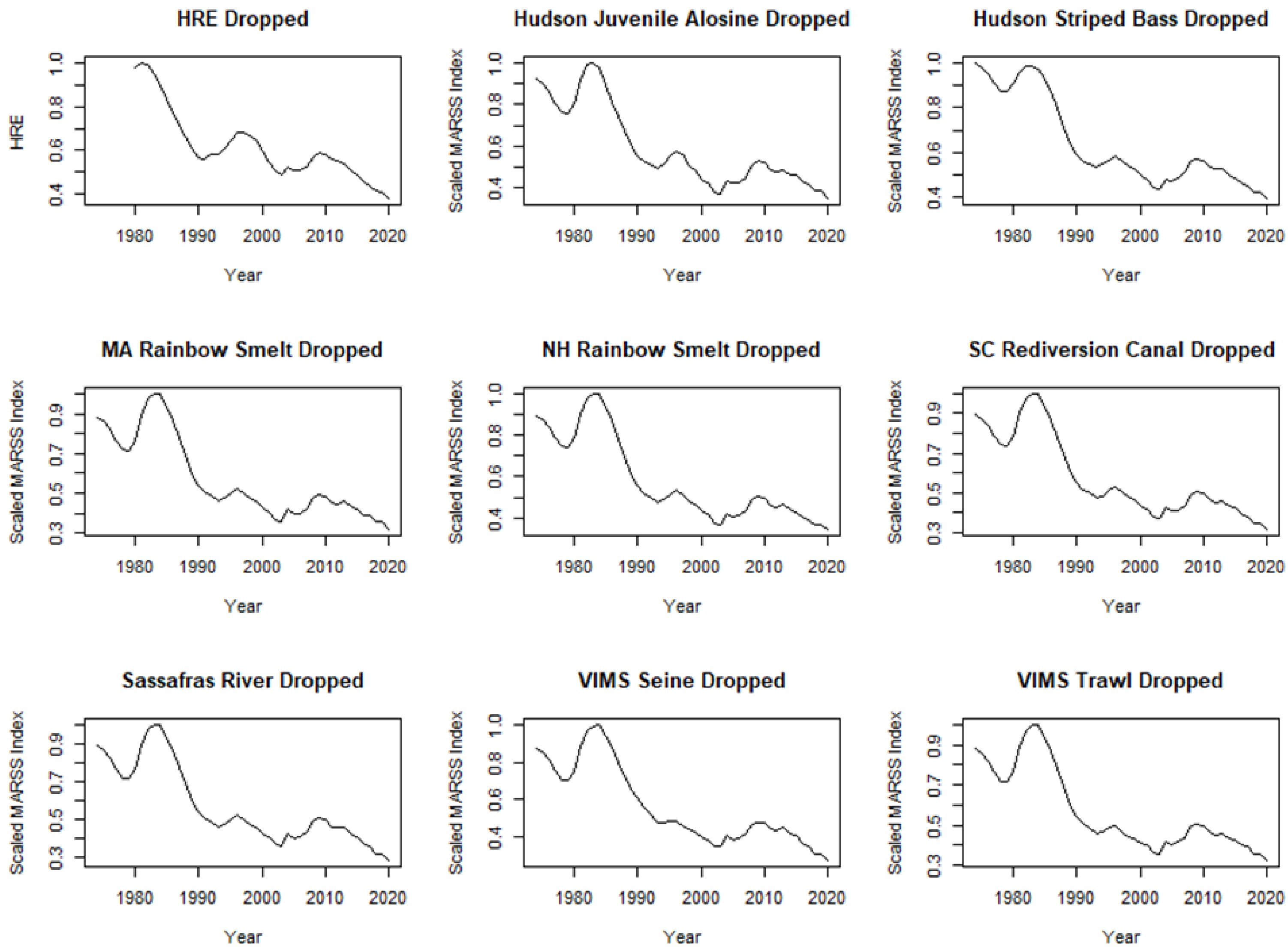
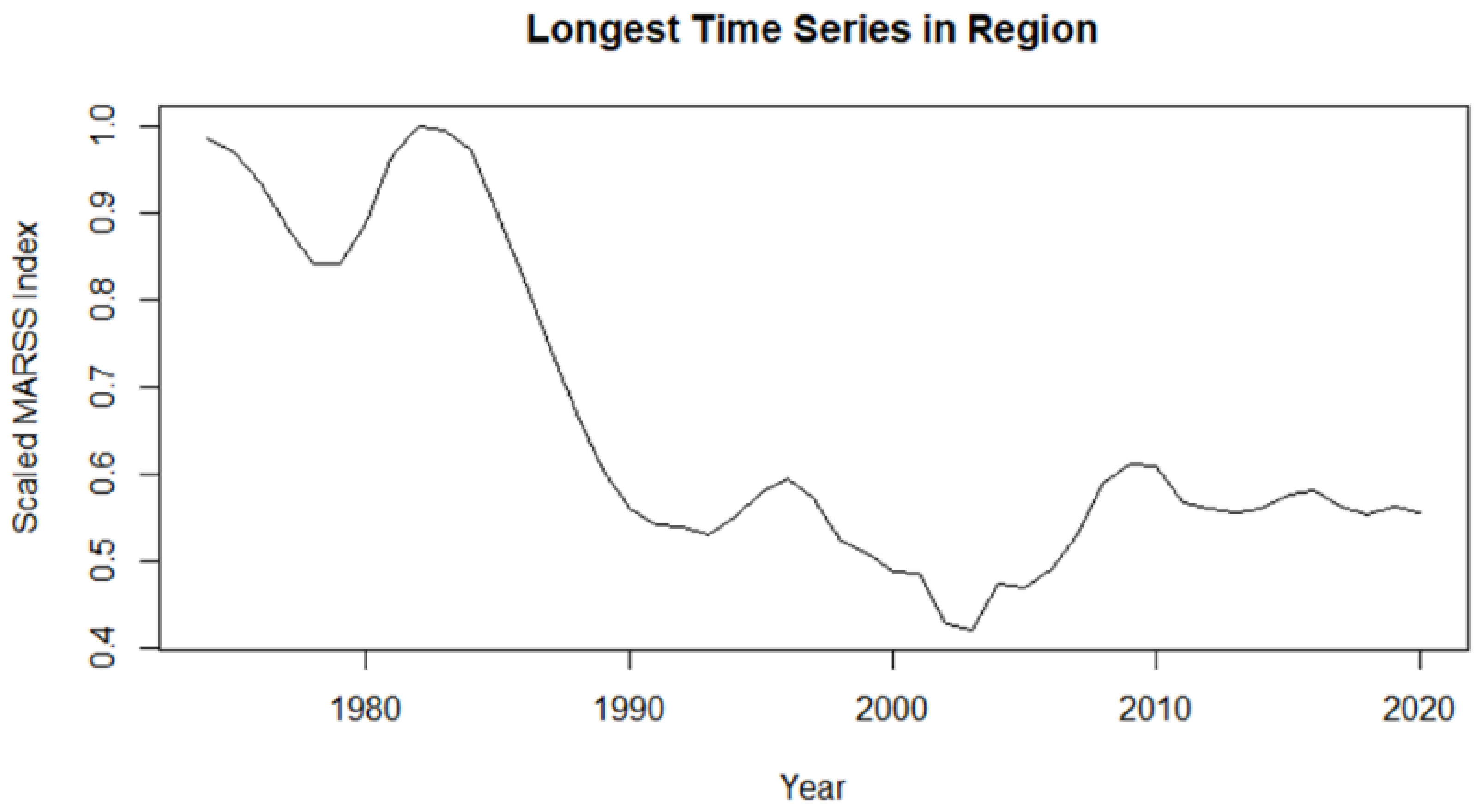


Sensitivity Testing - Leave-One-Out



Sensitivity Testing - Leave-One-Out

- Conclusions:
  - MARSS index can be influenced by the suite of surveys included and the length of their time series
  - No single survey completely drives the trends in the final abundance index time series
    - Hudson River is a large system representing a significant portion of the coastwide stock and to completely exclude the Hudson River from the analysis seems inappropriate
  - MARSS index is robust to deviations due to any single survey and it appears to be the best index of coastwide abundance of the species

Sensitivity Testing - Regime Shift Analysis

- Goal: To show the effects each survey had on the resulting abundance index trend for coastwide yellow eel and thus the choice of reference period in I_{TARGET} based on the regime shift analysis
- Methods: Use STARS to re-run regime shift analysis based on leave-one-out analysis

Sensitivity Testing - Regime Shift Analysis

Sensitivity Run	Regimes	Same as Base	Same or Similar to Base +/- one year
Base	1974-1987, 1988-1999, 2000-2020	X	X
1980 Cutoff	1980-1986, 1987-1998, 1999-2020		X
Drop MD Sassafras	1974-1987, 1988-1999, 2000-2020	X	X
Drop VIMS Seine	1974-1987, 1988-1996, 1997-2020		
Drop VIMS Trawl	1974-1987, 1988-1999, 2000-2020	X	X
Drop PA Area 6	1974-1987, 1988-1999, 2000-2020	X	X
Drop NJ Delaware River Seine	1974-1987, 1988-1999, 2000-2020	X	X
Drop DE Trawl	1974-1988, 1989-2020		X*
Drop MA Rainbow Smelt	1974-1987, 1988-1999, 2000-2020	X	X
Drop NH Rainbow Smelt	1974-1987, 1988-1999, 2000-2020	X	X
Drop HRE	1980-1985, 1986-2000, 2001-2020		
Drop Hudson River Alosine	1974-1986, 1987-1998, 1999-2020		X
Drop Hudson Striped Bass Seine	1974-1986, 1987-1998, 1999-2020		X
Drop CT Eightmile	1974-1987, 1988-2000, 2001-2020		X
Drop CT Farmill	1974-1986, 1987-1998, 1999-2020		X
Drop SC Redivision	1974-1987, 1988-1999, 2000-2020	X	X
Drop All Hudson Indices	1980-1994, 1995-2020		
Drop All CB Indices	1974-1987, 1988-1996, 1997-2020		
Include Longest Survey from Each Region	1974-1985, 1986-1997, 1998-2007, 2008-2020		

Sensitivity Testing - Regime Shift Analysis

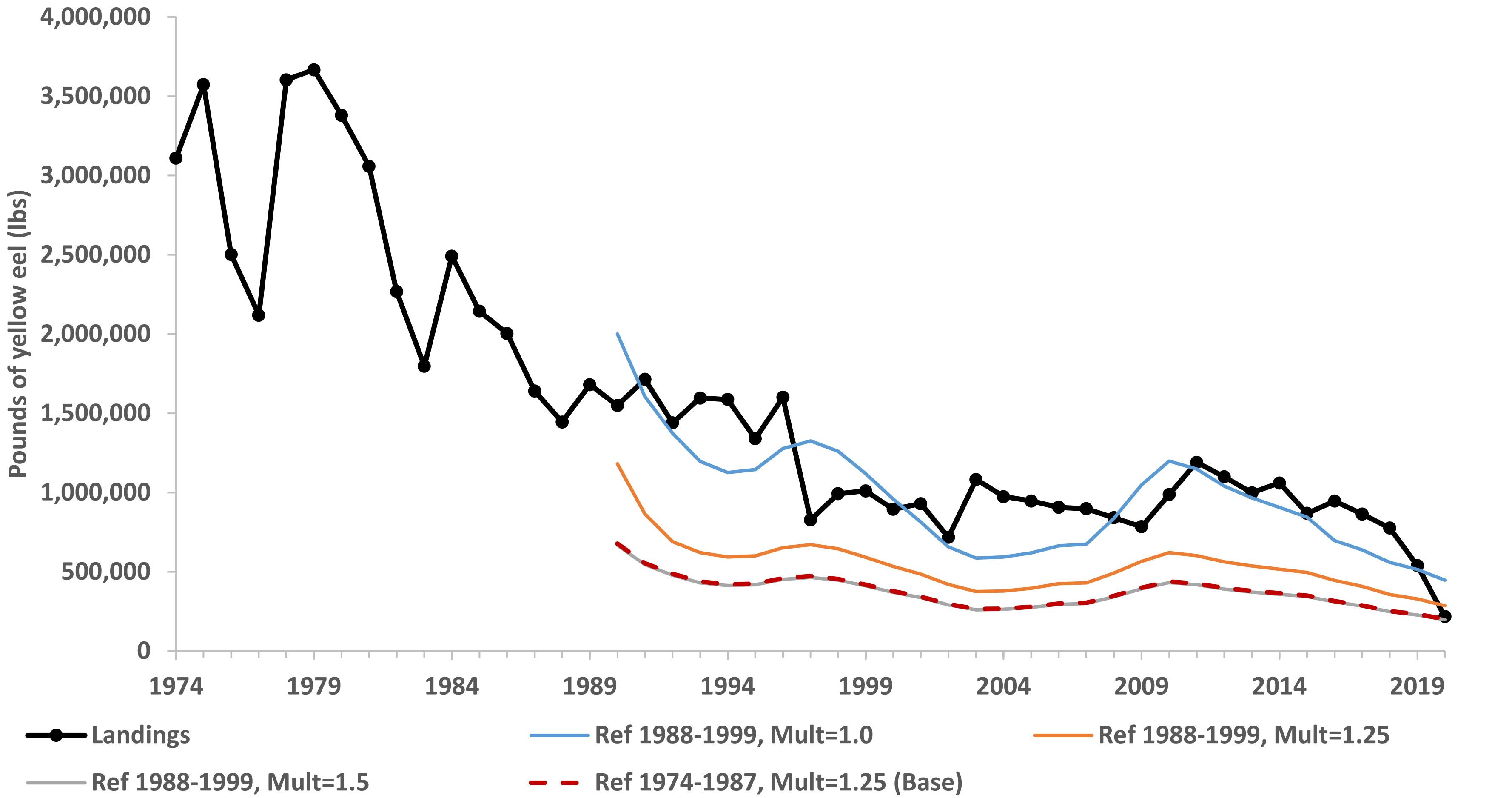
- <u>Conclusions</u>:
  - Omitting a single survey had little effect on the general pattern of the MARSS model index and therefore little effect on the regimes identified by STARS
  - No one index is driving the trend
  - Dropping all three Hudson River indices results in the largest difference

I_{TARGET} Configurations

- Inputs:
  - Catch
  - Index (MARSS yellow eel)
- Specify:
  - Reference period
    - A stable or desirable period of abundance
    - Determined by regime shift analysis
  - Multiplier
    - Setting a desired level of abundance that management is trying to achieve
  - Threshold
    - Setting the desired level of fishing on the stock

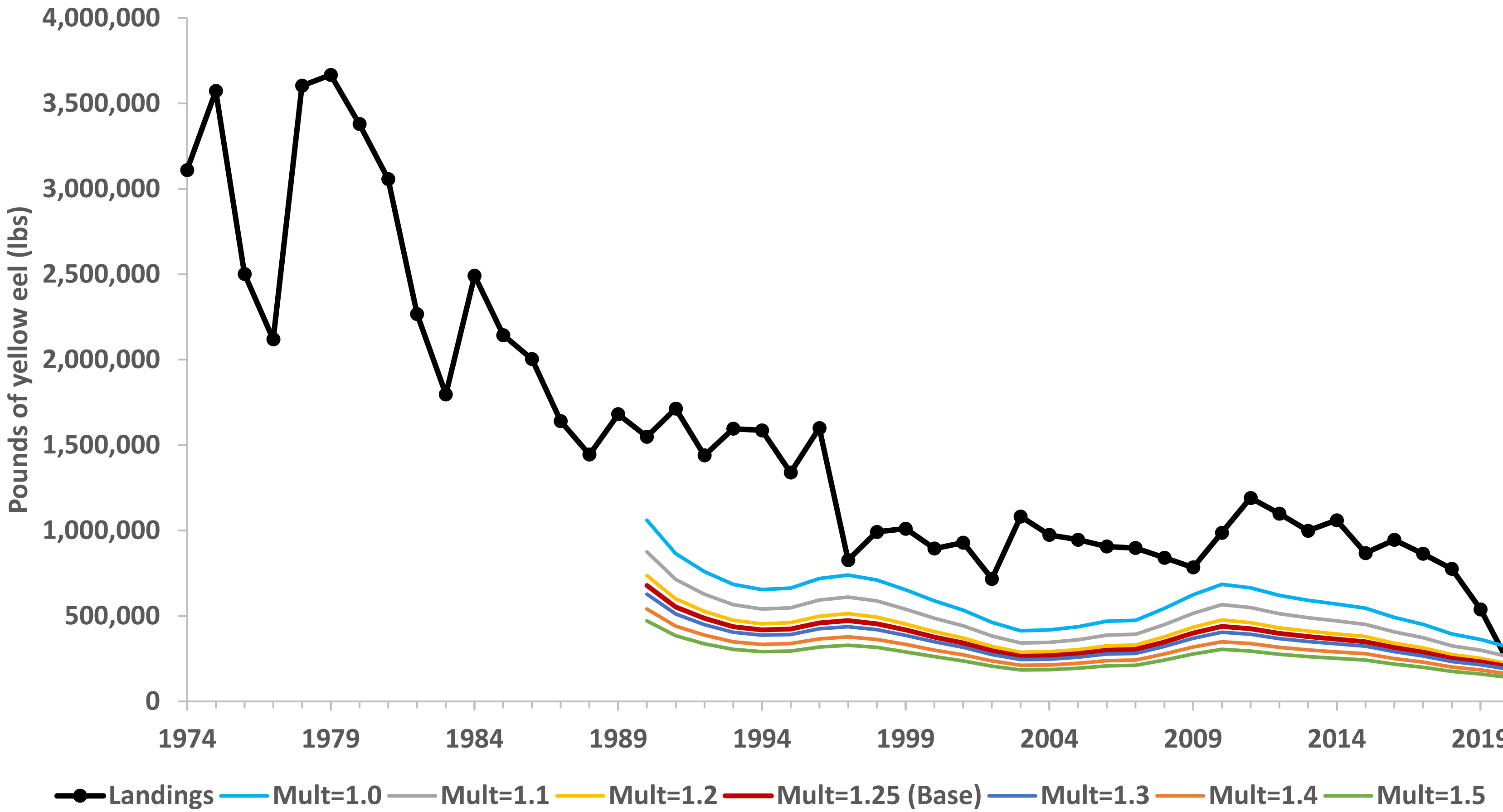
I_{TARGET}: Alt. Reference Period

- Explored 1988-1999 with other multipliers



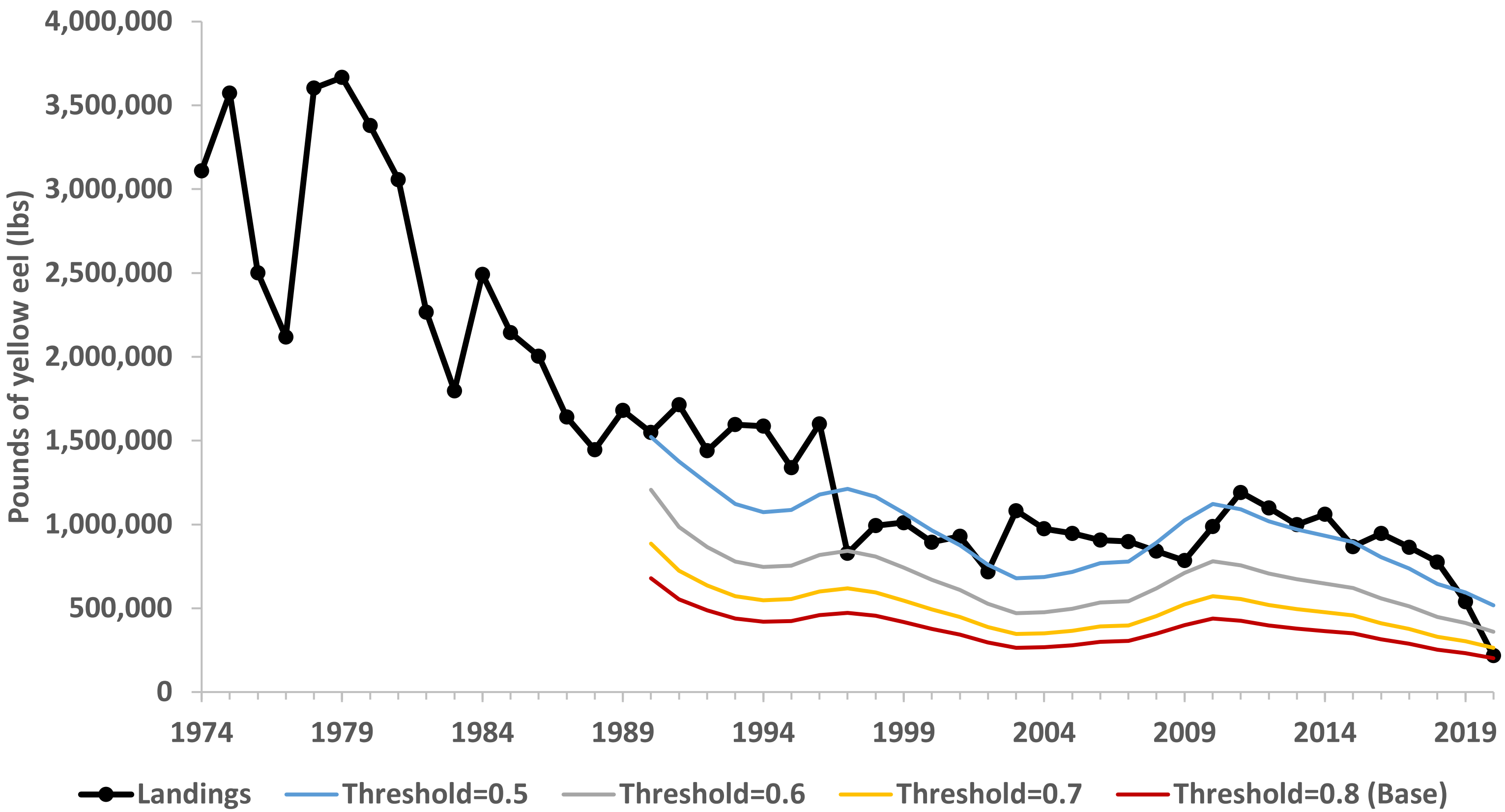
I_{TARGET}: Multiplier

- Explored 1.0-1.5 in 0.1 intervals



I_{TARGET}: Threshold

- Explored 0.5-0.8 in 0.1 intervals



I_{TARGET} Configurations

Reference Period	Multiplier Value	Threshold Value	Recommended 2020 Catch (lbs)
1974-1987 (Base)	1.25 (Base)	0.5	518,281
1974-1987 (Base)	1.25 (Base)	0.6	359,917
1974-1987 (Base)	1.25 (Base)	0.7	264,429
1974-1987 (Base)	1.25 (Base)	0.8 (Base)	202,453
1974-1987 (Base)	1.00	0.8 (Base)	316,334
1974-1987 (Base)	1.10	0.8 (Base)	261,433
1974-1987 (Base)	1.20	0.8 (Base)	219,676
1974-1987 (Base)	1.30	0.8 (Base)	187,180
1974-1987 (Base)	1.40	0.8 (Base)	161,395
1974-1987 (Base)	1.50	0.8 (Base)	140,593
1988-1999	1.00	0.8 (Base)	448,049
1988-1999	1.25 (Base)	0.8 (Base)	286,751
1988-1999	1.50	0.8 (Base)	199,133

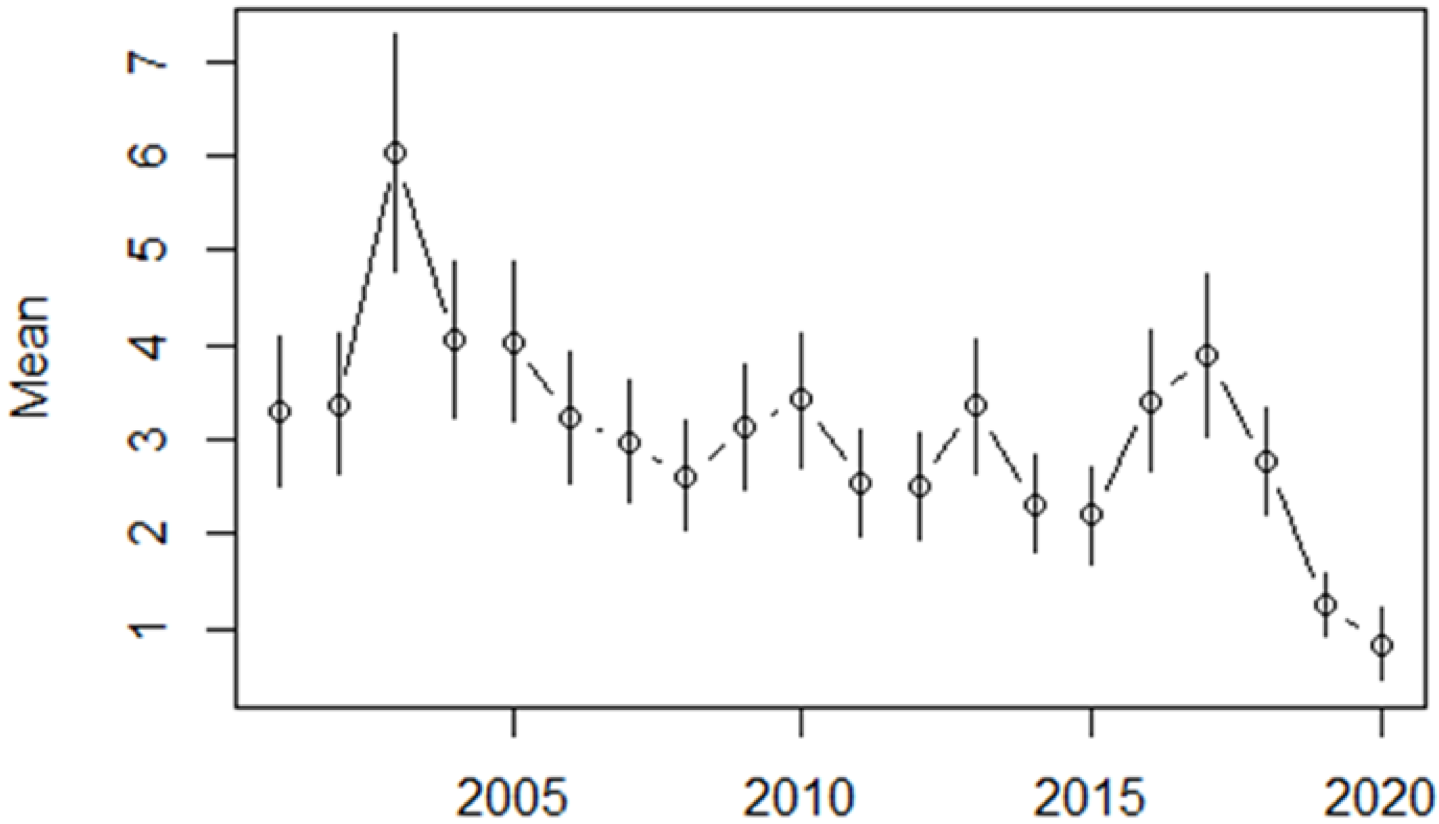
- Conclusions:
  - Should be discussed by a PDT if the Board accepts the assessment
  - Majority of SAS support a 1974-1987 reference period and 1.25 multiplier
  - Choice for threshold (0.5-0.8) should reflect goals of the fishery

I_{TARGET} Predictions

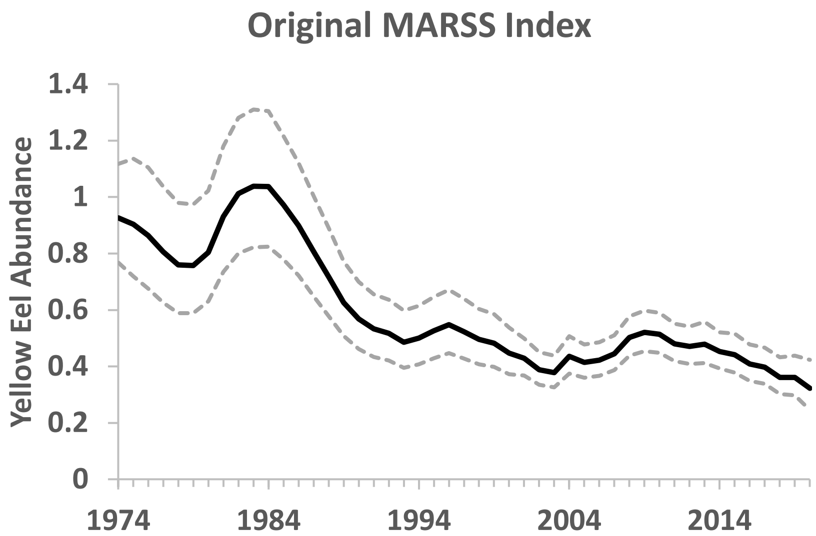
- Can I_{TARGET} make predictions on abundance increases in response to harvest reductions?
  - No, it cannot be used to forecast or project under different harvest scenarios
  - Data-limited tool
  - Does not include population parameters (growth, mortality, recruitment)

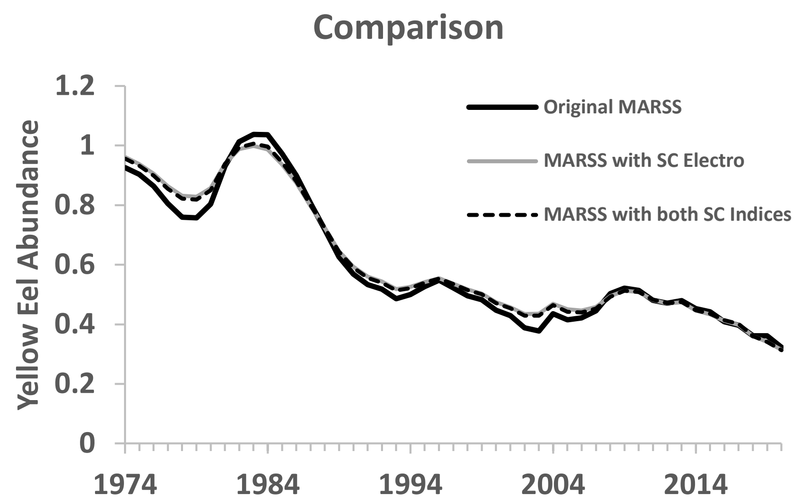
Omitted SC DNR Electrofishing Survey

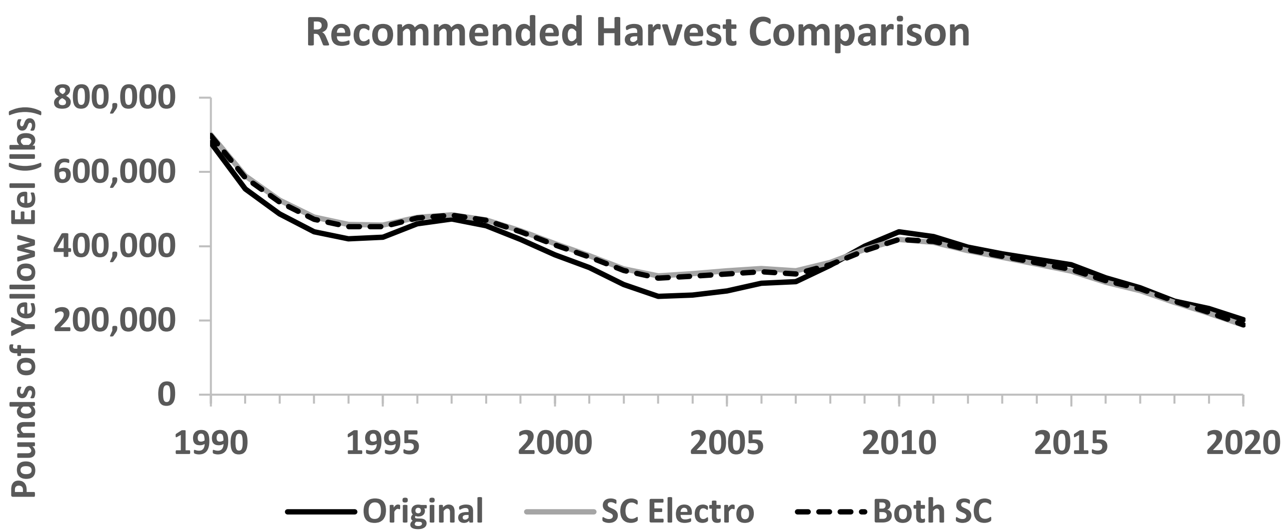
- Inadvertently omitted from the Assessment
- Met criteria for data collection



Omitted SC DNR Electrofishing Survey







Habitat Modelling

- How will having a habitat model help in future assessments?
  - Data limitations restrict the development of a coastwide habitat model, but advances in modeling may help in the future.
  - Recent advances in geospatial predictor datasets may help quantify river, stream, lake habitat area, volume, connectivity
  - Could use EPR to link escapement of inland past dams to reproductive output

Stock Status

- 2022 assessment determined stock was overfished and likely experiencing overfishing
- PR panel disagreed, depleted
- Based on the definitions of depleted, overfishing, and overfished, the American eel stock is <u>depleted</u> and coastwide catch should be decreased. If reference points are established through the use of I_{TARGET}, overfished and overfishing statuses could be determined.

Response to MSE

- Simulation approach within MSE requires underlying knowledge of important population parameters (i.e., recruitment, natural mortality, intrinsic growth)
- I_{TARGET} and other index-based methods were simulation tested across various life-history strategies
- Building the simulation and testing parameters would require extensive analysis, vetting, time
- Should be a long-term research and modeling objective

SUMMARY

- The simulated MARSS model fits were similar to fits in the 2022 stock assessment report
- Omitting a single survey from the MARSS index had little effect on the general coastwide abundance pattern, regimes identified, or reference period for I_{TARGET}
- Omitting all three Hudson River surveys (not recommended) shortens the time series and results in the largest change to the MARSS index and identified regimes

SUMMARY

- Changing the threshold value in I_{TARGET} results in recommended catches from 202,453 – 518,281 lbs.
  - Choice of configuration should be determined by a Plan Development Team through a management document to reflect the goals of the fishery
  - SAS does not recommend changing multiplier or reference period (only threshold)
- Population projections are not possible using the index-based method, I_{TARGET}

SUMMARY

- Data limitations restrict development of a coastwide habitat model; future modeling advances may help
- An MSE could be considered during the next benchmark, but in the meantime the I_{TARGET} tool can be used for management because it was designed for when traditional assessment models fail
- SAS agrees with PR that American eel stock is depleted, coastwide catch should be decreased
- If reference points are established through I_{TARGET}, overfishing and overfished statuses could be determined

ATLANTIC STATES MARINE FISHERIES COMMISSION

Yellow Eel Indices

State	Site	Gear	Model	Years of Survey	Trend
NH	Rainbow Smelt Fyke Net Survey	Fyke Net	NB GLM year+temp+river	2010-2020	NS
MA	Rainbow Smelt Fyke Net Survey	Fyke Net	NB GLM year+temp+offset(effort)	2004-2019	NS
CT	Farmill River	Electrofishing	Population estimate	2001-2012, 2014	NS
CT	Eightmile River	Electrofishing	Population estimate	2001-2003, 2005-2017, 2019	NS
NY	HRE Monitoring	Epibenthic sled & tucker trawl	Quasi-poisson GLM year+temp+river mile+water volume	1974-2017	↓
NY	Hudson Juvenile Alosine	Beach Seine	NB GLM year+station+temp	1985-2019	↓
NY	Hudson Juv Striped Bass	Beach Seine	NB GLM year+station+temp	1980-2019	↓
NJ	Delaware River Seine	Seine	NB GLM year+station+temp	1998-2019	NS
DE	Delaware Juvenile Trawl	Trawl	Nominal index with delta distribution	1980-2019	NS
PA	Delaware River Area 6	Electrofishing	Nominal	2005-2020	↓
MD	Sassafras River	Pot	Nominal	2006-2019	↑
VA	VIMS Trawl Survey	Trawl	NB GLM year+salinity+offset(effort)	1996-2019	NS
VA	VIMS Seine Survey	Seine	NB GLM year+salinity	1989-2019	↑
SC	Rediversion canal	Aluminum ladder	Quasi-poisson GLM year+temp+gear condition	2003, 2005-2007, 2009-2020	NS

Addendum V
Glass Eel Quota Provision

American Eel Management Board
August 1, 2023

Addendum V Provision

- Maine glass eel quota = 9,688 lbs
  - Based on 2014 Maine landings
- In 2021, Board extended this quota through 2024
- A new addendum is required to set the Maine glass eel quota beyond 2024

Board Action

- Consider initiating an addendum to establish a glass eel quota for Maine for 2025 and beyond

Questions ?

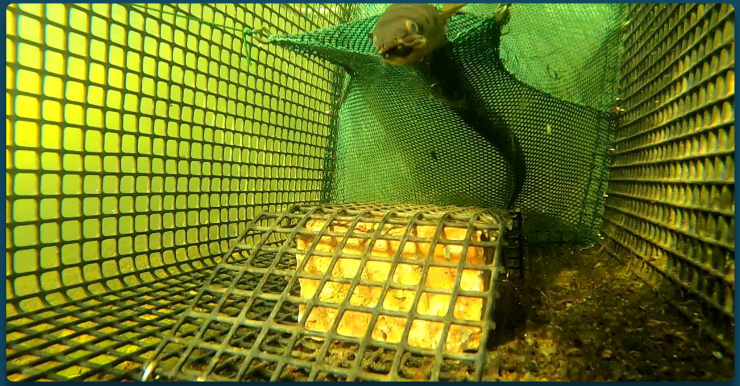
The American Eel

DMR Life Cycle Study

Prepared by Jason Bartlett and Casey Clark

Marine Scientist, Department of Marine Resources

Sampling-West Harbor Pond



Glass eels

This part of the study was initiated in 2001 per ASMFC requirements for a Young-of-Year (YOY) study.

Yellow eels

Pot fishing to sample yellow eels was initiated in 2018 as part of the Life Cycle study.

Silver eels

Fyke net sampling to collect out-migrating silver eels was also initiated in 2018 as part of the Life Cycle study.

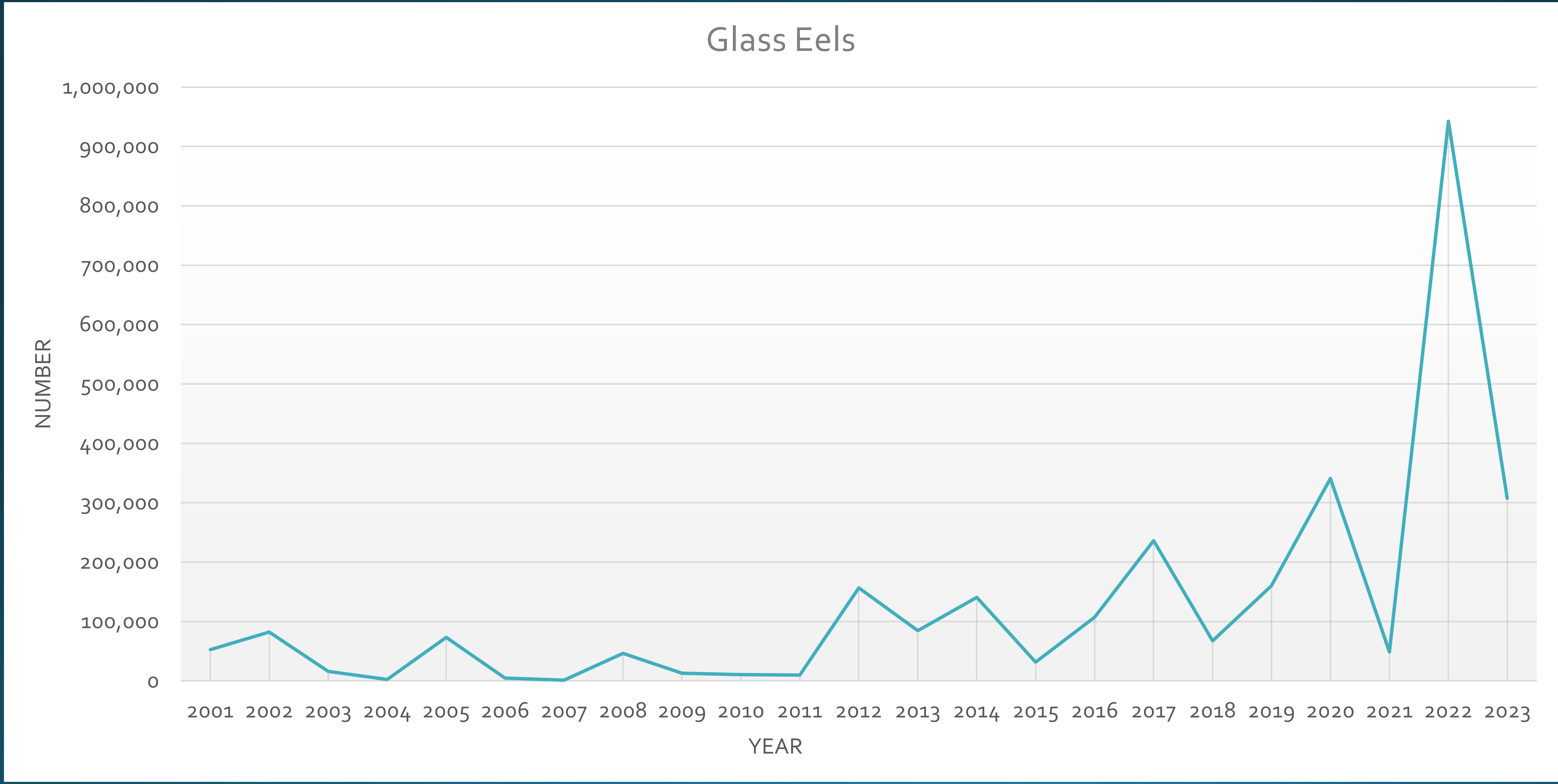
Glass Eels

- Sampling begins at approximately the same time the commercial season opens (March 24th) and continues through June.
- Two vertical ramps are attached to the dam at the outlet of West Harbor Pond.
- Fresh water is supplied to the ramps from early flood tide through late ebb tide.
- Eels ascend the ramps while the water is flowing and drop into boxes secured in the pond.
- Glass eels are separated from elvers, counted or weighed, and released into the pond.
- The number caught varies from year to year, with 2022 resulting in the largest catch since the study began.

Glass eels (cont.)

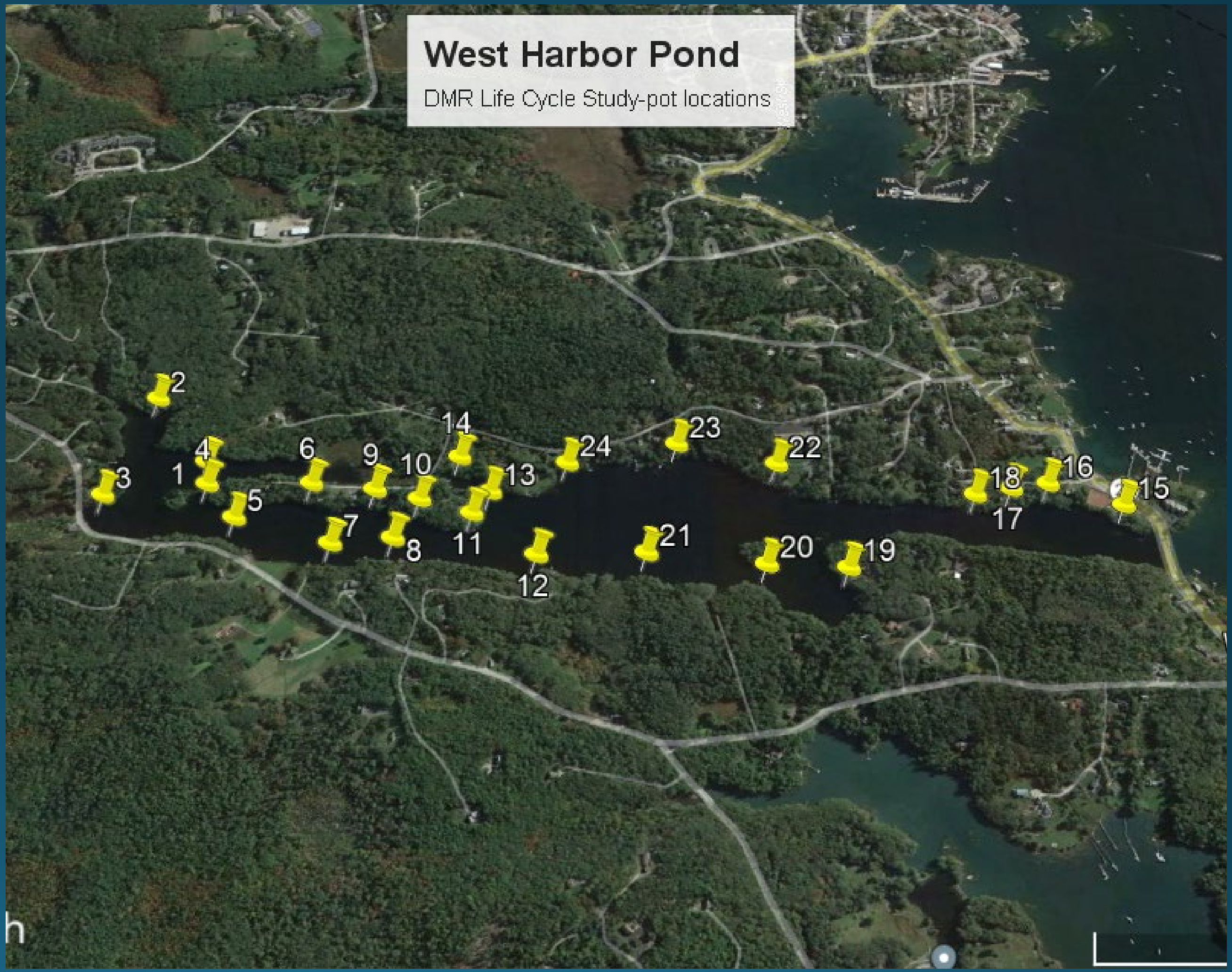
- Over the course of the sampling season, several 60-fish subsamples are taken for individual measurements and pigment code determination.
- Average individual lengths and weights tend to decrease as the season progresses.

Number of Glass Eels Caught by Year



Yellow Eels

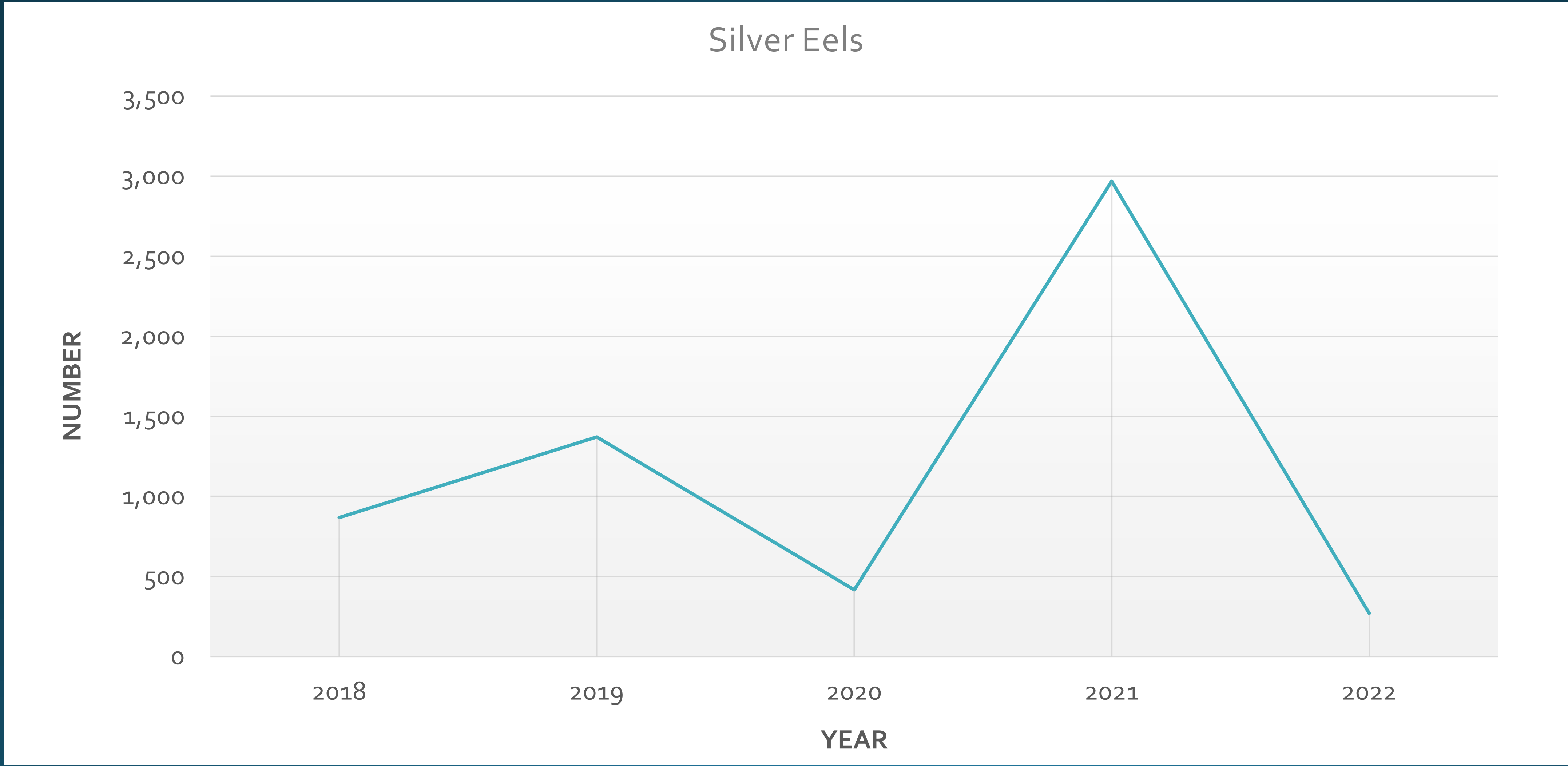
- Sampling with baited eel pots begins in July and continues through September.
- 24 pots are deployed every other week for 5 cycles at set locations around the pond. They are checked after 24 hours, rebaited, and deployed again for another 24 hours.
- Each time the pots are checked all eels are removed, measured for length and weight, tagged with a PIT tag if they don't already have one, and released.
- 1,019 yellow eels have been tagged to date. Most have been recaptured at least once.



Silver Eels

- A fyke net is set at the outlet of West Harbor Pond starting in September to catch out-migrating silver eels.
- Sampling continues until December, or when no more silver eels are caught.
- All eels are removed from the trap and scanned for PIT tags. A subsample of length and weight measurements are taken.
- Rain events trigger silver eels to migrate.
- To date 5,888 silver eels have been captured.

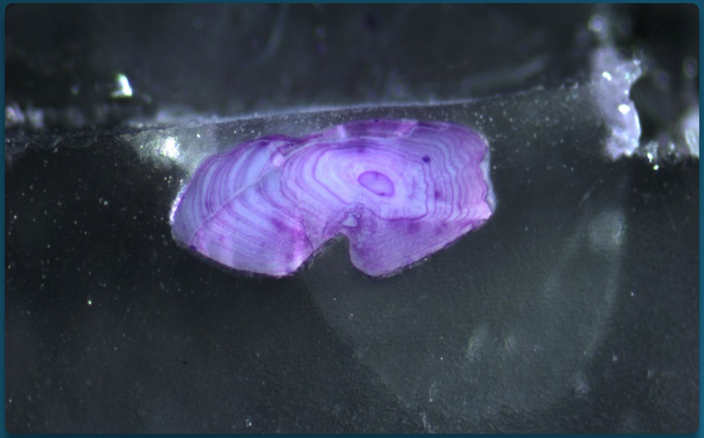
Number of Silver Eels Caught



Additional Sampling

Ageing otoliths

- Otoliths are sectioned, polished, and stained to count the annuli.
- The average ages of silver eels leaving West Harbor Pond are- males 8 yrs, females 14 yrs.



Average Length of silver eels

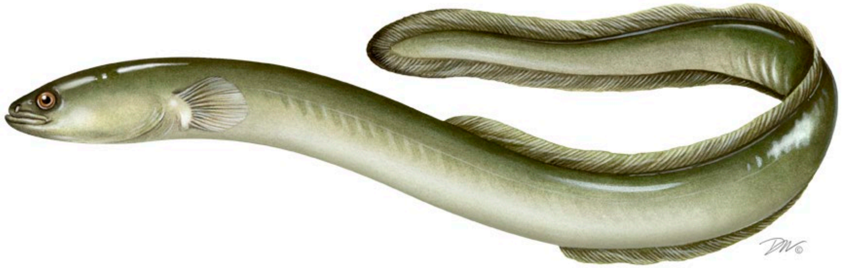
- The average lengths of silver eels leaving West Harbor Pond are- males 297 mm, females 443 mm.

Swim Bladder Parasite

- The invasive eel parasite *Anguillacoloides crassus* is present in eels living in West Harbor Pond.
- Over 50% of the eels sampled are infected with this parasite.

Questions?

American Eel Aquaculture Proposals



American Eel Management Board
August 1, 2023

Outline

- Background
- Maine Proposal
- Technical Committee Review
- Questions

Background

- Aquaculture provision established through Addendum IV
  - Maintained by Addendum V

- States and jurisdictions can develop Plans for domestic aquaculture
  - Under an approved Aquaculture Plan, states and jurisdictions can harvest a maximum of 200 pounds of glass eel per year

Maine Proposal

- Maine has utilized aquaculture quota since 2019

2019	2020	2021	2022	2023
130.5	0	138.91	200	200

- 2023 Summary
  - Same harvest locations as previous years, plus new harvests in the Union River, Passagassawakeag River, and St. Croix River
  - Increased CPUEs in 2022 and 2023

Maine Proposal

- 2024 Proposal
  - No changes in facility or monitoring
  - American Unagi requests to harvest full 200 lbs allocation

TC Summary

- ME Proposal: No concerns
- **TC recommended approval of the proposal**

Questions?