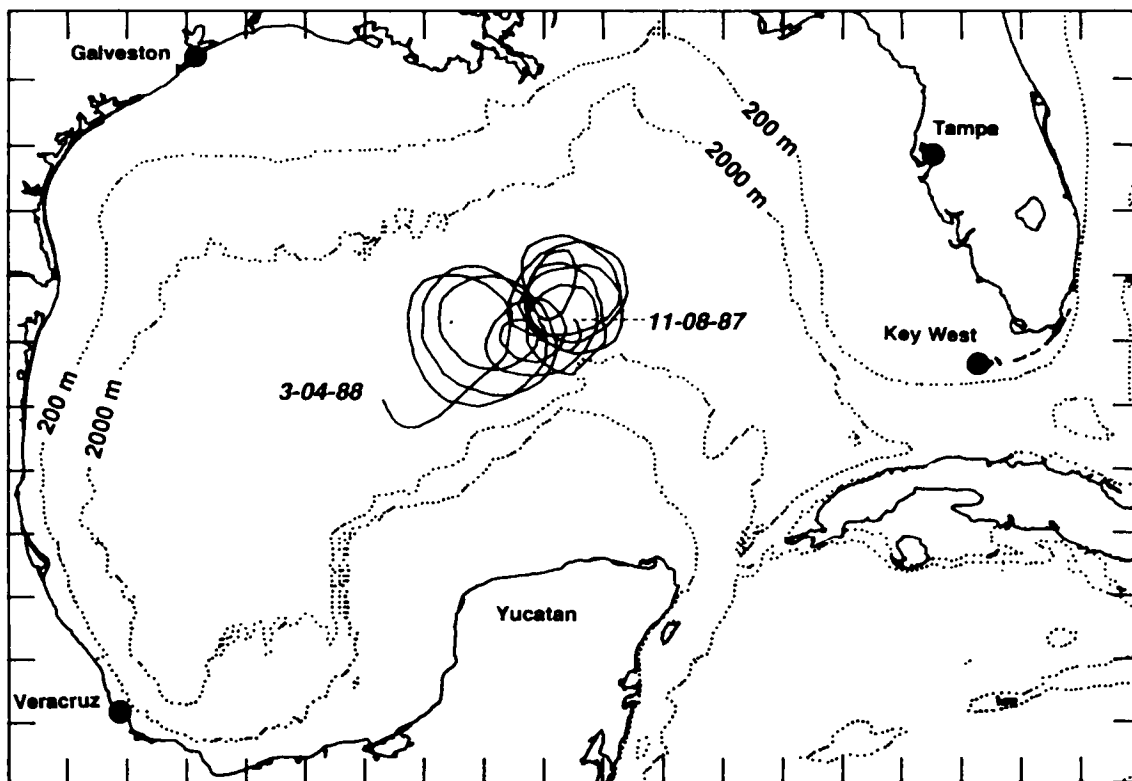


# Proceedings: Spring Ternary Gulf of Mexico Studies Meeting

March 1988



**Gulf of Mexico OCS Region**

**OCS Study  
MMS 88-0041**

# **Proceedings: Spring Ternary Gulf of Mexico Studies Meeting**

**March 1988**

Author

**Minerals Management Service**

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Minerals Management Service  
Gulf of Mexico OCS Regional Office  
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New Orleans, Louisiana 70123-2394

Attention: Public Information Unit (OPS-3-4)

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## ABOUT THE COVER

Cover artwork is taken from the abstract of a paper given by Dr. Evans Waddell of Science Applications International Corporation. The paper was presented at the Spring Ternary Studies Meeting held on March 8, 1988, at the Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, Louisiana. The figure is presented in its entirety on page 62 of this report.

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## MEETING SUMMARY

### Introduction

The Minerals Management Service (MMS), Gulf of Mexico OCS Regional Office, convened the first Ternary Meeting of 1988 on March 8th. These public meetings are held as a forum for information exchange between interested and involved parties. This generally includes MMS personnel, representatives of various MMS-funded programs, state representatives, public interest groups, other Federal agencies, and invited investigators working on problems similar to or supportive of those of the MMS.

The meeting is a compilation of presentations given by several speakers. The speakers include both representatives of various MMS-funded studies, as well as invited guests. The purpose of each presentation is to provide information that defines each study's goals, schedule, methodology, present status, and any important or relevant insights recently developed. The meeting is planned so that ample opportunity for exchange of information between speakers and audience is provided. In addition, a sufficient amount of unallocated time for discussion is also made available.

### Meeting Agenda and Abstracts

The meeting's agenda is reproduced on page three. Prior to the scheduled presentations, each speaker provides an abstract for distribution so that others have an opportunity to become familiar with the material to be presented. This procedure provides the audience an opportunity to formulate questions before each presentation is given and to attend each presentation with less distraction. These abstracts form the basis for this Meeting Summary Report.

Abstracts included in this volume are copies of those provided by each speaker. No adjustments have been made to the form and substance of these submissions.

Any questions regarding the presented material should be directed to the appropriate speaker. General questions regarding the Ternary Meeting or the Gulf of Mexico Environmental Studies Program should be directed to the Environmental Studies Section of the MMS Gulf of Mexico OCS Regional Office (504-736-2897).



# MMS

## Environmental Studies Information

GULF OF MEXICO OCS REGION

U.S. DEPARTMENT OF THE INTERIOR / MINERALS MANAGEMENT SERVICE

### ENVIRONMENTAL STUDIES PROGRAM FOR THE GULF OF MEXICO

#### SPRING TERNARY MEETING

March 8, 1988

The Minerals Management Service (MMS), Gulf of Mexico OCS Region, will hold an Environmental Studies Program Ternary Meeting on March 8, 1988. The meeting will take place in the Region's Main Conference Rooms 111/115, 1201 Elmwood Park Boulevard, Jefferson, Louisiana. The meeting will present progress reports by various participating contractors on their individual study efforts. You are cordially invited to attend this informal meeting or any of the individual presentations listed below. Please contact the Chief, Environmental Studies Section for further information (address below).

Also, the Gulf of Mexico Regional Technical Working Group, an advisory body serving the MMS, will hold a business meeting at the same location on March 9-10. Please contact Ms. Eileen Angelico (address below, mail stop ORD-5, (504) 736-2959) for further information.

TIME	SPEAKER	TOPIC
9:00 a.m.	Mr. J. Rogers Percy Regional Director, MMS and Mr. Ruben Garza Geo-Marine, Inc.	Welcome
9:10 a.m.	Dr. Charles Giammona Texas A&M University	Cultural Resource Management Zone I Re-evaluation
9:40 a.m.	Dr. Lawrence McKenzie Applied Technology Research Corporation	Study of Socio-Economic Impacts of Declining OCS Activities
10:20 a.m.	Dr. Richard Burger Jackson State University	Environmental Analysis Program
10:40 a.m.	Dr. Don Davis Nicholls State University	Chenier Plain Ecological Atlas
11:00 a.m.	Dr. Chip Groat Louisiana DNR	Wetlands Mitigation Project
11:30 a.m.	Adjourn for Lunch	
1:30 p.m.	* Dr. Karen Wicker Coastal Environments, Inc.	Study of Impacts of OCS Activities on Barrier Beaches and Wetlands
2:00 p.m.	Dr. Don Boesch LUMCON	Produced Waters Studies: LaMOGA and MMS
2:30 p.m.	Dr. Richard Rezak Dr. James Brooks Texas A&M University	Mississippi-Alabama Shelf Marine Ecosystems Study
3:00 p.m.	Dr. Bela James Continental Shelf Associates	Texas-Louisiana Shelf Marine Ecosystems Synthesis
3:30 p.m.	Dr. Van Waddell Science Applications International Corporation	Physical Oceanography Field Measurements Program
4:00 p.m.	Adjourn	

\*Dr. Wicker's paper was not formally presented at the meeting.

ABSTRACT  
FOR  
HISTORIC SHIPWRECK STUDIES, NORTHERN GULF  
OF MEXICO CONTINENTAL SHELF: TASKS I & II UPDATE

Presented by

Ervan G. Garrison  
Environmental & Water Resources Engineering Division  
Civil Engineering Department  
Texas A&M University

at

The Spring 1988 Ternary Studies Meeting  
Minerals Management Service  
Gulf of Mexico OCS Regional Office  
1201 Elmwood Park Boulevard  
New Orleans, LA 70123-2394

March 8, 1988

## ABSTRACT

Since October 1986 we have conducted activities to meet study requirements under Tasks I and II, "An Archaeological Investigation to Re-evaluate Cultural Resource Management Zone 1 (CRMZ1) in the Gulf of Mexico" and "Establish an Interpretative Framework to Characterize Unidentified Magnetic Anomalies and Side-Scan Sonar Contacts." Task I is nearly complete with final analyses underway at this time. Shipwreck patterns and preservation potential across the Northern Gulf have been evaluated. Task II is currently underway with one lease block survey complete and the remainder of the data being taken at this time off Texas. The approach to Task II, high resolution marine survey at 50, 100, 150 meter line spacings, has been modified to include high resolution, low-level aerial magnetic survey. This study is being carried out contemporaneously with Texas A&M by SOAREX, Inc. Field surveys will be complete by late March with ground-truthing to begin in April of selected anomalies and side-scan sonar targets.



## SLIDES

### TASK I

- 1 Title Slide
- 2 Methodology, Task I
- 3 Data Bases, Task I
- 4 Shipwreck Distribution Analysis Example
- 5 Selected Gulf Area, Example: Louisiana
- 6 Chronological Patterns, Example: 1546-1650
- 7 Loss Patterns, Yearly: Correlated to Storms
- 8 Loss Patterns, Yearly: Correlated to Storms
- 9 Loss Patterns, Yearly: Correlated to Storms
- 10 Loss Patterns and Shipping/Traffic Routes Over Time
- 11 Port Development: Correlation to # Shipwrecks
- 12 Preservation Studies: Ferrous Metals
- 13 Preservation Studies: Anaerobic Muds
- 14 Sediments and Preservation Potential
- 15 Gulf Areas and Expected Preservation Potential

### TASK II

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- 17 R/V EXCELLENCE II
- 18 Instrument Shed ("Dog House")
- 19 Shed Layout
- 20 Magnetometer: Analog Recording
- 21 HP87 Microcomputer: Digital Recording
- 22 Event Mark Timer/Del Norte Navigation Unit
- 23 EG&G Model 260 Side-scan Sonar
- 24 Teledyne Depth Recorder
- 25 Santa Fe Minerals Platform, GAL310
- 26 R/T Model 217E, Santa Fe, GA310
- 27 LORAC R/T Location
- 28 USCG R/T Location

**ABSTRACT**

**SOCIOECONOMIC IMPACTS OF DECLINING  
OUTER CONTINENTAL SHELF (OCS) OIL AND  
GAS ACTIVITIES IN THE GULF OF MEXICO (GOM)**

**(MMS CONTRACT NO. 14-12-0001-30335)**

**Prepared for presentation at the:  
SPRING 1988 TERNARY STUDIES MEETING**

**Sponsored by the:**

**MINERALS MANAGEMENT SERVICE  
GULF OF MEXICO REGIONAL OCS OFFICE  
1201 Elmwood Park Boulevard  
New Orleans, Louisiana**

**Prepared by:**

**APPLIED TECHNOLOGY RESEARCH CORPORATION  
727 Spain Street  
Baton Rouge, Louisiana 70802**

**8 MARCH 1988**

## ABSTRACT

### SOCIOECONOMIC IMPACTS OF DECLINING OUTER CONTINENTAL SHELF (OCS) OIL AND GAS ACTIVITIES IN THE GULF OF MEXICO (GOM)

#### BACKGROUND

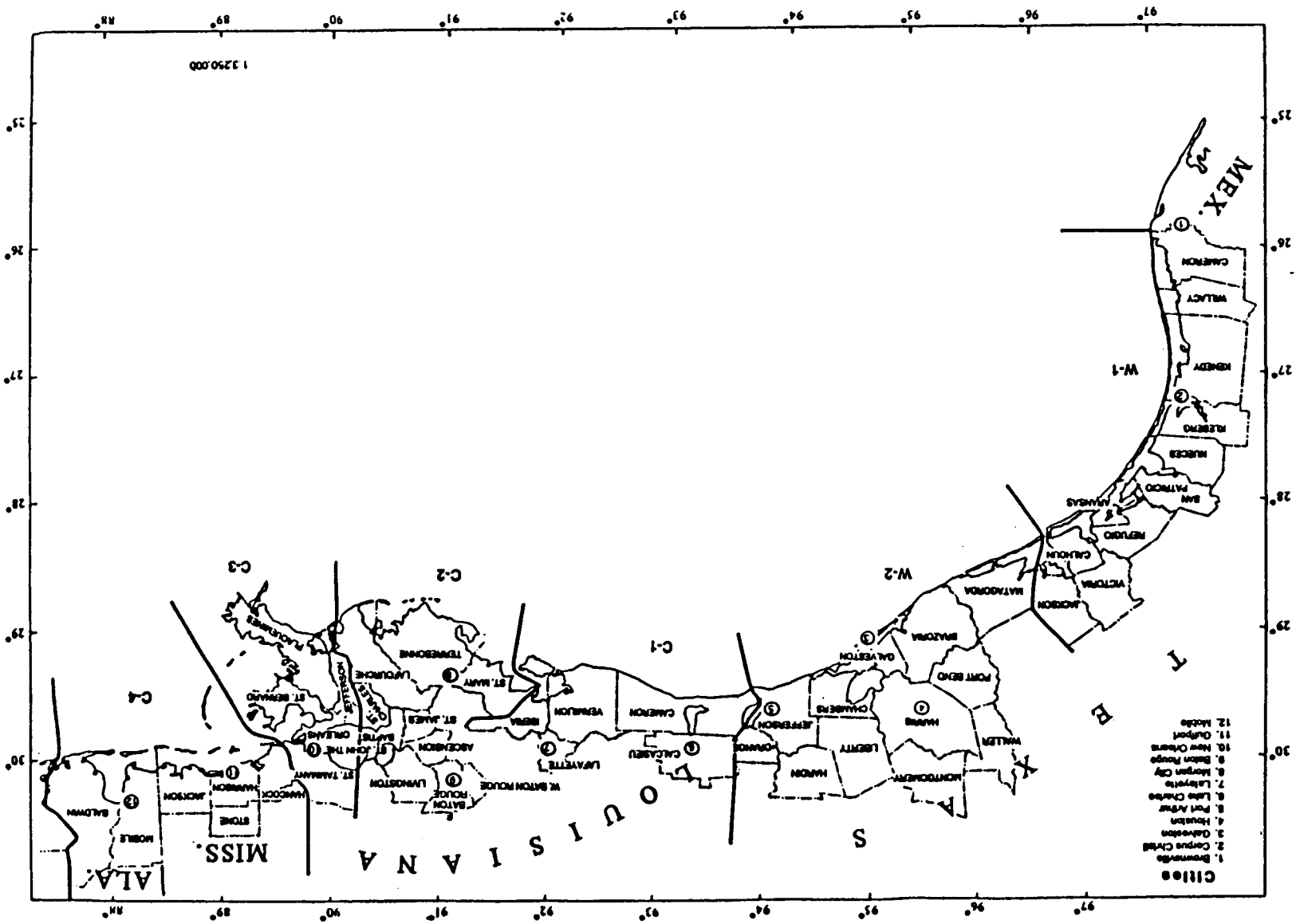
This project is the third in a series of phased studies initiated by the Minerals Management Service (MMS) addressing the socioeconomic impact of outer continental shelf (OCS) oil and gas activities in the Gulf of Mexico (GOM). The Phase I study was oriented toward obtaining and analyzing primary data to characterize the OCS workforce and the direct economic impact of OCS-related activities on communities located along the Gulf of Mexico. The Phase II study involved the development of an economic input/output model designed to generate estimates of the indirect economic impact of OCS-related activities in the Gulf of Mexico.

Recent declines in the price of oil and gas have led to corresponding declines in OCS oil and gas activities. This recent price-related decline has contributed to increased unemployment and has created a general economic recession within coastal communities whose economic base is founded on oil and gas activities. The conditions resulting from the recent price-related decline provide a case study scenario upon which future socioeconomic impacts resulting from a resource depletion decline can be formulated.

#### STUDY AREA

The project study area encompasses portions of the states of Alabama, Louisiana, Mississippi, and Texas (Figure 1). The 49 counties and parishes within the study area are located inshore of and inland from the central and western Gulf of Mexico coastal analysis areas. The study area covers thirteen (13) standard metropolitan statistical areas (SMSAs) (31 counties and parishes) and 18 counties and parishes outside SMSA boundaries.

Figure 1.--Study Area Map.



## OBJECTIVES

Three objectives have been established for the current project; they are:

1. to analyze the socioeconomic impacts of recent price-related declines in outer continental shelf oil and gas activities,
2. to formulate a set of conceptual cause-effect models that express the relationships between changes in OCS activities and select socioeconomic attributes, and
3. to identify and evaluate coastal resource development opportunities that could result from the utilization of in-lace OCS-related infrastructure or environmental modification.

Each project objective is associated with a respective project task (Figure 2).

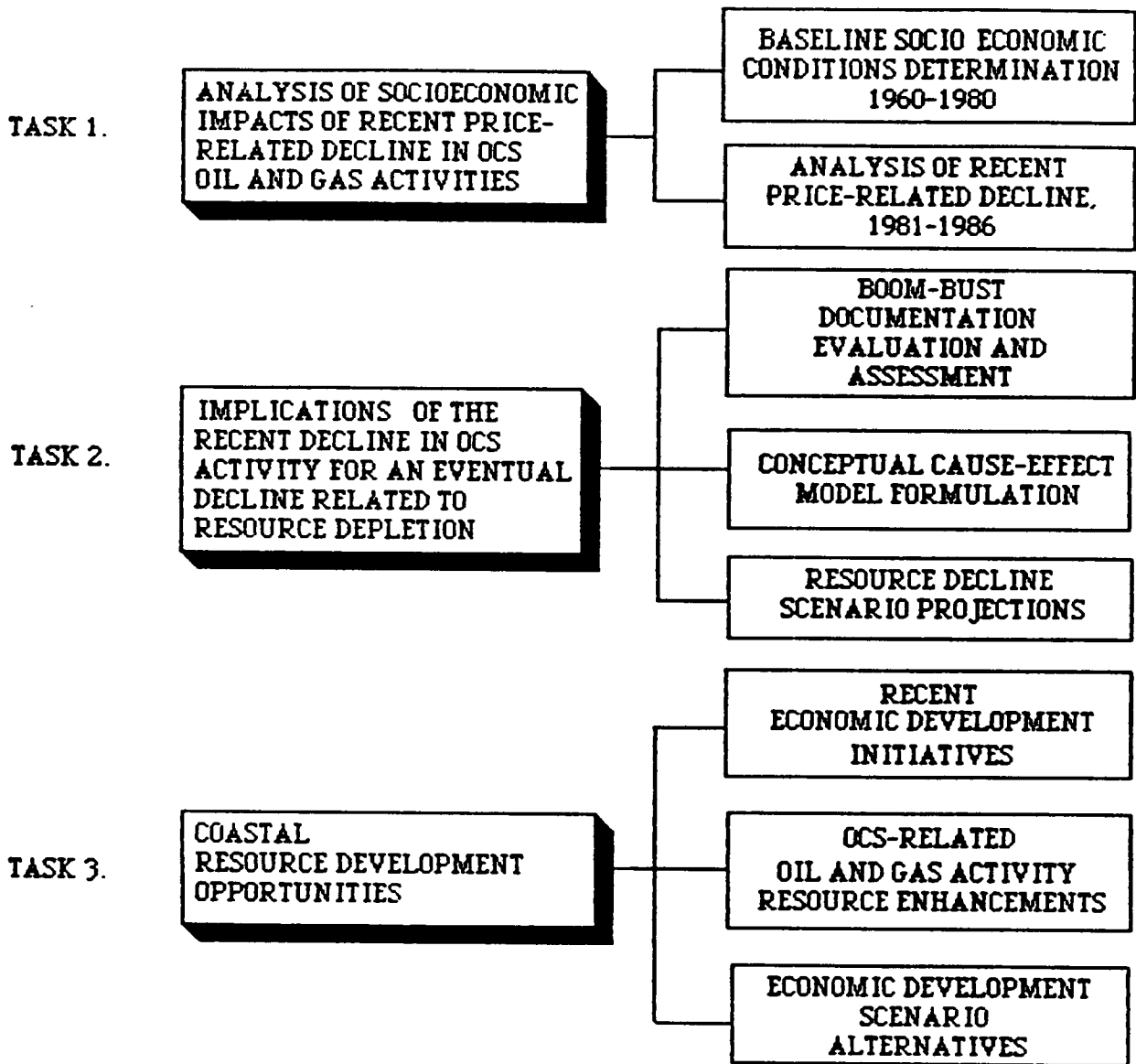


Figure 2.—Socioeconomic Impacts of Declining Outer Continental Shelf (OCS) Oil and Gas Activities in the Gulf of Mexico (GOM).

## CURRENT AND PLANNED ACTIVITIES

Project efforts began in January 1988. Since the startup, the project team has concluded its advanced planning efforts and has begun the initial elements on each of the three project tasks.

The methodology for attaining the objective associated with project task 1 involves the compilation of an extensive database which exhibits measurable socioeconomic attribute indicators and oil and gas activity indicators. A substantial portion of the socioeconomic data required is being obtained from Louisiana Tech University's College of Business Administration, Research Division, which is a census depository. The project team has consulted with the director and staff of the Research Division and a tentative list of appropriate attribute data which are uniform over the timeframe required has been compiled. Statistical relationships will be established between the socioeconomic attribute indicators and oil and gas activity indicators. These relationships will be used to guide the development of the conceptual cause-effect models under task 2.

The conceptual cause-effect models will be formulated from the derived statistical relationships and from relevant findings from available "boom-bust" documentation. The volume of literature on "boom-bust" scenarios involving resource exploitation is extensive. The "boom-bust" documentation is expected to provide insight into the staged dismantling of a resource extraction industry with particular reference to the progression of employment curtailment and the associated socioeconomic impacts of such curtailment.

High, moderate, and low resource decline, long-term scenario projections will be prepared based on the best available estimates of resource depletion rates and in view of certain caveats with respect to undiscovered reserves, uncertainties in the demand for oil and gas, and undeveloped technological innovations.

Under task 3, the project team will identify and evaluate coastal resource development opportunities with an emphasis on alternatives which could result from the utilization of in-place OCS-related infrastructure or environmental modification. Attention will be given to federal, state, and local economic development initiatives which were developed as a result of the recent price-related decline.

ABSTRACT  
FOR  
ENVIRONMENTAL ANALYSIS PROGRAM

First 1988  
MMS Ternary Studies Meeting  
March 8, 1988  
New Orleans, Louisiana

Submitted to: Minerals Management Service  
Gulf of Mexico OCS Regional Office  
Environmental Studies Section

Submitted by: Bruce Davis  
Jackson State University  
P.O. Box 18604  
Jackson, MS 39217



ENVIRONMENTAL ANALYSIS PROGRAM  
JACKSON STATE UNIVERSITY  
JACKSON, MS

ABSTRACT

The Environmental Analysis Program is a five-year effort to develop and establish computerized geographical information systems (GIS) for Minerals Management Service (MMS) interests in the Gulf of Mexico (GOM). The working hypothesis is that GIS is a practical, cost-effective, and stimulating technology for the spatial analysis of environmental data, e.g., thematic feature inventories and mapping, generation and compilation of impact statement data, resource analysis, socio-economic appraisal, and support for environmental decision making. GIS is especially well-suited to provide graphic and statistical information in that it provides layers of spatial data (e.g., maps, imagery) that can be combined in a variety of ways to inventory and analyze the landscape. An attached integrated relational data base enhances the storage, retrieval, and manipulation of information. Data entry is by manual digitizing of maps and imagery and by direct portage from existing digital tapes. Jackson State's primary charter is to develop procedures for implementing GIS for Gulf of Mexico environmental analysis. To realize such a goal, JSU has inaugurated a "Center of Excellence for Spatial Data Research and Applications."

The project began in October, 1987, with the first year devoted to obtaining facilities, personnel, equipment, and software as well as beginning substantive organization and research. We have established a Center for Spatial Data Research and Applications, located in a converted 925 square foot lab in the New Science Building on campus. Aside from existing faculty and staff who are affiliated with the project, two full-time professional positions have been filled (Center director and lab manager) and a dozen graduate students are involved in individual research projects in spatial analysis. Two master's theses are underway and another is planned. The necessary equipment and software are under order and should be operational by mid-April. Central to the project is a Vax-based Arc-Info GIS system, a topologically-structured mapping graphics package that has an integrated relational data base. Remote sensing imagery analysis will be provided by an ELAS system.

The first year's work focusses on three initial Gulf of Mexico projects: (1) mapping of live bottom sites, (2) mapping of lease blocks, and (3) construction of base maps for MMS research and applications. These tasks are mechanisms to refine project organization and to demonstrate basic GIS capabilities. Live bottom site mapping will be accomplished with manual digitizing of selected features from diverse scales of maps, formatted to a common scale(s), and produced in a variety of outputs. Data are now being collected. Lease block mapping will be achieved from digital tape data conversion. MMS has the pertinent data on tape and we are to convert to Arc-Info format for inventory and to produce hard copy maps. Production of base maps will be in the form of a base map atlas. Because of the very large size of the Gulf and the very broad range of MMS interests, from very localized ecosystem research to GOM-wide ocean dynamics, no single map scale can provide the base upon which to plot data for every case. Therefore, we plan to produce a series of maps ranging from very large to very small scales to accommodate any level of data. Using the atlas, an investigator selects the best scale(s) for his/her research and we then transfer information to that base map(s). Organization and basic planning are underway.

"Environmental Analysis" is a comprehensive concept that embraces a variety of themes and issues. Basic plans for the near future include selection of further investigations and data collection. As we become more proficient with Arc-Info and ELAS, our capabilities will expand to accommodate more complex projects. A major current task is to explore the possibilities and to begin preparation for them. Eventually, we will have a very large GOM environmental data base (graphic and tabular), from primary data mapping (existing information) and from research project analyses. MMS will have the ability to query a given data base to identify, measure, and analyze environmental features or processes at select locations. Results can be returned to the data base for later use, displayed as thematic maps, and reproduced on various media at selected scales.

ABSTRACT  
FOR  
CHENIER PLAIN ECOLOGICAL ATLAS OF LOUISIANA AND TEXAS

First 1988  
MMS Ternary Studies Meeting  
March 8, 1988  
New Orleans, Louisiana

Submitted to: Minerals Management Service  
Gulf of Mexico OCS Regional Office  
Environmental Studies Section

Submitted by: Lawrence R. Handley  
U.S. Fish and Wildlife Service  
National Wetlands Research Center  
1010 Gause Boulevard  
Slidell, LA 70458

CHENIER PLAIN ECOLOGICAL ATLAS  
OF LOUISIANA AND TEXAS

by  
Lawrence R. Handley  
U.S. Fish and Wildlife Service  
National Wetlands Research Center  
1010 Gause Boulevard  
Slidell, LA 70458

and  
Donald W. Davis  
Department of Earth Sciences  
Nichols State University  
Thibodaux, LA 70310

This project involves preparing a draft atlas of Texas and Louisiana's Chenier Plain. The accumulated maps will depict a diversified and massive variety of material. The completed overlays will be utilized by a professional cartographic staff, selected by the National Wetlands Research Center, to compile the finished product. The published atlas will cover all or parts of six 1:100,000 United States Geological Survey maps of the Chenier Plain.

Data have been collected and assigned to four subject fields:

- (1) Biological Resources involves nesting sites for seabirds, wading birds, shorebirds and marine turtles, and critical habitats and harvest areas for major estuarine shellfish.
- (2) Socioeconomic Features encompasses agricultural, forest, and urban land uses, airports, ports, navigable waterways, major transportation systems, land fills, and industrial and municipal point source discharge and dredge spoil sites.
- (3) Soils and Landforms includes regional surface landforms, soil types, the 5-foot contour, beach erosion and accretion zones, faults, salt domes, high-energy beaches, and cheniers along with active dunes.
- (4) Hydrology and Climatology comprises stream and river discharge, surface runoff, chloride records, availability of freshwater, and water quality.

The compilation process embraces all past mapping efforts, studies, and papers dealing with the region. As the required mapping elements are not in one place, the most difficult task has been assembling the mappable information. Unfortunately, when one crosses the state line, data sets do not match, complicating the acquisition process. In addition, this information requires considerable interpretation; it is difficult to transfer material from maps at a scale of nearly 1:500,000 to 1:100,000. Spatial information is also a problem, since two source maps may have completely different

boundaries, or the borders are so generalized, accurate interpretation is quite impossible. This is, however, the best available.

The mapping effort is progressing nicely. Currently, we have only a few data gaps, with government agencies in Louisiana and Texas cooperating fully in the data collection process. The key problems are in Texas, but these difficulties can be explained in the required narrative. Funding for this project was provided by the National Wetlands Research Center, Slidell, Louisiana.

ABSTRACT  
FOR  
WETLANDS MITIGATION: A STUDY OF MARSH MANAGEMENT

First 1988  
MMS Ternary Studies Meeting  
March 8, 1988  
New Orleans, Louisiana

Submitted to: Minerals Management Service  
Gulf of Mexico OCS Regional Office  
Environmental Studies Section

Submitted by: Donald R. Cahoon  
Coastal Ecology Institute  
Center for Wetland Resources  
Louisiana State University  
Baton Rouge, LA 70803

Wetlands Mitigation: A Study  
of Marsh Management

Man has played a significant role in causing shoreline erosion, barrier island destruction and wetland loss in coastal Louisiana. By leveeing the Mississippi River, causing river sediments to be deposited beyond the continental shelf, dredging canals and constructing various facilities in the wetlands, we have accelerated the conversion of delta plain marshes to open water. Oil and gas activities, both in state and federal waters, have contributed to this loss of wetlands. Various marsh management techniques have been implemented to reduce wetland loss and to protect facilities located in the marshes.

Traditional approaches to marsh management utilize levees and water control structures to impound or partially impound wetlands, allowing control of water levels and salinity. This has made it possible to enhance the productivity of some wetlands, especially for waterfowl and furbearers. These techniques have been criticized by some members of the technical community who argue that they may be ineffective or actually contribute to wetland loss in some cases. There has also been concern regarding interference with the ingress and egress of commercial and recreational fisheries species. The most important objective of the wetlands mitigation study is providing an objective assessment of the suitability and feasibility of using marsh management techniques to protect and enhance coastal wetlands and the renewable resources

they produce.

The study will be conducted by the Louisiana Geological Survey and the Coastal Management Division of the Louisiana Department of Natural Resources. A Technical Steering Committee composed of representatives from state and federal agencies, private landowners and the academic community will guide the study and review findings and draft reports. Some of the tasks will be subcontracted to Louisiana State University and federal agencies.

The data acquisition phase will consist of three tasks. The first will identify the administrative procedures, legislation, and regulations controlling wetland management in Louisiana. The second task will inventory management activities in the wetlands including public interest goals, data sources, engineering and construction techniques, and economic considerations. It will also include mapping of the study area and marsh management projects; characterization of environmental conditions including habitats, hydrologic and geologic conditions; and a review of management plans and information on permitted sites. The third task will involve monitoring habitat changes resulting from marsh management plan implementation. The monitoring program will include field studies of 24 sites.

The second phase, data synthesis, analysis and interpretation, consists of four tasks, each drawing upon the data derived from the first phase. The first analysis deals with engineering and economic concerns; the second with study area conditions including habitats, hydrologic and geologic conditions, and management plans. The third task will analyze the monitoring data and ecological factors. The fourth task will assess the feasibility and



suitability of marsh management practices and will include maps portraying suitable and unsuitable areas.

The third phase, report preparation, will result in eight reports or chapters:

- Administrative Framework
- Public Interest Goals
- Data Source Bibliography
- General Study Area Conditions
- Engineering and Construction Techniques
- Monitoring and Ecological Analysis
- Feasibility and Suitability
- Executive Summary

Information from this study will also be used by the U.S. Army Corps of Engineers in preparing a programmatic environmental impact statement dealing with marsh management practices. The study term is two years, beginning in March 1988 and ending in March 1990. To date, all subcontract proposals have been submitted, formation of the steering committee has commenced, and all staffing commitments have been identified and job descriptions written.

ABSTRACT  
FOR  
IMPACTS OF THE OUTER CONTINENTAL SHELF (OCS)  
RELATED ACTIVITIES ON SENSITIVE COASTAL HABITATS

First 1988  
MMS Ternary Studies Meeting  
March 8, 1988  
New Orleans, Louisiana

Submitted to: Minerals Management Service  
Gulf of Mexico OCS Regional Office  
Environmental Studies Section

Submitted by: Karen Wicker  
Coastal Environments, Inc.  
1260 Main Street  
Baton Rouge, LA 70802

**Impacts of the Outer Continental Shelf (OCS)  
Related Activities on Sensitive Coastal Habitats  
MMS Contract No. 14-12-0001-30325**

**Karen M. Wicker  
Coastal Environments, Inc.  
1260 Main Street  
Baton Rouge, Louisiana 70802**

This present study has focused on ascertaining the impacts of OCS related activities on sensitive coastal habitats of the Gulf Coast from South Texas to Northwest Florida. The sensitive coastal habitats have included all barrier islands and beaches and all marshes except those located in Louisiana. The OCS related activities whose impacts were studied are pipelines and navigation channels whose recorded justification for construction and maintenance was to serve OCS activities. Impacts of OCS related facilities have been briefly discussed, but a comprehensive overview is not possible because the existing data base on facility location and operation is inadequate.

A great deal of time was expended on verifying the data bases for OCS pipelines and locating the pipelines on U.S. Geological Survey maps and recent and historic aerial photographs. This task was difficult because there is no central file for as-built maps showing pipeline locations and data had to be acquired from individual companies with varying degrees of success. This task was essential for quantifying changes (e.g., shoreline and habitat changes) that might be related to pipeline emplacement techniques (e.g., push ditch, floatation canal, directional drilling).

We have located with a high degree of certainty, 154 federal OCS pipelines in Texas and Louisiana. Of the 11 pipelines we studied in Mississippi and Alabama only two carried products directly from OCS waters.

All pipelines in Texas were emplaced by the push ditch method and the trench was backfilled. In several instances, portions of the marsh or the foredune were revegetated as required by the U.S. Army Corps of Engineers permit. Approximately nine of the 49 pipelines making landfall in the Chenier Plain region of Louisiana were emplaced using a flotation canal which was dammed at the beach. The remainder of the pipelines appear to have been installed using a push ditch method, with most having been backfilled. In all cases, a dam was placed at the juncture of the push point canal slip dredged through the beach and the push ditch. By 1988, beach material had plugged all of these cuts, making shorelines at the pipeline right-of-way appear the same as the shoreline adjacent to the pipeline. Shoreline retreat has left many bulkheads in the gulf, but new bulkheads have only been constructed in several of the flotation canals. The remainder of the canals have been plugged naturally by beach sand and shell.

Of the 89 OCS pipelines making landfall in the Louisiana Deltaic Plain, only 39 cross barrier islands and beaches. Of these 39 lines, five appear to have been laid in water between barrier islands. The eight lines on Grand Isle are backfilled except for the one which was directionally drilled. Of the 26 remaining lines in the deltaic plain, nine are in flotation canals which are dammed; seven are in push ditches which appear to have been backfilled and 10 pipelines have undetermined emplacement techniques because no data was provided by the companies and subsequent natural and man-made changes have greatly modified the shoreline erasing their scars. Two of the six lines making landfall in Mississippi also cross a Louisiana barrier island. These lines were emplaced across the

Chandeleur Islands in a floatation canal. The canals have been blocked by beach sand and the canals are barely visible on 1985 photography.

Of the six pipelines studied in Mississippi, three were emplaced in a corridor using a push ditch; one was in a push ditch that was backfilled and two were in floatation canals dammed near the shoreline. All of these lines traversed brackish-to-saline marshes and none crossed barrier islands or beaches. All five of the pipelines studied in Alabama were emplaced using a directional drilling technique which had no impact on the bay shore.

The impacts of these OCS pipelines vary depending upon the construction technique used and the environmental processes active in the area. All pipeline sites are presently being analyzed to determine the type and degree of impact and the cause. Field sampling of vegetative, hydrologic and geologic parameters at eleven pipelines in the four coastal systems has provided additional data to explain the impact process and magnitude.

A detailed discussion of the environmental effects of Coastal Produced Water Discharges, another major task within this study, is presented by Dr. Donald Boesh in the following section.

ABSTRACT  
FOR  
ENVIRONMENTAL EFFECTS OF COASTAL PRODUCED  
WATER DISCHARGES: ONGOING AND PLANNED STUDIES

First 1988  
MMS Ternary Studies Meeting  
March 8, 1988  
New Orleans, Louisiana

Submitted to: Minerals Management Service  
Gulf of Mexico OCS Regional Office  
Environmental Studies Section

Submitted by: Donald Boesch  
Louisiana Universities Marine Consortium  
Chauvin, LA 70344

## **Environmental Effects of Coastal Produced Water Discharges: Ongoing and Planned Studies**

**Donald F. Boesch  
Louisiana Universities Marine Consortium  
Chauvin, LA 70344**

The environmental effects of discharges of formation waters associated with oil and gas production into coastal environments of the northwestern Gulf of Mexico are being assessed in an ongoing study sponsored by the Minerals Management Service (MMS) and are to be further assessed in studies proposed by the Louisiana Division of the Mid-Continent Oil and Gas Association (LaMOGA). The MMS-sponsored studies focus on the effects of discharges from onshore separation facilities which process oil and gas received from the Outer Continental Shelf (OCS). The LaMOGA studies will focus on discharges associated with oil and gas production in coastal wetland environments.

It is common practice in the northwestern Gulf region to discharge briny produced waters into surface waters when these receiving waters are brackish or saline. In contrast the conventional practice for oil and gas production in inland areas where surface waters are fresh is to reinject the produced water into subsurface formations. This coastal disposal practice has raised concerns related to the effects of elevation of salinity in receiving waters, particularly on sensitive wetland plants, and to the effects on water and sediment quality. Produced waters typically have concentrations of total dissolved solids of 75 to 225 g/kg compared to that of seawater of 35 g/kg. In addition, the major ion ratios of these formation waters differ from that of seawater, being relatively enriched in calcium and depleted in magnesium. Produced water typically have higher concentrations of several dissolved trace metals compared to seawater: barium, beryllium, cadmium, chromium, copper, iron, lead, nickel, silver and zinc. Barium, lead and zinc are commonly present at concentrations more than one thousand-fold those in seawater. Produced waters generally have little or no dissolved oxygen and high concentrations of sulfide and elemental sulfur. Because these waters have closely intermingled with petroleum, they contain variable concentrations, depending on the effectiveness of gravity or chemically or thermally enhanced separation, of dissolved or dispersed petroleum hydrocarbons. They may contain up to 72 ppm "oil and grease" according to EPA criteria. Low molecular weight monoaromatics (including benzene and toluene) and alkanes with less than 14 carbon atoms in their molecular structure predominate among the dissolved hydrocarbons and naphthalenes and C<sub>15</sub> to C<sub>30</sub> alkanes are primary constituents of the dispersed phase. In addition, high concentrations of other soluble organic compounds (characteristically >200 ppm) are found in discharged produced waters. These compounds have been poorly characterized, but include phenols and organic acids.

Because of the lack of comprehensive information on the extent and location of produced water discharges in the northwestern Gulf of Mexico, data were assembled from the files of state and federal regulatory agencies. Personal computer accessible data bases have been developed which include the location, volume of discharges and characteristics of receiving waters of reported discharges into the coastal and estuarine environments of Louisiana and Texas. Louisiana data were assembled from permit applications submitted to the Louisiana Department of Environmental Quality (DEQ). Texas data were extracted from a data base maintained by the Texas Railroad Commission. Based on summaries of these data it appears that a total of 3.6 million barrels (570 million liters) per day of produced waters are discharged into estuarine or

offshore waters. Of this, approximately 1.8 million barrels per day are discharged into estuarine and nearshore waters of Louisiana and 0.8 million barrels per day into similar waters of Texas. Mass discharge emissions in Texas are mainly into the Sabine Lake, Galveston Bay and Matagorda Bay estuarine systems. Produced water discharges take place in all of Louisiana's estuarine systems, but are more voluminous in the southeastern part of the state: Vermilion Bay, Terrebonne-Timbalier Bay, Barataria Bay, Mississippi Delta and Chandeleur Sound estuarine systems. Discharges from the 17 facilities which handle OCS-generated produced waters are concentrated in the Terrebonne-Timbalier, Barataria and Mississippi Delta estuaries. These OCS-related discharges are few in number, but individual discharges are large, totalling approximately 400,000 barrels/day.

An atlas consisting of a series of maps showing the location and volume of each of the discharges in Texas and Louisiana is being prepared. In addition, the number and volumes of discharges will be summarized by estuarine basin and receiving habitat. Because of concerns regarding the impact of produced water discharges on wetland vegetation, discharges into fresh and brackish wetlands merit particular attention. These are summarized below:

Estuarine Basin	Total Volume Discharged (bbl/day)					OCS
	Fresh	Brackish	Saline	Open Bay	Total	
Sabine	18,000	25,000		1,262	44,262	
Calcasieu	5,667	16,570	6	900	23,143	
Mermentau	7,222	4,000	981		12,203	
Vermilion	4,000	123,484		106,230	233,714	400
Atchafalaya	53,635	2,833		13,645	70,113	
Terrebonne	9	45,323	34,059	96,472	175,863	24,058
Barataria	6,940	112,845	234,746	1,977	356,508	172,000
Delta	315,526	47,598			363,124	191,542
Chandeleur		7,713	56,690	274,091	338,494	
Pontchartrain		405		762	1,167	
Gulf					176,834	41,277

Most discharges into fresh marsh habitats are into distributaries of the Mississippi or Atchafalaya rivers, where the large flow and associated dilution of the waste stream may mitigate adverse impacts.

Three areas receiving significant OCS-generated produced water discharges were selected for preliminary field assessments of the effects on water and sediment quality and biota of the region. The sites were Bayou Rigaud, behind Grand Isle, which receives approximately 145,000 barrels per day of produced waters from two major facilities; Pass Fourchon, which receives approximately 18,000 barrels per day; and Timbalier Bay behind East Timbalier Island, which receives approximately 53,000 barrels per day (24,000 barrels per day from OCS sources). At each site, produced waters were sampled for hydrocarbon and trace metal analysis, bottom sediments were sampled for analysis of trace metals and hydrocarbons and for macrobenthos, and molluscs were sampled for body burden analyses.

The results of the analyses are yet incomplete and are only summarized here for the Bayou Rigaud and Pass Fourchon sites. Based on salinity distribution, the effluents into Bayou Rigaud formed dense plumes at the bottom which were effectively dispersed within a few hundred meters by the large tidal flow through this channelized bayou.

Concentrations of benzene of up to 930 ng/ml were measured in water overlying the bottom within 100 m of the largest discharge. Bottom sediments near the discharges had concentrations of total hydrocarbons up to 1600 ug/g and these concentrations decreased with distance from the discharge. These hydrocarbons were qualitatively similar to those in the discharged produced waters. Macrobenthic organisms were essentially absent from the most heavily contaminated sediments and population densities and species richness increased with distance from the discharges and decreasing sediment hydrocarbon concentrations. The presence of the polychaete *Capitella capitata* at more distant stations suggests an intermediate-field organic enrichment effects similar to that described around produced water discharges in Texas bays. Sediments in Bayou Rigaud extending at least 1 km in either direction from the discharges show evidence of hydrocarbon contamination and effects on benthic communities.

The natural connection between Pass Fourchon and the Gulf of Mexico has been closed off, creating a dead-end channel with poor flushing into which produced waters are discharged. As a result the dense, bottom plume of produced water extends at least 800 m from the discharge point. Bottom sediments showed a pattern of contamination very similar to that in Bayou Rigaud, except that concentrations of hydrocarbons dropped quickly upon moving from the dead-end portion of the pass into the portion influenced by larger tidal flow into the canal system to the east. Macrobenthos was essentially absent from the most heavily contaminated sediments.

The pattern of sediment contamination and benthic effects extending on the scale of 1 km from the discharge at Bayou Rigaud and Pass Fourchon sites differs from other studies of the effects of produced water discharges in the Gulf region in which contamination and effects were generally restricted to within 100 m of the discharges. As summarized below, this is probably attributable to the much larger volume of the discharges studied here and the more enclosed nature of the receiving waters, which limits dilution and enhances the deposition of fine, contaminated sediments.

Location	Discharge Bbl/day	Receiving Water Depth (m)	Environment
Bayou Rigaud	145,000	5	Dredged Bayou
East Timbalier Is.	53,000 (24,000 OCS)	2	Canals near Bay
Pass Fourchon	18,000	3	Canal-Dredged Bayou
Trinity Bay (Armstrong et al., 1979)	4,000-10,000	3	Open Bay
Lake Pelto (Battelle, 1987)	3,700	2	Open Bay (near pass)
Eugene Island 120 (Battelle, 1987)	3,000	12	Shallow shelf
Buccaneer Field (Middleditch, 1981)	120-2,000	20	Shallow shelf



The LaMOGA study is scheduled to be undertaken in 1988 and will focus on three sites of produced water discharges into fresh and brackish marsh habitats. It will include the following components: 1) modeling effects on salinity patterns within estuarine basins; 2) remote sensing analysis of the effects on wetlands of the three regions; and 3) field assessments involving analyses of hydrology, environmental chemistry, marsh vegetation and benthos. Results are expected to be available in early 1989.

These studies and others on produced water effects proposed by MMS are very timely in light of the increased scrutiny the practice of discharging produced waters into coastal environments is receiving. Recent and ongoing regulatory attention includes development of permits and permit conditions by the Louisiana Department of Environmental Quality; review by the Environmental Protection Agency of the provisional exemption granted oil and gas exploration and production wastes under the Resource Conservation and Recovery Act; the potential that the EPA will require National Pollution Discharge Elimination System (NPDES) permits under the Clean Water Act; and proposals within the state administration in Louisiana for a legislated prohibition or limitation of produced water discharges in the coastal zone.

ABSTRACT  
FOR  
MISSISSIPPI-ALABAMA MARINE ECOSYSTEM STUDY

First 1988  
MMS Ternary Studies Meeting  
March 8, 1988  
New Orleans, Louisiana

Submitted to: Minerals Management Service  
Gulf of Mexico OCS Regional Office  
Environmental Studies Section

Submitted by: James Brooks and Richard Rezak  
Texas A&M University  
Department of Oceanography  
College Station, TX 77840

## MISSISSIPPI/ALABAMA MARINE ECOSYSTEM PROGRAM

James Brooks and Richard Rezak  
Texas A&M University

The primary goal of the "Mississippi/Alabama Marine Ecosystem Program" is to describe the existing ecosystem and to interrelate dominant natural processes in a way that can be used to understand the impacts of man's activities in the area, especially as it relates to petroleum exploration and development.

Field sampling has been designed to characterize dominant physical and chemical processes on the OCS and to provide a basis for further investigations of spatial and temporal variations in biologic populations. Included in this study phase are analyses of trophic relationships among dominant biologic components of the ecosystem, descriptions of current movements, and descriptions of geologic features such as hard bottom areas that may be biologically sensitive or unique compared to surrounding habitats. The second year of this field effort consists of field sampling cruises to further characterize the biology and chemistry of the OCS, continued current measurements on the OCS, and biological reconnaissance of continental slope topographic features. The third year of this effort consists of final field work to gather environmental data that may be needed to fill information gaps. More importantly, it will be a time of synthesis and integration of information compiled during the previous years of field effort and literature review.

The general goals of this study are: (1) to biologically characterize the hard banks located on the outer shelf of the study area; (2) to describe the sediments and transition areas of the region; (3) to determine the seafloor topography and how it affects sediment distribution; (4) to evaluate the presence or absence of live bottom areas in the Mobile and northern Viosca Knoll leasing areas; (5) to study circulation patterns and driving forces, especially due to the Loop Current, around DeSoto Canyon, including meteorology, hydrography, currents, sea state, and freshwater discharge; (6) to study the occurrence and extent of the nepheloid layer; (7) to investigate the extent and significance of hypoxia on the shelf; (8) to study the fates of pollutants associated with shelf activities, especially petroleum exploration/production; (9) to define shelf benthic communities and emphasis on habitats not previously described and near-slope environments; and (10) to analyze trophic relationships among biotic components of the shelf ecosystem with emphasis on energy transfer within and between pelagic and benthic components.

The study area occupies the continental shelf from the Chandeleur Islands and Mississippi River delta on the west to a line extending from the Alabama/Florida border southeastward intersecting the head of DeSoto Canyon (Figure 1). It extends from the shoreline or barrier islands across the shelf to the 200 m isobath. The area extends about 140 miles from east to west, and the width of the shelf varies from around 40 miles in the east to about 80 miles in the west. The Mississippi/Alabama shelf is referred to as the Mississippi Bight, although technically it might better be termed the East Mississippi Bight.

Rocky, hard bottom outcrops have been reported to occur in several areas, and the distribution of many of these were mapped in a report of the M/V Oregon for Cruise No. 72 (December 7, 1960). Directly south of Mobile Bay at a depth

of about 20 fms, there are extensive areas of low relief calcareous outcrops of unknown origin, known locally as "broken bottoms or ragged bottoms." Personnel from the National Marine Fisheries Service have indicated that these areas are major spawning grounds for the Atlantic croaker, spot, and other estuary-related species; extremely heavy species concentrations were demonstrated in this area by Darnell (1985). Because of its ecological importance, this area represents one of the study sites selected for the present project. Additional rocky outcrops have been reported to occur in depths of 80-200 fms in the area from south of Mobile Bay and eastward toward DeSoto Canyon. Another outcrop has been noted at depths of 40-50 fms directly south of Biloxi, MS. Others occur in deeper waters of the Mississippi Bight area. From submersible observations, Shipp and Hopkins (1978) reported that the deepwater outcrops around the edges of DeSoto Canyon are flat limestone slabs lying on the surface. This is probably true for many of the other deepwater hard bottoms. Other hard bottom structures have been tentatively identified in our cruises earlier this year.

Biological features of the Mississippi Bight area have been discussed by numerous authors and include invertebrate and demersal fish fauna that are generally typical of the widespread species of the northern Gulf Coast. However, detailed analysis shows that there is a considerable admixture of species more typical of the calcareous bottoms of the shelf of the Florida peninsula. Additional faunal elements include slope species that intrude onto the shelf around the Mississippi River delta and around DeSoto Canyon and tropical elements that are apparently brought in by the Gulf Loop Current. Many of these are not permanent residents, but Humm and Darnell (1959) reported resident populations of many tropical species of marine algae in the lee of the Chandeleur Islands. Parker (1960) and Defenbaugh (1976) referred to a unique pro-delta environment and fauna near the Mississippi River delta. Reviewing the available faunal information, Darnell and Kleypas (1987) concluded that the fauna of the Mississippi delta is a transitional fauna, representing elements of both the northwestern and eastern Gulf shelf areas. However, it is more than a transition area. It is a unique mix of species, some of which are not found elsewhere along the U.S. Gulf Coast, and it is characterized by extremely high biological productivity and fisheries yield (Roithmayr, 1965). For these reasons, it is considered biologically and ecologically unique and a major faunal area in its own right.

The overall responsibility for the program management of this study is assigned to Dr. James Brooks, Director of the Geochemical and Environmental Research Center at Texas A&M University (TAMU) and his Deputy Manager, Dr. Charles Giammona, Associated Professor and Program Manager in the Civil Engineering Department, TAMU. The overall data synthesis and integration is the responsibility of the Associated Program Manager, Dr. Rezneat Darnell, Professor of Oceanography, TAMU. A research team composed of scientists from the Department of Oceanography, Wildlife and Fisheries, Civil Engineering, the Geochemical and Environmental Research Center and Texas A&M - Galveston participates in this program.

Progress on the study presently include the completion of two biological/chemical sampling cruises, a physical oceanography/current meter deployment and servicing cruise and a geological mapping cruise. Initial findings indicate a diverse hardbottom regime consisting of a series of ridges and pinnacles on the outer continental shelf. Further emphasis on this area during the summer will include more side-scan surveys and the investigation of biological communities using an ROV.

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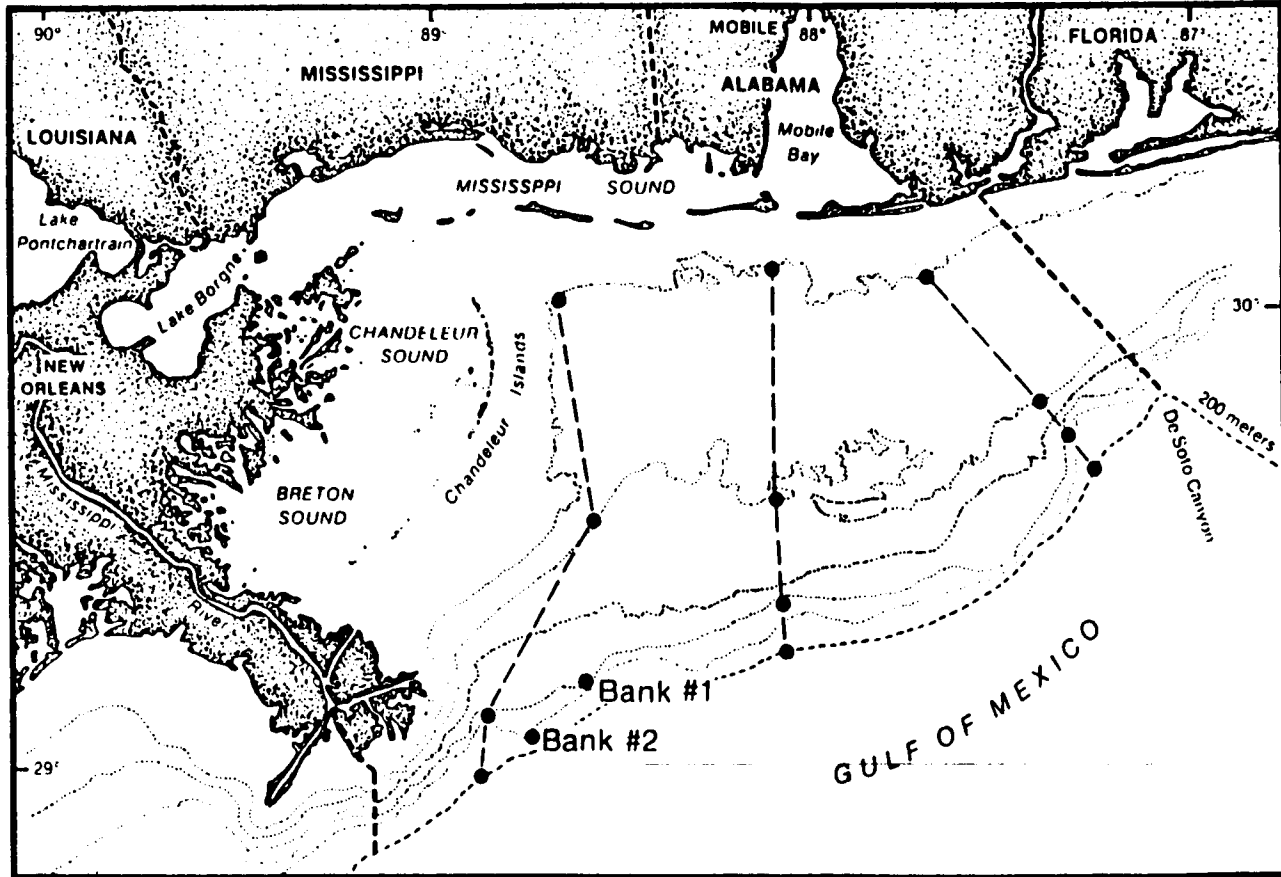


Figure 1.--Map of Mississippi/Alabama OCS study area.

CSA

# Continental Shelf Associates, Inc.

OFFSHORE TEXAS AND LOUISIANA  
MARINE ECOSYSTEMS DATA SYNTHESIS

SPRING TERNARY MEETING PROGRESS REPORT

8 MARCH 1968

PREPARED FOR:

Minerals Management Service  
1201 Elmwood Park Boulevard  
New Orleans, Louisiana 70123

Contract No. 14-12-0001-30380

PREPARED BY:

Continental Shelf Associates, Inc.  
7607 EastMark Drive, Suite 250  
College Station, Texas 77840  
Telephone (409) 696-5493

*"Applied Science and Technology"*



## OFFSHORE TEXAS AND LOUISIANA MARINE ECOSYSTEMS DATA SYNTHESIS

### Spring Ternary Meeting Progress Report 8 March 1988

Award of the contract was made on 28 September 1987 for a 12-month study designed to provide a synthesis of available environmental information on the continental shelf from the shallow sublittoral to a depth of 500m for the area between Corpus Christi Bay, Texas and the Mississippi River Delta (Figure 1). This is an area of valuable natural resources that could potentially be affected by historic and future OCS leasing and subsequent production activities. Results of this synthesis may be used to aid in the design of a separate one to three year field study to obtain missing information needed for a more complete understanding of the ecological processes in the area. The goals of the study are: (1) to collect, review, annotate, and computer catalog pertinent literature; (2) to produce a synthesis report describing the physical, chemical, geological, and biological settings of the area; and (3) to integrate, through conceptual modeling, these findings among themselves and with likely relationships, causes and effects of oil and gas operations.

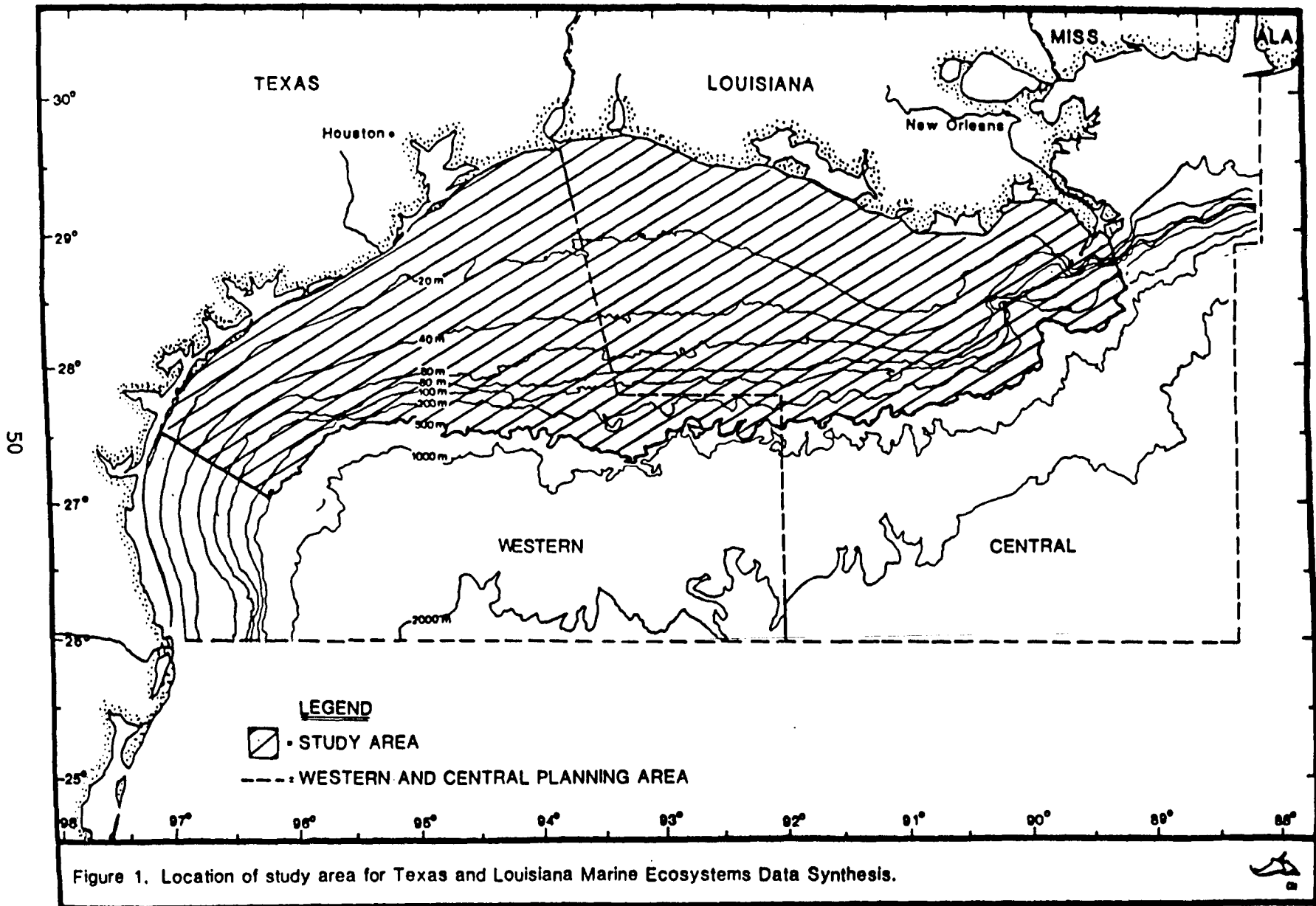
The following are key scientific personnel and their areas of responsibilities:

Dr. Bela James	Program Manager
Dr. Richard Hammer	Quality Assurance Officer
Mr. David Snyder	Information Collection and Annotation
Dr. Neal Phillips	Oil and Gas Effects, Computer Cataloging
Mr. Frank Kelly	Physical Oceanography
Dr. Richard Rezak	Geological Oceanography
Dr. James Brooks	Chemical Oceanography
Dr. Bobby Presley	Chemical Oceanography
Dr. Rezneat Darnell	Biological Oceanography, Conceptual Modeling
Dr. David Schmidly	Endangered Species
Dr. Thomas Linton	Fisheries

The proposed project schedule is shown in Figure 2. We have deviated slightly from this schedule; in that, more emphasis has been placed on the computer literature search and subsequent electronic gathering of abstracts and annotations. Presently, the bibliographic data base is about 70% complete. By mid-April the data base should be 80-90% complete, and between now and mid-April contact will be made with outside individuals and institutional libraries will be visited. The 95% complete, draft, annotated bibliography will be available to all authors in mid-May, when they are finalizing their contribution on the environmental setting.

The present preliminary bibliography contains approximately 900 references that have been obtained by downloading from online data base searches and by utilizing pertinent references in the MMS Tuscaloosa Trend bibliography which was obtained on floppy disks. We expect a final data base of 1,100 to 1300 citations, with abstracts for about 60% of the total.





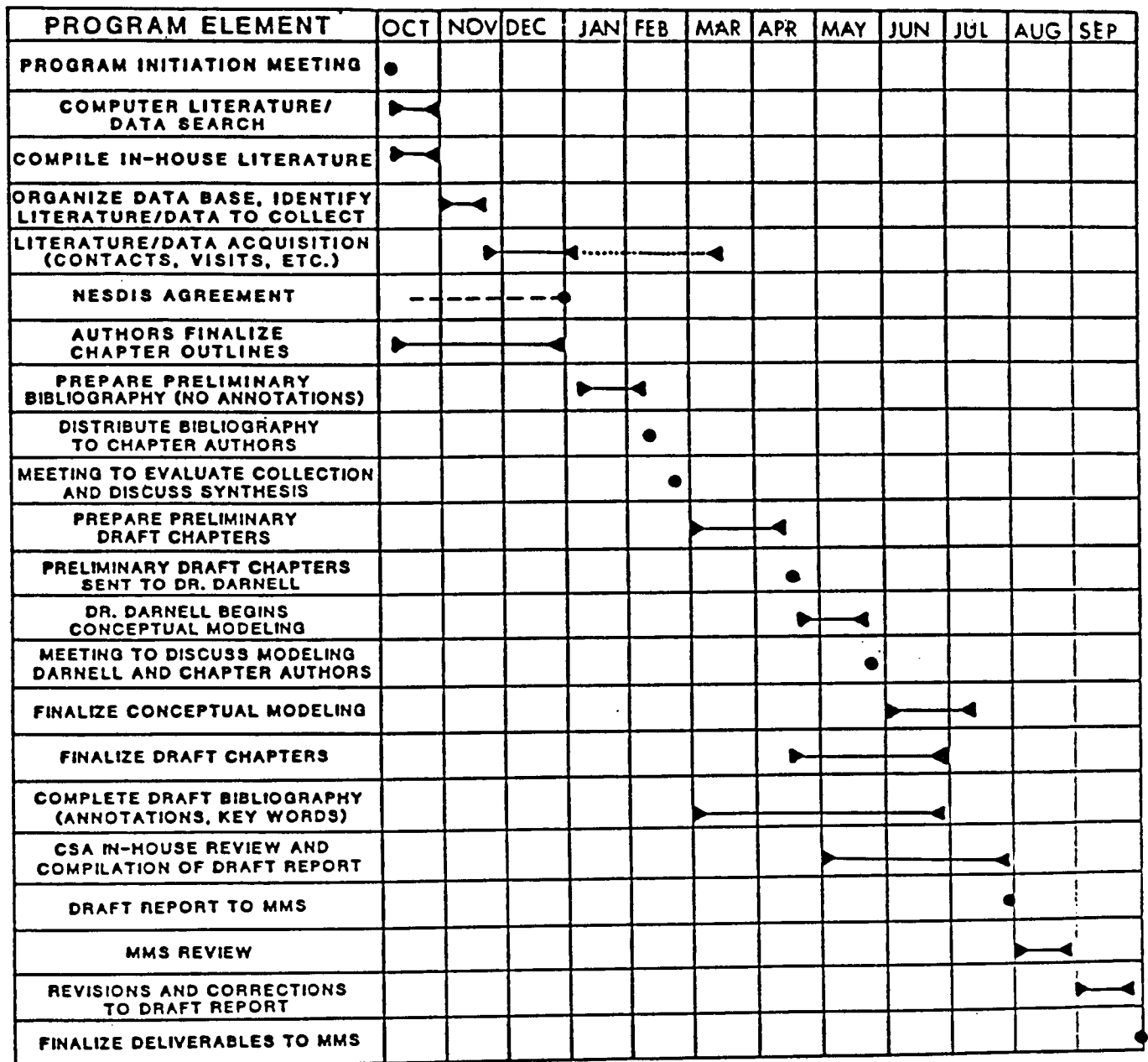


Figure 2. Program Schedule

The following data bases were searched through computer facilities at Harbor Branch Institution in Fort Pierce, Florida:

OCEANIC ABSTRACTS  
SCISEARCH DATABASE (Science Citation Abstracts)  
CONFERENCE PAPERS INDEX  
CA SEARCH (Chemical Abstracts)  
BIOSIS PREVIEWS (Biological Abstracts)  
AQUATIC SCIENCE AND FISHERIES ABSTRACTS  
METEOROLOGICAL/GEOASTROPHYSICAL ABSTRACTS  
DISSERTATION ABSTRACTS  
NTIS (National Technical Information Service)

The searches were very successful in pinpointing useful references. About 50 to 80% of the citations obtained from each data base were judged to be topically and geographically pertinent. Most citations included abstracts and keywords. All of the citations have been edited with a word processing program, Word Perfect, to put them in a common format. The files have been checked for spelling errors, and duplicate entries have been removed. The bibliographic computer program, FYI-3000 Plus, can work directly on files produced by the word processor. FYI-3000 Plus is an indexing, filing program. An indexing program is very fast because it doesn't have to search the entire data base for a match--instead, it only searches the index. The program can tell you almost immediately how many citations match your search request. A combination of search words can be linked by 'and', 'or', or 'not'. Wildcards ( i.e., Geo-----, Bio-----) can also be used in a search request. The citations that match the request can be viewed on the screen, sent to the printer, or saved in a separate disk file. The file can be sorted by author or year. The program has been setup to index and search the data base in five ways:

Keywords: Topic and geographic keywords (any combination, with wildcards and logical operators).

Author/  
date: Individual authors and publication date.

Cites: First author/date citations.

Title/  
source: Words in title and in source publication name.

Total  
search: All words in citation and abstract.

The project is proceeding on schedule. Authors are preparing draft reports on their assigned topics for submittal to Continental Shelf Associates, Inc. by the first of April. After an inhouse review, these draft reports will be given to Drs. Darnell and Phillips who will integrate the findings into conceptual environmental models which will be coupled with likely relationships, causes, and effects of oil and gas

operations. The draft report including the annotated bibliography is due to MMS on the first of August.

ABSTRACT  
FOR  
PHYSICAL OCEANOGRAPHY PROGRAM (YEAR 5): NORTH CENTRAL GULF

First 1988  
MMS Ternary Studies Meeting  
March 8, 1988  
New Orleans, Louisiana

Submitted to: Minerals Management Service  
Gulf of Mexico OCS Regional Office  
Environmental Studies Section

Submitted by: Evans Waddell  
Science Applications International Corporation  
4900 Water's Edge Drive  
Raleigh, NC 27606

## ABSTRACT

**Physical Oceanography Program(Year 5): North Central Gulf.** Evans Waddell, Science Applications International Corporation, Raleigh, North Carolina. Spring Ternary Meeting; MMS New Orleans, La. 8 March 1988.

The objective of Year 5 of the MMS-funded, Gulf of Mexico Physical Oceanography Program is to better understand the coupled conditions and processes extending across the west Louisiana shelf, slope and rise. The measurement scheme was developed with an appreciation of the linkage and interactions between open-Gulf processes and patterns on the slope. Similarly, the slope patterns influence and are directly influenced by outer shelf processes. This sequential association is characteristic of many coastal locations. On the shelf, measurements are being made far enough to the west so the Mississippi River and Atchafalya discharge are all to the east(Figure 1).

Primary program measurements include:

- Subsurface currents/temperature
- Transmissivity
- Quarterly hydrographic surveys
- Satellite imagery and related analysis
- Drifting buoys
- Marine optics
- Ship-of-Opportunity Program (SOOP)
- Inverted Echo Sounders

Field measurements were to occur for one year(April, 1987 - April, 1988). However, due to manufacturer-related current meter problems which were discussed in previous meetings, the subsurface current and inverted echo sounder measurements will be extended an additional six-months to allow for a good data return and a comprehensive data base over a complete yearly cycle(October, 1987 - October, 1988).

To date, four cruises have been conducted each with a hydrographic and current mooring deployment/rotation leg. Two marine optics cruises have been completed. Because of initial instrument problems, a concurrent and spatially extensive(shelf to deep Gulf) current data set is not yet available(Figure 2). Due to the six-month rotation cycle for instruments on the slope and rise, the first comprehensive data set will be retrieved in April, 1988.

Monthly composite frontal maps for a ten-year period (1975-85) have been compiled. These will be analyzed to provide a statistical characterization of the occurrence of features such as Loop Current fronts and water, LC eddy fronts and water and shelf-slope fronts. Although limited to the cooler months when surface thermal fronts can be detected in the Gulf, this analysis should provide a much needed description, in a statistical sense, of the expected patterns and deviations from the expected.

Limited preliminary subsurface current data on the shelf show evidence of what may be a shelf-contained circulation pattern or gyre. This is reflected as an across-shelf reversal of low

frequency along-shelf currents with a nodal point in the mid-shelf. Such a pattern would be consistent with published descriptions of seasonal circulation patterns as estimated from historical hydrographic surveys.

The period of field measurements has been rich in Loop Current related circulation patterns such as detached eddies and related features. More than one eddy has been documented within the general study area. These have been seeded with drifting buoys and further documented by scheduled and SOOP surveys (Figure 3 and 4). These data show the importance of flexibility in the program design. Such an approach allows us to respond to opportunities which could not be anticipated yet which directly support the program tasks and objectives.

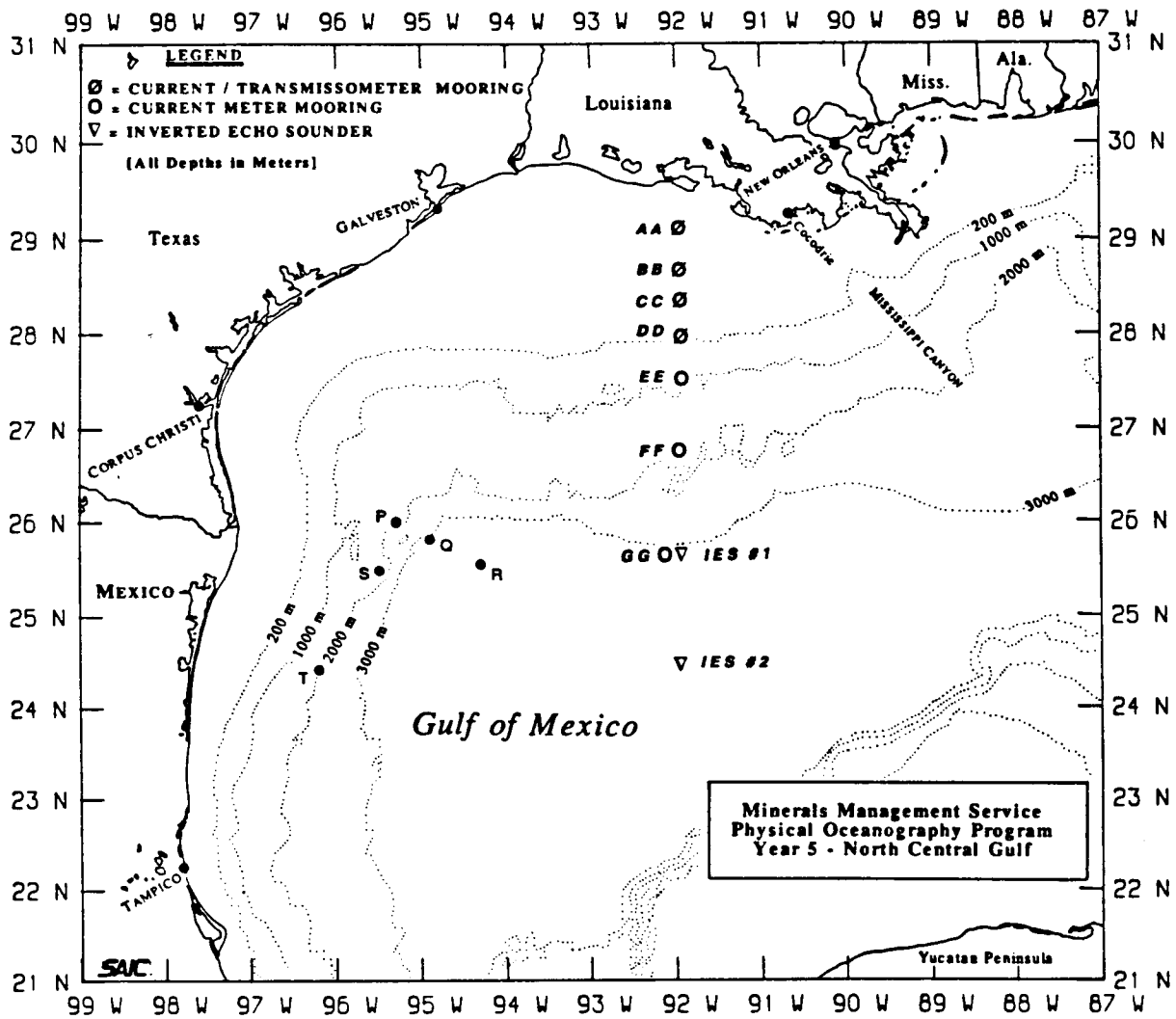


Figure 1. Regional map of the Year 5 study area. The locations of in-situ instrumentation is shown along a line extending offshore of Louisiana. Locations of Year 3 moorings are shown as small dots (Moorings P, Q, R, S, and T).





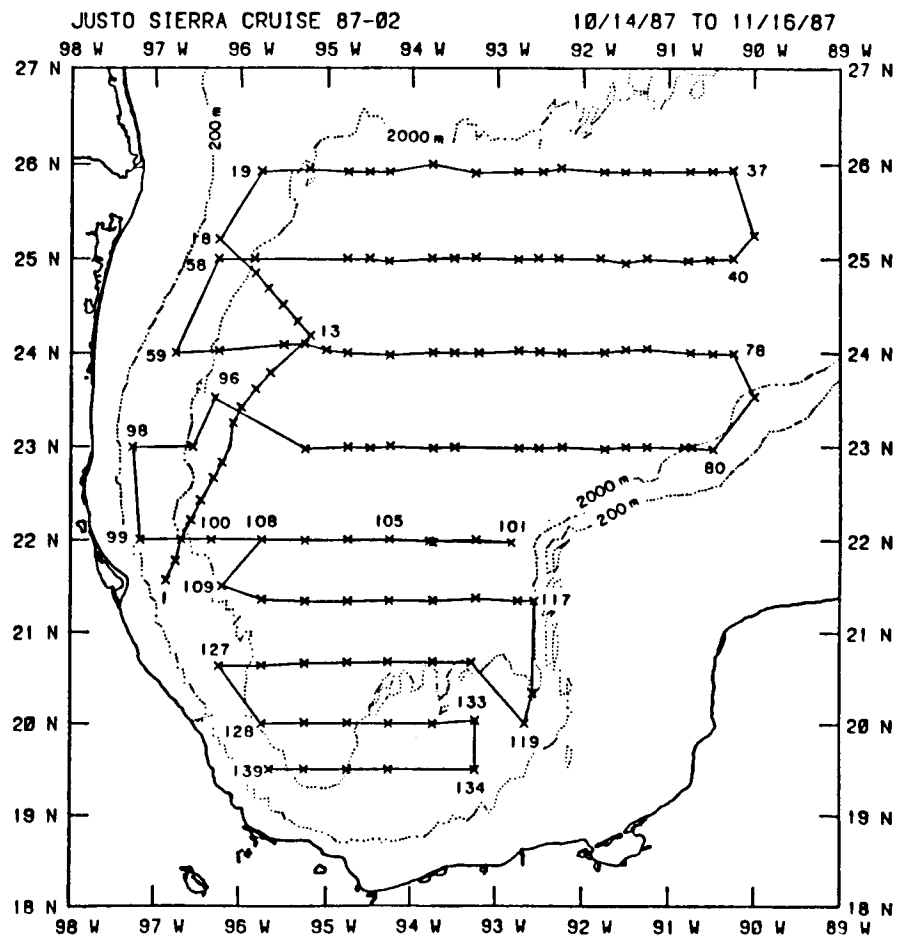
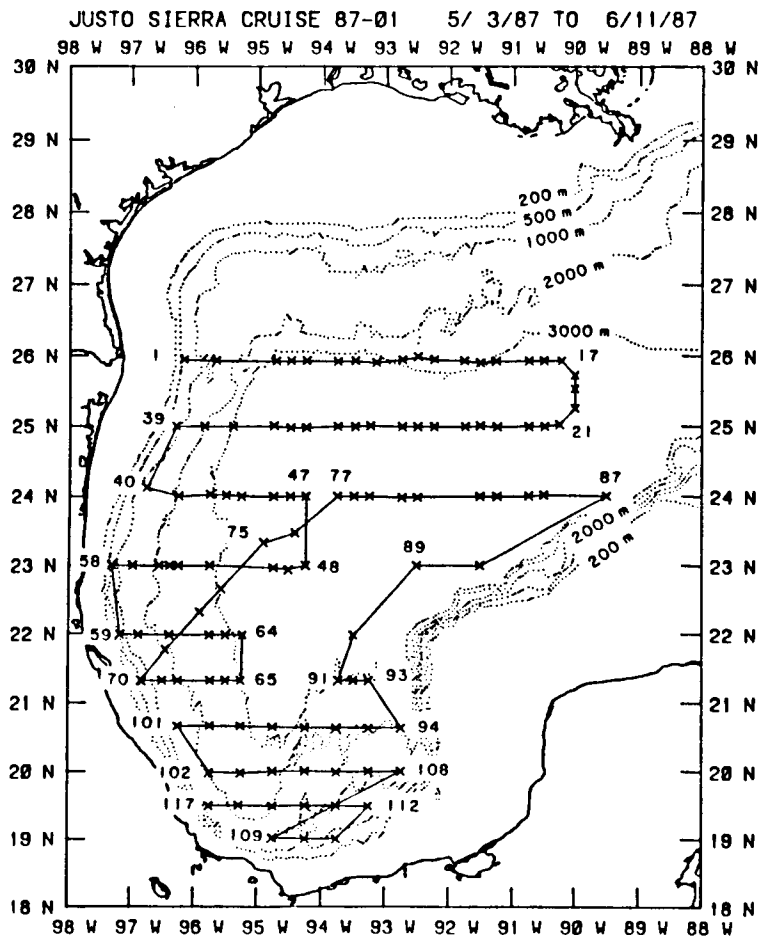


Figure 3. Cruise tracks and station locations for R/V Justo Sierra Cruises  
(a) 87-01 and (b) 87-02.

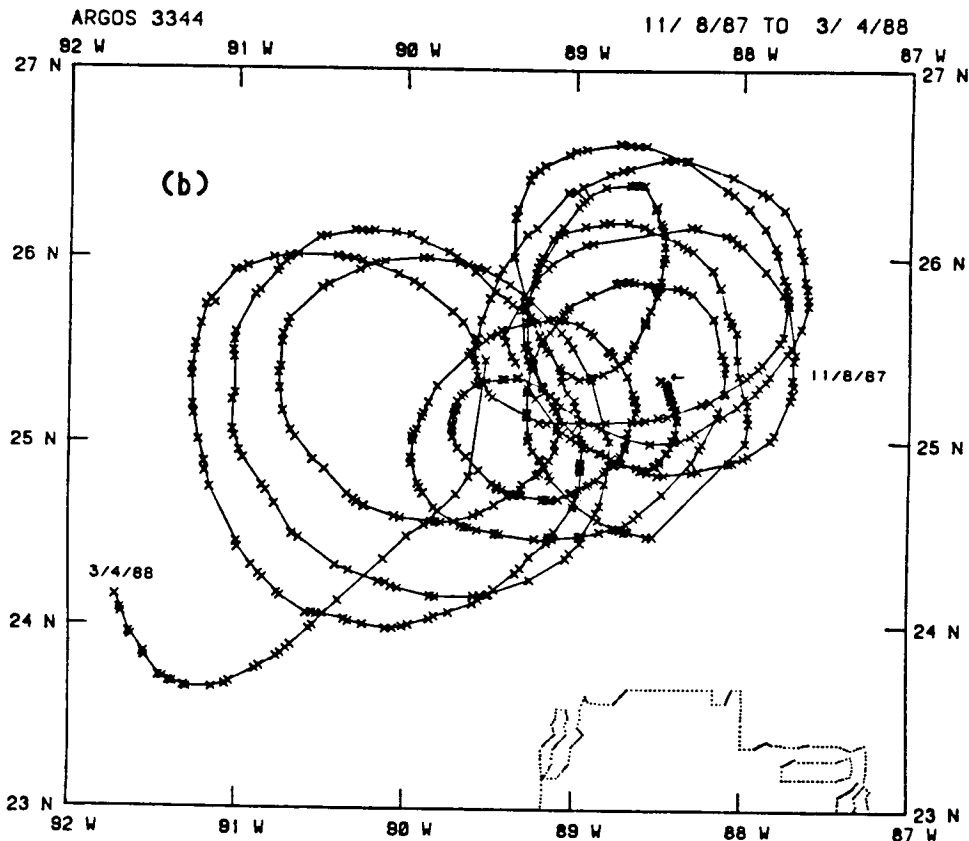
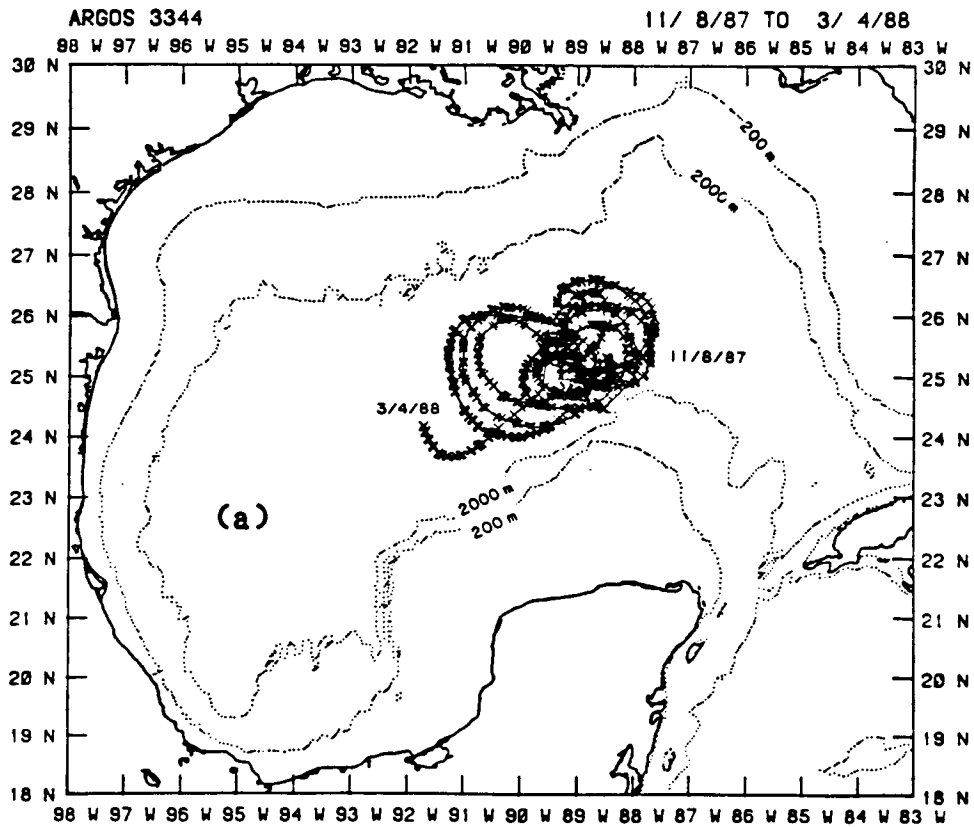


Figure 4. (a) Trajectory for Buoy 3344 placed in a LC eddy which separated in or before September 1987. This buoy replaced a drifter released in the eddy in September. (b) An enlarged plot of the buoy trajectory.

LIST OF REGISTERED ATTENDEES

Minerals Management Service  
Ternary Meeting  
8 March 1988

Ms. Diane Ashton, U.S. Army Corps of Engineers, New Orleans District, P.O. Box 60267, New Orleans, Louisiana 70160-0267

Dr. Robert M. Avent, U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, Leasing and Environment, 1201 Elmwood Park Boulevard, New Orleans, Louisiana 70123-2394

Mr. Robert H. Baumann, Energy Studies, Louisiana State University, Baton Rouge, Louisiana 70808

Ms. Janice Blake, U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, Leasing and Environment, 1201 Elmwood Park Boulevard, New Orleans, Louisiana 70123-2394

Mr. Don Boesch, Louisiana Universities Marine Consortium, Chauvin, Louisiana 70344

Mr. Jerry Brashier, U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, Leasing and Environment, 1201 Elmwood Park Boulevard, New Orleans, Louisiana 70123-2394

Dr. Donald R. Cahoon, Louisiana Geological Survey, P.O. Box G, Baton Rouge, Louisiana 70893

Mr. D.F. Charlton, Shell Offshore Inc., One Shell Square, New Orleans, Louisiana 70130

Mr. Dennis Chew, U.S. Army Corps of Engineers, New Orleans District, P.O. Box 60267, New Orleans, Louisiana 70160-0267

Mr. Steve Chustz, Louisiana Department of Natural Resources, P.O. Box 44487, Baton Rouge, Louisiana 70811

Mr. Barney Congdon, U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, Office of the Regional Director, 1201 Elmwood Park Boulevard, New Orleans, Louisiana 70123-2394

Mr. Les Dauterive, U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, Leasing and Environment, 1201 Elmwood Park Boulevard, New Orleans, Louisiana 70123-2394

Mr. Bruce Davis, Jackson State University, Jackson, Mississippi 39205

Mr. H. Devin Dedeaux, TAI Environmental Science Inc., 1717 Old Shell Road, Mobile, Alabama 36604

Mr. William Freudenburg, University of Wisconsin, 5413 Mathews Road, Middleton, Wisconsin 53562

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### **The Department of the Interior Mission**

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.



### **The Minerals Management Service Mission**

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Minerals Revenue Management** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.