Environmental Considerations in Dredging

Looking out on the horizon

WEDA
October 9-11, 2012

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Outline

I. Summary – WEDA 2011

II. Using Technology to Solve Problems

III. Geospatial Tools

IV. Sea Turtles - Spatial and Temporal Behavior Patterns

V. Risk Based Management

VI. Beach Nourishment Borrow Sources

VII. "Precision Dredging"

VIII. Borrow Use Optimization

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Summary

WEDA 2011

Three Federal Laws Play a Significant Role in Dredging

1. National Environmental Policy Act of 1969
   - Federal agencies must evaluate proposals and alternatives for levels of GHG (25,000 metric ton threshold)
2. Endangered Species Act of 1973
   - Listing process, new species, increased costs, etc.
3. Marine Mammal Protection Act of 1972
   - "Take" – Lethal, Level A harassment, Level B harassment (i.e. blasting, dredging, ship noise)

•Reference: Jordan-Sellers, T. "Environmental Considerations for the Future of Dredging," *Proceedings of the Western Dredging Association Technical Conference and Texas A&M University Dredging Seminar*, Nashville, Tennessee, June 5-8, 2011.

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Summary

WEDA 2011

Requirements

- All require the federal government to determine the effects of an action on a specific group of species, or assess and disclose the effects of a proposed action on the "human environment"

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Summary

WEDA 2011

"As technology advances, our ability to assess the effects of our actions on the environment improves. This increase in knowledge may result in determining new environmental impacts not previously assessed for dredging projects, as well as reevaluation of the importance of certain habitat types that were not previously considered significant."

Technology = **Opportunity**

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Using Technology to Solve Spatial Planning Problems

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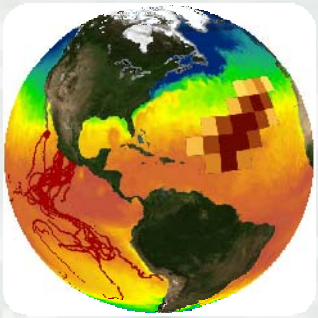
Geospatial Tools

Evaluating Spatial and Temporal Interactions

Example Tools:



- ***Marine Geospatial Ecology Tools** (http://mgel.env.duke.edu/mget/)
- **OBIS-SEAMAP** – Geo-referenced online database
  - Aggregate marine mammal, seabird and sea turtle data all over the world. (www.iobis.org)
- **Satellite Tracking and Analysis Tool** (STAT) (www.seaturtle.org)

Applications:

- Habitat modeling
- Species behavior

*Roberts, JJ, Best BD, Dunn DC, Treml EA, Halpin PN (2010) Marine Geospatial Ecology Tools: An integrated framework for ecological geoprocessing with ArcGIS, Python, R, MATLAB, and C++. *Environmental Modelling & Software 25*: 1197-1207.

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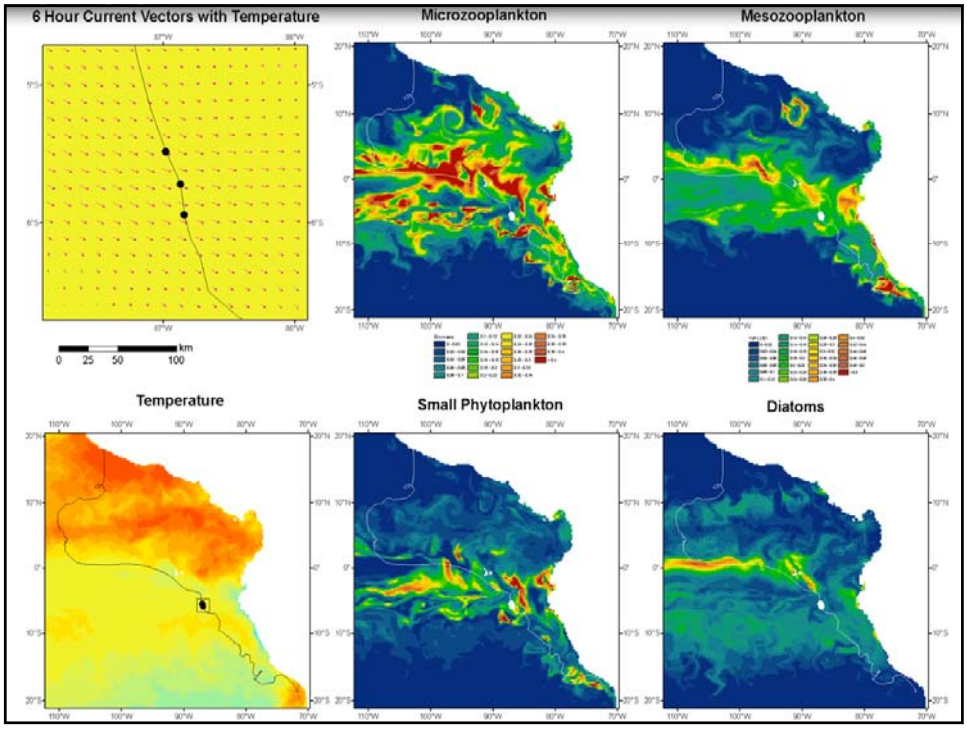
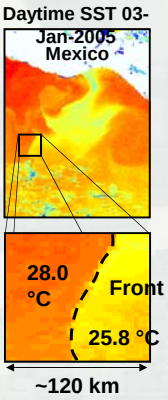
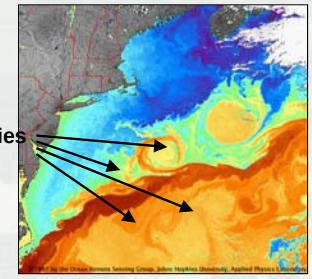
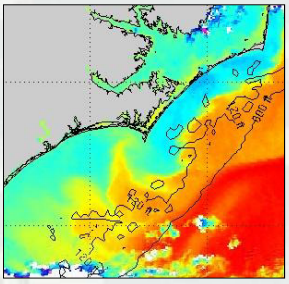


Sea Surface Temperature Fronts and Eddies



Eddies





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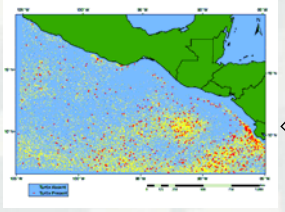
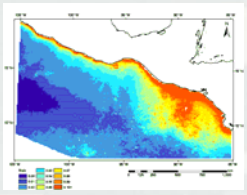
Model Species Habitat

Point observations of species

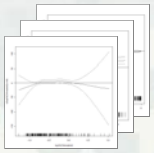


Probability of occurrence predicted from environmental covariates

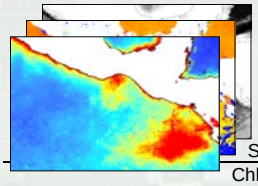


Predictive model

$$g(\mu) = \beta_0 + \beta_1 x_1 + \cdots + \beta_m x_m$$

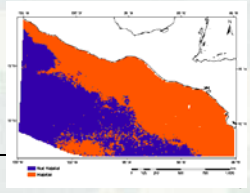


Gridded environmental data

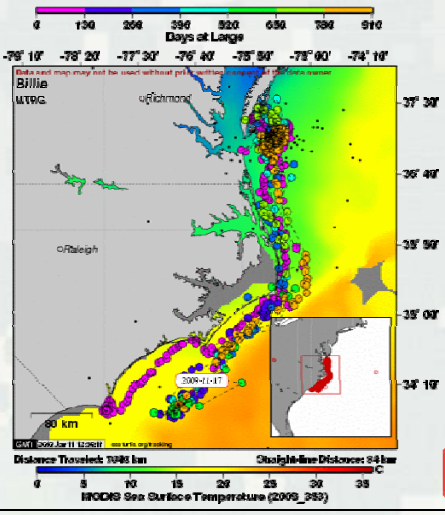


Bathymetry
SST
Chlorophyll

Binary classification



Spatial and Temporal Utilization of Hopper Dredging Locations by Sea Turtles



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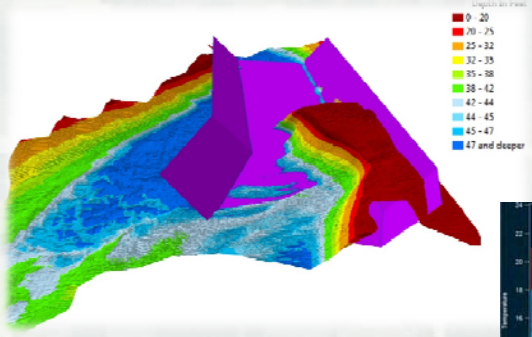
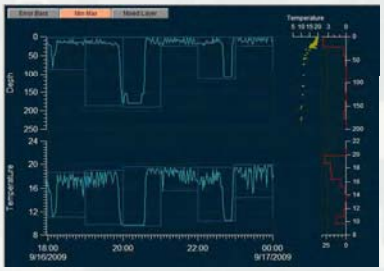
Risk Based Management

Sea Turtles

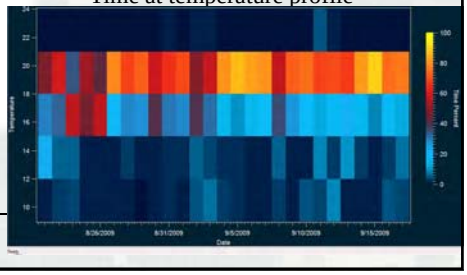
Time Series Data

Morehead City Harbor, NC





Time at temperature profile



Atlantic Sturgeon - Endangered

- **Atlantic Sturgeon Listing - Endangered**
  - Federal Register dated February 6, 2012
  - Final rule - effective April 6, 2012.
  - Critical habitat has not been designated.
- **Dredging Interaction Risk**
  - Anadromous species
  - Tagging and genetic data
  - Little is known regarding the offshore distribution
  - NC Shallow nearshore waters (i.e. 30-60 ft.) – important winter habitat for juveniles
- **Historic Takes**
  - Dredging
  - Closed net trawling:
- **Potential New Conditions**
  - Hopper dredge screening
  - Windows
  - Tissue sampling
  - Safe handling procedures and Tagging (associated with trawling)

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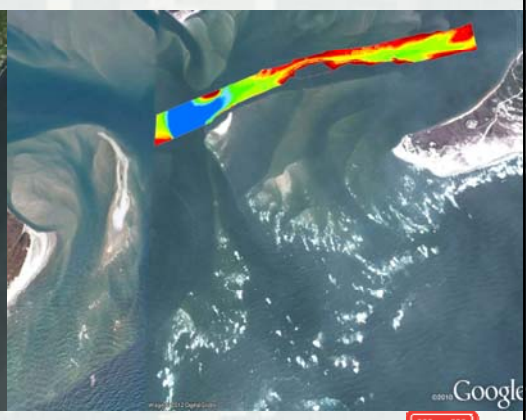
Risk Based Management

Atlantic Sturgeon



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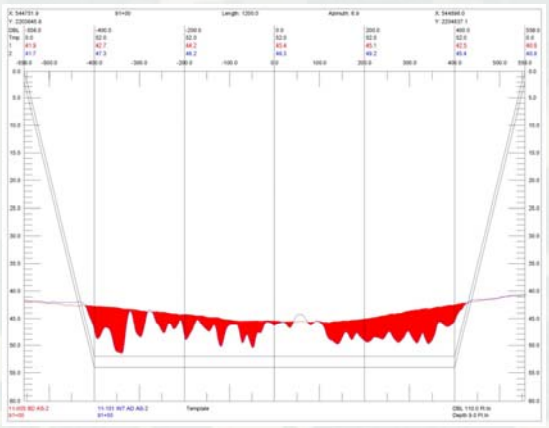
Risk of New Work Dredging

Lessons Learned from Naval Station Mayport, Duval County, FL

- **O&M** - sand and silts
- **New work** - primarily characterized by stiff clay
- **Rigid vertical face** - Draghead deflector inefficiencies
  - Pull the draghead down into the trough.
- **Increased Risk** - Turtles may be concentrating in troughs due to food sources (i.e horseshoe crabs) collecting based on water currents and channel dynamics.



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Beach Nourishment Borrow Sources

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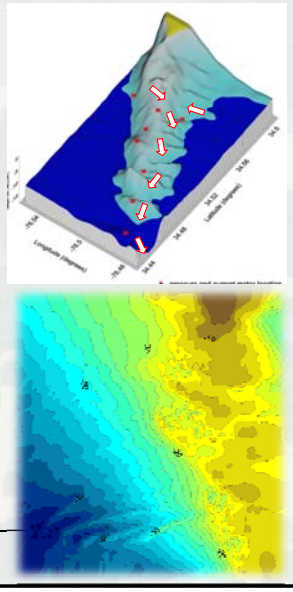
Dredging Cuspate Forelands

- **Assumption**:
  - Offset impacts
    - Relative size
    - Infilling
    - Avoid inlet related EFH concerns.
  - Structural integrity drives ecological functions
  - Wave/wind/tidal forces will maintain sediment transport and structural integrity.
  - Maintain shoal integrity ⇨ Maintain ecological functions
  - Avoid significant adverse impacts to EFH
  - Quick recovery

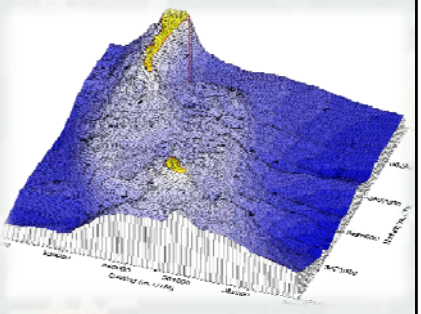
- **Challenges:**
  - Shallower more dynamic working environment
  - Innovative dredging methodologies



"Precision Dredging"

Future Environmental Conditions:

- Positive slope towards the shoal
- Avoid box cut designs
- Wider and shallower rather than deep holes
- "Striped" dredging pattern
- Partial dredging of shoals
- Minimize impacts to overall shoal integrity
- Prioritize dredging of the shoals (1) leading edge for faster infilling rates, (2) crest and, (3) trailing edge
- Avoid interrupting natural shoal migration and potentially reduce the time required for site refilling



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Borrow Area Use Optimization

Problem:

- •Sediment scarcity
- •Multiple use conflicts
- •No consistent borrow area use plans
- •Dredging intensity is not systematically planned

Need:

- •Regional strategies
- •Optimize the use of sand resources
- •Advanced planning framework
- •Impact minimizing strategies

Strategy: "Three Tiered Approach"

1. Regional sediment transport dynamics and project engineering requirements
2. Environmental considerations
3. Best Management Practices and mitigation measures

Summary

Key Points

- •Utilize geospatial tools to better understand spatial and temporal resource interactions with dredging activities
- •Risk informed decision making
- •Borrow area optimization
- •"Precision dredging"

Photo: DJ Struntz

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