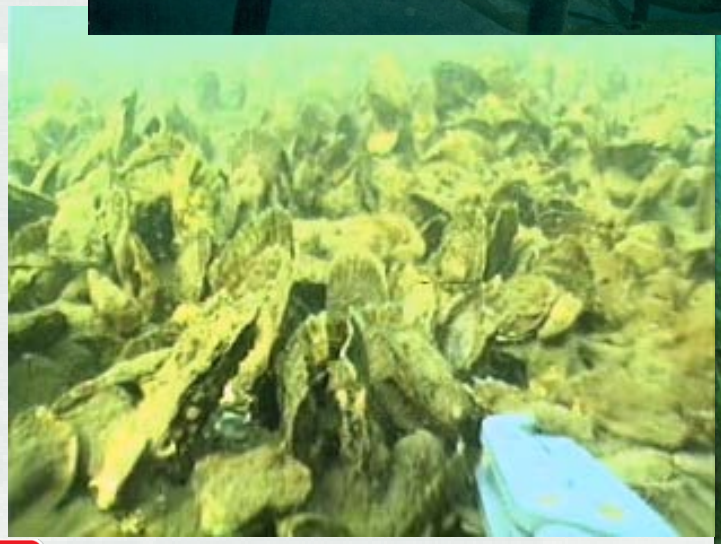
Evaluating Exposure of Biological Resources During Dredging and Placement Operations

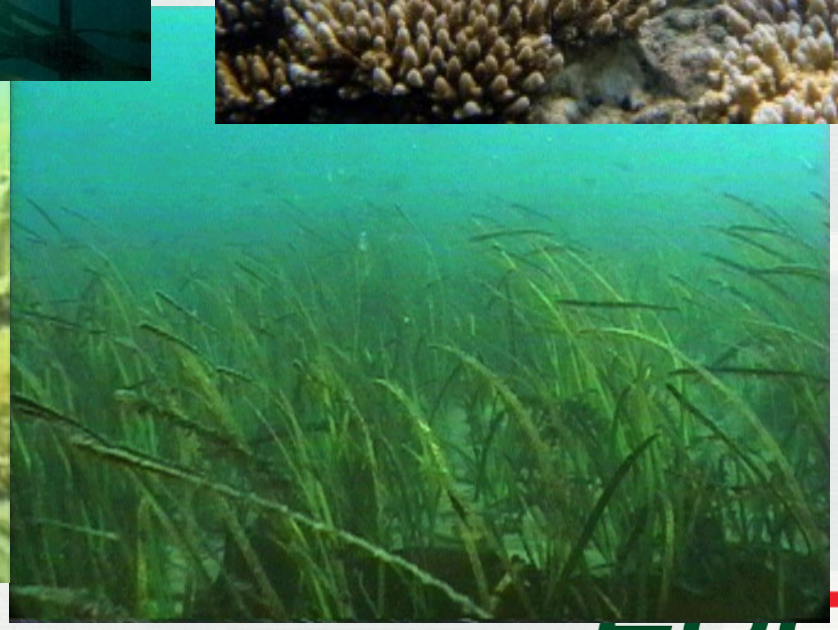
PIs: Deborah Shafer (EL) and Cheryl Pollock (CHL)

Problem: Assumed negative effects of dredging operations on sensitive benthic resources may lead to exaggerated limitations that result in **unnecessary costs and delays** in dredging operations.

The effects of dredging-induced exposure on biological resources are difficult to interpret unless the measured parameters can be **related to physiological thresholds** of target organisms.

Resources of Concern





Dredging Impacts to Seagrass Resources

Case Study: St. Andrew Bay, Florida

- **Study Objective: Assess potential impacts to nearby seagrass resources as a result of dredging and in-water disposal activities at Port of Panama City**

- Funding for this project provided by USACE Mobile District.

3 Study Components

Multi-phased study designed to provide information at a variety of spatial and temporal scales

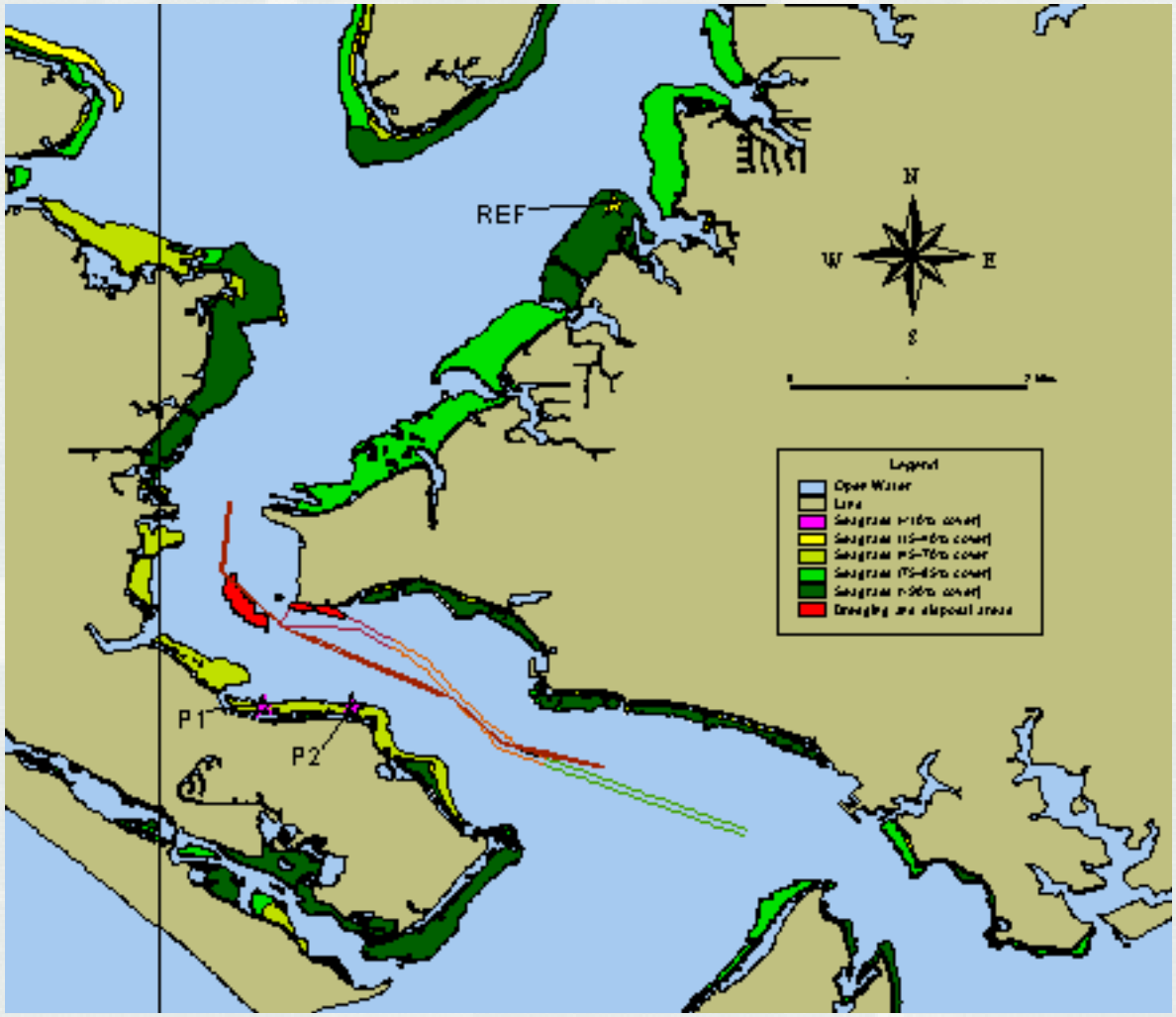
- Hydroacoustic mapping of seagrass distribution conducted at large spatial (reaches) and temporal scales (annual).

- Plume tracking to determine the magnitude and behavior of the sediment plume at relatively small spatial and temporal scales (hours to days).

- Continuous PAR measurements at small spatial scales (series of 3 fixed locations) over the course of months (intermediate time scale).

Careful interpretation of the combined datasets provides insights regarding the spatial and temporal patterns of dredging effects that would not be possible if each dataset were examined individually.

St. Andrew Bay, Florida



Hydroacoustic Seagrass Mapping

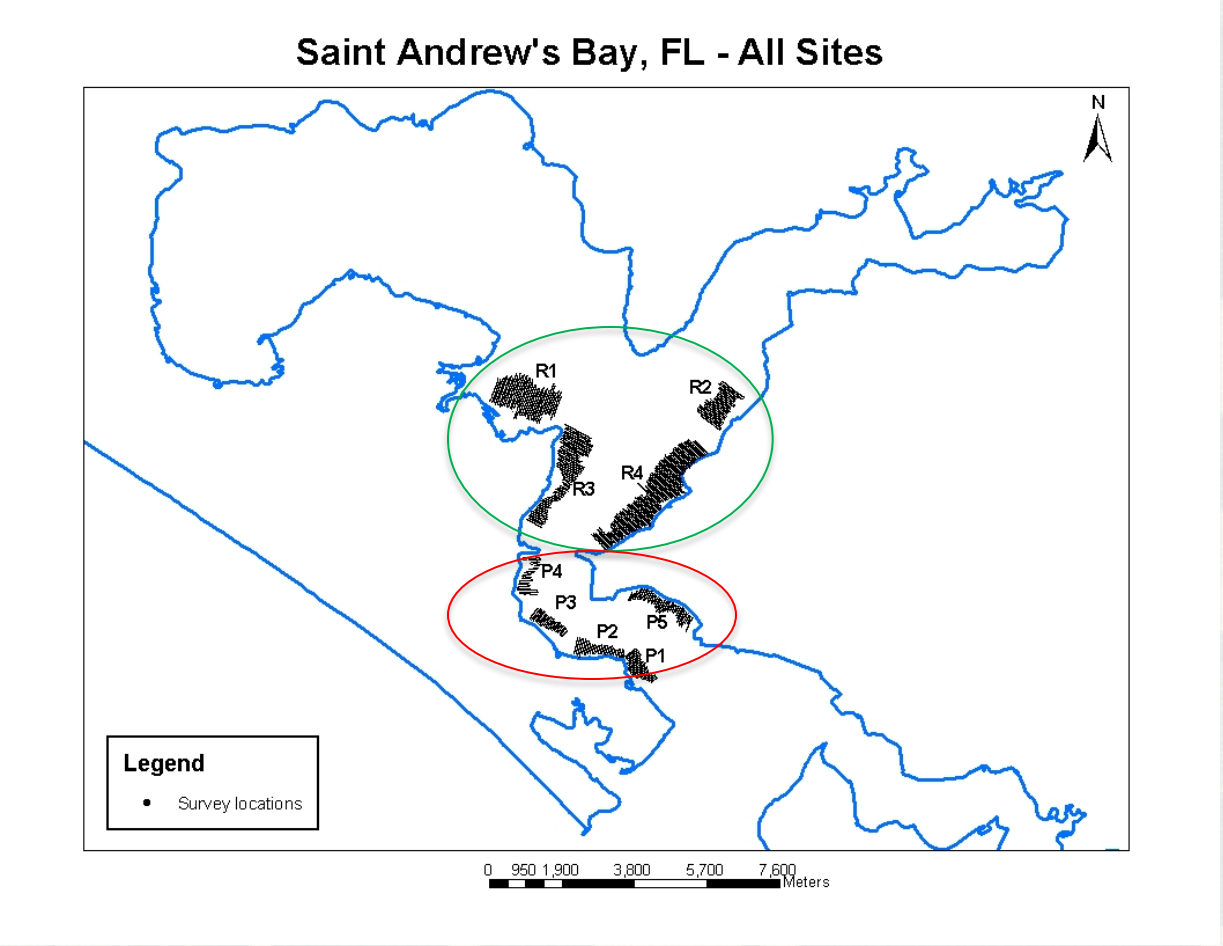
Study Design:

Pre-dredging and post-dredging of seagrass beds conducted at 1-year intervals.

Before-After

Control-Impact

Study Design

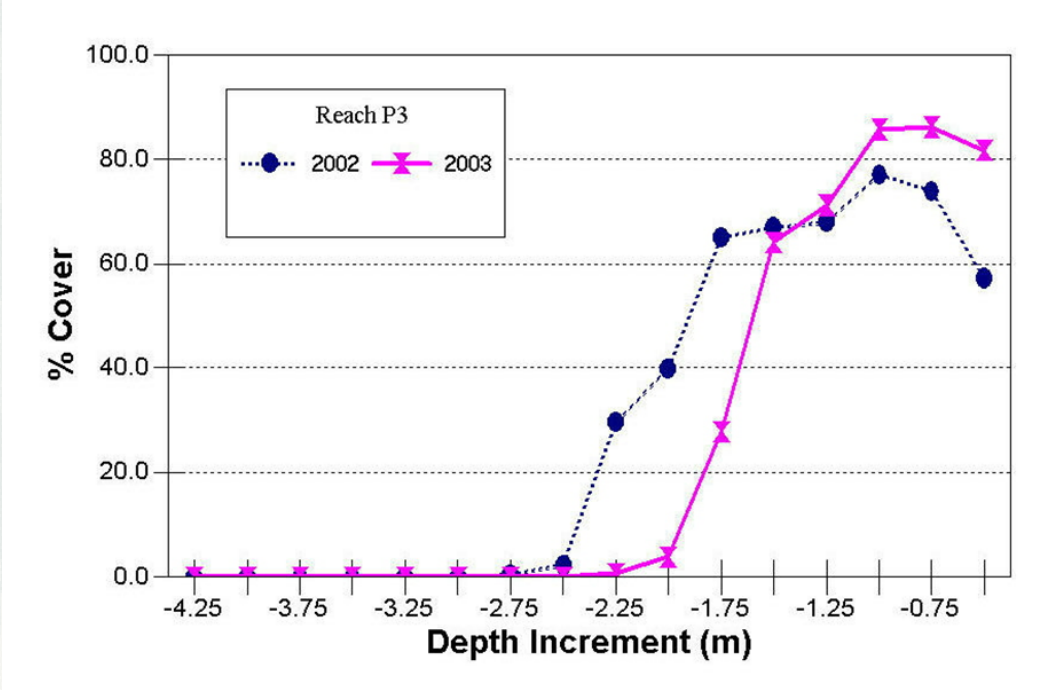


5 Project Reaches

4 Reference Reaches

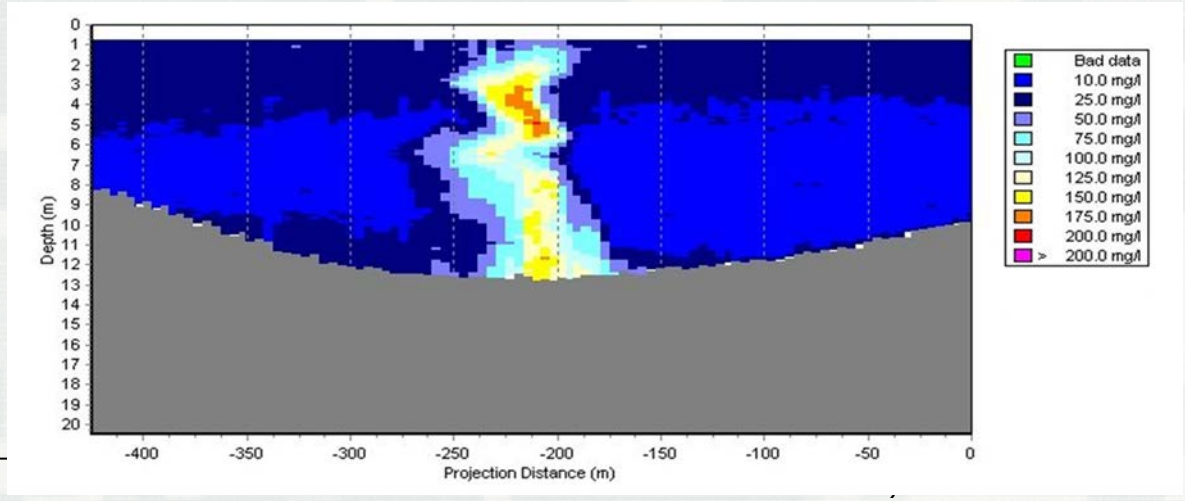
Hydroacoustic Seagrass Survey Results

- Between pre- and post-dredging surveys, there were significant declines in the maximum depth of seagrass colonization in both the Project (-15%) and Reference (-8%) reaches
- This is consistent with a chronic light reduction effect



ADCP Plume Tracking Results

- ADCP were an effective means of characterizing sediment plumes associated with dredging and disposal operations
- Sediment plumes were ‘near-field’ phenomena constrained to within 0.75 km of the disposal area and did not disperse to within 500 m of seagrass beds
- Sediments were predominantly coarse sands, which settled quickly

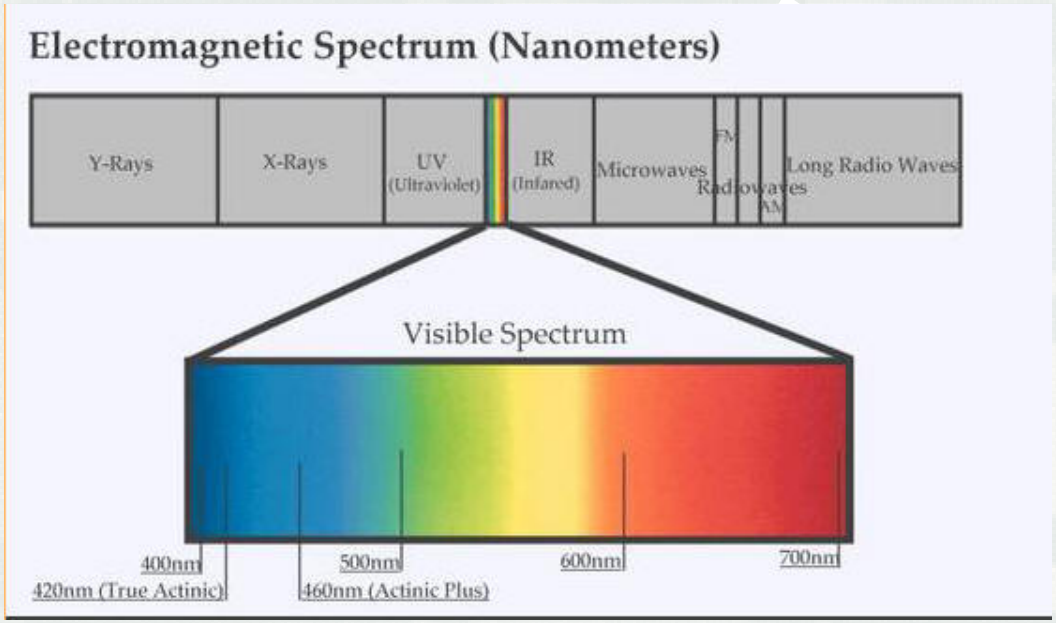


Light Data Collection

- **As green plants, seagrasses require light in order to survive**
- **Minimum light levels for many seagrass species are well-known, but tolerances to sustained light reductions not well quantified**
- **Light is one of the most important parameters to measure in any assessment of potential dredging impacts to underwater plants**

Light Measurement

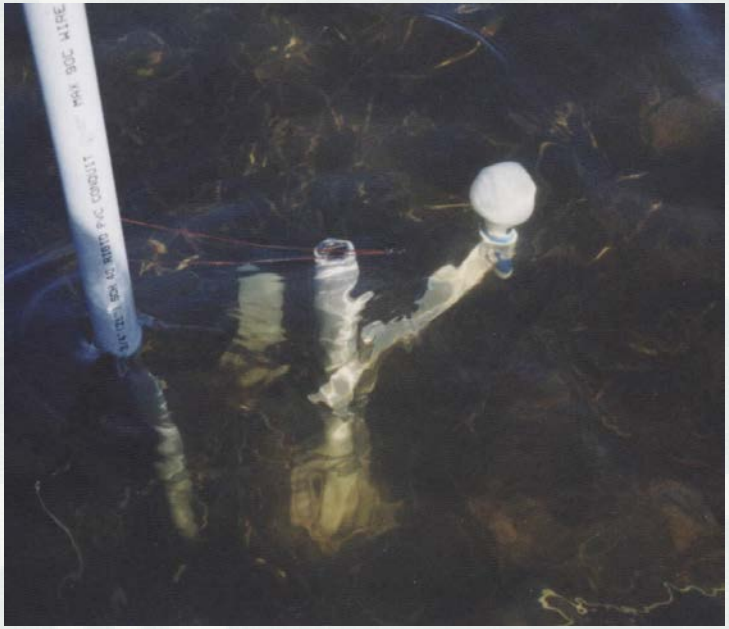
- Plants can only use light with wavelengths between 400 to 700 nm.
- *K*nown as Photosynthetically Active Radiation (PAR)
- Highly variable on both spatial and temporal scales



PAR measurement requires specialized instruments

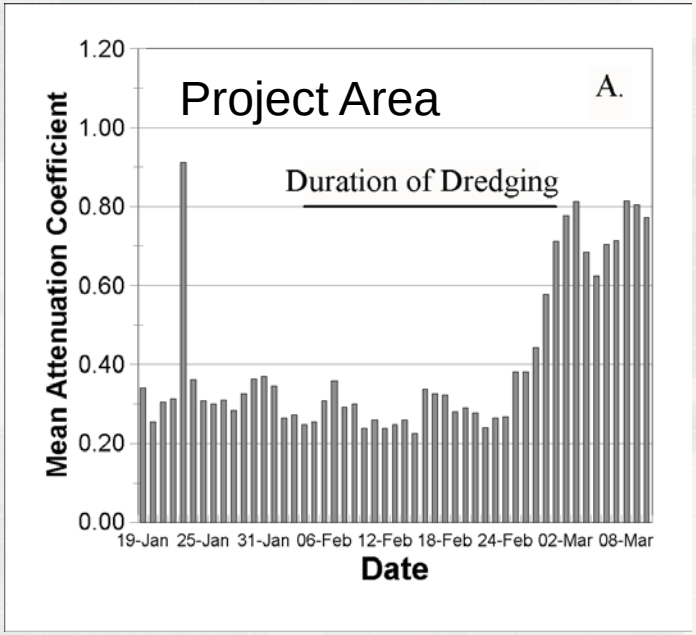
Light (PAR) Measurement

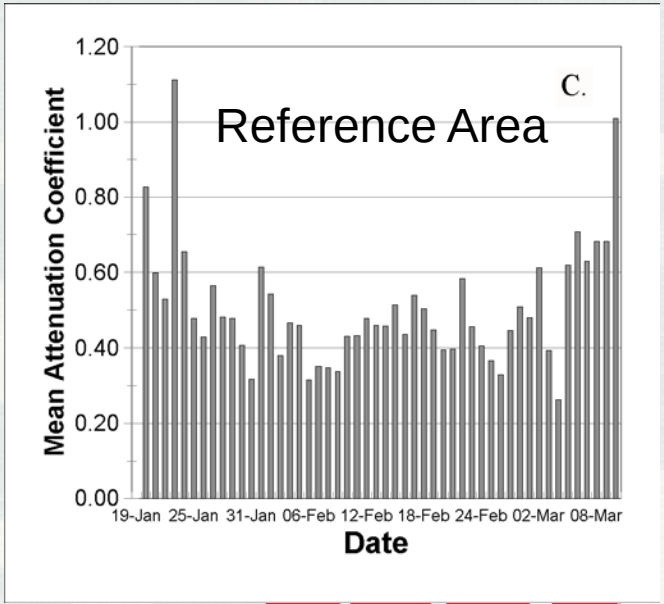
Continuous time-series PAR data prior to, during, and following dredging and disposal activities allows evaluation of the magnitude and duration of the associated light attenuation



Light Attenuation Coefficients During Dredging and Disposal Operations Compared with Natural Ambient Conditions

- Light levels remained above minimum seagrass thresholds at both Project and Reference areas before and during dredging and disposal operations
- Light Attenuation associated with disposal operations did not differ from ambient calm conditions
- Disposal operations caused no additional light attenuation over and above typical background conditions





Summary

- Seagrass mapping, plume tracking and PAR measurement are necessary in order to get the full picture:
  - Resource agencies are interested in potential changes in extent of seagrass distribution provided by hydroacoustic mapping
  - However, IF only Hydroacoustic mapping results were used, you might conclude there was a dredging effect
  - However, light levels within seagrass beds were not affected by dredging and disposal operations
  - With coarse sediments, plumes were small-scale phenomena, settled quickly, no evidence of dredging effect on seagrasses
  - Storm events caused light attenuation to double compared to background conditions—need measurements during ambient as well as dredging periods

Light Data Collection….then…

- **Measuring light in underwater environment is challenging**
- **Standard equipment involved a fragile underwater light sensor, linked to a surface data logger by a long cable**
- **Periodic hand-wiping was required to prevent fouling of the sensor**
- **Labor intensive and costly**
- **Long-term deployments are difficult and cost-prohibitive**

- Labor Intensive
- Deployment options limited by cables
- Boat has to be anchored at deployment site
- Limits spatial coverage

New DOER Research:

Evaluating Exposure of Biological Resources During Dredging and Placement Operations

PIs: Deborah Shafer (EL) and Cheryl Pollock (CHL)

Objectives:
Quantify exposure of aquatic biological resources to dredging associated reductions in light availability, sedimentation, and other biologically relevant parameters in order to address resource agency concerns.

Develop a system for collecting long-term records that can be used to compare conditions during dredging related activities with ambient exposure levels

Evaluating Exposure of Biological Resources During Dredging and Placement Operations

Approach:

1) Develop/test a robust/reliable rapid deployment field instrument package to evaluate exposure of biological resources to potential dredging effects
2) Coordinate with District POCs for future reimbursable case study opportunities
3) Create a library of dredging related light attenuation and exposure datasets to facilitate direct comparisons with proposed dredging and disposal activities
4) Case Study Examples - improved communication with resource agencies should expedite project approval

Light Data Collection….now…

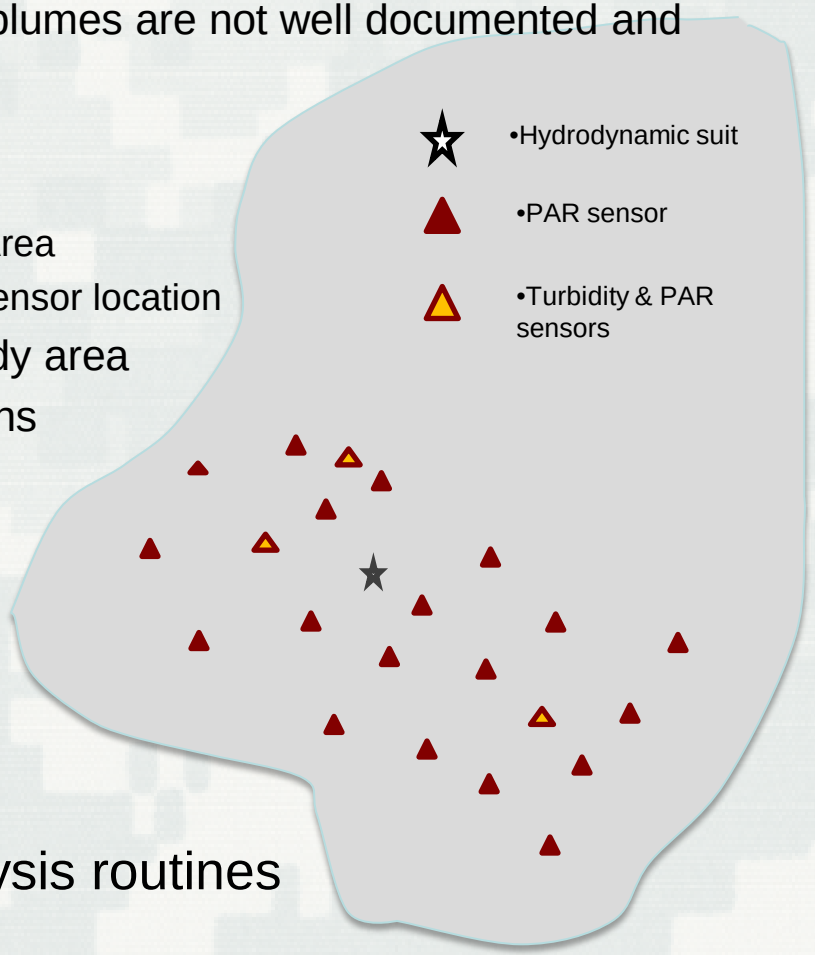
- **Variety of self-contained data logging PAR systems now available**
- **Eliminates need for cables and surface data logger**
- **Some systems have wipers to periodically clean sensor**
- **Lower costs and reduced labor allows use of multiple sensors to achieve greater spatial and temporal data coverage**
- **Long-term deployments are now more feasible**

PAR Instrument Calibration, Testing, and Evaluation

- 15 Odesseys
- 2 Wetlabs
- 1 LICOR
- 1 YSI
- In Air
- In water

Field Application

- Multiple instrument deployment packages
  - The size, intensity, and duration of dredge plumes are not well documented and are difficult to capture
  - Single Base Station
    - PAR and Turbidity sensors
    - Collecting hydrodynamic data for the study Area
    - Hydrodynamic data relatable to other PAR sensor location
  - Self-contained PAR sensors blanketing study area
  - Paired with turbidity meters at some locations
  - Control PAR sensor above water
- Ready for rapid deployment
  - Short term or long term deployments
  - Ambient background data collection
  - Dredging event data collection
  - Post dredging event data collection
- Standardized data collection and analysis routines
- Case-Study Library



Why do we care?

Because you are going to get calls!

Beach Nourishment Project

Idealized Beach Nourishment PAR Study

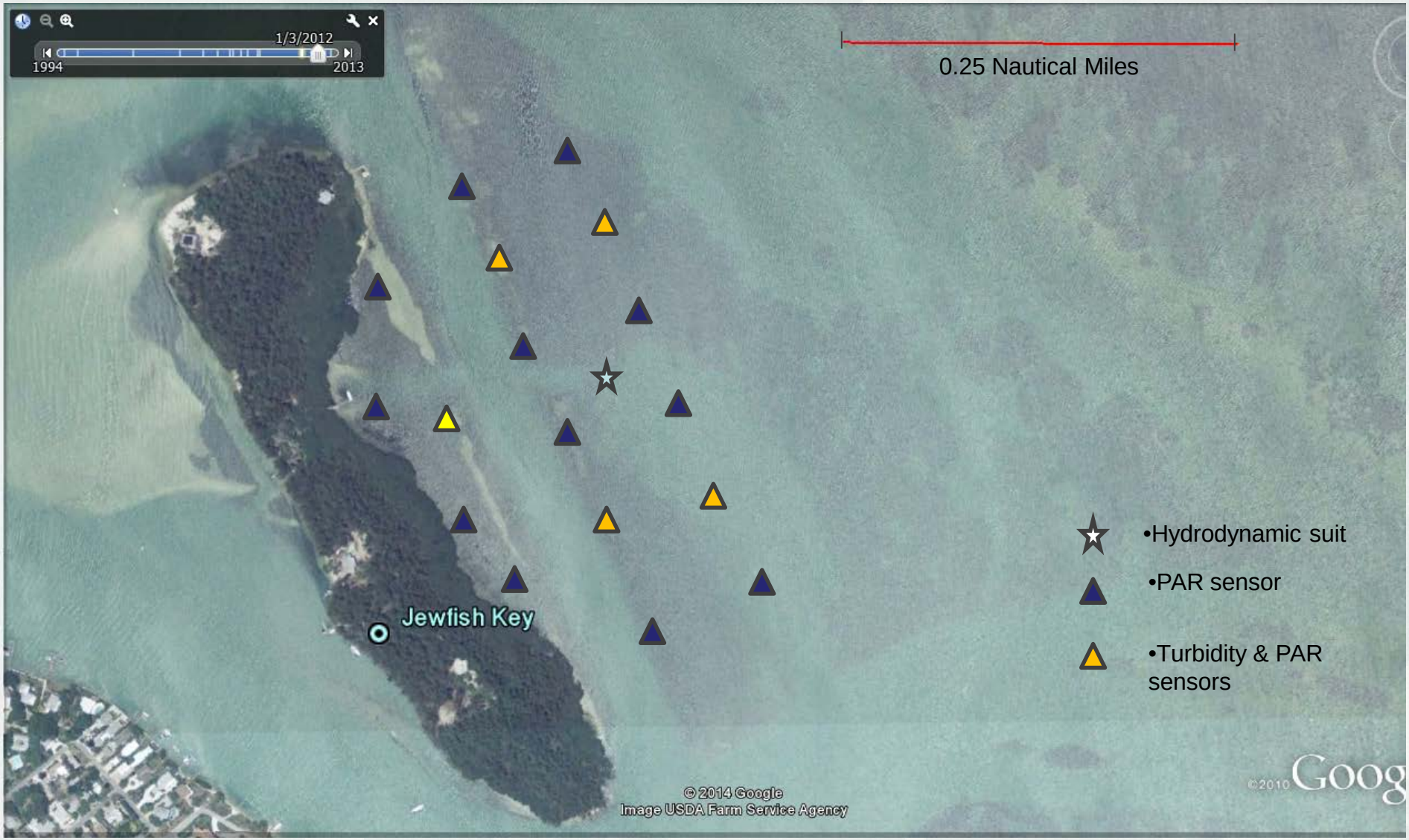
What if you had this example with a time scale to refer to?

- •Hydrodynamic suite
- •PAR sensor
- •Turbidity & PAR sensors

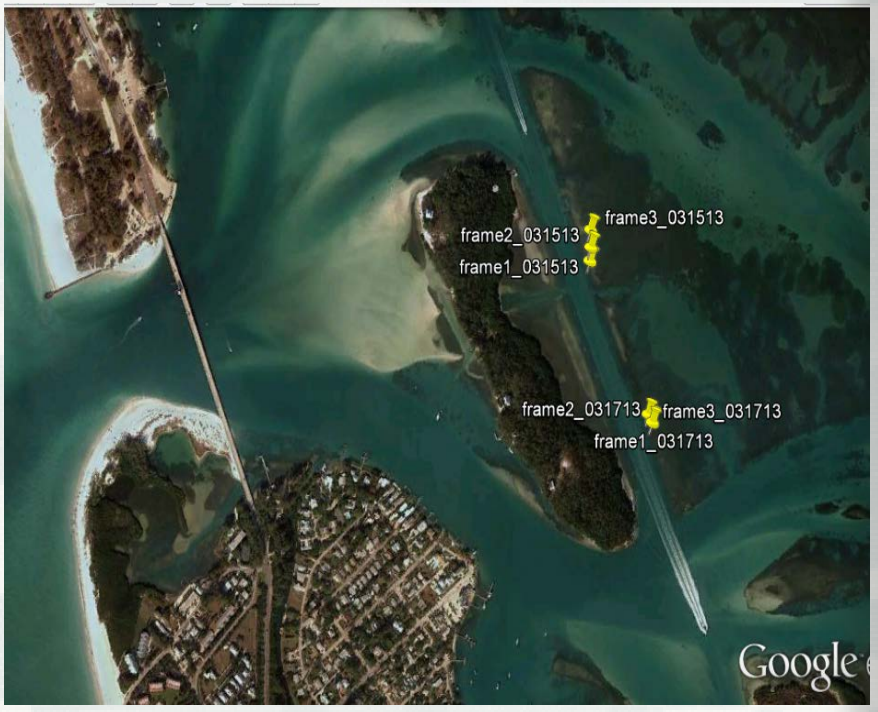
ERDC

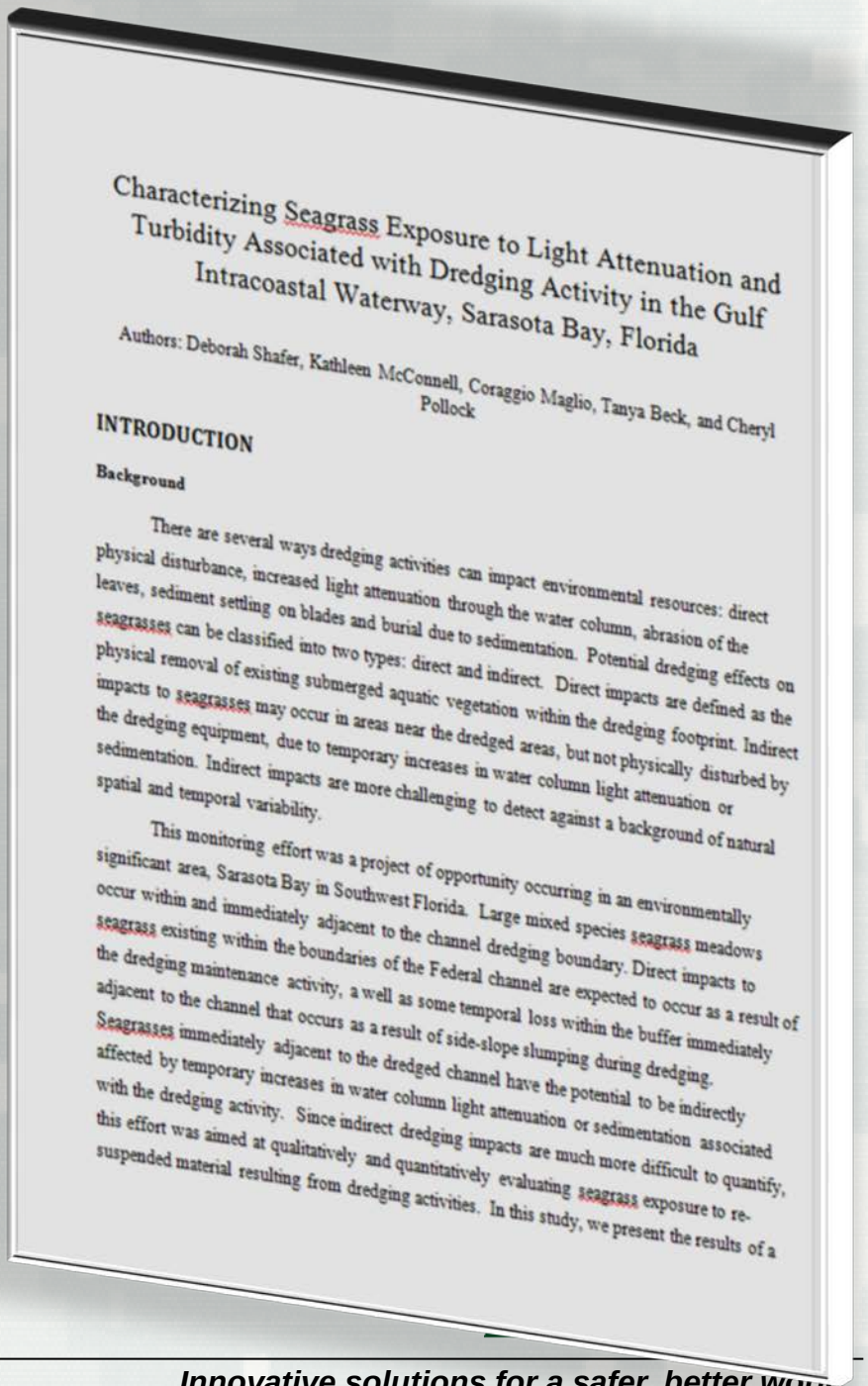
Idealized Channel Study

(or this example with a time scale?)



Seagrass Dredging Exposure Study: Egmont Key, FL March 2013





Characterizing Seagrass Exposure to Light Attenuation and Turbidity Associated with Dredging Activity in the Gulf Intracoastal Waterway, Sarasota Bay, Florida

Authors: Deborah Shafer, Kathleen McConnell, Coraggio Maglio, Tanya Beck, and Cheryl Pollock

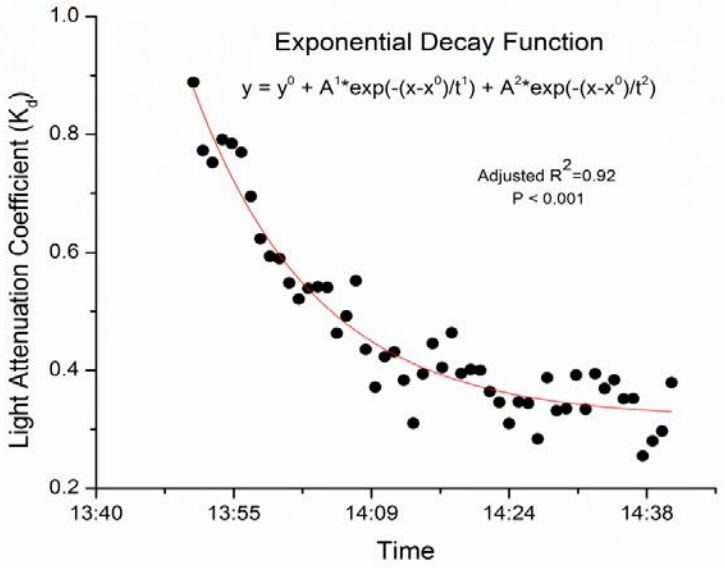
INTRODUCTION

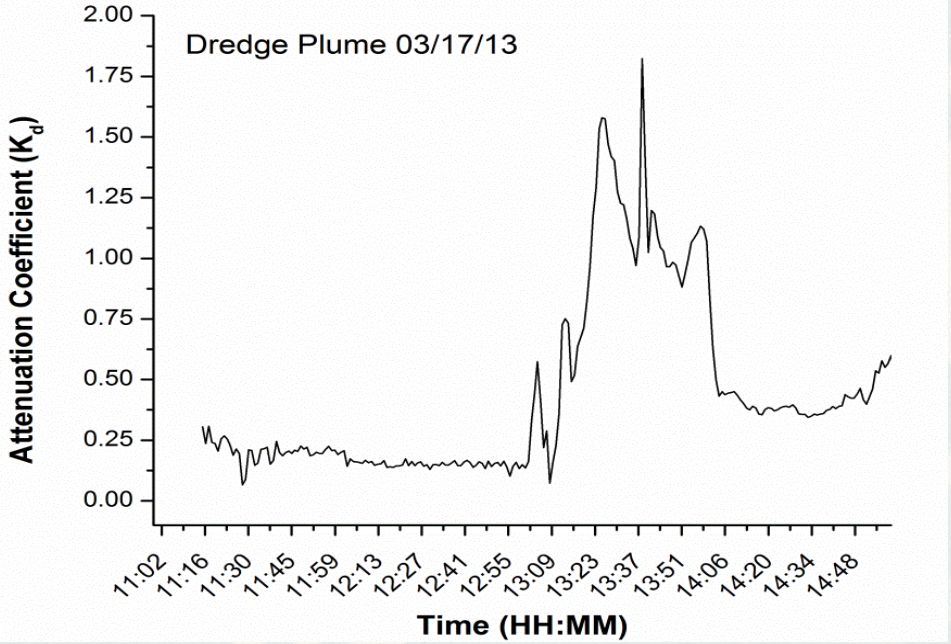
Background

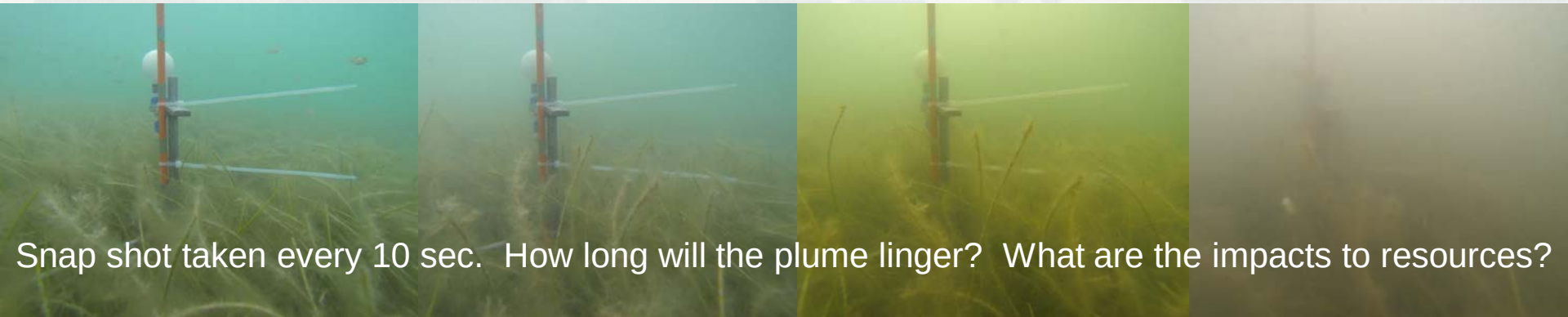
There are several ways dredging activities can impact environmental resources: direct physical disturbance, increased light attenuation through the water column, abrasion of the leaves, sediment settling on blades and burial due to sedimentation. Potential dredging effects on seagrasses can be classified into two types: direct and indirect. Direct impacts are defined as the physical removal of existing submerged aquatic vegetation within the dredging footprint. Indirect impacts to seagrasses may occur in areas near the dredged areas, but not physically disturbed by the dredging equipment, due to temporary increases in water column light attenuation or sedimentation. Indirect impacts are more challenging to detect against a background of natural spatial and temporal variability.

This monitoring effort was a project of opportunity occurring in an environmentally significant area, Sarasota Bay in Southwest Florida. Large mixed species seagrass meadows occur within and immediately adjacent to the channel dredging boundary. Direct impacts to seagrass existing within the boundaries of the Federal channel are expected to occur as a result of the dredging maintenance activity, a well as some temporal loss within the buffer immediately adjacent to the channel that occurs as a result of side-slope slumping during dredging. Seagrasses immediately adjacent to the dredged channel have the potential to be indirectly affected by temporary increases in water column light attenuation or sedimentation associated with the dredging activity. Since indirect dredging impacts are much more difficult to quantify, this effort was aimed at qualitatively and quantitatively evaluating seagrass exposure to re-suspended material resulting from dredging activities. In this study, we present the results of a

Changes in Light Associated with Dredging Event: Egmont Key, FL March 2013





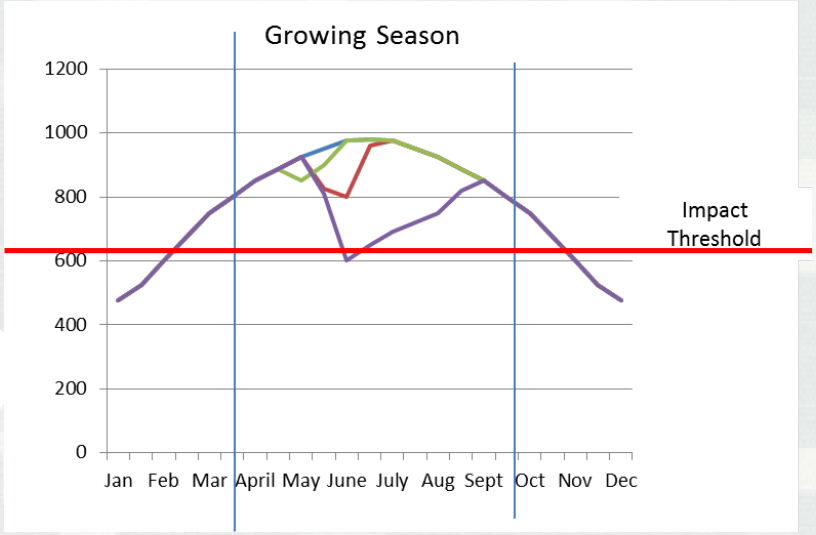


Snap shot taken every 10 sec. How long will the plume linger? What are the impacts to resources?

Evaluating Exposure of Biological Resources During Dredging and Placement Operations

Next Steps:

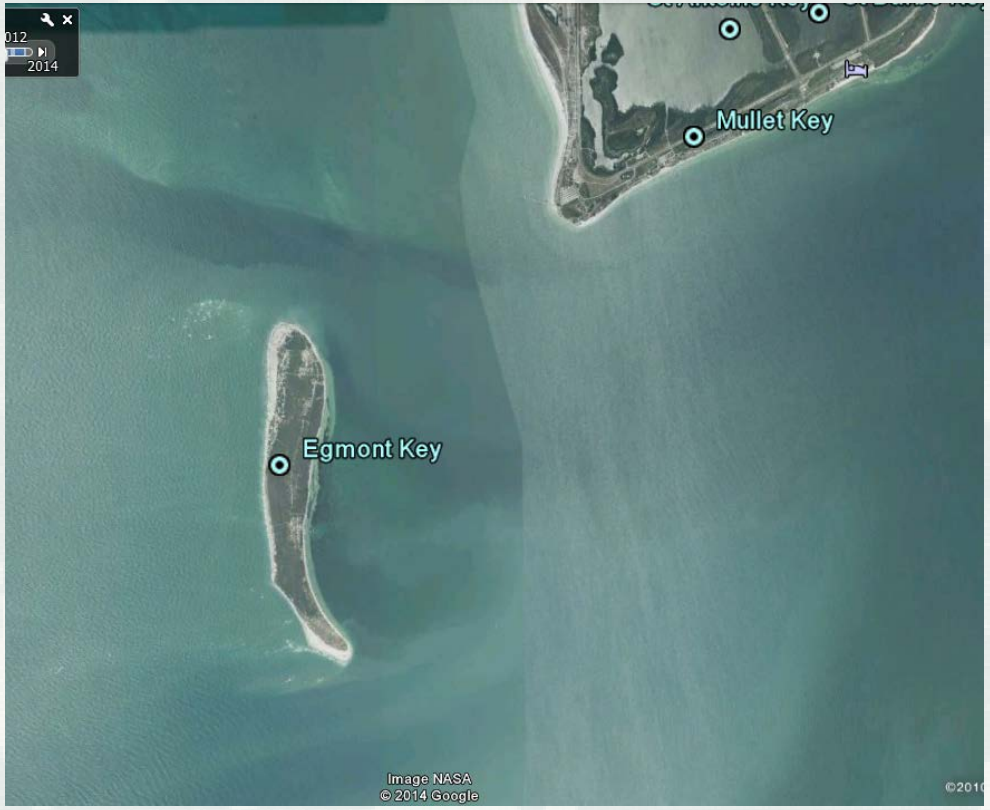
- Complete instrument testing
- Develop standardized routines for data analysis and reporting
- Seek sponsorship opportunities for field deployments
- Populate a database that correlates sediment type and grain size with PAR-related plume characteristics



Potential Deployment Demo Opportunity: Egmont Key, FL Fall 2014

- Jacksonville District
- Beach nourishment project
- Single point placement

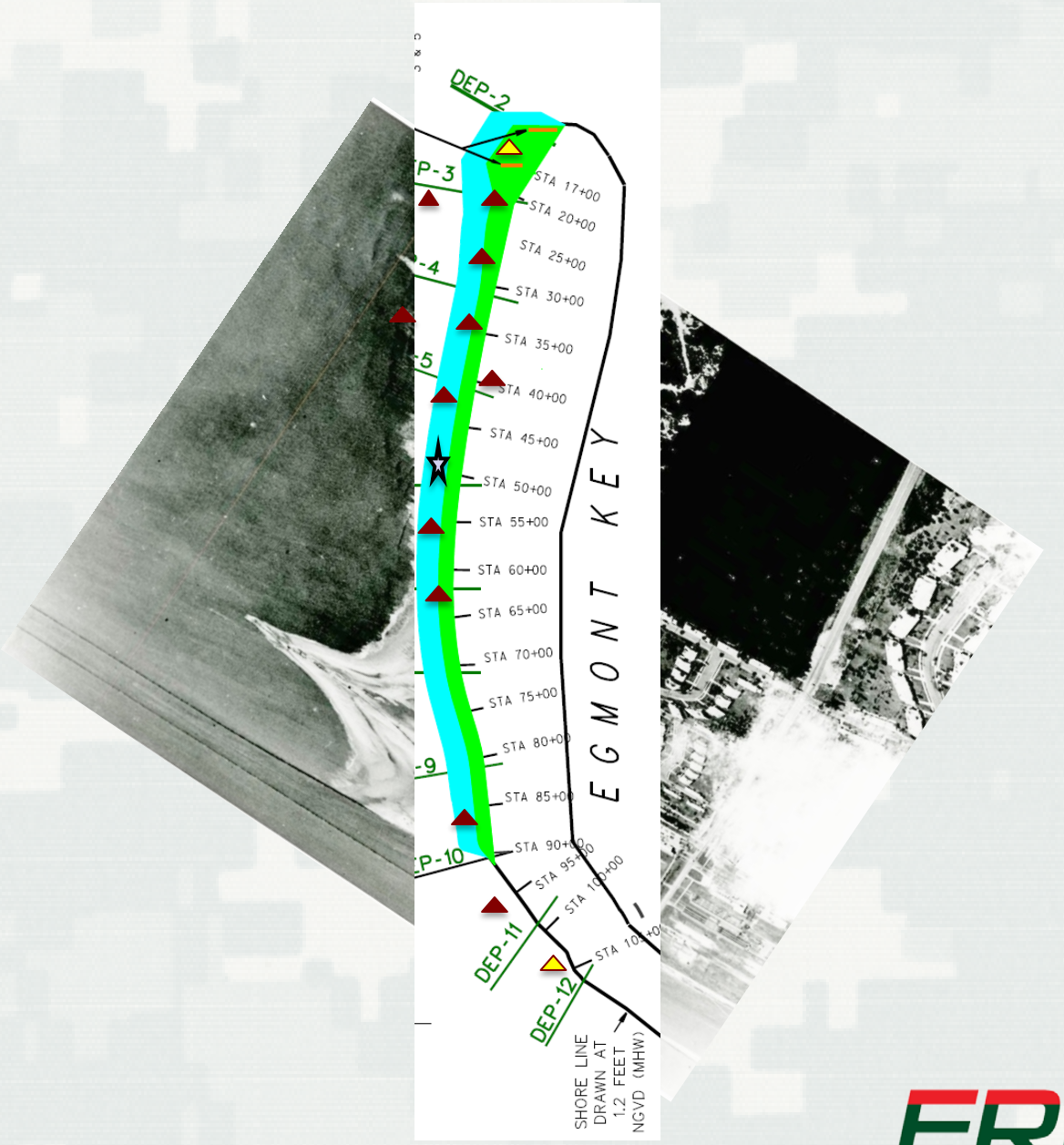
- POC: Coraggio Maglio



Single Point Placement

Jacksonville, Florida; Mayport Beach 1972

Egmont Key, Fl
Short-term
Monitoring
Option



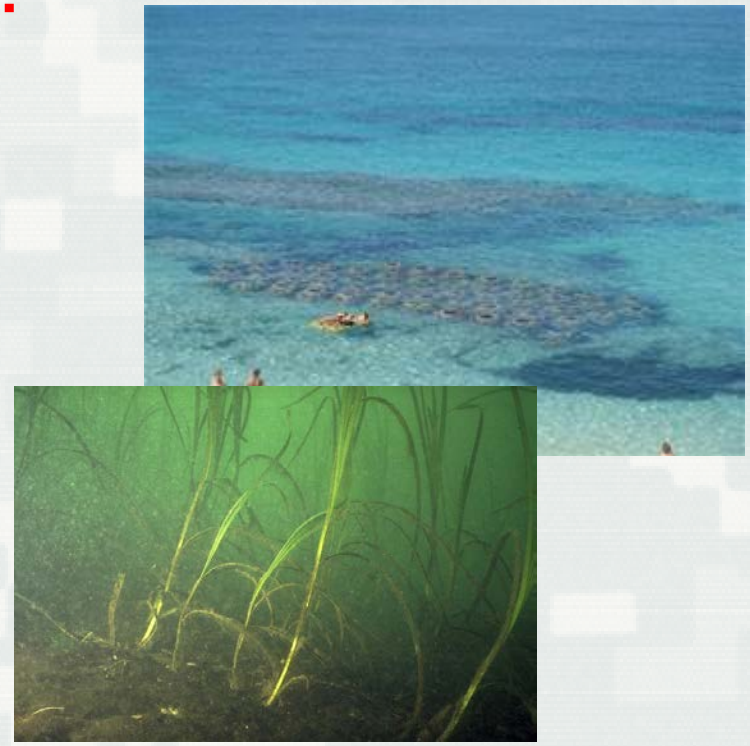
Evaluating Exposure of Biological Resources During Dredging and Placement Operations

How can Districts use this info?

- Given project sediment grain size and type and hydrodynamic conditions…similarities in site conditions

- Query library of case studies for similar projects to estimate likely plume PAR magnitude and durations and turbidity information

- Communicate with resource agencies in quantifiable terms regarding potential impacts to PAR and turbidity associated with dredging and disposal operations



Discussion?