

Review of the 2024 Atlantic Sturgeon Stock Assessment Update



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Terms of Reference



- TOR 1: Update Fishery-Dependent Data
- TOR 2: Update Fishery-Independent Data
- TOR 3: Tabulate and Update Life History Info
- TOR 4: Update Models
- TOR 5: Determine Stock Status
- *TOR 6: Do Projections (N/A)*
- TOR 7: Comment on and Update Research Recommendations

TOR 1: Commercial Fishery



- Mid to late 1990s: several states closed their Atlantic sturgeon fisheries
- 1998: Coastwide moratorium
- Historical landings are available in ASMFC 2017
- Three sources of bycatch estimates:
 - Northeast Fishery Observer Program (NEFOP)
 - NC Estuarine Gill Net Fishery
 - SC American Shad Fishery

TOR 1: NEFOP Bycatch



Atlantic sturgeon bycatch for otter trawls

| Year | Total Bycatch Estimate | Standard Error | Proportion Dead | Dead Bycatch Estimate |
|------|------------------------|----------------|-----------------|-----------------------|
| 2006 | 1,187 | 103 | 18% | 212 |
| 2007 | 1,099 | 105 | 9% | 95 |
| 2008 | 1,033 | 156 | 16% | 167 |
| 2009 | 1,025 | 116 | 2% | 21 |
| 2010 | 986 | 96 | 1% | 9 |
| 2011 | 922 | 97 | 0% | 0 |
| 2012 | 848 | 85 | 0% | 0 |
| 2013 | 892 | 96 | 0% | 0 |
| 2014 | 789 | 79 | 0% | 0 |
| 2015 | 735 | 72 | 0% | 0 |
| 2016 | 759 | 71 | 0% | 0 |
| 2017 | 723 | 72 | 0% | 0 |
| 2018 | 684 | 69 | 8% | 54 |
| 2019 | 835 | 94 | 0% | 0 |
| 2020 | | | | |
| 2021 | 633 | 64 | 6% | 40 |
| 2022 | 478 | 52 | 9% | 43 |

Atlantic sturgeon bycatch for drift and sink gill nets

| Year | Total Bycatch Estimate | Standard Error | Proportion Dead | Dead Bycatch Estimate |
|------|------------------------|----------------|-----------------|-----------------------|
| 2006 | 1,512 | 332 | 12% | 187 |
| 2007 | 1,506 | 386 | 20% | 301 |
| 2008 | 813 | 495 | 28% | 227 |
| 2009 | 1,151 | 561 | 13% | 148 |
| 2010 | 281 | 84 | 51% | 143 |
| 2011 | 442 | 228 | 44% | 195 |
| 2012 | 281 | 81 | 44% | 123 |
| 2013 | 1,583 | 620 | 38% | 594 |
| 2014 | 668 | 199 | 33% | 223 |
| 2015 | 711 | 112 | 28% | 197 |
| 2016 | 1,209 | 151 | 32% | 382 |
| 2017 | 1,276 | 215 | 22% | 276 |
| 2018 | 1,049 | 149 | 27% | 278 |
| 2019 | 1,029 | 132 | 20% | 206 |
| 2020 | | | | |
| 2021 | 1,077 | 375 | 46% | 497 |
| 2022 | 561 | 108 | 33% | 183 |

TOR1: NC Estuarine Gill Net Fishery



- GLM was used to predict sturgeon interactions in NC's gill net fishery using same methods ASMFC 2017
 - NC no longer recommends using 2004-2012 data

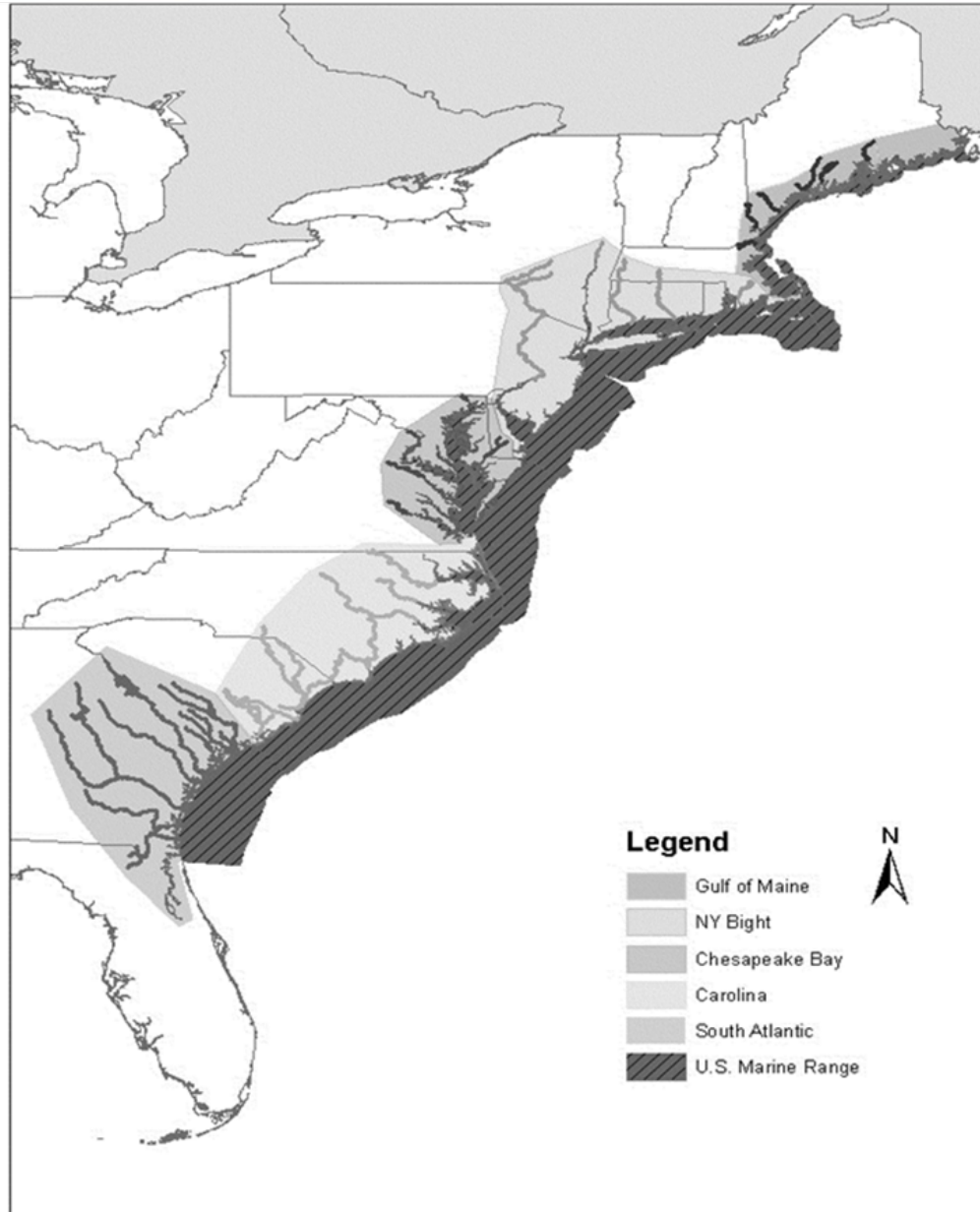
| Year | Total Bycatch | % Dead | Number Dead |
|------|---------------|--------|-------------|
| 2013 | 508 | 7% | 34 |
| 2014 | 1,104 | 3% | 37 |
| 2015 | 1,413 | 4% | 57 |
| 2016 | 998 | 6% | 58 |
| 2017 | 765 | 6% | 44 |
| 2018 | 365 | 8% | 30 |
| 2019 | 119 | 25% | 30 |
| 2020 | 388 | 0% | 0 |
| 2021 | 406 | 23% | 94 |
| 2022 | 498 | 17% | 85 |

TOR 1: SC American Shad Fishery



| Year | Carolina DPS | | | South Atlantic DPS | | |
|------|---------------------|-------------------------|--|---------------------|-------------------------|--|
| | # Atlantic Sturgeon | Effort (Net Yards/Hour) | CPUE (#Atlantic Sturgeon/Net Yards/Hour) | # Atlantic Sturgeon | Effort (Net Yards/Hour) | CPUE (#Atlantic Sturgeon/Net Yards/Hour) |
| 2000 | 40 | 2,284,770 | 0.0000175 | 5 | 559,575 | 0.0000089 |
| 2001 | 128 | 3,339,789 | 0.0000383 | 20 | 493,149 | 0.0000406 |
| 2002 | 74 | 4,222,339 | 0.0000175 | 5 | 301,618 | 0.0000166 |
| 2003 | 16 | 3,881,793 | 0.0000041 | 3 | 425,421 | 0.0000071 |
| 2004 | 11 | 4,094,782 | 0.0000027 | 0 | 527,201 | 0.0000000 |
| 2005 | 0 | 3,963,111 | 0.0000000 | 1 | 367,849 | 0.0000027 |
| 2006 | 226 | 6,607,328 | 0.0000342 | 2 | 389,517 | 0.0000051 |
| 2007 | 162 | 2,562,688 | 0.0000632 | 6 | 384,197 | 0.0000156 |
| 2008 | 76 | 4,070,683 | 0.0000187 | 0 | 270,265 | 0.0000000 |
| 2009 | 186 | 5,110,128 | 0.0000364 | 3 | 276,875 | 0.0000108 |
| 2010 | 12 | 3,357,022 | 0.0000036 | 3 | 221,982 | 0.0000135 |
| 2011 | 173 | 5,818,003 | 0.0000297 | 8 | 240,967 | 0.0000332 |
| 2012 | 194 | 5,617,356 | 0.0000345 | 11 | 260,664 | 0.0000422 |
| 2013 | 157 | 3,457,182 | 0.0000454 | 1 | 214,095 | 0.0000047 |
| 2014 | 15 | 2,876,558 | 0.0000052 | 0 | 163,182 | 0.0000000 |
| 2015 | 10 | 3,207,376 | 0.0000031 | 0 | 148,910 | 0.0000000 |
| 2016 | 15 | 1,782,507 | 0.0000084 | 0 | 126,589 | 0.0000000 |
| 2017 | 66 | 2,486,297 | 0.0000265 | 0 | 122,626 | 0.0000000 |
| 2018 | 138 | 2,436,613 | 0.0000566 | 0 | 108,405 | 0.0000000 |
| 2019 | 19 | 1,529,485 | 0.0000124 | 0 | 189,697 | 0.0000000 |
| 2020 | 2 | 1,777,785 | 0.0000011 | 0 | 80,115 | 0.0000000 |
| 2021 | 4 | 1,235,016 | 0.0000032 | 0 | 71,515 | 0.0000000 |
| 2022 | 4 | 1,149,057 | 0.0083333 | 1 | 63,061 | 0.0086957 |

Distinct Population Segments

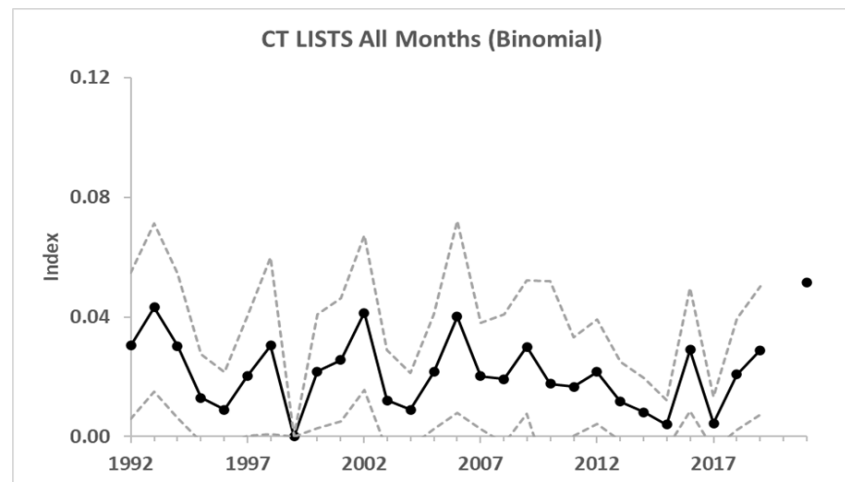
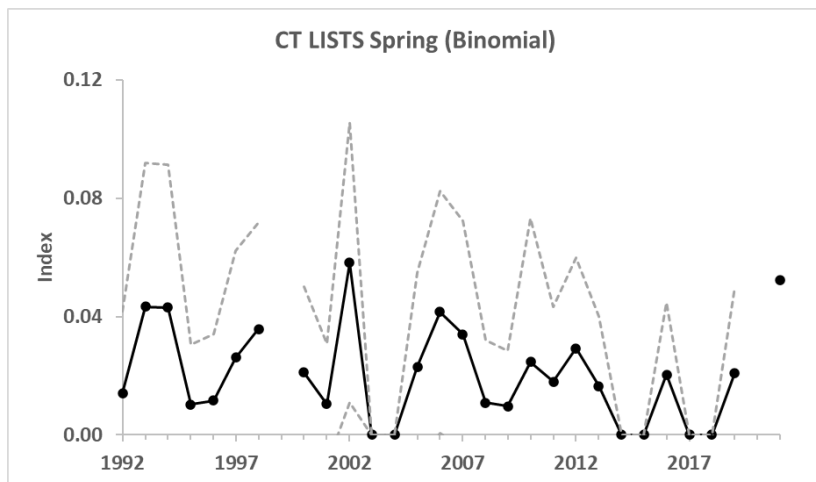
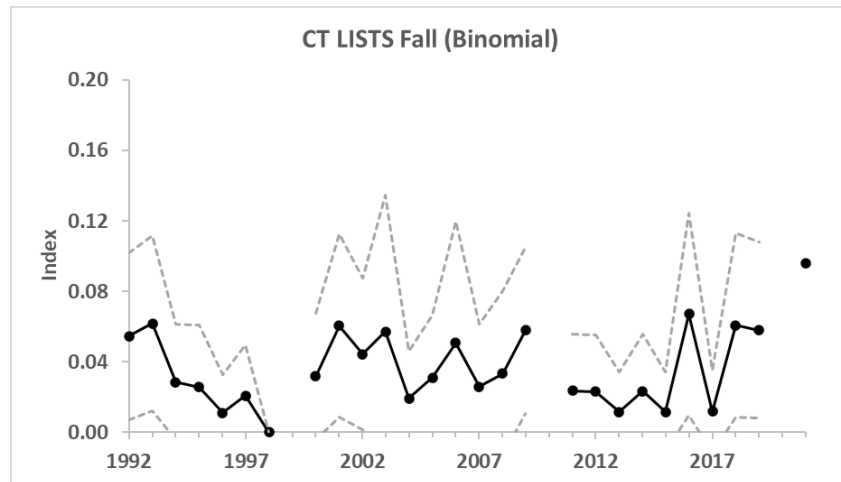
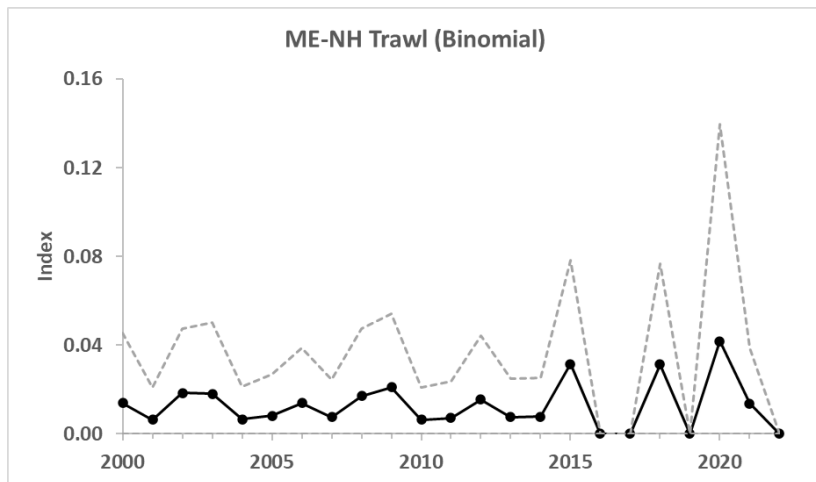


TOR 2: Surveys



| Survey | Months/Season | Model | Stage | Start Year | End Year |
|---|--------------------|----------|------------------------|------------|----------|
| Maine-New Hampshire Trawl (ME-NH Trawl) | May, Sept, Nov | Binomial | Juveniles and Adults | 2000 | 2022 |
| Connecticut Long Island Sound Trawl Survey (CT LISTS) | Fall | Binomial | Juveniles | 1992 | 2021 |
| CT LISTS | Spring | Binomial | Juveniles | 1992 | 2021 |
| CT LISTS | All | Binomial | Juveniles | 1992 | 2021 |
| Northeast Area Monitoring and Assessment Program Trawl Survey (NEAMAP) | Fall | Binomial | Juveniles | 2007 | 2021 |
| New York State Department of Environmental Conservation Juvenile Atlantic Sturgeon Abundance Monitoring Program (NY JASAMP) | Spring | GAM | Juveniles | 2004 | 2022 |
| New Jersey Ocean Trawl Survey (NJ OT) | Jan, Apr, Jun, Oct | GLM | Juveniles | 1990 | 2022 |
| Virginia Institute of Marine Science Shad and River Herring Monitoring Survey (VIMS) | Spring | Binomial | Juveniles | 1998 | 2019 |
| VIMS James River Only | Spring | Binomial | Juveniles | 1998 | 2019 |
| North Carolina Program 135 (NC p135) | Spring | GLM | YOY and Juveniles | 1991 | 2019 |
| NC p135 | Spring | GLM | YOY | 1991 | 2019 |
| NC p135 | Spring | GLM | Juveniles | 1991 | 2019 |
| NC p135 | Fall | GLM | YOY and Juveniles | 1990 | 2019 |
| NC p135 | Fall | GLM | YOY | 1990 | 2019 |
| NC p135 | Fall | GLM | Juveniles | 1990 | 2019 |
| South Carolina Edisto River Sturgeon Monitoring Project Survey (SC Edisto) | All Months | GLM | Juveniles | 2004 | 2022 |
| US Fish and Wildlife Cooperative Tagging Cruise (USFWS Coop) | Winter | GLM | Juveniles and Adults | 1988 | 2010 |
| Coastwide Index | All Months | Conn | YOY, Juveniles, Adults | 1990 | 2022 |

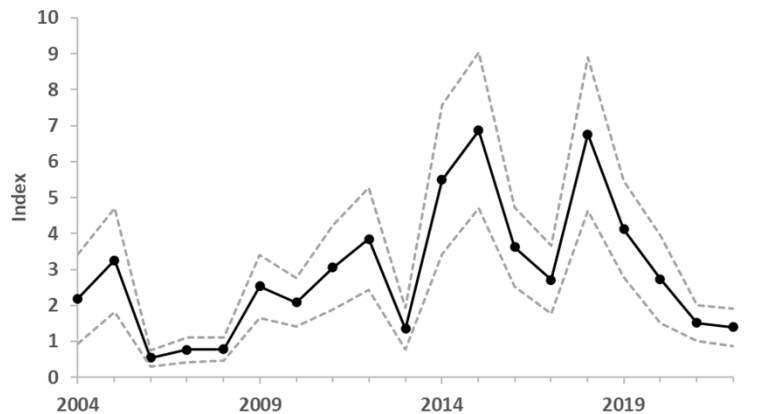
TOR 2: Indices



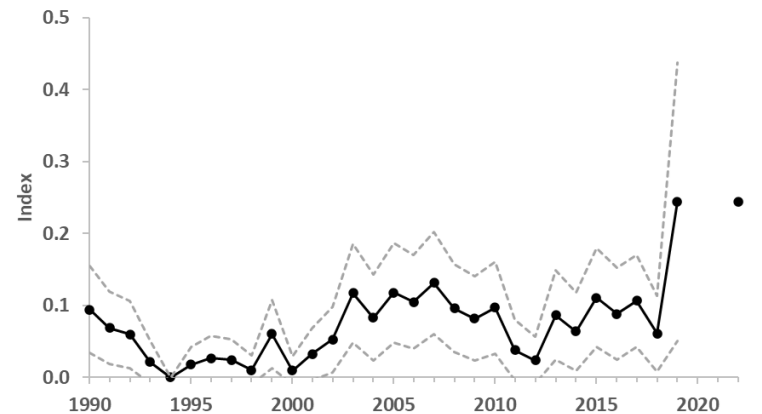
TOR 2: Indices



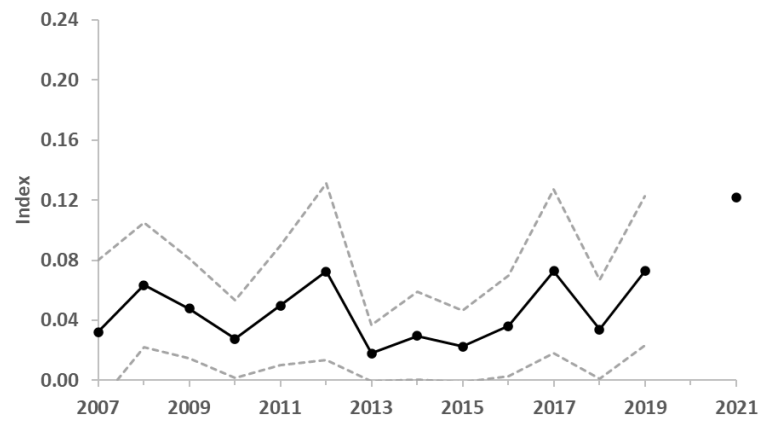
NY JASAMP (GAM)



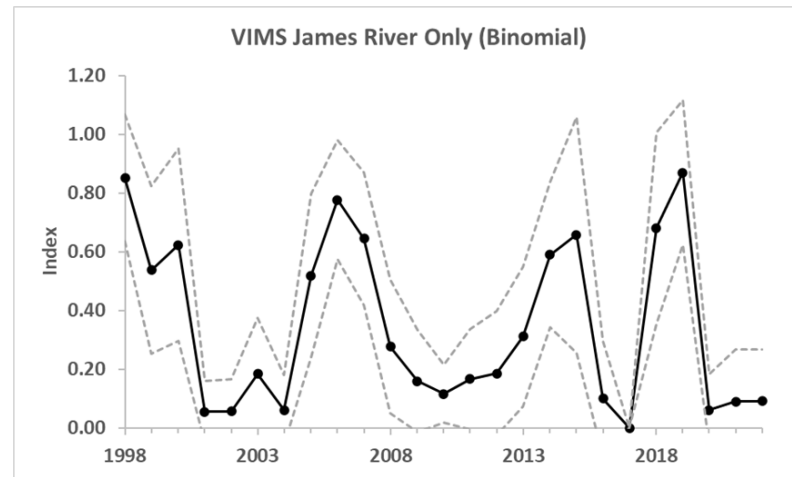
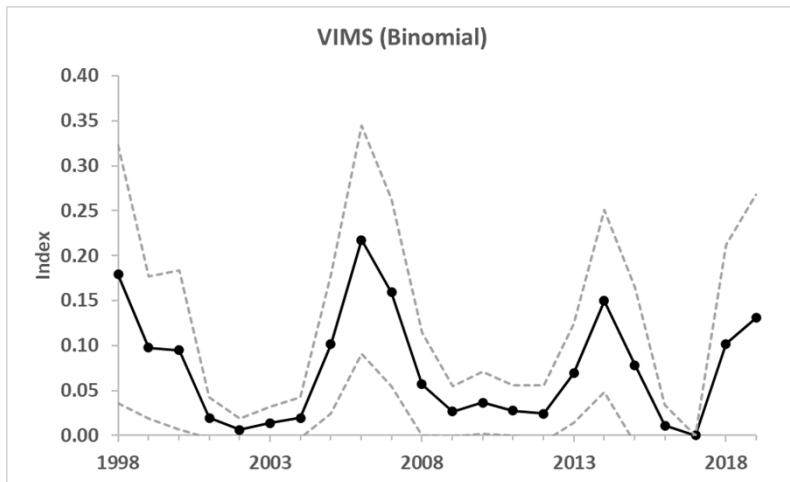
NJ OT (GLM)



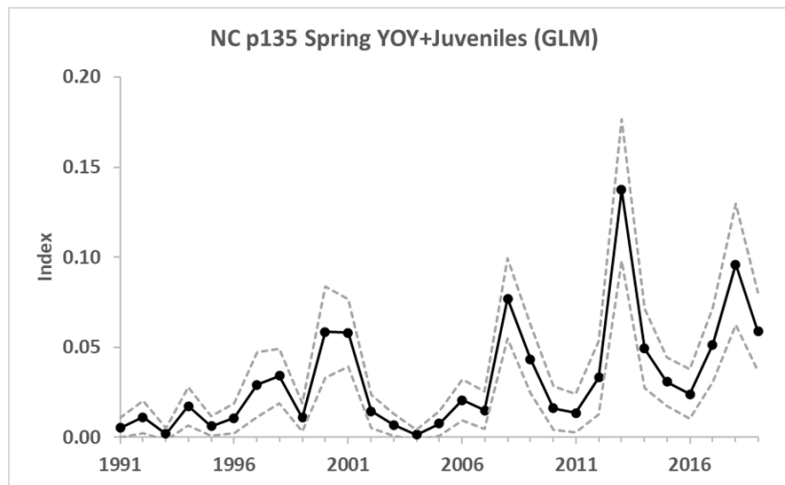
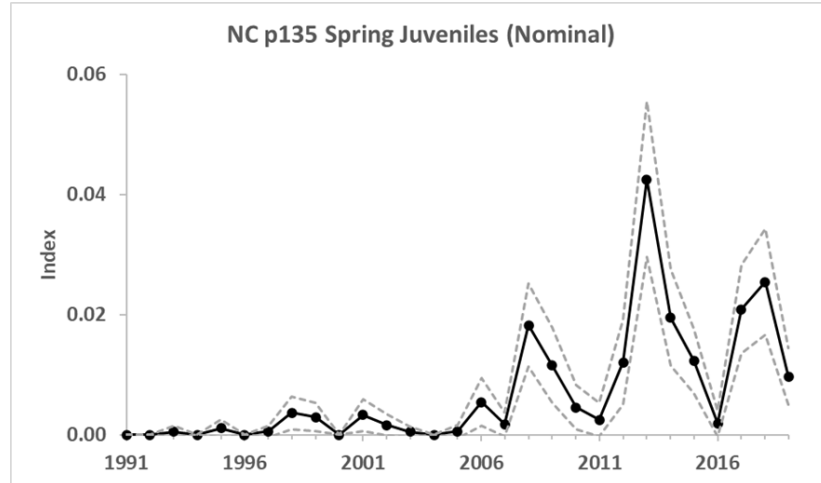
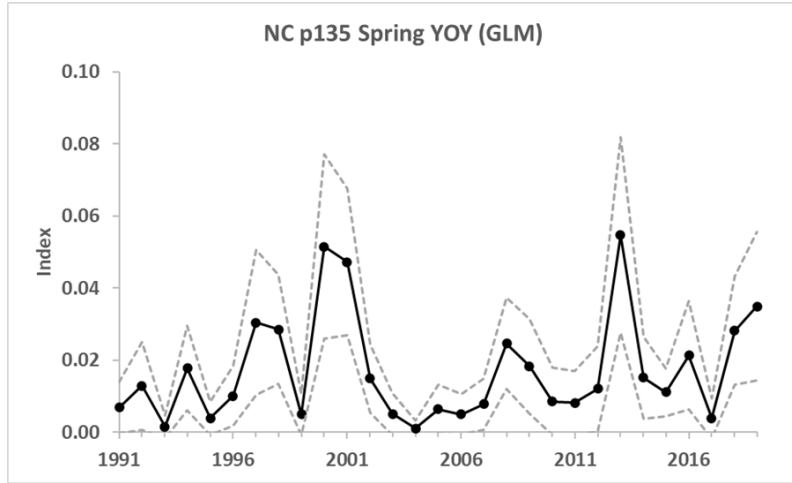
NEAMAP (Binomial)



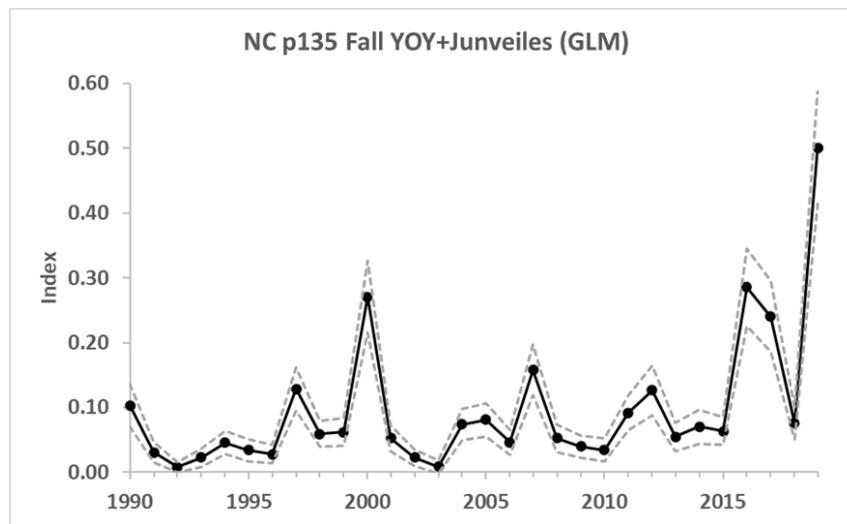
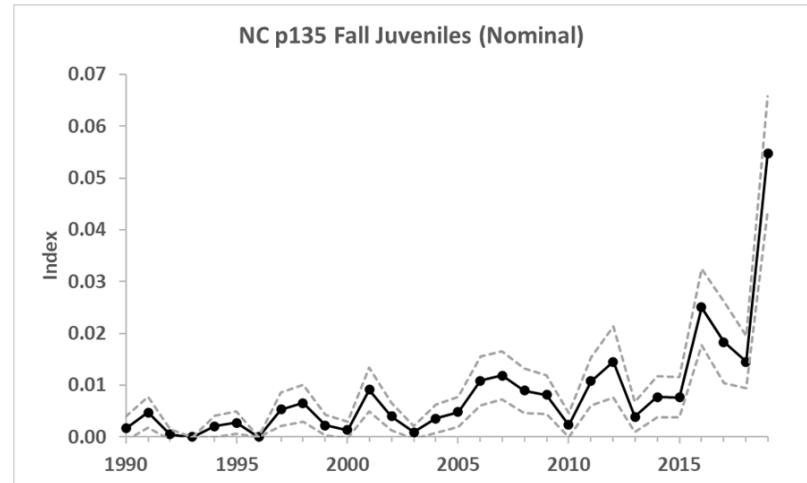
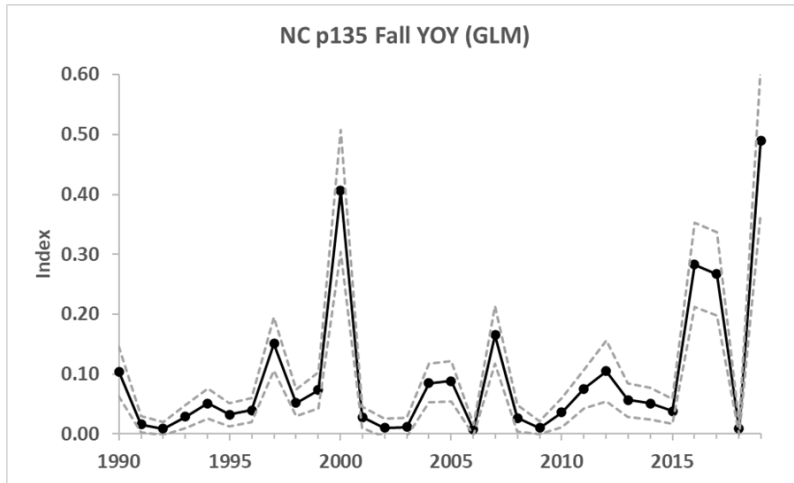
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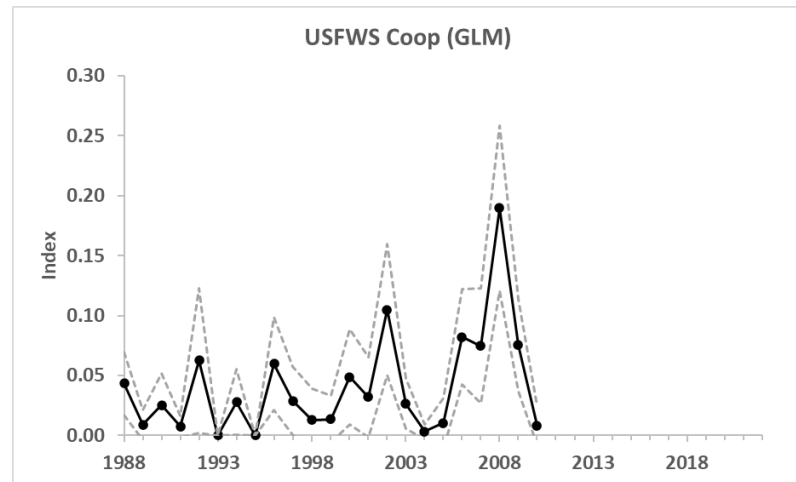
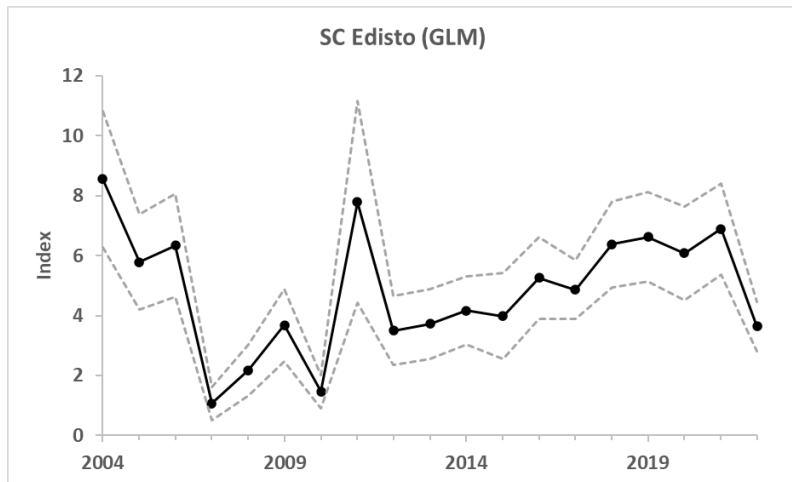
TOR 2: Indices



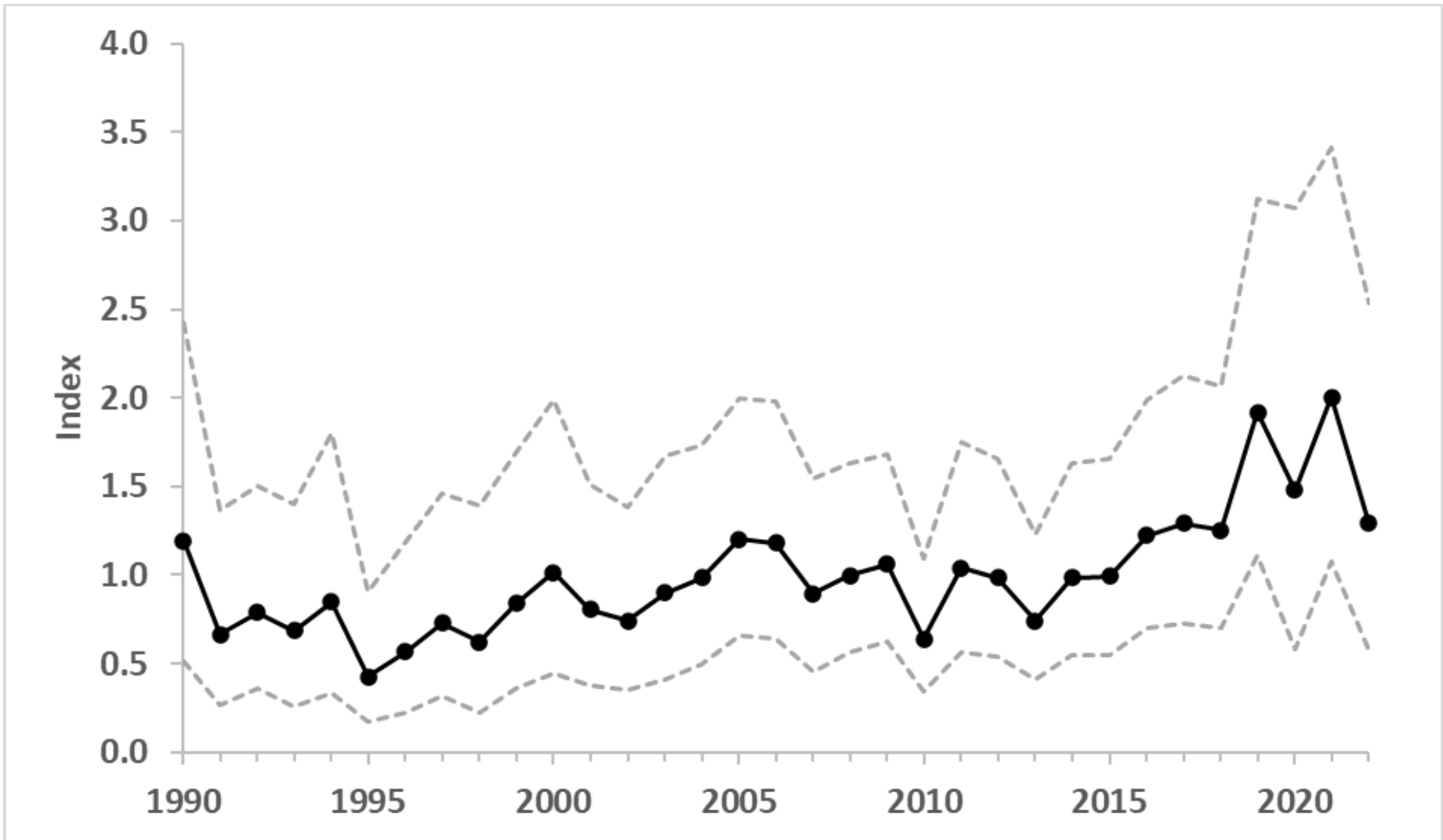
TOR 2: Indices



TOR 2: Indices



TOR 2: Coastwide Index



TOR 4: Tagging Model



- Evaluated acoustic tagging data from all sources across range
- DPS determined by tagging location, unless genetic data is available
- Cormack-Jolly-Seber model
 - Estimated detection probability (P) and survival (S)
 - Survival was used to estimate total mortality (Z)

$$Z = -\ln(S)$$

TOR 4: Tagging Model



- Number of acoustically tagged Atlantic sturgeon vary by DPS and size group (sub-adults and adults)

| DPS | Total | < 1300 mm | > 1300 mm |
|----------------|-------|-----------|-----------|
| Gulf of Maine | 224 | 55 | 169 |
| New York Bight | 534 | 144 | 390 |
| Chesapeake Bay | 464 | 74 | 390 |
| Carolinas | 489 | 208 | 281 |
| South Atlantic | 364 | 133 | 231 |

TOR 4: Tagging Model



| Population | Median Annual Survival Rate, S (2.5th-97.5th percentiles) | Median Annual Total Mortality, Z (2.5th-97.5th percentiles) |
|-------------------|---|---|
| Coast | 0.99 (0.89-1.00) | 0.01 (0.001-0.11) |
| Gulf of Maine | 0.86 (0.34-0.98) | 0.15 (0.018-1.08) |
| NY Bight | 0.94 (0.63-1.00) | 0.06 (0.005-0.46) |
| Chesapeake Bay | 0.95 (0.67-1.00) | 0.05 (0.003-0.41) |
| Carolina | 0.95 (0.63-1.00) | 0.05 (0.003-0.46) |
| South Atlantic | 0.93 (0.60-1.00) | 0.07 (0.004-0.51) |

TOR 4: Tagging



- Number of tags increased since benchmark, improving estimates, but analysis still sensitive to sample size (e.g., Gulf of Maine DPS)
 - Tagging studies are often short-term and may not have steady funding
- Possibility of improved modeling in next benchmark (2028) with maintained or increased tagging network
 - Include covariates
 - Use finer temporal or spatial resolution

TOR 4: ARIMA



- Trend analysis evaluated if:
 - The last year of the index was above the 25th percentile of the time series
 - The last year of the index was above 1998 (the year of the moratorium) or the first year of the survey
- ARIMA methods were updated from ASMFC 2017 to be able to handle missing index values (e.g., COVID years, vessel mechanical issues)

TOR 4: ARIMA



| DPS | Survey | First yr | Terminal yr | Reference point yr | P(ty > 25th pctl) | P(ty > RefPtYr) | ARIMA trend |
|----------|--------------------------|----------|-------------|--------------------|-------------------|-----------------|-------------|
| GOM | ME-NH Trawl | 2000 | 2022 | 2000 | 59% | 45% | - |
| NYB | CT LISTS Fall | 1992 | 2021 | 1998 | 96% | 97% | n.s. |
| NYB | CT LISTS Spring | 1992 | 2021 | 1998 | 51% | 29% | - |
| NYB | CT LISTS All Months | 1992 | 2021 | 1998 | 43% | 12% | - |
| NYB | NY JASAMP | 2004 | 2022 | 2004 | 65% | 57% | n.s. |
| NYB | NJ Ocean Trawl | 1990 | 2022 | 1998 | 100% | 100% | + |
| CB | VIMS-JYR | 1998 | 2019 | 1998 | 97% | 38% | n.s. |
| CB | VIMS-J Spring | 1998 | 2019 | 1998 | 45% | 15% | - |
| C | NC p135 Spring YOY + Juv | 1991 | 2019 | 1998 | 100% | 99% | + |
| C | NC p135 Spring YOY | 1991 | 2019 | 1998 | 82% | 82% | + |
| C | NC p135 Spring Juv | 1991 | 2019 | 1998 | 100% | 100% | + |
| C | NC p135 Fall YOY+Juv | 1990 | 2019 | 1998 | 99% | 99% | + |
| C | NC p135 Fall YOY | 1990 | 2019 | 1998 | 66% | 63% | + |
| C | NC p135 Fall Juv | 1990 | 2019 | 1998 | 100% | 100% | + |
| C | USFWS | 1988 | 2010 | 1998 | 53% | 42% | n.s. |
| SA | SC Edisto | 2004 | 2022 | 2004 | 76% | 31% | + |
| NYB-CB-C | NEAMAP Fall | 2007 | 2021 | 2007 | 93% | 84% | n.s. |
| Coast | Conn | 1990 | 2022 | 1998 | 100% | 100% | + |

TOR 5: Stock Status



- Federal designation as endangered in 2012
 - There remains no estimates of unexploited biomass or abundance at coastwide or DPS-level against which to evaluate status
 - Abundance estimates are available in a few rivers
- Traditional overfished and overfishing designations not meaningful for sturgeon
- Stock status was determined from:
 - Probability Z from tagging model $> Z_{50\%EPR}$
 - Probability terminal year of indices $>$ reference year (from ARIMA)
 - Qualitative assessment compared to historical levels

TOR 5. Stock Status



| Population | Median Annual Survival Rate, <i>S</i> (2.5 th -97.5 th percentiles) | Median Annual Total Mortality, <i>Z</i> (2.5 th -97.5 th percentiles) | <i>Z</i> _{50%EPR} reference point | Probability that <i>Z</i> is greater than the <i>Z</i> _{50%EPR} reference point (ASMFC 2024) | Probability that <i>Z</i> is greater than the <i>Z</i> _{50%EPR} reference point (ASMFC 2017) |
|----------------|--|--|--|---|---|
| Coast | 0.99 (0.89-1.00) | 0.01 (0.001-0.11) | 0.14 | 1.8% | 6.5% |
| Gulf of Maine | 0.86 (0.34-0.98) | 0.15 (0.018-1.08) | | 55.5% | 73.5% |
| NY Bight | 0.94 (0.63-1.00) | 0.06 (0.005-0.46) | | 20.2% | 31.2% |
| Chesapeake Bay | 0.95 (0.67-1.00) | 0.05 (0.003-0.41) | | 14.1% | 30.0% |
| Carolina | 0.95 (0.63-1.00) | 0.05 (0.003-0.46) | | 18.2% | 75.4% |
| South Atlantic | 0.93 (0.60-1.00) | 0.07 (0.004-0.51) | | 26.5% | 40.2% |

TOR 5: Stock Status



| Population | Mortality Status | Biomass/Abundance Status | | |
|----------------|---|-------------------------------|------------------|---|
| | $P(Z) > Z_{50\%EPR}$ Reference Point | Relative to Historical Levels | NOAA Designation | Average probability of terminal year of indices > reference year* |
| Coastwide | 1.8% | Depleted | | 100% |
| Gulf of Maine | 55.5% | Depleted | Threatened | 45% |
| New York Bight | 20.2% | Depleted | Endangered | 59% |
| Chesapeake Bay | 14.1% | Depleted | Endangered | 27% |
| Carolina | 18.2% | Depleted | Endangered | 77% |
| South Atlantic | 26.5% | Depleted | Endangered | 31% |

*Reference year is 1998, or the first year of the survey for indices that started after 1998

TOR 7: Research Recommendations



Identify spawning units along the Atlantic coast at the river or tributary and coast-wide level.

- Significant progress has been made
 - Evidence of spawning in:
 - Connecticut River
 - Nanticoke River–Marshyhope Creek
 - Separate spring and fall spawning populations in both the Pee Dee and Ogeechee Rivers
 - Still some populations left to document (Carolina DPS in particular)

TOR 7: Research Recommendations



Expand and improve the genetic stock definitions of Atlantic sturgeon, including developing an updated genetic baseline sample collection at the coast-wide, DPS, and river-specific level for Atlantic sturgeon, with the consideration of spawning season-specific data collection.

- Genetic baseline published – 18 distinct groups collected in 13 rivers/1 estuary
- Fall/spring spawning-genetically distinct within at least 4 rivers
- Mixed stock
 - Hudson mixed stock subadults, composition similar to historic fishery
 - Mid-Atlantic – significant mixing
 - Coastal environments-high contribution Ogeechee (highly migratory)
 - Mortalities in permitted activities - Mostly Hudson but substantial numbers from James (fall-spawning) and Delaware.
 - Monitoring survey Hudson, majority Hudson assignments

TOR 7: Research Recommendations



Determine habitat use by life history stage including adult staging, spawning, and early juvenile residency; expand the understanding of migratory ingress of spawning adults and egress of adults and juveniles along the coast.

- Research done:
 - Spawning intervals and occupancy Hudson
 - Spawning run size Hudson ($N=466$), similar to estimate from later years of fishery
 - Spawning and migration cues Savannah River
 - Acoustic & mixed effects modeling Great Pee Dee
 - Non natal river use Delaware and Hudson Rivers
 - Cape Hatteras acoustic array identifies seasonal presence

TOR 7: Research Recommendations



Collect DPS-specific age, growth, fecundity, and maturity information.

- Growth Hudson
 - Hatchery with OTC and recaps-growth different between fall/spring, success sensitive first year survival
 - SDAFS workshop
 - ASMFC to plan workshop to develop standardized protocol for processing and reading-later 2024, then hard part exchange

TOR 7: Research Recommendations



Collect more information on regional vessel strike occurrences, including mortality estimates. Identify hot spots for vessel strikes and develop strategies to minimize impacts on Atlantic sturgeon.

- Ship strikes remain a threat
 - DE reporting rate – 4.8%
 - DE River and use of DE Bay-vessel strikes and habitat disruption due to increase use
 - Ship strike mortality York River is low, survival 99.2%
- Mortality estimates
 - Marine waters in NY have a late spring hot spot
 - Suggested use of real-time telemetry for fishery closures
- Wind farm use remains a concern

TOR 7: Research Recommendations



Establish regional (river or DPS-specific) fishery-independent surveys to monitor Atlantic sturgeon abundance or expand existing regional surveys to include annual Atlantic sturgeon monitoring. Estimates of abundance should be for both spawning adults and early juveniles at age.

- Abundance estimates
 - Delaware River (genetics) – 125-250 adults
 - Hudson River (SSS/acoustic telemetry) – 466 adults
 - York River (mark-recap models) – Annual estimates 2013-2018, 2018 estimated 145 adults
 - Savannah River (SSS/N mixture models) – max daily spawner abundance 35-55 adults *not a full census

TOR 7: Research Recommendations



Encourage data sharing of acoustic tagged fish, particularly in underrepresented DPSs, and support programs that provide a data sharing platform such as The Atlantic Cooperative Telemetry Network. Data sharing would be accelerated if it was required or encouraged by funding agencies.

- Large telemetry project slated to wrap up in 2024. BOEM funded a large collaborative synthesis, helped foster collaborative relationships

Maintain and support current networks of acoustic receivers and acoustic tagging programs to improve the estimates of total mortality. Expand these programs in underrepresented DPSs.

- Continued support of the arrays for long term maintenance is critical to provide management relevant insight

Questions?

