Oyster Biology & Ecology and Oil Spill Clean up Relevant to the Louisiana Oyster Industry

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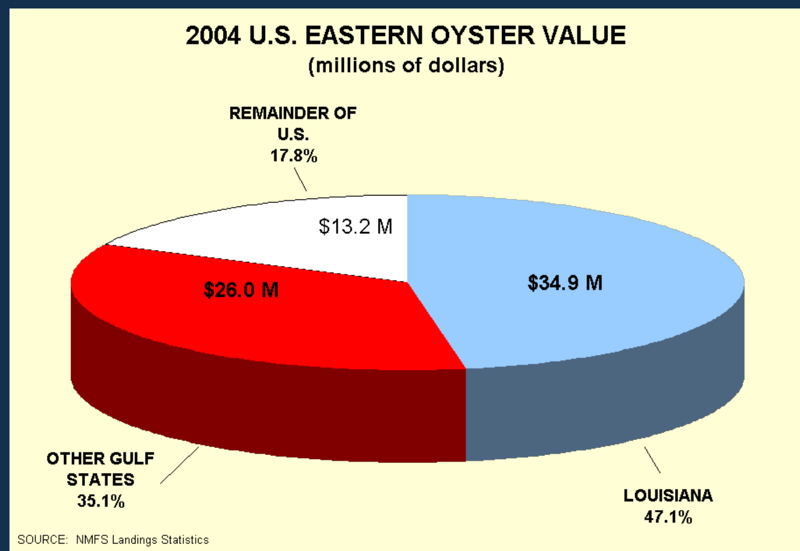
An Industry with Families Investing In Louisiana as a Nationally-Recognized Fishery



Unique Centuries-old Culture passed down from Generation to generation

Salinity and Water Temperature

Are the two most dominant factors for oyster survival and growth when other environmental parameters are within tolerance range

Optimum Salinity Regime (Red Lines) for Louisiana Production on State Public Grounds
Seed oysters 1-3" shell length, 5-15ppt (from Chatry et al. 1985)
Blue dashed line (added by Melancon)**optimum salinity for oyster larvae and recruitment survival ≥ 8ppt**

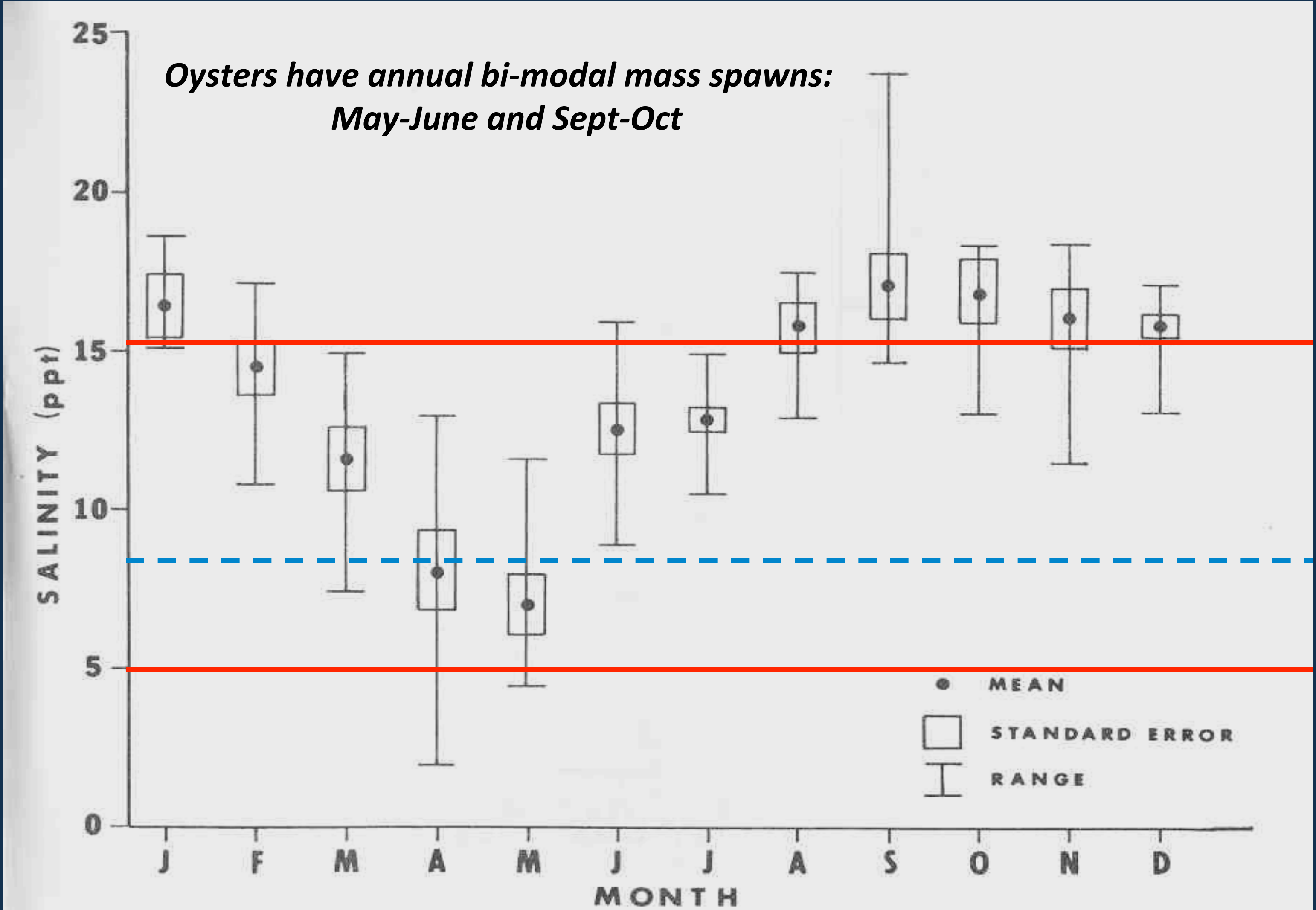
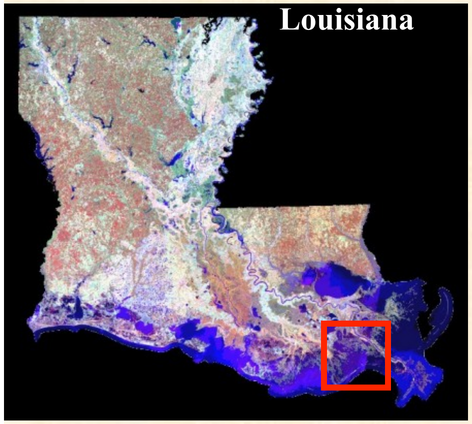


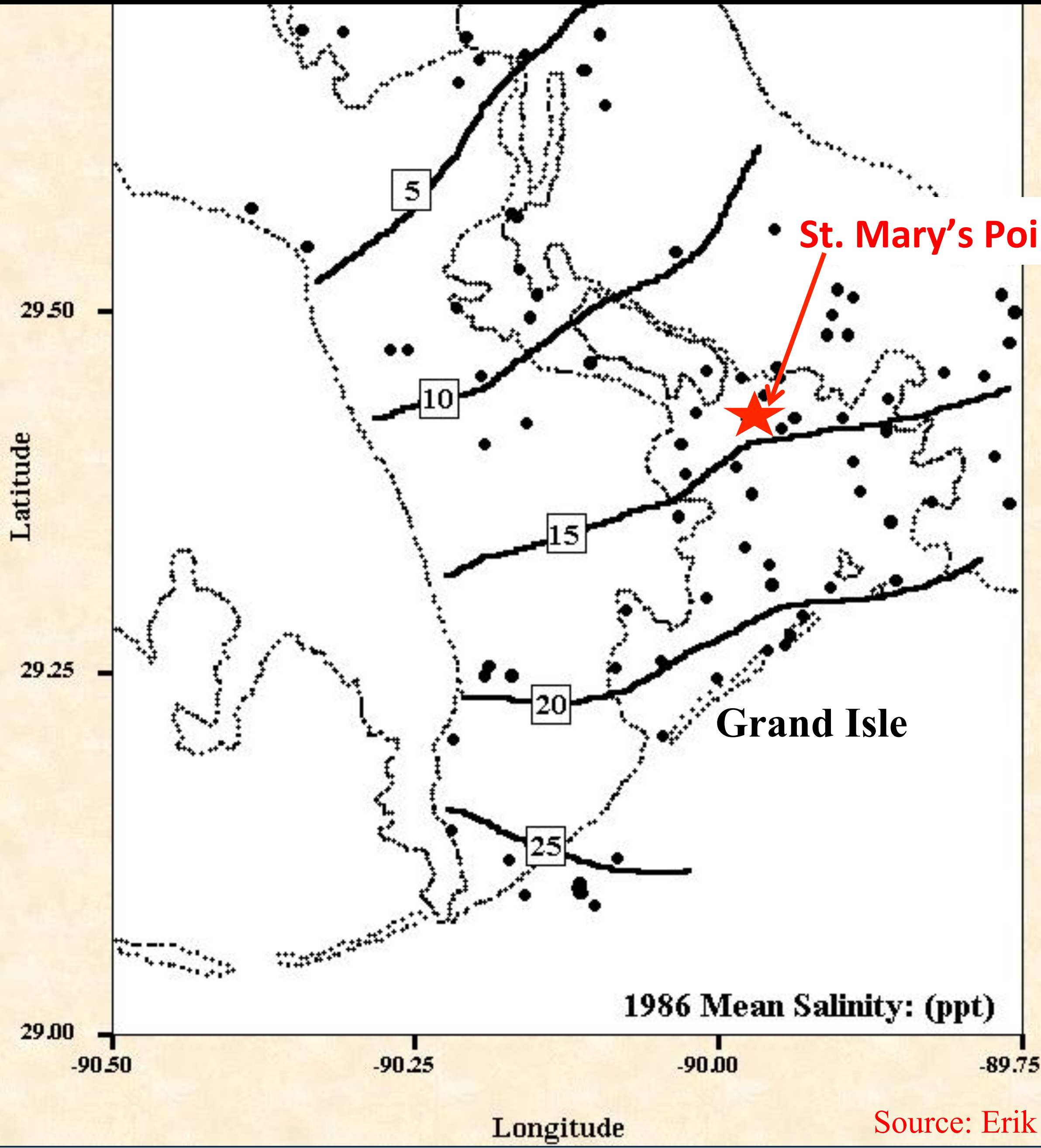
FIG. 6. Derived optimum annual salinity regime for seed oyster production.

1986

Mean Annual Salinity Habitats in the Barataria Estuary

Drought Year

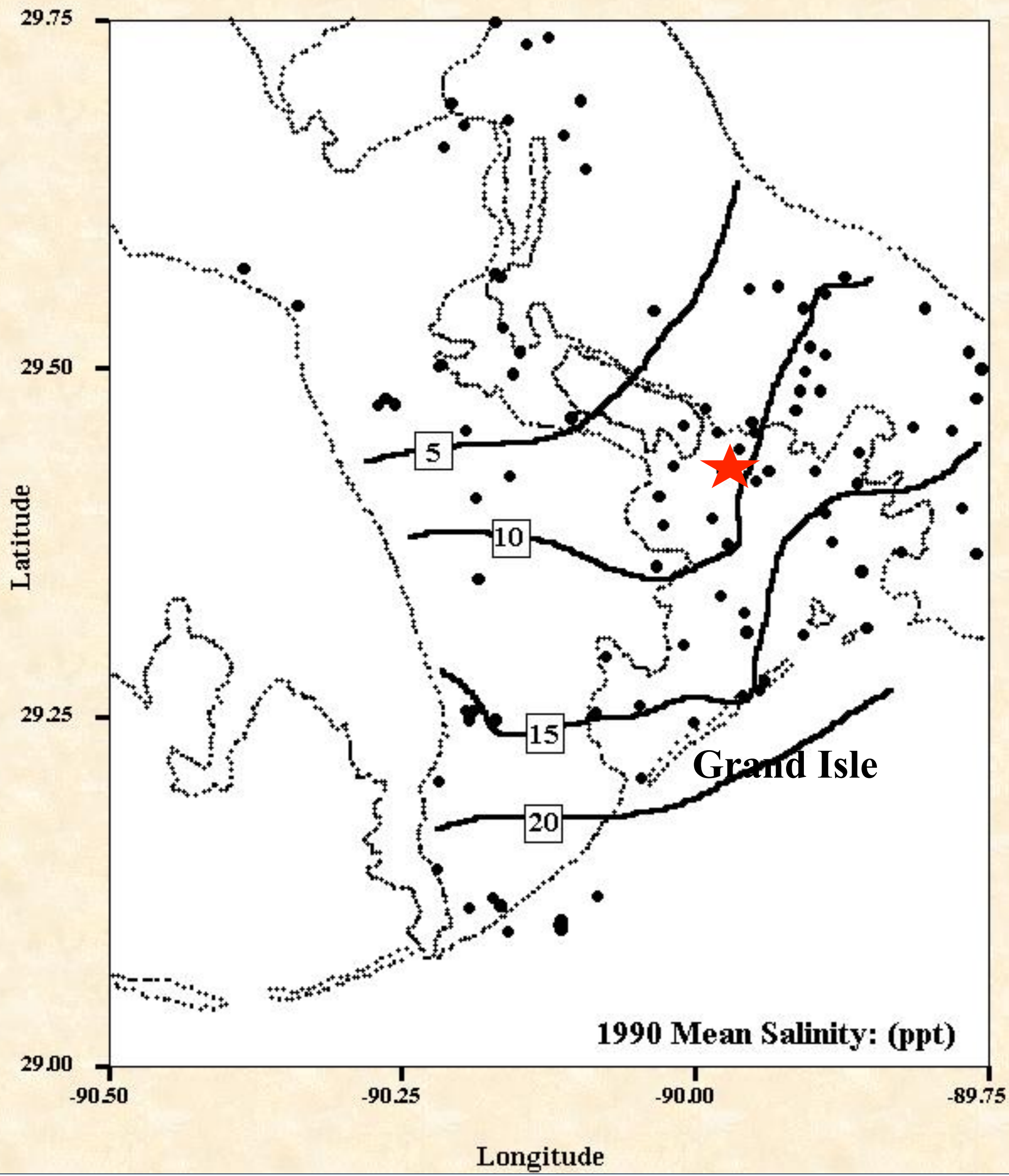




Source: Erik Swenson, LSU

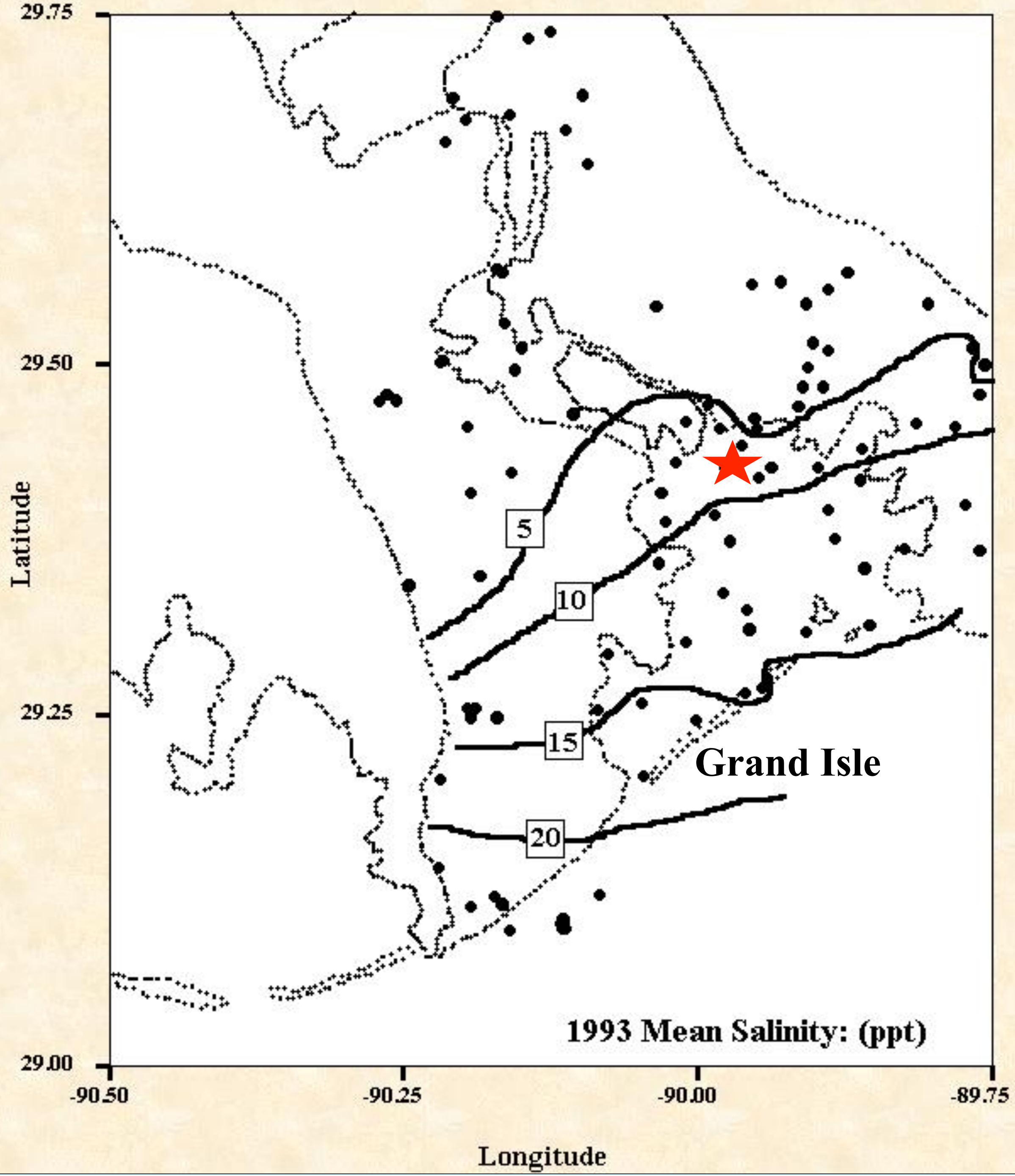
1990

Normal Year

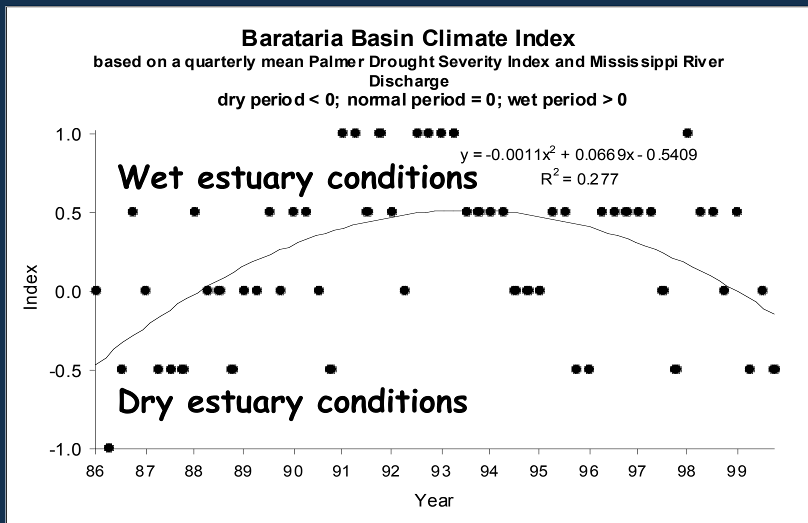


1993

Wet Year



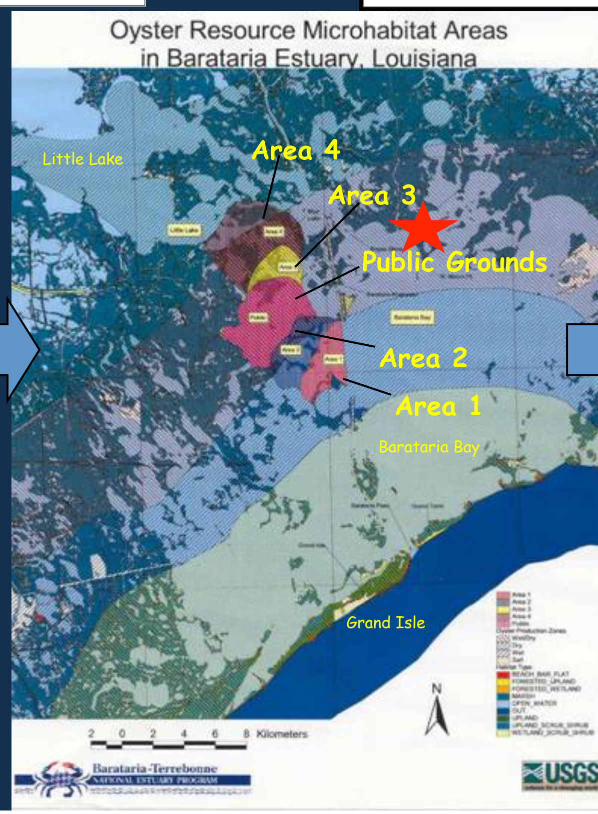
Oyster Harvester's Perspective- changing with salinity is normal

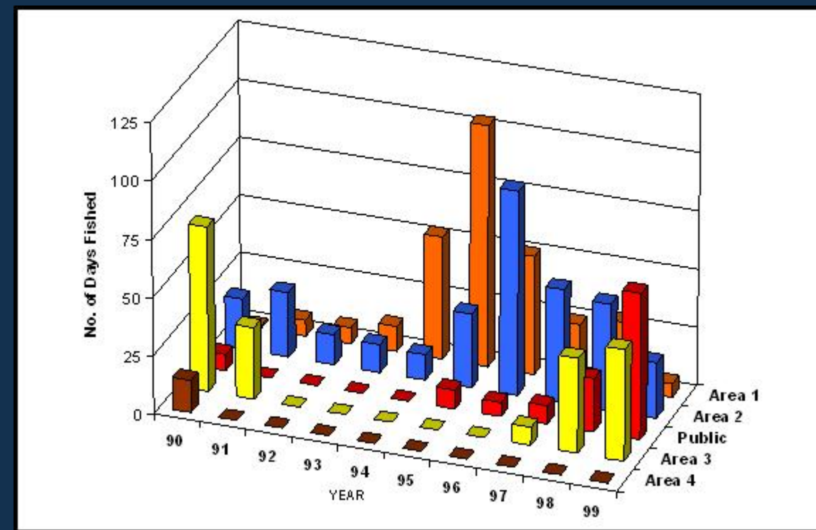


A

As mother nature shifts through natural dry and rainy periods, oyster survival changes and oyster locations change up and down estuary.

B





C

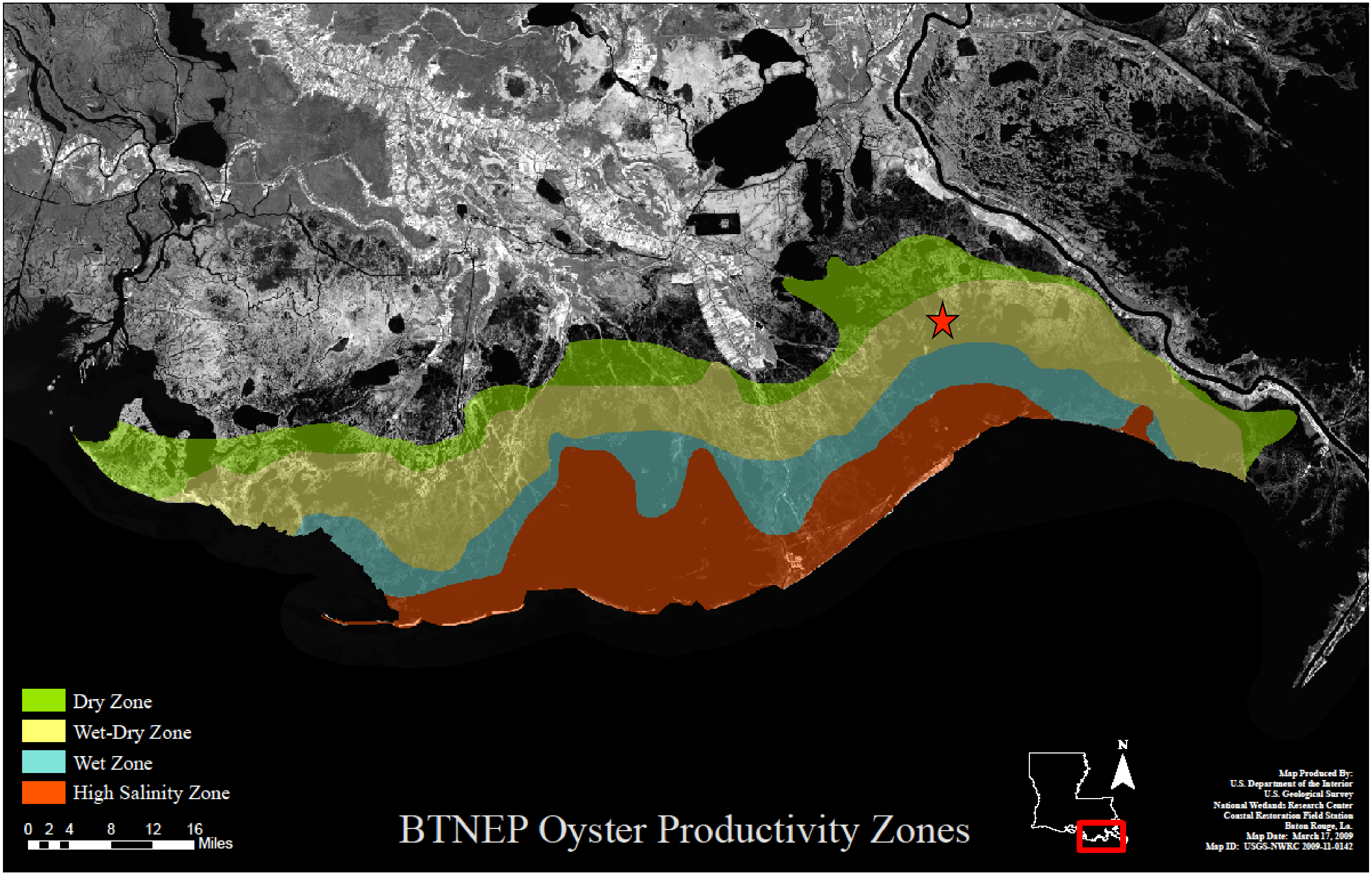
As oyster habitat locations change, an oyster harvester shifts efforts to productive areas up and down estuary.

The Human Dimension & Fishing Strategy

Data sources: E. Melancon, E. Swenson, P. Vujnovich unpublished

Oyster Habitat Zones Based on Salinity (Wet & Dry Estuary Conditions)

Melancon et al. 1998

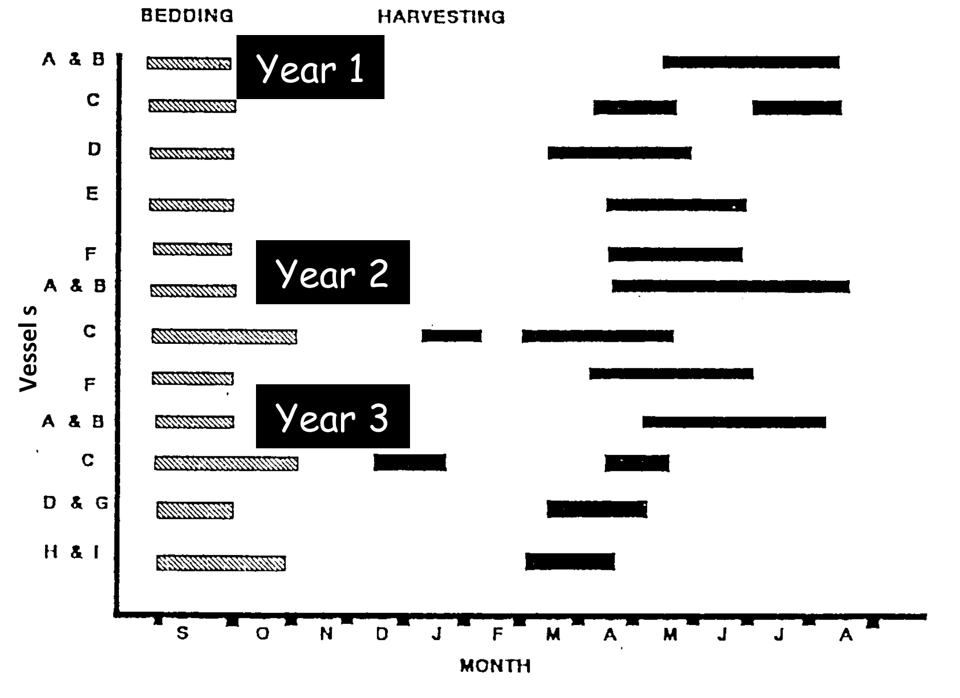


Seed Bedding FISHERY

Oystermen transport seed from Public Grounds or private leases to bed in areas that grow oysters fast (high-salinity zone) depending on prevailing conditions

Oyster Survival and Growth

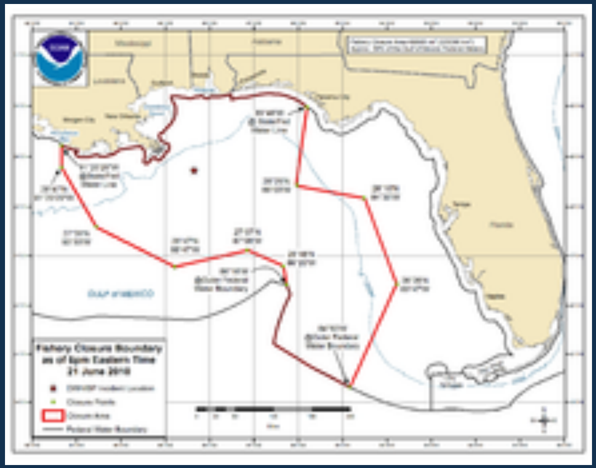
High-salinity habitat produces very good growth, but problems with abundant predators. If plant in fall of year, must harvest by next summer

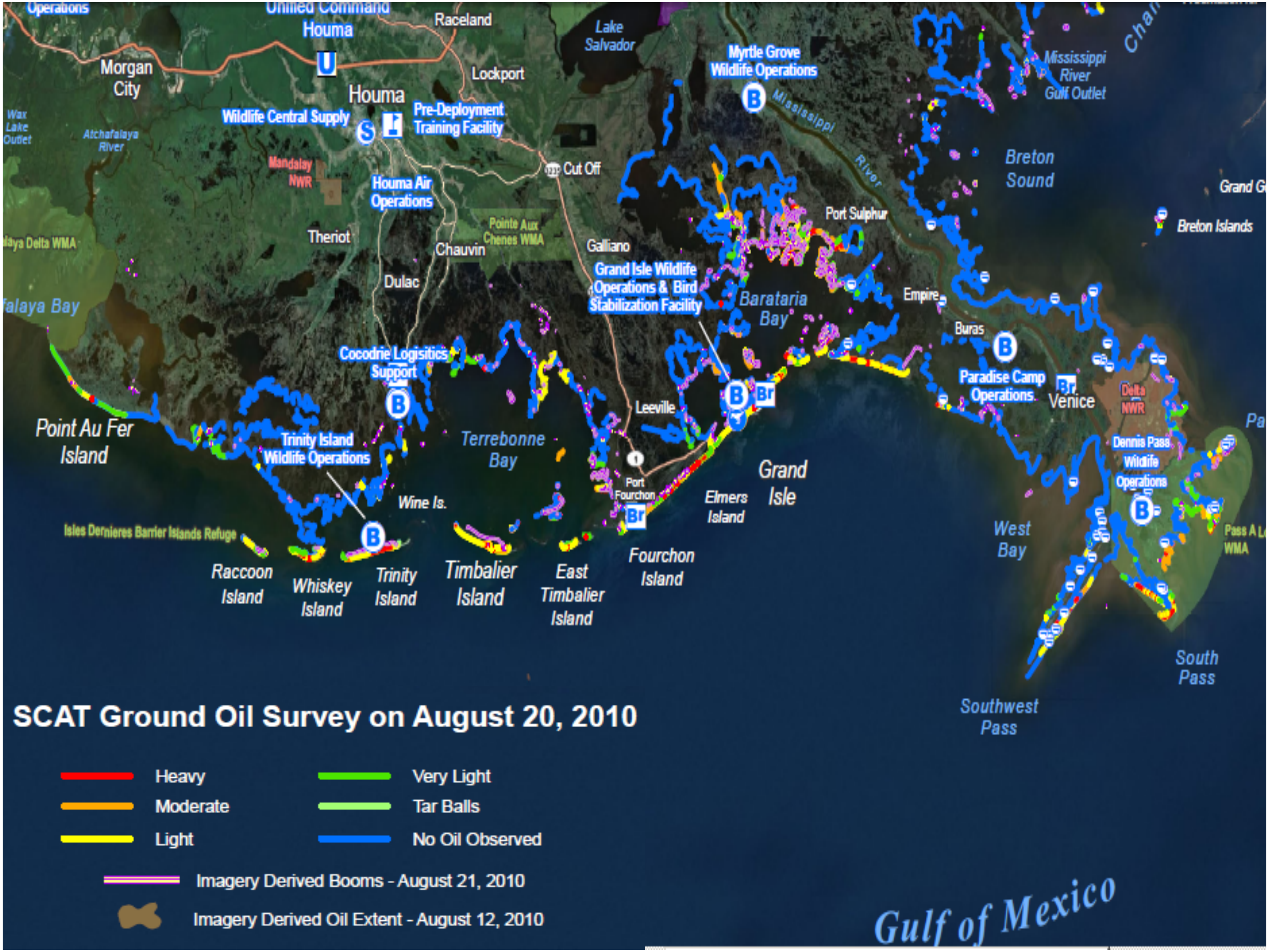


Data sources: E. Melancon

April 20th BP Oil Spill Incident

Oil Spill Response





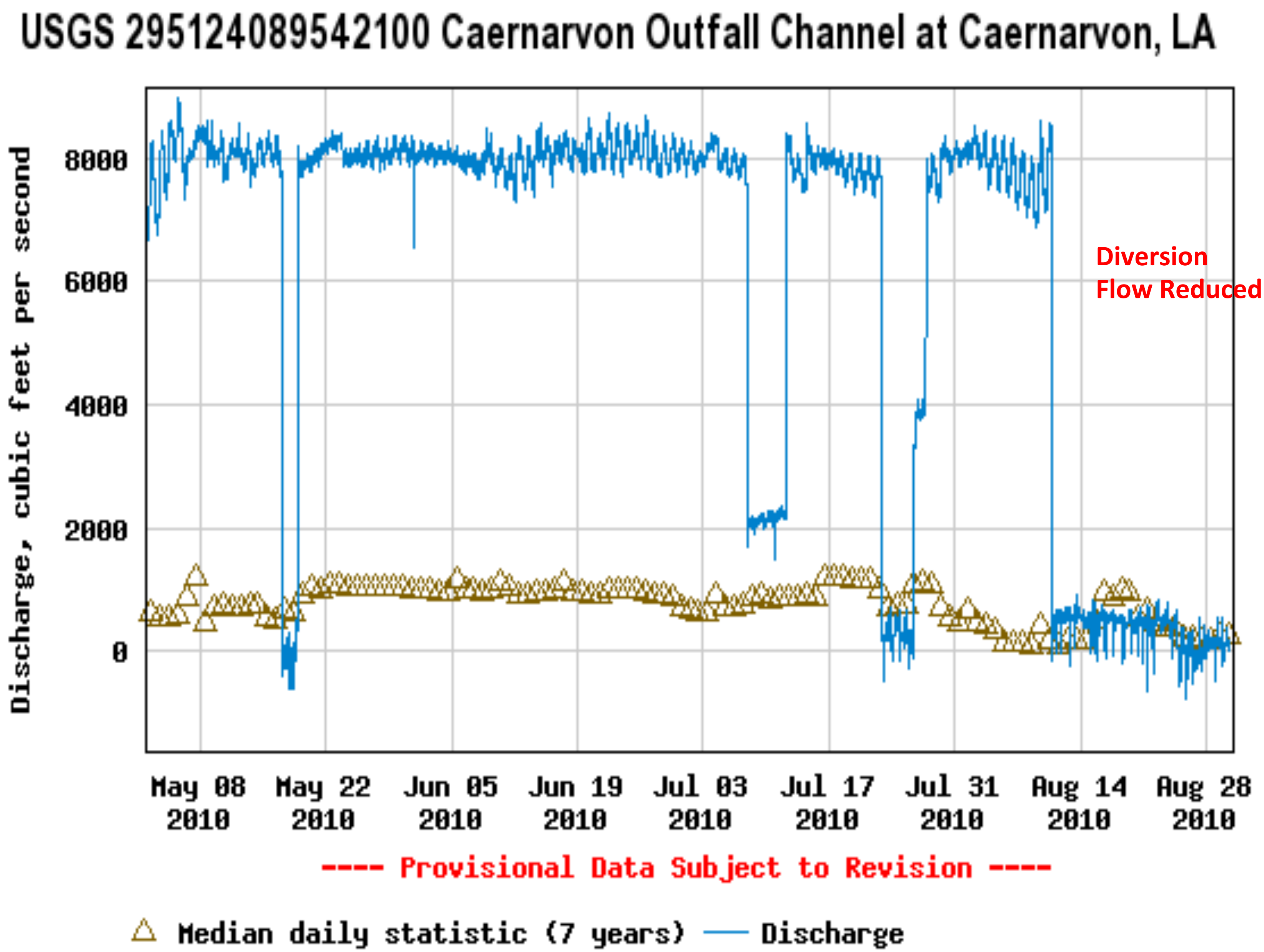
Unified Command Houma
Raceland
Lake Salvador
Morgan City
Lockport
Houma
Myrtle Grove Wildlife Operations
Mississippi River Gulf Outlet
Wax Lake Outlet
Atchafalaya River
Wildlife Central Supply
Pre-Deployment Training Facility
Mississippi River
Breton Sound
Mandalay NWR
Cut Off
Houma Air Operations
Port Sulphur
Breton Islands
Theriot
Pointe Aux Chenes WMA
Chauvin
Galliano
Grand Isle Wildlife Operations & Bird Stabilization Facility
Dulac
Barataria Bay
Empire
Buras
Cocodrie Logistics Support
Paradise Camp Operations
Venice
Delta NWR
Leeville
Point Au Fer Island
Terrebonne Bay
Trinity Island Wildlife Operations
Dennis Pass Wildlife Operations
Port Fourchon
Grand Isle
Elmers Island
Wine Is.
West Bay
Isles Dernieres Barrier Islands Refuge
Fourchon Island
Raccoon Island
Whiskey Island
Trinity Island
Timbalier Island
East Timbalier Island
South Pass
Southwest Pass
SCAT Ground Oil Survey on August 20, 2010
Heavy
Moderate
Light
Very Light
Tar Balls
No Oil Observed
Imagery Derived Booms - August 21, 2010
Imagery Derived Oil Extent - August 12, 2010
Gulf of Mexico

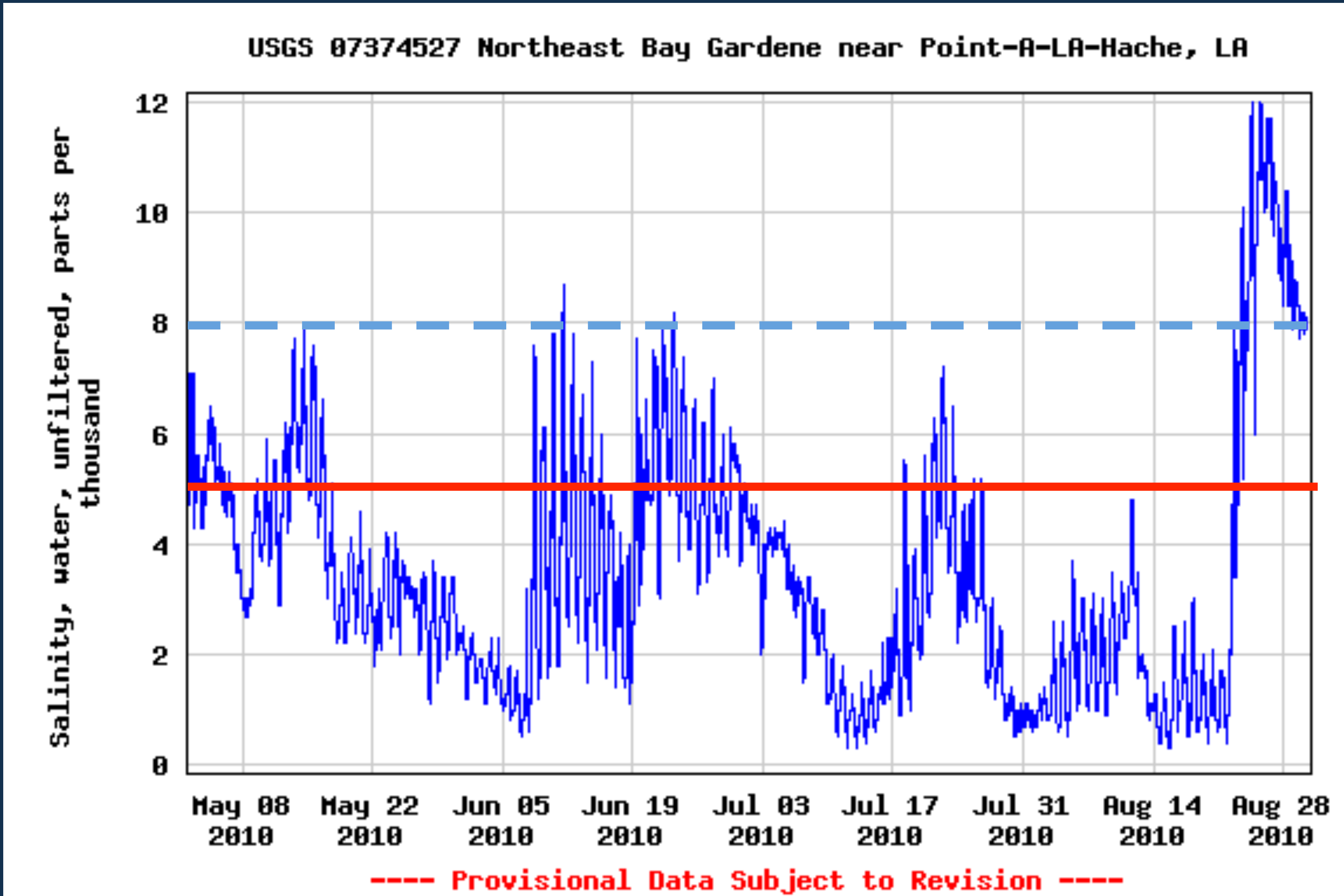
Oil Spill Residue Estimate

Category	Estimate
Direct Recovery from Wellhead	17%
Burned at the surface	5%
Skimmed from the surface	3%
Chemically dispersed	8%
Naturally Dispersed	16%
Evaporated or dissolved	25%
Residual Remaining	25%

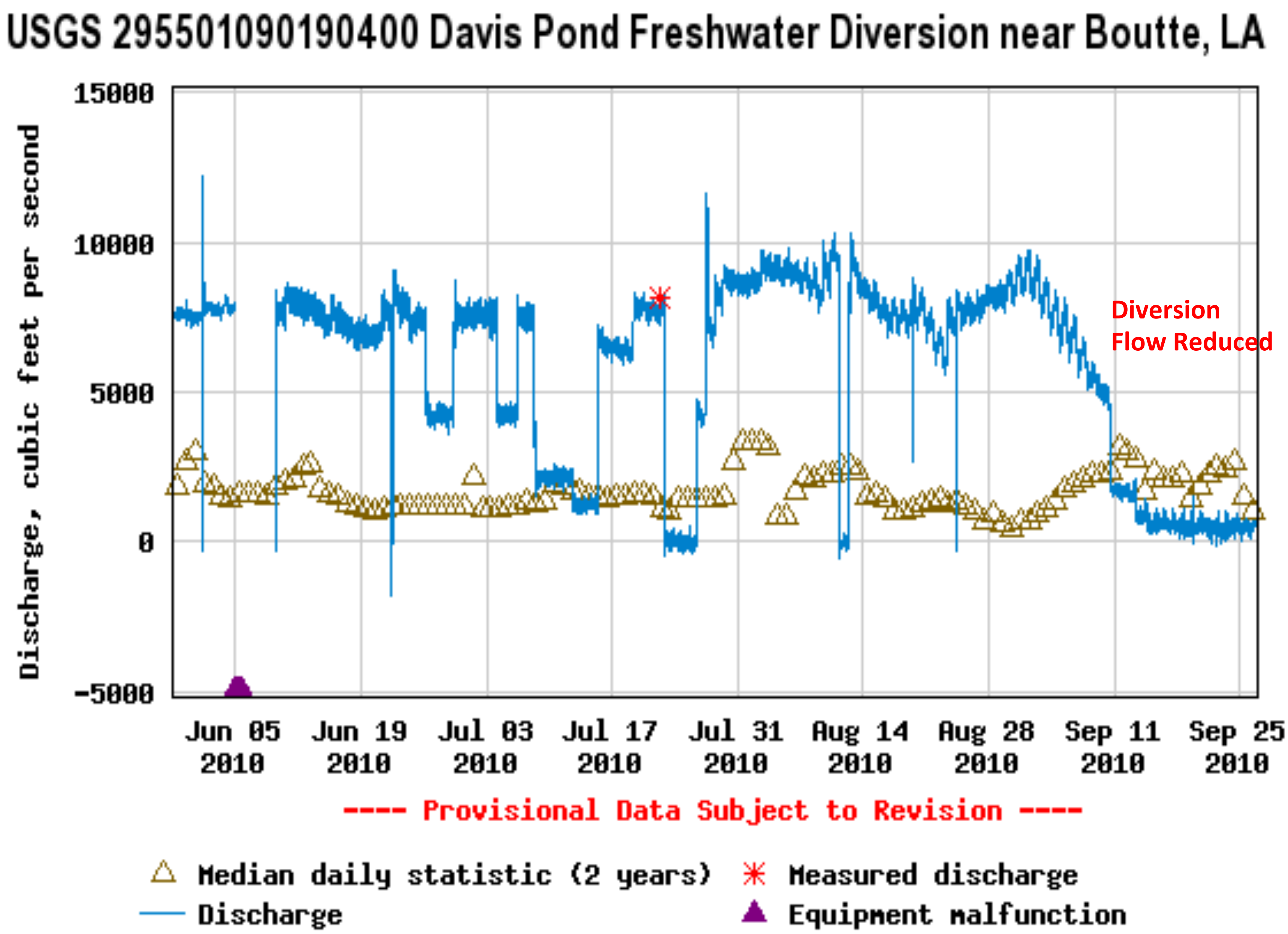
Source: NOAA

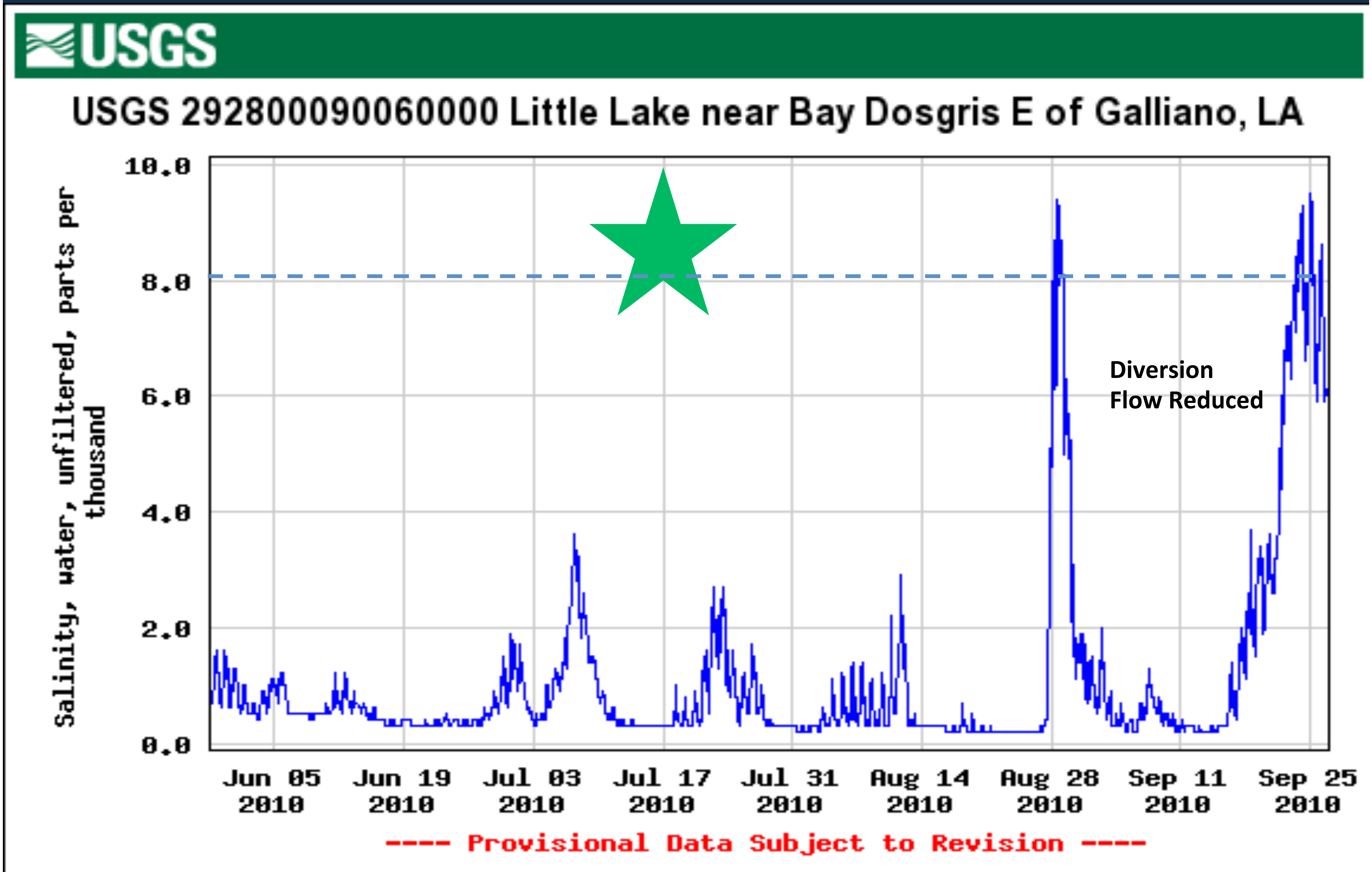
CAERNARVON DIVERSION FLOW MAY-AUG 2010



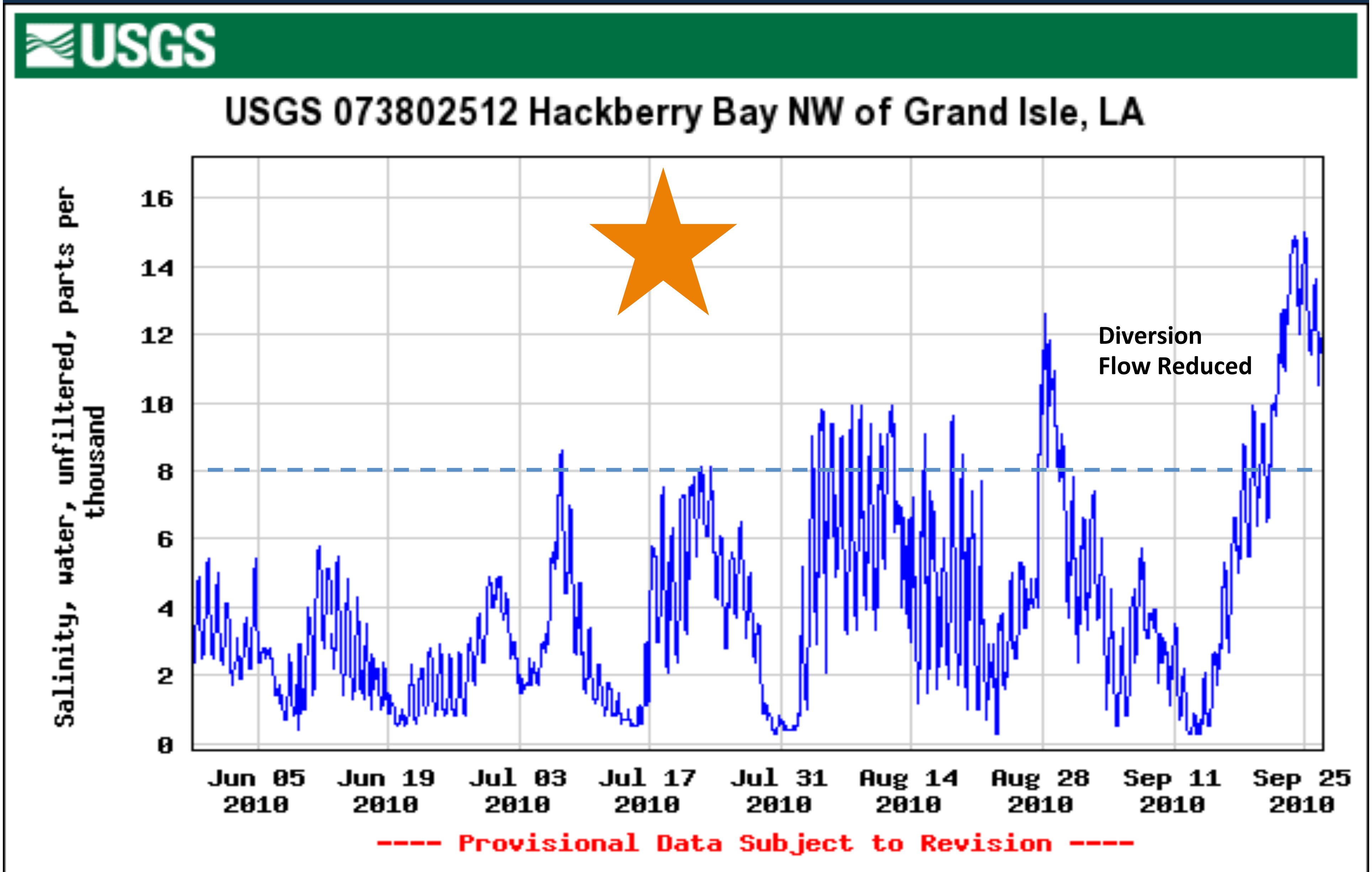

USGS 07374527 Northeast Bay Gardene near Point-A-LA-Hache, LA
Salinity, water, unfiltered, parts per thousand
12
10
8
6
4
2
0
May 08 2010
May 22 2010
Jun 05 2010
Jun 19 2010
Jul 03 2010
Jul 17 2010
Jul 31 2010
Aug 14 2010
Aug 28 2010
---- Provisional Data Subject to Revision ----

DAVIS POND DIVERSION FLOW June-Sept 2010





USGS
USGS 292800090060000 Little Lake near Bay Dosgris E of Galliano, LA
Salinity, water, unfiltered, parts per thousand
10.0
8.0
6.0
4.0
2.0
0.0
Diversion Flow Reduced
Jun 05 2010
Jun 19 2010
Jul 03 2010
Jul 17 2010
Jul 31 2010
Aug 14 2010
Aug 28 2010
Sep 11 2010
Sep 25 2010
---- Provisional Data Subject to Revision ----


USGS
USGS 073802512 Hackberry Bay NW of Grand Isle, LA
Salinity, water, unfiltered, parts per thousand
16
14
12
10
8
6
4
2
0
Jun 05 2010
Jun 19 2010
Jul 03 2010
Jul 17 2010
Jul 31 2010
Aug 14 2010
Aug 28 2010
Sep 11 2010
Sep 25 2010
Diversion Flow Reduced
---- Provisional Data Subject to Revision ----

Barataria Bay
July 20, 2010
Shellfish Ecology Laboratory
Oyster Survey with dredge
After Opening of Davis Pond Diversion
In Response to Deepwater Horizon Oil Spill

Anaerobic Degradation of Petroleum Hydrocarbons Under Mixed Electron Acceptor Conditions

Past work at Nicholls in Wetland sediments

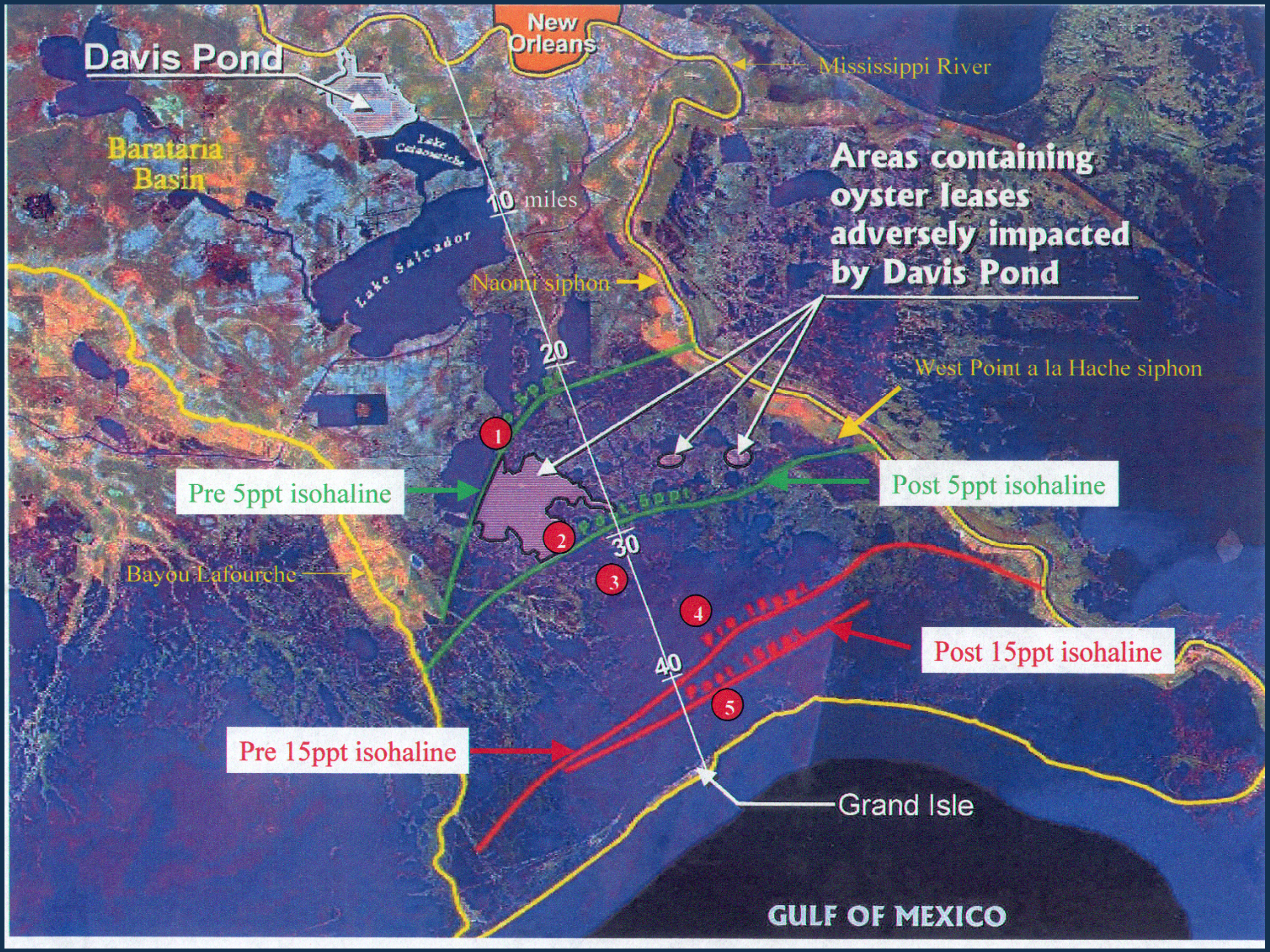
No.2 Diesel Oil Spill in Barataria Bay in 2002

- Approximately 10,000 gallon of diesel spill in Barataria Bay
- Aerobic Biological Treatment of Oil Spills
- Passive Bioremediation
- Biostimulation
- Bioaugmentation
- In-Situ Treatment
- Why Anaerobic Bioremediation is Important?

Chronic sediment and soil contamination

Anaerobiosis and redox conditions

Sediment Site



Methods

- Sediment samples were collected from the diesel contaminated site and a composite sample was prepared for the study.
- TPH analysis was performed.
- The conditions chosen were nitrate, sulfate, iron-reducing, methanogenic, fermenting, and mixed electron acceptor conditions.
- Soil slurry reactor and soil column studies were done.

Physico-chemical characterization of soil

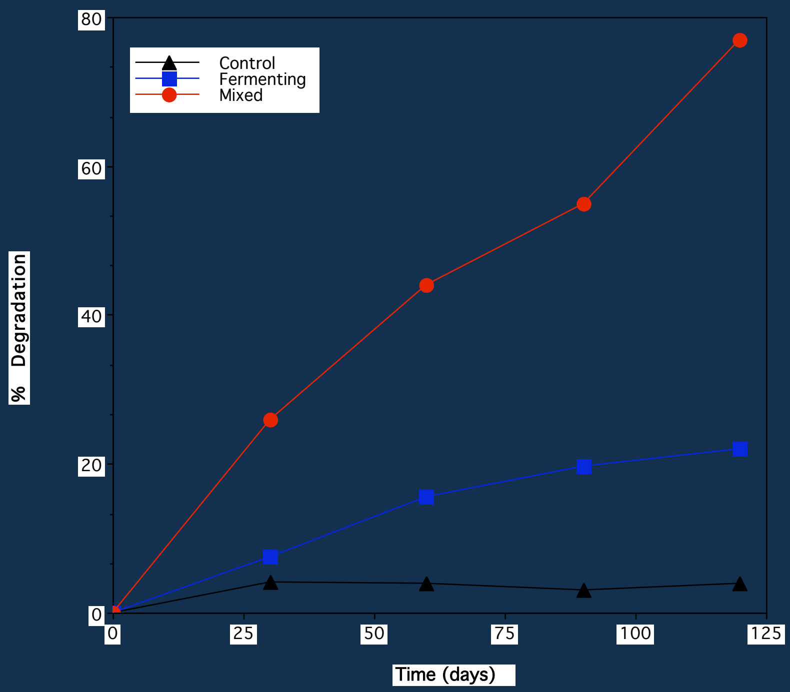
Parameter	Mean (range of 4 samples)
pH	6.5 (6.1 – 6.9)
Eh (mV)	-46 (-28 to -77)
Total solid (%)	88 (74 – 95)
Total organic carbon (%)	3.5 (3 –4)
TPH (g/kg of soil)	6 (3 – 11)

Experimental Set-up

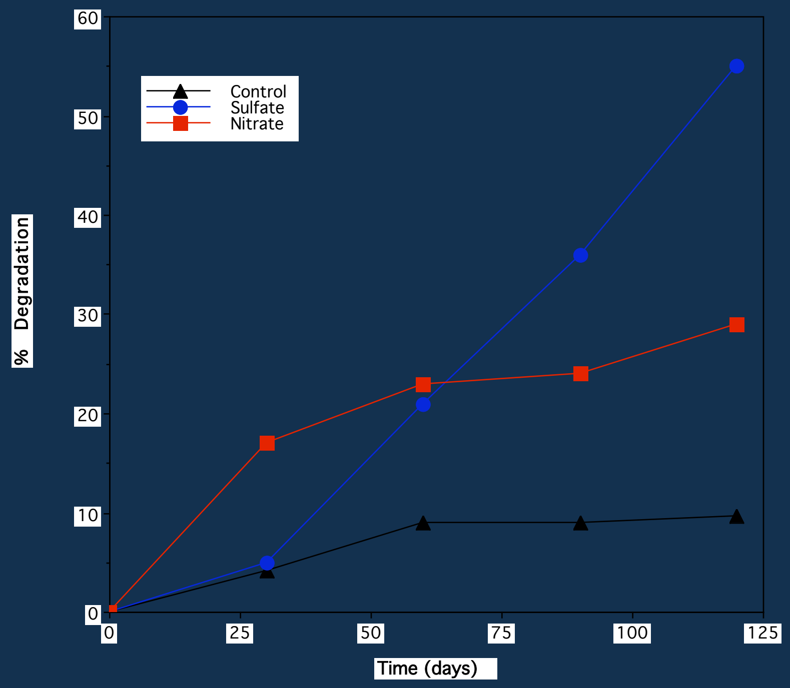
- Anaerobic conditions studied: sulfate, nitrate, iron-reducing, methanogenic, mixed electron acceptor, fermenting,and abiotic control.
- Duplicate cultures in each condition.
- At every sampling event samples were collected and TPHs were extracted according to EPA approved method.

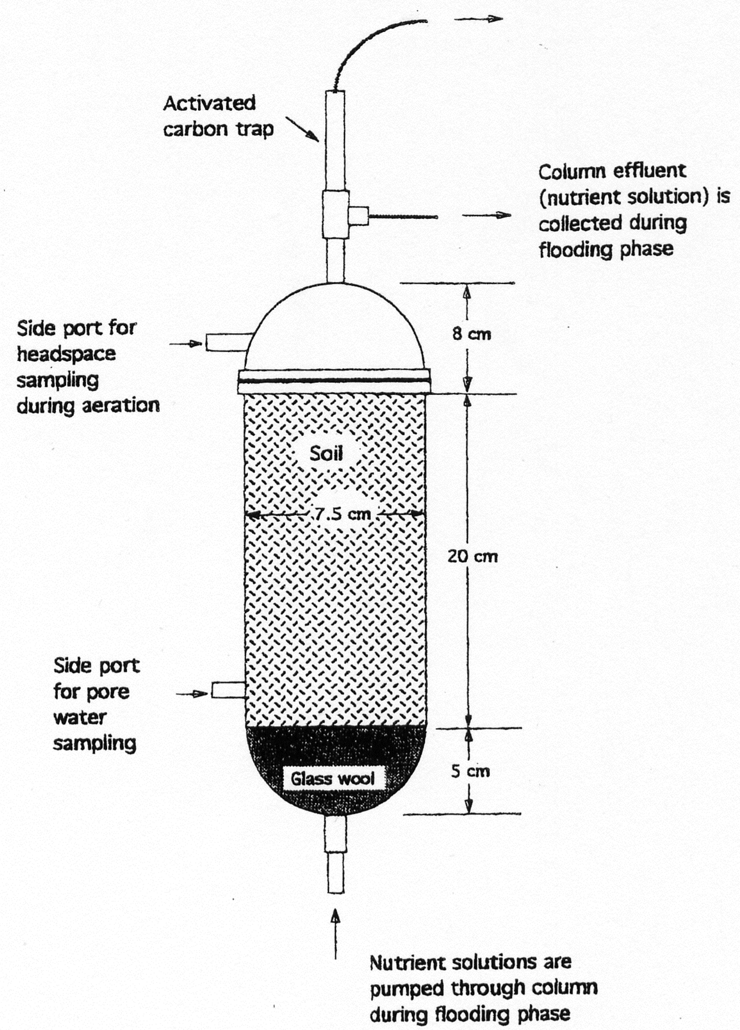
Experimental set-up

TPH Removal Under Fermenting & Mixed Electron Acceptor Conditions



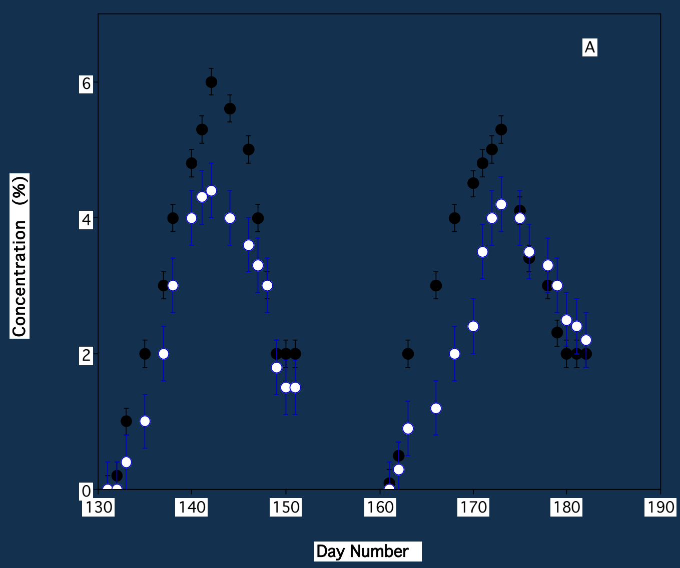
TPH Removal Under Sulfate & Nitrate Reducing Conditions



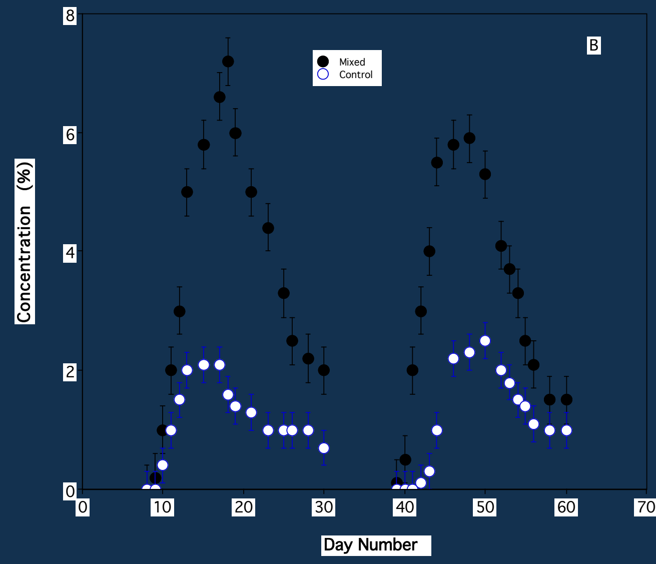

Activated
carbon trap
Column effluent
(nutrient solution) is
collected during
flooding phase
Side port for
headspace
sampling
during aeration
8 cm
Soil
7.5 cm
20 cm
Side port
for pore
water
sampling
Glass wool
5 cm
Nutrient solutions are
pumped through column
during flooding phase

Soil Column

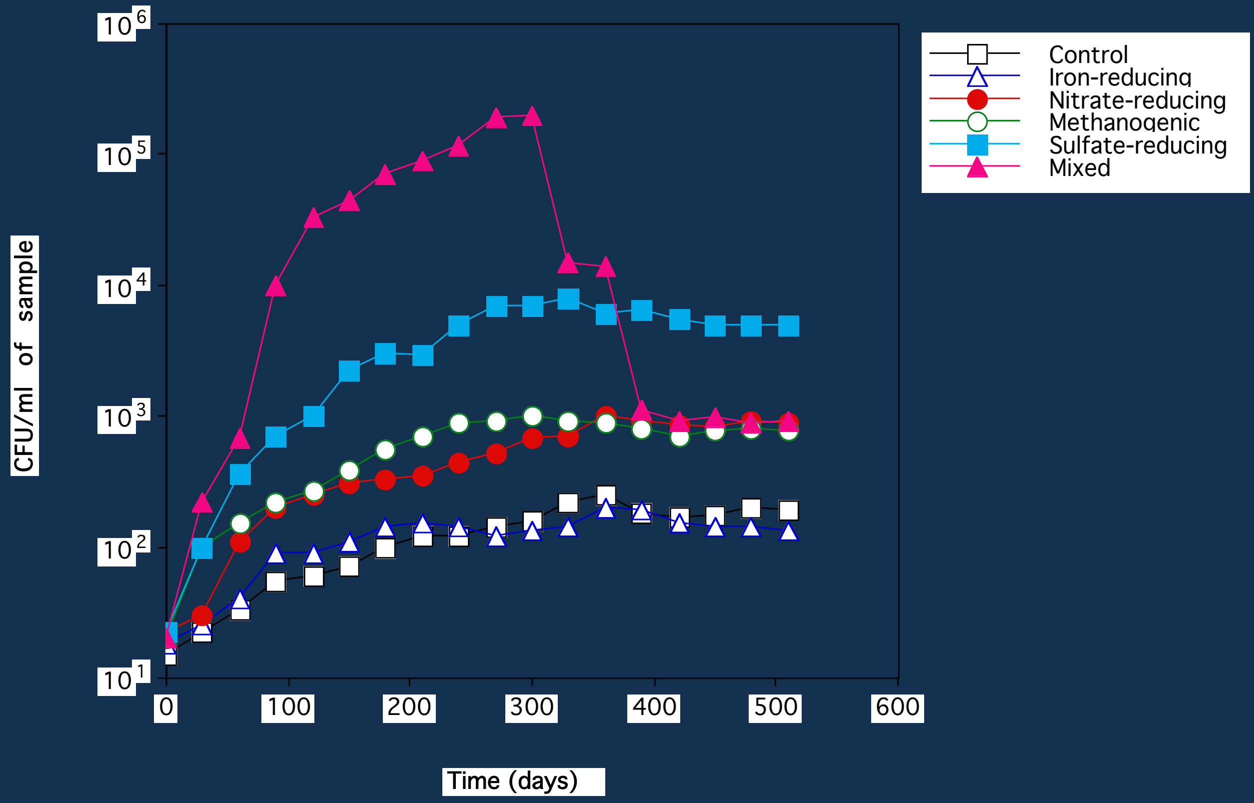
CO2 Production



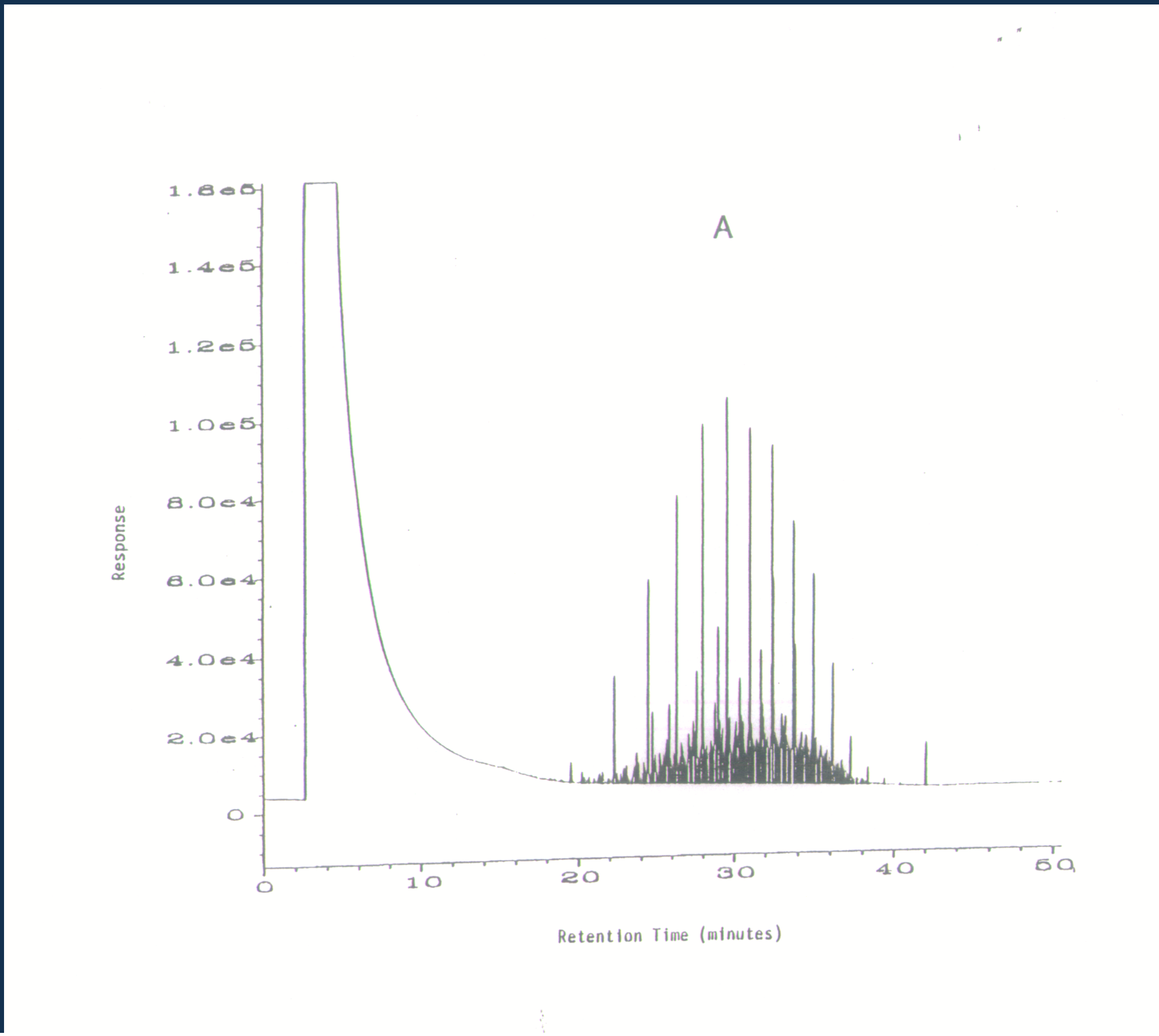
Methane Production



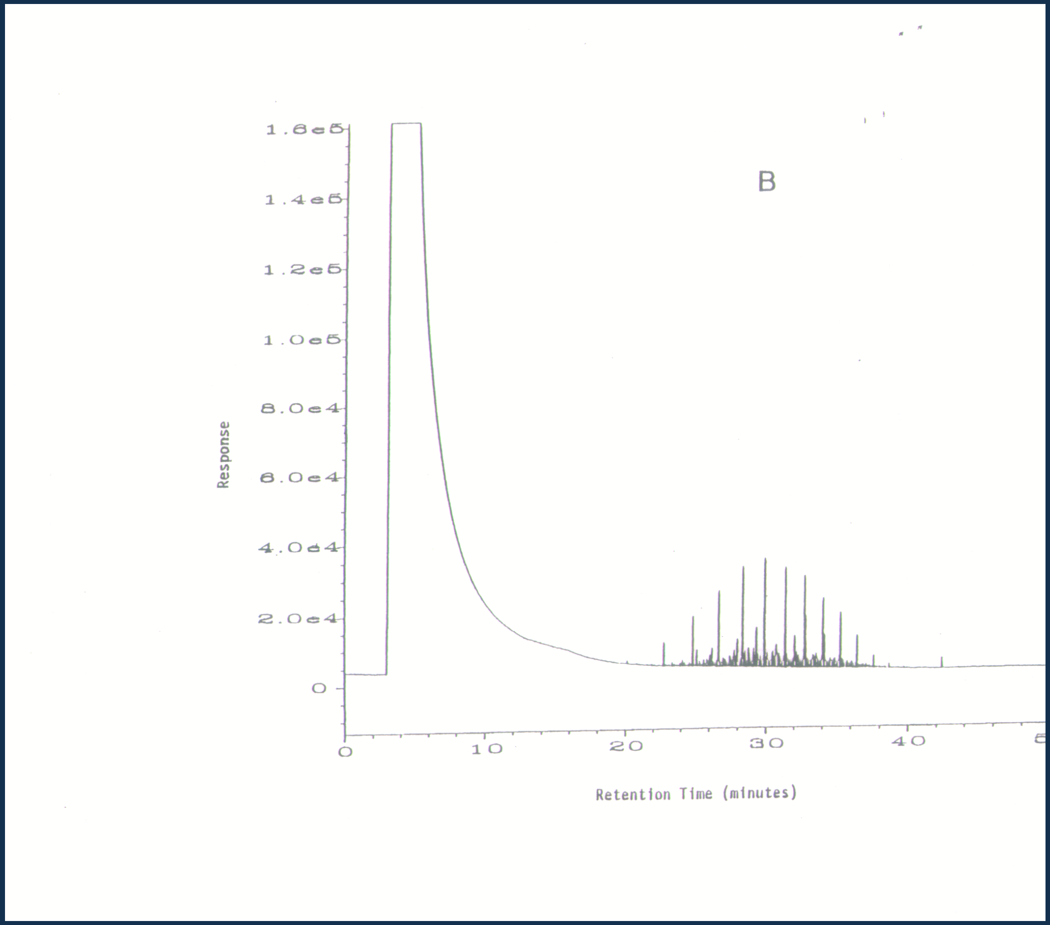
Bacterial Counts



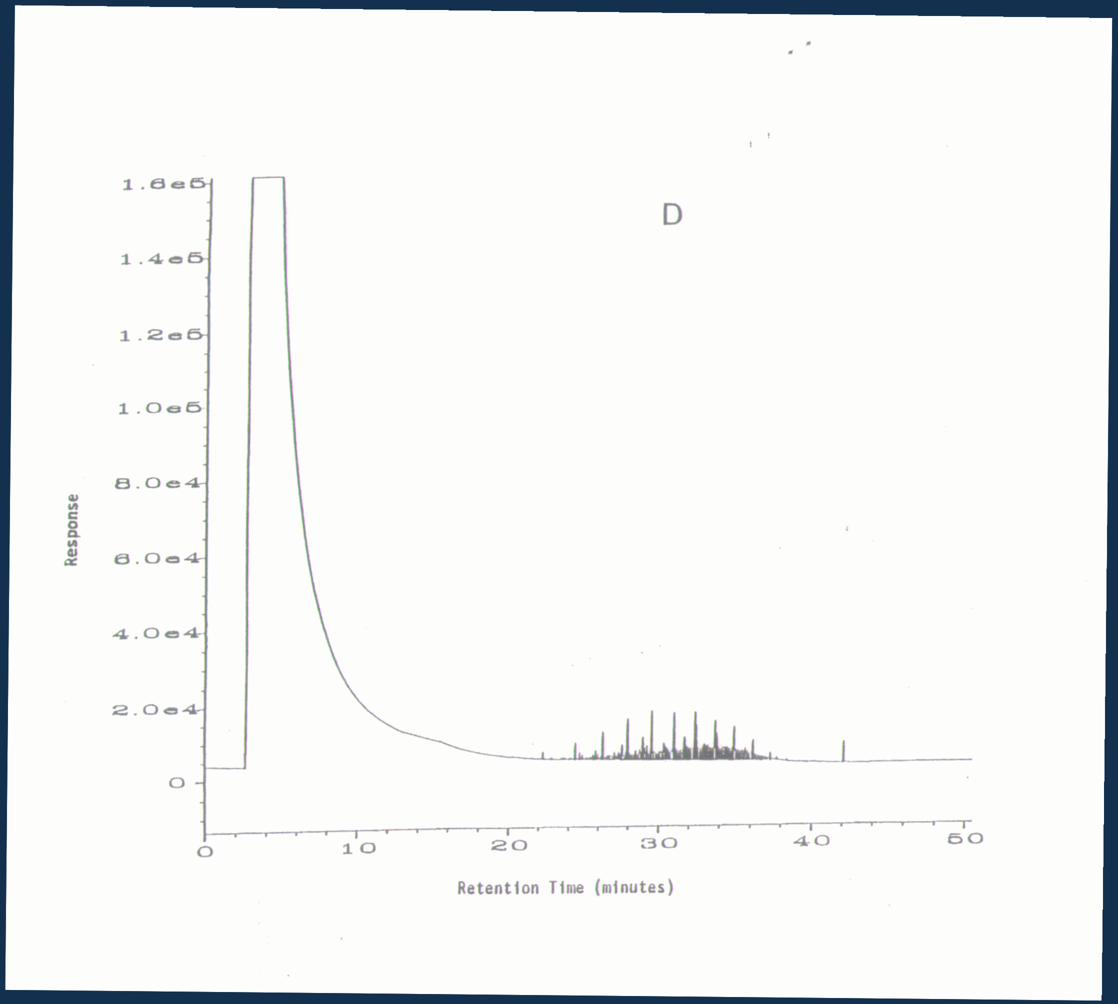
Gas Chromatogram: Day Zero



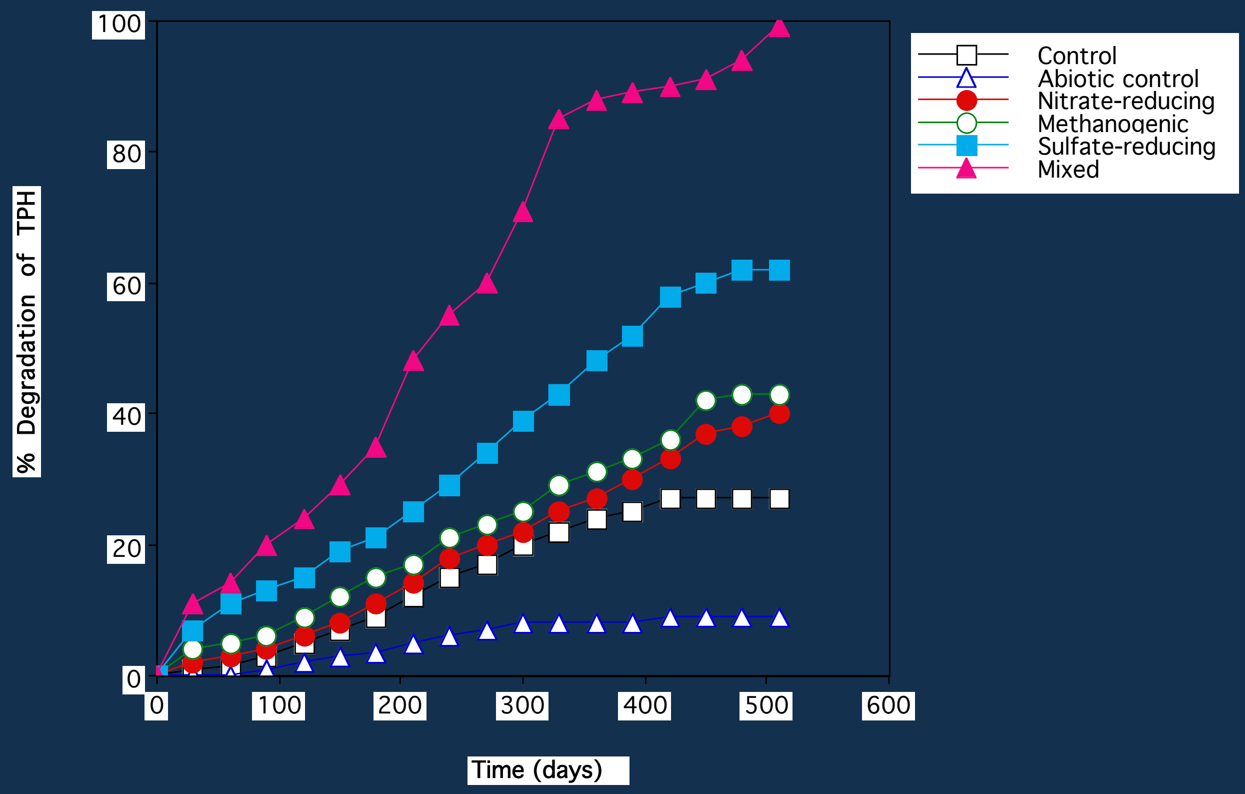
Gas Chromatogram of Mixed Electron Acceptor Conditions after 160 days



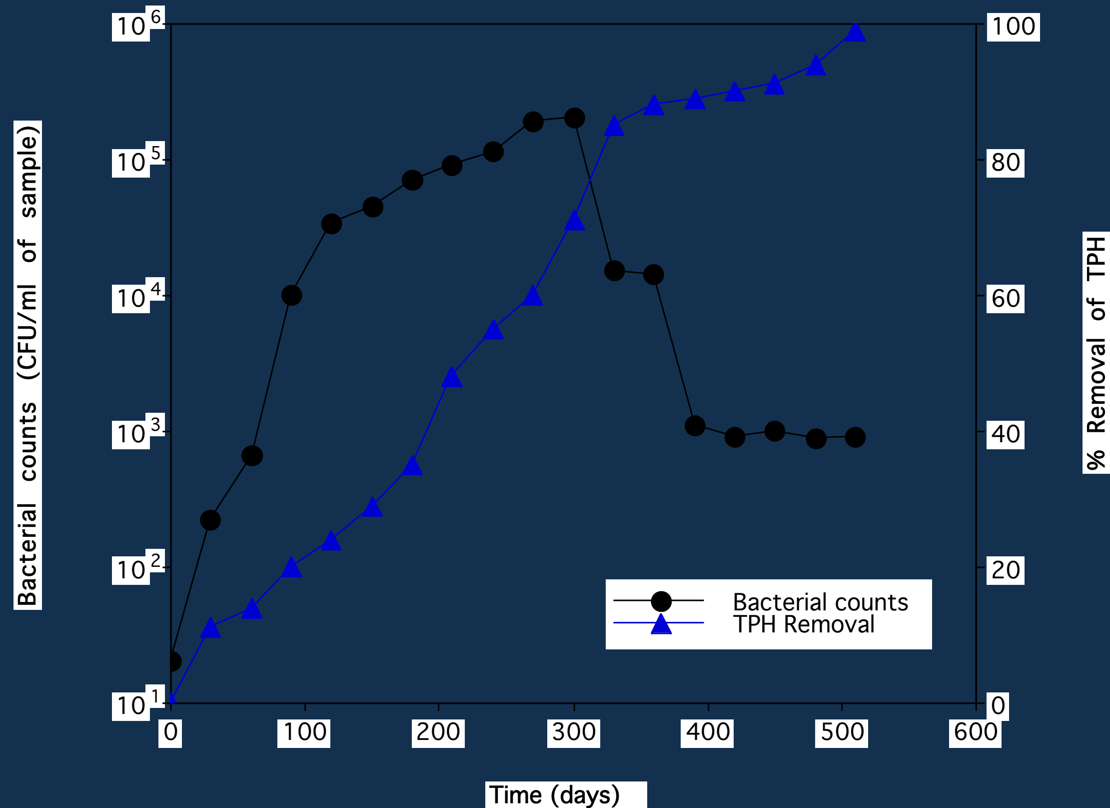
Gas Chromatogram of Mixed Electron Acceptor Conditions after 290 days



TPH Removal in Soil Column



Mixed Electron Acceptor Conditions



Microbes Under Mixed Electron Acceptor Conditions

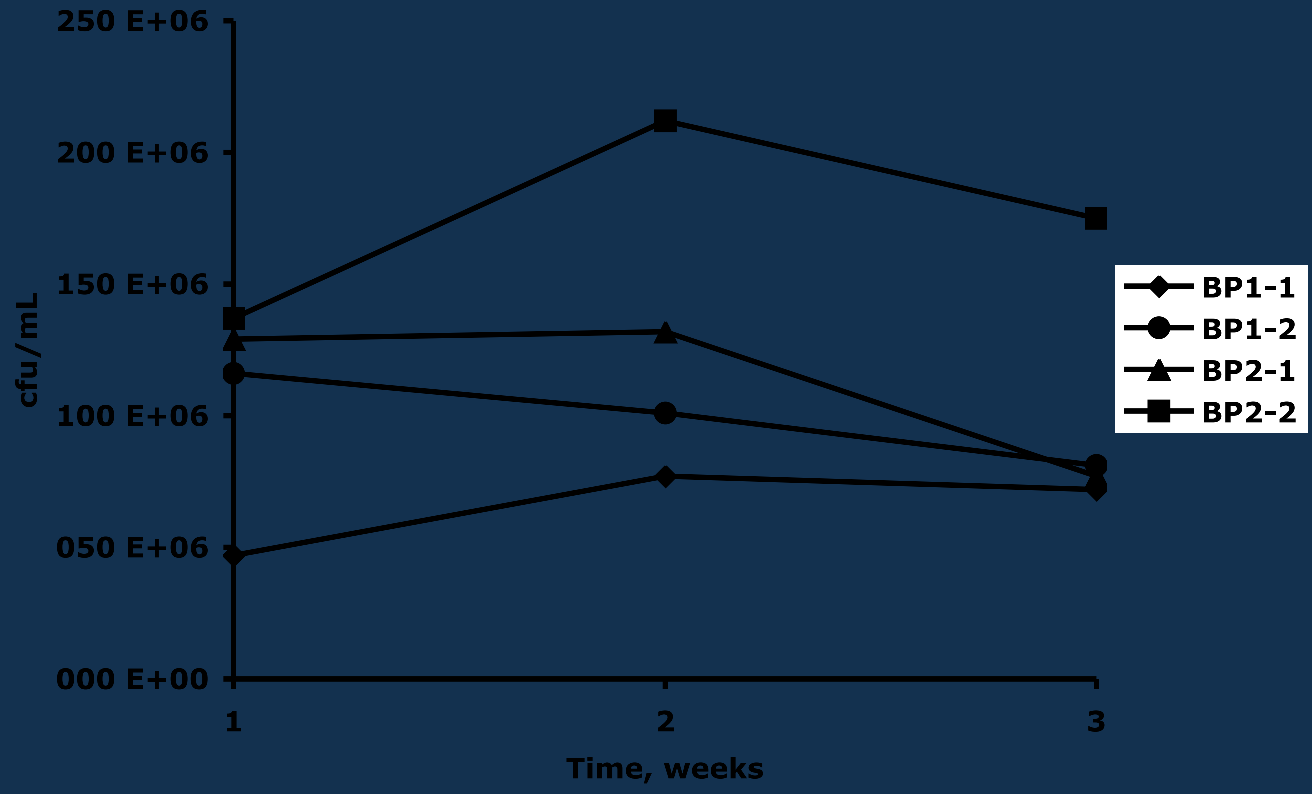
Current Oil Spill Research

- Monthly sample collection of Sediment, water, and oyster.
- Analyze PAH and TPH in the sample
- Carry out Biostimulation studies in water samples by supplementing nitrogen and Phosphorous.
- Plan to study anaerobic degradation under various electron accepting conditions in sediments.

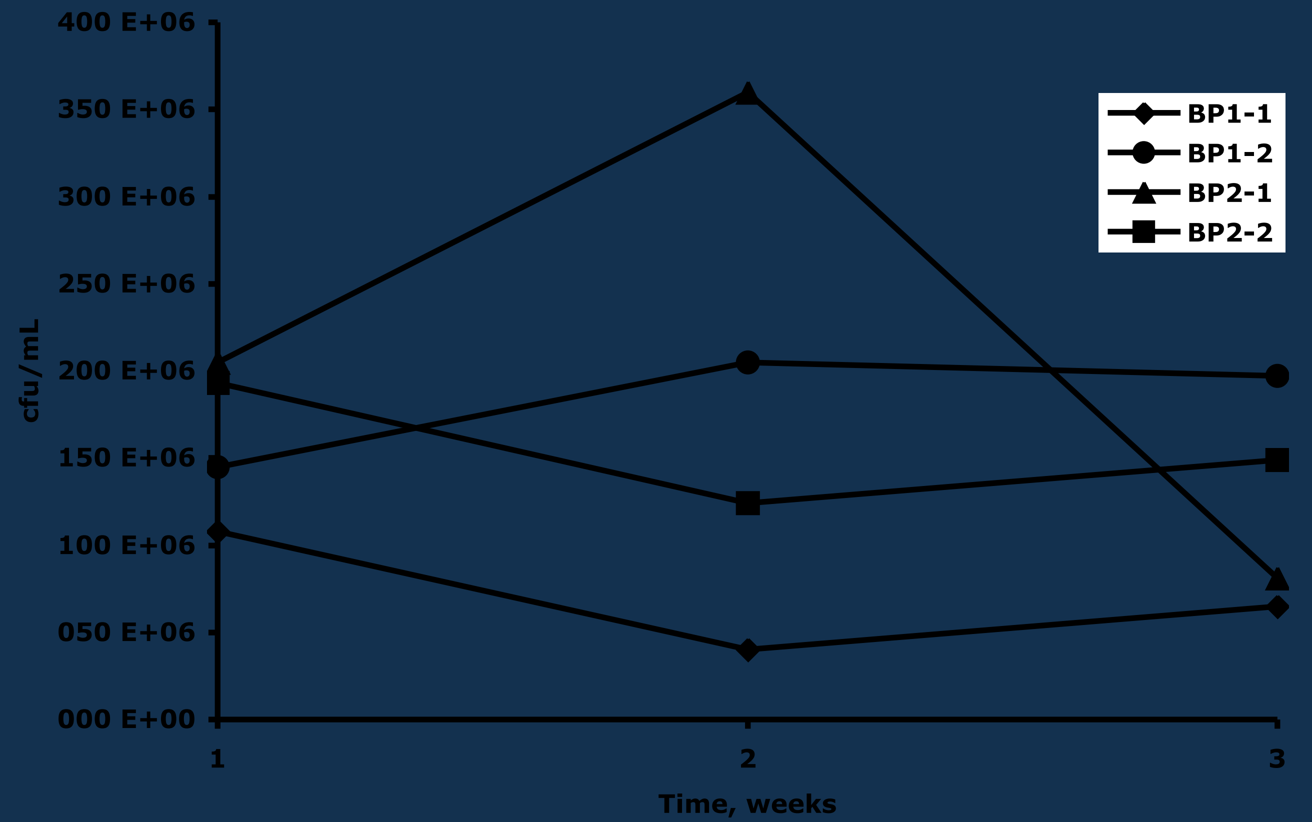
Results till date

- No significant oil was found in the last three months of samples in water, sediments, and oysters.
- Maximum TPH value was found in sediment sample (4.7 PPM) and water sample (1.2 PPM). No oil was recovered from oysters.
- Bacterial survey in water column showed significant oil degrading bacteria.

Bacterial Growth in Sediment Sample with Crude Oil as Sole Carbon source



Bacterial Growth in Water Samples



Bacteria Identified

- *Flavobacterium mizutaii* in 1-1 sediment sample.
- *Acinetobacter johnsonii* in 2-2 sediment sample.
- *Pseudomonas putida* in 1-2 water sample.

Conclusions

- Biodegradation of oil spill under anaerobic conditions is possible.
- Biodegradation depends on the microbial ecology of the study site.
- Mixed electron acceptor conditions showed superior metabolic capabilities in degrading TPH.

Acknowledgments

- The past work was supported by the grant from Louisiana Board of Regents
- Current work is funded by BP through Nicholls Center for Seafood Studies.
- Dr. Earl Melancon for Oyster data
- Dr. Marilyn Kilgen, Director of Center for Seafood Studies.
- Sara Shields and many undergraduate students.

Thank you.