Supports for SAV Research

• Economic value of seagrass/SAV beds vs. the equivalent acreage of coral reefs or salt marshes
  – SAV/seagrass receive the least media, funding, and research attention

• Much of the SAV research and funding efforts have been focusing on marine seagrass habitats
  – Brackish and intermediate SAV beds provide important services and unique function to the environments and fisheries.
Conventional SAV Habitat Models

• Developed based on long-term water quality monitoring data
  – Model application by end users also requires many years of consistent water quality monitoring
  – Model usages are limited to the areas with well monitored habitats.

• Developed from classical regression methods
  – Difficult to apply them in areas with complex landscape features
Research Needs

• Habitat Suitability Index (HSI) modeling approach
  – Establish and use functional relationships between biological factors and habitat/landscape variable
  – Useful in development of habitat quality models that incorporate landscape parameters
Research Objectives

• To model coastal SAV communities of the fresh, brackish, and estuarine zone using relatively static features that do not require long-term data collection.

• To develop a HSI for SAV beds/types through a decision tree approach that utilizes parameters related to landscape/topographic information.
Methods

I. Survey Areas

Shallow waters in estuaries, channels, adjoining bayous, streams, inlets, and lagoons of coastal MS and Mobile Bay, AL were surveyed from 2008 to 2010. The survey extended to 20 miles upstream from the river mouth.
Methods

1. Field Surveys

- Survey methods
  - raking from a boat, wading, snorkeling in the water
- Data collection
  - The location and species of SAV
  - Nearby floating aquatic
  - Dominant shoreline emergent plants
  - GPS coordinates recorded using a Trimble™ GeoXH handheld GPS unit and TerraSync™ software.
  - Depth profiles from the shoreline to the bed edge
  - Sediment type
  - Water quality
Methods
2. Mapping

- The survey locations and data were added onto base maps using Google Earth and ArcGIS
Methods
3. SAV Habitat Characterization

Landscape parameters that are important for locating and characterizing SAV resource structures were identified using topomaps, GIS, and other ancillary data.

- Substrate type
- Shoreline type
- Curve
- # In and Outlets
- Stream Order
- Distance to Sound
- Shore Aspect
- Stream Width
- Shoreface Profile
- Maximum Depth
- Shoreline vegetation
Methods
3. SAV Habitat Characterization

- **Substrate type**
  - Fine sand/Clay
  - Mud
  - Mud/OM
  - Mud/Sand
  - OM
  - OM dominated others
  - Sand
  - Sandy mud
  - Shells with others

- **Shoreline type**
  - Marsh
  - Bulkhead
  - Beach
  - Woody bank
  - Mud bank
  - Riprap
  - Shell
Methods

3. SAV Habitat Characterization

- Curve (meandering)
  - Concave
  - Convex
  - Straight

- # In and Outlets

http://www.mostreamteam.org/activity_guide/watershed/missouri_riverBasins_watersheds.htm

Methods

3. SAV Habitat Characterization

- Stream Order
- Distance to Sound
- Shoreline Aspect
- Stream Width
- Shoreface Profile
- Maximum Depth

3. SAV Habitat Characterization

- Shoreline vegetation
Data Analysis
1. Shoreline Vegetation Clustering

Example:

- **ShoreVeg Group 1**
  - Saltmarsh and intermediate marsh grass, sedge, rush species
- **ShoreVeg Group 2**
  - Oligohaline and freshwater emergent species and tree/shrubs
- **ShoreVeg Group 3**
  - Less abundant, higher diversity, upstream freshwater shoreline vegetation groups
Data Analysis

2. SAV clustering

Complete linkage (=max dist)

Ward's linkage (=min var dist)
Data Analysis

2. SAV clustering

Example:

- **SAV Group 1**
  - *Ruppia, Vallisneria, Myriophyllum* spp.

- **SAV Group 2**
  - *Vallisneria, Potamogeton, Zannichellia, Najas*

- **SAV Group 3**
  - All others that are less abundant or occur in upstream areas
Data Analysis
3. CART Analysis

• CART (Classification and Regression Tree)
  – builds classification and regression trees for predicting continuous dependent variables (regression) and categorical predictor variables (classification).
  – Using R language
  – Using surveyed data as the “learning sample”
Results
e.g. CART Analysis result for *Ruppia*

Overall accuracy: \( \frac{70 + 10 + 13}{106} = 88\% \)
Results

e.g. CART Analysis result for *Vallisneria*

```
Aspt.36=abcdefghmnoqrstuvwxyz
  Substrate< 3.5
    0
      24/5
    0
      Profile>=0.165
        0
          6/1
        Aspt.36=mnuwz
            0
              6/3
            1
              3/17
  1
    5/36
```
Other Products and Resources

• **Aquatic Plants Website**
  – jcho.masgc.org
  – http://msaquaticmaps.byethost8.com

• **Field guide Book**
  – Aquatic Plants of the Mississippi Coast, 154 pp

• **SAV brochure**
  – Submerged Aquatic Vegetation and Seagrasses of Coastal Mississippi and Mobile Bay, Alabama

• **Journal Articles**
  – Cho, H.J., A. Lu, P. Biber, J.D. Caldwell. (Submitted). Aquatic Plants of the Mississippi Coast. *Southeastern Naturalist*
Site 36

Biloxi Back Bay
Location: Old Fort Bayou
Survey Period: May-10
Coordinates: 30.4357, -88.74337

Plants growing in and on water:
- Vallisneria americana
- Eleocharis parvula

Dominant shore vegetation:
- Baccharis halimifolia
- Juncus roemeriannus
- Pinus sp.
Eleocharis parvula Link
Further Work

• Readjustments of the landscape parameters into more meaningful continuous or categorical orders
• Application of the Index and Accuracy Assessment
• User manual to introduce the model application and index interpretation
Acknowledgements

• Mississippi-Alabama Sea Grant Consortium
  – USM-GR02639/OMNIBUS-ED-19PD
  – USM GR02639/OMNIBUS-R/CEH-31-PD

• Dauphin Island Sea Lab and NOAA Coastal Services Center in support of the Gulf of Mexico Alliance.

• J.D. Caldwell, Scott Caldwell, Mike Poirrier, Linh Pham, Smoot Major

• Gulf Coast Research Laboratory boat captains: John Anderson, William Dempster, and Gary Gray.

• Albert Williams at NCBC of Jackson State University
Coastal Habitat Mapping:
Spectral algorithm for improved submerged aquatic vegetation signals
REMOTE SENSING?

- the science and art of obtaining information about an object, area, or phenomenon through the analysis of data acquired by an electromagnetic energy sensor that is not in contact with the object under investigation
Spectral Reflectance Characteristics of Vegetation and Conventional Vegetation Indices

Image source: http://extnasa.usu.edu/on_target/imagess_independent/nir_vegetation_graph.gif
Submerged Aquatic Vegetation (SAV)/Seagrass

- Valuable resource and indicator of aquatic habitat quality

Image Source:
http://www.unc.edu/ims/paerllab/research/seagrass/concept.html
Algorithm to model water effects (water absorption)

* water absorption can be derived from the following way

\[ 1 \times (1 - A_w/2) \times R_r \times (1 - A_w/2) + R_w = R_m \]

\( A_w \) and \( R_w \) are the functions of water.

* For any bottom panel, \( R_r \)
can be directly measured.
\[ \text{Reflectance}_{\text{corrected}} = f(\text{ref}_{\text{measured}}, \text{depth}) \]

- Water Absorption
- Water Volumetric Reflectance
Graphical User Interface
694 nm (Red Energy)
ACKNOWLEDGMENTS

• Funding
  – National Oceanic and Administration Agency (3 awards)
  – National Geospatial-Intelligence Agency (2 awards)
  – National Aeronautics and Space Administration (2 awards)
  – National Science Foundation (2 awards)
  – Mississippi-Alabama Sea Grant Consortium (4 awards)
  – Mississippi Department of Marine Resources
  – Jackson State University