



Submerged Aquatic Vegetation (SAV)

Habitat Ecology and NC's Management Framework

DEPARTMENT OF ENVIRONMENTAL QUALITY

Marine Fisheries

August 2024 | Charlie Deaton | 23-Aug-2024



Background

How we got here:

- Historical management: piecemeal habitat protection
- Shrimp FMP Amendment 2 – SAV issue paper (2022)
 - Developed concurrently with 2021 CHPP's focus on water quality
 - What we heard:
 - Serious concerns about water quality
 - SAV protection is important to all stakeholders
 - MFC approach needs to be holistic - avoid singling out individual stakeholder groups
 - *The Marine Fisheries Commission (MFC) requests the DMF work with the MFC's Habitat and Water Quality Advisory Committee to examine and develop more comprehensive options to protect identified SAV habitat related to all activities under the authority of the MFC, consistent with the N.C. Coastal Habitat Protection Plan.*
- Where we are today: science and management basics to inform future actions

Outline

- Biology of SAV in NC
- SAV as an important fish habitat
 - Other ecosystem features
- SAV loss in NC
 - Primary drivers
- Management and the CHPP
 - EMC – water quality
 - CRC – in-water development
 - MFC – gear impacts
- Takeaways











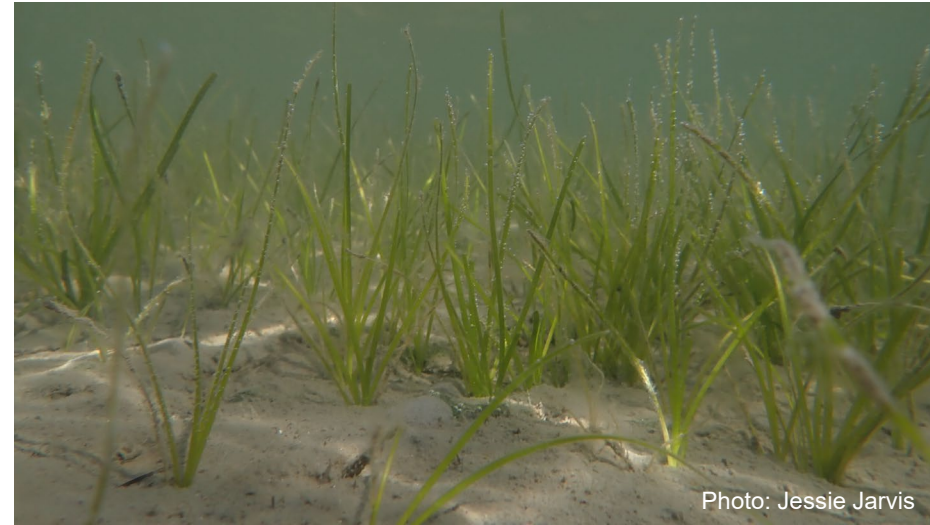






SAV biology

- Submerged aquatic vegetation = plants that are continuously (mostly) underwater
 - 3 high-salinity seagrass species (>10 ppt)
 - 11 low-salinity species (0 to 10 ppt)
- Excludes algae
 - e.g. *Ulva* (sea lettuce), *Codium* (dead man's fingers)
- Also excludes marsh grasses which are exclusively intertidal
 - e.g. *Spartina* (cordgrass), *Juncus* (needlerush)





SAV as fish habitat

State-managed species

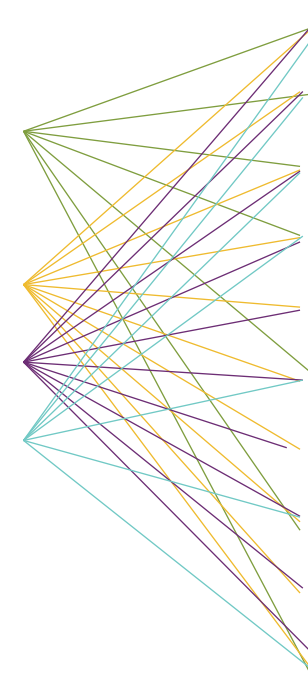
- **Red drum**
- **Spotted seatrout**
- **Bay scallop**
- **Blue crab**
- **Hard clam**
- **Shrimp**
- Kingfishes
- River herring
- Sheepshead
- Southern flounder
- Striped bass (estuarine)

Habitat functions

- Refuge
- Spawning
- Nursery
- Foraging
- Corridor

Interjurisdictional species

- American eel
- Atlantic croaker
- Atlantic menhaden
- Black sea bass
- Bluefish
- Gag grouper
- Spanish mackerel
- Spot
- Summer flounder
- Weakfish



***Bolded species** documented as more abundant in SAV than other habitats

Nearly 200 species of fish caught in UNC-IMS seagrass trawls from 2010-2023



Courtesy Madeline Payne - UNC Institute of Marine Sciences

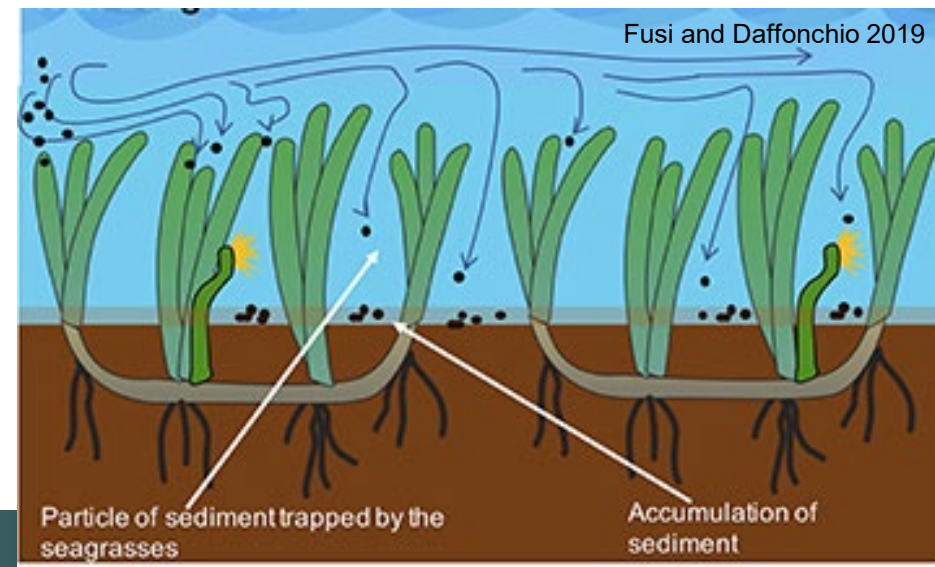
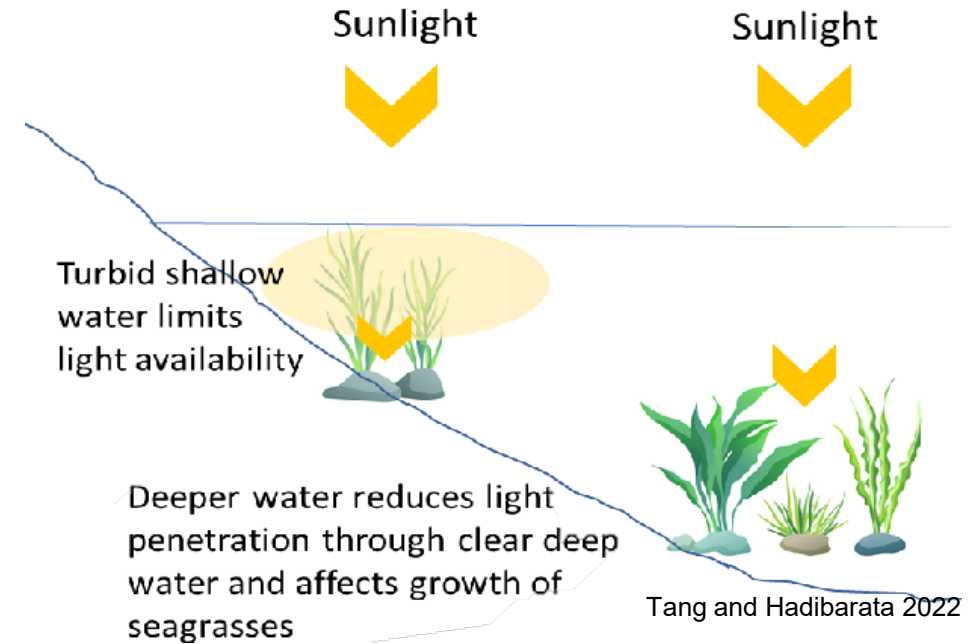
SAV habitat features

- Per unit area, seagrass supports 10 times more fishes than mudflat habitat, and 2-3 times more fishes than marsh creeks (Baillie et al. 2015 *Est Coasts*)
- Fishery production from high-salinity SAV provides >10% of the economic value of NC's commercial fisheries (Payne et al. *in prep*)
- NC's eelgrass meadows have the highest prey consumption rates in the northern hemisphere, indicating incredibly high fish habitat value (Whalen et al. 2020 *PNAS*; Reynolds et al. 2018 *Ecol*)
- Ecosystem services beyond fish habitat:
 - Water quality enhancement (e.g. Moore 2004, *JCR*)
 - Sediment stabilization (e.g. Carr et al. 2010, *JGR*)
 - Carbon sequestration (2023 NC Coastal Habitat GHG Inventory)



Requirements for SAV growth

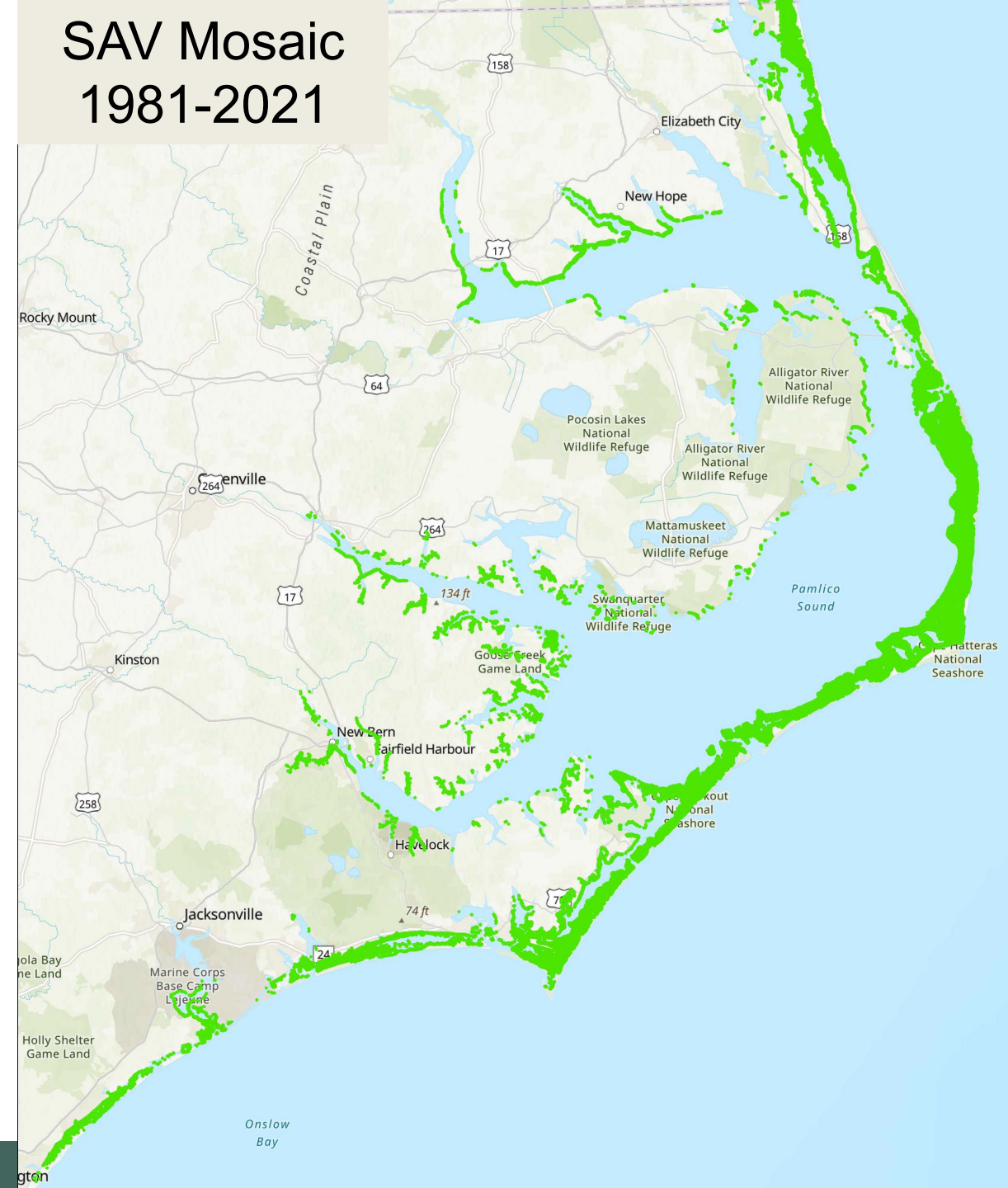
- Light availability
 - Water clarity + depth
 - Some species (low salinity) have evolved tolerance for lower light
- Physical stability
 - Site-specific, but some combo of wave energy, depth, and sediment stability
- Salinity + temperature
 - Drive species zonation and seasonality



Mapping NC's SAV Habitat

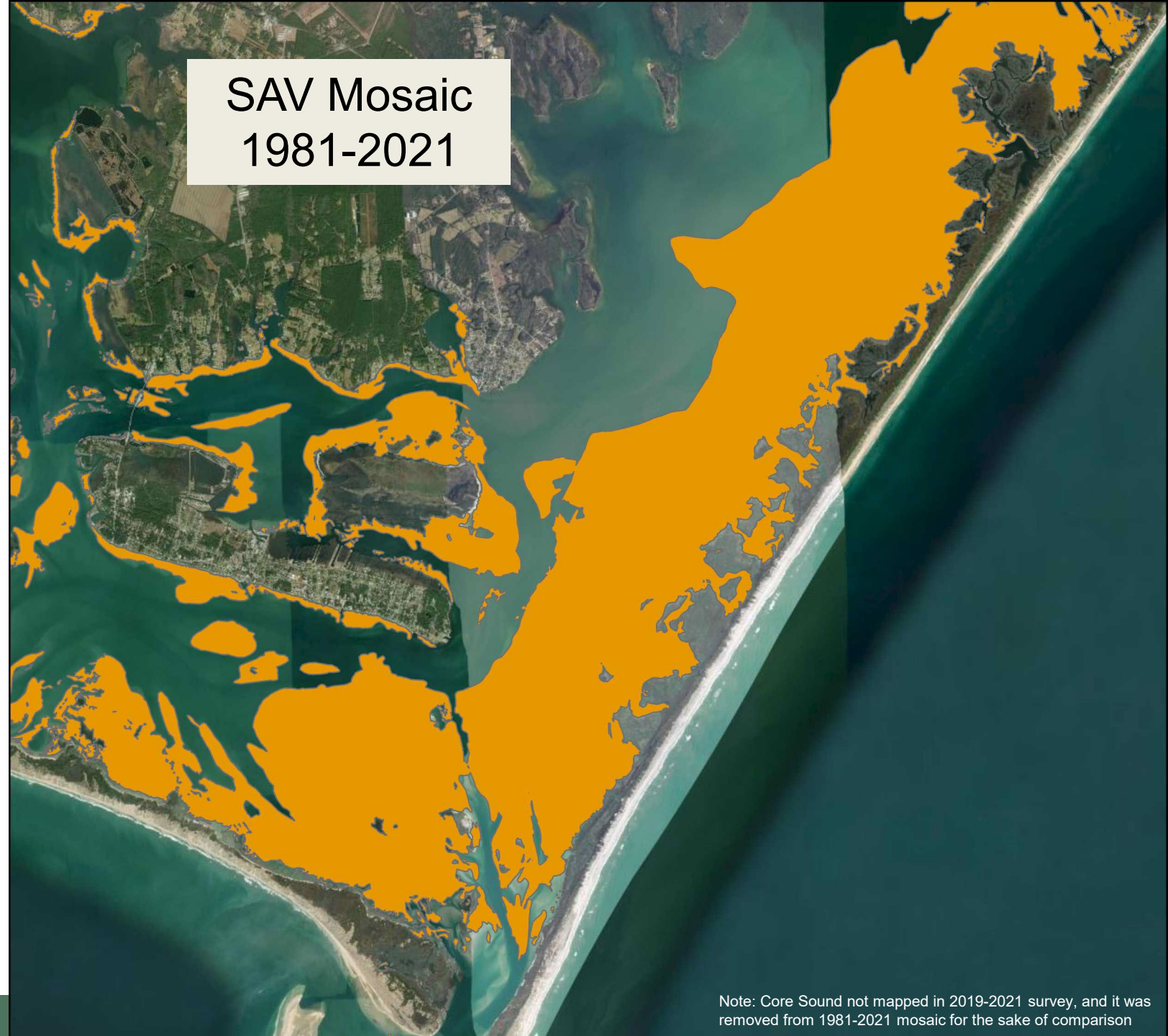
- Reliable maps exist back to 1981
- Composite/mosaic SAV map of 18 separate surveys from 1981-2021
- ~196,000 acres of SAV habitat statewide
- SAV extent variable year-to-year
- Past SAV presence = suitable SAV habitat

SAV Mosaic 1981-2021



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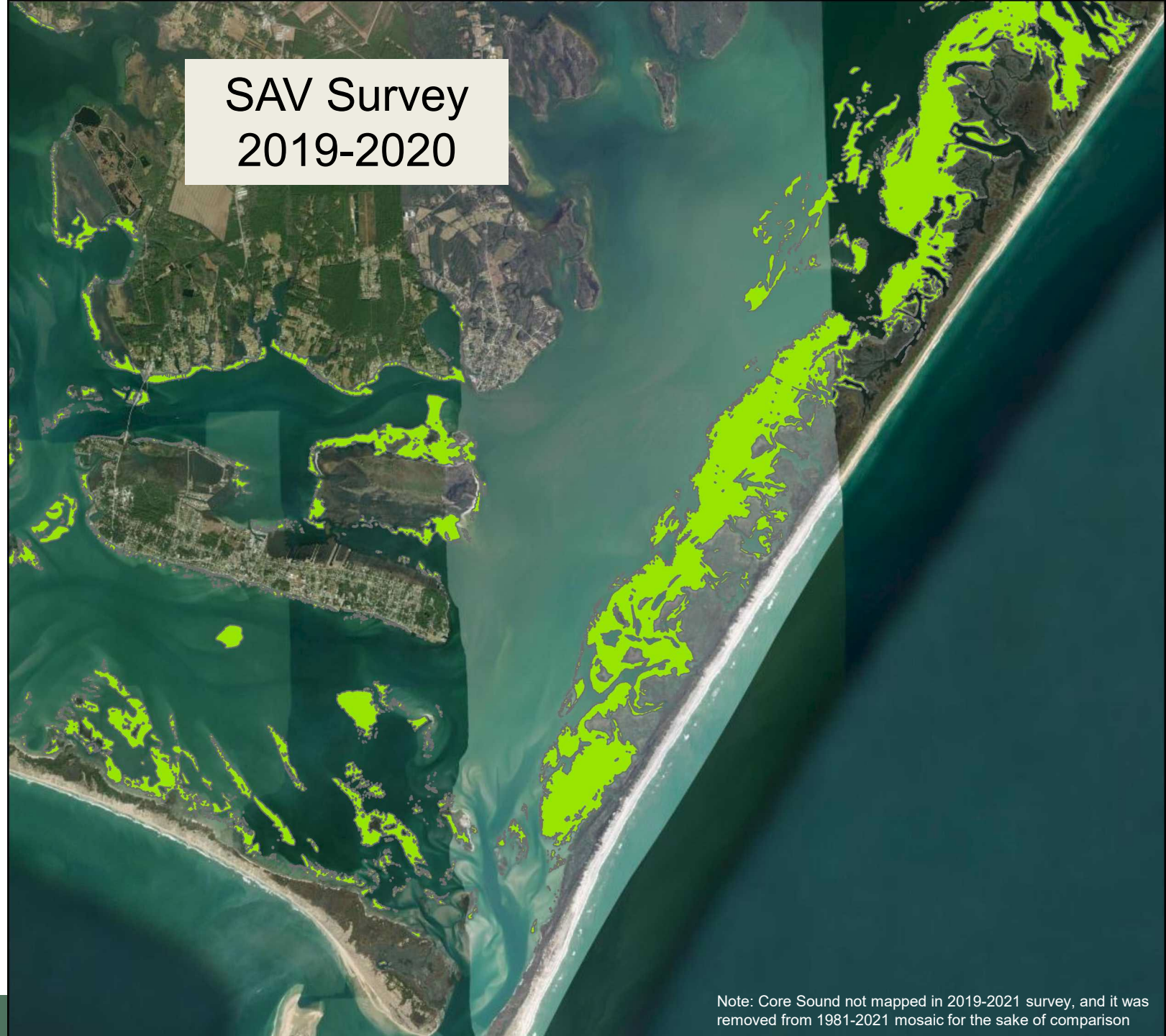


SAV Mosaic
1981-2021

Note: Core Sound not mapped in 2019-2021 survey, and it was removed from 1981-2021 mosaic for the sake of comparison

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SAV Survey
2019-2020

Note: Core Sound not mapped in 2019-2021 survey, and it was removed from 1981-2021 mosaic for the sake of comparison

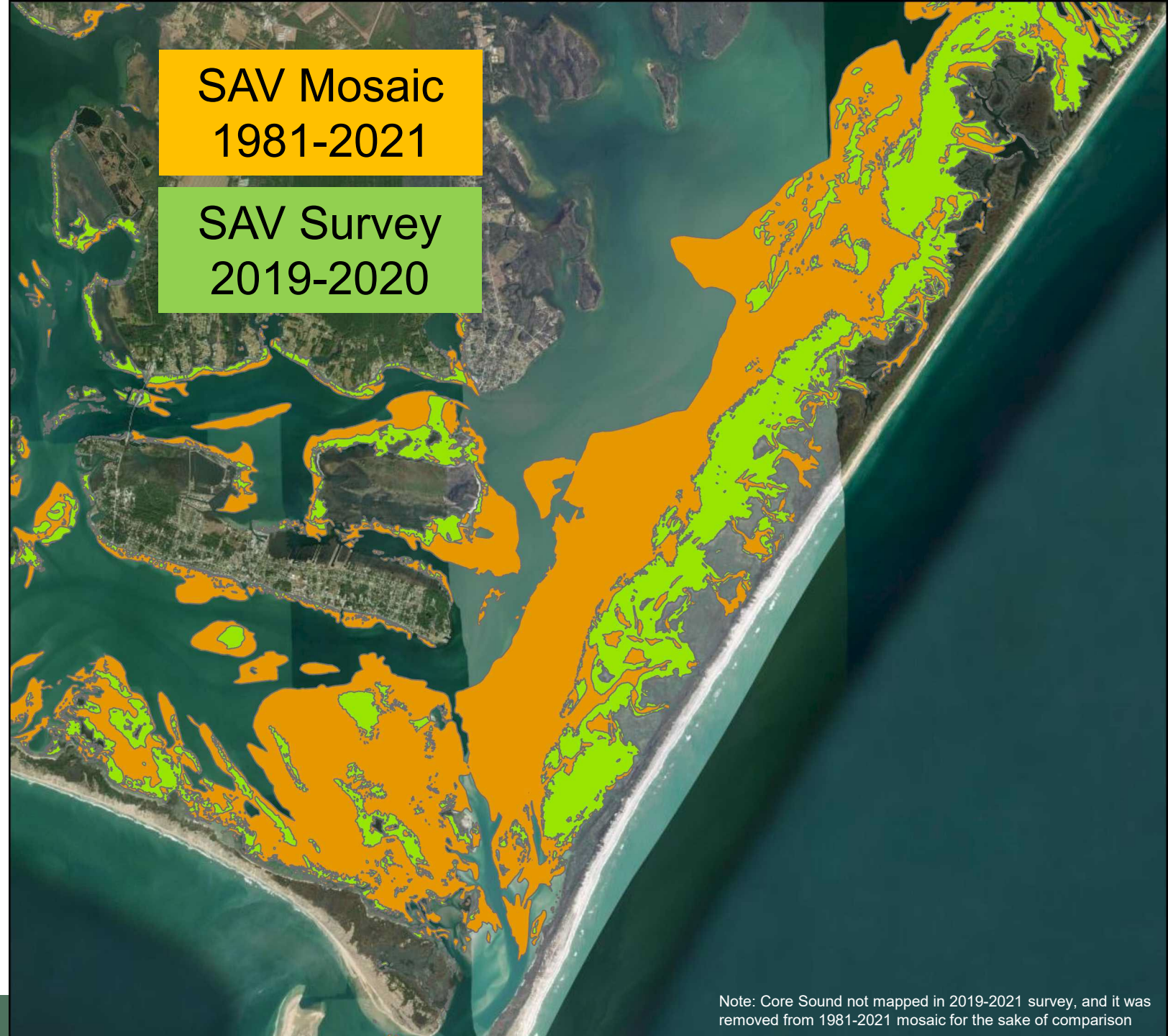
SAV loss in NC

High salinity SAV Loss

- APNEP 6-year analysis 2007-2013:
5.6% loss (~1% per year)
 - 10.5% loss in Bogue/Back Sounds
- Preliminary 40-year DMF analysis:
~39% loss (~1% per year)
 - ~93,000 acres in 2019-2021 vs.
~145,000 acres 1981-2021

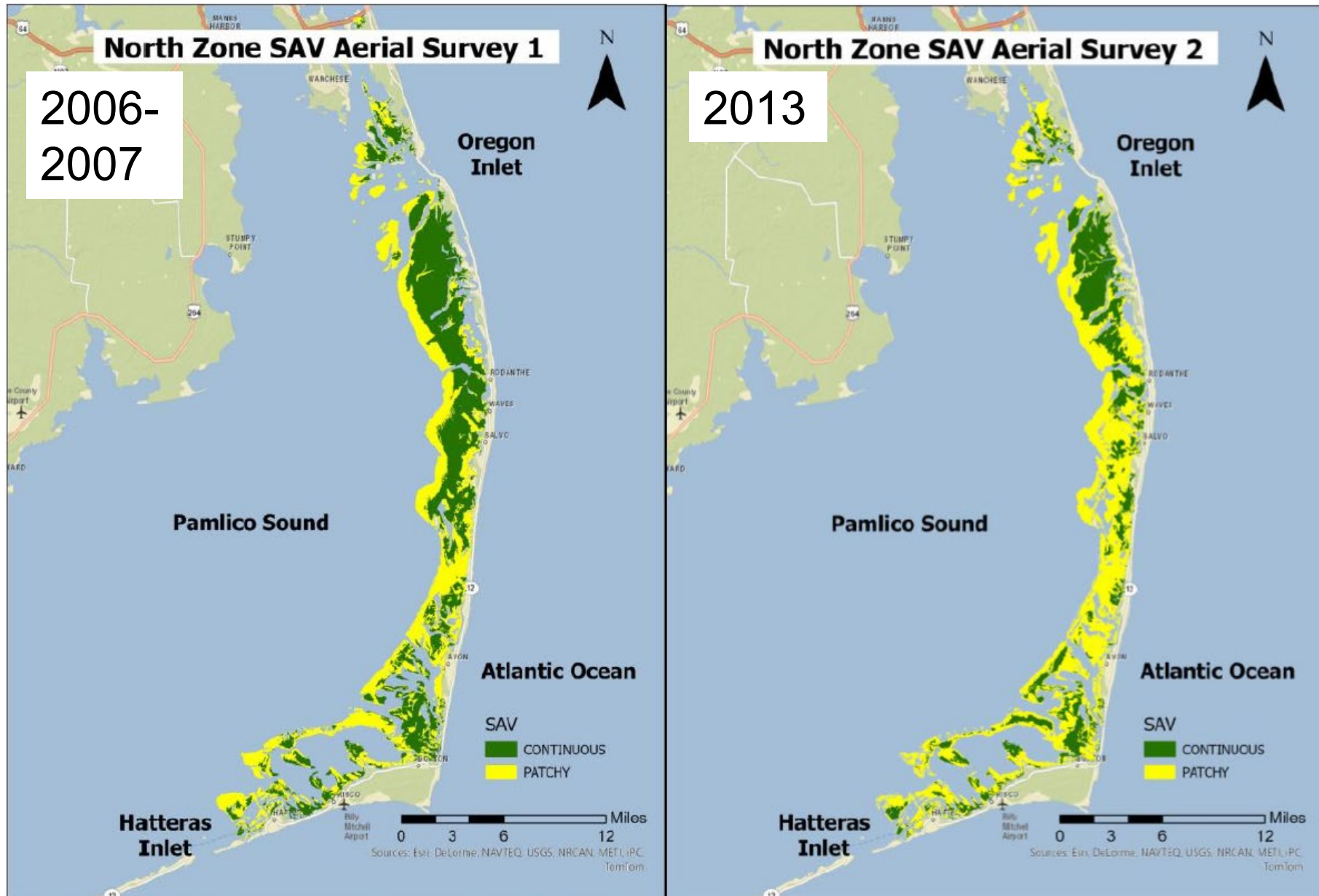
Low salinity SAV Loss

- APNEP analysis: **~33% loss (~1% per year)**
 - Historical linear extent vs. 2014-2017 surveys



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Seagrass meadows are becoming more fragmented/patchy



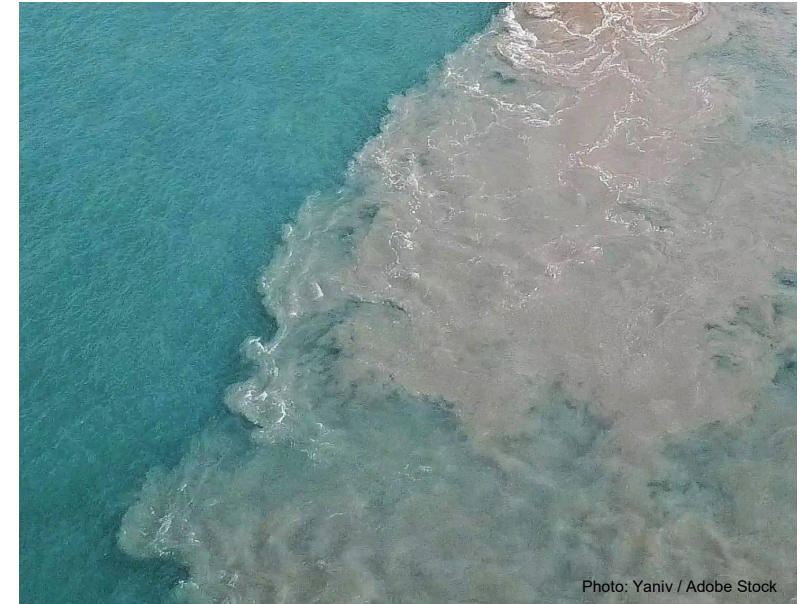
Causes of loss

From SAFMC 2014 SAV Policy:

“The major anthropogenic threats include:

1. light limitation due to:

- a. increased particles and colored dissolved organic matter (CDOM) in runoff from land;
- b. increased phytoplankton in coastal waters due to elevated nutrient inputs from runoff;
- c. sediment resuspension from wind, wave, or boat action.



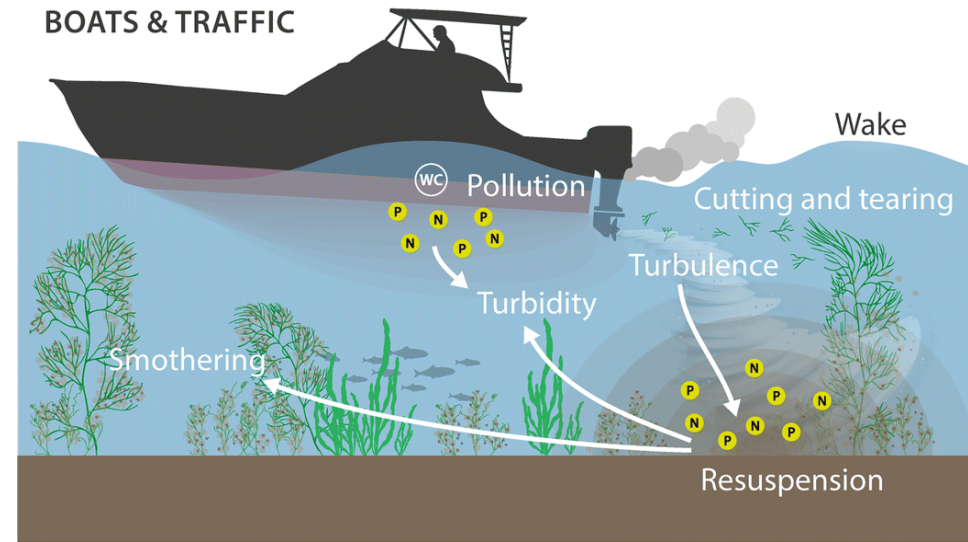
Causes of loss

From SAFMC 2014 SAV Policy (continued):

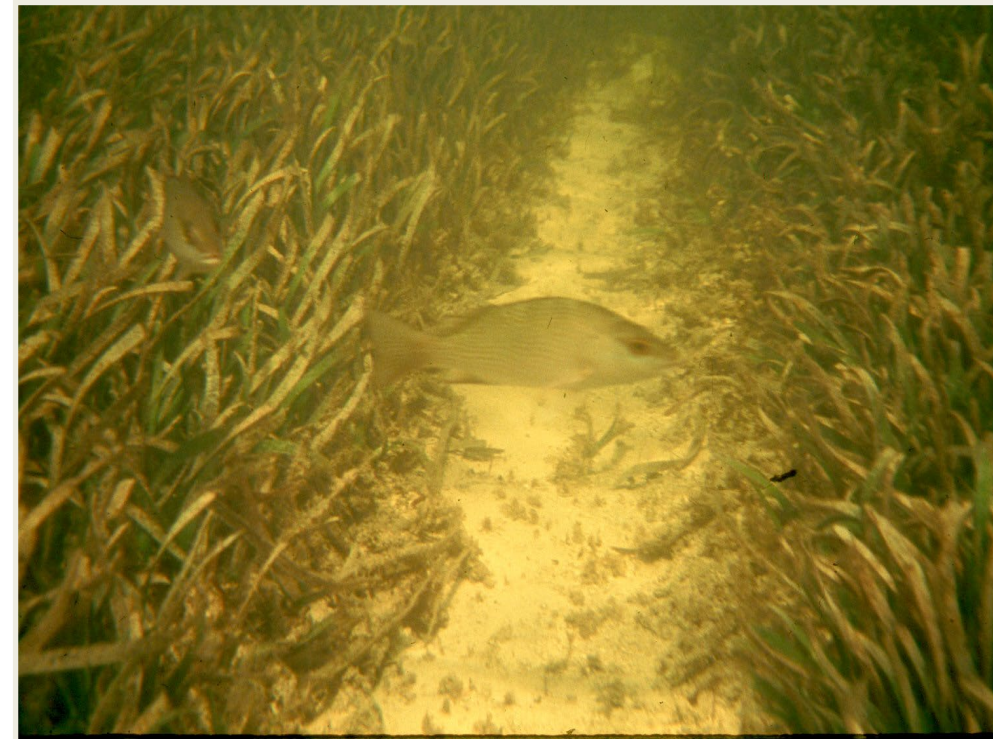
“The major anthropogenic threats include:

2. mechanical damage due to:

- a. propeller damage from boats;
- b. bottom-disturbing fish-harvesting techniques;
- c. dredging and filling.”



Sagerman et al. 2019, *Ambio*



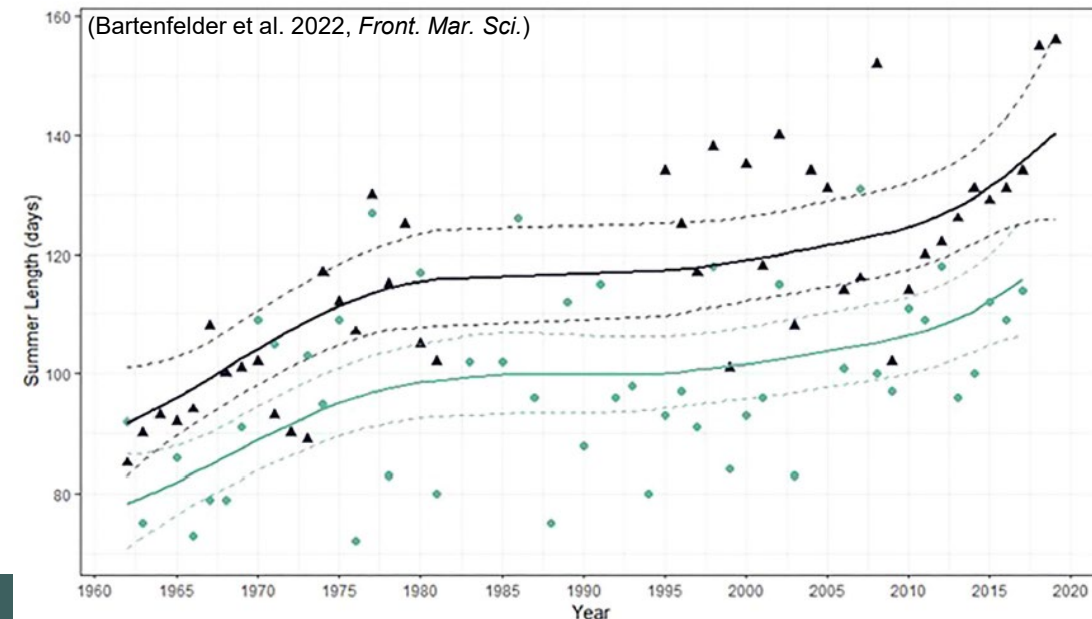
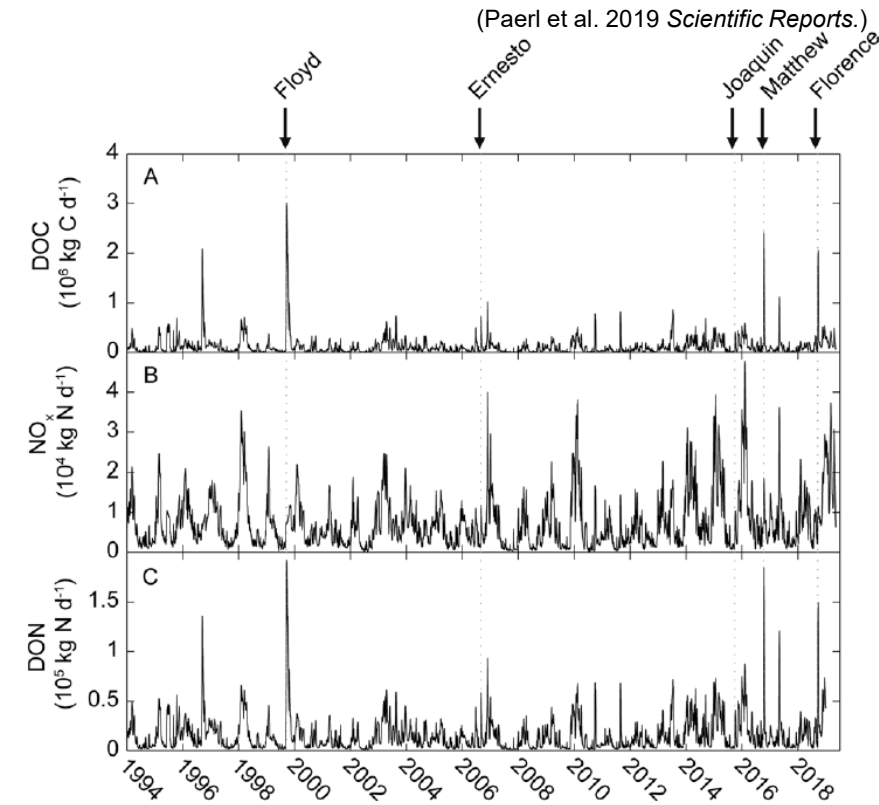
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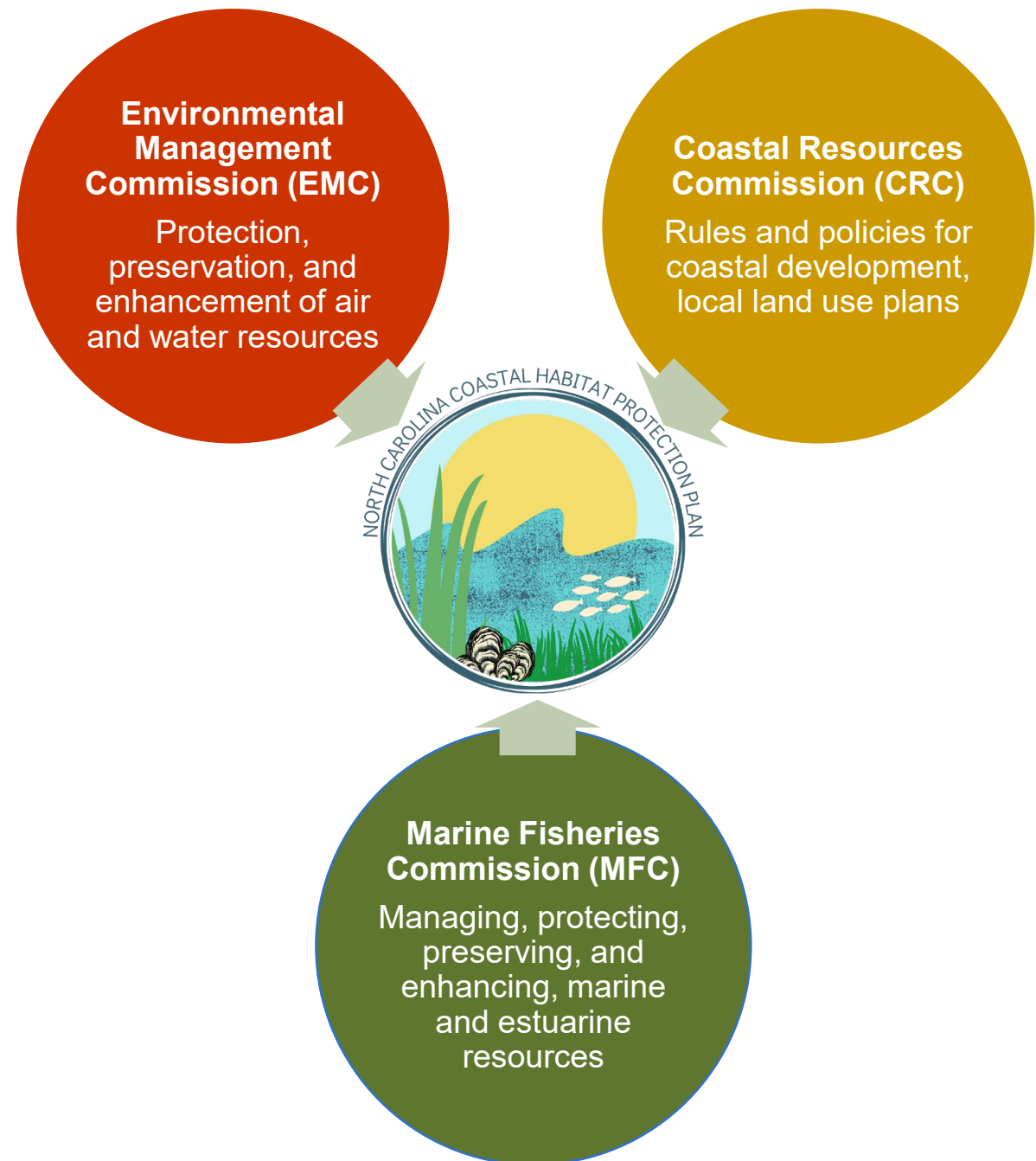
“**Climate change** and sea level rise could cause large-scale losses of SAV habitat due to rising water levels and temperatures, changing weather patterns...”

- Climate change = more rain, more big storms (Kunkel et al. 2019: *NC Climate Science Report*; Paerl et al. 2019: *Scientific Reports*)
- High-rainfall storms can double annual nutrient runoff to estuaries – weekslong phytoplankton blooms (Paerl et al. 2020: *Biogeochemistry*)
- In NC, eelgrass is severely threatened by rising water temperatures and is expected to experience dramatic declines over the coming decades (Wilson and Lotze 2019: *Mar Ecol Prog Ser*)
- “Summer length” for eelgrass has nearly doubled
 - 85 stressful-temp days in 1962 vs. 156 days in 2019 (Bartenfelder et al. 2022: *Front. Mar. Sci.*)



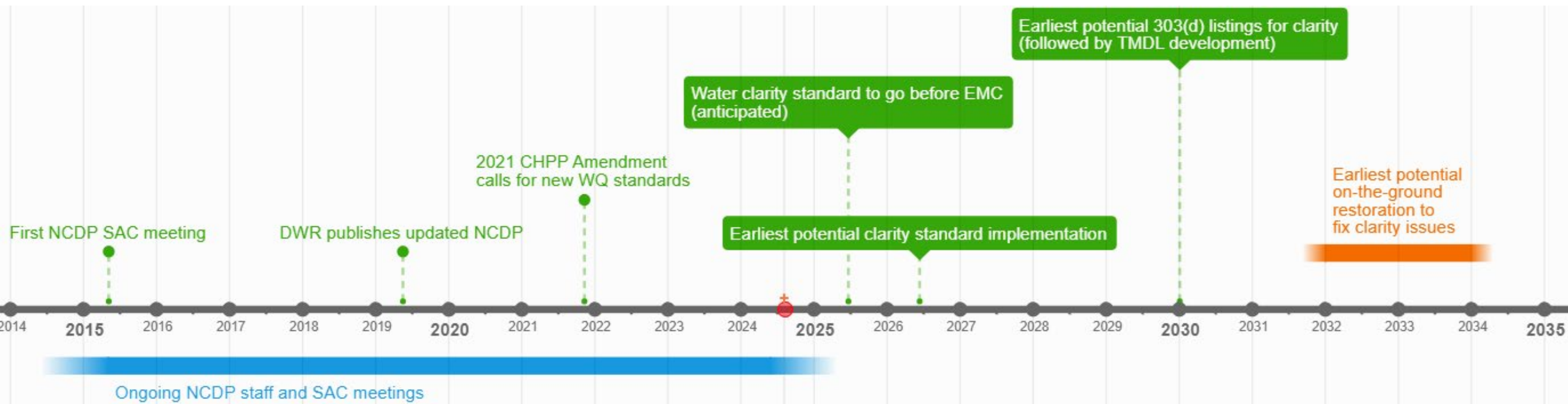
Management in NC

- Coastal habitat management through the Coastal Habitat Protection Plan (CHPP)
- CHPP is a DEQ plan, led by DMF (mandated by 1997 Fisheries Reform Act)
- MFC, CRC, and EMC all must approve the CHPP



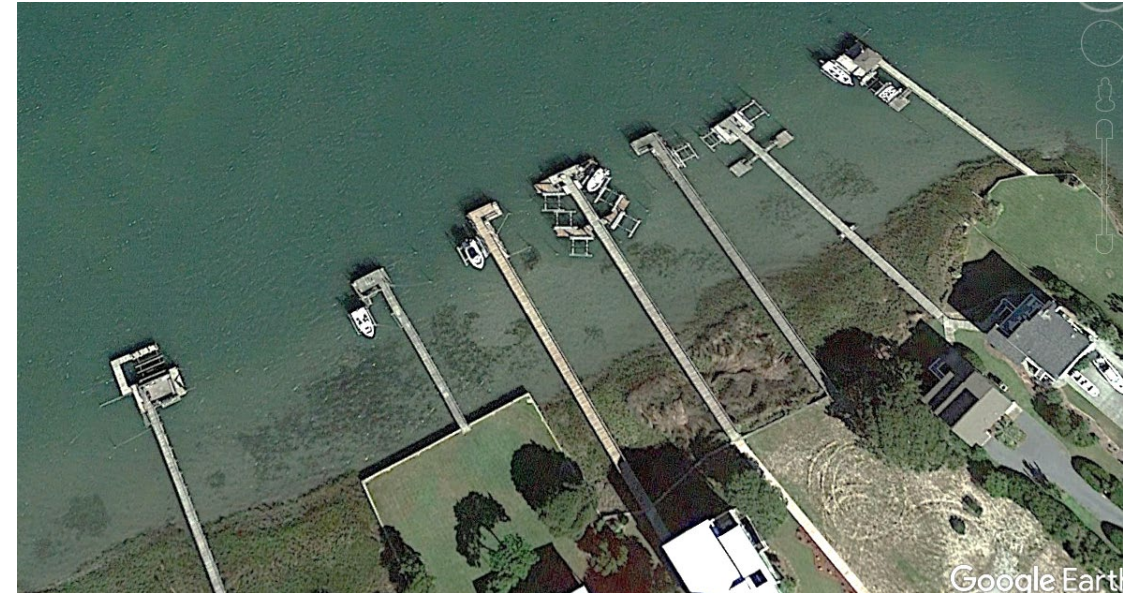
Environmental Management Commission

- EMC governs water quality impacts
 - Chlorophyll and turbidity standards influence light availability for SAV
- Designates SAV habitat as Outstanding Resource Waters (ORW)
 - Applies additional requirements, e.g. stormwater in new development
- DWR staff (with DMF) have developed a proposed water clarity standard, called for by 2021 CHPP
 - We're ~ a decade from the *beginning* of potential water quality improvements



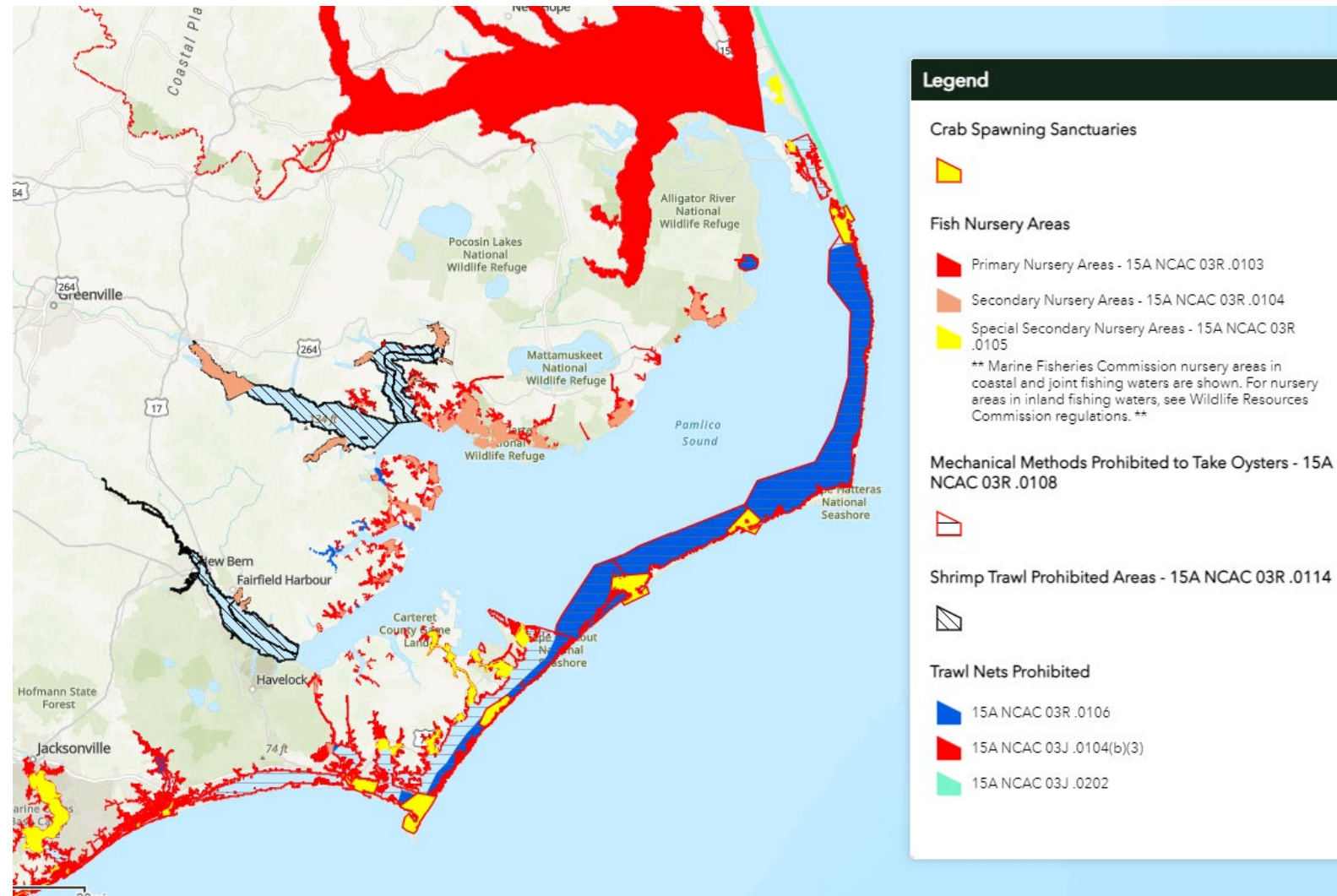
Coastal Resources Commission

- CRC governs impacts from coastal development via permits
- Policy: development shall avoid significant adverse impacts to SAV habitat
 - MFC definition used here
- DMF permit reviewers assess DCM major permit applications for impacts to SAV and other coastal habitats
- Applications:
 - Broad: No new dredging in SAV (channels, marinas, boat basins)
 - Specific: Docks proposed over SAV need at least 2 ft MLW water depth for Gen. Permit. If less, elevated to Major Permit application



MFC Management

- MFC has traditionally managed physical impacts through individual commercial gear restrictions
 - Shrimp trawling area restrictions
 - Oyster/clam/crab dredging area restrictions
 - Nursery area designations
 - Shellfish rake size/weight limits
- Piecemeal approach
 - Restrictions not all designed for SAV specifically
- SAV habitat definition



Takeaways

- NC's SAV habitat plays a major role in NC's fisheries
- NC is losing SAV – and likely to lose it faster
- EMC oversees water quality protection and will consider a clarity standard next year
 - At least 10 years to start seeing improvements from that rule, if approved
- CRC has authority over in-water development impacts (e.g. dredging, docks)
- MFC has managed physical impacts via fishing gear restrictions
- Action to protect NC's declining SAV habitat remains urgent

Questions?



Thanks to Dr. Joel Fodrie, Dr. Tony Rodriguez, Dr. Jessie Jarvis, Anne Deaton, Casey Knight, Madeline Payne, and APNEP for materials used in this presentation

Extra slides follow

MFC definition

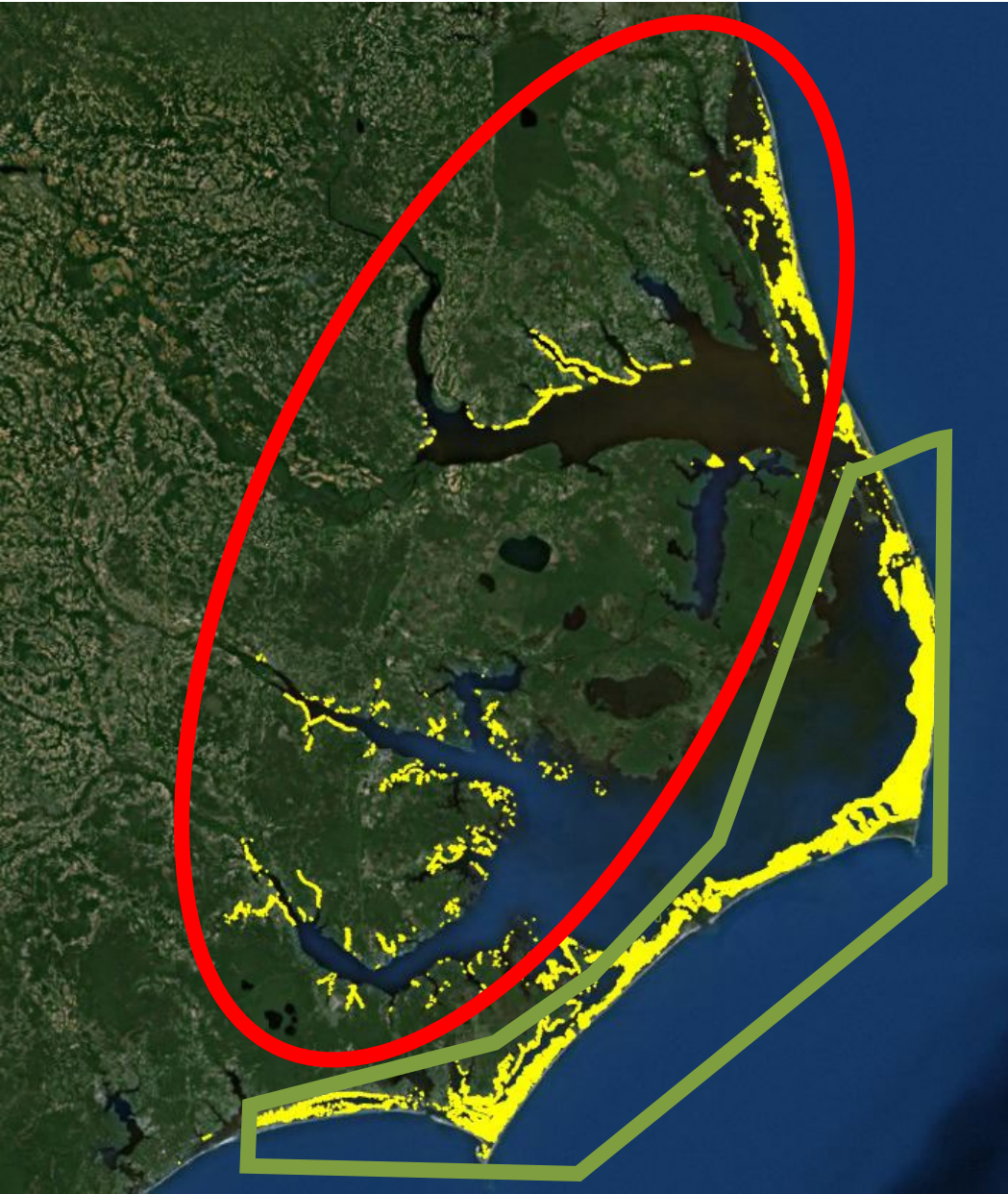
03I .0101 (4)(i) "Submerged aquatic vegetation (SAV) habitat" means submerged lands that:

(i) **are vegetated with one or more species of submerged aquatic vegetation** including bushy pondweed or southern naiad (*Najas guadalupensis*), coontail (*Ceratophyllum demersum*), eelgrass (*Zostera marina*), horned pondweed (*Zannichellia palustris*), naiads (*Najas* spp.), redhead grass (*Potamogeton perfoliatus*), sago pondweed (*Stuckenia pectinata*, formerly *Potamogeton pectinatus*), shoalgrass (*Halodule wrightii*), slender pondweed (*Potamogeton pusillus*), water stargrass (*Heteranthera dubia*), water starwort (*Callitriche heterophylla*), waterweeds (*Elodea* spp.), widgeongrass (*Ruppia maritima*), and wild celery (*Vallisneria americana*). These areas may be identified by the presence of above-ground leaves, below-ground rhizomes, or reproductive structures associated with one or more SAV species and include the sediment within these areas;

or (ii) have been vegetated by one or more of the species identified in Sub-item (4)(i)(i) of this Rule **within the past 10 annual growing seasons** and that **meet the average physical requirements of water depth (six feet or less), average light availability (secchi depth of one foot or more), and limited wave exposure** that characterize the environment suitable for growth of SAV. The past presence of SAV may be demonstrated by aerial photography, SAV survey, map, or other documentation. An extension of the past 10 annual growing seasons criteria may be considered when average environmental conditions are altered by drought, rainfall, or storm force winds.

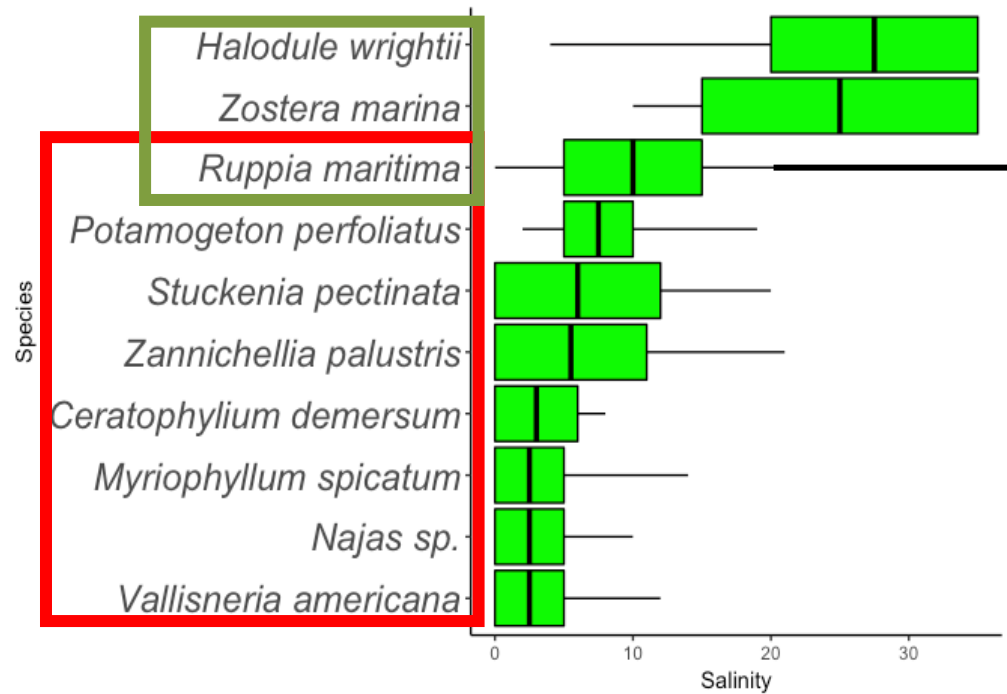
This habitat occurs in both subtidal and intertidal zones and may occur in isolated patches or cover extensive areas. In defining SAV habitat, the Marine Fisheries Commission recognizes the Aquatic Weed Control Act of 1991 (G.S. 113A-220 et. seq.) and does not intend the submerged aquatic vegetation definition, or this Rule or 15A NCAC 03K .0304 and .0404, to apply to or conflict with the non-development control activities authorized by that Act.

NC's SAV Communities



Two Distinct Communities

- High Salinity
- Low Salinity



Clean Water Act: Process

- To get to “restoration” (TMDLs), waterbodies must be
 - Monitored, with data collected
 - Data analyzed on two-year cycles, compared against WQ standard requirements
 - May require more than two years of data, e.g. if exceedances are allowable once in three years
 - Waters in violation of WQ standards put on 303(d) list
 - 5 categories, 4&5 are impaired
 - TMDLs can be developed for Impaired waters
 - Implementation takes the form of:
 - Point source control through NPDES permits
 - Non-point source control through a wide range of options (mostly not permitting-based)

