

Assessment of seagrass habitat quality and plant physiological condition in Texas coastal waters: Summer 2012

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Report to SMWG, 4 May 2012

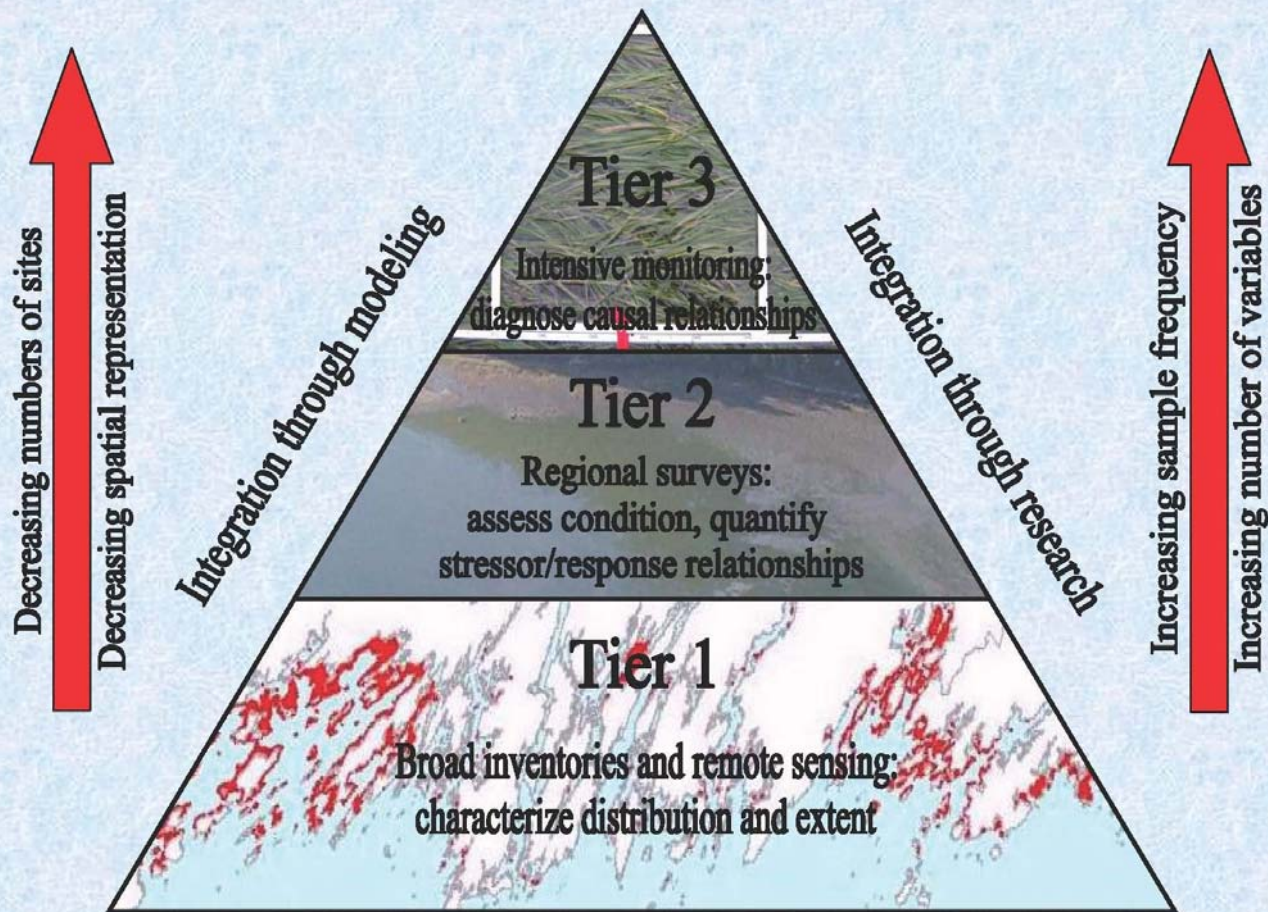


Our Goal:

To provide a State-wide assessment of seagrass condition on both temporal and spatial scales to better evaluate anthropogenic threats to seagrass resources to fulfill seagrass conservation objectives.



Hierarchical Monitoring Framework



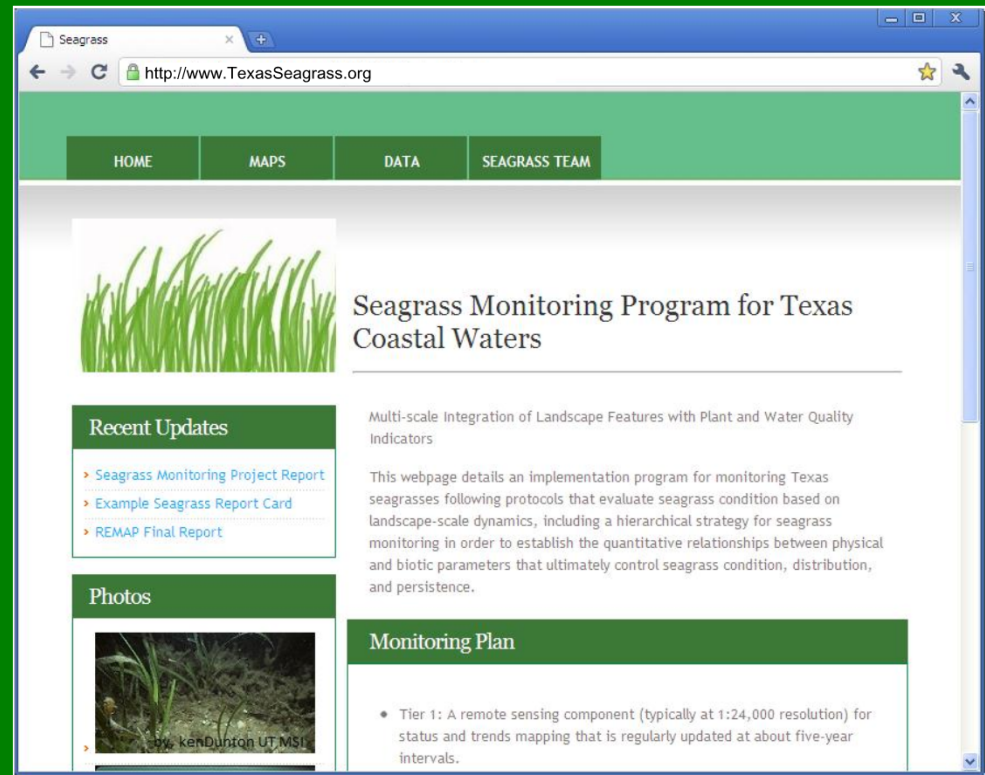
Neckles, HA, BS Kopp, BJ Peterson and PS Pooler. 2012. Integrating Scales of Seagrass Monitoring to Meet Conservation Needs. *Estuaries and Coasts*. Vol. 35: pp 23-46.

Established Methods and Protocols

All of the protocols used in this sampling effort will be posted for general use and reference on www.TexasSeagrass.org

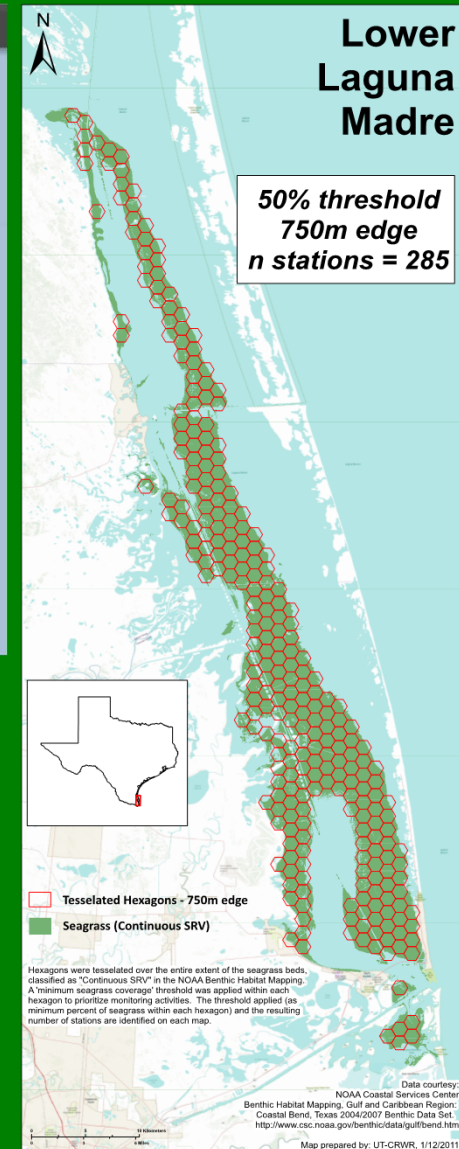
In the very near future, website visitors will be able to query individual methods and locate literature references describing, testing, and implementing these procedures.

Such a resource is easily available to resource managers and ensures measurement consistency amongst different groups and agencies.



www.TexasSeagrass.org

Tier 2 Methods: Site Selection



1. Previously delineated seagrass meadows were used to identify specific regions of interest (NOAA Benthic Habitat Mapping, Texas 2004/2007 Benthic Data Set)*
2. Polygons were used to create a tessellated map overlying these regions of interest
3. Random site locations (567 total) were then identified within each polygon
4. For mapping purposes, the data was interpolated using an inverse distance weighting squared method

*TPWD Seagrass Viewer: <http://www.tpwd.state.tx.us/gis/seagrass/>

Tier 2 Methods: *Rapid* Sampling

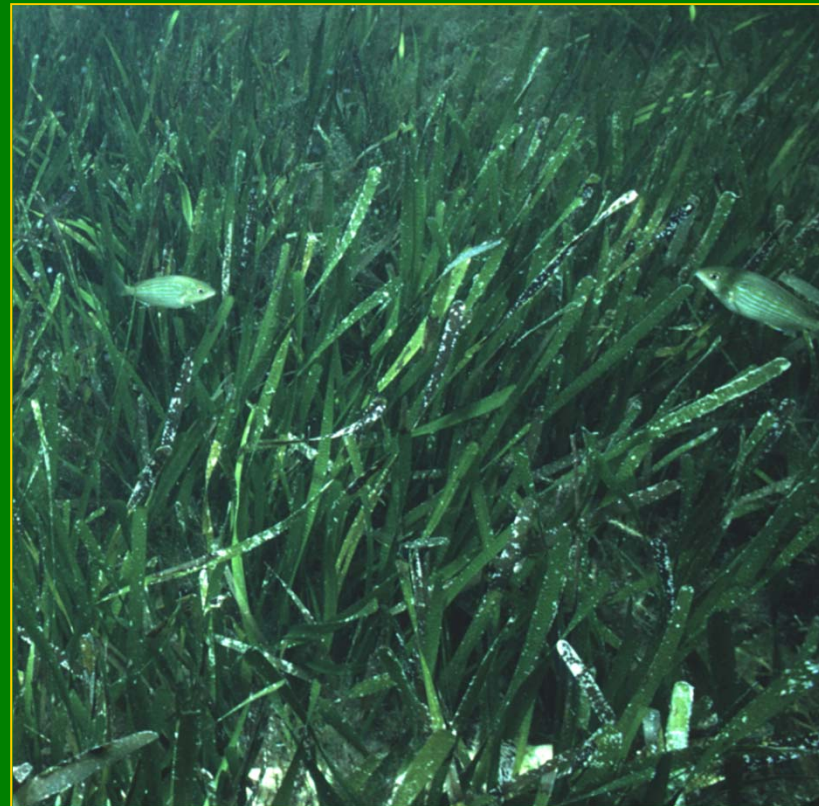
Potential Stressors:

- Light Attenuation
- Total Suspended Solids
- Depth and Secchi Depth
- Temperature, Salinity, pH, DO and Water Column Chlorophyll*

** Measured with YSI Datasonde*

Plant Condition Indicators:

- Percent Coverage
- Species Composition
- Canopy Height
- Tissue C:N:P, δN^{15} and δC^{13}



Tier 2 Results: Lower Laguna Madre (I)

Field measurements of seagrass coverage serve to:

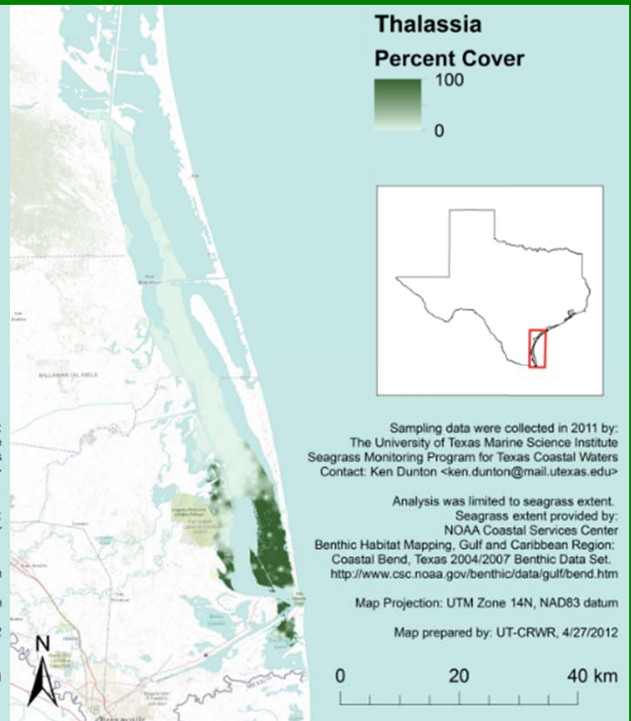
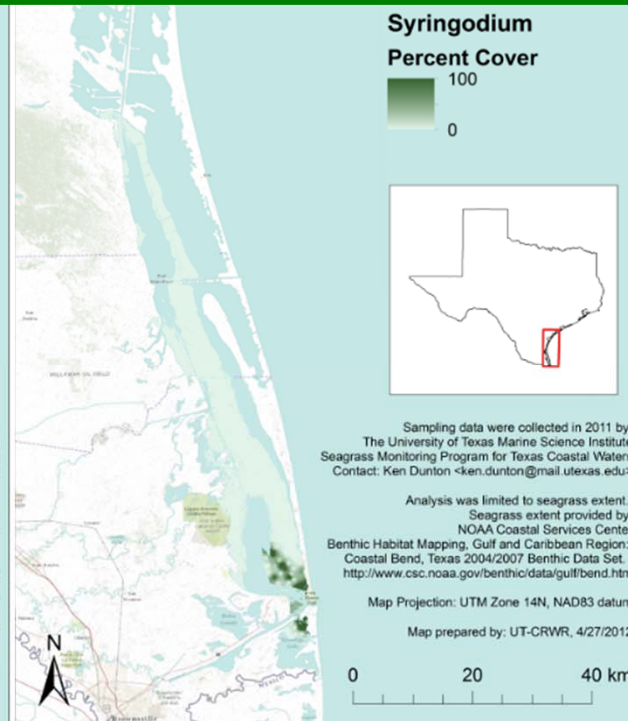
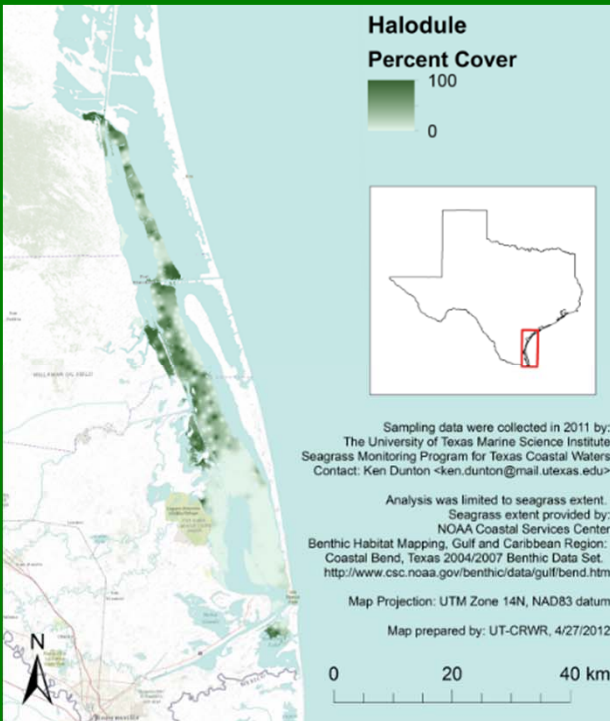
1. *Ground truth remote sensing data*
2. *Quantify the magnitude of seagrass coverage*



Tier 2 Results: Lower Laguna Madre (II)



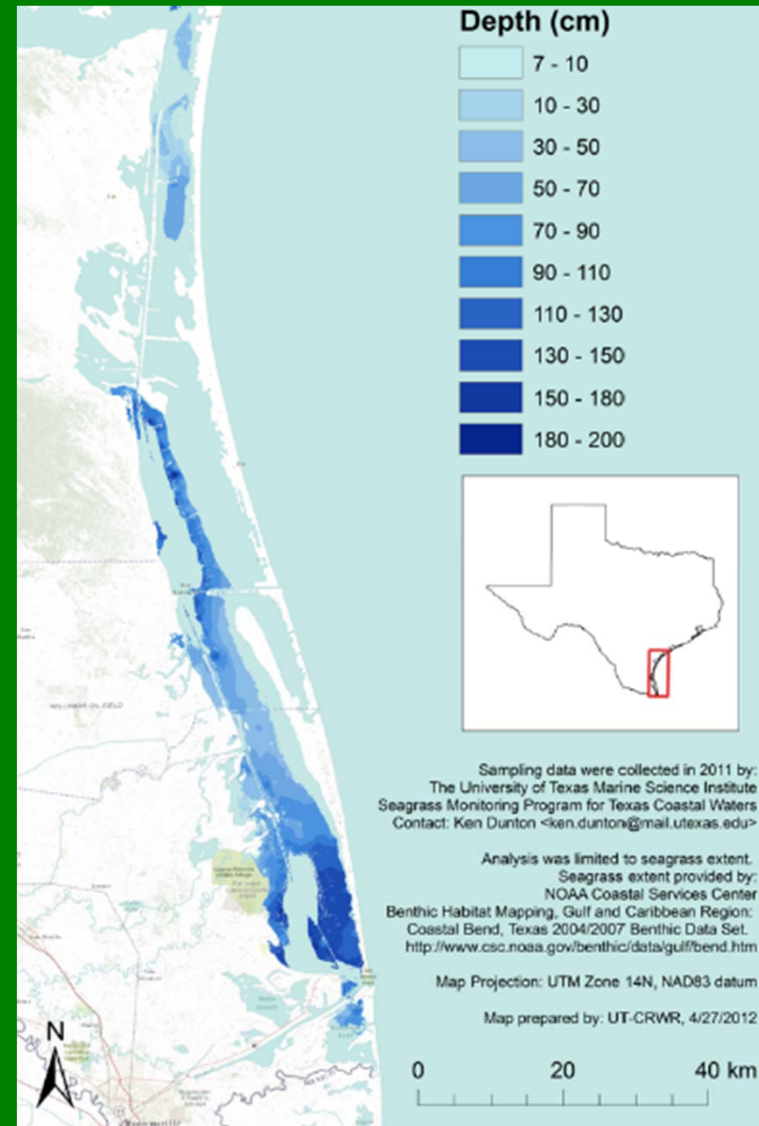
Species identification during the rapid assessment greatly improves the quality and applicability of maps generated using remote sensing techniques.



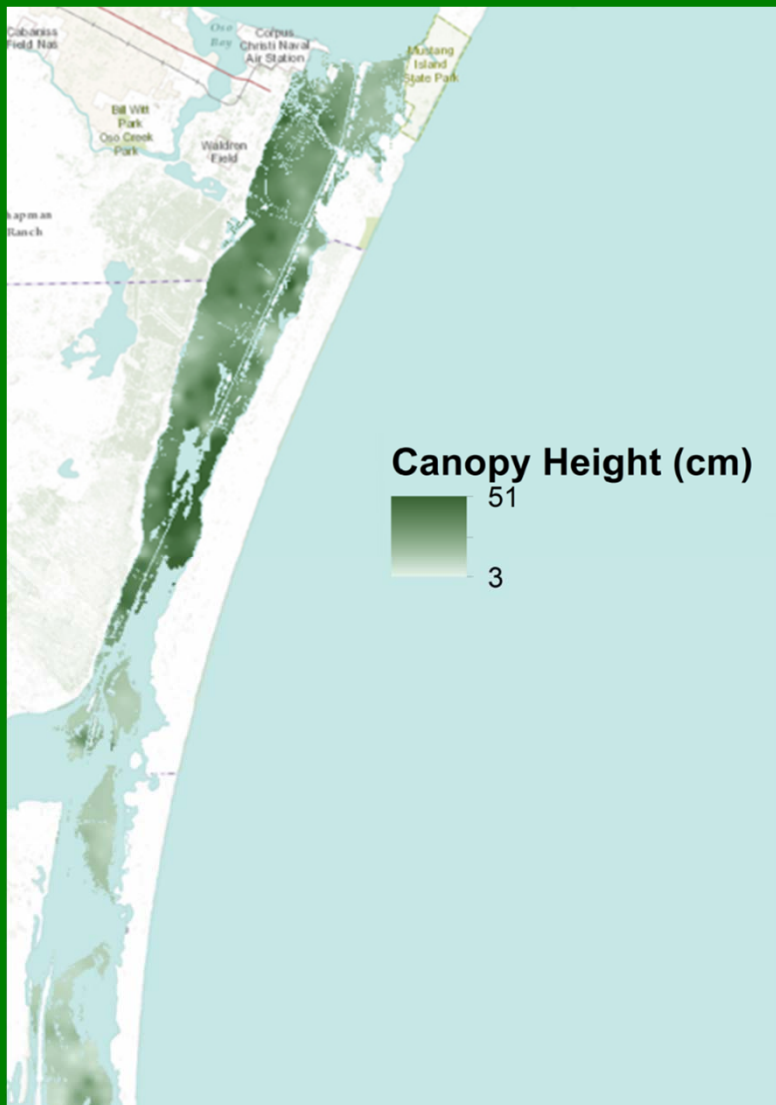
Tier 2 Results: Lower Laguna Madre (III)



Field measurements of bathymetry provide a valuable metric for tracking changes in available seagrass habitat over time resulting from dredging and/or natural erosion.

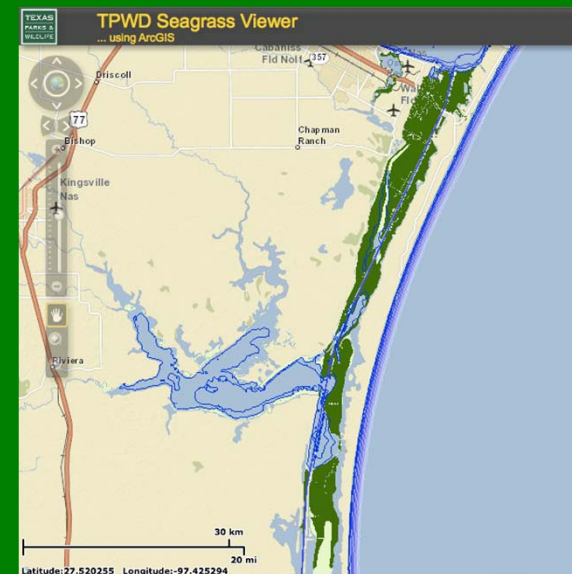


Tier 2 Results: Upper Laguna Madre (II)



Annual measurements of canopy height provide a useful metric for assessing plant condition and habitat availability for resident fauna.

Increasing the sampling frequency for this metric could also yield seasonal or annual estimates of plant growth.



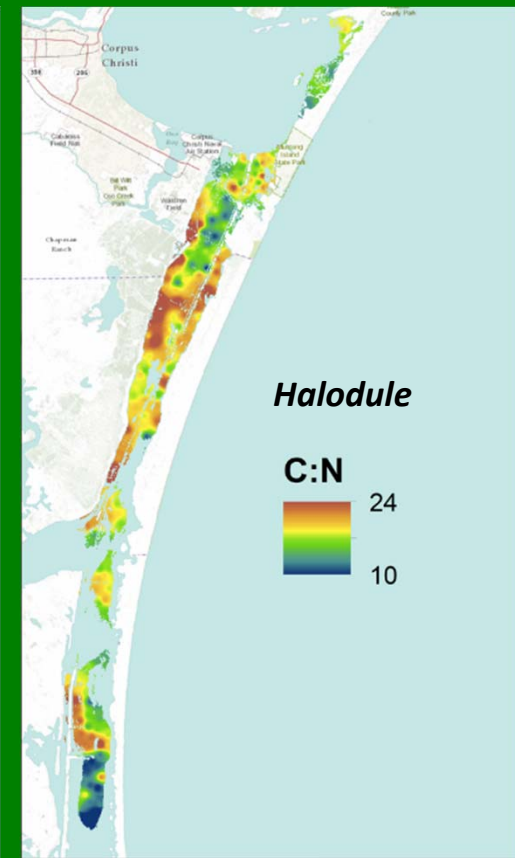
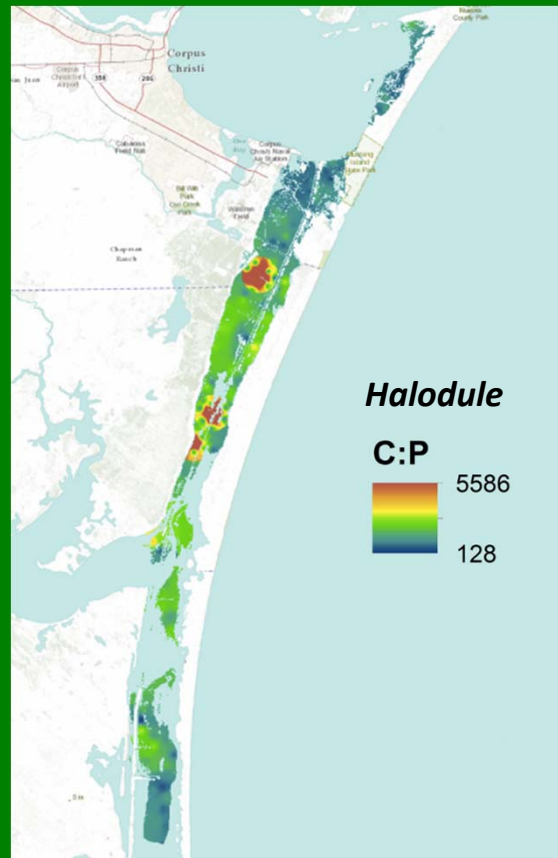
Tier 2 Results: Upper Laguna Madre (III)

The N and P content of seagrass tissues integrate the nutrient conditions in overlying waters and sediments. They are excellent condition indicators and are sensitive to N-loading events.

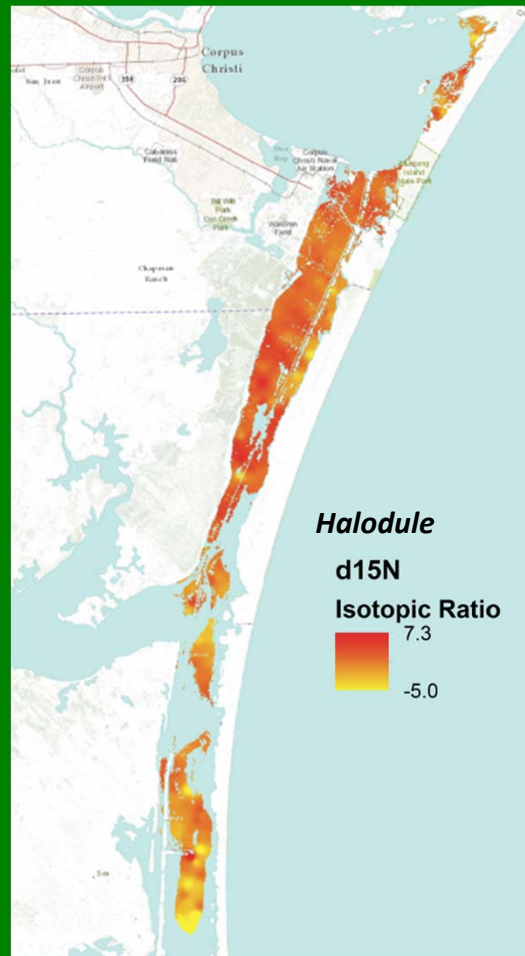
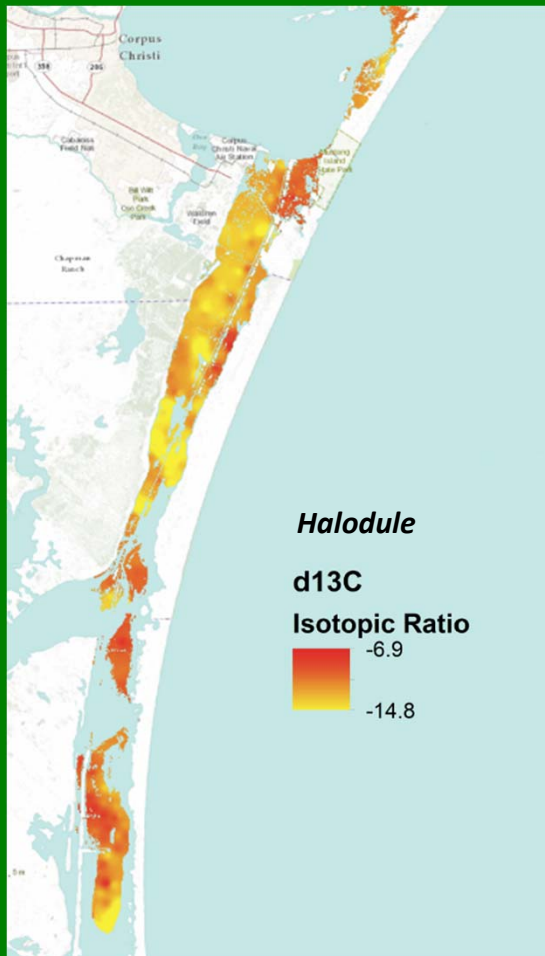


Extremely high C:P and C:N ratios of plant tissue suggests that portions of the ULM are nutrient limited.

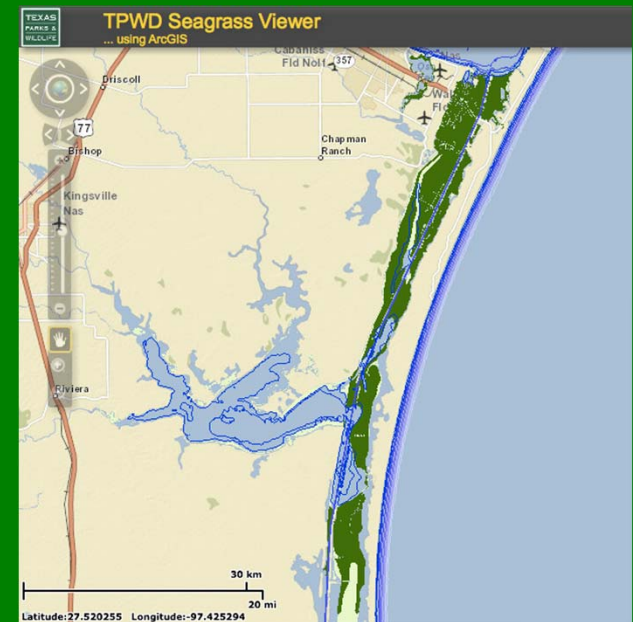
This is likely attributed to the lack of a significant freshwater (nutrient) source to the estuary.



Tier 2 Results: Upper Laguna Madre (IV)



Stable carbon and nitrogen isotopic ratios of plant tissue are useful for identifying changes in nutrient sources over time (i.e. from wastewater effluent).



Case Study #1: Loss of Seagrass



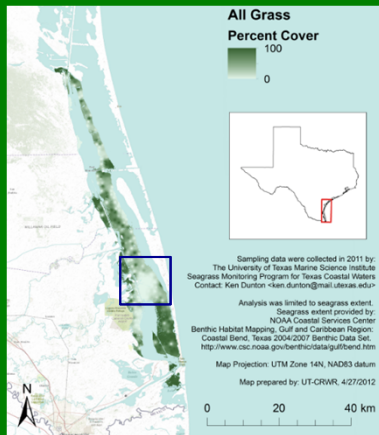
MANAGEMENT CONCERN

- Rapid assessment of seagrass coverage revealed a noticeable absence of vegetation at a suitable depth.
- The last remote sensing effort (2007) showed seagrass cover at this location.
- The location of this bare area is coincident with low salinities in fall/winter 2010 associated with the Arroyo Colorado watershed.

QUESTION

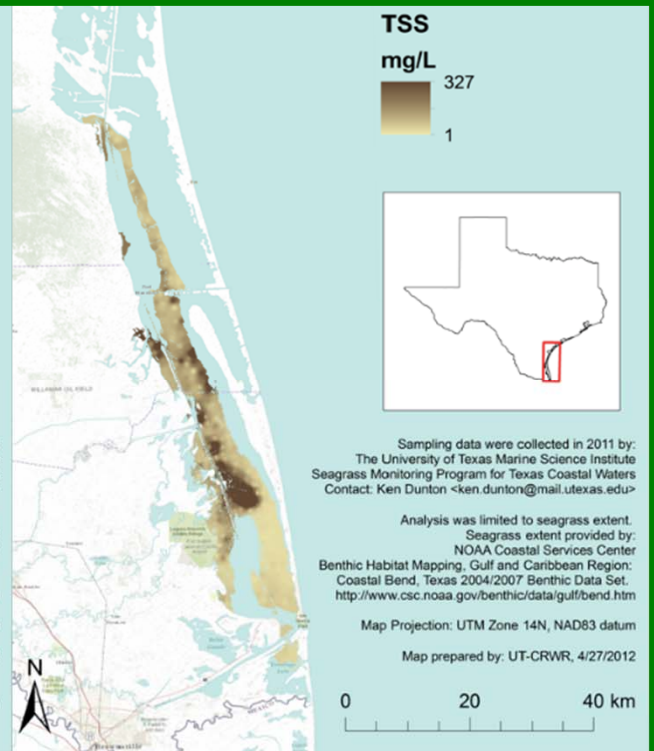
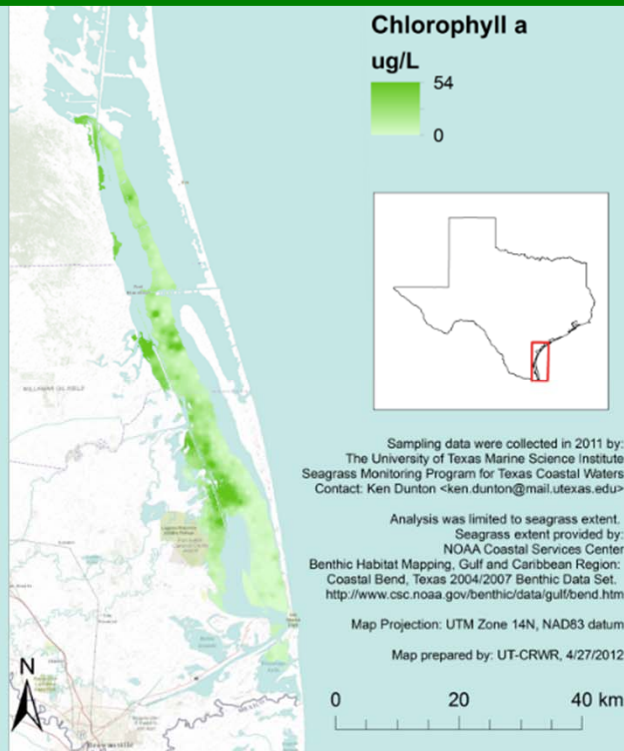
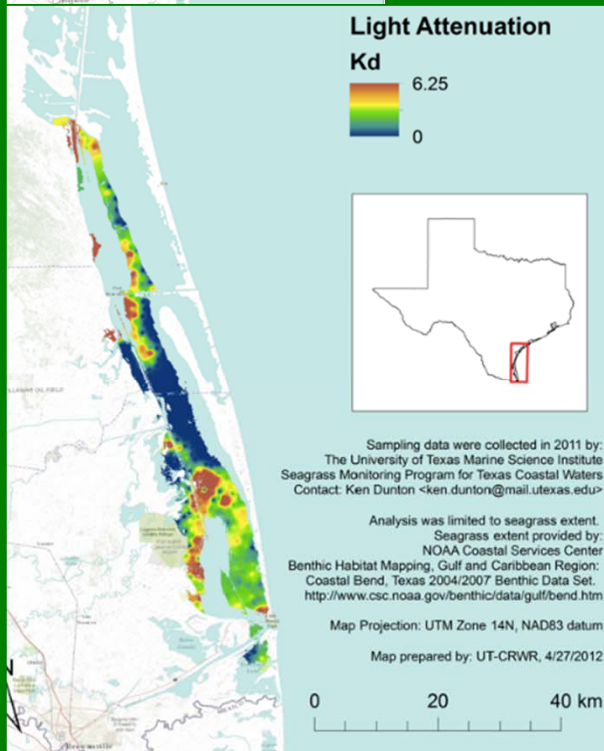
- Do the environmental parameters measured during the Tier 2 assessment sufficiently identify conditions inhibiting seagrass proliferation?

Case Study #1: Loss of Seagrass



The absence of seagrass coverage corresponds to an area of high light attenuation resulting from high concentrations of chlorophyll and TSS.

High spatial coverage and resolution in field data allows resource managers to focus conservation efforts on specific areas of concern.



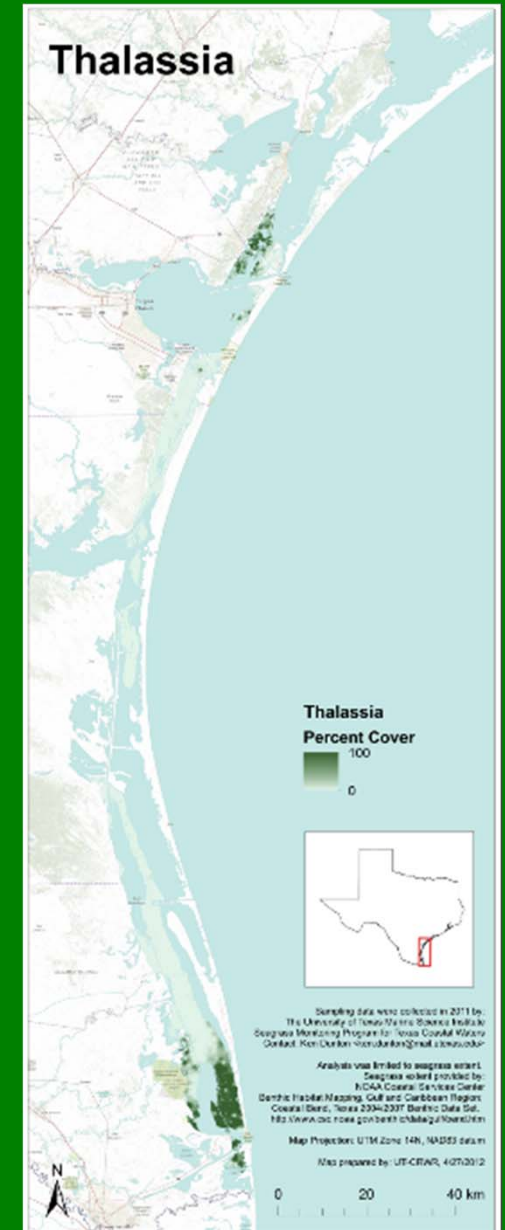
Case Study # 2: Understanding Species Distributions

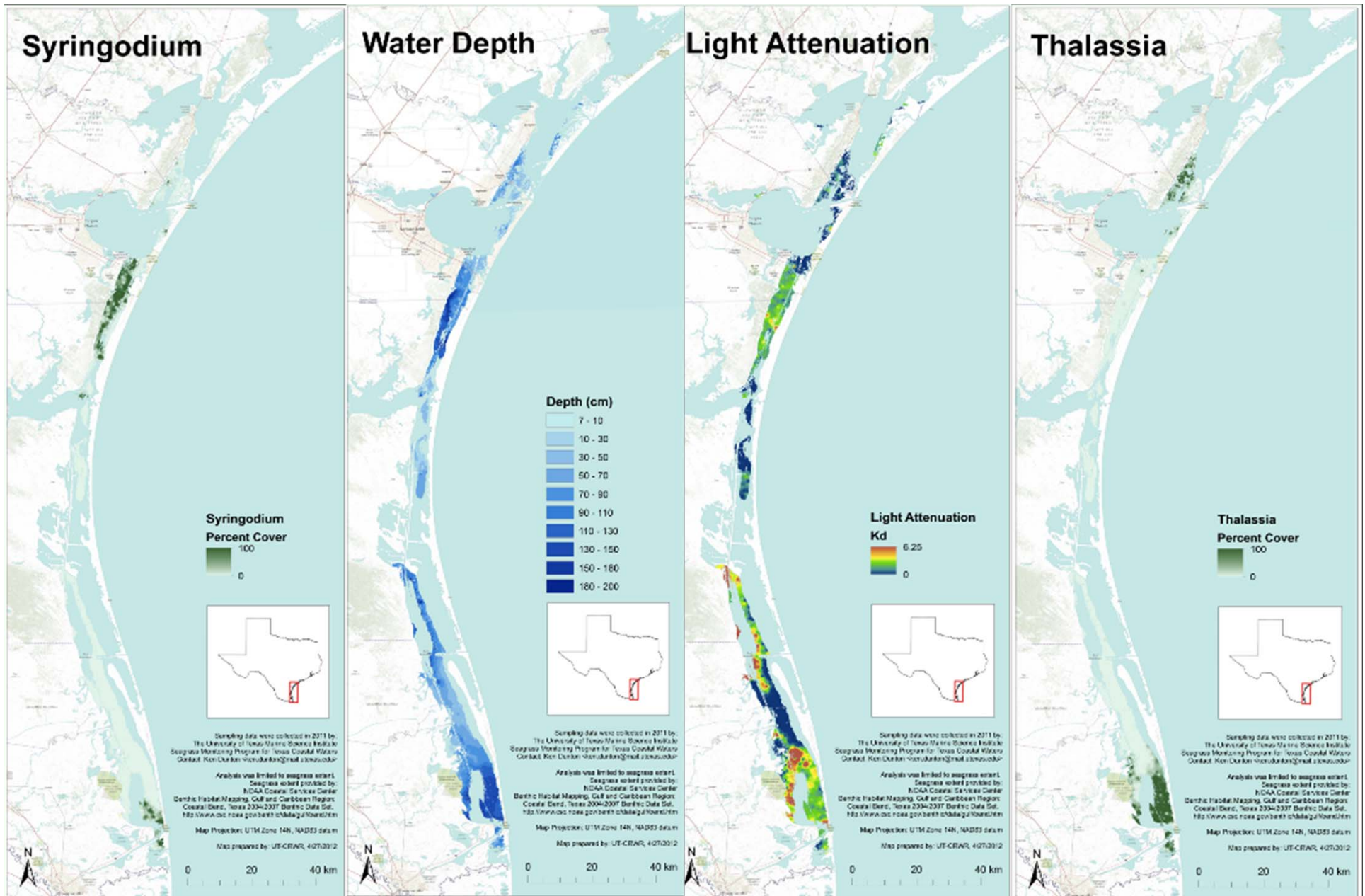
MANAGEMENT CONCERN

- A mitigation agreement from a proposed construction project requires the successful restoration of *T. testudinum* and *S. filiforme*.

QUESTION

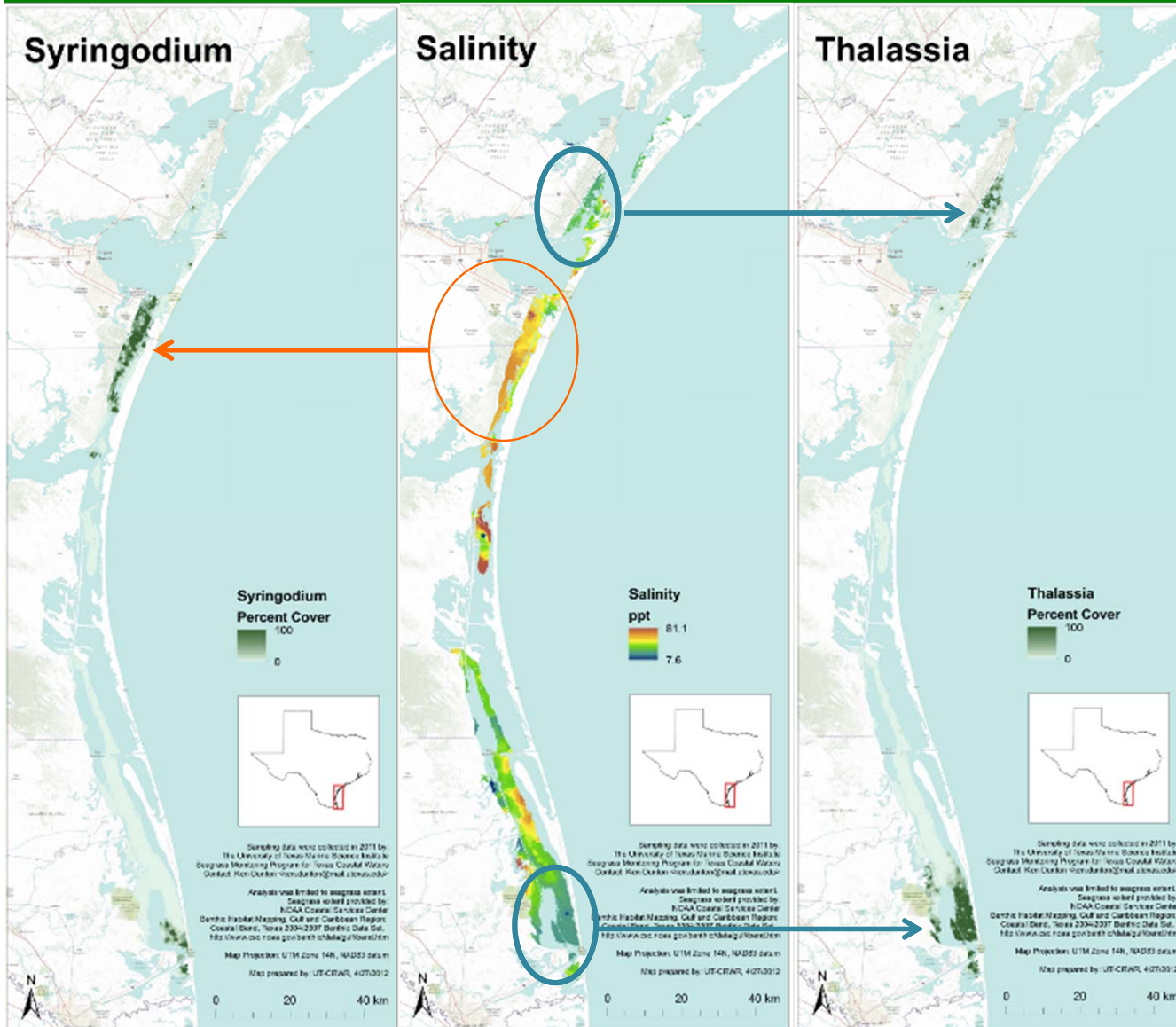
- Are the natural distributions of *S. filiforme* and *T. testudinum* controlled by specific environmental conditions? If so, how can managers successfully identify species-specific restoration locations?





Syringodium and *Thalassia* both reside in deeper waters with similar optical properties...

Case Study # 2: Understanding Species Distributions



Syringodium is generally restricted to the ULM, which has a high residence time and salinity.

Thalassia is restricted to areas near large inlets with lower residence times and salinities.

Since *Syringodium* is known to thrive in locations with lower salinities than the ULM (i.e. Florida), *Thalassia* is likely excluding *Syringodium* in CCB and LLM

Case Study # 3: Managing a Rare Species

MANAGEMENT CONCERN

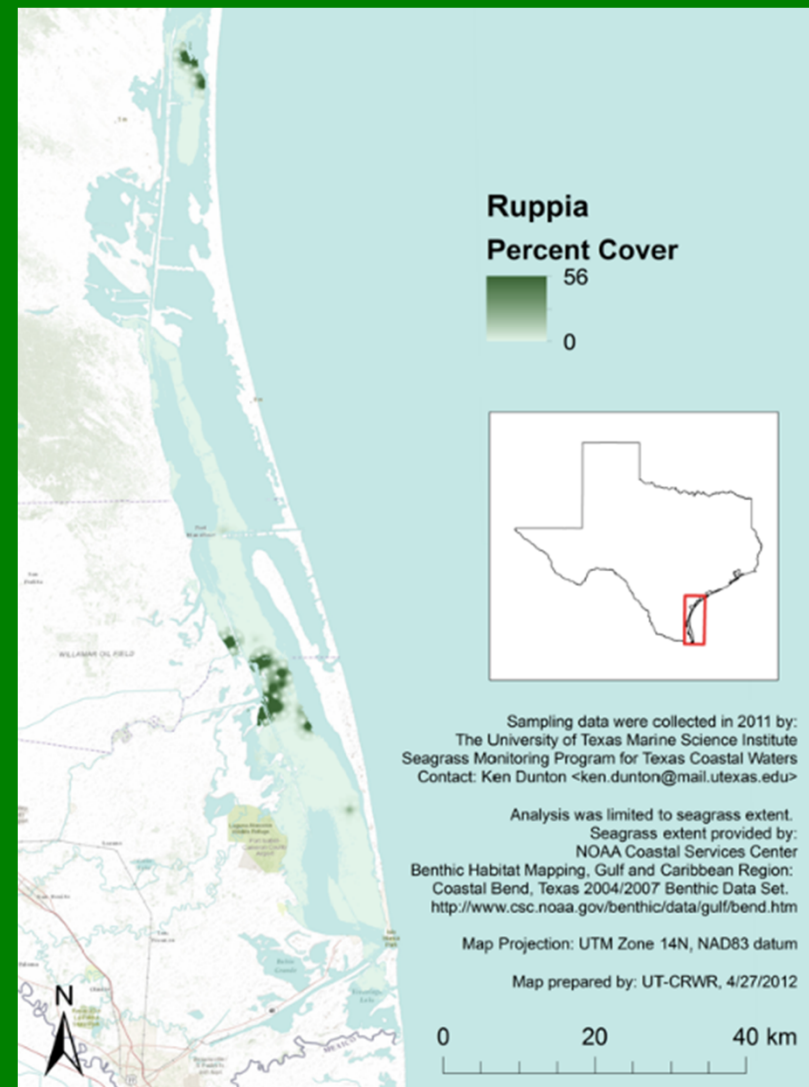
- A rare seagrass species has recently become listed as a “species of concern” and requires legislative protection

QUESTION

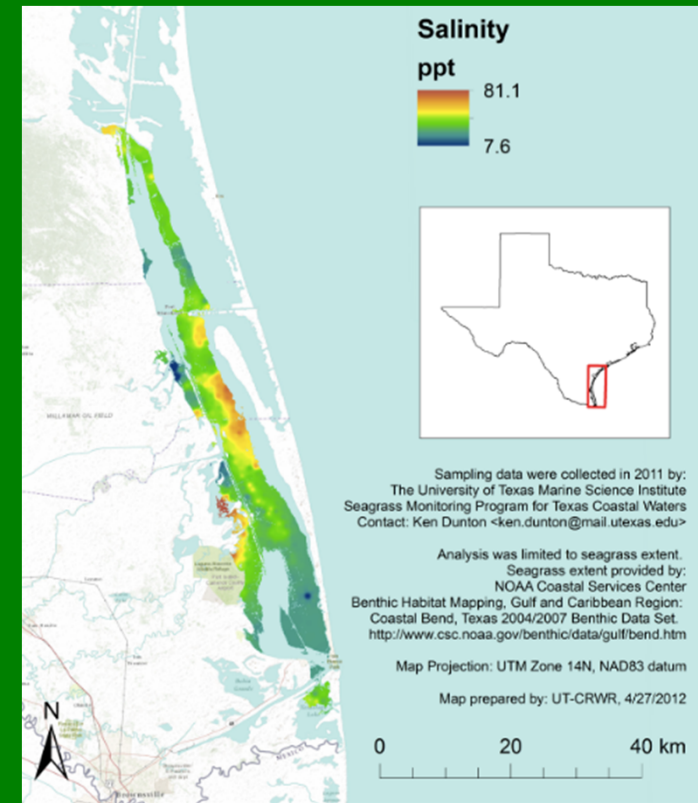
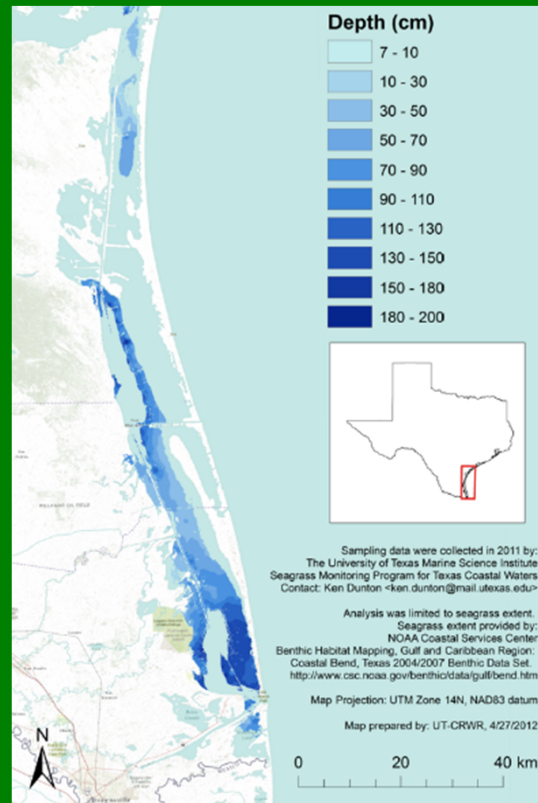
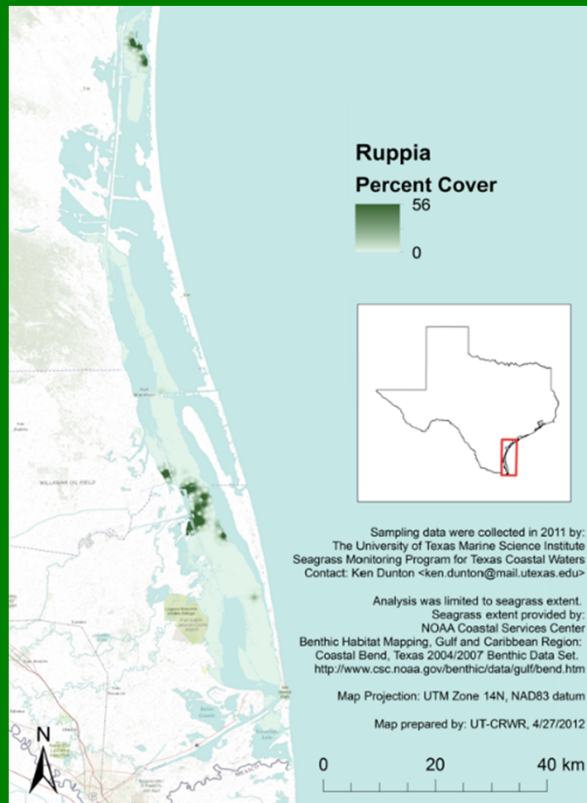
- Where is this species distributed along the coastline of Texas? Which areas require protection, and under what conditions does this species flourish?



<http://flora.nhm-wien.ac.at/>



Case Study # 3: Managing a Rare Species



In the LLM, *Ruppia* is patchily distributed and restricted to extremely shallow habitat (< 10 cm). This habitat exhibits a higher salinity due to evaporation, which suggests that *Ruppia* has a high tolerance to salinity. Because of its distribution in shallow waters, *Ruppia* is at a high risk from prop scars and trampling.

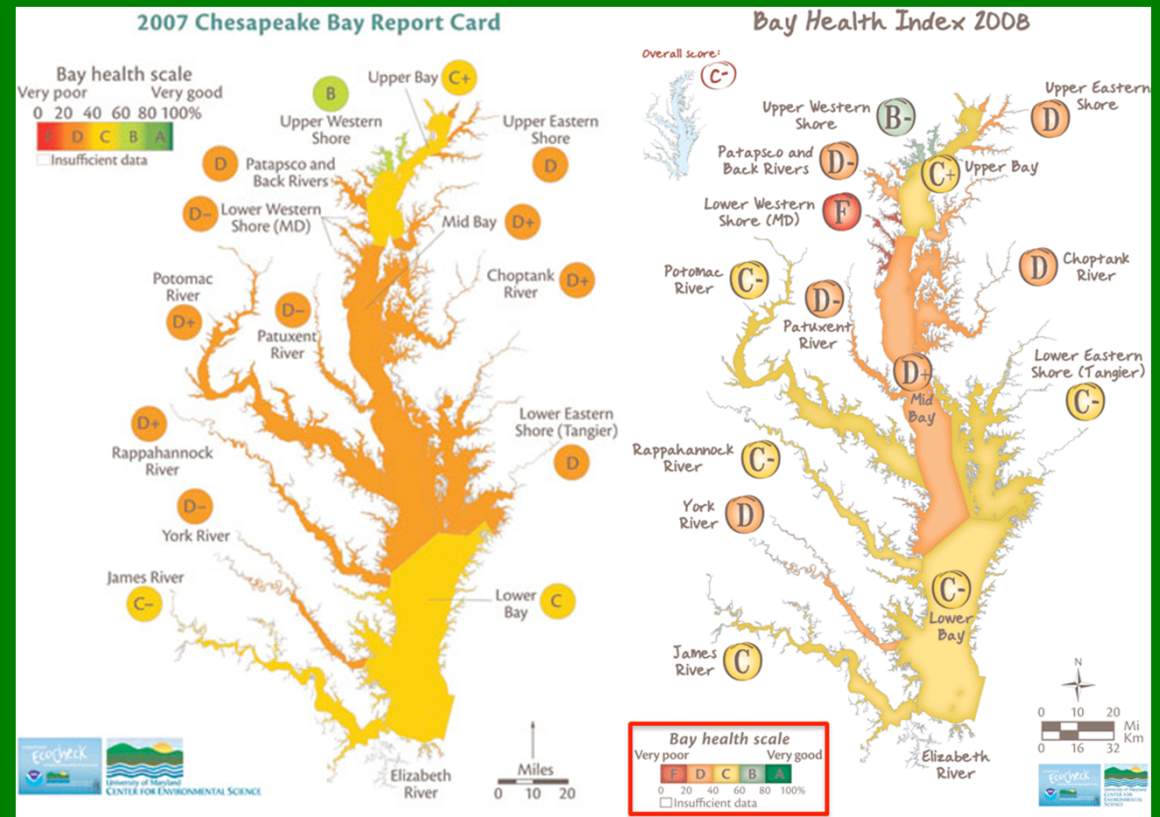
Future Applications of the Tier 2 Data (I)

<http://ian.umces.edu>

Apply information on seagrass growth requirements with yearly observations of water quality to develop annual Report Cards.

Such a categorical classification of water quality is:

1. A valuable integration of multiple variables
2. Directly comparable over multiple surveys/years
3. Easily understood by the general public



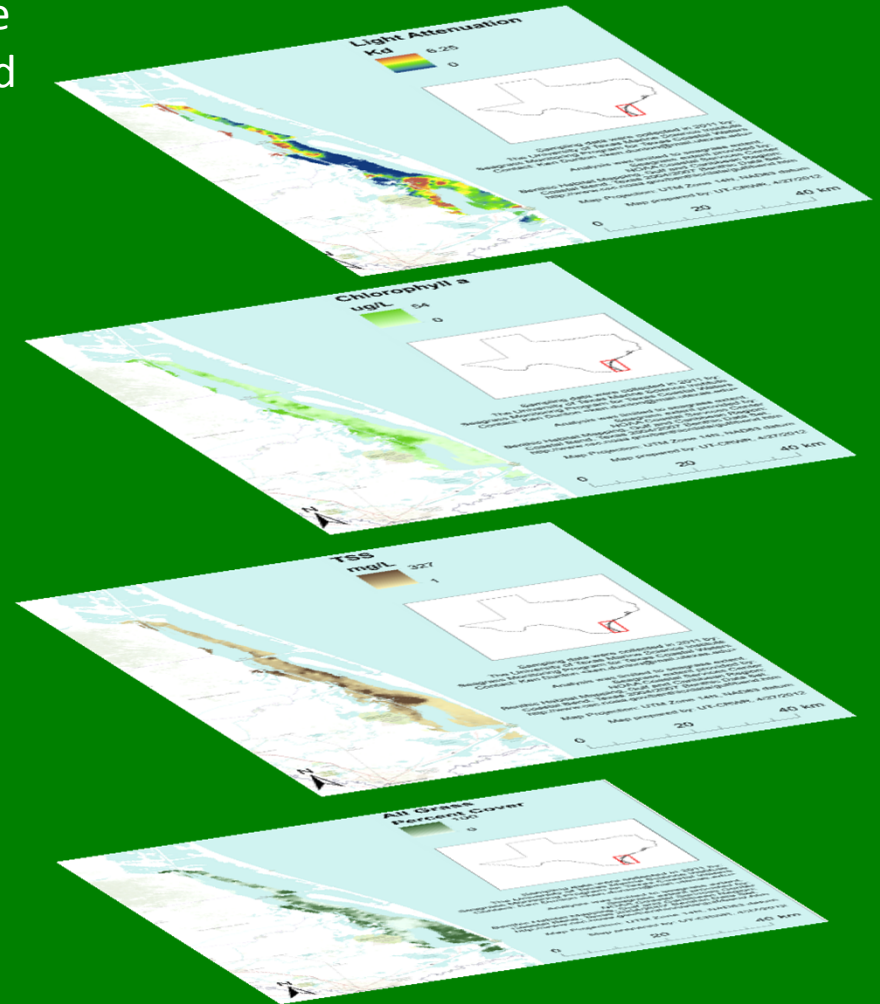
Future Applications of the Tier 2 Data (II)

The Tier 2 sampling effort provides a quantitative description of both plant condition indicators and habitat quality parameters.

This information will be utilized to develop a species-specific habitat suitability index (HSI) for Texas seagrasses.

The HSI will be refined with the addition of each annual survey and will serve as a valuable tool for:

1. Monitoring available habitat acreage
2. Identifying areas of promise for restoration efforts
3. Predicting the future impact of climate change, sea level rise and coastal development

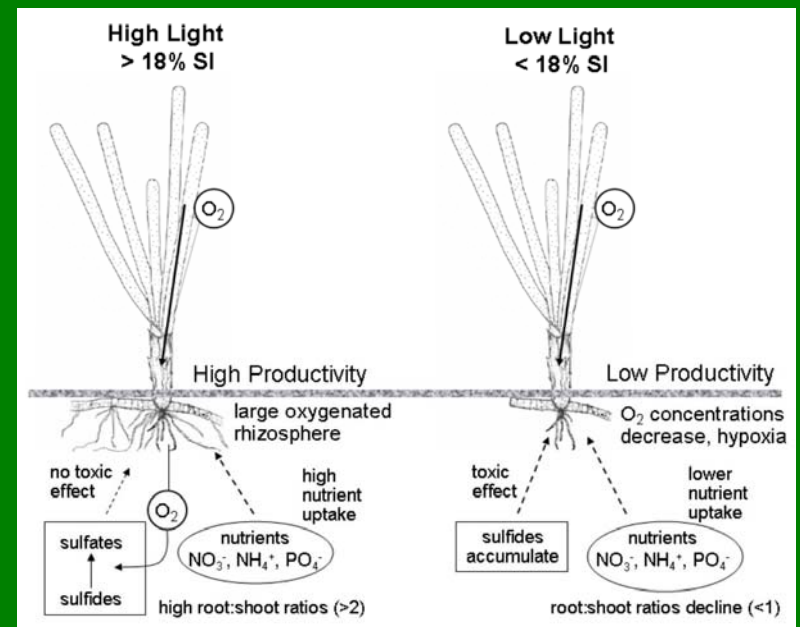


Tier 3: Intensive Monitoring to Diagnose Causal Relationships

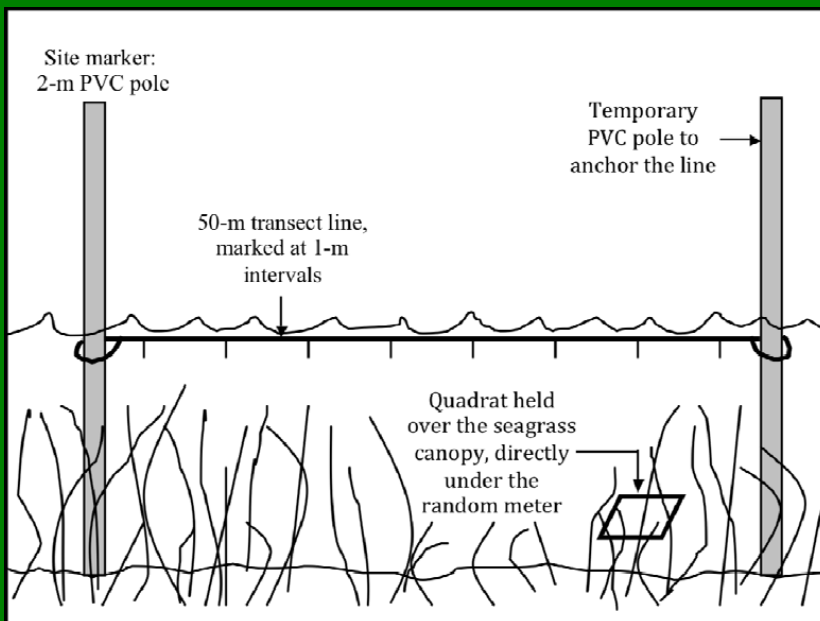


Tier 3 implements an intensive monitoring program intended to address specific ecophysiological questions.

This Tier is the most geographically limited, but also provides the most detailed information. Such information is often required to develop innovative and effective management solutions to unique problems.



Tier 3 Sampling Design



Transect Orientation

Permanent transects (50 m) are positioned perpendicular to the shoreline to incorporate the deep edge of the seagrass meadow and provide a depth gradient

Water Quality

- Chlorophyll a, TSS, Nutrients and Sonde
- Discrete light measurements (K_d and %SI)
- Continuous light measurements

Benthic Habitat

- Seagrass tissue: nutrient/isotopic analysis
- Above- and below-ground seagrass biomass
- % Cover, canopy height and shoot density
- Epiphyte and macroalgal cover
- Sediment characteristics (TOC and grain size)

** Measurement parameters and sampling frequency are flexible to meet project objectives*



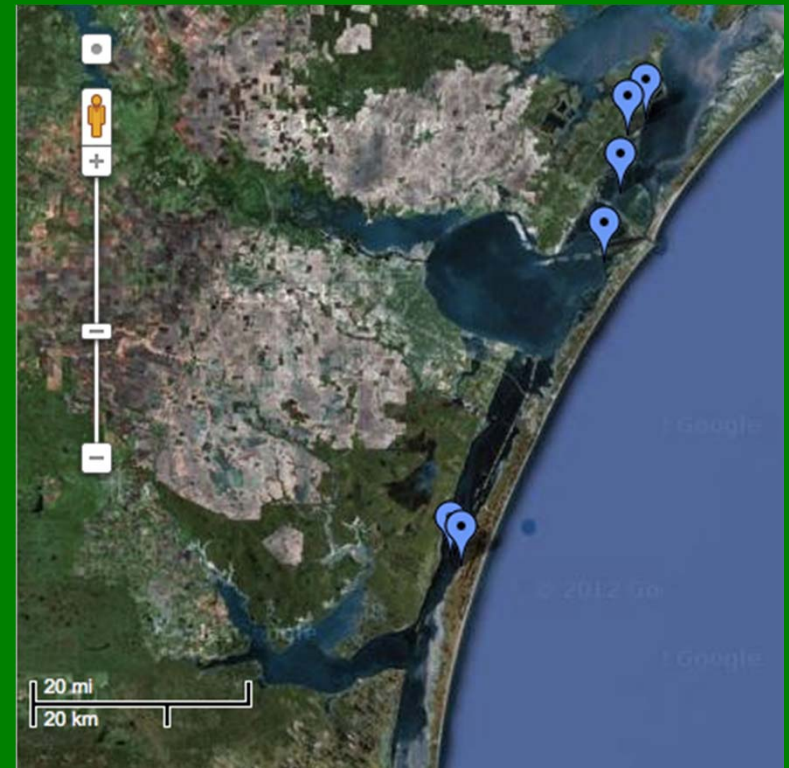
Tier 3 Established Sampling Locations

Permanent Transects (North : South)

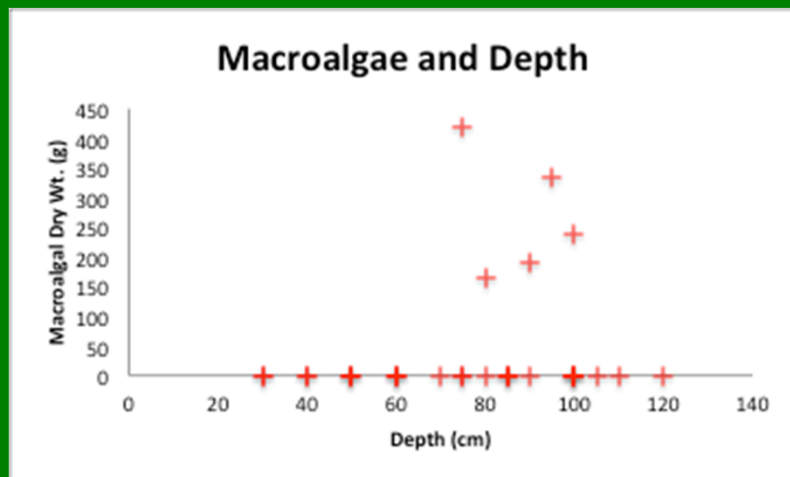
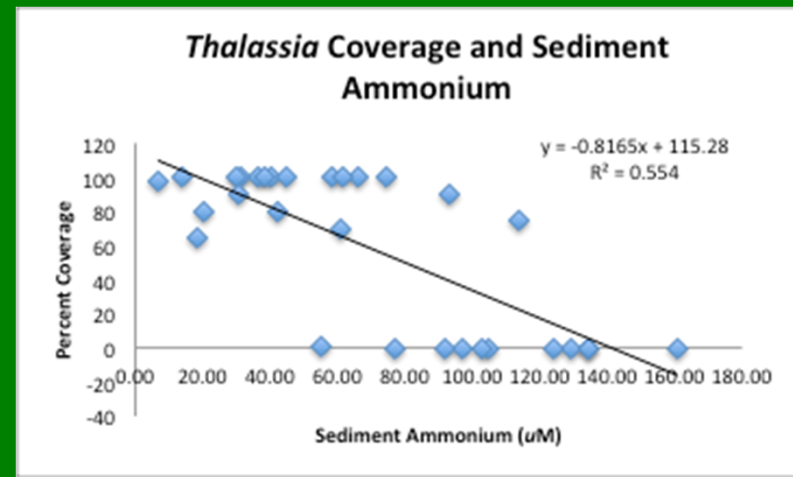
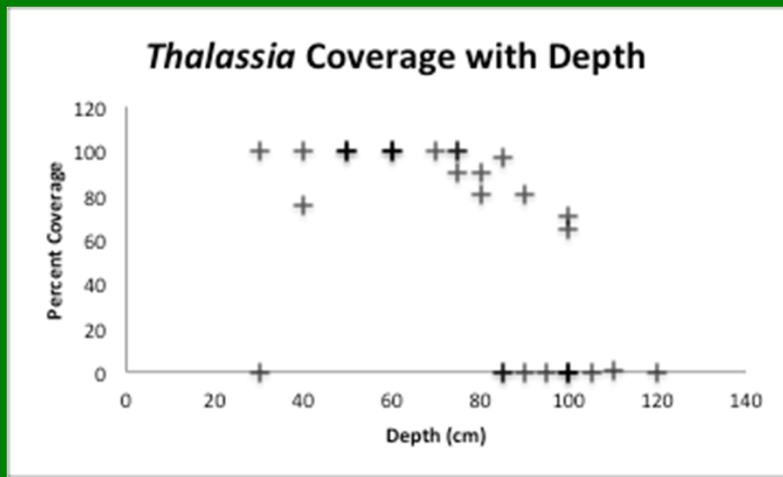
- Traylor Island¹
- Hog Island¹
- Mud Island¹
- East Flats¹
- Padre Island National Seashore¹
- LM 151^{1,2}

¹ Transect locations are visited annually to document: % cover, seagrass biomass, light availability, water quality, sediment characteristics and epiphyte/macroalgal cover

² LM151 is a long-term monitoring site utilized for continuous measurements of underwater irradiance, monthly water quality surveys and quarterly assessments of plant condition



Tier 3 Results: Hog Island

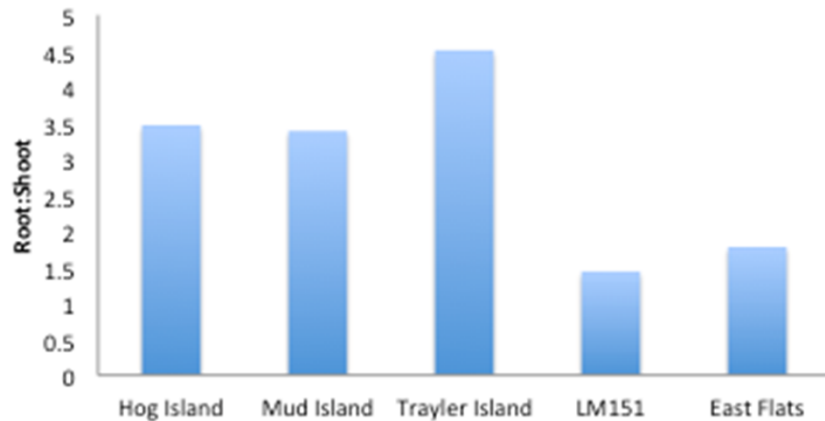


Based on a light requirement of 20 %SI and a measured K_D of 1.02, *Thalassia* should extend into deeper waters up to 1.57m.

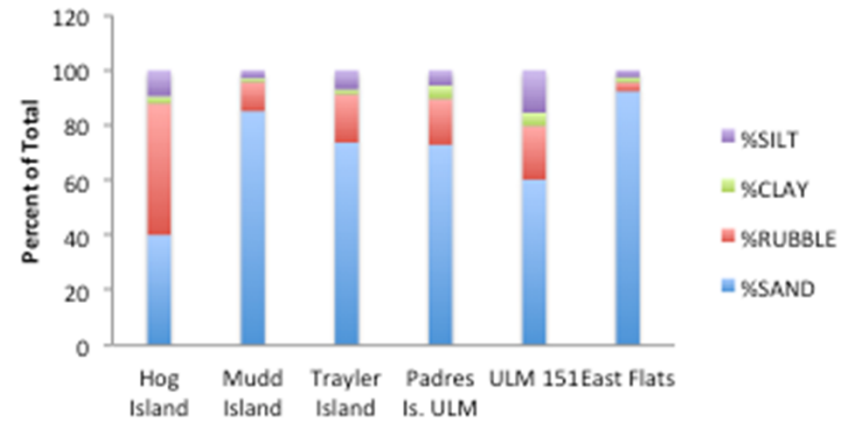
However, Tier 3 sampling revealed the prevalence of drift macroalgae within the 60-100 cm depth range and a negative correlation between *Thalassia* coverage and sediment ammonium.

Tier 3 Results: Site Comparisons

Root to Shoot Ratios by Site



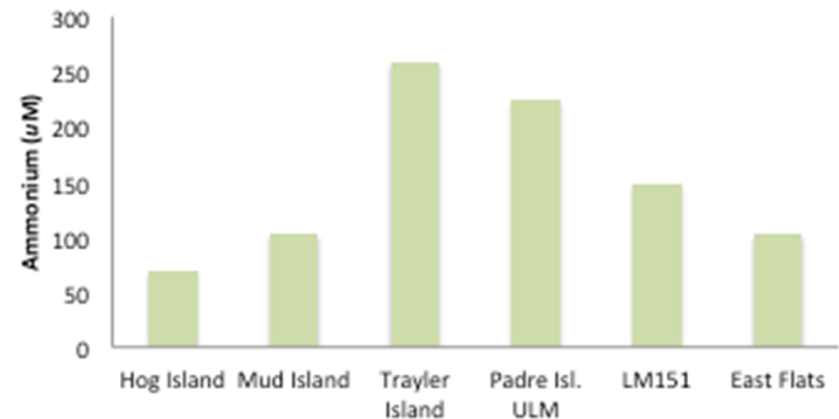
Sediment Characteristics by Site



Seagrass distributions and plant physiological characteristics are often influenced by complex biogeochemical processes.

The Tier 3 sampling program affords scientists with the ability to research and identify complex linkages between seagrass plants and their environment.

Sediment Ammonium by Site



Texas Seagrass Monitoring Program: Year 1 Summary

Program Status: Tier 2

- A total of 567 individual monitoring sites were identified within the NERR, CCB, ULM and LLM
- These sites were all sampled between August and September 2011
- The georeferenced data has been checked for Q/A and mapped for all regions
- Preparations are currently underway for the 2012 sampling season

Program Status: Tier 3

- A total of 6 permanent transects were identified within the NERR, CCB and ULM
- These transects were all surveyed between August and September 2011
- The data is currently under review for Q/A

Overall State of the Texas Seagrass Monitoring Program

- Funding is currently in place for continued monitoring through FY 2012
- All of the raw data currently resides within a professionally developed central database
- A central website has been created to house all of the protocols, sample data and GIS information
- We are currently developing an annual report on the overall condition of Texas seagrass meadows

Seagrass Data Sharing and Reporting

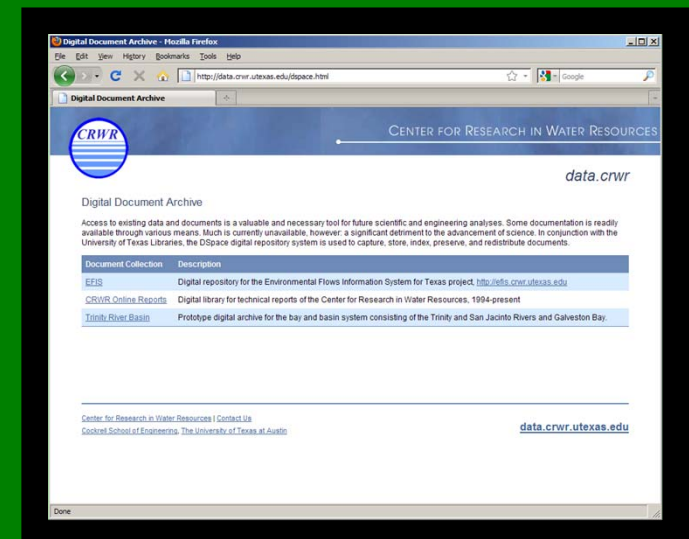


Long-term monitoring data must be easily accessible to resource managers and the general public.

This website is up and running and will serve as the primary source for sampling protocols, observational data, maps and monitoring reports.

All of the Tier 2 and Tier 3 data presented here will soon be available for use!

www.TexasSeagrass.org



The Texas Digital Library is a multi-university consortium providing the digital infrastructure to support a fully online scholarly community for institutions of higher education in Texas and the widespread availability of their enormous intellectual capital.



Current Member Institutions

The Texas Digital Library is currently comprised of sixteen member institutions of higher education, listed below. Together these universities represent 20% of the state's four-year and health-related institutions of higher education (1).

- ⊙ Angelo State University
- ⊙ Baylor University
- ⊙ Texas A&M University
- ⊙ Texas A&M University - Corpus Christi
- ⊙ Texas A&M University at Galveston
- ⊙ Texas State University
- ⊙ Texas Tech University
- ⊙ University of Houston
- ⊙ University of North Texas
- ⊙ The University of Texas at Arlington
- ⊙ The University of Texas at Austin
- ⊙ The University of Texas at Brownsville
- ⊙ The University of Texas at Dallas
- ⊙ The University of Texas MD Anderson Cancer Center
- ⊙ The University of Texas Southwestern Medical Center at Dallas



<http://www.tdl.org/>

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Estuaries Program*
- Melissa Porter, *Texas General
Land Office*

GIS and Website

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Resources (David Maidment)
- Eric Hersh and Tim Whiteaker

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- Travis Bartholomew
- Kelly Darnell
- Nathan McTigue
- Geoff Hensgen
- Joe Stachelek
- Beau Hardegree
- Karen Bishop
- Dana Sjostrom
- Jace Tunnell
- Joe Meiman

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- Bill Dennison
- Jim Fourqurean