



Sapelo Island NERR

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*Results (preliminary Oct. 09)

Abstract

Approaches for conducting and analyzing ecological assessments within similar systems using a set of standardized methods, indicators and threats have long been criticized for their lack of obtaining pertinent, system-specific health information on the site scale, and comparable information on regional and national scales. Likewise, many parameter metrics obtained in broad-spectrum "snapshot" assessments are adjusted to a standardized ranking scale for indexing a particular level of health which may be either inappropriate or not applicable to the system under examination. In this study several different scientific approaches, methods and objectives have been collated into a spectrum of tools that will allow for both quantitative and qualitative assessments of the estuarine waters and marshes of the Sapelo NERR. Sampling sites were selected based on utilizing a randomized probabilistic method. System analysis is based on water column biochemistry, benthic community and nekton tissue constituents, emergent vegetation community characterizations, watershed - scale GIS context of the site and known contaminant threats. The study also builds on previous efforts to assess sentinel habitat (tidal creeks) within the Sapelo NERR and ongoing efforts using the bottlenose dolphin as sentinel species for organochlorine and mercury exposure. Completed, the assessment will establish the foundation for a regional, integrated approach to system-health indexing based on site characteristics, reference condition and proximity and scale of threats.

Keywords: Randomized probabilistic sampling, Ecological assessment, Tidal creeks, Sentinel site, Reference site.

Introduction

Over the past five years Georgia's mid-coast estuaries have been the subject of many sponsored research studies with the similar objective of attempting to define the ecological condition and health of these wetland areas. These studies, sponsored by a wide spectrum of agencies have focused upon a gradient of impacted areas including highly impacted industrial sites (NIST, NCCOS:Center for Human Health Risk); moderately impacted small tidal creeks associated with residential and commercial development (NCCOS: Hollings Center; **Figure 1**), and most recently the low impact, reference condition marshes of the Sapelo NERR (NCCOS: Centers for Human Health, Coastal Environmental Health and Biomolecular Research Center and Sapelo Island NERR). Collectively, these assessment efforts have been able to establish an impressive spectrum of quantified environmental parameters; however, all participants also recognize the need for a venue offering higher information exchange and collaboration. It is felt that to achieve enhanced program synergy and integration, the inclusion of additional qualitative approaches, direct human-health studies, and local scientific and conservation participation will enhance the scope and application of objectives while decreasing redundancy and conflicts. These considerations led to the development of a pre-sample season information exchange symposium held by the SAP NERR in May 2009 (**Figure 2**).

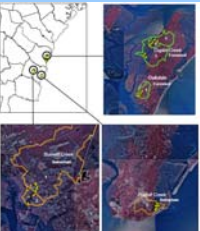


Figure 1. Oceans and Human Health study to validate the use of small tidal creeks as sentinels for ecosystem impacts. SAP NERR was used as a reference site for comparison with more developed areas of the coast. From: Sanger et al., 2007



Figure 2. The Sapelo NERR partnership information exchange symposium held on Sapelo Island to establishing sampling methods, parameters and responsibilities for the ecological assessment.

Methods (historical and background)

Studies focusing on the extent, range, and impacts at Superfund sites and associated contaminant releases near Brunswick, GA raised initial concern and awareness to area. Fish tissue body burdens of specific compounds of concern such as the Aroclor 1268 (PCB) (**Figure 3**) were examined by Maruya and Lee (1998). PCB, DDT, chlordane and PBDE body burdens were also examined in the tissues of marine mammals (bottlenose dolphins) (**Figure 4**) and compared with concentrations measured from other dolphin populations (Kucklick et. al., in prep). Tissue bio-accumulation, geographical range of transmission, and the system-wide spectrum of absorption made many of these compounds attractive research targets from the perspectives of:

- Dissemination rate and range of signature chemical impacts across temporal and geographical scales.
- Absorption amounts, mechanisms of transfer, and effects of these legacy toxins within the estuarine food web and up the trophic cascade, including human health effects, from direct consumption of the same food resources as those studied in marine mammal body burdens, as illustrated (**Figures 3, 4**).
- Building an estuarine ecological assessment program that infused local parameters of concern while also developing a standardized sampling approach with methods and analysis that had regional and national wetland assessment benefits.

	2004	2005
Silver perch	3.61	2.84
Red drum	0.92	0.71
Black drum	3.06	7.82
Spotted seatrout	3.68	6.49
Striped mullet	10.08	12.00

Figure 3. Aroclor 1268 content in sampled fish tissue associated with the Turtle River LCP Superfund site (Brunswick, GA). From: Kucklick /Nist presentation Sapelo Island NERR, Spring 2009.

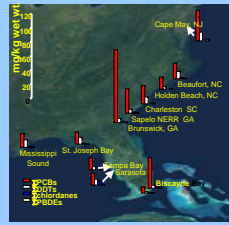


Figure 4. Body burdens associated with male Atlantic bottlenose dolphins (*Turciops truncatus*) in sampled areas of the Gulf and Atlantic coastlines, U.S. Note the extremely high body burdens of PCB's within the Brunswick area. (Kucklick et. al., in prep).

Methods: Spring-Summer 09

Prior to the beginning of the summer sampling season for the Sapelo NERR ecological assessment, scientists and program representatives collaborated in an information exchange symposium on Sapelo Island. During this meeting it was decided that the SAP NERR staff would be responsible for the emergent vegetation community sampling, while NCCOS:CCEHBR personnel would be responsible for water column, benthic community, and fish tissue samples. This approach allowed the scientific teams efficient division of labor and greater integration among programs reducing sampling redundancy and enhanced parameter information. These efforts also complemented the dolphin contaminant study which in-turn helped in establishing interests in a CDC human effects pilot study targeting body burden toxin transfers from the contaminated sediments/waters to fish to humans. A Generalized Random-tessellation Stratified design (GRTS) was used to select sampling sites(**Figure 5**). The preliminary results presented in the subsequent sections focus mainly on the wetlands components tackled by SAP NERR staff at the peak season of biomass in Southeastern marshes (Sept.-Oct.)



Figure 5. Computer generated randomized probabilistic sampling of sites within the SAP NERR. NCCOS sampling sites for benthic communities, water column and fish tissue (Blue). SAP NERR emergent vegetation community sampling sites (Yellow).

Sapelo NERR staff and graduate students from Savannah State University selected a three-phase EPA Rapid Assessment Method (RAM) (Nestlerode et. al., 2009) that was modified to meet Southeastern regional estuarine habitat applications (**Figure 6**). Assessment area (AA) descriptors and the sampling parameters and methods used within these emergent communities were guided by the three tier EPA approach to wetland assessment.

- Tier 1: Remote sensing, GIS watershed-context assessment of the AA.
- Tier 2: Qualitative checklist of stressors, threats and impact proximity to the AA
- Tier 3: Vegetative and soil sampling completed in replicates (3) of the biological/chemical components/properties of the AA.



Figure 6. Modified EPA (RAM) assessment approach (Heitmuller, T., 2008).

The protocols used in the SAP NERR emergent community ecological assessment demonstrated the following preliminary results (From Maher et. al, 2009):

- Spartina alterniflora* is the dominant plant species
- The mean density of *S. alterniflora* was 161.1±13.8 stems per m² and ranged from 68.0-326.6 stems per m²
- The mean height of *S. alterniflora* was 79.9±4.2 cm and ranged from 37.7-119.9 cm
- There was an inverse relationship between density and height (R²=0.47, Figure 2)
- Mean porewater temperature was 28.1±0.3°C and ranged between 24.7-31.3°C
- Mean pH was 6.5±0.0 and ranged from 6.2-7.0
- Mean salinity was 22.7±1.6 ppt and only ranged from 8.4-36.3 ppt

During our preliminary observation of macrofauna, we identified 10 species of invertebrates, 2 species of vertebrates, and 1 invasive species, the Caribbean mud fiddler *Uca thayerirtina alata*.

*sans analysis of pore water, creek water, fish tissue, benthic sediment, vegetation biomass (above and belowground), live/dead leaf C:N:P and soil characterization.



RTK mapping and reference



Belowground biomass sampling



Pore water sampling



Stem counts, heights and above ground biomass sampling

Discussion

Using the EPA RAM multi-tiered method has allowed for both quantitative and qualitative approaches to the eco-assessment. The partnership process has increased the scope of the chemical, physical and biological parameters analyzed, defrayed individual program costs, and facilitated novel research and assessment methods such as:

- Complementary research by NERR's Fellow Christine Hladik using hyper spectral and LIDAR technologies coupled with the RAM vegetation data for developing correlate estimates of marsh productivity (under development).
- Sponsorship of a graduate student at Savannah State University.
- Precipitation of two new studies involving:
 - The use of sentinel animals (Atlantic bottlenose dolphins) as indicators for human health effects: Center for Disease Control: Pilot study for toxic body burdens within the human population of Sapelo Island, GA.
 - Capture-release health assessment of 29 dolphins to examine potential adverse health effects in relation to high contaminant exposures. Dolphins were also fitted with radio transmitters to allow for follow-up monitoring and tracking of movements to better understand contaminant exposure sources.
 - Use of the modified Southeast RAM into a statewide wetland assessment program (GA CMP: Ecological Services project currently under design), with the SAP NERR marshes serving as high-quality reference control sites. Additionally, efforts are underway to link similar ecological assessments to the EPA coastal assessment process thus, developing a funding mechanism for this work based upon CZMP and EPA funding (to be promoted at the upcoming National Coastal States Meeting (Feb. 2010 Washington, D.C.).

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