Smalltooth Sawfish – 2026 Status Update

NOAA FISHERIES
Southeast Region

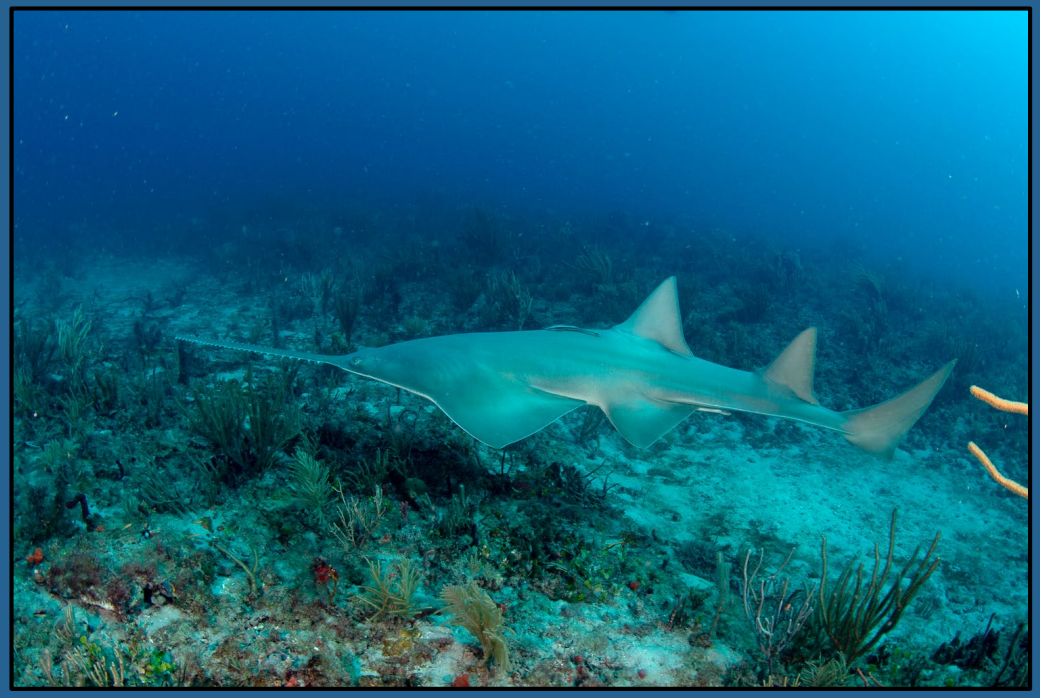
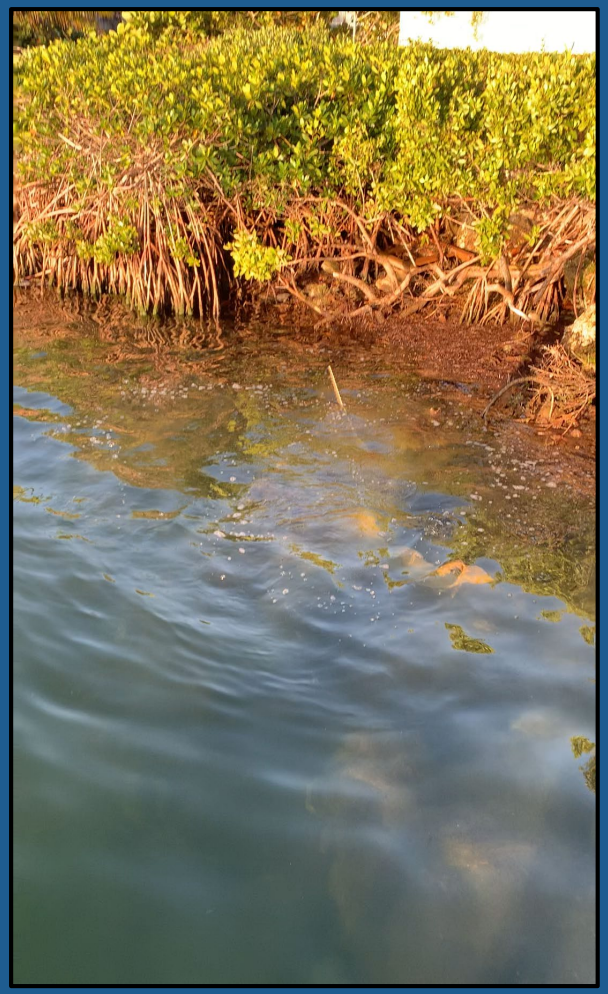


Photo credit: Enrique Jaramillo-May

Adam Brame
NOAA Sawfish Recovery Coordinator
Adam.Brame@noaa.gov

South Atlantic Bycatch Working Group
November 2026

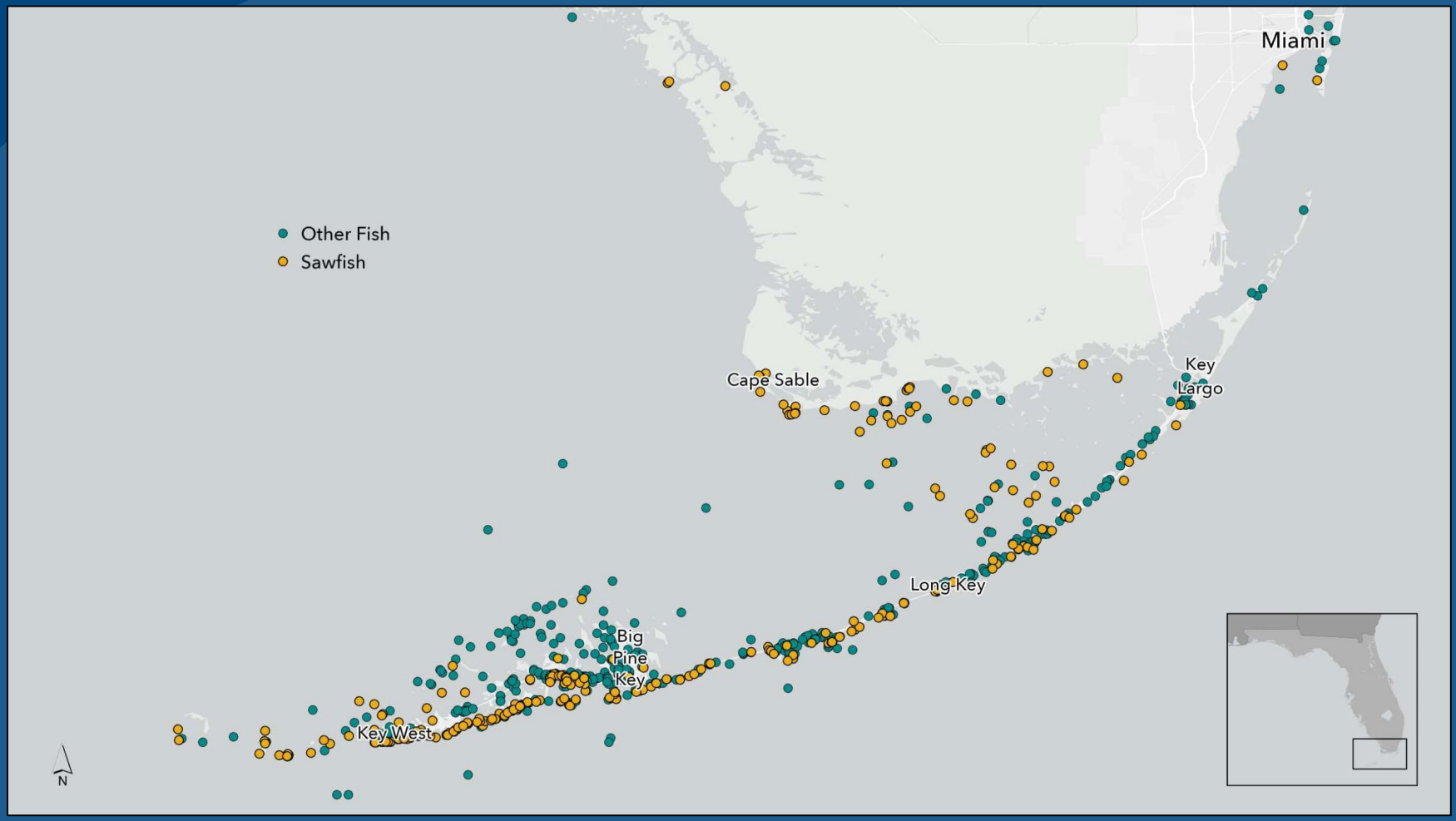
Spinning Fish Events



Spinning Event Overview

- Timing – winter/spring (dry) period (Nov 2023 – Aug 2024 & Nov 2024 – May 2025)
  - Peak spinning reports – Feb through Apr
  - Coincided with sawfish migration to and residence in south Florida
- Cause – environmental exposure to neurotoxins from an algal bloom, *Gambierdiscus* spp., (benthic dinoflagellate)
- Species affected – 80+ species, mostly fish (n=59) and elasmosbranchs (n=11)
- Behavioral response – spinning, thrashing, disorientation, beaching, use of unusually shallow water, sensitivity to stimuli (light)
- Reported sawfish cases/confirmed mortalities
  - 2024 – 230/56
  - 2025 – 69/9
- Affected sawfish size classes – large juveniles and adults
  - Adult – 38.6%
  - Large Juvenile (≥8 ft) – 60.0%
  - Small juveniles (<8 ft) – 2.4%

Scale of Event – Spatial Center



From M. Bakenhaster (FWC)

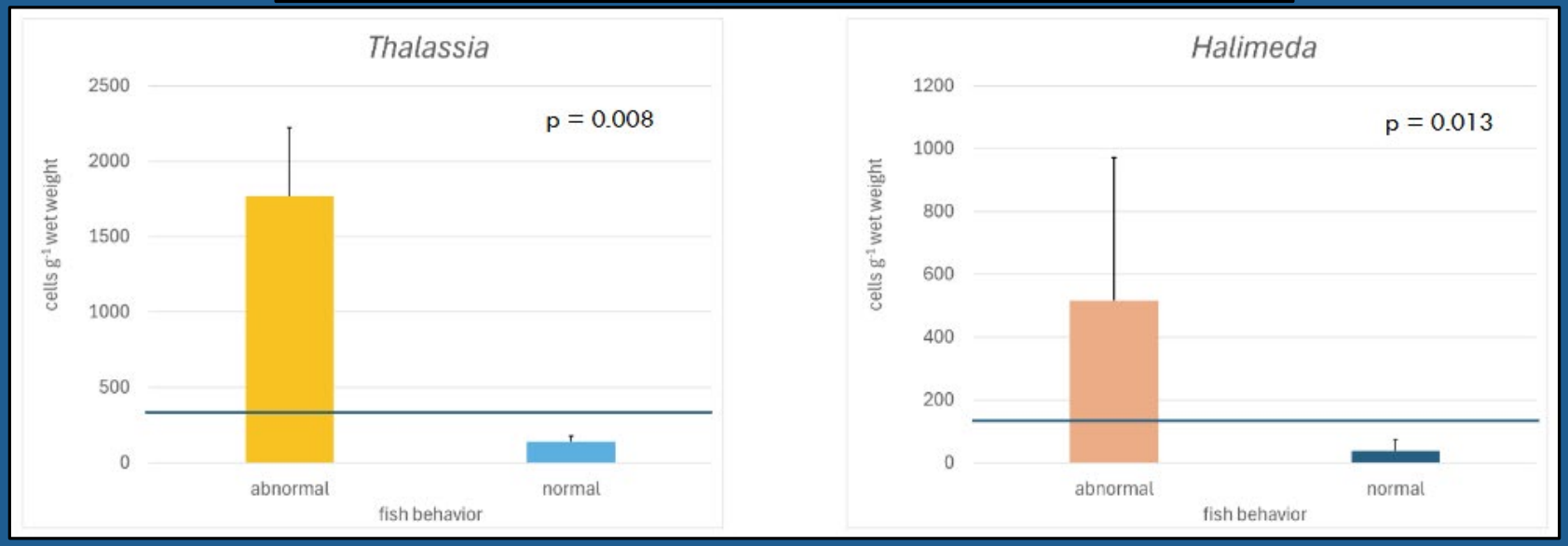
Investigating the Events

- Potential causes
  - Water chemistry – dissolved oxygen, salinity, temperature
  - Thiamine deficiency – dietary changes
  - Algae – toxins
  - Contaminants – pesticides, pharmaceuticals, metals
- Samples assessed
  - Fish tissue
  - Water
  - Algae (micro and macro)
  - Sediment
- Ruled out
  - Low dissolved oxygen
  - Disease/parasites
  - Contaminants
  - Thiamine deficiency
  - Some microalgae – *Karenia brevis*, *Pyrodinium* spp., *Pseudo-nitzschia* spp.

Gambierdiscus caribaeus

- A benthic dinoflagellate
- Known to produce several toxins – ciguatoxins, maitotoxin
- 7 times greater density during the events compared to historical values

Gambierdiscus cell densities from February 2024



As prepared by M. Parsons and presented by A. Robertson at the 2026 Spinning Sawfish Symposium

Toxin Analysis

- Tested 5 different classes of algal toxins
  - Ciguatoxins
  - Gamberiones
  - Cyclic Imines
  - Okadaic Acid
  - Maitotoxins
- Used 6 toxin testing strategies
- Assessed environmental (water, algae, sediment) and fish tissue (gill, muscle, liver) samples
- Results
  - Several algal-derived neurotoxins identified in environmental and tissue samples
  - All symptomatic animals tested contained multiple algal toxins
  - High toxin concentration in gill tissue indicates the likely exposure pathway
  - Analysis identified known, novel, and new to the region toxins

2024 Postmortem Sawfish Exams

- 43 necropsy exams (33 were confirmed “spinning”)
  - 18 males (9 mature, 9 immature)
  - 15 females (9 mature [5 pregnant], 6 immature)

Sex	Median (cm)	Mean (cm)	Min, Max
Male	360.8	364.1	314.2, 423.0
Female	389.2	396.2	315.1, 490.0

- Gross finding for spinning sawfish
  - Skin blisters and abrasions
  - Empty gastrointestinal tracts
  - Organs such as livers and pancreas generally of normal size

Histopathology

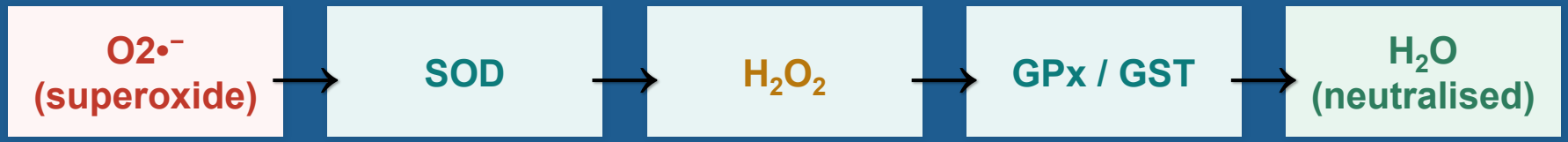
- Brain: tissue with the most interesting changes
  - Hard to analyze as brains rapidly digest themselves after death
  - Analyzing whole brains can be more informative than portions
  - Edema (swelling due to fluid accumulation) - Intracranial pressure increase that can lead to disorientation
  - Myelin (fatty insulation that wraps nerve axons) damage – slows impulse speed
  - Lesions in the midbrain and hindbrain (n=15), portions that control movement, orientation, and muscle coordination
- Gills: 5/12 samples had fibrin thrombi
  - Creates a significant circulatory disturbance and may disrupt the body's blood clotting system
- Liver: 26/30 livers showed adequate to abundant lipid reserves
  - Consistent with good body condition
  - Suggests acute onset of the spinning
- Pancreas: 16/22 pancreases contained varying degrees of lymphoplasmacytic infiltrates
  - Accumulation of white blood cells signaling chronic inflammation or an immune mediated process
- Kidney: 25 samples showed vacuolar changes/injury
  - Possible sign of metabolic stress, low oxygen, or reaction to toxins



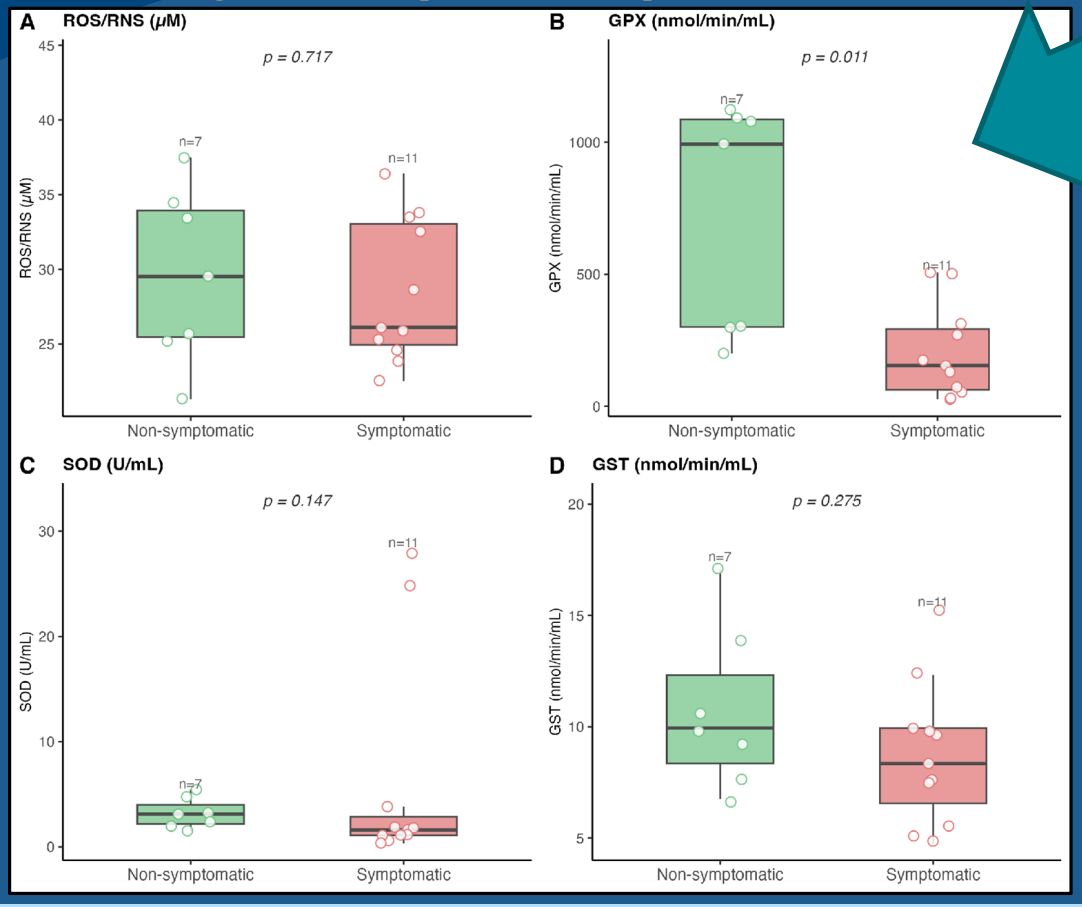
A. Newton, Ocearch/ZooQuatic

Blood Analysis

- Analysis of blood chemistry, trace nutrients, and toxic elements found
  - Statistical difference in 3 trace nutrients between affected and non-affected sawfish
  - Decreased trace nutrients could be result of: dietary intake, oxidative stress, acute phase reactions
- Oxidative Stress Analysis – considers the balance between unstable molecules (reactive oxygen species [ROS] and free radicals) produced during cellular metabolism and antioxidant defenses (SOD, GPx, & GST)
  - ROS increases during stress, hypoxia, inflammation, or disease
  - The body must combat ROS increase to prevent cell damage
  - SOD (Superoxide Dismutase) is a Phase I defense that acts to convert ROS to hydrogen peroxide (H_2O_2)
  - GPx (Glutathione Peroxidase) and GST (Glutathione S-Transferase) are Phase II detoxification enzymes
    - GPx process prevents oxidative damage from cascading into cellular or DNA destruction
    - GST neutralizes toxins by making them water soluble so they can be excreted



Blood Analysis (cont.)



C. Malinowski, Shark Docs

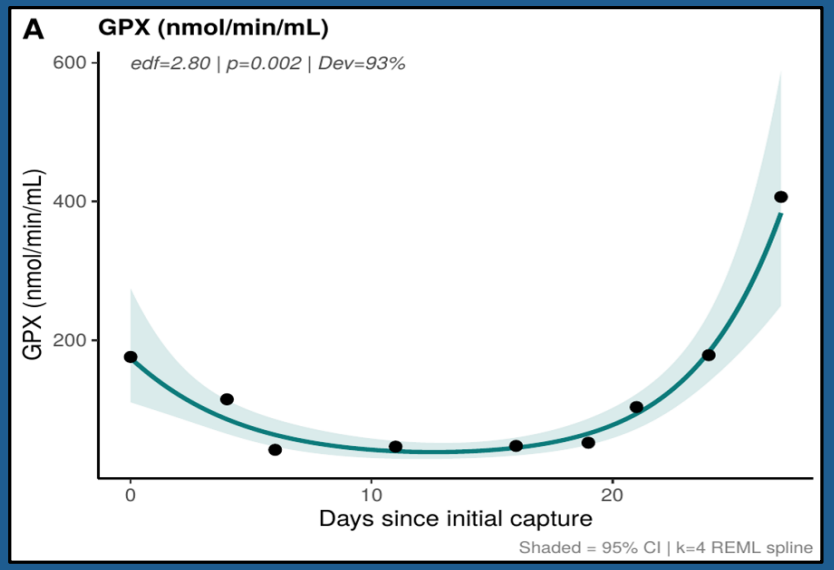
Comparison of affected (n=11) and non-affected (n=7) sawfish blood chemistry indicated a statistically significant decrease in GPx in affected sawfish

- GPx depletion = **systemic antioxidant failure**

Blood Analysis (cont.)

- Rescued sawfish blood analyzed through time (9 draws over 27 days)
- Multiple analytical methods converge on GPx as the only biologically meaningful finding
- Results of rescued sawfish are directly consistent with population-level finding
- GPx recovery did not translate to survival – irreversible damage had already occurred
- Oxidative damage accumulated beyond a “point of no return”





Spinning Event Summary

- Toxin exposure affected multiple physiological systems
  - Nervous
  - Excretory/Renal and Hepatic
  - Cardiovascular
- Behavioral changes led to additional injuries
  - Abrasions, bruising, broken teeth, sunburn
- Antioxidant failure led to cell destruction
- Attempted rescue did not survive
  - Among the healthier affected individuals when rescued
  - Received intensive veterinary care
  - Unable to overcome the cellular damage caused by the oxidative cascade
- Highly likely that most if not all affected sawfish ultimately died
- Sawfish do not contain swim bladders – do not float to surface when dead
  - Possibility that mortality was under-reported

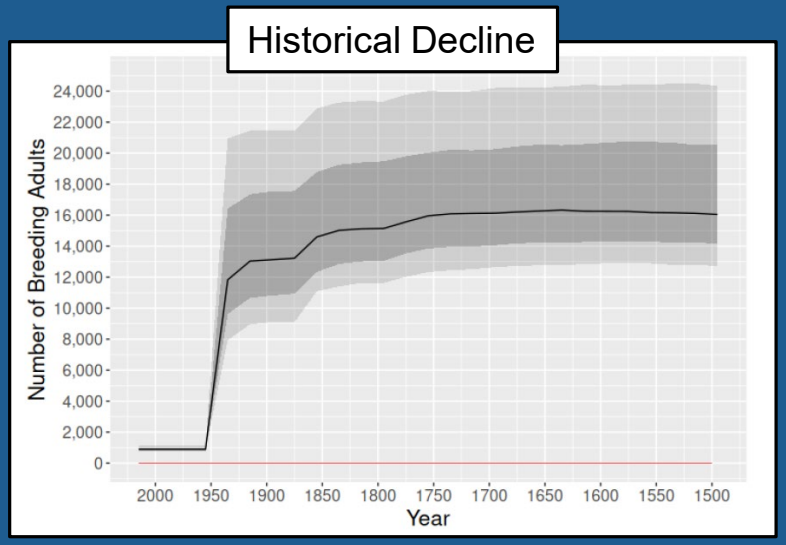
Additional New(ish) Data

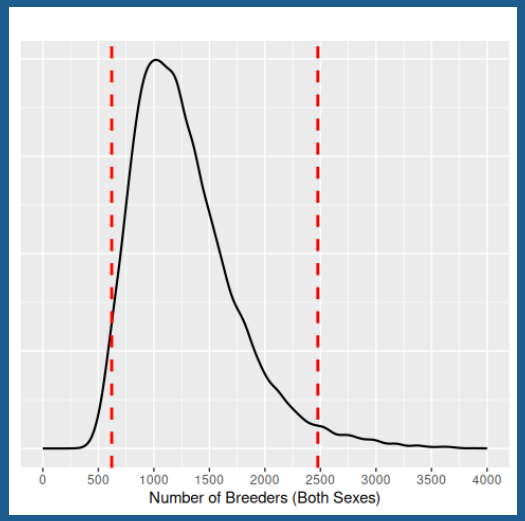


Genomics - Close Kin Mark Recapture

- Robust analysis: 565 juvenile genetic samples (2010-2020)
- 353 full sibling pairs
  - 98% from the same litter
- 184 half sibling pairs
  - 135 maternal pairs
  - 49 paternal pairs
- Regional contribution – TTI/ENP ≈ 60%, CH ≈ 40%
- ~94% decline from historical population level
- N_C ~1000 breeding adults in 2015

D. Swift, TAMU





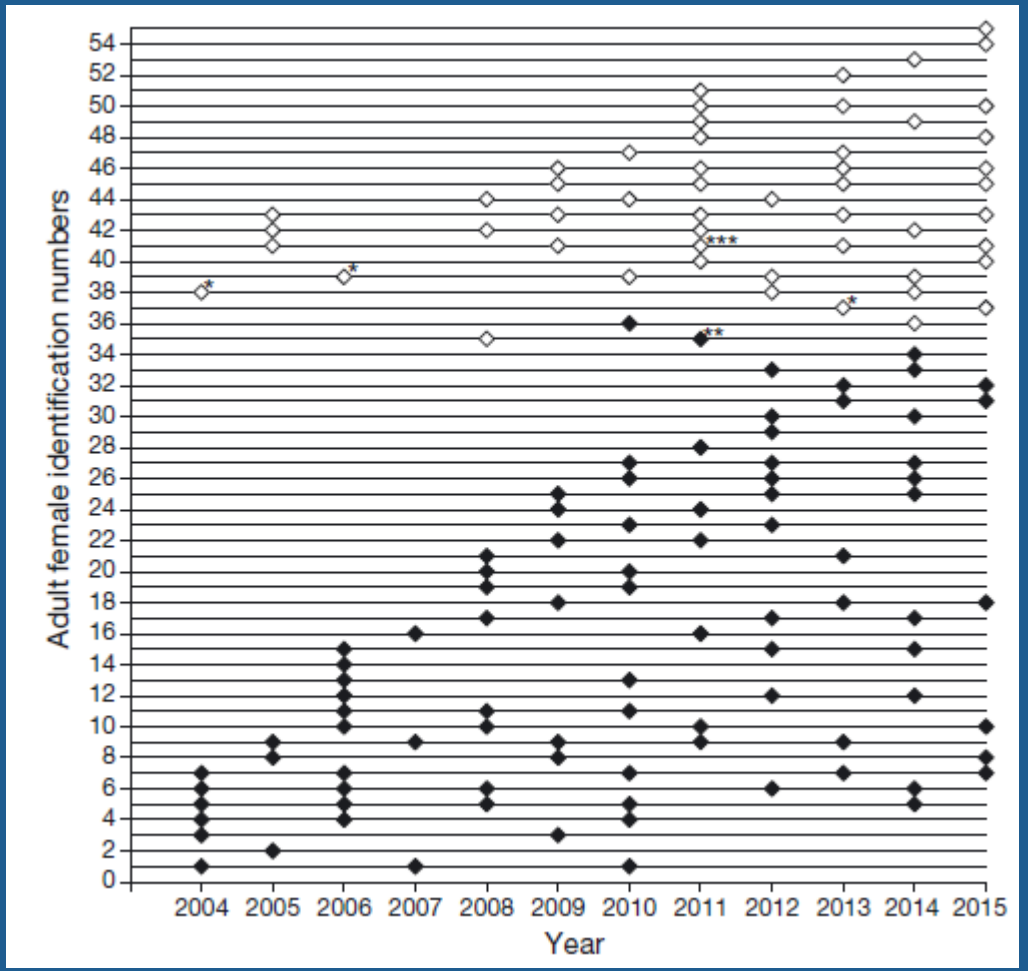
Modeled using the paternal half siblings

Other Genetics

- N_e doubled during the period between 2008 (N_e = 321) and 2015 (N_e = 650)
- Biennial parturition →
- Philopatry →
- Limited breeders ↓
- Decrease in L_{max}

	Feldheim et al. (2017)	This study
Tissue samples collected	349	307
Reconstructed females	55	71
Reconstructed males	192	117
Number of litters	142	138
Max. no. of pups	8	12
Mating strategy	Polyandry	Polyandry
Parturition frequency	Biennial	Biennial
Regional philopatry?	Yes	Yes

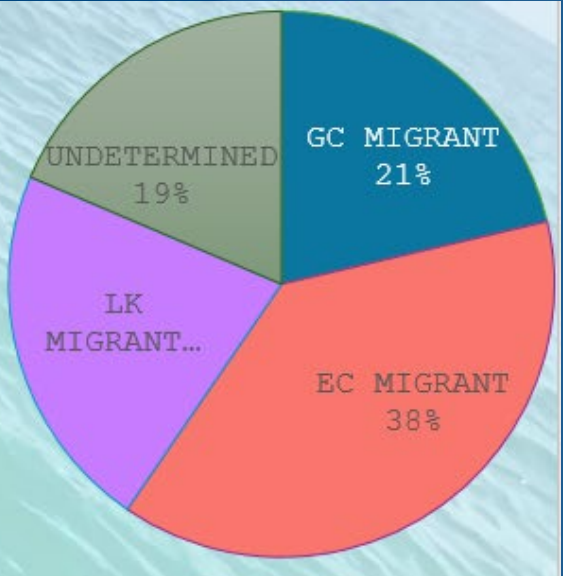
Smith et al. 2021



Feldheim et al. 2017

Migratory Behavior





Gulf Coast Migrants

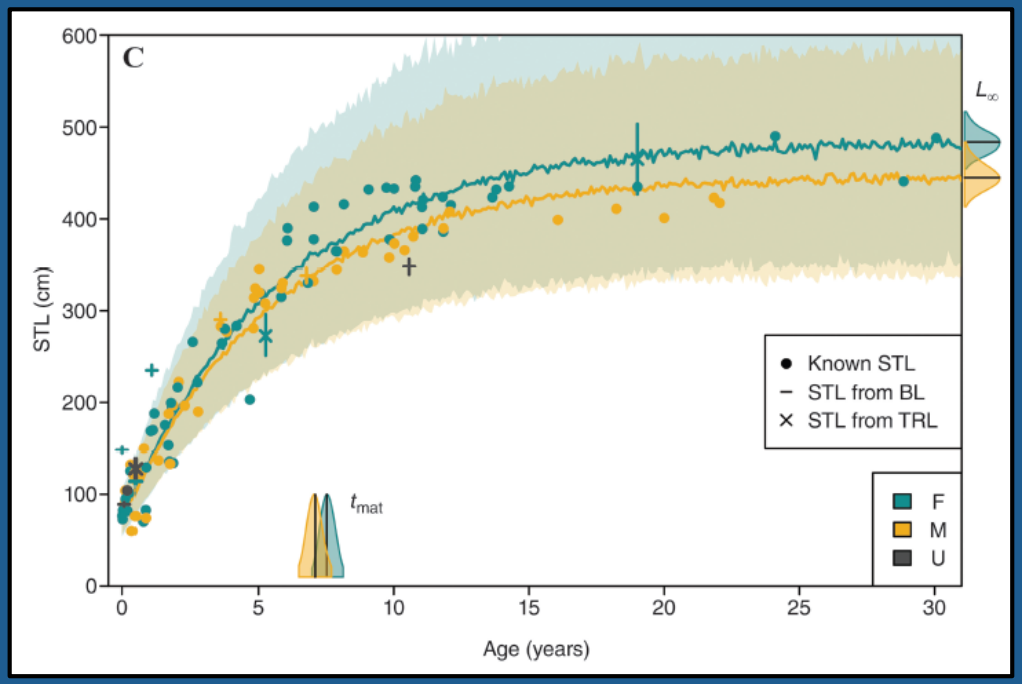
East Coast Migrants

Lower Keys Migrants

A. Dawdy, FSU

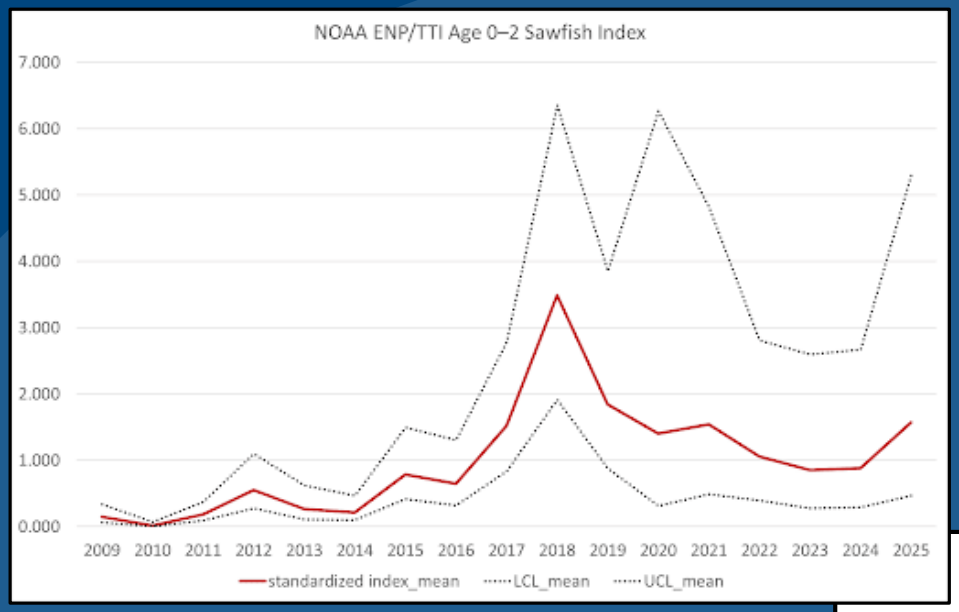
Life History Update

- Early growth slightly slower than previously reported (k= 0.174 yr^{-1}
  - 73.7 cm at birth
  - 136 by age 1
  - 220 by age 2
- Age at 50% maturity
  - M – 6.9 yr (95% CI: 6.0–7.9)
  - F – 7.9 yr (95% CI: 6.9–8.8)
- Length at 50% maturity
  - M – 345 cm (334.9–355.0)
  - F – 383 cm (371.4–397.2)
- Maximum age observed – 30.1
- Maximum age modeled – 44.6

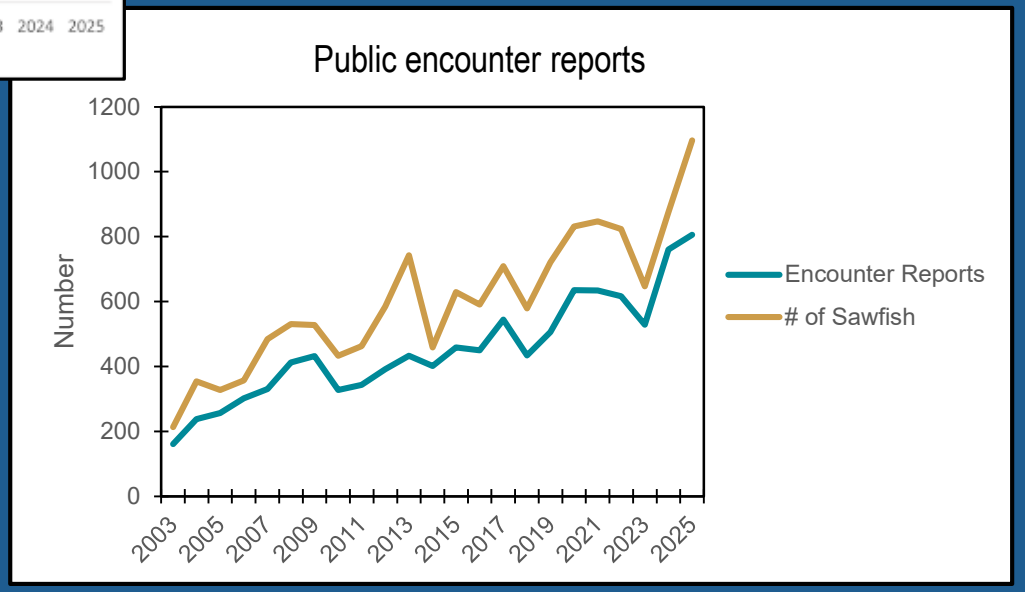


Kroetz et al. 2025

Unpublished Trend Data



ENP/TTI trend from J. Carlson (SEFSC)



Juvenile Decline in Charlotte Harbor

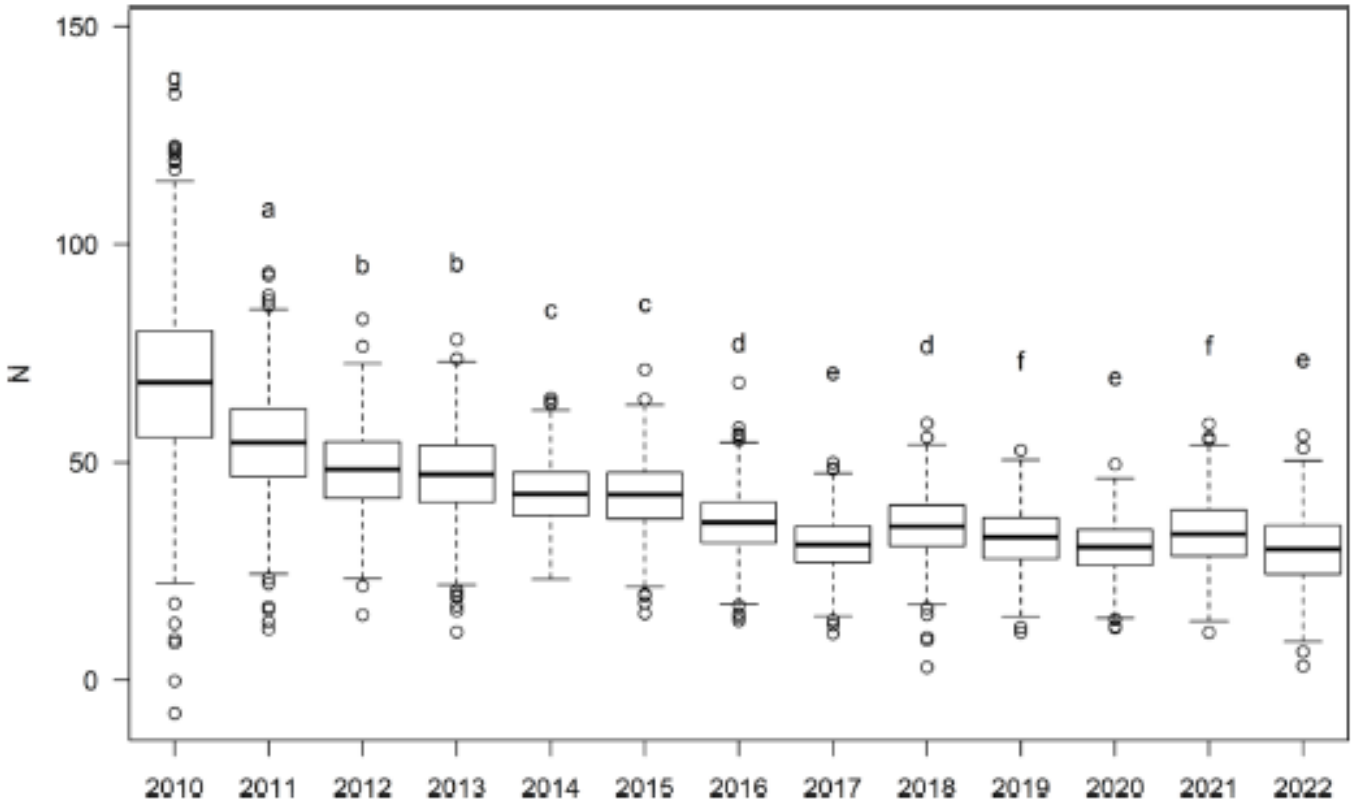
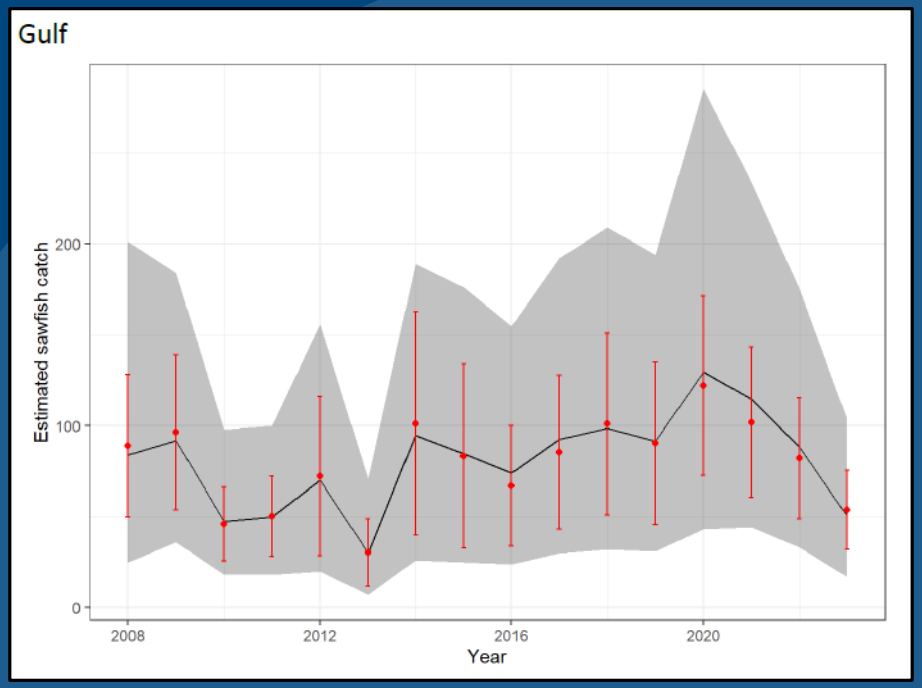


Fig. 7. Declining trend in smalltooth sawfish (*Pristis pectinata*) relative abundance. Model-estimated Spring/Summer abundance (N) of age-0 and age-1 individuals in Charlotte Harbor from random gillnet sampling, accounting for parameter uncertainty and environmental variability. Lettering denotes significant differences revealed by post-hoc pairwise comparisons using Tukey tests.

Farmer et al. 2026

Shrimp Bycatch



? Mortality rate ?

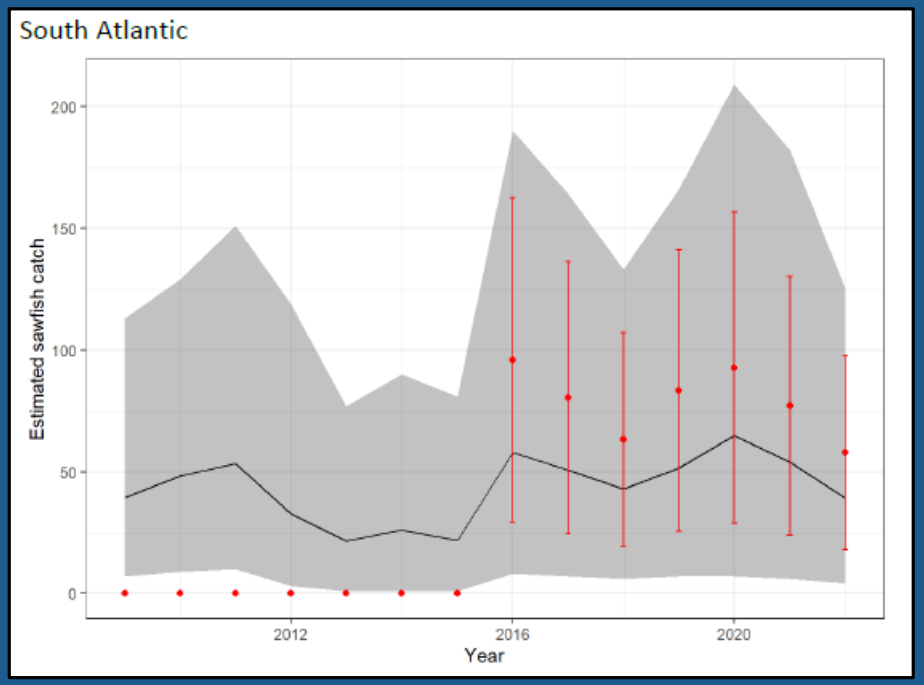
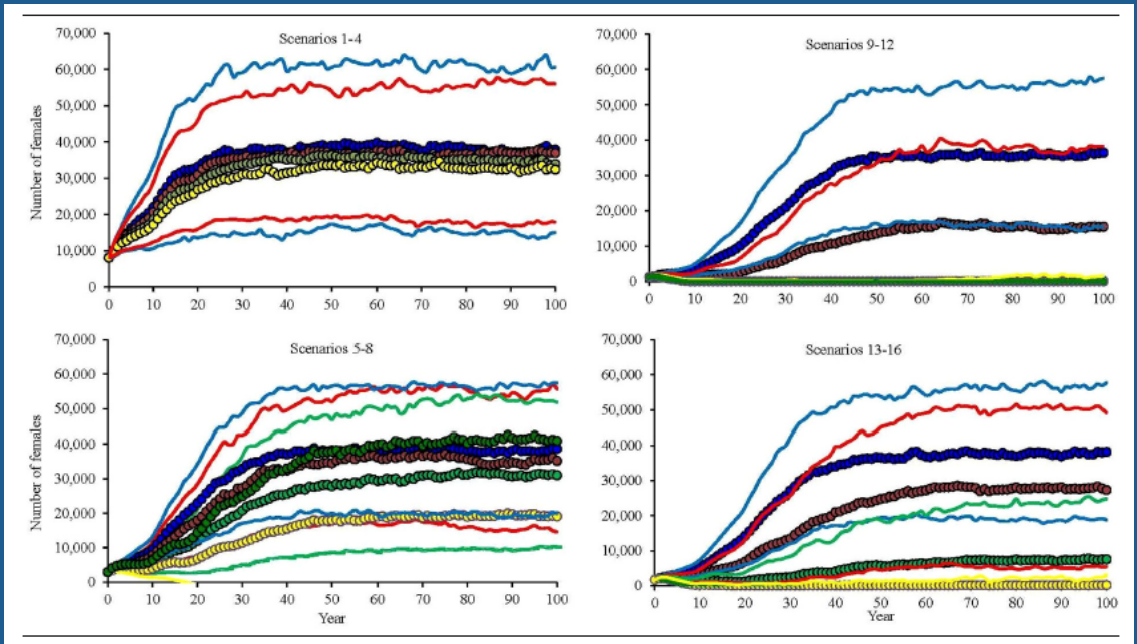


Figure 7 in Babcock et al 2025. Best Bayesian model (line and shading of 95% C.I.) compared to pooled ratio estimate (red - confidence intervals are 2 standard errors) for sawfish.

Population Viability Analyses

- Models that incorporate life history parameters, population size, and mortality estimates from threats to assess extinction risk and future population size
- Carlson 2023 – largely an update of the 2015 model
  - 4 initial population sizes (1255, 1695, 2975, 8075 females only)
  - Threats: Rec Fishing, Shark longline, Shrimp trawling (4 mortality rates)
  - Quasi extinction in 6 of 16 scenarios



Population Viability Analyses

- Carlson and Farmer 2025
  - 2024 spinning event (2 mortality scenarios)
  - Updated shrimp bycatch from Babcock et al. 2025
  - 2 initial population sizes (1255 and 1695 females)
  - 25% extinction probability in all 8 scenarios and 50% in 4 scenarios

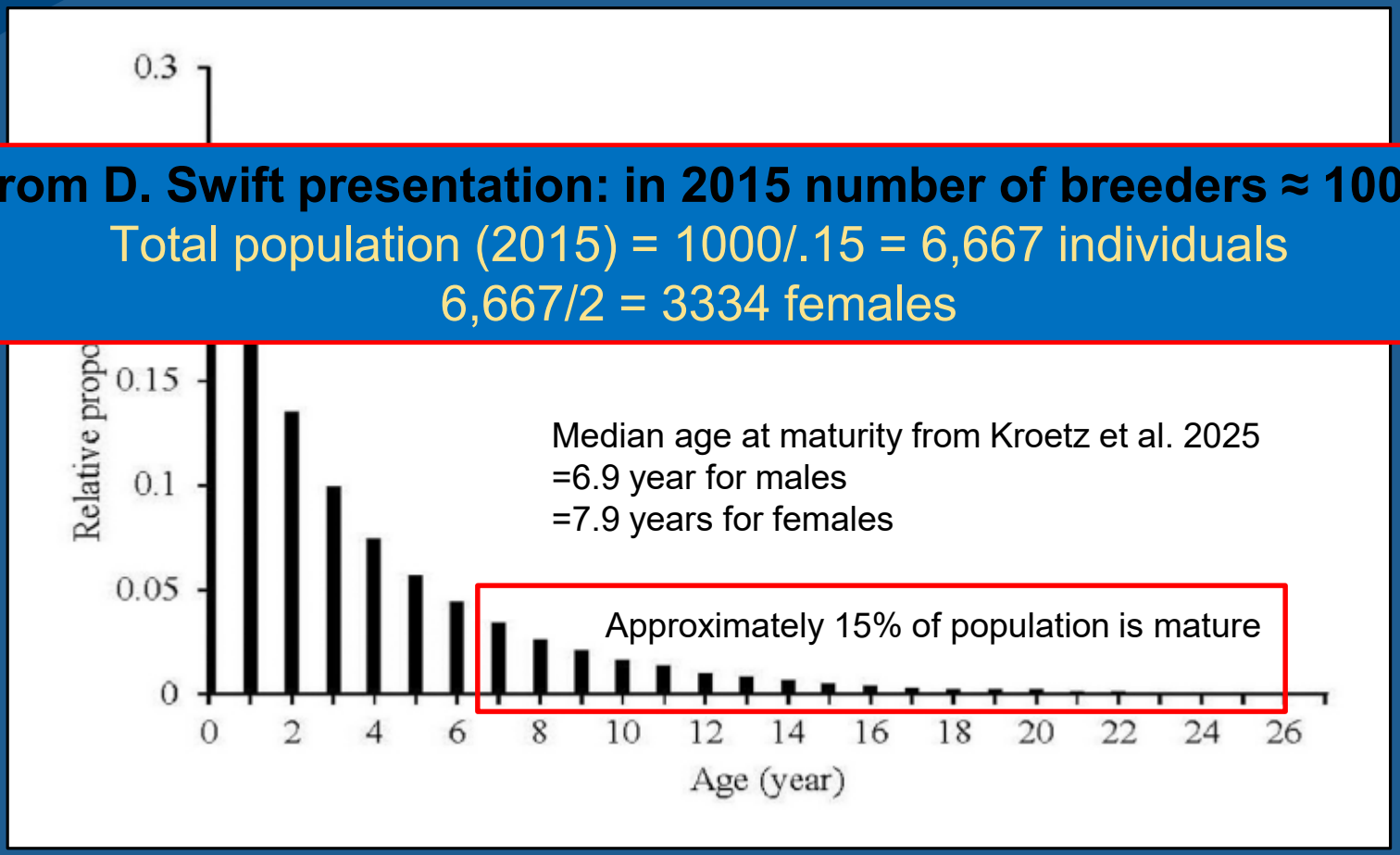
- Farmer in development
  - Improved survivorship by age
  - Updated initial population – CKMR results
  - Stochasticity in the frequency and severity of HABs and cold kills
  - Ground truthed with indices of abundance

Estimating Population Size

From D. Swift presentation: in 2015 number of breeders ≈ 1000

Total population (2015) = 1000/.15 = 6,667 individuals

6,667/2 = 3334 females



From Figure 1 of Carlson 2023 – Modeled stable age distribution

Spinning Sawfish – Pop. Effect

- Likely that at least 11% of the adult population died
  - 114 of the reported sawfish were assumed to be adult (38%)
  - Estimate of 1000 adults in the population (Swift in prep.)
  - Assumes all 114 died

- Impact is not just instantaneous
  - 174 affected subadults (age ~3-6) would have matured over the next 1-4 years
  - Expect a decline in juvenile recruitment over the next several years

- Mortality event captured in acoustic telemetry
  - 27% of tagged sawfish (49/183) died (no detections after August 2024)

Current Status Summary

- Population trend is uncertain
  - Strategy (random vs directed), location (ENP vs CH), & size class
  - Need to assess more recent data
- Updated PVA will estimate a current population size
- Historical population size and the decline (94%)
- Genetic diversity may be more limited than once thought
- Modest increase in range
  - Pupping in St. Lucie
  - Encounter reports in GA and SC
- Recovery potential remains provided threats are limited
  - New major threat identified – HAB events
- Greatest ongoing threats to recovery:
  - Stochastic events (frequency and magnitude)
  - Bycatch (frequency and mortality rate)