Regional Dredging NEPA In-Person Workshop

United States Army Corps of Engineers, South Atlantic Division

Workshop Summary

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Abstract

The U.S. Army Corps of Engineers (USACE) South Atlantic Division (SAD) convened a workshop to address the impacts of operational and maintenance (O&M) dredging on river, estuarine, and coastal environments in key harbors along the South Atlantic Coast. The workshop, held in Charleston, South Carolina, on May 29-30, brought together experts from USACE and various federal and state fish and wildlife agencies and universities. These specialists focused on the effects of dredging on sea turtles, sturgeon, North Atlantic right whales, and fisheries and habitats in Morehead City, NC; Wilmington, NC; Charleston, SC; Brunswick, GA; and Kings Bay Naval Submarine Base, GA. The event aimed to identify knowledge gaps and strategies to mitigate potential risks associated with O&M dredging. This workshop summary document summarizes discussions and input from participants, presentation overviews, breakout group discussions, species presence and absence reviews, and next steps. Input provided by the experts, summarized below, will inform the preparation of a Research Gap Analysis and Recommendations Summary Report that will support the development of future environmental reviews under the National Environmental Policy Act (NEPA) and prioritization of future analysis and monitoring efforts.

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1. Introduction

The U.S. Army Corps of Engineers (USACE) South Atlantic Division (SAD) invited key experts to participate in an in-person workshop to better understand the effects of operational and maintenance (O&M) dredging in river, estuarine, and coastal environments of key harbors along the South Atlantic Coast. The five focal harbors included Morehead City, NC; Wilmington, NC; Charleston, SC; Brunswick, GA; and Kings Bay Naval Submarine Base, GA. The workshop occurred at the Charleston Marriott in Charleston, South Carolina, on Wednesday, May 29th, from 9:00 a.m. to 5:30 p.m. and Thursday, May 30th, from 9:00 a.m. to 12:30 p.m. The invited participants were identified by USACE and other interested Federal and state fish and wildlife agencies, as experts in the fields of sea turtles, sturgeon, North Atlantic right whales, and fisheries and habitats. The workshop solicited input to help identify potential information gaps concerning the potential effects and associated risks to key resources associated with O&M dredging and to identify strategies to help address those gaps. The outcomes from the workshop will be used to inform the preparation of a Research Gap Analysis and Recommendations Summary Report that will support the development of future environmental reviews under the National Environmental Policy Act (NEPA) and prioritization of future analysis and monitoring efforts.

Workshop Objectives and Structure

The stated objectives of the workshop included:

- Convene scientific experts to discuss and summarize potential effects from O&M dredging and sediment placement in focal geographies along the South Atlantic and the potential associated risk to key Endangered Species Act (ESA)-listed species (i.e., North Atlantic right whales, sea turtles, Atlantic sturgeon) and species and habitat protected under the Magnuson-Stevens Fisheries Conservation Management Act based on location and time of the year.
- Identify strategies and approaches (qualitative and quantitative) for bridging knowledge gaps in the collective understanding of the effects on key species and habitats.
- Utilize a graphic facilitator to create and refine visual graphics that summarize the routes of effects identified and prioritized during discussions. A graphic representation of the identified harbors will also be developed and refined, identifying unique attributes and habitats plus areas utilized by species discussed.

The two-day workshop agenda is available in Appendix A. Day One, **Wednesday, May 29th,** focused on developing a shared understanding of the problem the USACE team is trying to solve and the role of the invited experts in contributing to the process. Day One morning topics included defining the South Atlantic Regional Biological Opinion (SARBO) that covers Endangered Species Act (ESA) consultation for species under NMFS purview that are affected by O&M dredging. The 2020 SARBO removed the environmental window for dredging of December to March and recommended using a risk assessment process to identify an approved time frame and risk minimization measures for each harbor to minimize risk to multiple species. The USACE is beginning the process to gather

information on what we know and do not know (data gaps) about the effects of O&M dredging at different times of year in the five harbors. This information will support upcoming NEPA efforts to evaluate effects on other species and habitat that are part of the whole human environment and broader than the SARBO. Day One continued with an overview of the planning process for the workshop and the graphics developed as part of that effort, describing U.S. Army Engineer Research and Development Center's (ERDC) quantitative approaches and strategies, characterizing the general state of the science and publicly available dredging data, and providing an opportunity for experts to make brief presentations on emerging research and data on species and known risks associated with dredging. Following the presentations, participants self-organized into species-focused breakout groups, where they engaged in detailed discussions and analyses of key risks and unknowns and recommended priorities and approaches to address the unknowns.

Day Two, **Thursday, May 30th**, started with the breakout groups sharing key findings, risks, and unknowns identified during their Day One discussions. Following these report-outs, participants engaged in a plenary discussion focused on identifying key opportunities, tradeoffs, and important areas for future analysis (both short-term and longer-term) associated with the five harbors. The workshop ended with a recap of the next steps in the process.

The meeting was facilitated by a Kearns & West team that included a technical expert from Continental Shelf Associates (CSA) and a graphic facilitator from Crowley and Associates.

Meeting Summary Format

This summary captures key outcomes and the next steps from the workshop. It focuses on discussions and input received rather than the detailed synopsis of the formal presentations. It is not intended to be a detailed transcript. This document is organized into the following main sections:

- Workshop invitees and participants (including Key Experts, the USACE NEPA Science Planning Team, and the Facilitation Team)
- Overview of Presentations
    - Key context
    - State of the Science
    - Participant "lightning presentations"
- Breakout Group Discussion: Confirming Routes of Effect between Dredging and Species and Identifying Knowledge Gaps
- Review of Species Presence and Absence
- Wrap Up & Next Steps
- Appendix:
    - Agenda
    - Workshop participants and invitees
    - Virtual breakout meeting summaries
    - Species graphics
    - Preliminary citation list

- Flipchart notes
- Harbor map and presence and absence matrix

Please note: the PowerPoint slides were shared with participants following the meeting.

2. Workshop Invitees and Participants

The USACE team coordinated invitations to the identified key experts. Eighty-four individuals, including experts, USACE staff, and the facilitation team, accepted the invitation. Sixty-one participants attended both workshop days in total. Workshop invitees and participants are listed in Appendix B.

3. Overview of Presentations

Nicole Bonine, USACE SAD, opened the meeting by welcoming the participants, introducing the planning and facilitation team, and reiterating the project objectives and intended outcomes. The Kearns & West facilitator reviewed the workshop agenda and proposed process guidelines to help ensure a productive meeting. Following the workshop, the presentation slides were shared with participants.

3.1. Key Context Presentations

The USACE team made several presentations on background topics to inform the subsequent expert group discussions. The following provides a short overview of each background presentation topic.

3.1.1 How do we describe 'risk'? | Nicole Bonine, USACE South Atlantic Division

To help establish a shared starting point for the workshop, Nicole Bonine reviewed the history of dredging and the SARBO and described how risk is defined in the 2020 SARBO.[1] A risk assessment is a requirement of the SARBO process and can be considered a project assessment. A standard Risk Matrix approach includes the following steps: Identify the Risk, Analyze the Risk, Plan a Response, and Monitor and Adapt as projects progress. Nicole emphasized that the first two steps (Identifying the risk and analyzing the risk) were completed in the 2020 SARBO. USACE then develops an annual planned response to meet the SARBO requirements and uses an adaptive management approach to Monitor and Adapt. This technique allows the USACE to assess what works well in an operation, identify when the probability of future take is deemed too high and stops work, and evaluate how to adjust future O&M dredging projects based on lessons learned. Collaborating with key experts, discussing known data to understand routes of effect, and identifying minimization measures play a role in the process. More information about SARBO is available at https://www.sad.usace.army.mil/Missions/Civil-Works/SARBO.

[1] https://www.sad.usace.army.mil/Missions/Civil-Works/SARBO

3.1.2. National Environmental Policy Act (NEPA) Overview | Suzanne Hill, USACE Savannah District

Suzanne Hill's presentation focused on reviewing the NEPA process, its connection to SARBO, and how the information from the workshop will inform the process. She defined NEPA's guiding principles that all Federal actions need to consider effects on the human environment prior to implementation. She explained the process to develop an Environmental Impact Statement (EIS). The 2020 SARBO allows for flexibility in O&M dredging timing, which requires an evaluation of the impacts on ESA species and identifying ways to reduce risks. The USACE is in the early phase of the NEPA process. In this phase, they are focusing on evidence-gathering through discussions with the scientific community and key experts. Evidence gathering focuses on identifying key resources, understating gaps and risks, and identifying potential modeling and analytical approaches to evaluate effects on the human environment as part of future NEPA efforts.

3.1.3. Workshop Background & Virtual Breakout Sessions | Andy LoSchiavo, USACE South Atlantic Division

Andy LoSchiavo provided an overview of the four Virtual Breakout Meetings that the USACE had convened in February 2024 to help prepare for the present workshop. Several of the experts participating in the workshop had also participated in the Virtual Breakout Meetings, which had also been targeted to the same focal species: sturgeon, sea turtles, right whales, and fisheries and habitats. Key outcomes from the Virtual Breakout meetings are available in Appendix C. The information provided by experts during the Virtual Breakout Meetings with regard to key knowledge gaps around risks and impacts were used to inform the process design for the in-person workshop as well as the pre-prepared graphics and read-ahead materials. Andy presented the dredging routes of effect graphics developed from the Virtual Breakout Meetings, highlighting the different types of dredges and common issues, such as turbidity and entrainment.

3.1.4. Questions & Comments on Key Context Presentation

- Question: Are we aiming for a multi-species assessment by species?
    - USACE: We want to understand risk by time of year and if there are overlaps between species.
- Question: Can habitat (e.g., seagrass) be added to the graphics? Habitat is under the radar for SARBO but should be included as part of the effects on the human environment.
    - USACE: SARBO does not include Essential Fish Habitat species and habitats. We recognize that it's missing. We are using SARBO as a starting point to have data-driven discussions on the aspects that are not included.

3.2. State of the Science Presentations

The USACE planning team developed presentations on their analytical approaches and available dredging information to help further establish a shared foundation for the upcoming breakout group discussions. The following provides a brief overview of each state of the science presentation.

3.2.1. Overview of Analytic Approaches | Todd Swannack and Safra Altman, USACE Engineer Research and Development Center (ERDC)

Todd Swannack and Safra Altman described analytical approaches and modeling parameters utilized by USACE in addition to key considerations recommended for working with the scientific community. Todd and Safra presented how the USACE selects the appropriate analysis, ensures transparency and repeatability, and distinguishes between correlation and causation. The presentation offered an integrated model for system analysis, which is composed of multiple models. Todd and Safra shared key questions the USACE use to select an appropriate scale for an analysis, including temporal and spatial analyses. They clarified that USACE project planning typically requires modeling that looks at a 50-year plan, combines hydrodynamic, ecological, and habitat suitability modeling, and considers environmental systems and species viability in varying conditions.

3.2.2. Overview of Available USACE Dredging Information | Mary Richards, USACE Savannah District

Mary Richards's presentation focused on the internal dredging data available to the USACE that can be shared with other resource agencies. For example, historical data such as where dredging specifically occurred in a channel, dredge volumes, draghead elevation, vessel speed, and disposal events for each dredged load can be collected from the National Dredging Quality Management (DQM) automated monitoring program and the USACE Resident Management System (RMS) used for quality management. Dredging vessels are required to provide data for the DQM and RMS databases. In addition, publicly available data related to dredging can be found on the following sites:

- Operations and Dredging Endangered Species System (ODESS) tracks take of ESA-listed species https://odess.usace.army.mil/)
- USACE Hydrographic Surveys via eHydro (https://www.arcgis.com/apps/opsdashboard/index.html#/4b8f2ba307684cf597617bf1b6d2f85d).

3.2.3. Questions & Comments on State of the Science Presentations

- Question: It's great that dredging data are available. These data vary from year to year. Can past years' data be made available to help design future studies?
    - USACE: We are actively working on getting the data reviewed and made accessible.
- Question: What is the spatial coverage of the Savannah maps?

    - USACE: For Savannah, there is dredging from the entrance channel to 103/105.
- Comment: Climate change will be a factor that will provide more uncertainty to species, habitats, and seasons. Climate change should be considered in future dredging operations.

3.3. Participant Lightning Presentations

To contribute to the shared understanding of the "state of the science," several expert participants made brief (5-minute) presentations on relevant and recent research on the focal species, geographies, and dredging impacts. This section summarizes the topics of each of these presentations.

3.3.1. History of Dredging and Species Protection | Chris Slay, Coastwise Consulting

- Shared an overview of the history of dredging and species protection since the 1980's. Chris highlighted the minimization measures that were experimented with, when they were implemented and why. This included the use of seasonal timing, protected species observers, right whale aerial surveys, hopper dredge draghead deflectors, screening, and relocation trawling.

3.3.2. Hopper Dredge Take Reduction | Ben Emery, Coastal & Hydraulics Laboratory, US Army Engineer Research and Development Center (ERDC)

- Shared current and proposed mitigation measures and discussed the efficacy of these measures to reduce turtle takes, including drag head deflectors. Presented the turtle tickler chains (TTC) pilot program. The next phase of the TTC pilot program research is to work with the dredging industry and active operations to determine if takes are reduced on Threatened and Endangered Species (TES).

3.3.3. Refining Windows for North Carolina | Pace Wilber, Lisa Wickliffe, Anne Deaton, and Jordan Wolfe, NMFS SERO, Habitat Conservation Division

- Highlighted the economic importance of South Atlantic fisheries and the various impacts of dredging on fisheries, including direct and indirect/sublethal impacts. The presenters provided insight into the importance of windows for dredging related to the SARBO Risk Assessment and identified the Regional Environmental Window assessment conducted in North Carolina as providing recommendations on dredging impacts to USACE.

3.3.4. Next-Gen Water Quality for Dredging Operations | Alan J Kennedy and Paige Krupa, USACE Army Engineer Research and Development Center (ERDC)

- Provided an overview of the USACE's current approach to understanding water quality impacts from dredging, and shared that turbidity is not the only metric for looking at suspended sediment.
- Evaluating water quality associated with dredging operations should consider a combination of databases, lab testing, and novel sensor development. Continued

research should focus on standardizing data and creating a water sampling framework to understand suspended sediment, sediment ratios, and impacts on lethal takes.

3.3.5. Water Quality Monitoring Around Hopper Dredges | Matt Balazik, Ph.D. USACE Engineer Research and Development Center (ERDC)

- Described the USACE's approach to monitoring water quality associated with hopper dredging at Wilmington and Beaufort Channel entrances. Each harbor and channel has a different ecosystem to consider during research. The turbidity levels can create lethal takes in the worst-case scenario in lab studies, but the duration levels in dredging areas are much shorter.
- Water sample testing should be done to understand how the sediment settles and affects oxygen levels. Sediment plumes in the water column can cause decreases in dissolved oxygen; however, turbidity and dissolved oxygen never exceeded North Carolina state standards.

3.3.6. The Important Role of the Cooperative Marine Turtle Tagging Program for Sea Turtle Dredging Projects | Cathi Campbell, Archie Carr Center for Sea Turtle Research, University of Florida, Dept. of Biology

- Provided an overview of the Cooperative Marine Turtle Tagging Program (CMTTP), whose goals are to create a centralized program, distribute tags, and manage a tags database to exchange information. Tags have been distributed to rehab facilities and trawling vessels.
- The CMTTP goal is to increase knowledge about turtle movements, habitat use, and population parameters, including survival, mortality, and growth. CMTTP encourages experts and their organizations to get involved in the program if they work with or encounter sea turtles.

3.3.7. Digitization of Relocation Trawling Data | Kristen Hart, Ph.D., U.S. Geological Survey (USGS), Wetland and Aquatic Research Center

- Shared an overview of a digitalization of thirty years of relocation trawling data that USGS started during the COVID-19 pandemic. This effort is co-funded by the Bureau of Ocean Energy Management, USACE, and USGS. USGS has combined available datasets, reformatted them, and aligned them to be cohesive.
- Parameters are needed to determine how to align new information on turtle sightings, distance traveled, etc., with the previously collected and organized data. The new information can be used in a risk-informed decision-making process to inform new studies and learn more about turtle takes.

3.3.8. Sturgeon Behavior Post Relocation Trawling | Matt Balazik, Ph.D. USACE Engineer Research and Development Center (ERDC)

- Described the process of tagging sturgeon caught during relocation trawling with external and internal tags surgically implanted. Telemetry data showed how the sturgeon reacted to dredging and indicated most sturgeon stayed away from returning to the channel or had a quick turnaround following trawling relocation. Relocation trawling can be an effective tool in mitigating risk for sturgeon.

3.3.9. SCDNR: Sturgeon occurrence in nearshore waters of SC | Bill Post, SCDNR, Marine Resources Division

- Shared telemetry data showing the presence and movement of adult sturgeon off the coast of South Carolina. Data showed sturgeon aggregating in semi-predictable patterns, indicating a potential opening for dredging operations between June and August due to less sturgeon being present. South Carolina DNR has created an ongoing tool indicating areas of sturgeon density and presence.

3.3.10. Sturgeon Study Committee: Collaborative effort to study the critical habitat and population size of the St. Marys River Atlantic Sturgeon | Emily Floore, St. Marys Riverkeeper

- Described a collaborative effort to study the critical habitat of the St. Marys River for Atlantic sturgeon. St. Marys River recently confirmed an active spawning site, and St. Marys Riverkeeper is in the process of identifying when and where sturgeon spawn in the St Marys River and collecting DNA samples to understand the genetic sturgeon in this river. The entrance channel in Kings Bay has had lethal Atlantic sturgeon takes. Precautions are necessary to reduce future takes in this river with a very small population.

3.3.11. Manatee GA/SC Telemetry and Health Study | Buddy Powell, Clearwater Marine Aquarium Research Institute

- Presented findings from aerial surveys of Kings Bay, which indicate manatee presence. Manatees are mostly found offshore or in rivers and waterways used as shortcuts in migration efforts. Thirty-four manatees have had complete health workups for tracking. The data indicates they are migrating north to areas in Georgia (St. Marys, Ogeechee, Savannah, Satilla, Altamaha, Brunswick River systems) and South Carolina (Broad and Cooper Rivers) perhaps in search of new vegetation.
- Additional research is needed to understand how, if any, dredging is affecting manatee habitat.

3.3.12. North Atlantic Right Whale Aerial Surveys | Buddy Powell, Clearwater Marine Aquarium Research Institute

- Presented on aerial surveys tracking right whale movement and migration. Brunswick Harbor was identified as a calving area that should be protected. More calves have been born in the last few years, and tracking calving rates is an important indicator of the health of the species. Calving locations should be considered when looking at dredging operation timeframes.

3.3.13. Forecasting near-term movements and density of North Atlantic Right Whales | Nathan Crum, Florida Fish and Wildlife Conservation Commission

- Presented on North Atlantic right whale aerial surveys, co-funded in Georgia and Florida since the 1980s by USACE, US Coast Guard, US Navy, and Georgia DNR. Surveys started in 2020 in North And South Carolina solely funded by USACE. Aerial surveys occur during good weather, primarily from November to April. Right whales are distinguishable by the white area on their heads but are hard to track beneath the surface.
- Vessel strikes are the highest risk to the right whale population and the highest concentrations are near Brunswick Harbor and King Bay. Visibility is critical in mitigating takes.
- Forecasting modeling is a helpful tool for estimating the likelihood of the presence of the right whale in the vicinity of dredging and support vessels. Sightings are publicly available at https://whalemap.org.

4. Breakout Group Discussion: Confirming Routes of Effect between Dredging and Species, and Identifying Knowledge Gaps

Workshop participants were asked to self-select into four species-specific breakout groups: sturgeon, sea turtles, fisheries and habitat, and right whales. Each breakout group was asked to address the following discussion questions for their species group:

1. Confirm the routes of effect between species and dredging. Are we missing any? How do those routes of effect differ by geography? How do those routes of effect differ by time of year?
2. For gaps in understanding, and drawing on the earlier presentation on analytical approaches, what strategies and approaches (qualitative and quantitative) can address these gaps? In your view, what studies are needed to characterize key risks before dredging should be conducted during particular times of the year?
3. How should those studies be prioritized or sequenced?

In addition to discussion questions, participants were asked to share relevant references and publications via a Microsoft Form. Appendix E contains the preliminary citation list and the citations provided during the workshop.

Breakout groups used the above discussion questions as guidelines. Some groups asked additional questions, and some groups did not answer all the provided questions. This variance is reflected in the report-outs shared by each breakout group, which were provided by designated rapporteurs at the beginning of Day 2. A summary of the key outcomes from each breakout group is listed below. Additional flipchart notes can be found in Appendix F.

4.1. Sturgeon Breakout Group

The sturgeon breakout group conversation focused on routes of effect and information gaps and provided insight into the presence and absence of sturgeons. The report-out shared key considerations for dredging windows, the potential for more research or studies, and opportunities for collaboration.

Routes of Effect:

- **Greatest Risk:** Hopper dredging (primarily within entrance channels) appears to be the most significant cause of a lethal take for Atlantic sturgeon. Suction cutterhead dredging does not pose a major impact on sturgeons.
- **June to August is the better time to dredge:** Atlantic and shortnose sturgeon typically are not present within entrance channels in the focus geographies during June, July, and August.
    - Conducting hopper dredging during these months would eliminate/reduce the potential for lethal take of sturgeon.
- **Seasonality as a factor:** Shortnose sturgeon spawning runs may be affected by winter/spring dredging.

Information & Data Gaps

- **Collaboration with researchers**: Researchers from SCDNR have provided detailed information about the life stages and times of the year when Atlantic and shortnose sturgeon are present.
    - The opportunity exists to identify and request additional information from other researchers (Federal, State, etc.).
- **Telemetry data** may be required to improve our understanding of sturgeon movements and foraging in and around all harbors.
- **St. Marys River as a critical habitat and dual-spawning event:** Data gaps include:
    - Determine whether all life stages are present and whether spawning occurs within the St. Marys River.
    - On shortnose sturgeon genetics.
    - Shortnose sturgeon appear to be making spawning runs in adjacent watersheds.
    - Tissue samples are needed.

- **Additional studies are needed** to understand the quantity of sturgeon, their presence in specific rivers and navigation channels, concerns about under-keel clearance, and lethal take limits.
- **Limits to data collection:** UGA sturgeon data is collected almost exclusively in the summer months when university students are available as field technicians.

4.2. Sea Turtles Breakout Group

The sea turtles breakout group's conversation focused on understanding hopper dredging impacts. The group discussed, developed, and expressed broad support for conducting a multi-variate analysis of protected species mortality due to hopper dredging. This analysis would apply not only to sea turtles but all of the other focus species as well for all five of the focal geographies. The group discussed the following set of parameters to be considered as part of the analysis:

- Load Numbers
- Data
- Time
- Dredge (Names)
- Size Class
- Zone (Outer/Inner/Inshore)
- Location (Lat/Long or Eng Sections Sta.)
- Catch (0/1 for presence, 0/X for full counts) per species
- Effort (CPU) Pump hours
- Number of drag arms in operations (DQM or PSO reports)
- Drag head type (Configuration) (UXO or not)
- Velocity (Can this be compartmentalized?)
- Drag head size/ pipe diameter
- Substrate
- Speed of vessel
- Current
- Water Temp
- Wind (Wind Direction)
- Barometric pressure
- Tide
- Beaufort Scale
- Relocation Trawling
- Bed-leveling used (Y/N)

Other discussion topics considered by the group included the following:

- **Cleanest Data Available:** Data stratification should focus on the region as a whole and not by channel. Collect the most recent data and look at previous predictions.
    - The cleanest data may not be the most recent data.
- **Additional Parameters** could include biological data sets and distribution models.
- Opportunity to **standardize the bycatch data** (in particular, how it is being counted and monitored by the onboard observers).

In addition, the sea turtle group identified short-term and long-term approaches to reducing take due to dredging. These included:

- **Short-term Approaches:** Evaluate effectiveness of water injection & Relocation trawling

- **Long-term Approaches:** Evaluate effectiveness of Tickler chains, exploring alternatives to hopper dredging, and consider additional ways to disincentivize turtle takes.
- Consider **Permitting Challenges** (e.g., ESA Section 7 and 10)

Finally, the group discussed key implementation questions regarding the proposed multivariate analysis and asked: How will this study be done? Who will do it? Who will fund it?

Transcriptions of the sea turtle breakout group flip chart notes are found in Appendix F.

4.3. Fisheries & Habitat Breakout Group

The fisheries breakout group highlighted the fact that each inlet and harbor is different and can be characterized by varying species impacts from dredging. Moving forward, considerations should answer the following question: How do we specify and minimize impacts for each harbor? The group report-out highlighted what is known and where there are key concerns:

What We Know and What is Working:

- There is an overlap between sturgeon and fisheries and ESA concerns.
- Lots of larvae information exists, but no year-round datasets exist (VIMS has developed a larval dispersal mode for Pamlico Sound and UNC Wilmington has data)
- Presence/absence of information regarding fisheries exists, need more information to characterize risk
- Information exists on where species are in the water column and where eggs are in the water column.
- Dissolved oxygen research is generally reasonable.

Key Concerns & Risks:

- **Habitat:** Inlets serve as migration corridors and can be bottlenecks for larvae distribution.
    - Impacts on other species and habitat features should be studied as well; this includes seagrass (i.e., seagrasses near Morehead City Harbor), oyster, red drum, horseshoe crab, southern flounder
    - What are habitat recovery rates?
- **Seasonality:** Diurnal and lunar considerations need to be taken into account.
- **Eggs/Larvae** are most at risk, so we need to better understand their position in the water column in addition to timing. How does dredging effect fish recruitment? Eggs are known to flush out of channel in 1-2 tidal cycles and relate to lunar cycles.
- **Data sharing**: The need exists to make data available, especially trawling bycatch data. In addition, ensure standard techniques and guidance for identifying species for observers to follow and build confidence in the data.
- **Noise sensitive species**: Sciaenidaes are sensitive to noise. Could dredging affect them at night during spawning events in channels, given during the day dredging noise is no louder than existing boating.

Knowledge Gaps & Needed Research:

- Key data needs include: Year-round larvae datasets, red drum spawning effects, horseshoe crabs (prey for listed Rufa Red Knot), effects on blue crab, phytoplankton and ichthyoplankton in the water column, and flounder.
- More information is needed on **turbidity**—e.g., sedimentation effects on habitats (such as oysters and seagrass) with long-term spatial data sets of daily turbidity dredging that also look at the bottom and not just the surface waters.
- Key research question: How much mortality occurs from dredges, and what is the impact on fisheries?

Transcriptions of the fisheries breakout group flip chart notes are found in Appendix F.

4.4. Right Whales Breakout Group

The right whales breakout group established that vessel strikes are the primary risk for the species and recognized that dredging vessels are one piece of regional vessel operations. The conversation focused on risk and mitigation measures that could be adapted to reduce take. Some suggested measures were new, while others focused on enforcing current regulations. Key measures discussed included the following:

- Improve **communication channels:** Ensure proper whale alerts to all vessel operators.
- Adjust for **seasonality:** Summertime is when right whales are least likely to be seen and will be out of calving season.
    - It may be possible to allow dredging during calving season (November to April) if no vehicles over 10 knots.
- **Enforce contractual obligations of speed.** Add penalties for going over the speed limit or incentives if vessels do not speed.
- Consider research and recent data to **adjust the survey aerial window** to start earlier.
- Look for **alternative disposal areas** that are not near calving areas to minimize potential interactions (time and distance).
- **Modeling Approach:** Utilize an analytical tool to evaluate different scenarios to quantify impacts and strike probabilities. Consider the model from the Southeast Fisheries Science Center.
- Consider adding **real-time passive acoustic monitoring** in high-density areas, dredging areas, or each harbor.
- Increase understanding of **vessel movement between projects** (i.e., the movement of support vessels when under contractor or not between projects).

5. Review of Species Presence and Absence

Following the breakout group discussions on Day 1, workshop facilitators invited each breakout group to visit a large graphic of each of the five harbors and provide additional information regarding their understandings of presence and absence of their focal species in each of the harbor geographies. Participants utilized sticky notes to illuminate conceptual gaps in understanding dredging effects on species and to identify additional analyses needed to address these gaps. In

addition, participants also added information to presence/absence matrix posters. In particular, participants were asked to share when a species would be present or not as well as information about the life stage of the species. The resulting harbor graphics/maps and the presence /absence matrices can be found in Appendix G. The information shared will be analyzed in the Gap Analysis Report.

On Day 2, participants were asked to walk around the room, review the previously added sticky notes on the harbor graphics and input on the presence/absence matrices for each of the five harbor geographies, and insert additional information as needed, all the while considering the following discussion questions:

1. *How do we address tradeoffs?*
2. *Where do key opportunities/synchronicities exist?*
3. *What are the priorities?*
4. *How does it align with expected dredging needs or schedules?*

Following this "walk about" exercise, workshop participants regrouped in plenary and reflected on these discussion questions for the five harbor geographies. Key comments included:

5.1. Morehead City

- **Turbidity:** Consider the benefit of waiting between dredging to let the turbidity settle a bit (i.e., let the plumes settle).
    - Current research studies are looking to understand turbidity on sea grass, invertebrates, and fish. These are lab studies that will be applied to the natural environment.
    - Consider moon and tide cycles.
- **Seasonality:** According to some experts, June to August typically has the fewest species present (i.e., fish species like snapper grouper, manatees, and sea turtles). In contrast, spring, winter, and fall months include many fish species, right whales, sea turtles, and sturgeon.
- **Suggested Models or Tools:** Hydrography can indicate dredge spillage and impacts on fish larvae/eggs.
    - Research previous impacts on fisheries spawning areas due to dredging.
- **Challenges:** There are decades of data, but it is essential to ground truth and determine what data are still relevant and what has changed.
    - More information is needed to understand why and where turtles are the most vulnerable to entrainment.
- **Questions for future consideration:** How do we monitor potential impacts?

5.2. Wilmington

- **Seasonality:** November to January has the lowest species density (fisheries).
    - July/August is when sturgeons are least present.
- **Approach to assess tradeoffs:** Consider choosing timing for dredging based on the least impactful for the highest-risk species, such as whales and turtles.

    - A high degree of debris and clay that clogs the inflow boxes, which poses challenges in tracking takes, might lead to undercounting.
- **Habitats:** There is beach-quality sand near the inlet.

5.3. Charleston

- **Seasonality:** Summer is the preferred time for dredging to minimize impacts on all listed species. Spring/Winter is the least viable option.
    - Sturgeons are present in spring, some experts recommended summer (June to August) as the least impactful time for the species.
    - Historic telemetry data shows turtles primarily on the shoals during the summer.
- **Priority Consideration:** Adult female sea turtle impacts should be avoided completely.

5.4. Brunswick

- **Approach to assess tradeoffs:** Utilize a structured decision-making approach to review data, determine goals, and assess the best model to determine the effects on the species. Note: this comment applies to all of the harbor geographies.

5.5. Kings Bay Naval Submarine Base

- **Priority consideration** includes figuring out how to handle any genetic samples taken.
    - Loggerhead turtles have been genetically tagged. Understanding the connection between nesting and foraging areas is important.
    - More data on sturgeon spawning areas is needed for sturgeon in the St. Marys River.
    - Kings Bay Harbor is valuable for sturgeon spawning, genetics, and family groupings.
- **Approach to assess tradeoffs**: It is valuable to compare datasets and neonatal genetic tagging.
    - Inner harbor dredging has caused concern for sea turtles and sturgeons.

6. Wrap Up

As the workshop concluded, the facilitator summarized some of the key comments and recommendations shared by expert participants over the course of the workshop. These included:

- **Recommended decision support tool:** Implement a structured decision-making process as a way to consider current data and make research-backed decisions on dredging.
- **Suggested modeling:** A multivariable analysis, as suggested by the sea turtles breakout group, and habitat modeling can help answer the question of preferred dredging windows by indicating the risk of impacts among all species at different times of year.
- **Bycatch counts:** Establish the balance between counting trawling catches for accuracy versus efficiency in returning catches to the ocean.
- **Consideration of dredging schedules and economics:** The availability of dredges is driven by competing projects around the country. Scheduling varies between maintenance dredging and high-priority, time-sensitive dredging. Operation costs need to be factored into consideration of tradeoffs regarding dredging impacts.
- **Seasonality**: Optimal dredging windows varied by harbor; however, summertime (July to August) appeared to be the most common suggestion.

- **Turbidity**: The need exists for better turbidity monitoring on both the surface and bottom before, during, and after dredging. This should be informed by sediment types in channels to better estimate the risk of negative effects to fish species and habitat.

7. Next Steps

USACE staff provided closing remarks and described the path forward. Key next steps included the following:

- The Kearns & West facilitation team will prepare a Workshop Summary capturing key outcomes from the workshop.
- Kearns & West will share a copy of the PowerPoint slide presentations with all workshop attendees
- All attendees are invited to continue to share additional relevant studies, references, and citations with USACE staff.
- Later this summer, the facilitation team will prepare a gap analysis document, which will be made available to workshop attendees. USACE staff will also use the gap analysis and workshop outcomes to inform their planning for the NEPA process.

Appendix A – Agenda

Regional Dredging NEPA Science Workshop

Charleston Marriott, 170 Lockwood Blvd, Charleston, SC 29403
Charleston, SC
May 29, 2024, 9:00 am – 5:00 pm ET
May 30, 9:00 am – 1:00 pm ET

Workshop Goal: Engage experts to better identify and document the state of the science regarding potential effects to species and habitat in the geographic areas listed below from operation and maintenance dredging and material placement. This will inform the development of future environmental reviews under the National Environmental Policy Act (NEPA).

Geographic Focal Areas:

1. Morehead City, NC
2. Wilmington, NC
3. Charleston, SC
4. Brunswick Harbor, GA
5. Kings Bay Naval Submarine Base, GA

Workshop Objectives:

1. Convene scientific experts to discuss and summarize potential effects from maintenance dredging and sediment placement in focal geographies along the South Atlantic and the potential associated risk to key ESA-listed species (i.e., North Atlantic right whales, sea turtles, Atlantic sturgeon) and species and habitat protected under the Magnuson-Stevens Fisheries Conservation Management Act based on location and time of the year.
2. Identify strategies and approaches (qualitative and quantitative) for bridging knowledge gaps in the collective understanding of the effects to key species.
3. Utilize a graphic facilitator to create and refine visual graphics that summarize the routes of effects identified and prioritized during discussions. A graphic representation of the geographic focal areas identified will also be created and refined that identifies unique attributes and habitats plus areas utilized by species discussed.

Read-Ahead Materials Provided to Participants:

- A preliminary citation list of relevant references and publications provided during the Virtual Breakout Meetings in February 2024 and from the 2020 SARBO
- An agenda and an anticipated participant list
- Species drawings created by the graphic notetaker during the February 2024 Virtual Breakout Meetings
- A 30-minute recorded Dredging 101 Overview presentation by Dylan Davis* to create a foundation of information before the workshop

Agenda – *Day 1*

Time	Topic
9:00 am	**Welcome, Introductions, and Agenda Overview**
9:15 am *(35) min*	**Key Context** • NEPA process • History of SARBO • Terms/definitions: How do we describe "risk"? • Overview of February Virtual Breakout Meetings and associated products • Clarifying questions
9:50 am	**Update on State of the Science and Analytical Approach** • Overview of analytical approaches • Summary of information gathered in Virtual Breakout Meetings. Review primary risks/routes of effects to species/fisheries associated with dredging? • Lightning presentations from experts on emerging research in geographies of interest and data • Mini research open house (sharing of posters)
12:30 pm	***Lunch (continued sharing of posters)***

2:00 pm	**Facilitated Breakout Group Discussion** (breakout groups include: 1) Fisheries, 2) Right Whales, 3) Sea Turtles, 4) Sturgeons)
	
	• Possible Discussion Questions:
	  ○ What are the routes of effect between species and dredging? How do those routes of effect differ by geography? How do those routes of effect differ by time of year?
	  ○ Review the state of the science citation list to identify any additional resources
	  ○ What strategies and approaches (qualitative and quantitative) can address gaps in understanding or research?
	  ○ How should those studies be prioritized and sequenced?

3:30 pm	***Break***

3:45 pm	**Breakout Group Discussions (cont.)**
	
	• Region Harbor Maps Activity:
	  ○ Indicate where conceptual gaps exist in understanding the dredging effect on species
	  ○ Indicate where additional analysis needs to take place
	  ○ Fill in presence/absence matrix
	• Prepare for Day 2 report back

5:30 pm	***Adjourn***
6:30 pm	*Group Dinner – Lewis BBQ*

Agenda – *Day 2*

Time	Topic
9:00 am	**Welcome and Overview** • Reflections on Day 1 • Overview of Day 2 agenda and objectives
9:15 am	**Reports Back from Day 1 Breakout Groups** • Fisheries • Right Whales • Sea Turtles • Sturgeons
10:15 am	***Break***

10:30 am	**Plenary Discussion**
	• Walk-about: Review harbor graphic additions from Day 1
	• Plenary Discussion:
	  • How to address tradeoffs?
	  • Where do key opportunities/synchronicities exist?
	  • Why is this a priority?
	  • How does this align with expected dredging needs/schedules?

12:00 pm	**Refine Graphics**
12:30 pm	**Wrap Up and Next Steps** • Workshop follow-up steps • Preparation of Research Gap Analysis
12:45 pm	***Adjourn***

Appendix B – Workshop Participant and Invite List

Name	Agency	Attendance
Adam Fox, Ph.D.	University of Georgia	
Alan Kenney, Ph.D.	US Army Corps of Engineers (USACE), Engineer Research and Development Center (ERDC)	X
Alan Shirey	US Army Corps of Engineers (USACE), Charleston District	X
Alicia Berlin, Ph.D.	U.S. Geological Survey (USGS), Eastern Ecological Science Center	
Allen Foley	Florida Fish and Wildlife Conservation Commission	
Amy Dukes	South Carolina Department of Natural Resources, Marine Resources Division	
Andrew Herndon	National Marine Fisheries Service (NMFS), Southern Regional Office (SERO), Protected Resources Division	
Andrew LoSchiavo	US Army Corps of Engineers (USACE), South Atlantic Division	X
Andrew McMains, Ph.D.	East Carolina University	
Anne Deaton	National Marine Fisheries Service (NMFS), Southern Regional Office (SERO) Habitat Conservation Division	X
Ben Carswell	University of Georgia	X
Ben Dyar	South Carolina Department of Natural Resources, Marine Resources Division	X
Ben Emery	US Army Corps of Engineers (USACE), Engineer Research and Development Center (ERDC)	X
Bill Post	South Carolina Department of Natural Resources, Marine Resources Division	X
Bo Douglas	Continental Shelf Associates (CSA)	X
Brandon Puckett, Ph.D.	National Oceanic and Atmospheric Administration (NOAA), National Centers for Coastal Ocean Science (NCCOS)	
Brian Shamblin, Ph.D.	University of Georgia, Warnell School of Forestry & Natural Resources	X
Brian Stacey, DVM	National Marine Fisheries Service (NMFS), Protected Resources Division	X
Buddy Powell, Ph.D.	Clearwater Marine Aquarium Research Institute	X
Carolyn Belcher, Ph.D.	Georgia Department of Natural Resources, Coastal Resources Division	X
Catherine O'Rourke	South Carolina Aquarium	
Cathi Campbell, Ph.D.	Archie Carr Center for Sea Turtle Research	X
Chris Slay	Coastwise Consulting	X
Chris Stewart	North Carolina, Department of Environmental Quality	
Chris Stout	South Carolina, Department of Health and Environmental Control	
Christian Karvounis	US Army Corps of Engineers (USACE), Jacksonville District	
Chuck Hightower	South Carolina, Department of Health and Environmental Control	
Clay George	National Marine Fisheries Service (NMFS), Southern Regional Office (SERO), Protected Resources Division	
Daniel Govoni	North Carolina, Department of Coastal Management	
Darren Pecora	US Army Corps of Engineers (USACE), Jacksonville District	X

Name	Agency	Attendance
Dave Eggleston, Ph.D.	North Carolina State University, Center for Marine Sciences and Technology	
David Hedeen	Georgia, Department of Natural Resources, Wetlands Unit	
David Kazyak, Ph.D.	U.S. Geological Survey (USGS), Eastern Ecological Science Center at the Leetown Research Laboratory	
Dennis Allen, Ph.D.	Retired, University of South Carolina	
Dennis Klemm	National Marine Fisheries Service (NMFS), Southern Regional Office (SERO), Protected Resources Division	
Dewey Richardson	Georgia, Department of Natural Resources, Wetlands Unit	X
Doug Piatkowski	Bureau of Ocean Energy Management (BOEM), Office of Strategic Resources	X
Dylan Davis	US Army Corps of Engineers (USACE), South Atlantic Division	X
Ellen Waldrop	South Carolina, Department of Natural Resources, Marine Resources Division	X
Emily Floore	St. Marys Riverkeeper	X
Eric Poncelet, Ph.D.	Kearns & West	X
Erica Fritz	US Army Corps of Engineers (USACE), Charleston District	X
Fred Scharf, Ph.D.	University of North Carolina, Wilmington	
Fritz Rohde	National Marine Fisheries Service (NMFS), Southern Regional Office (SERO), Habitat Conservation Division	
Gibb Frye	Coastwise Consulting	X
James Harrison	North Carolina, Department of Environmental Quality	
James Long	Georgia, Department of Natural Resources	X
James Morley	East Carolina University	
Jamie Johnson	Navy Region Southeast	X
Jenny Owens	US Army Corps of Engineers (USACE), Wilmington District	X
Jered Jackson	Naval Facilities Engineering Systems Command (NAVFAC), Southeast	
Jeremy Jennings	Naval Facilities Engineering Systems Command (NAVFAC), Southeast	X
Jessica Thompson	Georgia, Department of Natural Resources, Wildlife Conservation Section	X
Jim Hain, Ph.D.	Marine Land Right Whale Project	
Jim Nuttle	Graphic Facilitator	X
Jimmy Harrison	North Carolina, Department of Environmental Quality	
Joe Facendola	North Carolina, Department of Environmental Quality	
John E. Baxter, PE	Command, Navy Region Southeast N40	
Jonathan Howell	North Carolina, Department of Environmental Quality	
Kara Shervanick	National Marine Fisheries Service (NMFS), Southern Regional Office (SERO), Protected Resources Division	
Karen A. Bjorndal	Archie Carr Center for Sea Turtle Research	

Name	Agency	Attendance
Kari Coler	US Army Corps of Engineers (USACE), Engineer Research and Development Center (ERDC)	
Karla Reece	National Marine Fisheries Service (NMFS), Southern Regional Office (SERO), Protected Resources Division	
Katherine Sheppard	US Army Corps of Engineers (USACE), South Atlantic Division	X
Katheryn Matthews	U.S. Fish and Wildlife Service (USFWS)	
Katie Jackson	Florida Fish and Wildlife Conservation Commission	
Katie Moore	U.S. Coast Guard (USCG)	
Kellie Moore	Georgia, Department of Natural Resources	
Kimberlee Harding	North Carolina, Department of Environmental Quality, Marine Fisheries Habitat & Enhancement Section	X
Kristen Donofrio	US Army Corps of Engineers (USACE), Jacksonville District	
Kristen Hart, Ph.D.	U.S. Geological Survey (USGS), Wetland and Aquatic Research Center	X
Kyle Vint	Kearns & West	X
Lance Garrison, Ph.D.	National Oceanic and Atmospheric Administration (NOAA), Southeast Fisheries Science Center (SEFSC)	
Lisa Wickliffe, Ph.D.	National Marine Fisheries Service (NMFS), Southern Regional Office (SERO), Habitat Conservation Division	X
Lorianne Riggin	South Carolina, Department of Natural Resources, Office of Environmental Programs	X
Marina Dunn	North Carolina, Wildlife Resources Commission	X
Mark Dodd	Georgia, Department of Natural Resources, Marine Resources Division	X
Martin Posey	University of North Carolina, Wilmington	
Mary Richards	US Army Corps of Engineers (USACE), Savannah District	X
Matt Balazik, Ph.D.	US Army Corps of Engineers (USACE), Engineer Research and Development Center (ERDC)	X
Matthew Godfrey	North Carolina Wildlife Resources Commission	X
Matthew Lettrich	National Marine Fisheries Service (NMFS), Southern Regional Office (SERO) Affiliate	
Melanie White	Clearwater Marine Aquarium Research Institute	
Michael Montone	US Army Corps of Engineers (USACE), Savannah District	X
Michelle Kaylor	Georgia Sea Turtle Center	
Michelle Pate	South Carolina, Department of Natural Resources, Marine Resources Division	X
Mike Arendt, Ph.D.	South Carolina, Department of Natural Resources	X
Mike Mangold	U.S. Fish and Wildlife Service (USFWS)	
Naomi Jainarine	East Carolina University	X
Nat Ball	US Army Corps of Engineers (USACE), Charleston District	X
Nathan Crum	Fish and Wildlife Research Institute, Florida Fish & Wildlife Conservation Commission	X
Nicole Bonine	US Army Corps of Engineers (USACE), South Atlantic Division	X

Name	Agency	Attendance
Pace Wilber, Ph.D.	National Marine Fisheries Service (NMFS), Southern Regional Office (SERO), Habitat Conservation Division	X
Paul Richards, Ph.D.	National Oceanic and Atmospheric Administration (NOAA), Southeast Fisheries Science Center (SEFSC)	
Pearse Webster	South Carolina, Department of Natural Resources, Marine Resources Research Institute	
Rachel Kuntz	US Army Corps of Engineers (USACE), Savannah District	X
Rebecca G. Asch, Ph.D.	East Carolina University	X
Robby Smith	Naval Facilities Engineering Systems Command (NAVFAC), Southeast	
Safra Altman, Ph.D.	US Army Corps of Engineers (USACE), Engineer Research and Development Center (ERDC)	X
Sara Ellis	Marine Land Right Whale Project	
Sarah Garvin	National Marine Fisheries Service (NMFS), Southern Regional Office (SERO), Protected Resources Division	
Sarah Wise	US Army Corps of Engineers (USACE), Savannah District	
Selina Heppell	Oregon State University	
Shane Boylan, DVM	Georgia Sea Turtle Center	X
Shannon White, Ph.D.	U.S. Geological Survey (USGS), Eastern Ecological Science Center	
Simona Ceriani, Ph.D.	Florida Fish and Wildlife Conservation Commission	
Stacie Crowe	South Carolina, Department of Natural Resources, Office of Environmental Programs	X
Suzy Hill	US Army Corps of Engineers (USACE), Savannah District	X
Taylor Funderburk	Kearns & West	X
Teresa Young	US Army Corps of Engineers (USACE), Wilmington District	X
Todd Horton	US Army Corps of Engineers (USACE), Wilmington District	X
Todd Swannack, Ph.D.	US Army Corps of Engineers (USACE), Engineer Research and Development Center (ERDC)	X
Tom Pitchford	Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute	
Tracey Smart, Ph.D.	South Carolina, Department of Natural Resources, Coastal Research Section Manage	
Walter (Wally) Bubley, Ph.D.	South Carolina, Department of Natural Resources, Coastal Research Section	
Wei Zeng, Ph.D.	Georgia Department of Natural Resources	
Wilson Laney, Ph.D.	North Carolina Coastal Federation	
Yank Moore	Jekyll Island Authority	X
Zach Fehr	U.S. Geological Survey (USGS)	X

Appendix C – Virtual Breakout Meeting Summary

Virtual Breakout Workshop Summary: Regional Dredging NEPA Meetings

United States Army Corps of Engineers, South Atlantic Division

Executive Summary

The U.S. Army Corps of Engineers (USACE) South Atlantic Division (SAD) hosted a series of virtual breakout meetings to understand better the effects of operational and maintenance (O&M) dredging in rivers, estuarine, and coastal environments. USACE invited key experts from federal and state fish and wildlife agencies to these meetings. The virtual meetings were designed to bring together a small group of experts to compile and document information on how, when, and where species use coastal and estuarine environments and potential risks from dredging.

Four meetings were hosted, each focused on a specific species, and each covered five central focal geographical regions, including Wilmington Harbor, North Carolina; Morehead City Harbor, North Carolina; Charleston Harbor, South Carolina; Brunswick Harbor, Georgia; and Kings Bay Naval Submarine Base, Georgia. The meetings focused on Sturgeon, Turtles, Fisheries and Fishery Habitats, and Right Whales. Meetings were held on Wednesday, February 14th; Thursday, February 15th; Wednesday, February 21st; and Thursday, February 22nd. Each meeting was four (4) hours long and included an overview presentation on the fundamentals of dredging and the 2020 South Atlantic Regional Biological Opinion (SARBO) with a prioritization of discussions with key experts. A graphic notetaker took visual notes throughout the meeting.

The meeting agenda included the following items:

- Welcome, Introduction, and Agenda Overview
- USACE SAD Presentation.[2]
    - Why are we here?
    - Key Context - Dredging Operations, Overview of South Atlantic Region Biological Opinion (SARBO), & Dredging Routes of Effect
- Expert Discussion
- Graphic Review

The stated objectives of the virtual breakout meetings included:

- Convene critical experts to provide initial input on the following guiding questions, which will be used to plan and design a follow-up in-person workshop on the same broader topic.

[2] The 2020 SARBO, Risk Assessments, and Annual Report were discussed as part of the presentation and are accessible here. The presentation is included as Appendix A.

    - What do we know based on literature/research about species use of these environments at different times of year (e.g., seasonal or monthly) and their risk from hopper dredging? Please share references.
    - What are vital data gaps and strategies (qualitative and quantitative) to fill them that could be implemented in the short term and long term?
- Develop visual images for this input via a graphics facilitator.
- Discuss the next steps in preparing for the follow-up in-person workshop.

Each meeting included the same background overview presentation, given by Nicole Bonine (USACE SAD Environmental Compliance Program Manager, Operations) and Dylan Davis (USACE SAD Coastal Program Manager, Operations). The presentation provided an overview of the South Atlantic Region Biological Opinion (SARBO), types of dredging, and routes of effects for each type of dredging. Following the presentation, the presenters and expert participants engaged in a discussion to address clarifying questions. Experts asked clarifying questions on dredging, identifying each species-specific summary below.

Summary Format

This document summarizes the four virtual breakout meetings. Each meeting summary below includes the following information:

- Attendees – Key Experts, NEPA Science Planning Team, Listening Mode Only, Facilitation Team
- Identification of Scientific Experts Knowledgeable of the Geographical Focal Areas
- Relevant Publications and References
- Summary of Expert Discussion, including General Comments, Species Behavior, Risks and Impacts, Data and Research Gaps, and any Clarifying Questions on the Dredging Presentation.

Virtual Breakout Workshop Summary
Regional Dredging NEPA Meeting
Section 1. Sturgeon

Wednesday, February 14, 2024,
1:00 – 5:00 pm EST
Virtual Meeting (WebEx)

1.1. Sturgeon Meeting Participants & Invitees

Name	Organization	Classification	Attendance
Matt Balazik, Ph.D.	USACE Engineer Research and Development Center (ERDC)	Key Expert	X
Andy Herndon	National Marine Fisheries Service (NMFS), Southern Regional Office (SERO), Protected Resources Division, Atlantic and Shortnose Sturgeon Species Coordinator	Key Expert	X
Adam Fox, Ph.D.	University of Georgia	Key Expert	
David Kazyak, Ph.D.	U.S. Geological Survey (USGS), Eastern Ecological Science Center at the Leetown Research Laboratory	Key Expert	X
Chris Stewart	North Carolina, Department of Environmental Quality	Key Expert	X
Bill Post	Southern Carolina, Department of Natural Resources	Key Expert	X
Fritz Rohde	National Marine Fisheries Service (NMFS), Southern Regional Office (SERO), Habitat Conservation Division	Key Expert	X
Fred Scharf, Ph.D.	University of North Carolina Wilmington	Key Expert	
Mike Mangold	U.S. Fish and Wildlife Service (USFWS)	Key Expert	
Safra Altman, Ph.D.	US Army Corps of Engineers (USACE), Engineer Research and Development Center (ERDC)	NEPA Science Planning Team	X
Nicole Bonine	US Army Corps of Engineers (USACE), South Atlantic Division, Environmental Compliance Program Manager (Operations)	NEPA Science Planning Team	X
Dylan Davis	US Army Corps of Engineers (USACE), South Atlantic Division, Coastal Program Manager (Operations)	NEPA Science Planning Team	X
Suzanne Hill	US Army Corps of Engineers (USACE), Savannah District, Environmental Team Lead, Planning Branch	NEPA Science Planning Team	X
Andrew LoSchiavo	US Army Corps of Engineers (USACE), South Atlantic Division, Senior Environmental Specialist (Planning)	NEPA Science Planning Team	X
Doug Piatkowski	Bureau of Ocean Energy Management (BOEM)	NEPA Science Planning Team	X

Name	Organization	Classification	Attendance
Todd Swannack, Ph.D.	US Army Corps of Engineers (USACE), Engineer Research and Development Center (ERDC)	NEPA Science Planning Team	X
Erica Fritz	US Army Corps of Engineers (USACE), Charleston District	Listening Mode	X
Jamie Johnson	Navy Region Southeast (NRSE)	Listening Mode	X
Rachel Kuntz	US Army Corps of Engineers (USACE)	Listening Mode	X
Bo Douglas	CSA	Facilitation Team	X
Jim Nuttle	Graphic Facilitator	Facilitation Team	X
Eric Poncelet	Kearns & West	Facilitation Team	X
Taylor Funderburk	Kearns & West	Facilitation Team	X

1.2. Geographic Focal Areas (Key Experts)

Expert participants identified the following experts associated with the focal geographies:

- Wilmington - Fred Scharf, Fritz Rohde, Chris Stewart, & Joe Facendola
- Morehead City - Fritz Rohde; Roger William
- Charleston – Bill Post, Mike Arendt, Ellen Waldrop
- Kings Bay Naval Submarine Base - Adam Fox (UGA)
- Brunswick Harbor – Adam Fox (UGA), Chris Kalinowsky (UGA)

1.3. References & Publications Provided

Expert participants identified the following scientific authors and references about Sturgeon.

Balazik, Matthew T., and John A. Musick. "Dual annual spawning races in Atlantic Sturgeon." *PLOS ONE*, vol. 10, no. 5, 28 May 2015, https://doi.org/10.1371/journal.pone.0128234.

Balazik, Matthew, et al. "Dredging activity and associated sound have negligible effects on adult Atlantic sturgeon migration to spawning habitat in a large Coastal River." *PLOS ONE*, vol. 15, no. 3, 6 Mar. 2020, https://doi.org/10.1371/journal.pone.0230029.

Farrae, Daniel J., et al. "Genetic characterization of Atlantic Sturgeon, Acipenser Oxyrinchus Oxyrinchus, in the Edisto River, South Carolina and identification of genetically discrete fall and spring spawning." *Conservation Genetics*, vol. 18, no. 4, 24 Jan. 2017, pp. 813–823, https://doi.org/10.1007/s10592-017-0929-7.

Hilton, E. J., et al. "Review of the biology, fisheries, and conservation status of the atlantic sturgeon, *(acipenser oxyrinchus oxyrinchus*mitchill, 1815)." *Journal of Applied Ichthyology*, vol. 32, no. S1, Dec. 2016, pp. 30–66, https://doi.org/10.1111/jai.13242.

Johnson, Di, and Alexander Michael. "Atlantic Sturgeon (Acipenser oxyrinchus oxyrinchus) Behavioral Responses to Vessel Traffic and Habitat Use in the Delaware River, USA." *Delaware State University ProQuest Dissertations Publishing*, 2019,

https://doi.org/https://www.proquest.com/openview/ffa9f7245ca0371d00715f49fa17a680/1?pq-origsite=gscholar&cbl=18750&diss=y.

Miselis, J.L., Flocks, J.G., Zeigler, S., Passeri, D., Smith, D.R., Bourque, J., Sherwood, C.R., Smith, C.G., Ciarletta, D.J., Smith, K., Hart, K., Kazyak, D., Berlin, A., Prohaska, B., Calleson, T., and Yanchis, K., 2021, Impacts of sediment removal from and placement in coastal barrier island systems: U.S. Geological Survey Open-File Report 2021–1062, 94 p., https://doi.org/10.3133/ofr20211062.

Popper, A. N. and R. D. Calfee. 2023. Sound and sturgeon: Bioacoustics and anthropogenic sound. *J. of the Acoustical Soc. Of America*. 254(4O: https://pubs.aip.org/asa/jasa/article/154/4/2021/2914017

Post, W.C., et al. "Research and management of endangered and threatened species in the Southeast: riverine movements of shortnose and Atlantic sturgeon. Final Report to NMFS # NA10NMF4720036. 274 p.

South Carolina Department of Natural Resources. 2024. Tagged Marine Species Viewer. www.dnr.sc.gov/marine/receiverstudy/animations.html. Accessed 7 Apr 2024.

1.4. Summary of Expert Discussion

The meeting facilitator invited the experts to think about the current state of the science on sturgeon, characterize unknowns or research gaps, and identify researchers and literature to support planning for the follow-up, in-person workshop. Key discussion questions included:

- Where and how are the species using the area over a year?
    - Where does mating/reproduction occur? When?
    - Seasonal variation in behavior/activities
- How do they behave in non-ambient conditions (e.g., storms, artificial disturbances, etc.)?
- Data gaps? What is the confidence level in each of these areas?
- What avoidance and minimization efforts can be built into the Environmental Commitments?

1.4.1. General Comments

The experts shared several general comments on sturgeons.

- Additional offshore dredging outside the focal geographies is relevant for sturgeon, such as sand mining for beach nourishment projects.
- Regional data on sturgeon is available. Although sturgeons have been tracked with transmitters for ten years, the data are relatively new. Abundance data on Atlantic sturgeon is lacking and more information could be helpful.
- Add the dredging channels to the maps to indicate where operations overlap, including general dredging equipment types and any support vessels or equipment.

1.4.2. Species Behavior

Expert comments on sturgeon data and behavior are captured in the list below.

- Consider looking at behavior data by age – juvenile and adults.
- Atlantic sturgeon have both Fall and Spring spawning.
- Decades of data show no sturgeon off the coast in the South Carolina area between June and October.
- Juveniles and Young Adults stay in the river year-round.
- There are staging areas for spawning located near river mouths.
- Temperature is a factor in movement within the water column.
    - Typically, adults will be on the bottom, and the juveniles will be up and down in the water column.
- Sturgeons appear not to move while near active dredging machinery.

1.4.3. Risks and Impacts

The experts commented on the risks and impacts on sturgeon due to dredging activity.

- Entrainment from hopper dredging has the most direct impact on sturgeons relative to other forms of dredging.
- The limited space between vessels' bottoms and the river bottom (e.g., the under-keel clearance) puts the sturgeon at risk.
- Some think dredges may cause sturgeons to change their behaviors and routes as they make their way to spawning grounds. Others suggested sturgeon behavior is unaffected by the dredging vessels. Additional impacts may include disruption to sturgeon habitat.
- Dredging operations may cause funneling in deep channels.
- Substrate changes affect the fauna population.
- There can be a loss of larval prey from dredging activities.
- Dredging frequency affects the amount of time for the sediment to recolonize (prey species), which can affect the long-term fitness of sturgeons.

1.5. Data & Research Gaps

The experts shared the following regarding research questions for consideration and areas of insufficient information that need more data.

Areas of Insufficient Information

- Sturgeon river surveys have generated limited data.
- Better understanding of benthic fauna changes and recovery times after dredging operations are needed.
- There is little monitoring data for the Morehead City area, and Wilmington lacks tracking data. Morehead City has no significant river draining into it, so sturgeon may not be present.
- Presence data are available, but abundance data are lacking.
- We need better information on prey availability due to the long-term impacts of dredging.

- More research is needed to determine where and when the sturgeon travel within the water column.
- Acoustics impacts on fish behavior from dredging operations are unknown.
- Telemetry data exists, but it needs to be refined to determine when and where sturgeon are present. Multiple varying annual spawning makes correlation challenging.
- Water quality data (salinity and temperature) must be analyzed to indicate relationship to fish life cycle stages at various times.

Research Questions

- Is water temperature a stronger indicator for fish presence or is it the seasonal change?
- Are the dredging operations concentrating the fish in the deeper dredged channels?
- Keel clearance concern: Is there sufficient space for fish, or will they get out of the way when a vessel passes?
- How is sturgeon behavior being disrupted due to dredging on the way to and from spawning grounds?
- How do impacts to benthic fauna and recovery of prey affect sturgeon populations and behavior?

1.6. Clarifying Questions about Dredging

The experts asked the following clarifying questions of the USACE presenters on the topic of dredging:

- Question: Can you clarify how direct take impacts differ between dredging operations and trawling? How many mortalities do you see in the trawling? What are your ways of reducing that?
    - USACE: Take is tracked separately for direct dredging impacts, as mortality is more likely. Relocation trawling is a take (affects the species' behavior and physical condition) but is less likely to result in mortality.
    - USACE: Mortalities from relocation trawling are very rare. The handling techniques included in the SARBO PSO PDCs (short drag time and short time on board) reduce mortalities.
- Question: Do you tag any species taken during trawling and take biological genetic samples?
    - USACE: Yes, we also process to determine the Distinct Population Segments (DPS). Part of the sample is sent to a USGS genetic sample repository and shared with the sturgeon pit tagging database.

Virtual Breakout Workshop Summary

Regional Dredging NEPA Meeting

Section 2. Sea Turtles

Thursday, February 15, 2024,
1:00 – 5:00 pm EST
Virtual Meeting (WebEx)

2.1. Turtles Meeting Participants & Invitees

Name	Organization	Classification	Attendance
Mike Arendt, Ph.D.	South Carolina Department of Natural Resource	Key Expert	X
Kristen Hart, PhD	U.S. Geological Survey (USGS, Wetland and Aquatic Research Center, Center for Collaborative Research (CCR)	Key Expert	X
Matthew Godfrey	North Carolina Wildlife Resources Commission	Key Expert	X
Dennis Klemm	National Marine Fisheries Service (NMFS) Southeast Regional Office (SERO), Protected Resources Division, Sea Turtle Branch Chief	Key Expert	X
Michelle Pate	South Carolina Department of Natural Resource	Key Expert	X
Jeff Schwenter	South Carolina Department of Natural Resource	Key Expert	X
Mark Dodd	Georgia Department of Natural Resources, Marine Resources Division	Key Experts	
Michelle Kaylor	Georgia Sea Turtle Center	Key Expert	
Simona Ceriani, Ph.D.	US Fish and Wildlife Service (USFWS), Loggerhead/Green Status-Florida	Key Expert	
Safra Altman, Ph.D.	US Army Corps of Engineers (USACE), Engineer Research and Development Center (ERDC)	NEPA Science Planning Team	X
Nicole Bonine	US Army Corps of Engineers (USACE), South Atlantic Division, Environmental Compliance Program Manager (Operations)	NEPA Science Planning Team	X
Dylan Davis	US Army Corps of Engineers (USACE), South Atlantic Division, Coastal Program Manager (Operations)	NEPA Science Planning Team	X
Andrew LoSchiavo	US Army Corps of Engineers (USACE), South Atlantic Division, Senior Environmental Specialist (Planning)	NEPA Science Planning Team	X
Doug Piatkowski	Bureau of Ocean Energy Management (BOEM)	NEPA Science Planning Team	X

Name	Organization	Classification	Attendance
Todd Swannack, Ph.D.	US Army Corps of Engineers (USACE), Engineer Research and Development Center (ERDC)	NEPA Science Planning Team	X
Erica Fritz	US Army Corps of Engineers (USACE) Charleston District	Listening Mode	X
Jamie Johnson	Navy Region Southeast (NRSE)	Listening Mode	X
Rachel Kuntz	US Army Corps of Engineers (USACE), Savannah District (SAS)	Listening Mode	X
Mary Richards	US Army Corps of Engineers (USACE), Savannah District (SAS)	Listening Mode	X
Alan Shirley	U.S Army Corps of Engineers (USACE)	Listening Mode	X
Bo Douglas	CSA	Facilitation Team	X
Jim Nuttle	Graphic Facilitator	Facilitation Team	X
Taylor Funderburk	Kearns & West	Facilitation Team	X
Eric Poncelet	Kearns & West	Facilitation Team	X

2.2. Geographic Focal Areas (Key Experts)

Expert participants identified the following experts associated with the focal geographies:

- Wilmington - Larisa Avens (NOAA); Amanda Williard (University of North Carolina at Wilmington, UNCW)
- Morehead City - Larisa Avens (NOAA); Amanda Williard (UNCW); Kristen Hart w/National Park Service (NPS) support
- Charleston – Mike Arendt; Michelle Pate; Pearse Webster (South Carolina Department of Natural Resources [SC DNR]); Chris Slay
- Kings Bay Naval Submarine Base - Kristen Hart; Mike Arendt
- Brunswick Harbor – Kristen Hart (Michael Arendt has a report pending tracking turtle data)[3]

2.3. References & Publications Provided

Expert participants identified the following scientific authors and references about sea turtles.

Arendt, Michael D., et al. “Temporal trends (2000–2011) and influences on fishery-independent catch rates for loggerhead sea turtles (Caretta caretta) at an important coastal foraging

[3] Kristen Hart has been studying the overall presence of sea turtles throughout areas of interest, including tracking rehabbed and released turtles.

region in the southeastern United States." *Fishery Bulletin*, 2012, https://doi.org/http://hdl.handle.net/1834/30352.

Dickerson D, Wolters M, Theriot C, Slay C. 2004. Dredging impacts on sea turtles in the southeastern USA: A historical review of protection. Proceedings of World Dredging Congress XVII, Dredging in a Sensitive Environment 27. 13 pp.

Dickerson, D.D., K.J. Reine, D.A. Nelson, and C.E. Dickerson, Jr. (1995). Assessment of Sea Turtle Abundance in Six South Atlantic U.S. Channels. Miscellaneous Paper EL-95-5, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. https://erdc-library.erdc.dren.mil/xmlui/bitstream/handle/11681/27141/MP%20EL-95-5.pdf?isAllowed=y&sequence=1

DiMatteo A, Roberts JJ, Jones D, Garrison L, Hart KM, Kenney RD, McLellan WA, Lomac-MacNair K, Palka D, Rickard ME, Roberts KE. 2024. Sea turtle density surface models along the United States Atlantic coast. Endangered Species Research 53: 227-245.

Griffin, DuBose B., et al. 2013. "Foraging habitats and migration corridors utilized by a recovering subpopulation of adult female loggerhead sea turtles: implications for conservation" *Marine Biology* Vol. 160, https://doi.org/10.1007/s00227-013-2296-3

USACE, 2024. Operations and Dredging Endangered Species System (ODESS) website: https://dqm.usace.army.mil/odess/#/homew. Tracks and reports incidental take of endangered species from dredging operations.

Van Dolah, Robert F., and Phillip P. Maier. "The Distribution of Loggerhead Turtles (Caretta caretta) in the Entrance Channel of Charleston Harbor, South Carolina, U.S.A." *Journal of Coastal Research*, 1993, https://doi.org/https://www.jstor.org/stable/4298158.

2.4. Summary of Expert Discussion

The meeting facilitator invited the experts to think about the current state of the science on sea turtles, characterize unknowns or research gaps, and identify researchers and literature to support planning for the follow-up, in-person workshop. The identified questions for the Turtle meeting were refined from the sturgeon meeting based on feedback from the sturgeon experts. Key discussion questions included:

- What are the most significant risks or threats from dredging?
- What are the associated unknowns or research gaps?

2.4.1. General Comments

The experts shared several general comments on sea turtles.

- USACE has a lot of data on turtles and is working on digitizing all the data. This includes QA/QC of all hopper dredging take in the Atlantic from 2010-2020 plus digitizing 30 years of relocation trawling data from the Atlantic and Gulf of Mexico in partnership with USGS and BOEM.

- There is a lot of information and opportunities to identify data gaps.
- Research indicates turtles use the back channels and inlets in Georgia but not in South Carolina.
- There is a study underway in Florida on how sound and telemetry data impact sea turtles.
- Consider comparing rehabilitated and wild turtles to determine whether the behaviors are the same or different.
- Before more money is spent on new data, someone needs to thoroughly analyze the current data to be used for predicting risk.
- Each geographic area has specific vital differences that must be considered.[4]
- The Morehead shoaling area is a critical operational constraint. Add the species distribution, size, and class to the visual maps, and include the routine channel.
- Identify where and when the hot spot occurs and look further into that data set.
- Encourage a community of practice to meet regularly and continue the conversation to work towards solutions. Convening these conversations assists with flagging the gaps and needs, but a bridge is needed to focus on carrying the discussions forward.

2.4.2. Species Behaviors

The experts shared the following comments regarding turtle data and behavior.

- An analysis of the risk assessment shows overlap between turtle behavioral patterns and when dredging occurs. This can create operational challenges for dredging. The majority of sea turtle take by hopper dredging occurs in Brunswick Harbor and Kings Bay during the historic dredging window.
- Turtle activity can be tracked using acoustic telemetry.
- Take of sea turtles increases due to seasonal and high-density changes (active or inactive periods).
- Temperature variance is not a guaranteed indicator but can affect turtle behavior. Turtles can be more active during warmer months, and during the winter, they can go into a hibernation state and hunker down in channels and are not as likely to move out of the way.
- Dredge in the time of year to avoid turtles, and dredge in lower-risk areas. Historically, it was believed that dredging when there was a low density of sea turtles in the area would reduce take. The group discussed that low density doesn't always mean lower take. In North Carolina, dredging in warm summer months resulted in numerous trawling captures, but not lethal take by hopper dredging.
- Takes do occur in the summer and winter; fewer takes are associated with dredging during the summer. There have been fewer takes associated with beach projects dredging during the summer than winter O&M channel dredging projects.
- Breeding females will interact differently with dredging than non-breeding turtles.

[4] They specifically suggested Dickerson 1995, included within the citations.

2.4.3. Risks and Impacts

The experts shared the following comments on the risks and impacts on turtles due to dredging activity.

- Entrainment is the highest risk for hopper dredging.
- Substrate differences and injuries from catching under the drag head may lead to more takes.
- Identify where typical dredging and shoaling occur and what material is typical in those locations.
- Sea floor topography is uncertain and varies over time.
- Dredges cannot react quickly to uneven terrain, losing complete contact with the channel bottom, creating more significant opportunities for entrainment.
- Vessel strikes from slow-moving dredges are unlikely, but there is greater opportunity from faster-moving support/service vessels.
- Impacts should also be considered for nesting beaches and burrow sites.
- Beach deposition could impact the fitness of the hatchlings, reduce hatching success, and impact the gender ratio.
- Beach deposition could impact future nest successes but measuring impacts (avoidance) is difficult. Beach deposition during turtle nesting season varies by region. For example, Beach renourishments on Tybee Island, GA are also restricted to outside the sea turtle nesting window (May 1 - Sep 30).
- Consider prioritizing where the dredging threats are (i.e., the high-density areas) and then move the dredging to the lower-threat regions. The threat areas vary as the water temperature gets warmer in some of the regions. This is not applicable to the Brunswick channel where there are no known channel reaches where the density of sea turtles is greater compared to other reaches.

2.5. Data & Research Gaps

The experts shared proposed following research questions and suggested several areas for additional consideration to address insufficient information.

Areas of Insufficient Information

- Data on fine skill behavior to avoid dredging heads is lacking. More seasonal dive data is needed.
- There is a lack of annual turtle distribution throughout the Southeast region. The Navy is currently researching this.
- There is a lack of existing research for general turtle distribution in the water column.
- There is a lack of existing research on seasonal behavior of turtles based on sex and age groups.
- There is a lack of existing research on turtle take numbers for different benthic habitat types.

- More receivers must be installed throughout the region to expand the monitoring of existing transmitters.
- Identification of higher concentration dredging areas is needed to minimize risks/takes.
- Survey dredging contractors to identify where known anomalies (takes, observations) occur.
- Analyze existing data generated during dredging operations to correlate to anomalies and trends.
- Identify "no take" areas based on seasonal concentrations.
- Investigate site characteristics and seasons that make Charleston's Turtle Reef attractive to turtles.
- Schedule dredging around hot spots when they are at peak density.
- Incorporate data from multiple sources and agencies (fisheries, dredging, catch trawler, etc.) to correlate turtle behavior and species presence.
- There is a lack of permit (Section 10) relocation trawl observers to satellite tag collected turtles before release to take advantage of captured turtles.
- Data collected on relocation trawlers needs to be reviewed to see if additional pertinent information can be recorded. Establish a secondary scientific objective for the work.
- Review the validity of the relocation trawler, considering the impacts of the trawler when no takes occur at the dredge.

Research Questions

- Monitoring must be improved on the hopper dredge to identify where takes occur during dredging operations. The number of takes is generally known, but where they occurred in the channel is not known. Are takes being identified sufficiently?
- How can better dredging methods be identified to minimize the times when the dredge head is not in contact with the bottom during dredging? The more time between transitions, the greater the potential for dredge head takes.
- How are environmental parameters and high-take areas being studied to understand the correlation?
- Can USACE provide information on types of information monitored and data collected during dredging operations?

2.6. Clarifying Questions about Dredging

The experts asked the following clarifying questions of the USACE presenters on the topic of dredging:

- Question: Why is the take limit so high for one of the most endangered species in the world? That is a considerable portion of the population numbers in the Atlantic
    - USACE: Incidental Take Limit determined by NMFS in SARBO. The majority of sea turtle and sturgeon takes occur at Kings Bay and Brunswick Harbor during the "historic dredging windows". There are no takes when dredging outside those windows in the summer in North Carolina.

    - USACE: For 2020 SARBO, NMFS analyzes Sea turtle take for O&M dredging is considered along with other Federal consultation takes to evaluate whether there is a risk to species recovery (jeopardy determination).
- Question: Are there people observing what is in the water during the dredging process? I know BOEM has protocols for that. Is it the same for USACE?
    - USACE**:** We have NMFS-approved observers on board. They go through the inflow/outflow baskets, are on the bridge looking for whales, and look at the drag heads.
- Question: How are annual dredgings scheduled?
    - USACE: Surveys are taken throughout the year at specific depths to determine whether maintenance is needed to get back to authorized project depths. For Brunswick, we have annual needs for dredging. Every project is a little different based on the shoaling rates and depths of the channel.
- Question: How do you know what comes into the pipes during dredging? Do you know when it happens and where?
    - USACE: Observers look in the inflow and overflow after each load. Pipe sensors track sediment. Takes are identified at the end of the hopper load. We cannot pinpoint precisely where a take occurred during the load.
- Question: How long do the dredge loads take? Could a meta-analysis be done to support predictions of where turtles will be?
    - USACE: The pumping time depends on the sediment and hopper size and is typically 1-3 hours. Dredging Quality Management (DQM) is used to collect location, speed, and viscosity, but the DQM metadata is not currently used for that analysis.
- Question: Are the data available for someone else to analyze?
    - USACE: Some data in DQM is proprietary. We review DQM data for compliance.
    - USACE: For the catch per unit effort (CPUE), historically, the Corps reported only the projects with take and the dredging amount (volume) on the Corps public website ODESS (https://dqm.usace.army.mil/odess/#/home). Projects without take were not reported in ODESS. The Corps is looking at adding those to re-evaluate CPUE.
- Question: Is temperature part of DQM?
    - USACE: Surface temperature is tracked, not water column temperatures. Water temperature is recorded each day.
- Question: Does the DQM data identify the vessel or how much geographical data is collected?
    - USACE: DQM identifies the vessel and its location.
- Question: Is relocation trawling generating enough information to warrant continuing trawling operations? Could it be considered to focus on scientific data collection instead?
    - USACE: Relocation trawling is to minimize the risk of lethal captures during hopper dredging, this could change based on new information. Relocation trawling data is being digitized, and QA/QC is in a joint effort between USACE, USGS, and BOEM.

Virtual Breakout Workshop Summary

Regional Dredging NEPA Meeting

Section 3. Fisheries

Wednesday, February 21, 2024,
8:00 am – 12:00 pm EST
Virtual Meeting (WebEx)

3.1. Fisheries Meeting Participants & Invitees

Name	Organization	Classification	Attendance
Carolyn Belcher, Ph.D.	Georgia Department of Natural Resources	Key Expert	X
John Brooks	North Carolina State University	Key Expert	X
John Ellis	US Fish and Wildlife Services (USFWS)	Key Expert	X
Kim Harding	North Carolina Division of Marine Fisheries	Key Expert	X
Jimmy Harrison	North Carolina Department of Environment and Natural Resources	Key Expert	X
Fritz Rohde	National Marine Fisheries Service (NMFS) Southeast Regional Office (SERO), Habitat Conservation Division	Key Expert	X
Chris Stewart	North Carolina Division of Marine Fisheries	Key Expert	X
Lisa C. Wickliffe, Ph.D.	National Oceanic and Atmospheric Administration (NOAA), Fisheries Service	Key Expert	X
Pace Wilber, Ph.D.	National Marine Fisheries Service (NMFS) Southeast Regional Office (SERO), Protected Resources Division	Key Expert	X
Anne Deaton	North Carolina Division of Marine Fisheries	Key Expert	
Wilson Laney, Ph.D.	Retired US Fish & Wildlife Department Services (USFWS)	Key Expert	
Dennis Allen, Ph.D.	Retired University of South Carolina	Key Expert	

Name	Organization	Classification	Attendance
Kathy Matthews	US Fish & Wildlife Department Services (USFWS)	Key Expert	
David Eggleston, Ph.D.	North Carolina State University	Key Expert	
Safra Altman, Ph.D.	US Army Corps of Engineers (USACE), Engineer Research and Development Center (ERDC)	NEPA Science Planning Team	X
Nicole Bonine	US Army Corps of Engineers (USACE) South Atlantic Division, Environmental Compliance Program Manager (Operations)	NEPA Science Planning Team	X
Dylan Davis	US Army Corps of Engineers (USACE) South Atlantic Division, Coastal Program Manager (Operations)	NEPA Science Planning Team	X
Suzanne Hill	US Army Corps of Engineers (USACE) Savannah District, Environmental Team Lead, Planning Branch	NEPA Science Planning Team	X
Andrew LoSchiavo	US Army Corps of Engineers (USACE) South Atlantic Division, Senior Environmental Specialist (Planning)	NEPA Science Planning Team	X
Doug Piatkowski	Bureau of Ocean Energy Management (BOEM)	NEPA Science Planning Team	X
Todd Swannack, Ph.D.	US Army Corps of Engineers (USACE), Engineer Research and Development Center (ERDC)	NEPA Science Planning Team	X
Erica Fritz	US Army Corps of Engineers (USACE), Charleston District	Listening Mode	X
Jamie Johnson	Navy Region Southeast (NRSE)	Listening Mode	X
John Policarpo	U.S Army Corps of Engineers (USACE)	Listening Mode	X
Bo Douglas	CSA	Facilitation Team	X
Jim Nuttle	Graphic Facilitator	Facilitation Team	X
Leigh Osterhus	Kearns & West	Facilitation Team	X
Kyle Vint	Kearns & West	Facilitation Team	X

3.2. Geographic Focal Areas (Key Experts)

Expert participants identified the following experts associated with the focal geographies:

- Wilmington – Chris Stewart, Dr Fred Scharf (UNCW)
- Morehead City – Jeff Buckle, Jeff Dobbs, Lucas Passenger, Jason Brown (Duke Energy)
- Charleston – Wally Bubbly, Dennis Allen, Tracy Smart
- Kings Bay Naval Submarine Base – Carolyn Belcher, Helen Moore
- Brunswick Harbor – Helen Moore

3.3. References & Publications Provided

Expert participants identified the following scientific authors and references about fisheries.

Atlantic States Marine Fisheries Commission. 2024. Fish Habitat of Concern Designations for Fish and Shellfish Species. 31 pp.

NOAA Fisheries. Fisheries Management Info. https://www.fisheries.noaa.gov/rules-and-announcements/plans-and-agreements. Accessed 7 Apr 2024

North Carolina Environmental Quality. Fisheries Management Plans https://www.deq.nc.gov/about/divisions/marine-fisheries/managing-fisheries/fishery-management-plans . Accessed 7 Apr 2024

An Assessment of Fisheries Species to Inform Time-of-Year Restrictions for North Carolina and South Carolina, NOAA ()(https://repository.library.noaa.gov/view/noaa/22032)

Information about the life cycles of blue crab and other state species is clearly laid out on NOAAs Fisheries Management Plans webpage. (https://www.fisheries.noaa.gov/rules-and-announcements/plans-and-agreements)

Fisheries Management Plans (North Carolina) (https://www.deq.nc.gov/about/divisions/marine-fisheries/managing-fisheries/fishery-management-plans)

ASMFC FHOC Designations (https://asmfc.org/files/Habitat/FHOC_Designations_Jan2024.pdf)

Atlantic States Marine Fisheries Commission (https://www.asmfc.org/)

3.4. Summary of Expert Discussion

The meeting facilitator invited the experts to think about the current state of the science on fisheries and fishery habitats, characterize unknowns or research gaps, and identify researchers and literature to support planning for the follow-up, in-person workshop. The identified questions for the fisheries meeting were refined from the sturgeon meeting based on feedback from the sturgeon experts. Key discussion questions included:

- What are the most significant risks or threats from dredging?
- What are the associated unknowns or research gaps?
- How is marine habitat function affected by dredging and what is the recovery time of different habitat types?

3.4.1. General Comments

The experts shared several general comments on fisheries.

General Information

- It is well known that certain fish are in certain areas at certain times of the year, which must be considered when deciding about dredging.
- More information is needed about larval recruitment.
- The water column is an essential habitat to consider.

3.4.2. Species Behavior

The experts shared the following comments regarding fisheries, fish behavior and fisheries data.

- Time-of-day behaviors are a critical consideration. Some fish are more active than others in the day versus the night and vice versa.
    - Spawning sometimes occurs at night. Sciaena (drums and croakers) are active at night from 7 pm – 1 or 2 am in North Carolina.
- Behaviors at different time-of-year are a critical consideration.
    - There are concerns about groups of fish that spawn during the wintertime and migrate inland with already low population levels. Populations with poor recruitment are of particular concern. Considering time-of-year-for relocation trawling is important.
    - Blue Crab spawning sanctuaries are now closed year-round for fishery trawling in North Carolina. Actual location of spawning aggregations haven't been verified recently.
    - Summertime has the highest biodiversity.
- Specifically, the blue crab moves off the beaches in the winter, so dropping sediment offshore at that time can have an impact.
- Georgia Department of Natural Resources has some sampling for the Cumberland Sound as well as some species monitoring in Brunswick. The monitoring is focused on species health, not anything specific for the effects of dredging.
- USACE has bycatch data from hopper dredging and trawling for all the harbors that could be used to consider Blue Crab bycatch.
- North Carolina State Center for Marine Sciences is working on a study in the Beaufort Inlet that includes a traditional otter trawl survey coupled with underwater acoustic monitoring for fish communications through sound.
- Literature exists about larval recruitment specific to North Carolina.
- Studies are being conducted in the Cape Fear and New Rivers that North Carolina Division of Marine Fisheries can share.
- North Carolina had a moratorium on dredging from 1 April – 30 September 2023 which offered protection to a wide range of species. Data collected during this time could be

useful in discerning how species were impacted during that time as well as outside of that time. Looking at fin fish would be a good starting point.

3.4.3. Risks and Impacts

The experts shared the following comments on the risks and impacts on fisheries due to dredging activity.

- Interruption to larval transport impacts nearby, oftentimes critical habitat. Larval transport for nearly every species varies drastically based on the time of year, which makes it difficult to find a time when dredging does not impact it.
- Saltwater intrusion of ports was raised as a key concern.
    - USACE clarified that this conversation is strictly related to operations associated with maintenance dredging. Any issues with deepening are handled separately, including saltwater intrusion.
    - A participant responded that the distinction between O&M dredging and deepening and widening dredging is not always cut and dry, as the channel location shifts, particularly in North Carolina. It will be important that an EIS does not dismiss that nuance.
- When discussing direct impacts to benthic organisms, the experts mentioned it is critical to understand which fish can get out of the way of the dredge and which fish (e.g., juvenile and larval stages) cannot.
    - To better understand direct impacts to benthic organisms, one would need to look at any available bycatch data, should it exist.
- It is critical to understand how sediment is carried outside of the channel and what impacts the sediment plume has on larval transport and recruitment.
- Laws (for example, the Magnuson-Stevens Act) exist and should be consulted as a first step to identify the highest priority species that are most at risk or in most need of additional protection.
- The disruption of larval transport due to dredging is of great concern. Larval entrainment may not show up as a significant impact in the data right away.
- General habitat loss is a big concern, especially critical nursery habitats, oyster reefs, and submerged aquatic vegetation (SAV). The water column is also a habitat that needs to be considered.
- Bycatch is a huge concern in the shrimp trawling industry. Using shrimp trawls to remove species can lead to mortality.
- Chris Slay (Coastwise Consulting) has been conducting relocation trawling associated with dredging. USACE SAD is working with Coastwise Consulting to improve bycatch data collection.

3.5. Data and Research Gaps

The experts shared the following research questions for consideration and areas of insufficient information that need more data.

Areas of Insufficient Information

- Species lists and calendars need to be updated due to climate change.
- There is a gap in knowledge around the effects of dredging on fishery recruitment.
    - There have been studies that attempted to relate an inlet to population levels but that is hard to do.
    - Population level impact is not required by mandates such as the Magnuson-Stevens Act (MSA) before mitigation measures are implemented. It is rare to have enough data for population level impact.
- There are several species impacted beyond those protected by the MSA and it is important to look beyond MSA species.
    - State agencies cannot receive federal funds to investigate state level species.
    - State level species of concern include:
        - Blue Crab (GA, NC)
        - Spotted Sea Trout (GA)
        - Oysters (GA)
- There is not enough data showing how dredging in inlets is impacting turtle habitats.
- Better spatial and temporal data are needed in terms of organisms, particularly larvae, in the water column.
- The route of effect is different for each species; therefore, the priority concerns also differ from species to species.
    - A trade off analysis would be helpful to look at how we consider all routes of effect for each species for one specific project or operation.

Research Questions

- What might be in the water column that is being sucked up by the dredge? This could be fish eggs, larvae, etc.
- Does diversity and/or the number of fish change in areas that are dredged versus areas that are not dredged?
- How do we better characterize the risk for certain species?
- Does sediment type make a difference in terms of impact to species?

Virtual Breakout Workshop Summary

Regional Dredging NEPA Meeting

Section 4. Right Whales

Thursday, February 22, 2024,
1:00 – 5:00 pm EST
Virtual Meeting (WebEx)

4.1. Right Whale Meeting Participants & Invitees

Name	Organization	Classification	Attendance
Nathan Crume	Fish and Wildlife Research Institute, Florida Fish & Wildlife Conservation Commission	Key Expert	X
Katie Jackson	Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute	Key Expert	X
Jen Jakush	Florida Fish and Wildlife Conservation Commission (FWC)	Key Expert	X
Kara Shervanick	National Marine Fisheries Service (NMFS) Southeast Regional Office (SERO), Protected Resources Division	Key Expert	X
Melanie White	Clearwater Marine Aquarium Research Institute	Key Expert	X
Clay George	National Marine Fisheries Service (NMFS) Southeast Regional Office (SERO), Protected Resources Division	Key Expert	
Buddy Powell, Ph.D.	Clearwater Marine Aquarium Research Institute	Key Expert	
Katie Moore	U.S. Geological Survey (USGS)	Key Expert	
Lance Garrison, Ph.D.	National Oceanic and Atmospheric Administration (NOAA), Southeast Fisheries Science Center (SEFSC)	Key Expert	
Safra Altman, Ph.D.	US Army Corps of Engineers (USACE), Engineer Research and Development Center (ERDC)	NEPA Science Planning Team	X
Nicole Bonine	USACE SAD Environmental Compliance Program Manager (Operations)	NEPA Science Planning Team	X
Kari Coler	U.S. Army Engineer Institute for Water Resources (IWR)	NEPA Science Planning Team	X
Dylan Davis	US Army Corps of Engineers (USACE) South Atlantic Division, Coastal Program Manager (Operations)	NEPA Science Planning Team	X
Suzanne Hill	US Army Corps of Engineers (USACE) Savannah District, Environmental Team Lead, Planning Branch	NEPA Science Planning Team	X

Name	Organization	Classification	Attendance
Andrew LoSchiavo	US Army Corps of Engineers (USACE) South Atlantic Division, Senior Environmental Specialist (Planning)	NEPA Science Planning Team	X
Doug Piatkowski	Bureau of Ocean Energy Management (BOEM)	NEPA Science Planning Team	X
Jenny Owens	US Army Corps of Engineers (USACE), Wilmington District (SAW)	Listening Mode	X
Alan Shirley	U.S. Army Engineer Institute (USACE)	Listening Mode	X
Bo Douglas	CSA	Facilitation Team	X
Jim Nuttle	Graphic Facilitator	Facilitation Team	X
Taylor Funderburk	Kearns & West	Facilitation Team	X
Kyle Vint	Kearns & West	Facilitation Team	X

4.2. Geographic Focal Areas (Key Experts)

Participants identified the following experts associated with the focal geographies:

- Wilmington – University of North Carolina at Wilmington (UNCW) as a Research Partner
- Morehead City - Duke Researchers; Southeast Fisheries Science Center
- Charleston – South Carolina Department of Natural Resources (SC DNR)
- Kings Bay Naval Submarine Base – none identified
- Brunswick Harbor – Clay George (NMFS SERO)
- General – Jason Roberts (Duke University); Lance Garrison (NOAA); Hannah Blondin (Post-Doc); Kara Shervanick (NMFS SERO); and Melanie White (Clearwater Marine Aquarium Research Institute)

4.3. References & Publications Provided

Expert participants identified the following scientific authors and references about right whales.

Cusano, D.A., Conger, L., Van Parijs, S.M., Parks, S.E. (2018). Implementing conservation measures for the North Atlantic right whale: considering the behavioral ontogeny of mother-calf pairs. Animal Conservation, 22, 228-237. doi:10.1111/acv.12457

Duke: Nicholas School of the Environment. 2019. Right Whale Mothers "Whisper" to Their Calves to Avoid Attracting Predators. https://nicholas.duke.edu/news/right-whale-mothers-whisper-their-calves-avoid-attracting-predators. Accessed 7 Apr 2024.

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Marine Mammal Commission. 2024. Marine Mammal Commission. North Atlantic right whale tagging workshop report. North-Atlantic-right-whale-tagging-workshop-report.pdf (mmc.gov). Accessed 9 April 2024.

NOAA Fisheries. 2023. A Whale's Perspective: Using Tags to Understand North Atlantic Right Whales. www.fisheries.noaa.gov/feature-story/whales-perspective-using-tags-understand-north-atlantic-right-whales. Accessed 7 Apr 2024

NOAA Fisheries. 2023. Reducing Entanglements and Vessel Strikes Makes Extinction Less Likely for North Atlantic Right Whales. www.fisheries.noaa.gov/feature-story/reducing-entanglements-and-vessel-strikes-makes-extinction-less-likely-north-atlantic . Accessed 7 Apr 2024

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NOAA Fisheries. 2024. Passive Acoustic Cetacean Map. https://apps-nefsc.fisheries.noaa.gov/pacm/#/. Accessed 7 Apr 2024.

RG Dombroski, J., Parks, S. E., & Nowacek, D. P. (2021). Dive behavior of North Atlantic right whales on the calving ground in the Southeast USA: implications for conservation. Endangered Species Research, 46, 35-48. doi: 10.3354/esr01141

US Navy Marine Species Monitoring. 2022. NARW Tagging Video. www.navymarinespeciesmonitoring.us/news/narw-tagging-video/. Accessed 7 Apr 2024.

US Navy Marine Species Monitoring. 2022. Right Whales Are on the Move. www.navymarinespeciesmonitoring.us/blog/right-whales-are-move/. Accessed 7 Apr 2024.

Whale Map. 2024. www.whalemap.org. Accessed 7 Apr 2024.

Wickliffe LC, Rohde FC, Riley KL, Morris JA. 2019. An Assessment of Fisheries Species to Inform Time-of-Year Restrictions for North Carolina and South Carolina. NOAA Technical Memorandum NOS NCCOS 263. 268 pp.

4.4. Summary of Expert Discussion

The meeting facilitator invited the experts to think about the current state of the science on whales, characterize unknowns or research gaps, and identify researchers and literature to support

planning for the follow-up, in-person workshop. The identified questions for the right whale meeting were refined from the sturgeon meeting based on feedback from the sturgeon experts. Key discussion questions included:

- What are the most significant risks or threats from dredging?
- What are the associated unknowns or research gaps?

4.4.1. General Comments

The experts shared several general comments on whales and whale research.

- There is an awareness gap with tug operators who transport pipelines. There have been instances of trapping whales between the shoreline and the vessel, seen twice off of St. Augustine and Amelia Island.
- Whales are very hard to detect since they lack a dorsal fin and often stay with their calf just below the surface.
- There was an increase in mortality events that started in 2017, which triggered an unusual mortality event deceleration and investigation.[5]
- There is limited visibility when conducting flying surveys. Only whales at the surface can be observed. Thermal imaging is ineffective in detecting whales below the surface.
- Passive acoustic studies are being conducted nearshore and offshore, but behaviors vary yearly, creating challenges in predicting where whales will be.
- Flying surveys are conducted from November to April, depending on weather conditions, the primary season when the whales are in the South Atlantic region.
    - Four survey crews fly surveys from shore to 25 to 50 miles offshore and about four miles apart.
    - Flights are flown on set survey track lines.
    - Right whales are also identified from vessels on the water and locations of injured/entangled/dead whales are identified.
    - Off the North and South Carolina coast, the Corps funds aerial surveys conducted from December 1st to March 31st. Preparations begin in November and conclude by April15th.
    - One limitation is that aerial surveys are only flown on good weather days so they are intermittent and also dependent on funding.
- The Corps committed to moving dredging outside of areas when and where right whales were present in SARBO North Atlantic Right Whale Conservation Plan. This cannot occur until the EIS is complete. Brunswick Habor and Kings Bay are required to work when right whales are routinely present.

4.4.2. Species Behaviors

[5] See: https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2024-north-atlantic-right-whale-unusual-mortality-event

The experts shared the following comments regarding whale data and behavior.

- Morehead City: Shackleford will likely encounter whales closer to shore, particularly from February to April. Whales often show up near Cape Lookout.
- Kings Bay: Whales are typically seen on Amelia Island near Kings Bay from mid to late January to February. During that season, seven or eight mom/calf pairs are spotted daily.
- Timeframes are projections and vary year-to-year.
- It takes a longer time for whales to migrate farther south, resulting in fewer whales sited from November to December.
- Pregnant whales arrive earlier in the season and may communicate more than after they have their calves.
- Behavior varies based on region and is influenced by why they migrate, where they are born or whether they travel.

4.4.3. Risks and Impacts

The experts shared the following comments on the risks and impacts on right whales due to dredging activity.

- Vessel strikes are the highest risk to whales from dredging.
- Vessel strike risk will vary based on the region. For example, dredging around Brunswick Harbor puts slow-moving mothers and calves at higher risk. Whales are routinely seen from the dredge in Brunswick Harbor and other locations. Vessel noise may result in higher stress levels in whales.
- Risk levels should be assessed by behavior categories including migration, birthing, traveling with mother/calf, etc.
- Understanding spatial locations and behaviors is critical to understanding SARBO and mitigating the strike risk.

4.5. Data and Research Gaps

The experts shared the following research questions for consideration and areas of insufficient information that need more data.

Areas of Insufficient Information

- North Atlantic Right Whale surveying has been done in Florida and Georgia for decades but has only been done routinely in the Carolina's waters since the Corps started surveys in 2020. More information on when and where whales are in the Carolinas is needed. This information could be biased, but it is not known if they're just transiting or residing there for periods.
- Aerial surveys need to be expanded in Florida and Georgia (the timing and location of the surveys).
- NOAA is looking into other technologies to identify vessel strikes and for monitoring.
- Use of satellites for monitoring is needed.
- Information is lacking regarding the use of nearshore vs. offshore areas at different life stages and during migrations and seasonal movements.
- Aerial survey needs:

    - Aerial surveys go out to 25-50 miles, but there is not much information farther offshore.
    - Tighter survey line separations are needed for more complete coverage.
    - Whales are not sticking to narrow timeframes, so the aerial survey season may need to be extended. The current survey effort would not be sufficient to identify if whales are present earlier than current survey periods. Surveying should be started annually before November.
- Data can be skewed since we cannot see whales if they are not at the surface. Current surveys can identify the presence of whales but not the absence.
- Acoustics impacts are unknown.
- More information is needed on the seasonal migration, calving, and patterns in the Carolinas and Florida south of Cape Canaveral.
- Whale behavior varies (at the surface vs. submerged) and how that relates to behavioral activities (feeding vs. moving vs. with calves). Tagging (D-tags and lipid tags) could provide the behavior data needed.

Research Questions

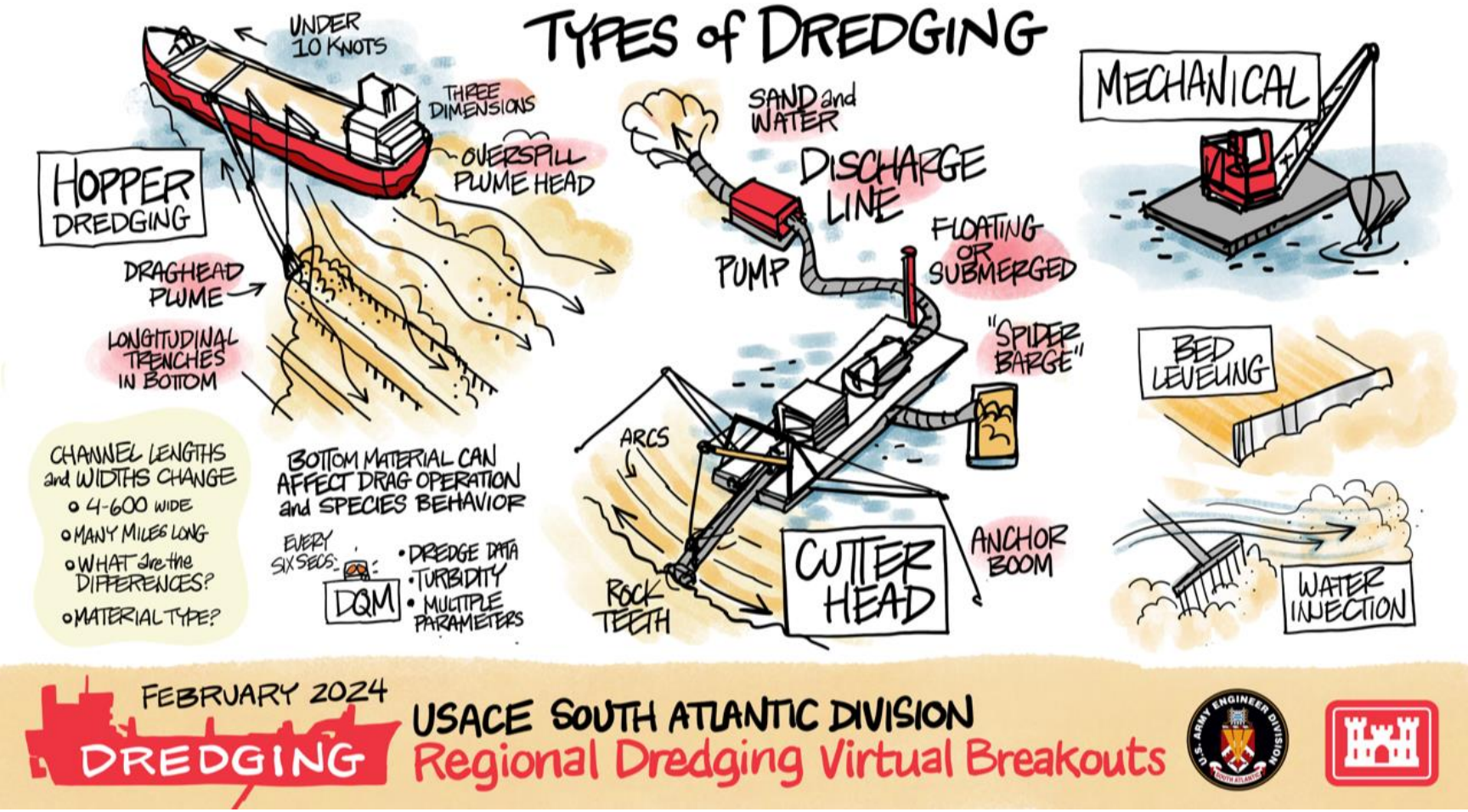
- Why are whale migration times changing? Whales have been observed leaving earlier and later, but more information is needed.
- What time of the year are whales more vulnerable to vessel strikes?
- Which geographic areas can be dredged with the most negligible impact on whales?

4.6. Clarifying Questions about Dredging

The experts asked the following clarifying questions of the USACE presenters on the topic of dredging:

- Question: How many support vessels are involved during a dredging operation?
    - USACE: It depends. Typically, 1-2 crew boats and survey boats. They average 50-70ft range in size and travel up to 30 knots. The SARBO North Atlantic Right Whale Conservation Plan includes speed restrictions for conservation purposes for vehicles 33 ft and bigger. Vessels must travel under 10 knots when whales are in the area.
- Question: How often is dredging done?
    - USACE: Maintenance dredging every 12 to 18 months for most entrance channels. Based on the historical window, it takes approximately 1 to 3 months to complete the work.
- Question: What are the observer's requirements?
    - USACE: The National Marine Fisheries Service (NMFS) has approved Protected Species Observers (PSO) to monitor whales and check the intake/outflow boxes for take. All hopper dredges have PSOs on board. Suction cutterhead dredges do not have PSOs on board. Smaller vessels do not have dedicated observers, but the captain has been trained to look for protected species.
- Question: What triggers an observer to be on board? Do the dredges south of Cape Canaveral have PSOs on board?

    - USACE: PSOs are required for all hopper dredging projects under SARBO.
- Question: Can you share the flow of communication during dredging operations? How does the flow of communication about whales get from SARBO/USACE to the operator of a crew vessel?
    - USACE: Dredging Operations are massive projects with multiple contracts. If the dredging operations are federally funded, regulations must be followed per SARBO.
        - Communication should be discussed in the pre-construction meetings, and expectations should be provided for the observers, including the Whale Alert System. All contracted companies should be on the NOAA Whale Alert system.
        - The SARBO North Atlantic Right Whale Conservation Plan requirements only apply once a project has started. If the crew and vessels are in transit between projects, they must follow the North Atlantic Right Whale Speed Rule. However, if it is a regional project moving between sites, they must follow the S SARBO North Atlantic Right Whale Conservation Plan.
- Question: How are current dredging timeframes narrowed down?
    - USACE: Contracts for a regional dredge operation indicate which areas need to be dredged but do not indicate the order of dredging specific areas. The contractors choose the dredging sequence to minimize mobilization costs and logistics.
- Question: What other vessels are involved in the dredging operation?
    - USACE: Besides the dredge itself, there are crew boats, survey boats, and typically one to two tugboats, to maneuver the dredge pipe. The tugs are sometimes local subcontractors because they have local knowledge of the area.


TYPES of DREDGING
UNDER 10 KNOTS
THREE DIMENSIONS
OVERSPILL PLUME HEAD
HOPPER DREDGING
DRAGHEAD PLUME
LONGITUDINAL TRENCHES IN BOTTOM
CHANNEL LENGTHS and WIDTHS CHANGE
o 4-600 WIDE
o MANY MILES LONG
o WHAT are the DIFFERENCES?
o MATERIAL TYPE?
BOTTOM MATERIAL CAN AFFECT DRAG OPERATION and SPECIES BEHAVIOR
EVERY SIX SECS:
DQM
• DREDGE DATA
• TURBIDITY
• MULTIPLE PARAMETERS
SAND and WATER
DISCHARGE LINE
PUMP
FLOATING OR SUBMERGED
"SPIDER BARGE"
ARCS
ROCK TEETH
CUTTER HEAD
ANCHOR BOOM
MECHANICAL
BED LEVELING
WATER INJECTION
FEBRUARY 2024
DREDGING
USACE SOUTH ATLANTIC DIVISION
Regional Dredging Virtual Breakouts

FEBRUARY 2024

DREDGING

USACE SOUTH ATLANTIC DIVISION

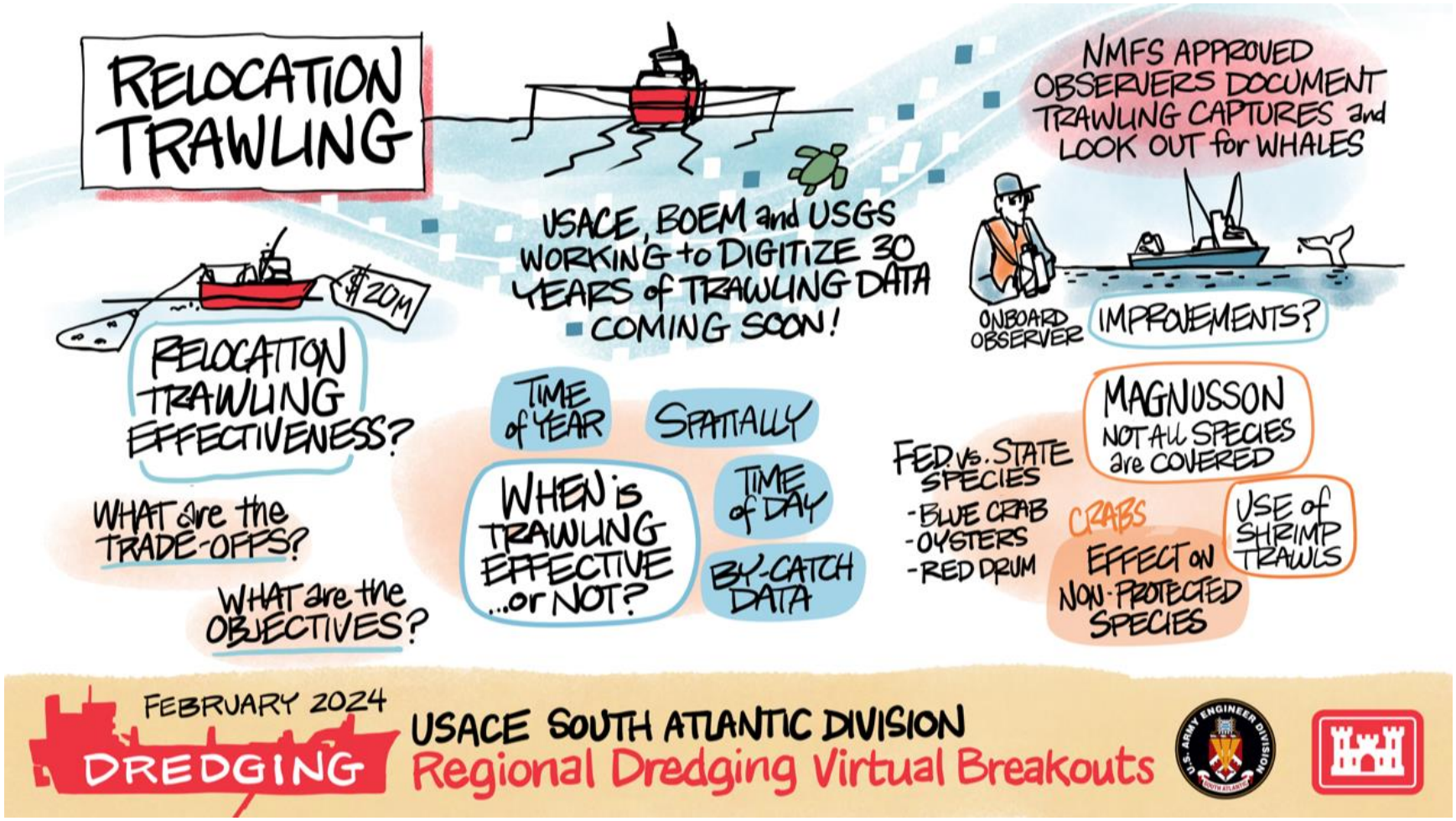
Regional Dredging Virtual Breakouts

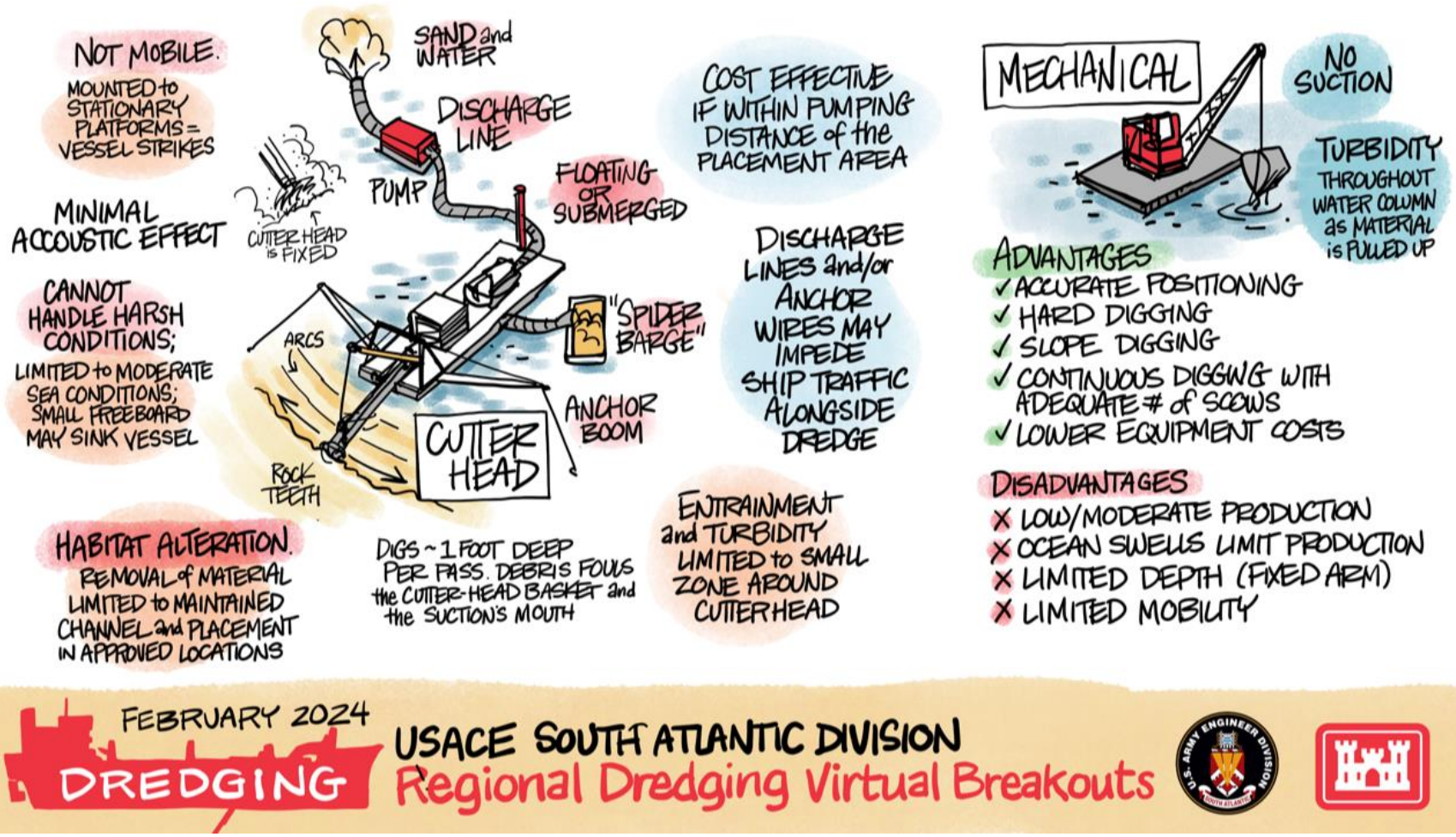
FEBRUARY 2024

DREDGING

USACE SOUTH ATLANTIC DIVISION

Regional Dredging Virtual Breakouts


RELOCATION TRAWLING
$120M
RELOCATION TRAWLING EFFECTIVENESS?
WHAT are the TRADE-OFFS?
WHAT are the OBJECTIVES?
USACE, BOEM and USGS WORKING to DIGITIZE 30 YEARS of TRAWLING DATA COMING SOON!
TIME of YEAR
SPATIALLY
WHEN is TRAWLING EFFECTIVE ...or NOT?
TIME of DAY
BY-CATCH DATA
NMFS APPROVED OBSERVERS DOCUMENT TRAWLING CAPTURES and LOOK OUT for WHALES
ONBOARD OBSERVER
IMPROVEMENTS?
MAGNUSSON
NOT ALL SPECIES are COVERED
FED vs. STATE SPECIES
-BLUE CRAB
-OYSTERS
-RED DRUM
CRABS
USE of SHRIMP TRAWLS
EFFECT ON NON-PROTECTED SPECIES
FEBRUARY 2024
DREDGING
USACE SOUTH ATLANTIC DIVISION
Regional Dredging Virtual Breakouts

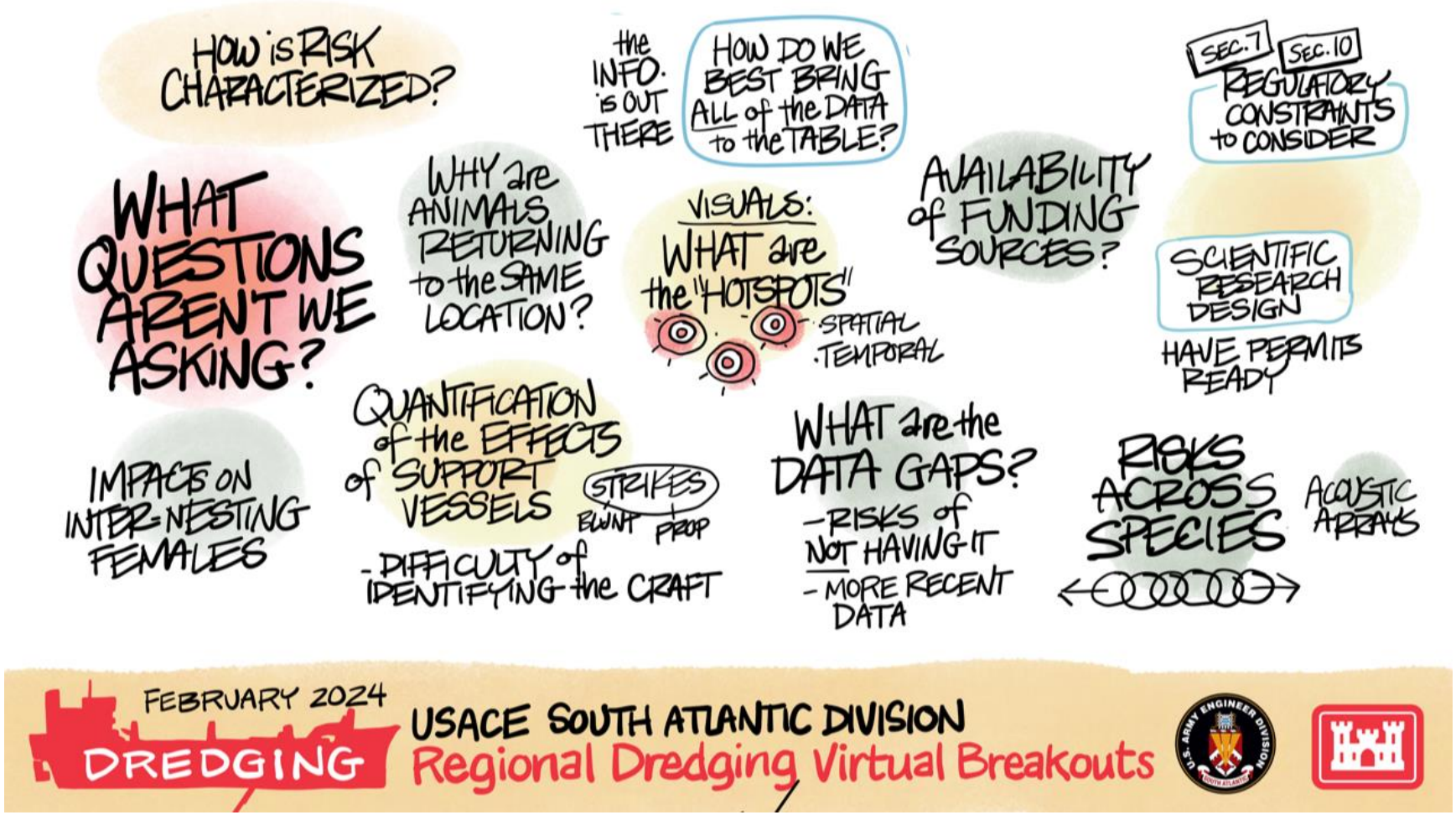


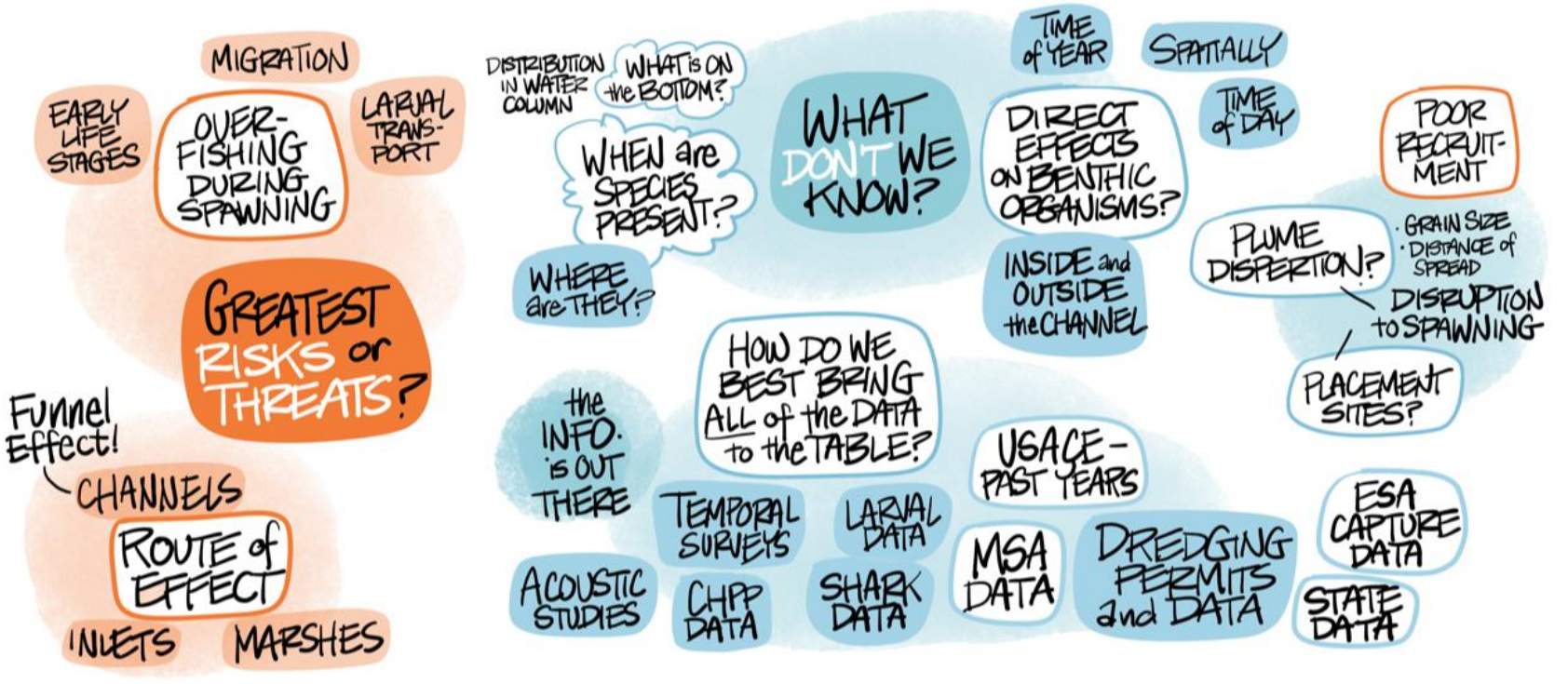
FEBRUARY 2024

DREDGING

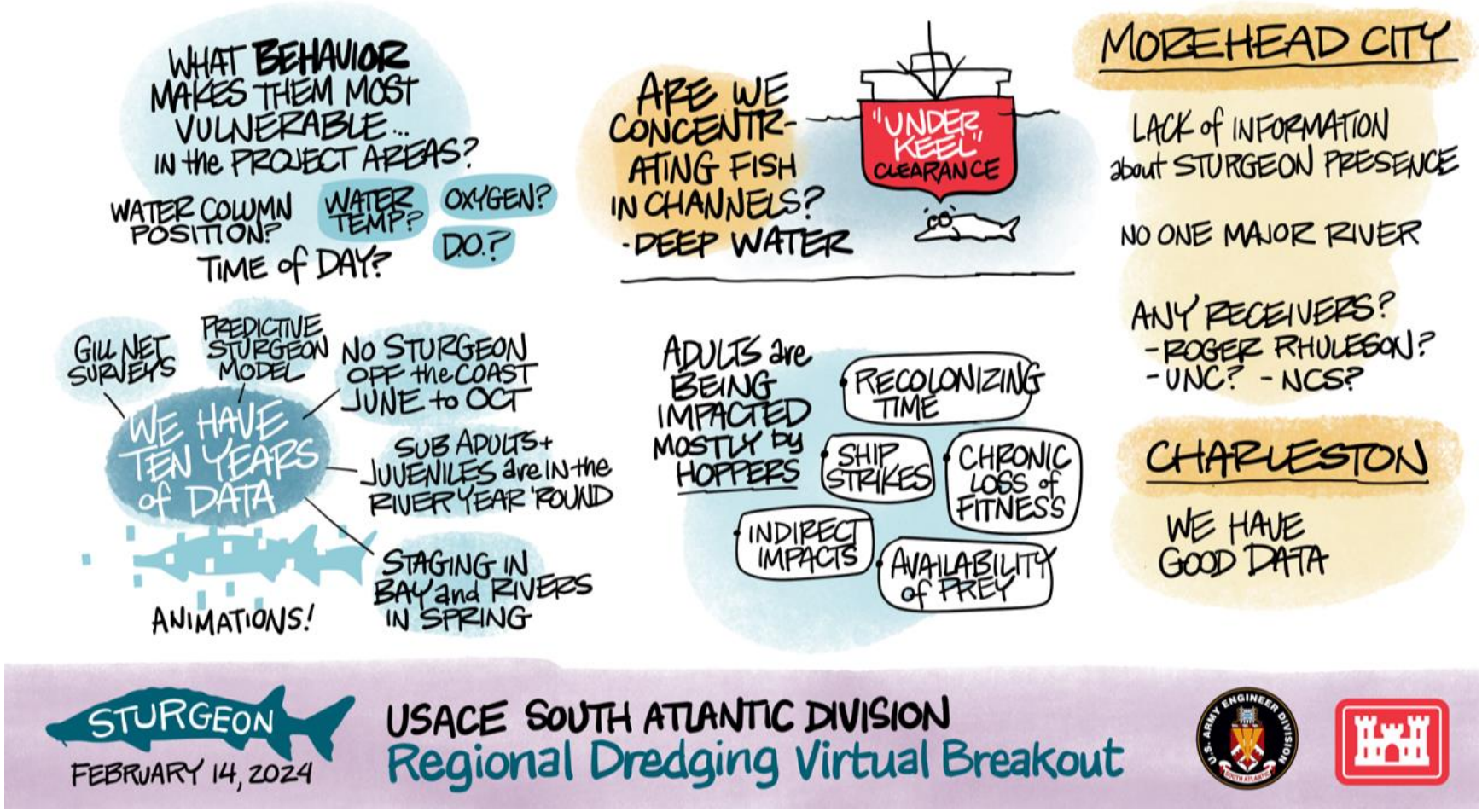
USACE SOUTH ATLANTIC DIVISION

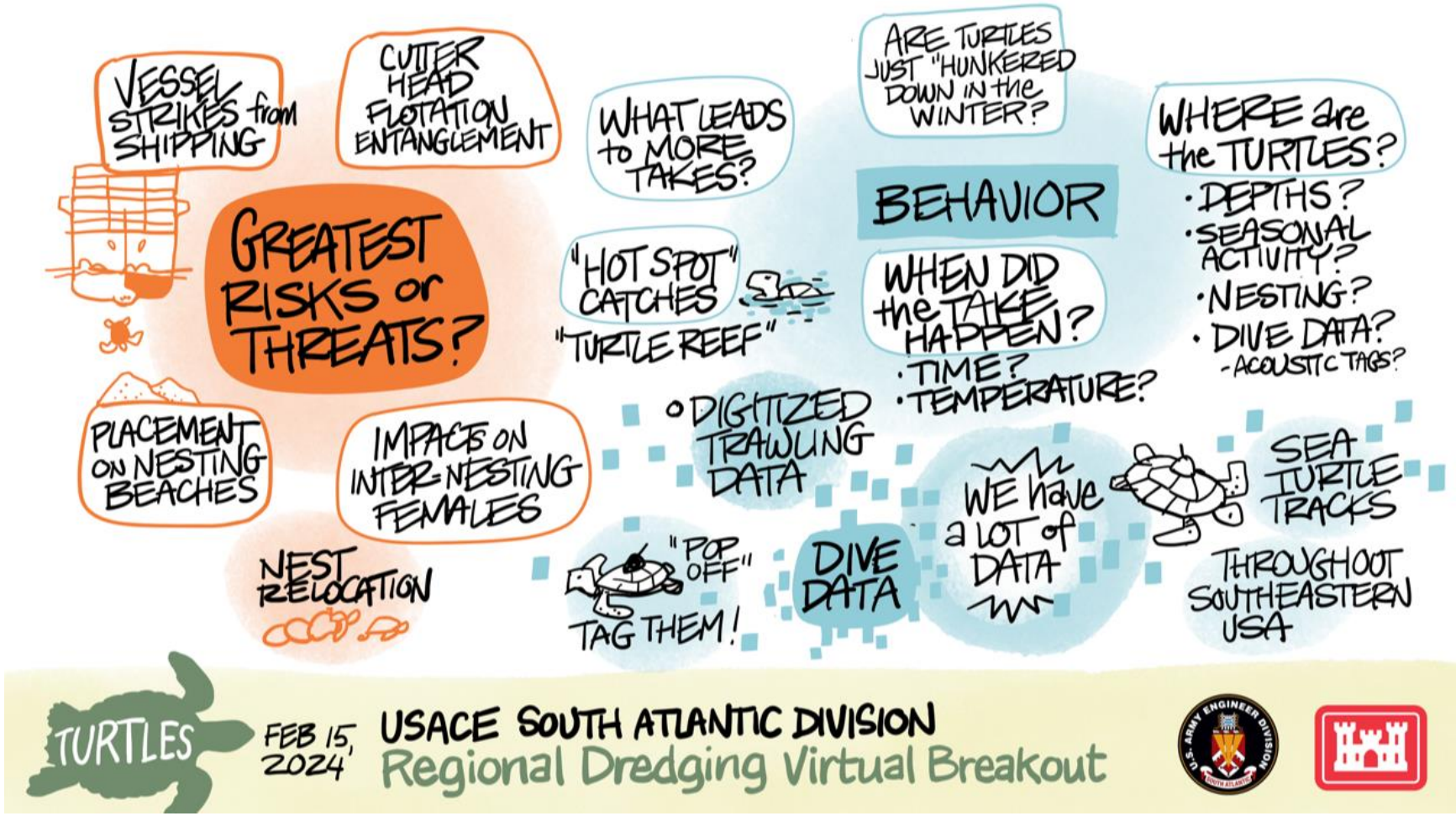
Regional Dredging Virtual Breakouts


HOW is RISK CHARACTERIZED?
the INFO. is OUT THERE
HOW DO WE BEST BRING ALL of the DATA to the TABLE?
SEC. 7
SEC. 10
REGULATORY CONSTRAINTS to CONSIDER
WHAT QUESTIONS AREN'T WE ASKING?
WHY are ANIMALS RETURNING to the SAME LOCATION?
VISUALS:
WHAT are the "HOTSPOTS"
SPATIAL
TEMPORAL
AVAILABILITY of FUNDING SOURCES?
SCIENTIFIC RESEARCH DESIGN
HAVE PERMITS READY
IMPACTS ON INTER-NESTING FEMALES
QUANTIFICATION of the EFFECTS of SUPPORT VESSELS
STRIKES
BLUNT PROP
- DIFFICULTY of IDENTIFYING the CRAFT
WHAT are the DATA GAPS?
- RISKS of NOT HAVING IT
- MORE RECENT DATA
RISKS ACROSS SPECIES
ACOUSTIC ARRAYS
FEBRUARY 2024
DREDGING
USACE SOUTH ATLANTIC DIVISION
Regional Dredging Virtual Breakouts



FISHERIES FEB 21, 2024 USACE SOUTH ATLANTIC DIVISION
Regional Dredging Virtual Breakout


WHAT BEHAVIOR MAKES THEM MOST VULNERABLE... IN the PROJECT AREAS?
WATER COLUMN POSITION?
WATER TEMP?
OXYGEN?
DO.?
TIME of DAY?
ARE WE CONCENTR-ATING FISH IN CHANNELS? -DEEP WATER
"UNDER KEEL" CLEARANCE
MOREHEAD CITY
LACK of INFORMATION about STURGEON PRESENCE
NO ONE MAJOR RIVER
ANY RECEIVERS? -ROGER RHULESON? -UNC? - NCS?
GILL NET SURVEYS
PREDICTIVE STURGEON MODEL
No STURGEON OFF the COAST JUNE to OCT
WE HAVE TEN YEARS of DATA
SUB ADULTS+ JUVENILES are IN the RIVER YEAR 'ROUND
STAGING IN BAY and RIVERS IN SPRING
ANIMATIONS!
ADULTS are BEING IMPACTED MOSTLY by HOPPERS
RECOLONIZING TIME
SHIP STRIKES
CHRONIC LOSS of FITNESS
INDIRECT IMPACTS
AVAILABILITY of PREY
CHARLESTON
WE HAVE GOOD DATA
STURGEON
FEBRUARY 14, 2024
USACE SOUTH ATLANTIC DIVISION
Regional Dredging Virtual Breakout


VESSEL STRIKES from SHIPPING
CUTTER HEAD FLOTATION ENTANGLEMENT
GREATEST RISKS or THREATS?
PLACEMENT ON NESTING BEACHES
IMPACTS ON INTER-NESTING FEMALES
NEST RELOCATION
WHAT LEADS to MORE TAKES?
"HOT SPOT" CATCHES "TURTLE REEF"
ARE TURTLES JUST "HUNKERED DOWN in the WINTER?
BEHAVIOR
WHEN DID the TAKE HAPPEN?
·TIME?
·TEMPERATURE?
WHERE are the TURTLES?
·DEPTHS?
·SEASONAL ACTIVITY?
·NESTING?
·DIVE DATA?
-ACOUSTIC TAGS?
o DIGITIZED TRAWLING DATA
"POP OFF"
TAG THEM!
DIVE DATA
WE have a LOT of DATA
SEA TURTLE TRACKS
THROUGHOUT SOUTHEASTERN USA
TURTLES
FEB 15, 2024
USACE SOUTH ATLANTIC DIVISION
Regional Dredging Virtual Breakout

WHALES

FEB 22, 2024

USACE SOUTH ATLANTIC DIVISION

Regional Dredging Virtual Breakout

Appendix E – Citation List

Please note that some citations were provided outside of the workshops and are still being reviewed for accuracy and consistency.

Virtual Meeting and Charleston Workshop Citations

Species	Reference
Dredging	Martin, J., Q. Sabatier, T.A. Gowan, C. Giraud, E. Gurarie, C.S. Calleson, J.G. Ortega-Ortiz, C.J. Deutsch, A. Rycyk and S.M. Koslovsky. 2016. A quantitative framework for investigating risk of deadly collisions between marine wildlife and boats. Methods in Ecology and Evolution 7:42-50. https://doi.org/10.1111/2041-210X.12447
Fisheries	Atlantic States Marine Fisheries Commission, 2024b. Fish Habitat of Concern Designations for Fish and Shellfish Species. January 2024. (https://asmfc.org/files/Habitat/FHOC_Designations_Jan2024.pdf.
Fisheries	Atlantic States Marine Fisheries Commission. 2024a. Webpage. https://www.asmfc.org/.
Fisheries	Dumont, J. D. 2011. Shark populations of Georgia: evaluating abundance, gear selectivity, and habitat use. M.S. Thesis. Savannah State University, Savannah, Georgia. 79 pp.
Fisheries	NOAA Fisheries. 2024a. Fisheries Management Info. https://www.fisheries.noaa.gov/rules-and-announcements/plans-and-agreements. ?
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Fisheries	North Carolina Department of Environmental Quality. 2024b. Fisheries Management Plans (North Carolina). https://www.deq.nc.gov/about/divisions/marine-fisheries/managing-fisheries/fishery-management-plans.
Fisheries	Ottley, A., C.N. Belcher, B. Good, J.L. Music, Jr., and C. Evans. 1998. Interstate Fisheries Management Planning and Implementation. Final Report. Award No. NA57FG0170. USDOC/NOAA/NMFS. Atlantic Coastal Fisheries Management Act (P.L. 103-206).
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Species	Reference
North Atlantic Right Whale	Crum, N., T. Gowan, A. Krzystan, and J. Martin. 2019. Quantifying risk of whale–vessel collisions across space, time, and management policies. Ecosphere 10(4):e02713. https://doi.org/10.1002/ecs2.2713
North Atlantic Right Whale	Cusano, D.A., L. Conge, S.M. Van Parijs, and S.E. Parks. 2018. Implementing conservation measures for the North Atlantic right whale: considering the behavioral ontogeny of mother-calf pairs. Animal Conservation, 22, 228-237. doi:10.1111/acv.12457.
North Atlantic Right Whale	Dombrosk, J.R.G., Parks, S.E.,and Nowacek, D.P. 2021. Dive behavior of North Atlantic right whales on the calving ground in the Southeast USA: implications for conservation. Endangered Species Research, 46, 35-48. doi: 10.3354/esr01141. https://www.int-res.com/articles/esr2021/46/n046p035.pdf
North Atlantic Right Whale	Duke: Nicholas School of the Environment. 2019. Right Whale Mothers "Whisper" to Their Calves to Avoid Attracting Predators. https://nicholas.duke.edu/news/right-whale-mothers-whisper-their-calves-avoid-attracting-predators.
North Atlantic Right Whale	Garrison, L.P., J. Adams, E.M. Patterson and C.P. Good. 2022. Assessing the Risk of Vessel Strike Mortality in North Atlantic Right Whales along the U.S. East Coast. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Southeast Fisheries Science Center. Miami, FL. NOAA Technical Memorandum NMFS-SEFSC-757. 36 pp. https://media.fisheries.noaa.gov/2022-07/Right_Whale_Vessel_Strike_Risk_Assessment_NMFS-SEFSC-757_508.pdf
North Atlantic Right Whale	Georgia Department of Natural Resources, Wildlife Resources Division. 2016. Year 2 of Tagging Right Whales in the Southeast. https://georgiawildlife.blog/2016/04/06/year-2-of-tagging-right-whales-in-the-southeast/
North Atlantic Right Whale	Gowan, T.A., J.G. Ortega-Ortiz, J.A., Hostetler, P.K. Hamilton, A.R. Knowlton, K.A. Jackson, R. C. George, C.R. Taylor and P.J. Naessig. 2019. Temporal and demographic variation in partial migration of the North Atlantic right whale. Scientific Reports 9:353. https://doi.org/10.1038/s41598-018-36723-3
North Atlantic Right Whale	Gowan, T.A. and J.G. Ortega-Ortiz. 2014. Wintering habitat model for the North Atlantic Right Whale (*Eubalaena glacialis*) in the southeastern United States. PLOS ONE 9(4): e95126. https://doi.org/10.1371/journal.pone.0095126
North Atlantic Right Whale	Gowan, T.A., N.J. Crum, and J.J. Roberts. 2021. An open spatial capture–recapture model for estimating density, movement, and population dynamics from line-transect surveys. Ecology and Evolution 11:7354–7365. https://doi.org/10.1002/ece3.7566
North Atlantic Right Whale	Krystan, A.M., T. A. Gowan, W. L. Kendall, J. Martin, J. G. Ortega-Ortiz, K. Jackson, A. R. Knowlton, P. Naessig, M. Zani, D. W. Schulte, and C. R. Taylor. 2018. Characterizing residence patterns of North Atlantic right whales in the southeastern USA with a multistate open robust design model. Endangered Species Research 36:279-295. https://doi.org/10.3354/esr00902
North Atlantic Right Whale	Marine Geospatial Ecology Lab and Duke University. 2024. Habitat-Based Marine Mammal Density Models for the U.S. Atlantic: Latest Version. https://seamap.env.duke.edu/models/Duke/EC/
North Atlantic Right Whale	Marine Mammal Commission. 2024. Marine Mammal Commission. North Atlantic right whale tagging workshop report. https://www.mmc.gov/wp-content/uploads/North-Atlantic-right-whale-tagging-workshop-report.pdf.
North Atlantic Right Whale	NOAA Fisheries. 2023a. A Whale's Perspective: Using Tags to Understand North Atlantic Right Whales. https://www.fisheries.noaa.gov/feature-story/whales-perspective-using-tags-understand-north-atlantic-right-whales?

Species	Reference
North Atlantic Right Whale	NOAA Fisheries. 2023b. Reducing Entanglements and Vessel Strikes Makes Extinction Less Likely for North Atlantic Right Whales. https://www.fisheries.noaa.gov/feature-story/reducing-entanglements-and-vessel-strikes-makes-extinction-less-likely-north-atlantic
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Sturgeon	SCDNR, 2023. Evaluating Atlantic and Shortnose Sturgeon Behavior Related to SHEP, Ongoing monitoring of Atlantic and shortnose sturgeon movement in the Savannah River estuary to determine potential impacts from harbor deepening
Sturgeon	Schueller, P., and D. L. Peterson. 2010. Abundance and recruitment of juvenile Atlantic sturgeon in the Altamaha River, Georgia. Transactions of the American Fisheries Society 139(5):1526-1535.
Sturgeon	Secor, D. H., and T. E. Gunderson. 1998. Effects of hypoxia and temperature on survival, growth, and respiration of juvenile Atlantic sturgeon (*Acipenser oxyrinchus*). Fishery Bulletin 96:603-613.
Sturgeon	Smith, J. A., H. J. Flowers, and J. E. Hightower. 2014. Fall spawning of Atlantic sturgeon in the Roanoke River, North Carolina. Transactions of the American Fisheries Society 144(1):48-54.
Sturgeon	Smith, T. I. J. 1985. The fishery, biology, and management of Atlantic sturgeon, *Acipenser oxyrhynchus*, in North America. Environmental Biology of Fishes 14(1):61-72.
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Sturgeon	Smith, T. I. J., E. K. Dingley, and D. E. Marchette. 1980. Induced spawning and culture of Atlantic sturgeon. The Progressive Fish-Culturist 42(3):147-151.
Sturgeon	U.S. Fish and Wildlife Service, Project AFS-9.
Sturgeon	USACE ERDC, Reine, K., D. Clarke, M. Balzaik, S. O'Haire, C. Dickerson, C. Frederickson, G. Garman, C. Hager, A. Spells, and C. Turner. 2014. Assessing Impacts of Navigation Dredging on Atlantic Sturgeon , Study results show no evidence that active dredging operations presented physical barriers to sturgeon movement.

Species	Reference
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Sturgeon	Waldman, J. R., and I. I. Wirgin. 1998. Status and restoration options for Atlantic sturgeon in North America. Conservation Biology 12(3):631-638.
Sturgeon	Waldman, J. R., C. Grunwald, J. Stabile, and I. I. Wirgin. 2002a. Impacts of life history and biogeography on the genetic stock structure of Atlantic sturgeon Acipenser oxyrinchus oxyrinchus, Gulf sturgeon A-oxyrinchus desotoi, and shortnose sturgeon A-brevirostrum. Journal of Applied Ichthyology 18(4-6):509-518.
Sturgeon	Waldman, J. R., C. Grunwald, J. Stabile, and I. I. Wirgin. 2002b. Impacts of life history and biogeography on the genetic stock structure of Atlantic sturgeon *Acipenser oxyrinchus oxyrinchus*, Gulf sturgeon *A. oxyrinchus desotoi*, and shortnose sturgeon *A. brevirostrum*. Journal of Applied Ichthyology 18(4-6):509-518.
Sturgeon	Waldman, J., S.E Alter, D. Peterson, L. Maceda, N. Roy, and I. Wirgin. 2018. Contemporary and historical effective population sizes of Atlantic sturgeon Acipenser oxyrinchus oxyrinchus. Conservation Genetics.
Sturgeon	Wilkens, J. L., A. W. Katzenmeyer, N. M. Hahn, J. J. Hoover, and B. C. Suedel. 2015.
Surveys	BOEM. 2014. Atlantic OCS proposed geological and geophysical activities Mid-Atlantic and South Atlantic planning areas final programmatic environmental impact statement. U.S. Department of the Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, New Orleans.
Water Quality	Burton, W. H. 1993. Effects of bucket dredging on water quality in the Delaware River and the potential for effects on fisheries resources. Versar, Inc., Columbia, MD.
Water Quality	Crocker, C. E., and J. J. Cech Jr. 1997. Effects of environmental hypoxia on oxygen consumption rate and swimming activity in juvenile white sturgeon, Acipenser transmontanus, in relation to temperature and life intervals. Environmental Biology of Fishes 50:383-289.
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Appendix F - Flipchart Notes

Sea Turtles

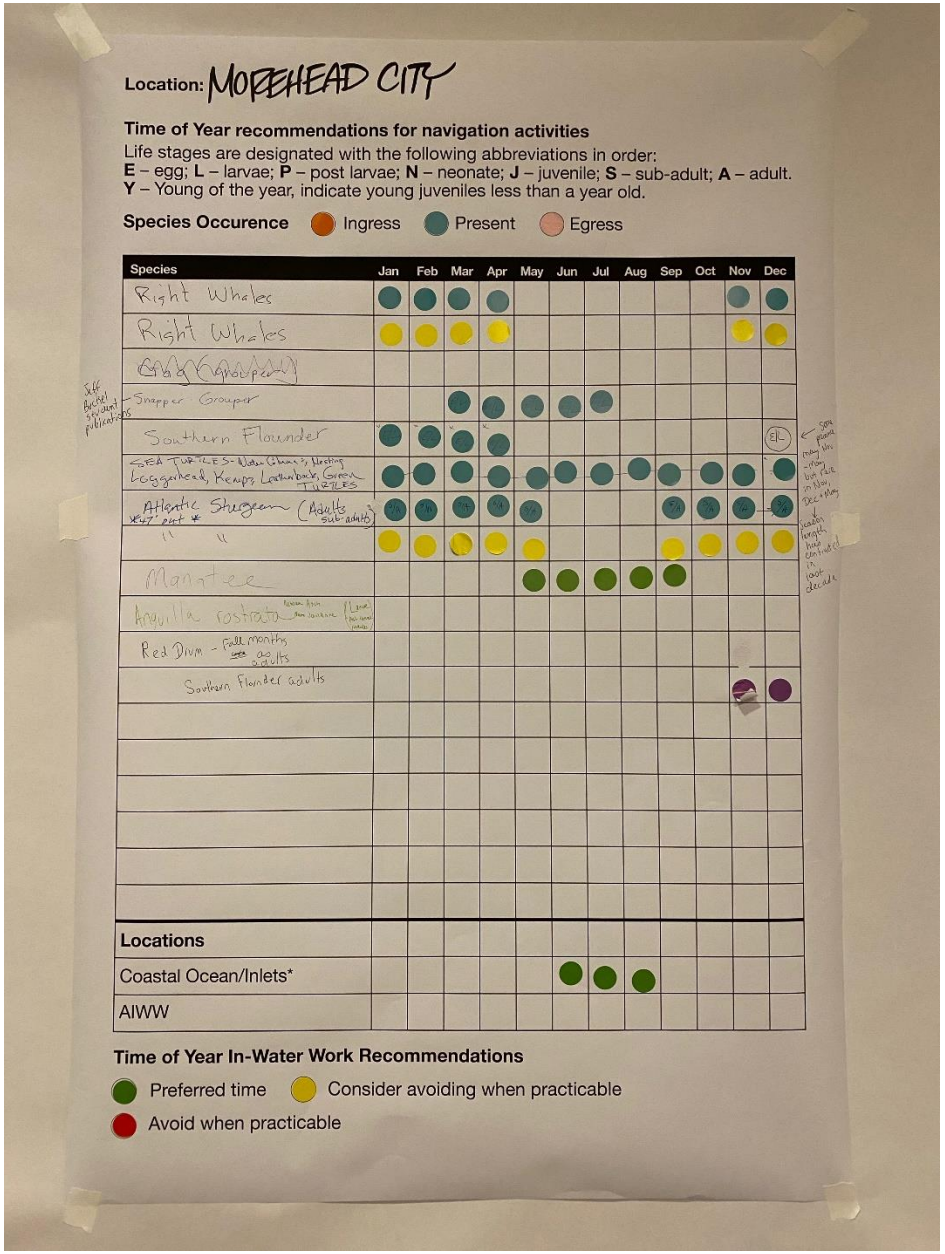
- Hopper Dredging – Unsustainable due to species take. Needs new tech
- Multi-variant analysis of protected species, mortality of hopper dredging
- Which parameters best predict take?
    - Load Numbers
    - Dates, Tides and Seasons
    - Zone (Spatial) – need to figure out the format
    - CPUE and No Catch (zeros) – Pump hours, number of drag heads, drag head type/configuration
    - Turtle population and density
    - Environ variables – water temperature, substrate, salinity, barometric pressure, wind, tide stage, wave heights
    - Repeat the nature of dredging
    - Vessel velocity
    - Mitigation measures in place
- Note: Must address confidentiality issues and data formatting challenges
- What factors inform when to dredge (windows)?
    - Air temperature
    - Water temperature
- Brunswick – Harder to dredge outside of typical windows
- Approach – Test Area
    - Test Area: State by state or district by district or harbor by the harbor
    - Start where you have the most interactions
- Test new technology/mitigation measures – Coordination needed on permitting
    - Tickler chains
    - Relocation trawling (not new)
    - Bed leveling (not new)
    - Water injection approaches

Fisheries

- Routes of Effect:
    - Noise
    - Swim bladder issues
    - Habitat loss
    - Larvae Entrainment
- Research Needs
    - Blue Crab
    - Baseline data on presence
        - Define key congregation locations
    - Larvae – where in the column they are taken
    - Gather more university data
    - Share dredging tracks to enable research coordination
    - Finetuning size of bycatch net
- Questions to consider and Species
    - How to incorporate takes and opportunities for adaptive approaches?
    - How can we collaborate on how much can or should happen?
    - Blue Crab
    - Horseshoe Crab
    - Red Drum
    - Oyster Reef
    - Founder

Appendix G – Harbor Maps & Presence and Absence Matrices

Morehead City, NC



Location: MOREHEAD CITY

Time of Year recommendations for navigation activities

Life stages are designated with the following abbreviations in order:
E – egg; **L** – larvae; **P** – post larvae; **N** – neonate; **J** – juvenile; **S** – sub-adult; **A** – adult.
Y – Young of the year, indicate young juveniles less than a year old.

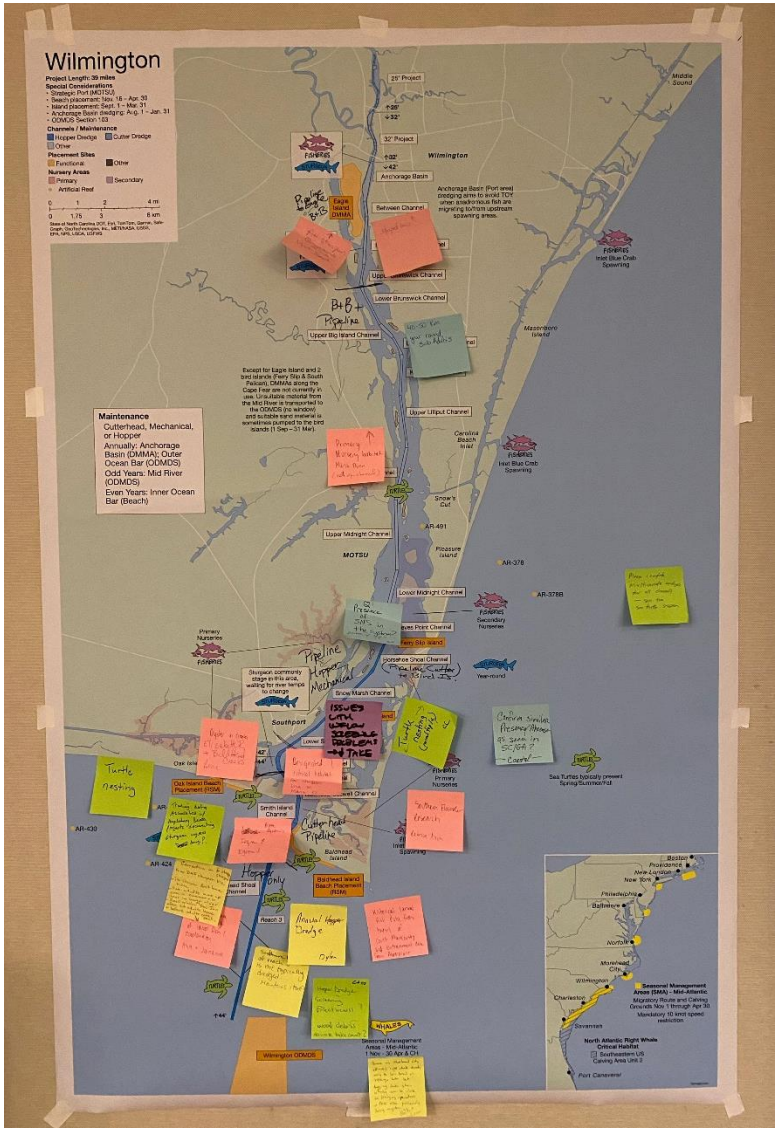
Species Occurence Ingress Present Egress

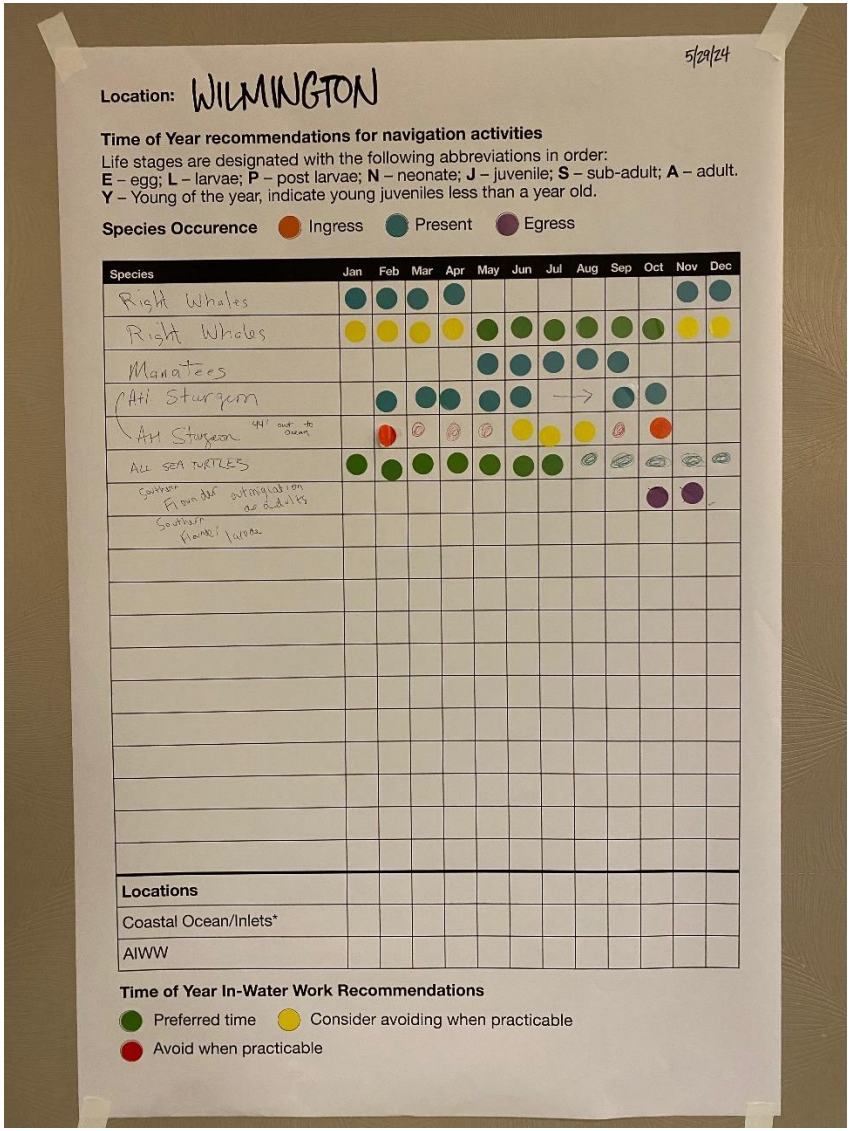
Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Right Whales	●	●	●	●							●	●
Right Whales	●	●	●	●							●	●
Grouper												
Snapper Grouper			●	●	●	●	●					
Southern Flounder	●	●	●	●								●
SEA TURTLES - Loggerhead, Kemps, Leatherback, Green TURTLES	●	●	●	●	●	●	●	●	●	●	●	●
Atlantic Sturgeon (Adults sub-adults)	●	●	●	●	●				●	●	●	●
" "	●	●	●	●	●				●	●	●	●
Manatee					●	●	●	●	●			
Anguilla rostrata												
Red Drum - Fall months see adults												
Southern Flounder adults											●	●
Locations												
Coastal Ocean/Inlets*						●	●	●				
AIWW												

Time of Year In-Water Work Recommendations

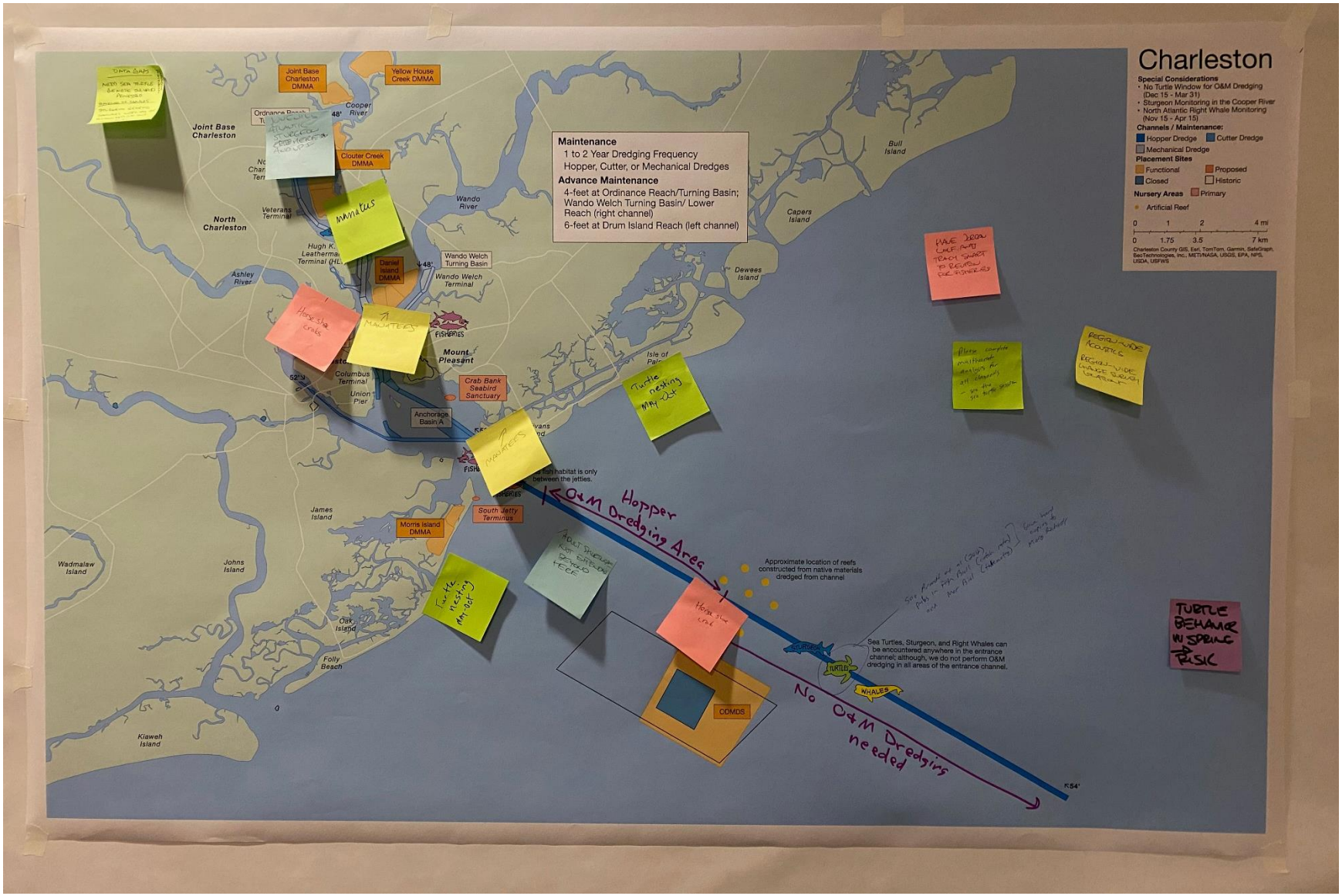
Preferred time Consider avoiding when practicable
Avoid when practicable

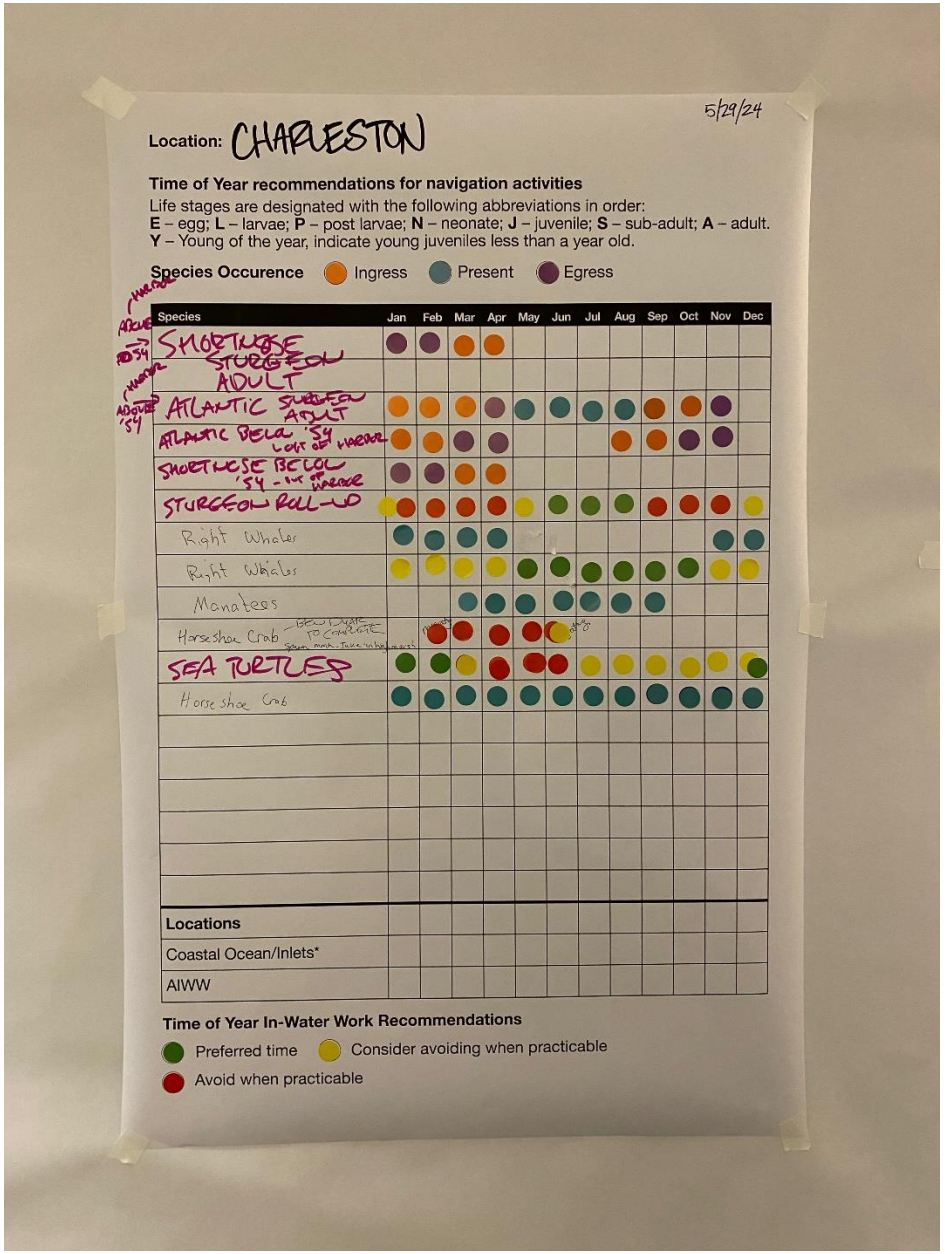
Wilmington, NC





Charleston, SC





Location: CHARLESTON

5/29/24

Time of Year recommendations for navigation activities

Life stages are designated with the following abbreviations in order:
E – egg; **L** – larvae; **P** – post larvae; **N** – neonate; **J** – juvenile; **S** – sub-adult; **A** – adult.
Y – Young of the year, indicate young juveniles less than a year old.

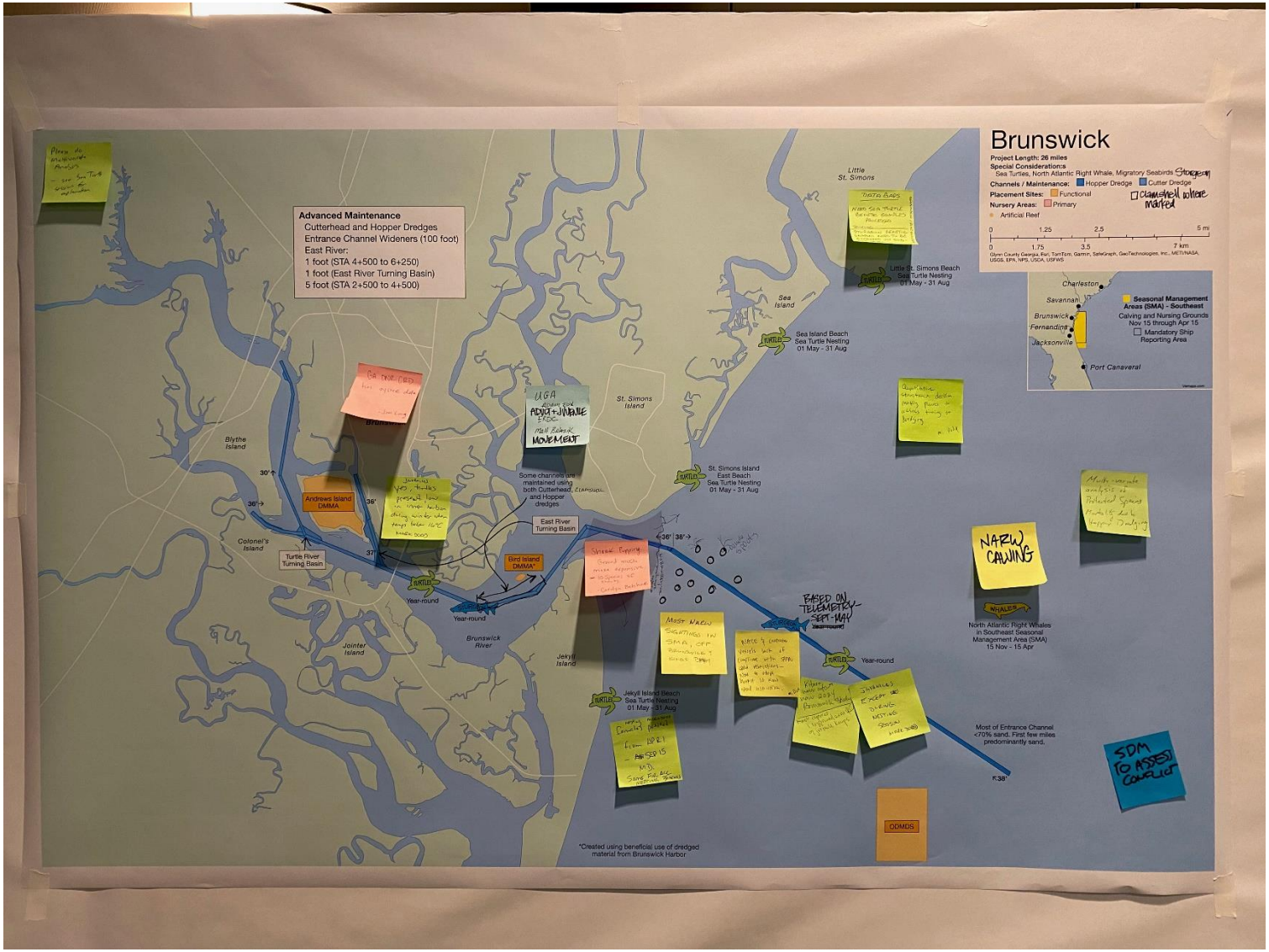
Species Occurence Ingress Present Egress

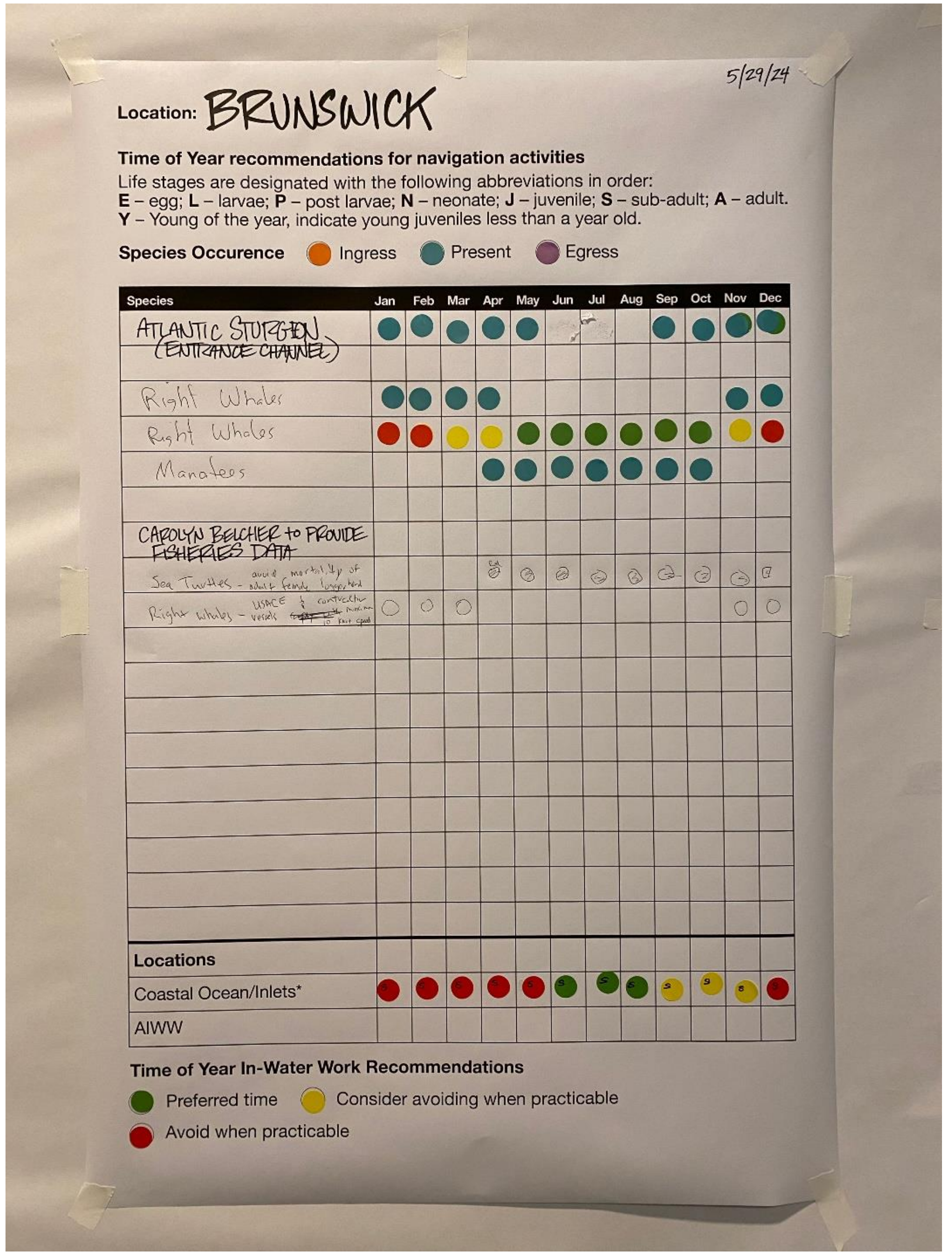
Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SHORTNOSE STURGEON ADULT												
ATLANTIC STURGEON ADULT												
ATLANTIC BELOW 'SY												
SHORTNOSE BELOW 'SY - OUT OF WATER												
STURGEON ROLL-UP												
Right Whales												
Right Whales												
Manatees												
Horseshoe Crab												
SEA TURTLES												
Horseshoe Crab												
Locations												
Coastal Ocean/Inlets*												
AIWW												

Time of Year In-Water Work Recommendations

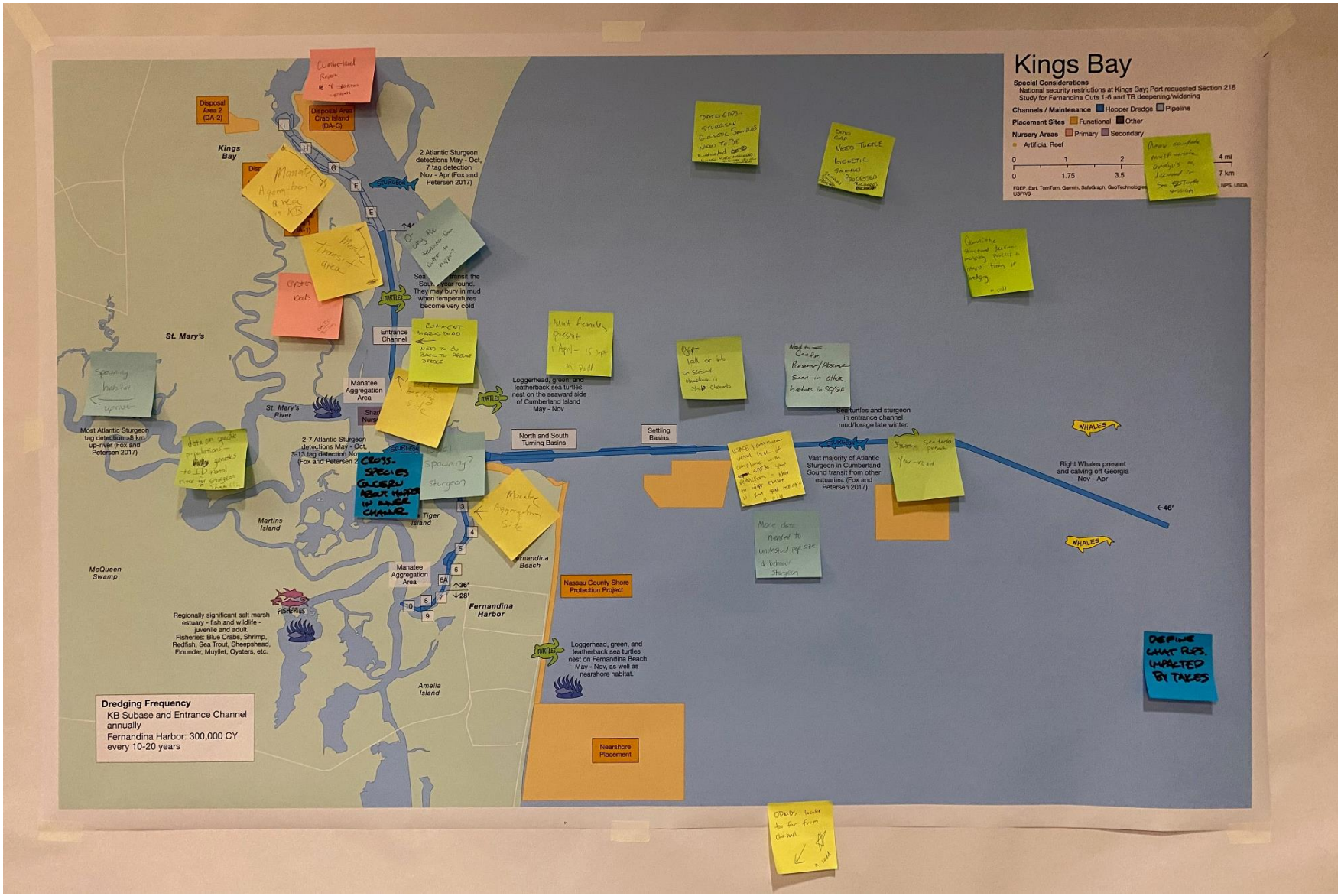
Preferred time
Consider avoiding when practicable
Avoid when practicable

Brunswick Harbor, GA




5/29/24
Location: BRUNSWICK
Time of Year recommendations for navigation activities
Life stages are designated with the following abbreviations in order:
E – egg; L – larvae; P – post larvae; N – neonate; J – juvenile; S – sub-adult; A – adult.
Y – Young of the year, indicate young juveniles less than a year old.
Species Occurence
Ingress
Present
Egress
Species
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
ATLANTIC STURGEON (ENTRANCE CHANNEL)
Right Whales
Right Whales
Manatees
CAROLYN BELCHER to PROVIDE FISHERIES DATA
Sea Turtles - avoid mortality of adult female loggerhead
Right whales - USACE & contractor vessels 10 knot speed
Locations
Coastal Ocean/Inlets*
AIWW
Time of Year In-Water Work Recommendations
Preferred time
Consider avoiding when practicable
Avoid when practicable

Kings Bay, GA


Kings Bay
Special Considerations
National security restrictions at Kings Bay; Port requested Section 216 Study for Fernandina Cuts 1-6 and TB deepening/widening
Channels / Maintenance Hopper Dredge Pipeline
Placement Sites Functional Other
Nursery Areas Primary Secondary
Artificial Reef
0 1 2 4 mi
0 1.75 3.5 7 km
Disposal Area 2 (DA-2)
Disposal Area Crab Island (DA-C)
Kings Bay
St. Mary's
St. Mary's River
Martins Island
McQueen Swamp
Tiger Island
Amelia Island
Fernandina Beach
Fernandina Harbor
2 Atlantic Sturgeon detections May - Oct, 7 tag detection Nov - Apr (Fox and Petersen 2017)
Sea turtles transit the South year round. They may bury in mud when temperatures become very cold
Entrance Channel
Manatee Aggregation Area
Most Atlantic Sturgeon tag detection >8 km up-river (Fox and Petersen 2017)
2-7 Atlantic Sturgeon detections May - Oct, 3-13 tag detection Nov Fox and Petersen 2
Loggerhead, green, and leatherback sea turtles nest on the seaward side of Cumberland Island May - Nov
North and South Turning Basins
Settling Basins
Sea turtles and sturgeon in entrance channel mud/forage late winter.
Vast majority of Atlantic Sturgeon in Cumberland Sound transit from other estuaries. (Fox and Petersen 2017)
Right Whales present and calving off Georgia Nov - Apr
WHALES
Nassau County Shore Protection Project
Nearshore Placement
Loggerhead, green, and leatherback sea turtles nest on Fernandina Beach May - Nov, as well as nearshore habitat.
Regionally significant salt marsh estuary - fish and wildlife - juvenile and adult.
Fisheries: Blue Crabs, Shrimp, Redfish, Sea Trout, Sheepshead, Flounder, Mullet, Oysters, etc.
Dredging Frequency
KB Subase and Entrance Channel annually
Fernandina Harbor: 300,000 CY every 10-20 years
CROSS-SPECIES CALCIUM ISOTOPE MARKER IN EAR CHANNEL
DREDGE CHART PLOTS IMPACTED BY TAKES

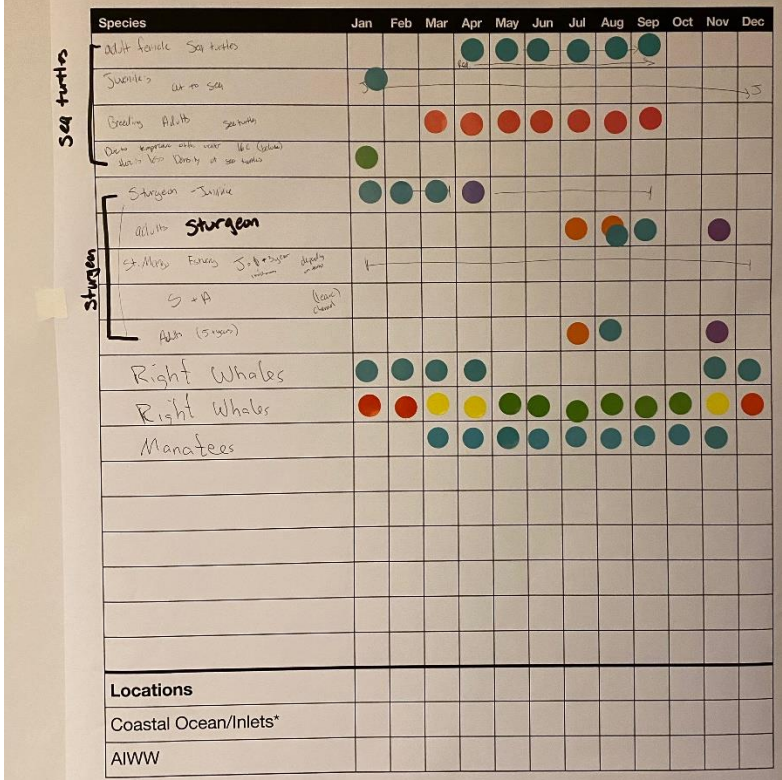
5/29/24

Location: Kings Bay

Time of Year recommendations for navigation activities

Life stages are designated with the following abbreviations in order:
E – egg; **L** – larvae; **P** – post larvae; **N** – neonate; **J** – juvenile; **S** – sub-adult; **A** – adult.
Y – Young of the year, indicate young juveniles less than a year old.

Species Occurence Ingress Present Egress



Time of Year In-Water Work Recommendations

Preferred time
Consider avoiding when practicable
Avoid when practicable