Northern Gulf Institute

Gulf Research Initiative Year 1 Monitoring

Presentation to the
National Water Quality Monitoring Council

May 4, 2011

NGI
NORTHERN GULF INSTITUTE

John Harding, PhD, Chief Scientist
Jharding@ngi.msstate.edu

www.NorthernGulfInstitute.org

What monitoring has your organization been doing?

What is your long term vision for coordinated monitoring in the Northern Gulf?

NGI
Northern Gulf Institute
a NOAA cooperative institute

Northern Gulf Institute

NOAA Cooperative Institute

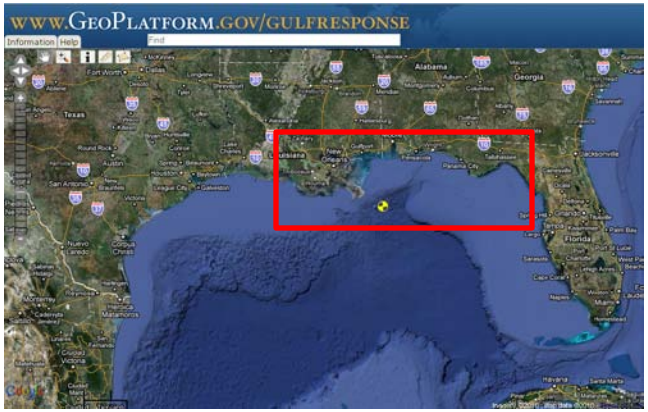
Research Themes

- Ecosystem-Based Management
- Coastal Hazards and Resiliency
- Climate Change & Climate Variability Effects on Regional Ecosystems
- Geospatial Data, Information & Visualization in Environmental Science

Research Partners

BP Gulf Research Initiative

- Apr 20 – Deepwater Horizon Oil Rig Explodes and Sinks
- May – NGI Annual Meeting Adds Targeted Workshop to develop research questions/ monitoring needs
- Jun - BP met with Gulf of Mexico universities to establish Gulf Research Initiaitive (GRI)
- Jul - BP awarded NGI (via MSU) $10M to use in emergent research to address DwH science issues
- Aug – NGI distributed ~$6M for 34 projects at 11 universities described at: http://NorthernGulfInstitute.org
- Jan – NGI selects additional 25 projects for remaining ~4M via independent review, competitive process



NGI
Northern Gulf Institute
a NOAA cooperative institute

BP Gulf Research Initiative Participants on NGI GRI Phase I Projects

- Mississippi State University
- Dauphin Island Sea Lab
- Florida State University
- Louisiana State University
- University of Southern Mississippi
- Harte Research Institute
- Jackson State University
- University of Mississippi
- University of New Orleans

5 NGI Partners

NGI
Northern Gulf Institute
a NOAA cooperative institute

MSU-led NGI GRI Phase I Projects

- <u>Program Office (Carron)</u>
  - Equipment for MS State Chem Lab
  - **NGI Organized Joint Research Cruise (MSU, USM, UM, etc.) – Oct 2010**

- <u>Integrated Assessment of Oil Spill (McAnally)</u>
  - Hurricane Effects (Fitzpatrick)
  - Fate and Transport of Oil and Dispersants (Martin)
  - **Natural Systems (Ervin)**
  - Technology and Data Integration (McAnally)
  - **Autonomous Monitoring and Remote Sensing of submerged oil (Yao & Ryan)**

Bold indicates Monitoring-related

NGI
Northern Gulf Institute
a NOAA cooperative institute

Natural Systems (Ervin)

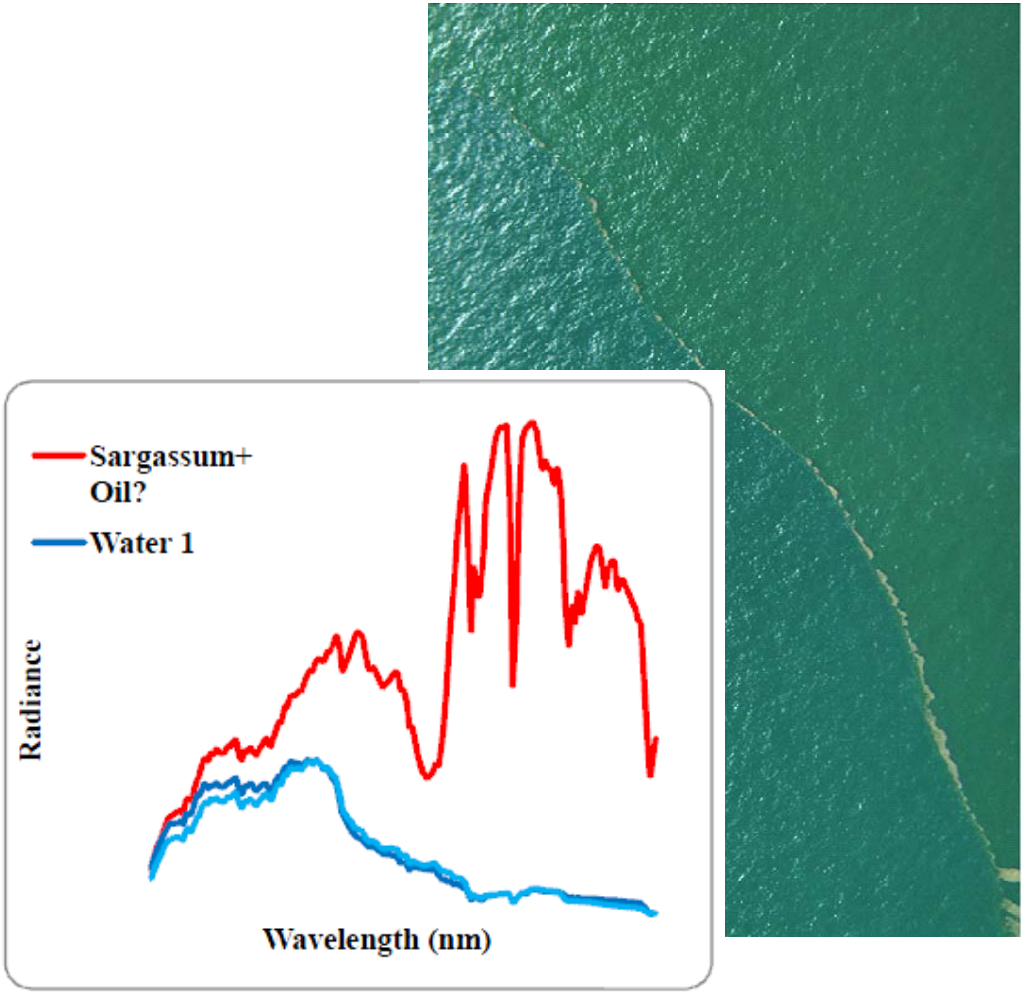
- Assessing early responses of intertidal habitats to oil/dispersant contamination
  - Field data and hyperspectral & multispectral imagery to visualize and detect stress induced in estuarine vegetation

- Assessing interactions between oil/dispersant system and soil/sediment microbial assemblages
  - Identify isotope signatures of samples collected from field sites 2-3 times between July and December 2010

NGI
Northern Gulf Institute
a NOAA cooperative institute

Autonomous Monitoring and Remote Sensing of Submerged Oil (Yao & Ryan)

- The FTIR system was used to detect and identify potentially hazardous gas emissions from the crude oil and the oil fires used to reduce the surface oil.
- The MSIR scanner was found to be an excellent tool for detecting oil and was routinely used to direct oil skimmers. Detecting oil reliability to organize the skimming efforts is a challenging activity.
- When the oil is floating on the water, the MSIRLS works well but it cannot detect the oil, if the oil is a mm or less beneath the surface (water is opaque in the infrared).
- Hyperspectral VNIR data penetrates the water surface and could increase the probability of detection and reduce false alarm rates for oil.



Reflectance from water and possible sargassum; RGB composite image of the airborne hyperspectral data over possible oil spill;

NGI
Northern Gulf Institute
a NOAA cooperative institute

USM-led NGI GRI Phase I Projects

- Comprehensive Assessment of Oil Distribution, Transport, Fate, and Impacts on Ecosystems & DwH Oil Release (Lohrenz)
  - **Coastal Observation Platforms in Support of Characterization of Oil Extent &Transport (Howden)**
    - Coastal radar to characterize near-real-time surface currents in MS Bight
  - **Chemical Effects Associated with Leaking Macondo Well Oil in the Northern GoM (Shiller & Guo)**
    - PAH, Metals, & optical properties in estuarine to deep Gulf waters
  - **Monitoring and Assessment of Potential Impacts of Oil Contamination on Coastal and Marine Ecosystems in the Northern GoM (Howden & Milroy)**
    - Monitor and analyze for PAH on existing USM survey lines in MS Sound/ MS Bight in surface and bottom waters, surficial sediments, phytoplankton, zooplankton, shrimp & oysters

Bold indicates Monitoring-related

NGI
Northern Gulf Institute
a NOAA cooperative institute

USM-led NGI GRI Phase I Projects (cont.)

- **Assessing Possible Impacts of the DwH Oil Spill on Summer Plankton Assemblages of the Inner Continental Shelf in the North Central GoM (Perry & Comyns)**
  - Collect and compare ichthyoplankton at historical SEAMAP survey sites and on 100 mile transect
- **Responses of Benthic Communities and Sedimentary Dynamics to Hydrocarbon Exposure in Neritic and Bathyal Ecosystems (Yeager et al)**
  - Collect & characterize benthic fauna and sediments from shallow shelf to deepwater
- **Monitoring the Impacts of Dispersed Oil Exposure on Ecologically and Economically Important Species in the Northern GoM Using molecular Biomarkers (Griffit & Overstreet)**
  - Collect and compare post exposure Brown Shrimp and Atlantic Croaker to pre-exposure collections via molecular, functional, and histopathological biomarkers

Bold indicates Monitoring-related

NGI
Northern Gulf Institute
a NOAA cooperative institute

USM-led NGI GRI Phase I Projects (cont.)

- **Microbial Response to Macondo Oil and Dispersant (Grimes & Dillon)** –

  - Bacterial respiration experiments with T,S, nutrient sampling on existing transect

- **Salt Marsh Habitat Sampling to Delineate Potential Oil Impacts from BP DwH Spill (Biber et al)**

  - Salt marsh, brackish marsh & freshwater marsh flora and fauna sampling and hydrocarbon analysis

- **Investigation of Juvenile Fishes Associated w/Pelagic Sargassum Habitat in North Central GoM (Franks et al)**

  - Juvenile fish sampling

- Public Health Impact of Gulf Oil Spill: Assessment of Risk and Health Education (Mitra & McGuire)

- Adaptation and Resilience of Mississippi Residents to the BP Oil Disaster (Osowski et al)

Bold indicates Monitoring-related

NGI
Northern Gulf Institute
a NOAA cooperative institute

UM/NIUST – led NGI GRI Phase I Projects

- NIUST Deepwater Horizon Oil Spill Multi-Task Research (Highsmith)
  - **Microbial Consumption of Oil and Gaseous Hydrocarbons in the Pelagic Waters of the Northern Gulf of Mexico (Joye)**
    - Cruise based sampling and analysis of microbial mediated Oxygen consumption
  - Implementing Sensor Technology to Monitor DwH Oil Spill Subsurface Plumes
  - **Measuring the Distribution of Oil and Oil Droplets Throughout the Water Column**
    - Digital camera imagery deployed to map size and 3-D distribution of oil droplets
  - **Impacts of Oil Contamination to Seagrass Beds: Proteomic Responses**
    - Use molecular, genetic & chemical biomarkers analyses on sea grass samples from MS Sound over 6 month period at ~10 sites

Bold indicates Monitoring-related

NGI
Northern Gulf Institute
a NOAA cooperative institute

JSU-led NGI GRI Phase I Project

- Data Sampling and Modeling of Contaminant Dispersant (Skelton)
  - Instrument development

The robotic sampling system including fluidics

NGI
Northern Gulf Institute
a NOAA cooperative institute

FSU-led NGI GRI Phase I Project

- Impact of Crude Oil on Coastal and Ocean Environments of the West Florida Shelf and Big Bend Region from the Shoreline to the Continental Shelf Edge (Chassignet & Coleman)
  - Oil & Layers on the Ocean: Impact of Capillary Wave Damping on Remote Sensing & Air-Sea Fluxes (Bourassa)
  - **Effects of Oil Deposition on Coastal Sand, Beach, Dune & Salt Marsh Environments (Heuttel)**
    - Microbial analyses on sandy sediment, coastal dune vegetation; effects of species diversity , consumer pressure & bioremediation on salt marsh recovery
  - **Examining the Impact of Oil on Essential Fish Habitat and Food Webs (Chanton)**
    - Diver video transects on shallow coral/sponge reefs; Sediment collection & analysis on shelf edge grouper habitat; *stable isotope tracing*

Bold indicates Monitoring-related

NGI
Northern Gulf Institute
a NOAA cooperative institute

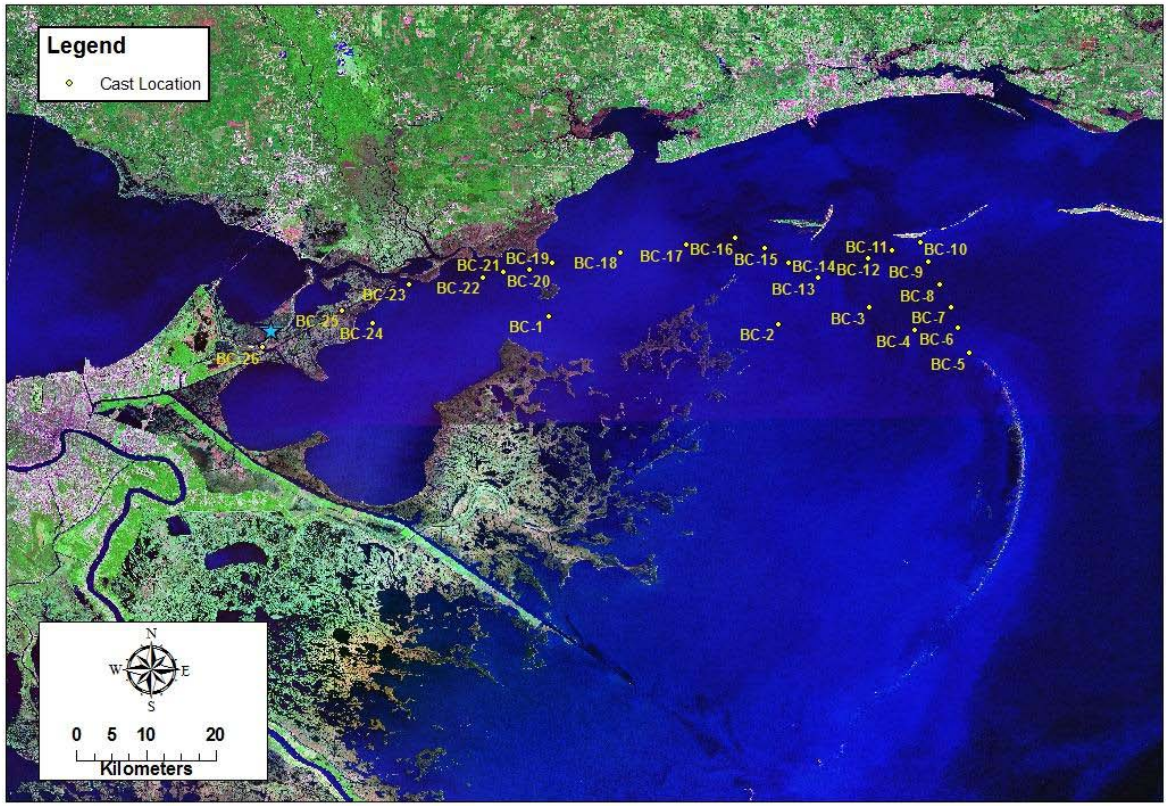
HRI-led NGI GRI Phase I Project

- Gulf of Mexico Research and Resource Support Tools (GulfBase, Gulf of Mexico Biodiversity Project, Gulf of Mexico books, etc.) (McKinney & Tunnell) *Complete Biodiversity data base and load onto GulfBase*

NGI
Northern Gulf Institute
a NOAA cooperative institute

UNO-led NGI GRI Phase I Project

- **<u>Monitoring of Natural Resources in the Pontchartrain Basin Following the Deepwater Horizon Oil Spill: Processes, Habitats, and Fisheries (Reed)</u>**



Map of estuarine process field sampling sites.

- Tracking oil and oil residue within the estuary in water samples, together with select samples of tissue, vegetation and sediment
- Assessment of oiling on key ecosystem components including Submerged aquatic vegetation, Bivalves including oysters (*Crassostrea virginica) and clams (Rangia cuneata), and Nekton.*
- Evaluating the transport processes influencing the distribution of oil through the coastal ecosystem.

Bold indicates Monitoring-related

NGI
Northern Gulf Institute
a NOAA cooperative institute

LSU-led NGI GRI Phase I Projects

- <u>Impact of DwH Oil Spill on the Louisiana Coastal Environments (Welsh)</u>
  - **Barataria Estuary Water Quality**
    - Nutrients, TSS, Chl, C, + others along transect
  - **Nutrient Dynamics and Primary Productivity in the Breton Sound Estuary as Impacted by the Gulf of Mexico Oil Spill**
    - Nutrients, TSS, Chl & S along transect
  - **Plankton Monitoring of the Barataria and Breton Sound Transects**
  - **Oil Spill Effects on Ecosystem Respiration for Two Louisiana Estuaries**
    - Respiration & Radiocarbon sampling & analyses

Bold indicates Monitoring-related

NGI
Northern Gulf Institute
a NOAA cooperative institute

LSU-led NGI GRI Phase I Projects

- Examining the Biological Uptake of Highly Carcinogenic Polycyclic Aromatic Hydrocarbon- -Benzo(a)pyrene from Crude Oil Polluted Environments in the Gulf of Mexico
- **Impact of the Deepwater Horizon Oil Spill on Vibrios in the Northern Gulf of Mexico**
  - Sample & analyze concentrations of *V. vulnificus* & *V. parahaemolyticus* in water sediment, & oysters in Breton Sound & Barataria Bay
- Physics, Oil, and Fish: Modeling the Effects of Pulsed River Diversion on Oil Transport and Fish Distribution

Bold indicates Monitoring-related

NGI
Northern Gulf Institute
a NOAA cooperative institute

DISL-led NGI GRI Phase I Projects

- <u>Impacts of the DwH Oil Spill on Ecosystem Structure and Function in Alabama's Marine Waters (Valentine)</u>
  - **Document the Impacts of Oil Intrusion on Economically and Ecologically Important Fishes in Alabama's Nearshore and Coastal Waters**
    - Vertical & longline sampling and benthic trawling at historically occupied stations in nearshore and inland waters of Alabama
  - **Document the Impacts of Oil Intrusion on Keystone Sentinels in Mobile Bay Waters**
    - Add PAH & stress targeted proteins to analyses of on-going oyster sampling in Alabama waters; track & monitor movement/ condition of 2-4 manatees in Alabama waters
  - Document the Impacts of Oil Intrusion on the Health of Critical Nursery Habitats and Habitat Utilization Patterns of the Young of Economically Important Fishes – *analysis of pre-collected data*

Bold indicates Monitoring-related

NGI
Northern Gulf Institute
a NOAA cooperative institute

DISL-led NGI GRI Phase I Monitoring Project

- Document the Impacts of Oil Intrusion on Keystone Sentinels in Mobile Bay Waters
  - Evaluate the acute impacts of DwH on planktonic organisms, economically and ecologically important adult fishes (both reef-associated and demersal), trophic pathways, key biogeochemical processes driven by microbial organisms, and finfish and shellfish nursery habitat function.
  - Capture, tag, and conduct health assessments on manatees. Manatees were monitored in near real time via satellite/GPS. Movement patterns of the manatees during and after the DwH spill was consistent with patterns seen in previous years. Continued tracking of tagged manatees will continued as long as the tags remain functional and future manatee movement data will be analyzed and compared to previous patterns.

NGI
Northern Gulf Institute
a NOAA cooperative institute

DISL-led NGI GRI Phase I Projects (cont.)

- **Evaluate the Impacts of Oil, Methane and Dispersant on Pelagic Food Web Structure and Organic Matter Cycling Along the Alabama Coast**
  - Bi-weekly sampling of bacterial biomass production, nutrients, dissolved and colloidal organic matter, methane, crude oil, DIC & pH; abundance of bacteria & phytoplankton
- **Evaluate the Extent to Which Sedimentary Biogeochemical Cycles and Specifically the Nitrogen Cycle have been Changed by Inundation of Coastal Waters by Oil**
  - Sample and evaluate Mobile Bay Marsh sediments measuring nutrient concentrations, porosity, and organic content, oxygen, sulfide, PAH +

Bold indicates Monitoring-related

NGI
Northern Gulf Institute
a NOAA cooperative institute

DISL-led NGI GRI Phase I Projects (cont.)

- Quantifying the Effects of Oil on the Microbial Community Structure and Processes in Alabama Coastal Waters – *In conjunction with Task 4*

- **Evaluate the Potential for Along-estuary Transport of Oil-derived substances in Surface and -Subsurface Waters of the Ship Channel of the Mobile Bay Estuary**
  - Replicated field surveys in Mobile Bay for currents, S,T, CDOM flourescence & DO

Bold indicates Monitoring-related

NGI
Northern Gulf Institute
a NOAA cooperative institute

NGI GRI Phase II Projects

Quantifying the Effects of Oil Exposure on the Carbon Cycling and Diversity of Pelagic Microbial Community of Coastal Alabama (Ortman)

Does the "Priming Effect" Caused by the DWH Oil-spill Result in Increased Microbial and Zooplankton Consumption of Labile and Refractory Dissolved Organic Carbon? (Condon)

Potential Impacts of the DWH Oil Spill on Fishery Resources: Will There be Reduced Recruitment of Economically Important Shrimp, Crabs, and Finfish in Seagrass and Marsh Nursery Habitats of the North Central Gulf of Mexico? (Heck & Cebrian)

Impacts of the Deepwater Horizon Accident on Food Web Structure in the North-Central Gulf of Mexico (Valentine & Powers)

NGI BP Earth System Modeling (Chassignet)

Automated Mapping of Surface Oil Spill: Surface Physics and Remote Sensing Associated with Movement and Identification of a Slick (Bourassa)

Uncertainty Quantification of Oil Spill Transport (Gallivan)

Bold indicates Monitoring-related

NGI
Northern Gulf Institute
a NOAA cooperative institute

NGI GRI Phase II Projects (cont.)

Deepwater Horizon Oil Deposition in Gulf of Mexico Beaches Phase 2: Recovery of the Beach Sedimentary Environment (Heuttel & Kostka)

Impact of Crude Oil on Coastal and Ocean Environments of the West Florida Shelf and Big Bend Region from the Shoreline to the Continental Shelf Edge: Radiocarbon and Stable Isotope Tracing (Chanton)

Post Macondo Well Oil Spill Water Quality Sampling- Barataria, Lake Pontchartrain, and Coastal Waters Part 2 (Turner)

Field Observation and Modeling of the Impact of Oil Spill on Marsh Erosion in Southern Louisiana (Chen)

Effects of Oil, Dispersant, and Remediation-related Human Activities on Marsh Plants and Associated Insects and Mollusks (Anderson & Turner)

Bold indicates Monitoring-related

NGI
Northern Gulf Institute
a NOAA cooperative institute

NGI GRI Phase II Projects (cont.)

Aquatic Primary Productivity and Spatial/Temporal Water Quality Variations of the Breton Sound Estuary and Impacts of Oil Pollution (Day & Lane)

Macondo 252 Oil Spill Impacts in Louisiana Coastal Wetlands: Effects on Soil-Microbial-Plant Systems (Mendelssohn)

Community Earth Modeling System for the NGOM (McAnally)

Extend Sulis Toolkit (Amburn)

The Influence of Weather and Ocean Processes Using Numerical Modeling on the Fate and Transport of the Deepwater Horizon Oil Spill (Fitzpatrick)

Quantitative Studies of the Effects of Oil Exposure on the Pelagic Microbial Community and Sheepshead Minnow, Using a Global Proteomics Approach (Edelmann & Pechan)

Comprehensive Study of the Impact of the Deepwater Horizon Oil Spill on the Health and Productivity of Gulf Coast Salt Marshes (Mishra)

Bold indicates Monitoring-related

NGI
Northern Gulf Institute
a NOAA cooperative institute

NGI GRI Phase II Projects (cont.)

An Ecosystem Modeling Framework to Examine Ecological Impacts of the Deepwater Horizon Oil Spill (Fulford)

Evaluating Changes in Fluorescence EEM and Size Spectra During the Degradation of Crude Oil and Dispersant in Seawater (Guo)

Chemical Effects Associated with Leaking Macondo Well Oil in the Northern Gulf of Mexico (Shiller & Guo)

Impacts of the Deepwater Horizon Oil Spill on the Health and Growth of Estuarine Fish *(sea trout & red drum)* and Ecosystem Functionality (Fulford)

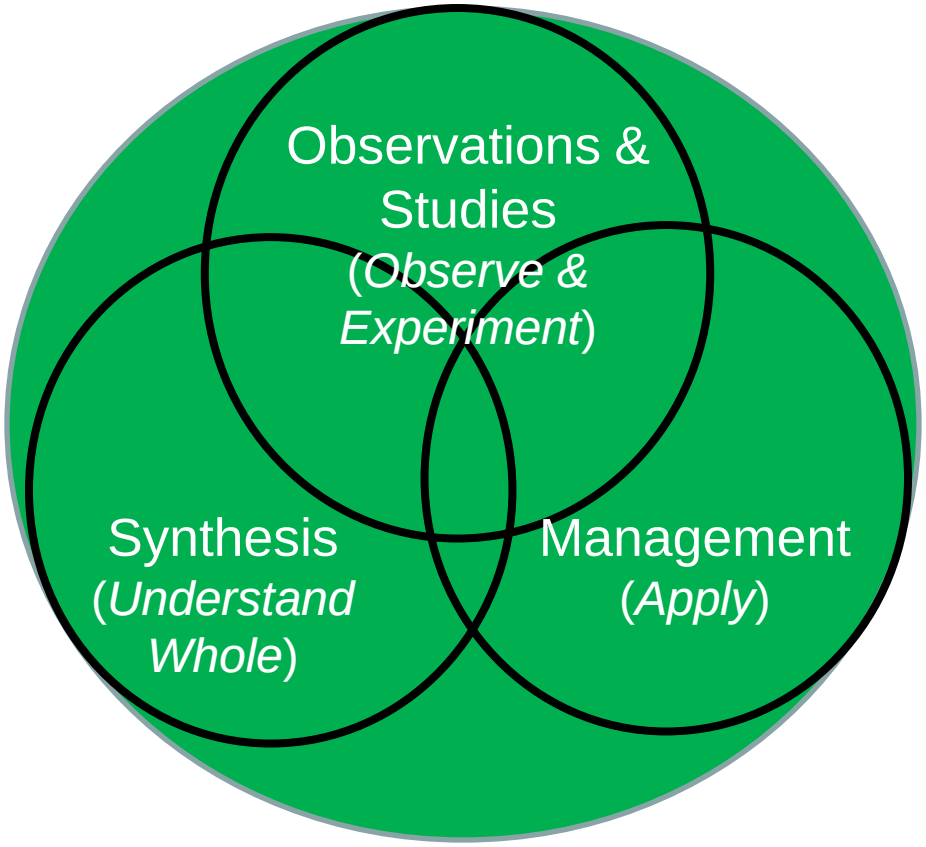
Responses of Benthic Communities and Sedimentary Dynamics to Hydro-carbon Exposure in Neritic and Bathyal Ecosystems: Phase II (Yeager)

Analyses of the effects of crude oil on increased disease susceptibility and physiological responses of selected Gulf of Mexico fishes (Petrie-Hanson)

Bold indicates Monitoring-related

NGI
Northern Gulf Institute
a NOAA cooperative institute

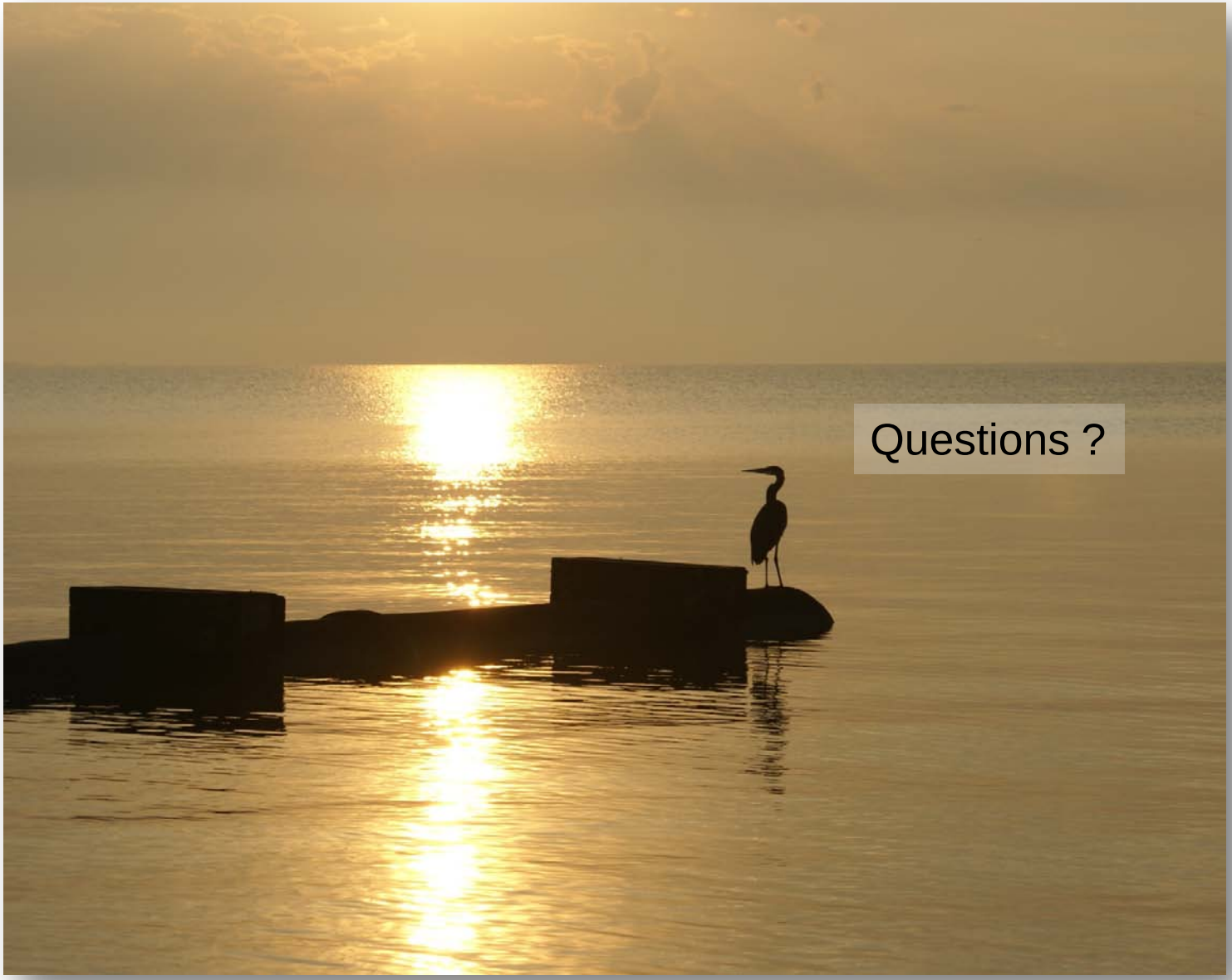
Northern Gulf Institute



Long term vision for coordinated monitoring in the Northern Gulf

HYPOTHESIS: Natural and anthropogenic perturbations significantly impact the Northern Gulf of Mexico (NGoM) ecosystem structure, function, and services"

www.NorthernGulfInstitute.org



NGI
Northern Gulf Institute
a NOAA cooperative institute