

Evaluating Sea Turtle & Fish Behavioral Responses to Dredging: A Proposed Comparative Study of Traditional & Hydrodynamic Dredging Techniques

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Agenda

- Proposed Study Purpose & Rationale
- Dredging Practices – Joe Wagner
- Ecological Impacts of Dredging Activities – Andy Pledger
- Outline of Proposed Sea Turtle Behavioral Study – Matt Balazik and Inwater Research Group
- Q&A & Discussion

Proposed Study Purpose & Rationale



Summary of Atlantic Sturgeon Behavioral Research Near Dredges

Behavioral Responses

Atlantic sturgeon and other fish exhibit route choice and avoidance at certain distances near active dredging.

Movement Patterns

During active dredging, Atlantic sturgeon alter their routes to skirt plumes and equipment, yet their overall migration success remains comparable to periods without dredging.

Risks

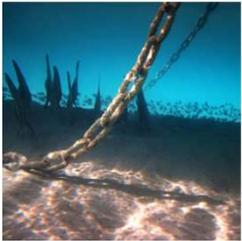
Exposure to dredging activities increases potential harm for Atlantic sturgeon. However, Juveniles are detected near active dredging without observed mortality.

Study Hypotheses & Objectives



Behavioral Avoidance Testing

The study will test whether fish/sea turtles avoid areas near dredging operations to understand behavioral responses.



Survival Impact Assessment

Researchers will assess potential survival impacts on fish/sea turtles caused by proximity to dredging activities.



Movement & Habitat Use

Objectives include quantifying changes in fish/sea turtle movement patterns & habitat use near dredging zones.

Study may use sonar, telemetry, & environmental monitoring to test how different dredging methods affect fish/sea turtle behavior.

Adaptation of Telemetry, Acoustic Monitoring, CPUE, & Sonar Indexing

Telemetry Tracking

Telemetry allows remote tracking of sea turtles by transmitting movement data in real-time for detailed behavioral study.

Acoustic Monitoring

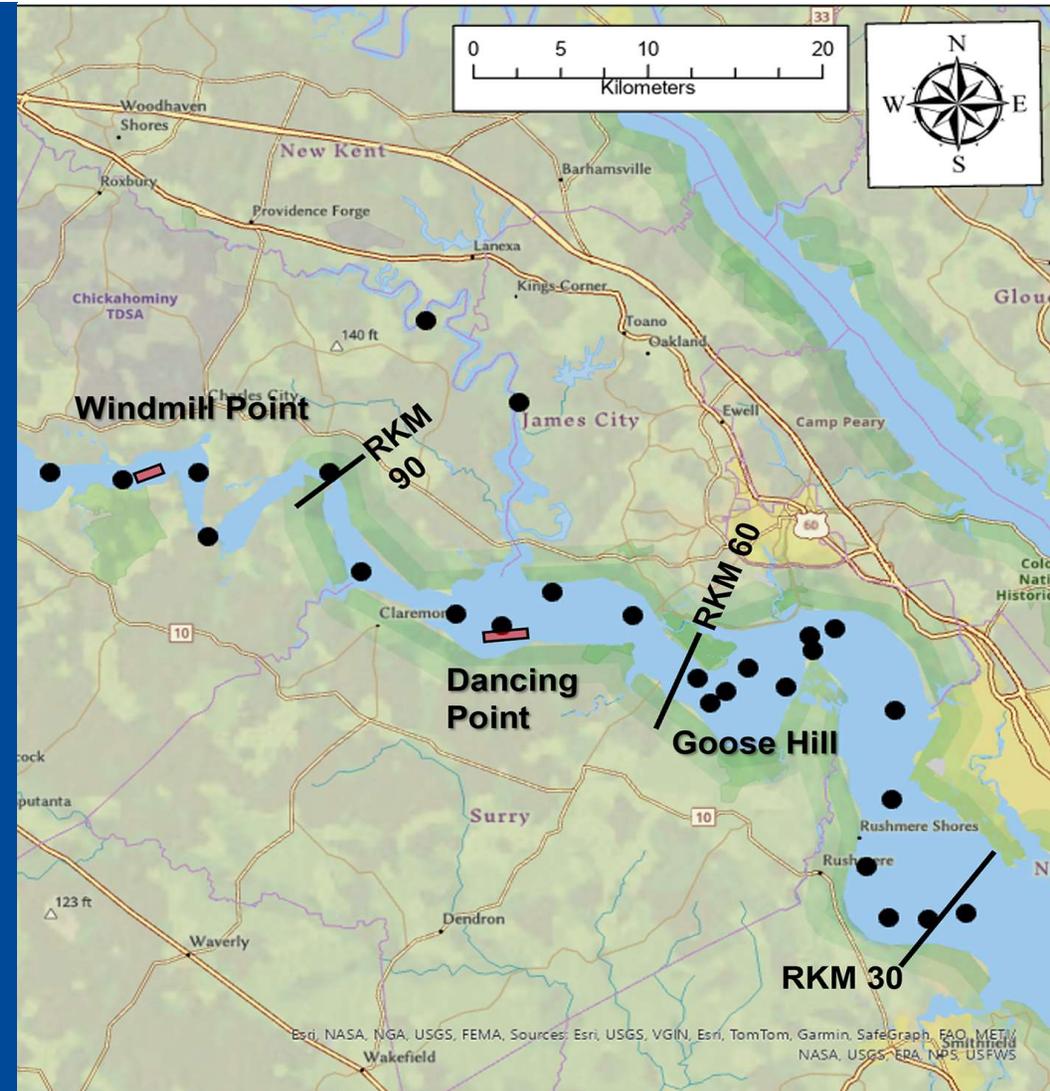
Acoustic monitoring uses underwater sound detection to monitor sea turtle presence & movement in aquatic habitats.

Catch-Per-Unit-Effort (CPUE)

CPUE measures the abundance & catch rates of sea turtles to evaluate population dynamics & habitat use.

Sonar Indexing

Sonar indexing employs sonar technology to map sea turtle locations & estimate population density under water.



Dredging Practices

Comparison of Dredging Techniques



Traditional dredging techniques hydraulically or mechanically remove sediments from a waterbody (*i.e. hopper and cutterhead dredging*)



In comparison, all ***Hydrodynamic Dredging*** techniques horizontally transport the dredged material ***entirely within the water column***



All ***Hydraulic & Mechanical Dredged*** sediments are ***transported*** using buckets, pipeline, hoppers, barges, etc.



All ***Hydrodynamic Dredging*** sediments ***flow through the water*** from the dredge area to the final disposal area

Water Injection Dredging



WID pumps water into channel bottom sediments at relatively **high-volume & low pressure**



The objective is to remove the material from a selected area by taking advantage of the near-bottom **density current**

- Tides
- Currents
- Gravity
- Other Hydrodynamic Forces



WID allows sediments to flow horizontally out of a waterbody while the **fluidized sediment layer** remains close to the bottom



Osprey WID, IHC-America, NCSPA



WID NCSPA

Ecological Impacts of Dredging Activities

Study System and Context

Study system:

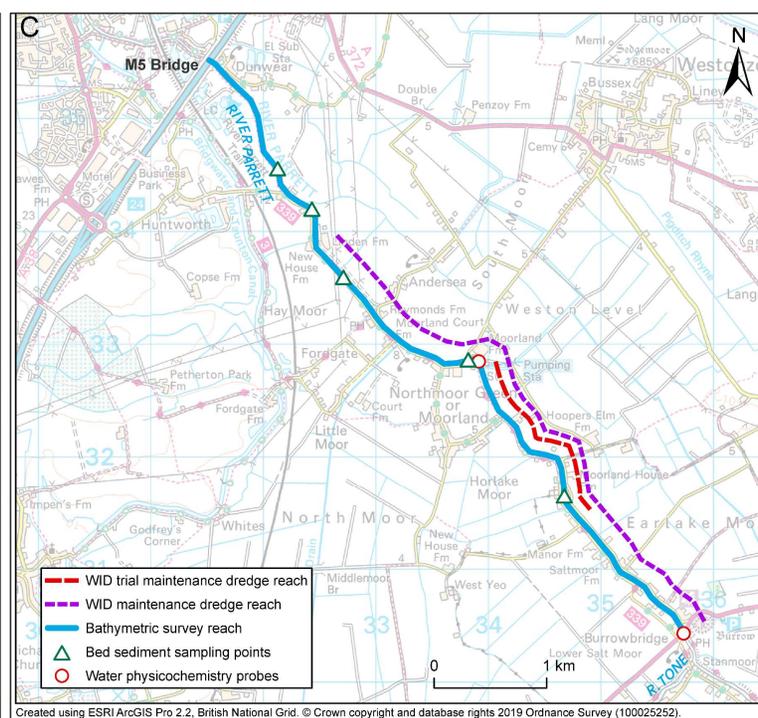
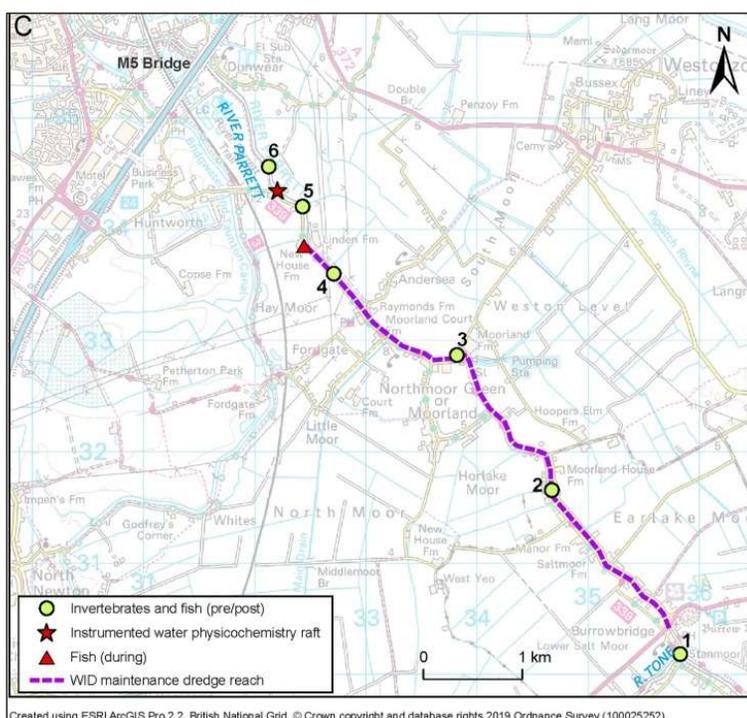
- Tidal River Parrett, Southwest England (UK)
- Temperate, macrotidal river estuary
- Fine, cohesive sediment dominate
- Legacy of dredging for flood relief with mechanical methods traditionally used – WID considered 2017/2018 as a more *time/cost effective* and potentially, more *ecologically sensitive*, alternative



Aims

Quantify effects (pre vs post) of Water Injection Dredging (WID) on aspects of:

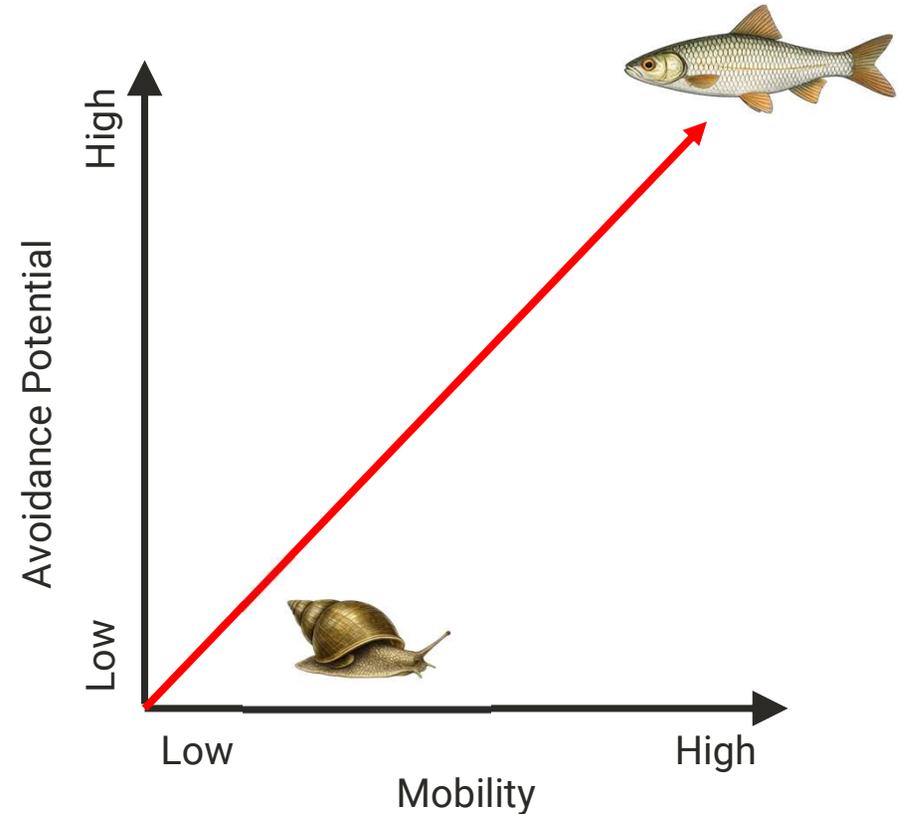
1. Hydromorphology incl. bathymetry, water physicochemistry, bed sediment GSD.
2. Ecology incl. diatom, fish and invertebrate populations and/or behaviors



Avoidance & Mortality Patterns

Patterns across taxa:

- Avoidance perceived to be common in mobile species
- Exposure duration likely more important than peak intensity
- Mortality rarely observed (never for fish)
- Sub-lethal effects dominate



Generalised relationship between mobility and likely biological response during WID.

James River, VA Studies & Key Results

James Dredge Open Placement TOYR Background

James River dredge TOYR from Feb 15-June 30 for anadromous fish run

Completely based on precautionary principle, no data suggesting dredge operations (sound, cutterhead and placement plumes) have deleterious impacts on migrating fish

Hard to address because unsure what to address, no reason provided for TOYR

Won't permit dredging in spring so can't see if there's an impact

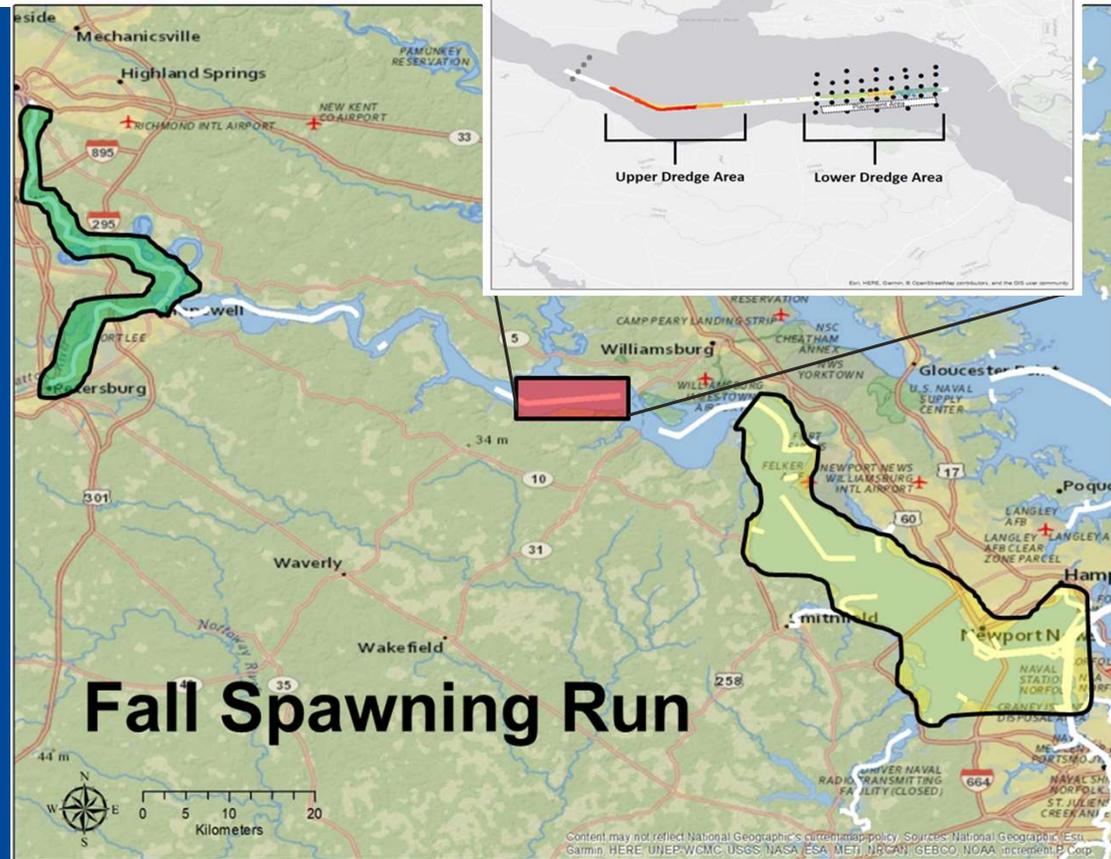


Atlantic Sturgeon Study (Fall Adults)

Telemetered Fish: 106 Adults Detected in Study

VPS Receiver Array: 37 receiver Vemco Positioning Array with two reference tags deployed July through November 2017

Dredge and Dredge Positions: Dredge Lexington/AIS

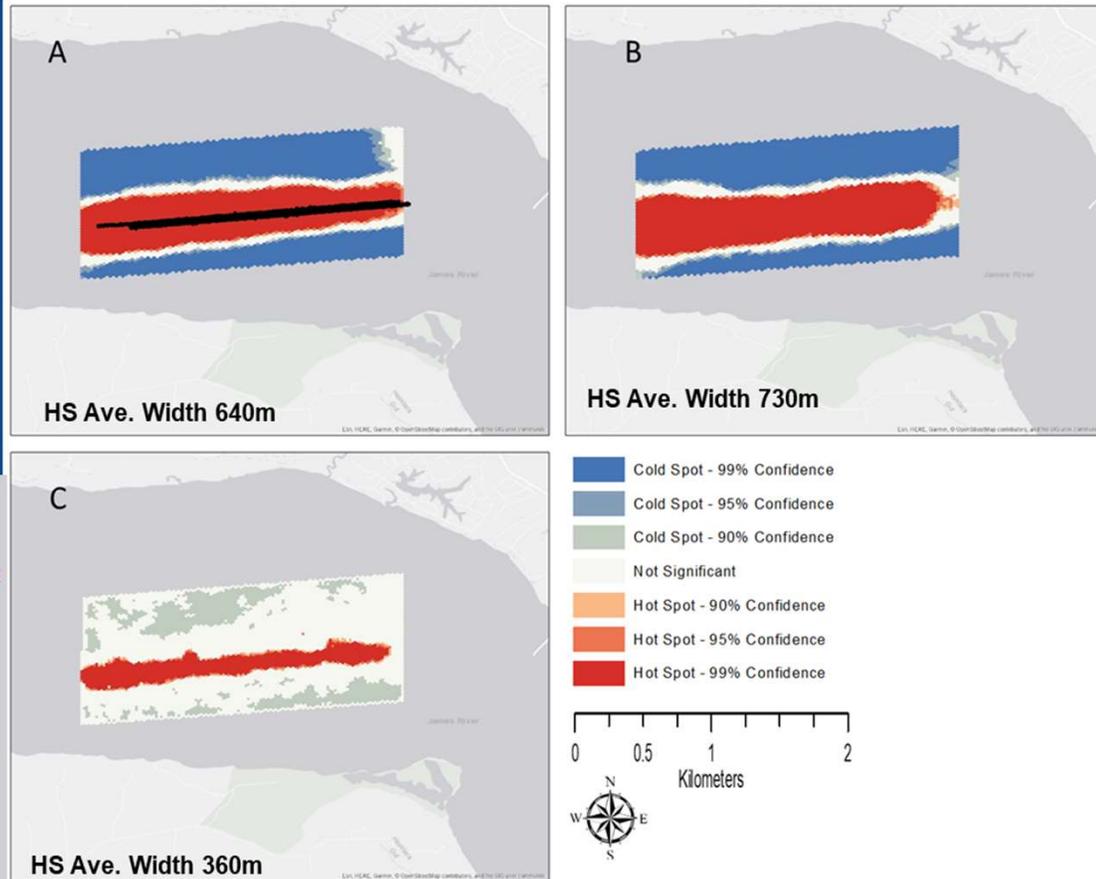
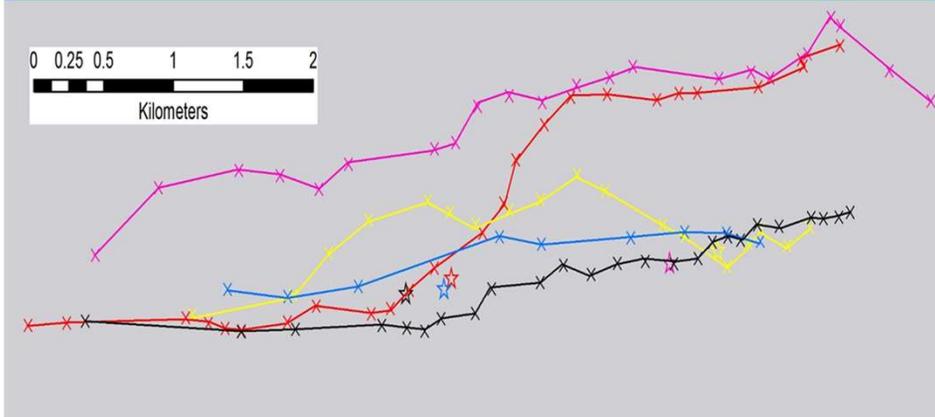


Atlantic Sturgeon Study (Fall Adults)

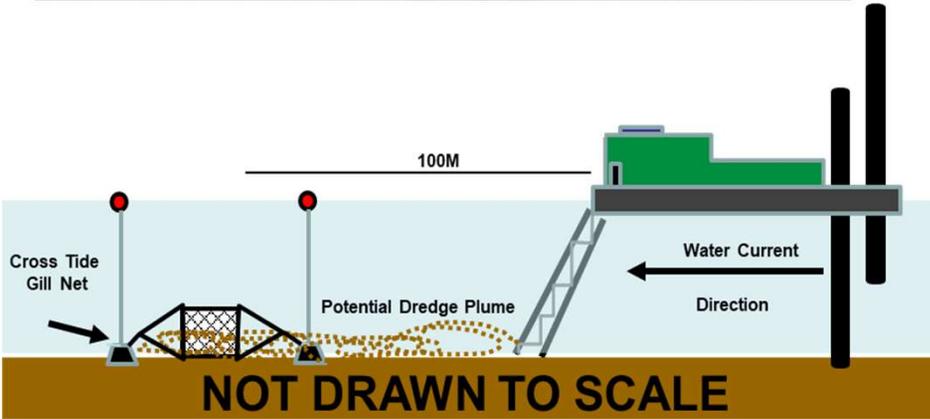
Summary: In this situation, data show active dredging did NOT cause noticeable problems for adults migrating to spawning habitat.

Published in

PLOS1: <https://doi.org/10.1371/journal.pone.0230029>



Atlantic Sturgeon Study (Juveniles)



Atlantic Sturgeon Study (Juveniles)

Catch: Caught 268 age 1-2y old juveniles with no trends in CPUE during dredge operations

Telemetered Fish: A total of 34 telemetered juveniles traversed dredge operations at least 125 times without mortality

Summary: Evidence suggests cutterhead dredging does not cause juveniles to flee the area. Seem to be actively feeding within a hundred meters of active dredging.

Published in

PLOS1: <https://doi.org/10.1371/journal.pone.0300489>



Outline of Proposed Sea Turtle Behavioral Studies

Satellite Telemetry

- Tag attached to animal
 - Signal sent to satellites
 - Track movements anywhere
 - Record dive behavior
- Near real time data
 - 12-24 hr lag
- Duration
 - Months – Years
- Accuracy - Traditional
 - 100s meters to > 10 km
- Accuracy - Fastloc GPS
 - 10s – 100s of meters
- Cost - High



Photos taken under NMFS 21169, 25696 & FWC MTP 125, 204

Acoustic Telemetry

- Tag attached to animal
 - Signal sent to underwater receivers
 - Track underwater position
- Data stored on deployed receiver
- Duration
 - Days – Years
- Accuracy – Individual Receiver
 - > 100 meters
- Accuracy - Positional Array
 - < 5 m
- Moderate Cost



Photo taken under NMFS 21169, 25696 & FWC MTP 125, 204

Turtle Tagging *Issues*

Sea Turtle Tracking Considerations

- Permitting
- Ability to capture animals
- Tag retention
- Movement of animals



Photo taken under NMFS 21169, 25696 & FWC MTP 125, 204

Satellite - Limitations

- Detections at surface only
- Low accuracy
 - Satellite dependent
- High tag cost
- Restrictions on tag size

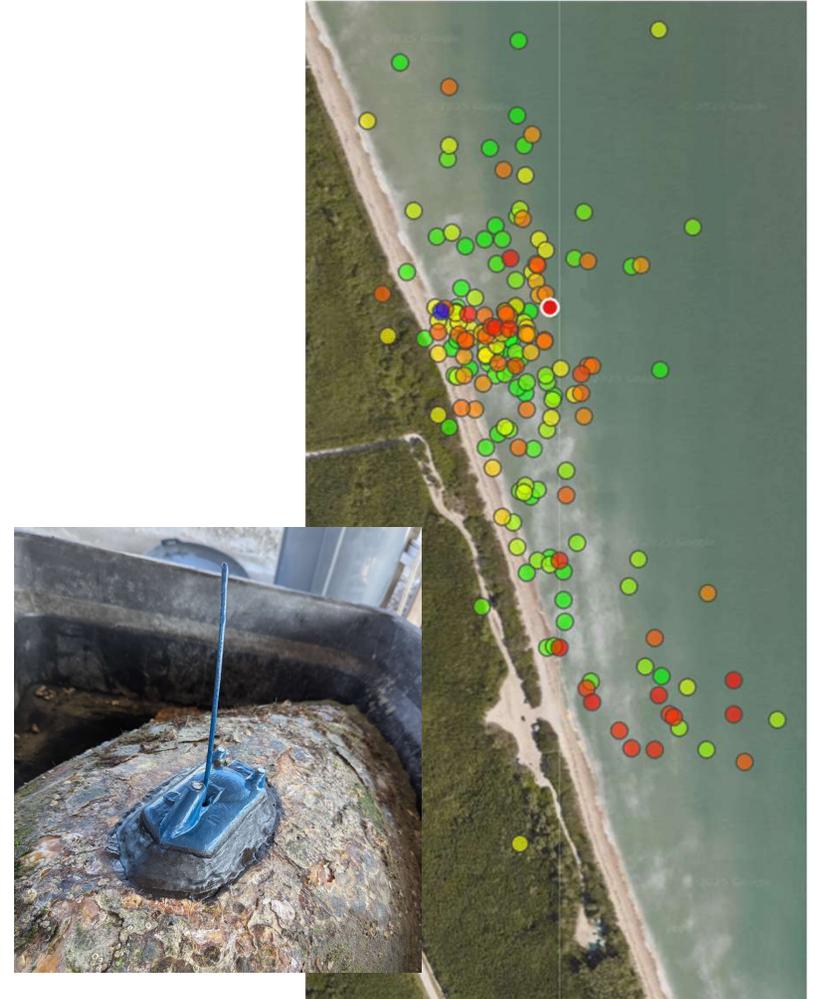


Photo taken under NMFS 21169, 25696 & FWC MTP 125, 204

Acoustic - Limitations

- Limited by placement and number of deployed receivers
- Data not available in real time
- Requires maintenance
- Potential for receiver loss



Broad Issues

- Working conditions
- Access to animals
- Residential vs. transient turtles
- Releasing animals into the project area
- Access to previously collected data

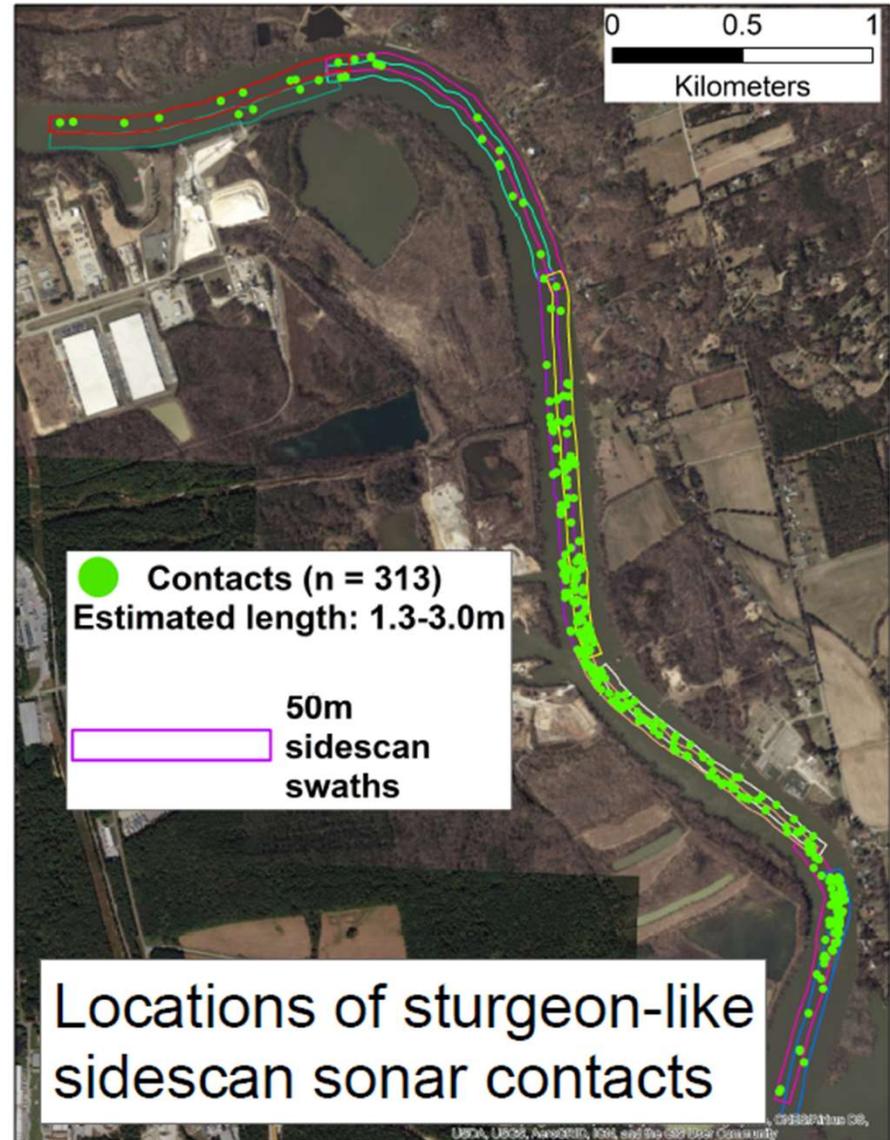


Sonar Detection

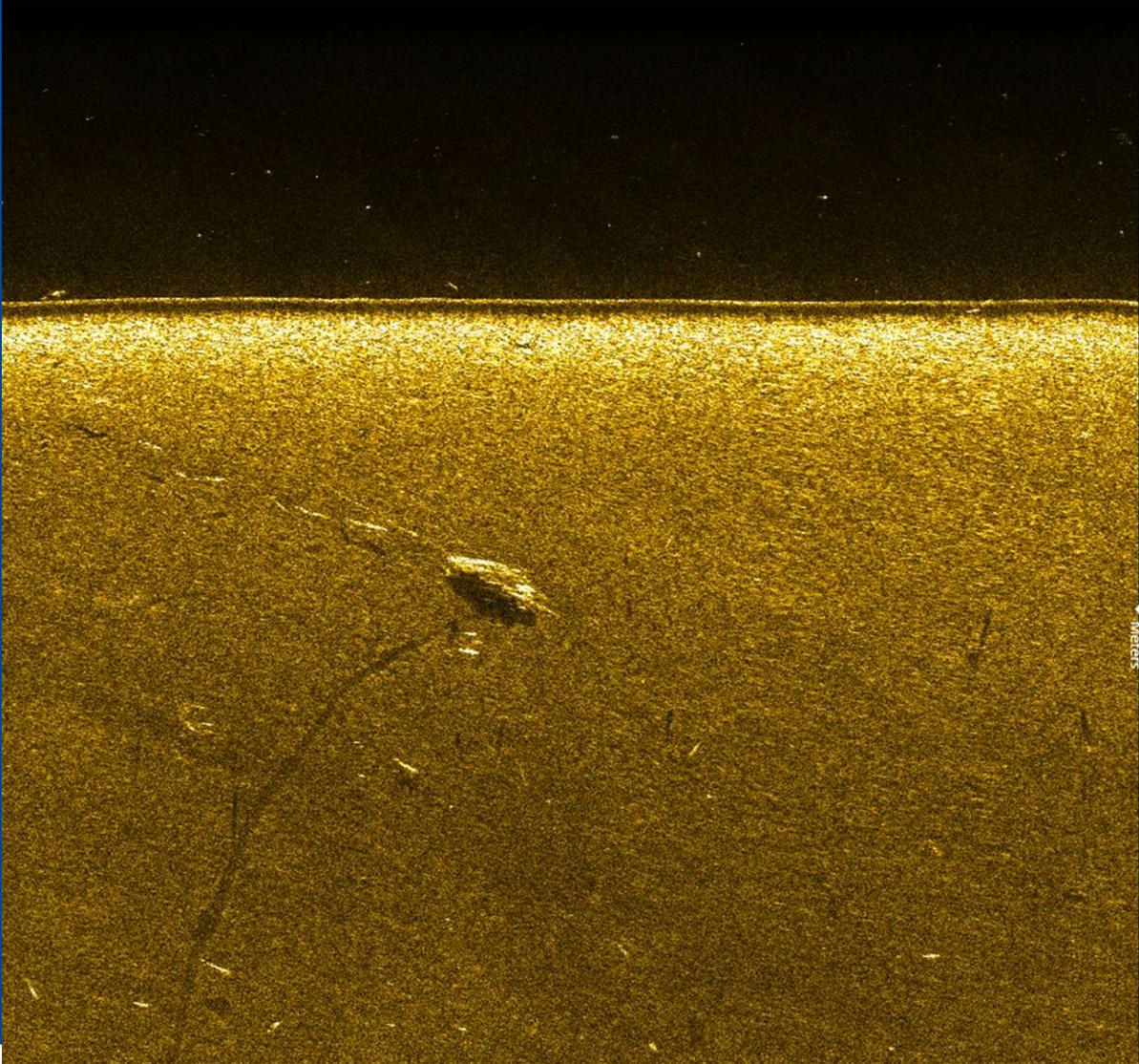
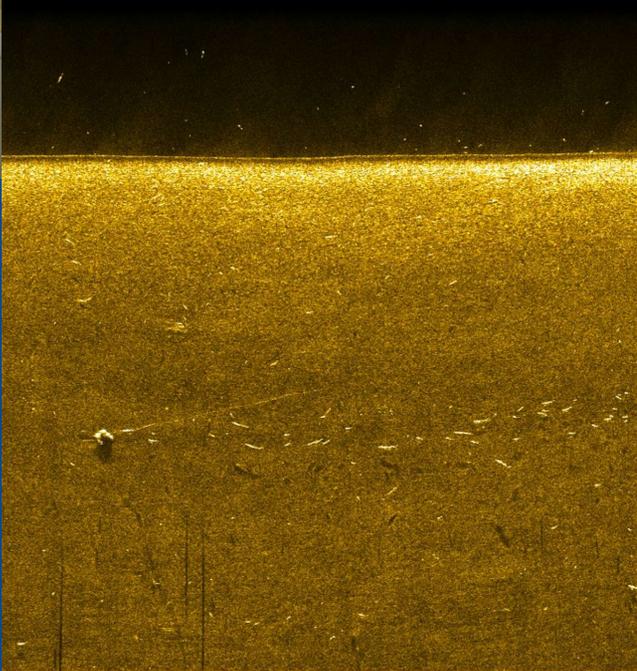
Sidescan Sonar

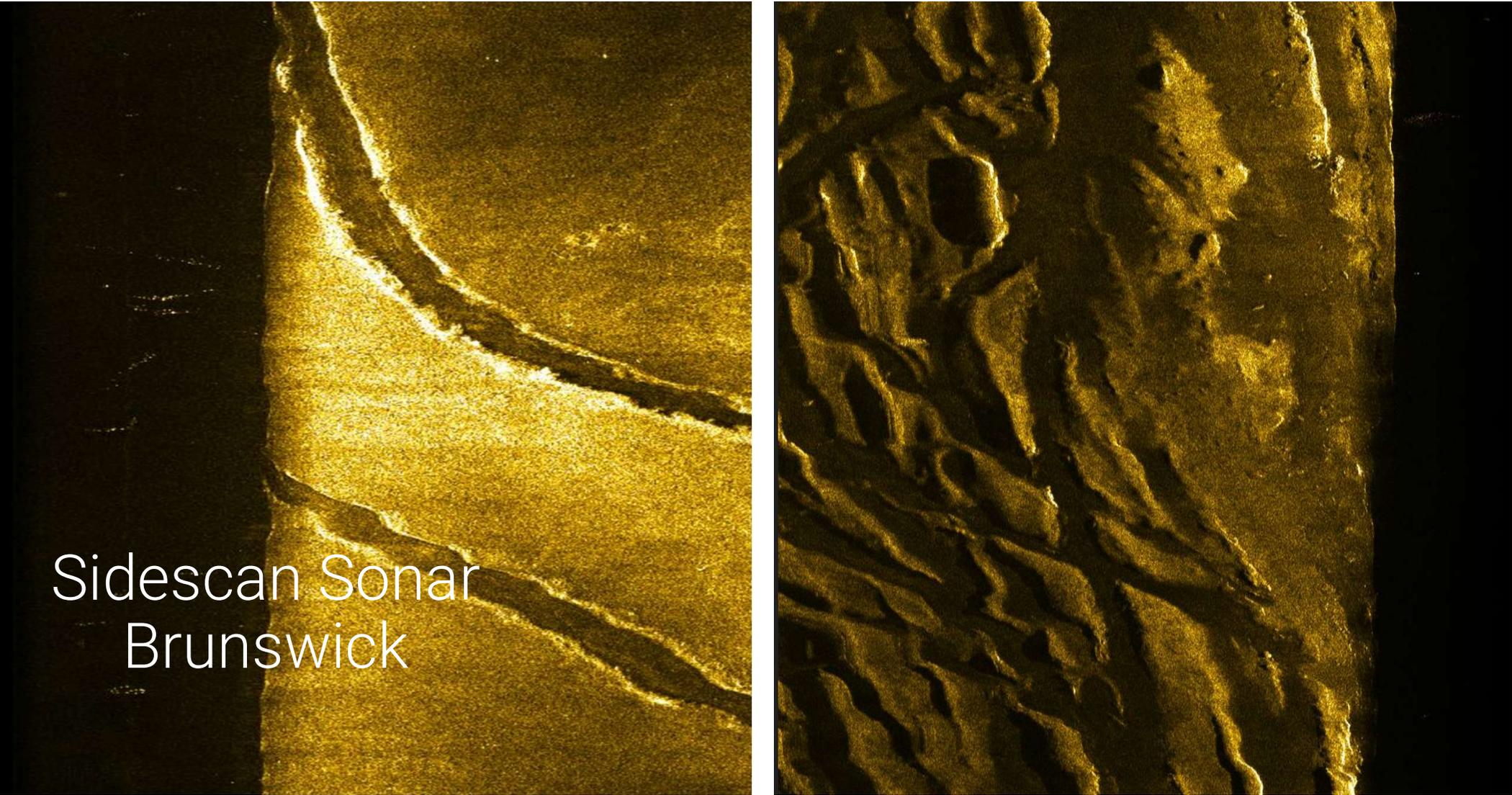


Sidescan Sonar



Sidescan Sonar





Sidescan Sonar Brunswick

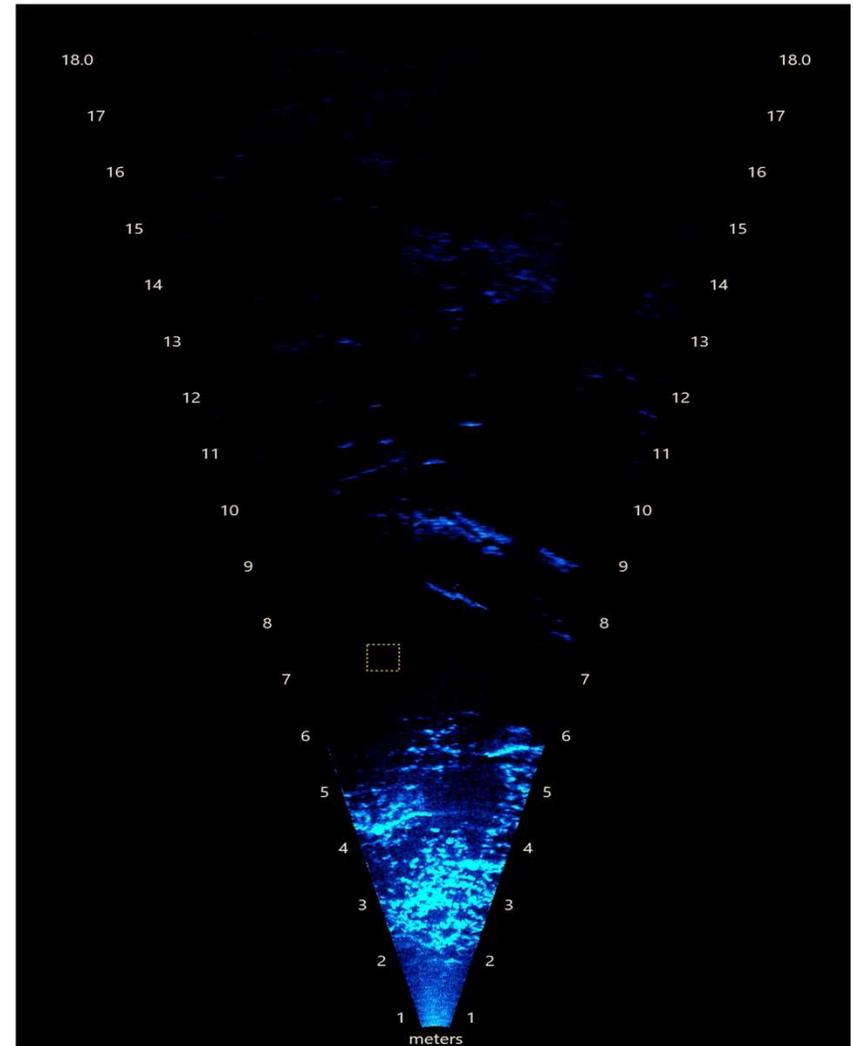
ARIS

Adjustable Resolution Imaging Sonar

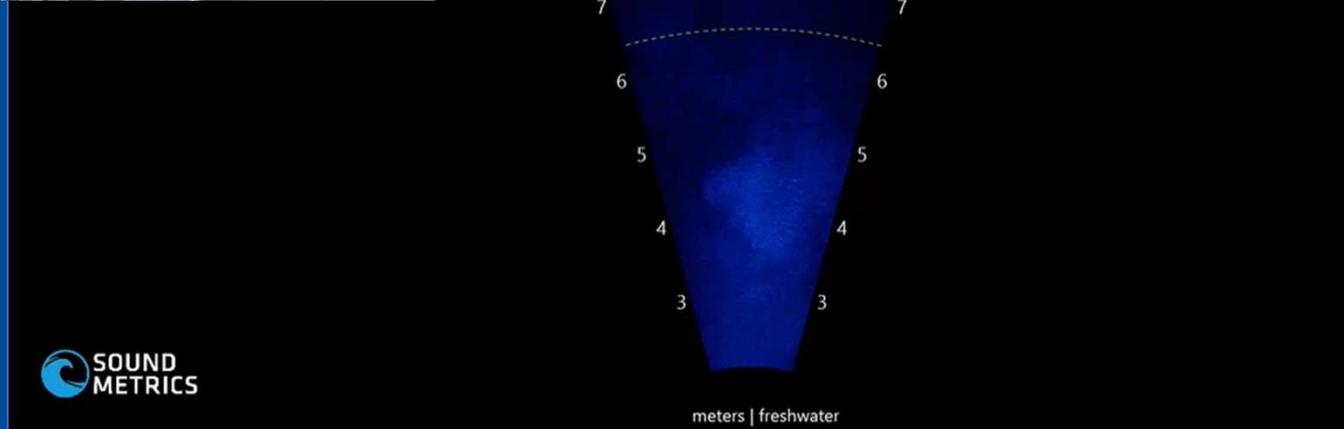


ARIS (Stationary)

FPL/IRG St. Lucie
Cooling Canal
Clear Water

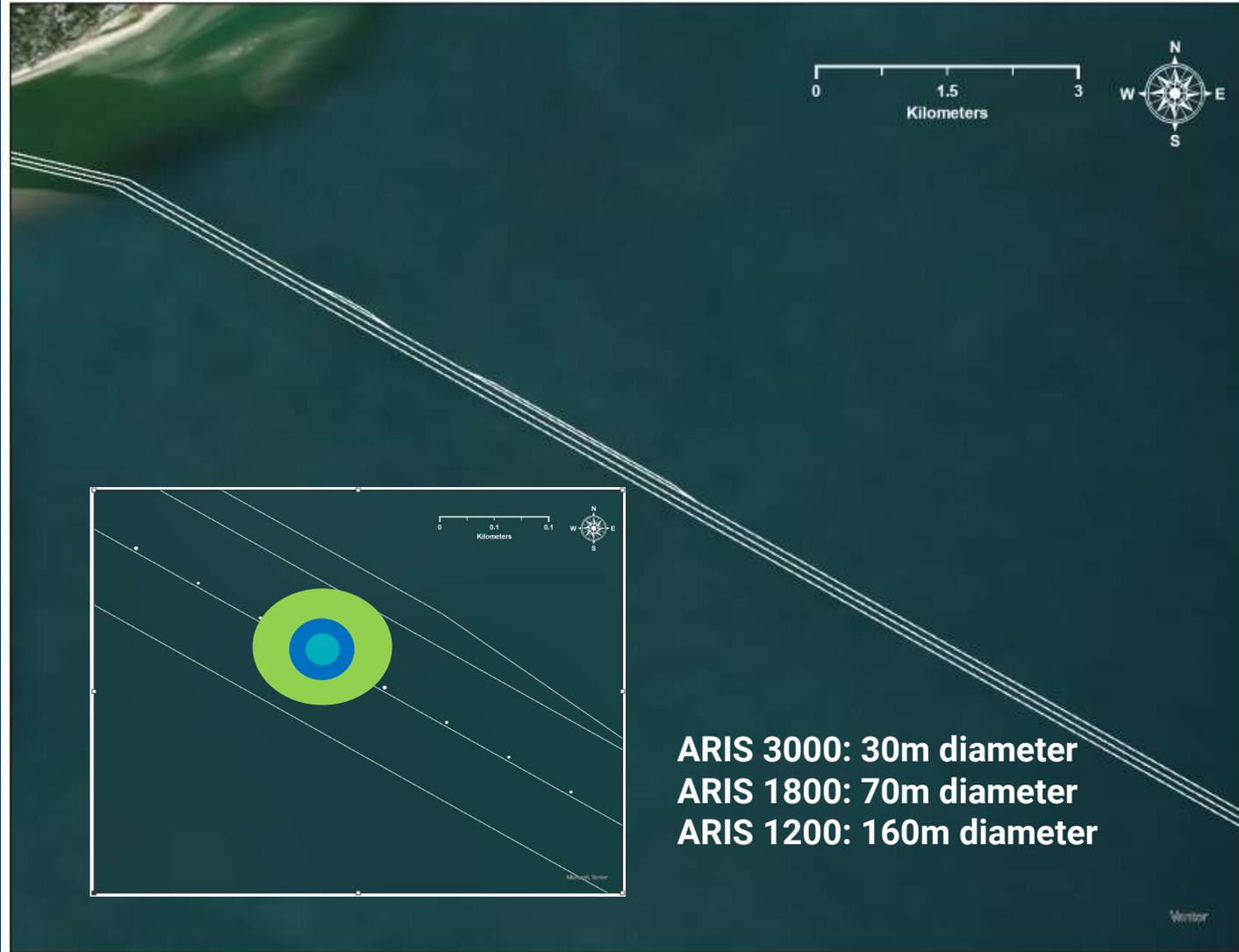


ARIS (Stationary) Turbid Water

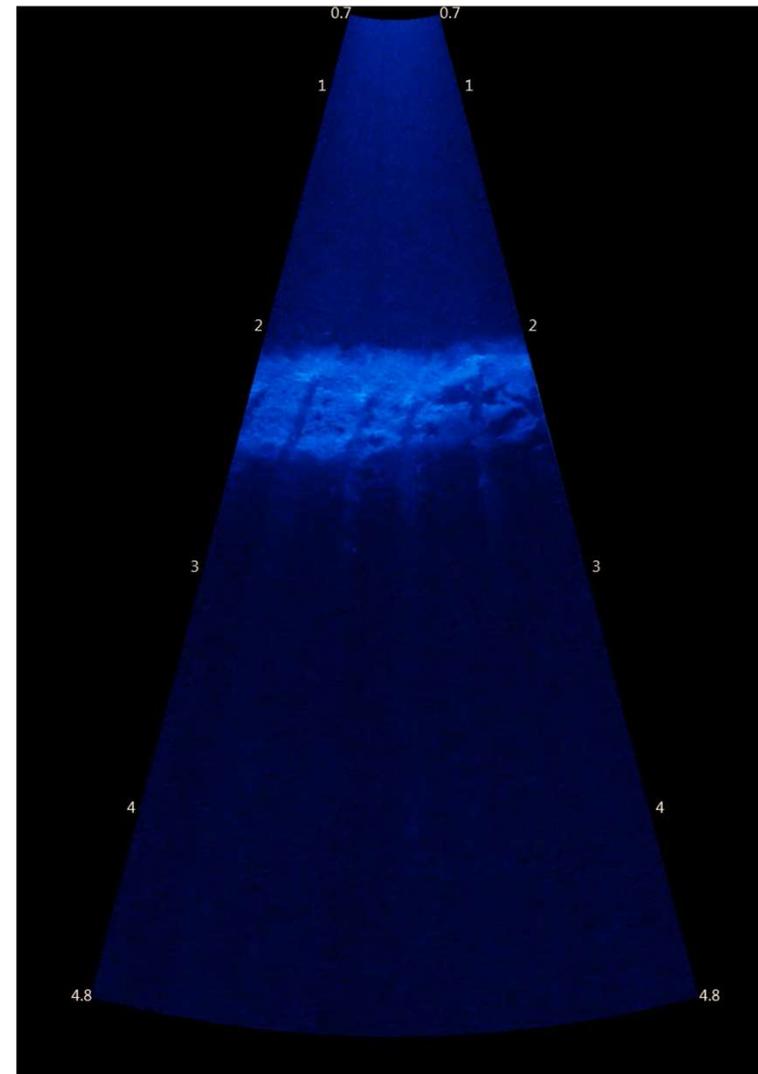


ARIS (Stationary) Density/Behavior

Hopper
Cutterhead
Mechanical
Water Injection



ARIS (Moving)



Next Steps:

COLLABORATION

- Resource Agencies
- Private Dredge Industry
 - GLDD (Tickler Chains & ARIS)
- USACE
- Local Sponsors
- Opportunity
- Time



"Science is not about being right or wrong, it's about being willing to ask the right questions and follow the evidence wherever it leads" - Neil deGrasse Tyson

Thank You



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