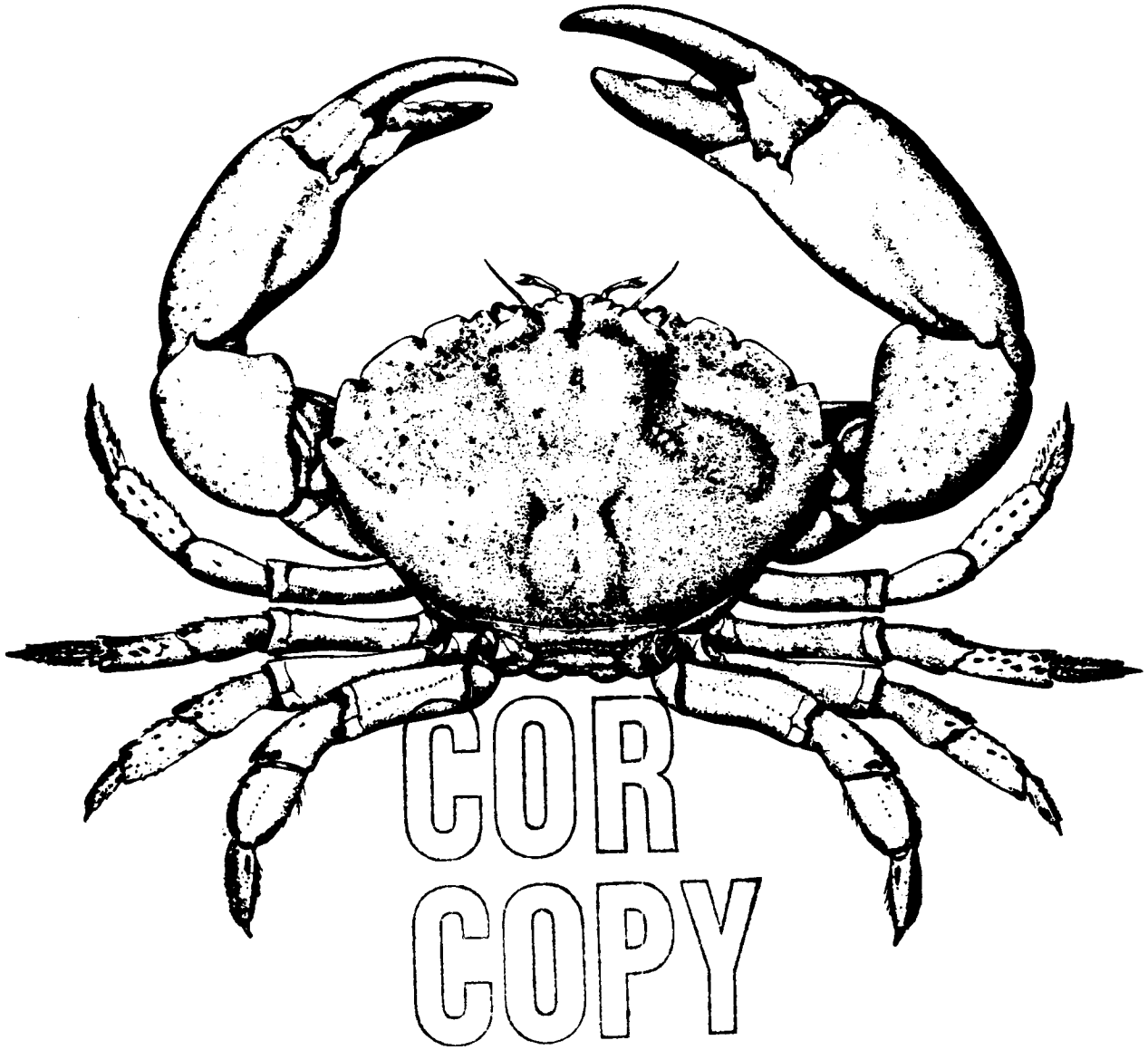
OCS STUDY
MMS 85-0003

PROCEEDINGS
SUMMER TERNARY
GULF OF MEXICO STUDIES MEETING

June 1984



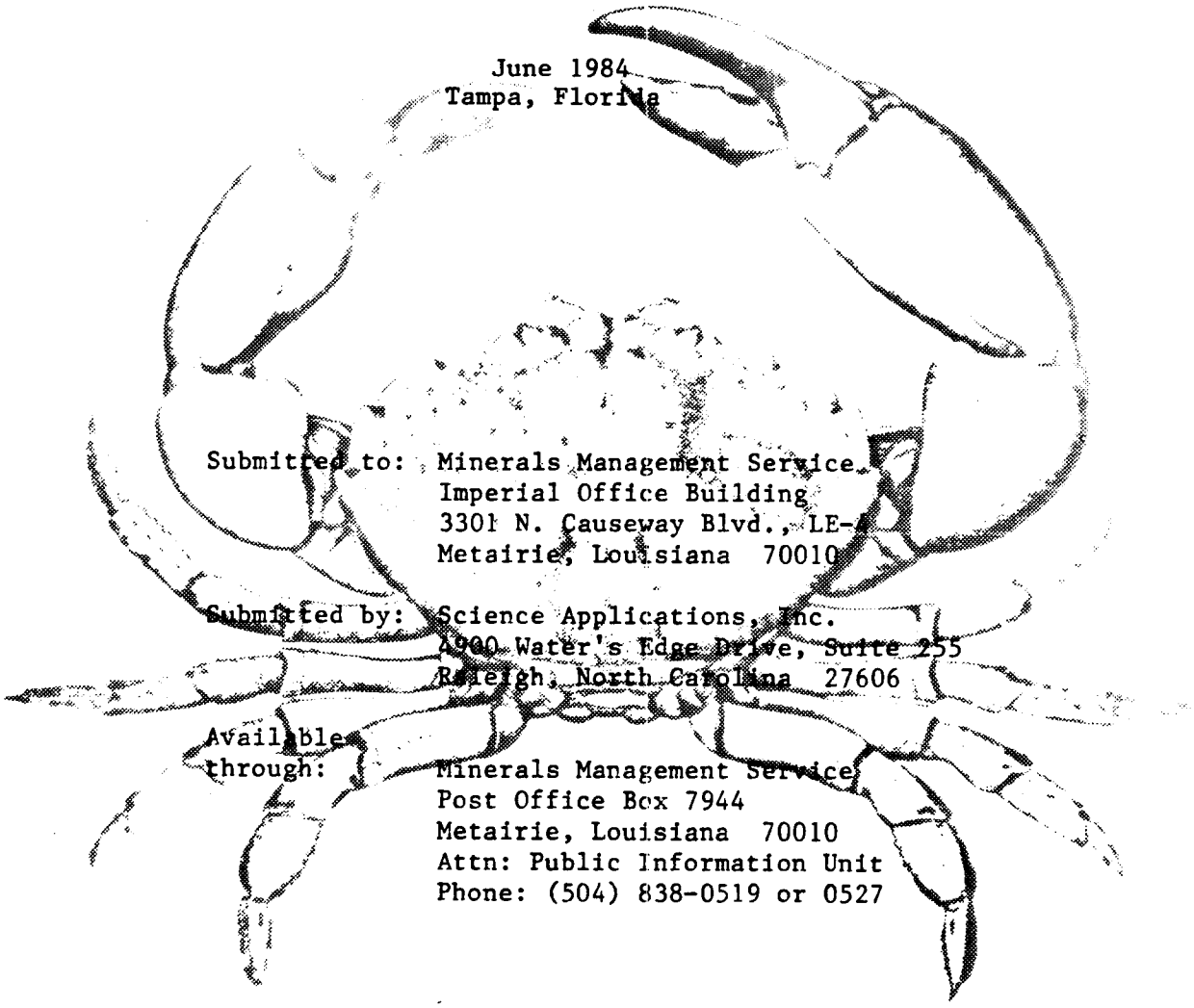
U.S. DEPARTMENT OF THE INTERIOR/MINERALS MANAGEMENT SERVICE

OCS STUDY
MMS 85-0003

PROCEEDINGS
SUMMER TERNARY
GULF OF MEXICO STUDIES MEETING

Proceedings of the
Summer Ternary Studies Meeting
of the Gulf of Mexico OCS Regional Office
U. S. Department of the Interior
Minerals Management Service

June 1984
Tampa, Florida



Submitted to: Minerals Management Service
Imperial Office Building
3301 N. Causeway Blvd., LE-4
Metairie, Louisiana 70010

Submitted by: Science Applications, Inc.
4900 Water's Edge Drive, Suite 255
Raleigh, North Carolina 27606

Available through: Minerals Management Service
Post Office Box 7944
Metairie, Louisiana 70010
Attn: Public Information Unit
Phone: (504) 838-0519 or 0527

Preface

This Proceedings volume is based on activities which occurred as part of the Summer Ternary Meeting held in Tampa on June 13-14, 1984. Arrangements for the meeting were made by Science Applications International Corporation (SAIC). Ms. Ellen Bivins (SAIC) was responsible for meeting logistics and much of the coordination with MMS.

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1.0. Introduction

Three times each year, the Environmental Studies Group in the Gulf Regional office of the Minerals Management Service, sponsors public Ternary Meetings. At present, these are supported as part of a contract between MMS and Science Applications International Corporation (SAIC). The goal of the meetings is severalfold: (1) to provide a forum for contractors to provide MMS, other contractors and interested parties with an update on ongoing programs; (2) to allow interested parties to use presented material to comment on the direction and progress of environmental studies, and (3) to provide information useful to the Technical Regional Working Group which generally meets coincidentally. Ternary meeetings are spread throughout the year so regular information flow and contact are maintained.

The present meeting, the second in 1984, was held on June 13 and 14, 1984, at the Sheraton-Tampa Hotel in Tampa, Florida. This location was chosen to encourage involvement of people in that geographic area. When possible, meeting sites are at different locations around the Gulf. This facilitates a wider participation.

The present report includes: a meeting summary, abstracts of presentations, and a list of attendees -- those who registered. Dr. Waddell (SAIC) convened the meeting with a brief welcome and a series of announcements. He was followed by Mr. H. Sieverding (MMS) welcoming those in attendance and discussing briefly MMS's rationale and objectives for holding Ternary Meetings. Dr. M. Brown (MMS) then gave an overview of presently active studies and how some of the studies related in content and in time. Dr. Brown identified the general organization of presentations to be made at the meeting (see Fig. 1 for agenda), i.e., ecosystems studies the first morning, research pertinent to the eastern Gulf during that afternoon and physical oceanograhic studies (field measurements and numerical modeling) the morning of the second day. Note that not all studies presented were MMS supported. Often others who are investigating environmental problems of concern are invited to make presentations.

Section Two of this report contains extended abstracts submitted by each speaker. These were generally available before the meeting so those in attendance could become familiar with aspects of the material prior to each presentation. Section Three of this report is a listing of registered attendees and their affiliations.

gure 1

Agenda

MINERALS MANAGEMENT SERVICE

ENVIRONMENTAL STUDIES TERNARY MEETING

June 13 & 14, 1984

Tampa, Florida

Time	Topic	Speaker
Wed. A.M.		
8:30	Welcome	Dr. Van Waddell Science Applications, Inc.
8:40	Welcome	Mr. Harry Sieverding Minerals Management Service
8:50	Introductory Remarks	Dr. Murray Brown Minerals Management Service
9:00	Southwest Florida Shelf Ecosystems	Dr. Larry Danek Environmental Science & Engineering, Inc.
9:30	Marine Program of the South Florida Research Unit	Mr. Richard Dawson U. S. National Park Service
10:00	BREAK	
10:30	Minerals Development in the Big Cypress	Mr. Cordell Roy National Park Service
11:00	Continental Slope Ecosystems	Dr. George Lewbel LGL Ecological Associates
11:30	LUNCH	
Wed. p.m.		
1:30	Overview of Florida Dept. of Natural Resources' Marine Research in the Gulf	Dr. Karen Steidinger Florida DNR Bureau of Marine Research

Figure 1 - Cont'd.

Time	Topic	Speaker
Wed. P.M.		
2:00	Red Tide and Ciguatera Studies	Dr. Karen Steidinger Florida DNR/BMR
2:30	Coral Communities Research in the Florida Keys	Dr. Walt Jaap Florida DNR/BMR
3:00	Mississippi/Alabama Ecosystems	Mr. Kevin Shaw Barry Vittor & Associates
3:30	Florida Coastal Atlases	Mr. Tom Kunneke Martel Laboratories, Inc.
Thurs. A.M.		
8:30	Physical Oceanographic Measurements	Dr. Van Waddell Science Applications, Inc.
9:30	The Meteorological Data Base Study	Mr. Jerry Ford Florida A & M University
9:50	BREAK	
10:00	Circulation Modeling	Dr. Alan Wallcraft Jaycor, Inc.
10:45	Availability of Program Documents; 1984 Information Transfer Meeting	Dr. Murray Brown Minerals Management Service
11:30	ADJOURN	

2.0. Meeting Abstracts

2.1. Introduction

The various speakers were organized so that presentations were grouped rationally or topically. As seen in the agenda, the three half day sessions had the following general emphasis: Ecosystems studies; biological studies having specific relevance to the west Florida shelf or slope or contiguous regions; and physical oceanographic studies -- both field measurements and modeling. Extended abstracts of these various presentations are presented below. These are in the order of presentation (Figure 1).

2.2. Extended Abstracts

SOUTHWEST FLORIDA
BENTHOS STUDY

OCTOBER 1983-SEPTEMBER 1984

ABSTRACT

Prepared by:

ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.
Gainesville, Florida

June 13, 1984

INTRODUCTION

The Southwest Florida Shelf Ecosystems Study began in 1980 and was originally designed as a 3-year, interdisciplinary study of the biogeochemical processes and seasonal distributions occurring in the region.

The overall objectives defined by the Bureau of Land Management (BLM) [Minerals Management Service (MMS)] for the Southwest Florida Shelf Ecosystems Study were as follows:

1. To determine the potential impact of OCS oil and gas offshore activities on live-bottom habitats and communities, which are integral components of the southwest Florida shelf ecosystem.
2. To produce habitat maps that show the location and distribution of various bottom substrates. This was to be done by exploring several widely spaced transects across the southwest Florida shelf.
3. To broadly classify the biological zonation across and along the shelf, projecting the percent of the area covered by live/reef bottoms and the amount covered by each type of live/reef bottom.

To meet these objectives, the study was conducted in three phases over a 3-year period. During the first year of the program, a variety of geophysical, hydrographic, and biological parameters were studied along five east-west transects across the southwest Florida shelf (see Figure 1). Geophysical data--bathymetric, seismic, and side scan sonar surveys--were collected along each transect from about 40-meter (m) water depth out to 200-m water depth. Visual data--combining underwater television (UTV) and 35-millimeter (mm) still color photography--were collected in depths between 20 and 200 m. Finally, a broad range of hydrographic measurements, water column samples, bottom sediment and benthic biological samples (e.g., triangle dredge, otter trawl, and box cores) were collected from 30 stations located along the various cross-shelf study transects. These sampling stations were occupied

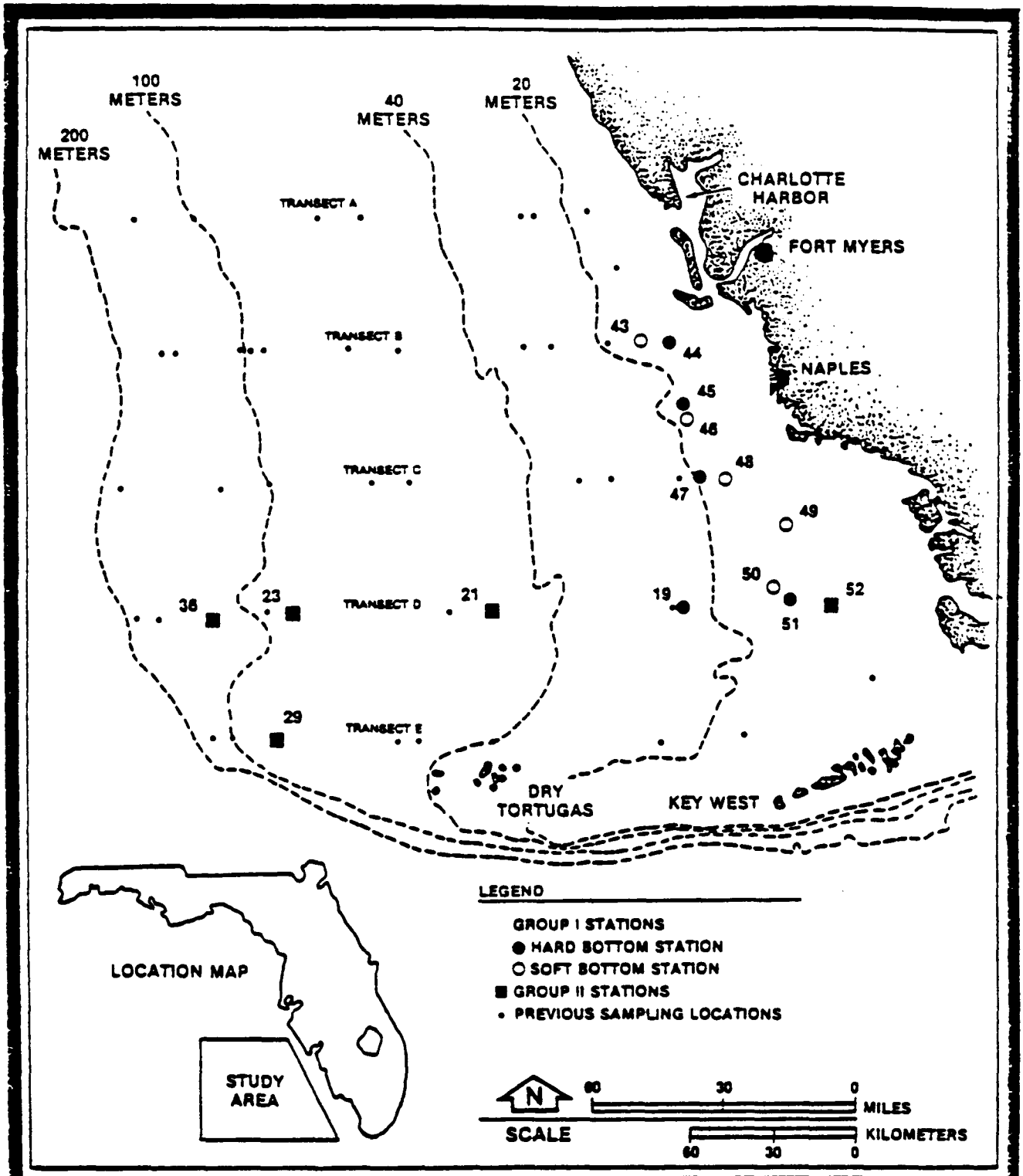

Figure 1
SOUTHWEST FLORIDA BENTHOS STUDY SAMPLING LOCATIONS

SOURCE: ESE, 1983.

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twice during the first year, once during a Fall Cruise (October-November 1980) and again during a Spring Cruise (April-May 1981).

The geophysical and visual data were to be combined with results obtained from benthic sampling to refine the gross sea bottom/substrate type identifications into interpretations of specific community types, with emphasis on speciation, diversity, biomass, recreational, and commercial value.

During the second year, additional geophysical information was collected along a new north-south transect, at about 100-m water depth, that tied together several of the previously surveyed east-west transects (Transects B through E). Visual data, again including UTV and still camera photography, were extended along each east-west transect from 100- to 200-m water depths.

Twenty-one of the 30 hydrographic and benthic biological sampling stations occupied during Year I were twice resampled--once during a Summer Cruise (July-August 1981) and again during a Winter Cruise (January-February 1982). For this set of stations, hydrographic and biological data are now available on a seasonal (quarterly) basis. In addition, nine new hydrographic and benthic biological stations were established on Transects A through E, in water depths ranging from 100 to 200 m. Each of these stations was sampled during both the Summer and Winter Cruises.

During Year III (which was essentially a modification to the Year II contract), two seasonal hydrographic cruises (April and September 1982) were conducted to provide data to be synthesized with Year I and II results to yield a hydrographic analysis and atlas of water quality parameters (temperature, salinity, transmissivity, chlorophyll *a*, phosphates, nitrates, nitrites, and dissolved silica). Primary productivity measurements were taken during both cruises to help explain distributions of nutrient and other physio-chemical data. A

simultaneous overflight by the National Aeronautics and Space Administration (NASA) Ocean Color Scanner during the April cruise was completed to investigate chlorophyll and productivity throughout the region during the spring bloom. Optical oceanographic measurements were also taken during the April cruise as ground truth for the Color Scanner data. In addition, 15 biological sampling stations within the 20-m contour line were added for the Year III studies.

The first 3 years of investigations effectively addressed Objectives 2 and 3 listed previously. However, it was determined that to effectively assess the potential impacts of OCS oil and gas activities more must be known about the dynamics of the ecosystem and natural stresses that are imposed on the systems by existing physical processes. Consequently, an additional 2-year study was designed to investigate the biological and physical processes of the southwest Florida shelf that, in combination with the first 3 years of study, would provide the information needed to better assess potential impacts of offshore development.

PROGRAM SCOPE

The overall objectives for the Years IV and V study required to investigate biological and physical processes and to provide information needed for impact assessment are as follows:

1. Compare and contrast the community structure of both live-bottom and soft-bottom fauna and flora to determine the differences and similarities between them and their dependence on substrate type.
2. Determine and compare the hydrographic structure of the water column and bottom conditions at selected sites within the study area.
3. Determine and compare sedimentary character at selected sites within the study area, and estimate sediment transport.
4. Relate differences in biological communities to hydrographic, sedimentary, and geographic variables.

5. Develop and conduct a research program which will provide essential information on the dynamics of selected "live-bottom" communities and determine the major factors which influence their development, maturation, stability, and seasonal variability.
6. Assemble and synthesize appropriate published and unpublished data with the results of this study, summarizing on a seasonal spatial basis all biological, habitat, and environmental observations and parameters. Relationships between biological and nonbiological factors shall be delineated through illustrations (maps, diagrams, charts, etc.), as well as descriptive text. Appropriate statistical analyses shall be performed to support the interpretations leading to the synthesis and conclusions.
7. Conduct an effective quality assurance and quality control program which ensures that all data acquired are accurate and repeatable within standards normally accepted for each type of observation, measurement, or determination.
8. Assess the need for and determine the type of studies to be conducted in future studies sponsored by MMS in the eastern Gulf of Mexico.

To meet these objectives, field studies were scheduled for four seasonal cruises, with sampling conducted at two mutually exclusive sets of stations. One set of stations (Group I) was scheduled to be sampled during fall 1983 and spring 1984, and consisted of the 5 hard-bottom and 5 of the 10 soft-bottom stations that were sampled during winter 1982-1983 and summer of 1983 (Year III study). This sampling essentially completed the seasonal baseline descriptive study of the inshore area in question.

Group II stations consist of five live-bottom stations, each representing a separate epifaunal community type, which will be sampled during each of four seasons--fall 1983, winter 1983-1984, spring 1984,

and summer 1984 (all but the summer 1984 sample has been completed). These station locations are presented in Figure 1. A description of the Group II hard bottom stations is presented in Table 1.

Some of the field sampling for Year IV was included to supplement data collected during previous years. For example, the infauna sampling at Group I soft-bottom stations was included to complete seasonal sampling begun during Year III. Trawls and dredge sampling were included to increase the species lists compiled to date, but, more importantly, were included to provide voucher specimens and positive identifications to supplement the UTV work and the benthic still photography (BSP).

The most important data to result from this study are expected to be provided by the UTV studies and in situ arrays. The stereo UTV work will provide detailed species composition values for epifauna and fish for each of the ten 1-square-kilometer (km) hard-bottom sampling sites. The studies will also delineate seasonal variability, as well as identify differences in species composition between the sites. This detailed information will help determine the interrelationships between species and, in turn, will help assess impacts should oil development upset certain components of the system.

Information relating physical processes to community type or tolerance of communities will be provided with data collected over a 2-year period with five in situ sampling arrays. The arrays are located at five Group II stations selected specifically to provide representative habitats of five major biological assemblages found on the Florida shelf. A schematic of the array design is presented in Figure 2. Each array contains the following instrumentation:

1. One ENDECO 174 current meter located 3 m above the bottom. This instrument measures current speed and direction, temperature, and salinity at 5-minute intervals. The current data, in addition to defining the water current regime at the sites, will be used for sediment transport modeling. The

Table 1. Group II Hardbottom Stations

Station	Depth (m)	Depth Zone	Substrate	Assemblage
52	13	Inner Shelf	Sand over hard substrate	Soft coral Assemblage I
21	47	Middle Shelf	Sand over hard substrate	Live bottom Assemblage II
23	74	Middle Shelf	Algal nodule layer/sand	Algal nodule assemblage
29	64	Middle Shelf	Algal nodule pavement	*Agaricia* coral plate
36	125	Outer Shelf	Sand over hard substrate	Crinoid assemblage

Source: ESE, 1984.

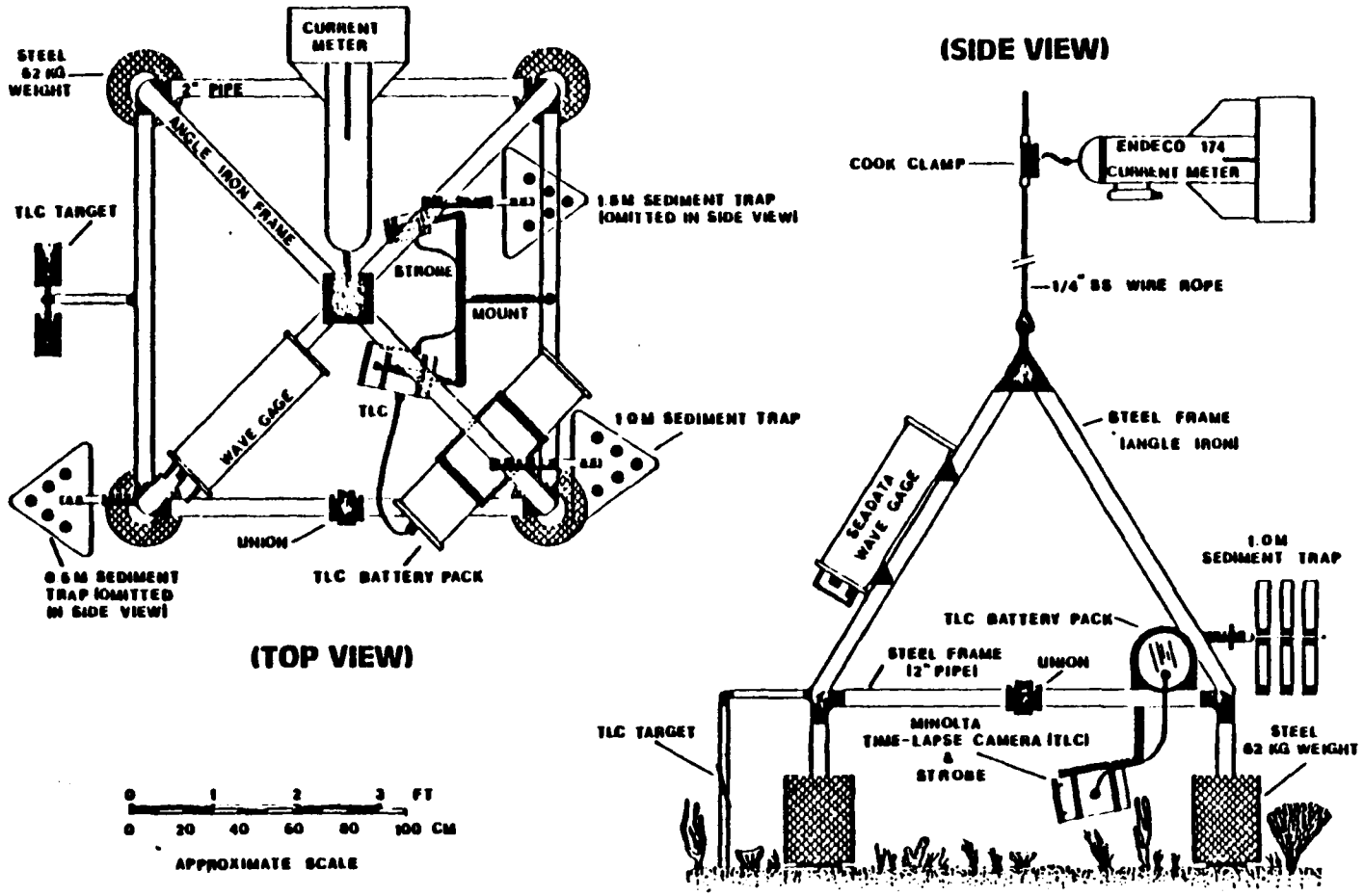

Figure 2
SCHEMATIC OF *IN SITU* SAMPLING ARRAYS (SUBSTRATE PLATES NOT SHOWN)

SOURCE: ESE, 1983.

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temperature and salinity values will define the variability of these parameters at each site and identify potential stresses affecting each habitat.

2. Three sets of sediment traps, one each at depths of 0.5 m, 1.0 m, and 1.5 m, were installed on each array and will be serviced quarterly. The traps are designed to measure the amount of sediment resuspension and settling that occurs and relate this value with the amount of drilling muds and cuttings that may be expected during drilling operations.
3. Artificial substrate plates were installed on each array to measure recruitment and growth rates. Ten racks of plates consisting of six replicate tiles each were installed on each array. Certain plates on each array will be retrieved and replaced each quarter to define seasonal variability; others are scheduled to be retrieved at intervals as long as 24 months over the 2-year study. The data, in addition to providing valuable growth and seasonal recruitment information, will provide an estimate of recruitment and replenishment time should a catastrophic event occur.
4. Time-lapse cameras are installed on two of the arrays (Stations 52 and 21 only) to monitor sediment transport and recruitment and growth rates. The cameras are set to take hourly photographs of a sediment rod in the motile sand layer and growth plates. The result should provide a time series record of sediment transport and biological growth on the plates.
5. Sea Data wave and tide gages were installed on two of the arrays (Stations 52 and 21 only) to document the wave climate and tidal fluctuations. Because of the loss of the array at Station 21, there is currently only one wave gage in operation (all other equipment at Station 21 has been replaced and is operational). The wave data will be used primarily to determine the relative importance of wave energy on sediment resuspension and transport and its effects on turbidity.

The arrays are designed to remain in place for the duration of the 2-year study. They will be serviced quarterly.

RESULTS

Three of the four scheduled field surveys have been completed. A summary of the planned station sampling and work completed to date is provided in Figure 3. The filled-in (dark) sections of each square in the figure indicate work completed, open sections within a square indicate work remaining, and stippled sections indicate missing or unrecoverable data. For example, hydrographic data sampling at Station 43 has been completed during both scheduled times; at Station 52, sampling has been completed three of the four scheduled times; and at Station 21, sampling has been completed twice with one data set missing and one remaining to complete.

In general, data recovery has been good with the only exception being the loss of the sampling array at Station 21. This array was apparently entangled by a long-line fisherman and dragged from the area because an exhaustive search with fathometer and underwater TV indicated the array was no longer in the vicinity of its deployment. The back up array was deployed at Station 21 in May 1984. The array at Station 36 could not be serviced in March 1984 because of rough weather and poor water visibility. The array, however, was serviced in May 1984. Currently, all five arrays are in operation.

All of the data collected during the first three cruises are still within various stages of data processing. The video tapes consisting of about 75 hours of TV images of the bottom are being processed to identify and enumerate fish populations and identify bottom features. Thousands of still photographs are also being sorted and being used to identify fish and epifauna in support of the UTV work. Fish from the trawl samples for Cruises I and II have all been sorted, weighed, and identified. The dredge samples, however, which are much more complex, are still being sorted and identified. All infauna data (benthic

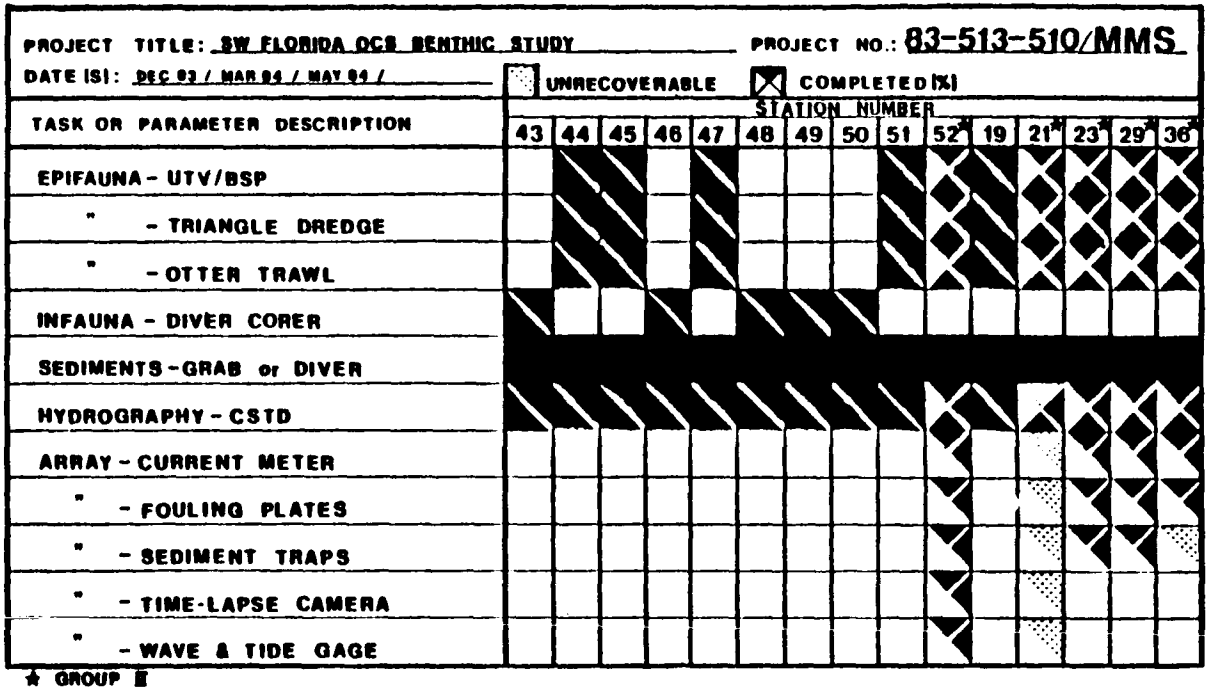

Figure 3. Summary of Station Sampling Activities and Current Status

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macroinvertebrates) for Cruise I have been sorted and are currently being identified. However, complete species lists or density calculations for any of the biological data are not available for presentation at this time.

Because most of the physical data were recorded on magnetic tape, processing is further advanced than the biological data. The grain-size analysis has all been completed and indicates the substrate at all stations is predominately carbonate sand with mean phi-sizes ranging from 0.7 to 2.4. The current meter data collected during Cruise II have been processed and indicate that current speed averaged about 25 cm/sec. An example of the recorded current speeds from January 1984 for a shallow station (Station 52) and a deep station (Station 23) is presented in Figure 4. The currents at the shallow station are totally dominated by the semi-diurnal tide with speeds varying from near zero at slack tide to over 70 cm/sec during flood or ebb tide. The currents at the deeper station are more uni-directional (flow predominately to the south); however, diurnal tidal currents are apparent in the data.

Examples of continuous temperature and salinity data for January 1984 are presented in Figure 5. The results are presented for a shallow station (Station 52) and a deep station (Station 23). The results indicate the salinity variations within the month were small and generally less than 0.5 ppt. The temperature variations, however, were larger with the deep station varying by more than 3.5°C during the month. This variation was probably caused by intrusions of the thermocline at the deeper station.

The hydrographic data for Cruises I and II have all been processed, and examples of profiles of the results are presented in Figure 6. In general, the water column was uniform with depth for all parameters, with the exception of a small thermocline present at some stations.

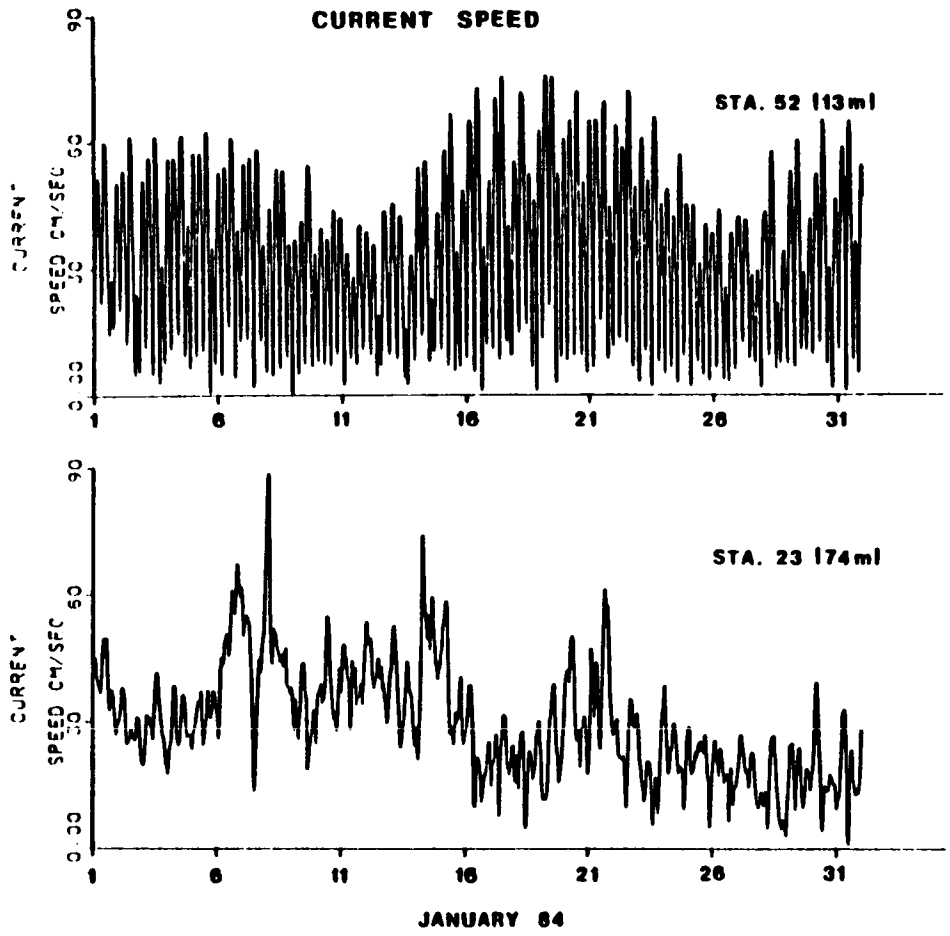

Figure 4. Current Speed Plots for Stations 52 and 23--January 1984

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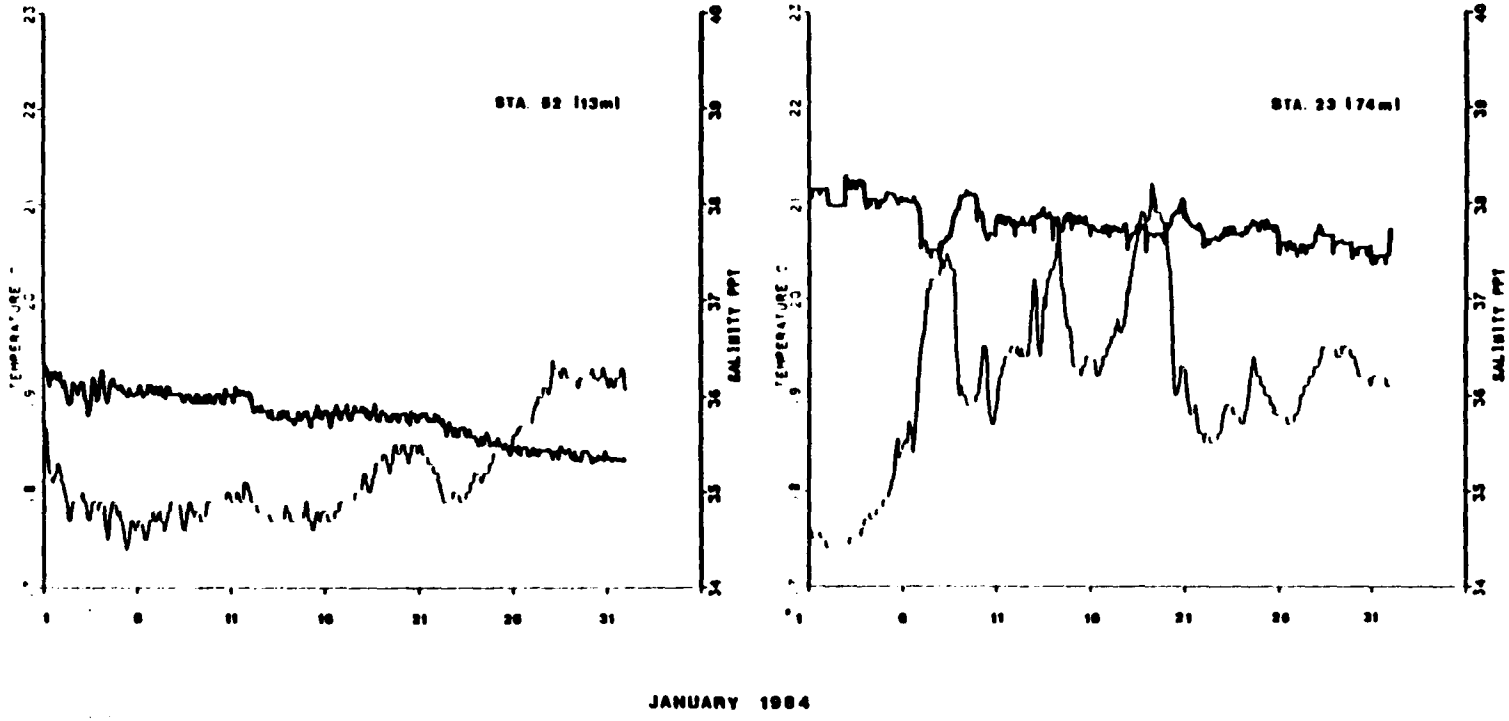

Figure 5, Temperatures and Salinity Plots for Stations 52 and 23--
January 1984

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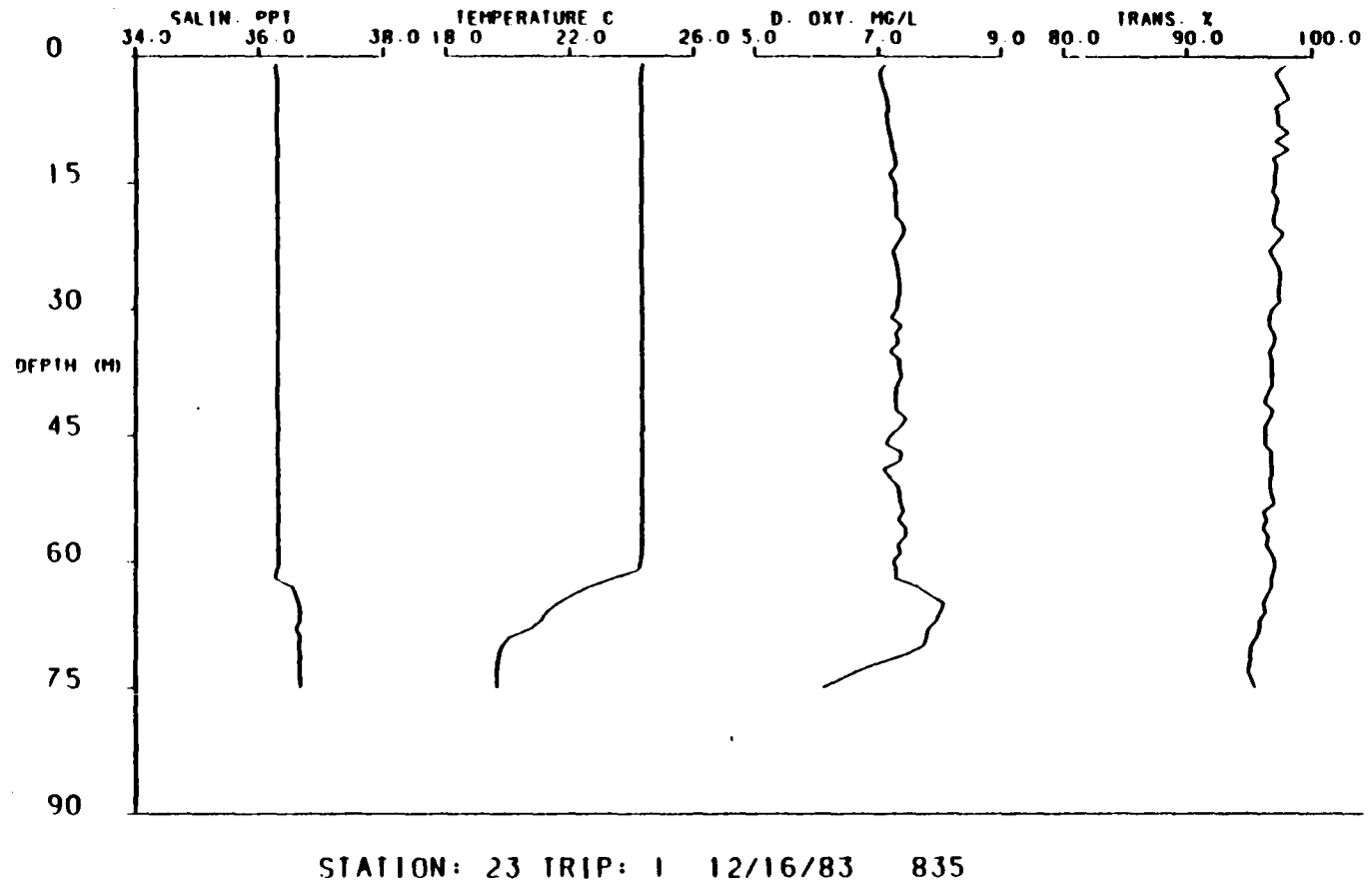

Figure 6. Profiles of Hydrographic Data for Stations 52 and 23--January 1984

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The fouling plates, sediment traps, and time-lapse camera data collected from the arrays during Cruise II are all currently being processed. The time-lapse film for the first period from Station 52 is excellent and illustrated fish populations as well as sediment transport and growth. ESE is currently assessing methods for using the film to assist in the fisheries aspect of the program.

In general, the data processing is progressing well; however, we are somewhat behind schedule. We, however, do not foresee any difficulties in meeting report deadlines or remaining within budget constraints.

1984 MMS SUMMER TERNARY STUDIES MEETING

ABSTRACT

MARINE RESEARCH AND RESOURCE MANAGEMENT PROGRAMS OF SOUTH FLORIDA PARKS: PAST AND PRESENT
(Everglades National Park and Ft. Jefferson National Monument)

BY
Richard H. Dawson
Resource Management Specialist

Approximately 180 miles of shoreline fronting on the Gulf of Mexico, below the 26th parallel, is controlled by the National Park Service and contained within either Everglades National Park (175 miles) or Fort Jefferson National Monument, Dry Tortugas (5 miles). The coastal zone of both areas contains some of the most pristine and abundant marine resources within southwest Florida. These conditions have promoted a great deal of research to take place in this century. The areas of interest for these research efforts are as diverse as the habitat, ranging from baseline inventories to marine archeology.

The larger of the two Park Service areas in south Florida, Everglades National Park, contains about 994,000 acres of estuarine and marine habitat, all of which is federally designated wilderness. This acreage makes up about 70% of the total acreage (1.4 million acres) of the park. The estuaries and shallow water bays of the park rely on sheet flow from upland sources to regulate salinities and deliver nutrients. Sheet flow has been manipulated since 1911 drainage and flood control projects as well as the explosive growth along Florida's southeastern coast. With manipulation have come changes in the estuaries and the marine life they foster. However, the mangroves, creeks, and bays of the coastal areas of the park have been spared the damage of uncontrolled dredging and filling that most of coastal Florida has endured in the past 30 years. Because of this, the park's marine environs are viewed as scientific standards against which the productivity of more disturbed habitats can be measured.

Early research of the park's marine resources occurred in the northern Florida Bay and Whitewater Bay areas from the late 1950s to the mid-1960s. Much of this research was inventorying the resources, measuring productivity, and describing habitats of the various intertidal and subtidal communities. As a result of this work, much is known of mangrove ecology (Odum, 1969 and Heald 1969), the response of estuaries to change (Tabb, et al., 1962 and Roessler, 1968), and the life cycle of the pink shrimp and the relationship of the Tortugas shrimp grounds to the Everglades (Costello and Allen, 1960 & 1966), and the effect of finfish harvest by recreational fishermen (Higman, 1967).

Following this period of basic science in the park's estuaries, the late 1960's brought a hiatus in marine research in the park. However, growing competition for the park's marine resources stimulated research again in 1972. At this time, monitoring of fisheries harvest, through a creel census and report log system, was reinstituted along with basic life history studies of the major (target) species of the fishery. In 1979, new public concern over the allocation of park fisheries resources brought a new set of regulations as well as accelerated research into the relative abundance and harvest of selected species within the fishery. Along with this basic fisheries research was a heightened effort to identify the role of upland flow in determining the productivity of the estuaries within the park. Much of the data and conclusions from these past park studies have been brought together in a recent publication (1982) out of the U. S. Fish and Wildlife Service's Coastal Ecosystem Team entitled: An Ecological Characterization of the Lower Everglades, Florida Bay, and the Florida Keys.

Currently, the research and resource management efforts in marine resources center on determining the answers to the following questions: (1) what are the major fishery resources of Everglades National Park; (2) what percent of each fished population is being harvested; (3) what are the annual changes in recruitment; (4) what habitats are important to the fishery resources; (5) what is the extent of movement of the major species comprising the fishery; and (6) what are the trends in harvest. In order to answer these questions, the National Park Service is continuing the monitoring of fish harvest through its creel census and catch log reporting system, making an aerial census of boats in the park for refinement of its predictive boating use equation, analyzing the past creel-catch log statistics (25 years of data), and conducting parkwide ichthyoplankton and juvenile fish surveys. Assisting the Park Service in their efforts is a special unit of the U.S. Fish and Wildlife Service who are concentrating on determining standing stock, relative abundance, and the extent of movement of selected species.

The Park Service is also conducting broader, ecosystem level studies in the estuaries which address the park's overall management charge of maintaining, to the greatest extent possible, a naturally functioning ecosystem. To this end, studies are currently investigating estuarine habitats; whereby, the productivity of the major habitat types within the estuary are evaluated for: standing stock biomass, overall productivity, isotopic signature of major primary producers, and environmental conditions influencing (or forcing) changes in the estuary. The National Audubon Society has been contracted to evaluate the relationships of wading birds to habitat and environmental conditions in the estuary and determine the food chains of the forage fishes

upon which these wading birds feed. Contracts with the University of Virginia focus on determining food chain relationships of fishes and invertebrates to the habitats, in which they are found, using isotope typing techniques. The Park Service is assembling habitat maps of Florida Bay and conducting food chain studies to determine what habitats are critical to pink shrimp and what are the inter-consumer relationships between fish and shrimp. This is important since pink shrimp is the main food item of the major gamefish species found in park waters.

Other studies which have been or are being conducted within the coastal zone of the park relate to water quality and water delivery schedules, identification of archeological sites, and geology (stratigraphy) and sediment chemistry of Florida Bay. There is an extensive research effort directed toward determining the most beneficial water management strategy for the park with the goal of restoring and maintaining a functioning, natural ecosystem. The Park Service's Southeast Archeological Center has identified 157 cultural resource sites within the park with the majority in coastal habitats. Many class trips and some basic research has occurred in Florida Bay and along Cape Sable looking at sediment deposition and island formation. Recovery Plan work is ongoing on the eight endangered and four threatened species which inhabit or depend on the marine and estuarine areas of the park. Most of these studies are aimed at population monitoring and management techniques. To this end, the park, in 1980, established an 18,000 acre sanctuary in northeastern Florida Bay which contains about 100-200 (50% of U.S. population) North American Crocodiles.

The other NPS area in southwest Florida is Fort Jefferson National Monument. This 64,657 acre area is 70 miles west of Key West in the Dry Tortugas. It was established by Presidential Proclamation in 1935 for the purpose of preservation of the historic third-system, masonry, coastal fortification (Ft. Jefferson) and conservation of the tern rookery located on the islands surrounding the fort. The area was named in 1513 by Ponce de Leon and visited by Alexander Agassiz in the 1881. Agassiz's study of the pristine coral reefs of the area were used to elucidate the geologic structure of the Florida peninsula and dispute Charles Darwin's hypothesis of reef formation by subsidence. In 1904, Alfred G. Mayer, one of Agassiz's students, established a tropical marine research station under the auspices of the Carnegie Institute on Loggerhead Key. During the next forty years, many of the world's leading coral reef scientists, ichthyologists, and physiologists studied at the Tortugas laboratory. Their work, constituting some of the most noteworthy on reef geology and biology, included classic studies of marine algae (Taylor, 1928), sponges (de Laubenfels, 1936), corals (Mayer, 1914; Wells, 1932; Yonge, 1935; Cary, 1914 & 1918), fishes (Longley and Hildebrand, 1941), and reef development (Vaughan, 1910 & 1914).

The National Park Service in 1976 initiated an interdisciplinary investigation of the Dry Tortugas reefs called the TORTUGAS REEF ATOLL CONTINUING TRANSECT STUDIES (TRACTS). The objectives of the TRACTS study were to develop a "bench mark" description of the marine resources at Ft. Jefferson National Monument from which long-term change could be defined and evaluated. The study mapped the entire 56,810 acre reef tract above the 10-fathom line and was under the direction of Gary Davis (NPS). This data was then compared to the work of Agassiz (1888) noting changes in types of habitat.

Along with extensive research on corals, the National Park Service has conducted population studies on the sooty and noddy tern colonies on Bush Key. These studies, conducted since 1958 by Dr. William Robertson Jr., have been able to document movement, growth, nesting frequency, fecundity, and environmental impacts on this rookery, the only one for these species of terns in the continental United States. Over the past decade, studies have been conducted by the U.S. Fish and Wildlife Service and the Peregrine Foundation during the seasonal (fall and spring) migration of the Peregrine Falcon through the area; whereby, young falcons while resting at Loggerhead Key are captured and tagged to track movement and growth. Studies relating to the recreational harvest of lobsters and the effect on their population were conducted by Davis in 1976. Monitoring of sportfishing harvest is currently underway as is a population study of sea turtles. The National Marine Fisheries Service is funding a four-year captive rearing study starting May 1984.

Substantial marine archeological work has been conducted by the Park Service in the Dry Tortugas. To date, over 60 historic shipwrecks have been identified with some dating back to the 1600s. This find represents one of the principal ship graveyards in the Gulf of Mexico.

Given the vast amount of past and present research activity concentrating on the marine resources of southwest Florida's National Parks, we find ourselves at a crossroads of understanding. This is a very important juncture in our quest for better management and maintenance of these precious natural ecosystems. Currently, the funding for these endeavors (FY 84) is about $2.5 million. However, given the complexity of these ecosystems and their geographic enormity, we now need much more detailed research using non-consumptive and state-of-the-art techniques. This new era of research will have its focus on management rather than basic inventory and will be conducted on an ecosystem approach. These are lofty goals but obtainable and necessary if we are to maintain and protect these national treasures.

1984 MMS SUMMER TERNARY STUDIES MEETING

ABSTRACT

SURFACE RESOURCE PROTECTION AND OIL AND GAS DEVELOPMENT IN THE BIG CYPRESS NATIONAL PRESERVE

by

Cordell J. Roy
Resource Management Specialist

Big Cypress National Preserve was established in 1974 to ensure "...the preservation, conservation, and protection of the natural, scenic, hydrologic floral and faunal, and recreational values of the Big Cypress Watershed in the State of Florida and to provide for the enhancement and public enjoyment thereof." The Big Cypress watershed is in southwest Florida in Collier, northern Monroe and western Dade counties. The 570,000 acre Preserve contains about three eighths of this watershed and it extends from the northern Everglades National Park boundary to seven miles north of Florida Highway 84.

Water is one of the most important components of the Big Cypress ecosystem. Abundant rainfall and flat topography allow water to collect during the wet season, covering 90% of the area and effectively extending the wet season several months beyond the actual rainfall period. During the January through May dry season water covers only about 10% of the land.

The Big Cypress watershed is a mix of plant communities and associated fauna, which in turn relates to the water level and its seasonal changes. It is called Big Cypress not because of the size of its trees, but because of its extent. Nearly half of the Preserve is covered by an open forest of small cypress trees and an undergrowth of plants like sawgrass and rushes. A difference of a few inches in elevation leads to the establishment of totally different plant communities. Pines grow on the relatively higher limestone ridges and tropical hardwood hammocks occur on rocky outcrops in marshes and prairies. The ponds of wet prairies give rise to willow and cypress heads. The deepest water areas are the topographic depressions that form wide, shallow drainages called sloughs or strands.

Most wildlife species native to south Florida occur in the Preserve and animal life is diverse and abundant. Ten faunal species found in the Preserve are on the federal list of endangered and threatened species. The species of principle concern with respect to oil and gas development are the Florida panther and the Red-cockcaded woodpecker.

South Florida has been the site of oil exploration since the late 1930's. Activity has been centered primarily in the western half of the region. In 1943 the first production well in the Big Cypress area was drilled at Sunniland immediately northwest of what was to become the Preserve. Subsequent discoveries have followed a northwest-southeast orientation across the Big Cypress area terminating at the northern boundary of Everglades National Park.

In 1972, Tribal Oil Company, on a "farm out" from Exxon Company, USA, made a significant discovery in the Bear Island area of the then proposed Preserve. Since then 22 producing wells and two dry holes have been drilled in Bear Island. In 1978, the field was unitized and a waterflood project was initiated. Today there are 14 wells producing 2,050 barrels of oil per day. In 1977, another discovery was made by Exxon at Raccoon Point. To date eight of 18 planned wells have been drilled with production currently at 1,050 barrels of oil per day. Other drilling prospects have been made by Bass Enterprises and Hughes Eastern but Exxon is the major operator and the only producer in the Preserve.

Prior to the establishment of the Preserve, oil and gas regulatory authority rested with the five member Big Cypress Swamp Advisory Committee. This committee reports directly to the Governor's Cabinet on all drilling issues within the Big Cypress drainage area. Authority was delegated to the committee from the state of Florida to issue Department of Natural Resources drilling permits and Department of Environmental Regulation permits for placement of fill in wetlands. Additionally, the committee was delegated permitting authority for Section 404, Clean Water Act dredge and fill activities from the U. S. Army, Corps of Engineers. Proposed drilling sites were visited only once, no research was performed, and all permitting decisions were finalized on-site during that one visit.

The land ownership of the Preserve is a split estate. The surface is almost completely federal while the mineral estate is almost totally in third party ownership. The Preserve's establishing legislation provides for this split to allow mineral development and directed the Secretary of Interior to develop regulations to limit or control surface use with respect to exploration for and production of oil and gas. In 1979, the National Park Service published regulations to insure that oil and gas activities are conducted in a manner which is consistant with the purposes of the park system and to prevent or minimize damage to the environment or other resource values.

These minerals management regulations require the involvement of the National Park Service in the review and approval of any oil and gas operations proposed within any system unit. In the Preserve, this responsibility is in support of, and in addition to, the previous permitting role of the Big Cypress Swamp Advisory Committee. There is no question that these regulations do require additional forethought and planning on the part of industry. Plans of operations

must now include, in addition to the discussion of the proposed operation, impact analyses and reclamation strategies as well as the estimated cost of reclamation. Although these elements were previously verbally discussed, now they are required in writing and are made available for scientific, as well as public, review.

To begin the process a prospective operator requests permission to stake a proposed location. Once the site has been marked, the National Park Service begins a resource inventory. The site and the access corridor are intensively surveyed for sensitive resources. These include: areas of deep surface water flow, endangered or threatened animal species, rare or unique plants, and sites of cultural significance. Because of the complexity of the resource inventory process, and the actual field inspection time required by a variety of scientists and resource managers, we have requested the oil companies to give the National Park Service 90 days to complete this portion of the review. Thus, we have to receive the marked, proposed site location 90 days prior to the quarterly meeting of the Big Cypress Swamp Advisory Committee.

Following the resource inventory, if no major problems with the proposed location are identified, the site is agreed upon by the Big Cypress Swamp Advisory Committee and the National Park Service. It is at this time that the plan of operations for the site is formally accepted. Prospective operators are encouraged to submit their proposed plans of operations at any time during the 90 day resource inventory process. However, since the plan may require revision as a result of the resource inventory, the plan is not formally accepted until the inventory is complete and site agreement is achieved.

Then two documents are submitted by the National Park Service. The first is entitled a Biological Assessment, in compliance with endangered species legislation, and addresses the effect the proposal will have on endangered species. This document is submitted to the U. S. Fish and Wildlife Service. They have 90 days to issue a biological opinion detailing how approval of the proposed plan will affect endangered species or its critical habitat. The biological opinion also includes reasonable alternatives which would avoid jeopardizing the continued existence of the species. The second document submitted is an Environmental Assessment, which is required by the National Environmental Policy Act. This assessment includes a summary of the endangered species consultation, and also addresses the potential impact of the proposal and alternatives. The importance of the Environmental Assessment is that it is available for public review and invites public comment. Following the comment period, the Environmental Assessment documents the necessity for an Environmental Impact Statement, based on whether the recommended alternative, if implemented, would have significant impact. These assessments are prepared to satisfy our regulatory obligations and to comply with applicable provisions of several other laws. This requires coordination with numerous agencies and offices throughout the southeastern United States.

The resulting comments from the public and official review process support the National Park Service in insuring that all reasonable steps are being taken to minimize the impact of oil and gas development within the Preserve. To date, all concerns have been addressed and mitigated to the extent that a "Finding of No Significant Impact" has been prepared and the companies have been authorized to conduct oil and gas exploration activities with only a few plan modifications. Typically this process takes about nine months from the survey authority request to formal plan authorization. The process can require more time, however. In the case of the Raccoon Point Master Plan of Operations, originally a plan for nearly 20 miles of roads and 25 wells drilled from five large pads, over two years was required.

In order to provide the oil and gas industry and mineral rights holders an overview of environmental issues associated with oil and gas development in the Preserve, the National Park Service has prepared a Sensitive Resource Areas Map and an accompanying discussion of those resources. It is hoped that this document will assist industry in its planning efforts by providing criteria for sensitive resource areas where development may conflict with National Park Service management goals and to provide a more defined framework for the service to review oil and gas plans of operation and manage those activities in a comprehensive and consistant manner.

Based on past activity the National Park Service can expect three or four plans of operation annually but it is unknown and difficult to predict the ultimate degree of development. Existing wells, producing from the Sunniland Formation, are expected to be productive another 20 - 30 years. There are ongoing investigations of production feasibility of other oil-showing formations above the Sunniland, such as the Trinity "C". If commercially feasible, such production could extend field life. Of course other wellfields could be discovered and developed.

The U. S. Fish and Wildlife Service and the National Park Service are highly interested in the overall direction of oil exploration and production activities and especially the cumulative impact of the total development as it applies to endangered species, access and resource protection in the Preserve. While the minerals management regulations and development of documents such as the Sensitive Resource Areas map were vital first steps of resource protection, we are not adequately addressing the issue of cumulative impact assessment. Rather, we are analyzing effects on a plan by plan basis rather than planning in advance or effectively assessing cumulative impact. This is obviously going to be a difficult task as lack of predictability is an innate part of exploration. But it is a worthy task, certainly one well worth our best effort, for at stake is the integrity of the Big Cypress ecosystem.

GULF OF MEXICO CONTINENTAL SLOPE STUDY
PROGRESS REPORT FOR MMS ENVIRONMENTAL STUDIES TERNARY MEETING
TAMPA, FLORIDA, 13-14 JUNE 1984

G.S. Lewbel, LGL Ecological Research Associates, Inc.
1410 Cavitt St., Bryan, TX 77801
(409) 775-2000

INTRODUCTION

LGL Ecological Research Associates, Inc. (LGL), is conducting a study of the continental slope of the northern Gulf of Mexico on behalf of the Minerals Management Service (MMS) under Contract No. 14-12-0001-30046, administered by the Environmental Studies Group of the MMS New Orleans Outer Continental Shelf office. This document briefly describes LGL's progress during the first nine months of that contract, summarizing material presented at the MMS Environmental Studies Ternary Meeting in Tampa, Florida, 13-14 June 1984.

This program is designed primarily to furnish MMS with ecological information about the benthic environment on the continental slope. It is conceived as a multi-year program, with emphasis during the first year on descriptions of the biological communities of the slope. The eventual goal of the study is to enable MMS to meet its legal mandates for administration of possible petroleum exploration and development activities in the area. Specific objectives of the continental slope program are listed in Attachment A.

Although LGL and MMS scientists bear the main responsibility for this study, a variety of other members of the scientific community are involved in its conduct. A Scientific Advisory Committee (SAC) was formed at the program's inception to provide independent comments and critical review, and will continue to meet periodically to review its progress. SAC members include faculty at Scripps Institution of Oceanography and Woods Hole Oceanographic Institution. Principal Investigators for biology include LGL staff members and independent researchers. Principal Investigators for

chemical, hydrological, and geological phases of the program are faculty members at Texas A&M University, which also has a subcontract from LGL for vessel time and field logistic support.

STUDY AREA AND SAMPLING DESIGN

The study area includes three MMS Lease Planning Areas (Western, Central, and Eastern). In each Lease Planning Area there is one transect consisting of five stations in a line spanning the continental slope from the edge of the outer continental shelf to near its base. The Central Transect begins near 28°02', just to the west of the Mississippi Trough; the Western Transect begins near 27°39' N, 93°46'W, south of the Flower Garden Banks and east of Alaminos Canyon; and the Eastern Transect begins near 28°22'N, 85°56'W, crossing the Florida Escarpment southeast of Desoto Canyon. Transect locations are shown in Attachment B. The stations range in depth from about 350-2800 m.

There have been two cruises during the first year of the study: November 1983 and April 1984. It was intended that the Central Transect be studied in more detail initially than the two outer transects since oil exploration was pending near the Central Transect. Accordingly, Cruise One examined stations along the Central Transect; Cruise Two visited all three transects. Some types of sampling are more intensive at stations on the Central Transect, also.

At each station, there are four main types of sampling gear used: box core, otter trawl, remote camera, and hydrographic samplers such as water bottles. Samples collected with each gear type have multiple uses. For example, the box core is used to collect macroinfauna, meiofauna, and sediment; and the trawl is used to collect fishes and macroepifaunal invertebrates. Each type of sample may be subjected to several kinds of analyses; e.g. fishes are identified and enumerated for community studies, and are also analyzed chemically for hydrocarbons. A summary of numbers of kinds of samples and numbers of replicates is provided as Attachment C.

SUMMARY OF PROGRESS

The program began in October 1983 with an organizational meeting between LGL, MMS, the SAC, and key project personnel. Following the overall description of the project, the group discussed specific details of the program, including station location, sampling design and replication, choice of sampling equipment, processing of chemical samples, taxonomic identification of organisms, and future directions for subsequent years. Detailed proceedings of the organizational meeting were submitted to MMS in LGL's Bi-monthly Progress Report, dated January 1984.

On Cruise One, all contractually required samples were obtained within the time allotted. A significant improvement on typical methodology included inserting six tubes along the inside of each box core to obtain meiofauna and sediment samples while minimizing the possibility of sample wash-out. These tubes extended all the way to the top of the box core, ensuring that the box core cover would effectively seal them after closing. The scoop dredge originally proposed was marginally successful at obtaining benthic organisms for chemical analysis; consequently, the trawl was deployed for longer bottom times to collect sufficient material. Another area of concern was the possibility that some loss of surficial sediments and organisms may have occurred during retrieval of the box cores; this subject is treated in greater detail below.

On Cruise One, the quality of the exposures from the remote camera was not as good as expected, although an adequate number was collected to meet contractual requirements. Between Cruise One and Cruise Two, LGL personnel traveled to Woods Hole to discuss and test improvements in the remote camera system, and to be trained to operate it themselves.

On Cruise Two, all required samples were obtained within the time allotted. Compared to Cruise One, box core quality was improved. Furthermore, a new bottom-sensing altimeter on the remote camera resulted in much higher photographic quality compared to the first cruise. In fact, the test strips (developed after each camera drop to confirm that the photographic system operated correctly) from Cruise Two contained more

useful shots than the entire film sample from Cruise One. LGL personnel were completely responsible for operation and maintenance of the remote photographic system. Finally, otter trawl time was increased and a beam trawl was added to supplement the collection of epifauna and fishes for hydrocarbon analysis. As a result, sample sizes in trawls were adequate for hydrocarbon analyses.

Sample analysis for Cruises One and Two is proceeding on schedule and within budget. A summary of the current status of analysis of each type of sample is provided as Attachment D.

SELECTED PRELIMINARY RESULTS

Some of the more interesting preliminary results are described below. Further information on these subjects can be found in the series of bi-monthly progress reports submitted regularly by LGL to the MMS.

Macroinfauna

The macroinfauna from Cruise One have been completely sorted, and are mostly in the hands of specialists for identification. It is our intention to build a voucher collection of identified specimens and to use that to aid identification of specimens from Cruise Two. Based upon the initial sorting, most individuals collected were polychaetes, nematodes, and harpacticoid copepods. Sample size was remarkably constant among the stations of the Central Transect, ranging from 1111 to 1930 individuals per six replicates, or 3,254-5,653 individuals per m^2. A cluster diagram showing abundance of major taxa and similarity between stations is provided as Attachment E. The macroinfauna from Cruise Two have not yet been fully sorted, so no conclusions can yet be made either about seasonality at the Central Transect or contrasts with the East or West Transect.

Meiofauna

The meiofauna from Cruise One have been completely sorted into major taxa; there are no plans for identification to lower taxa at this time. The most abundant meiofaunal taxa were nematodes, harpacticoids, and forams. Stations showed a general decrease in numbers of individuals with depth, but (as for macroinfauna) the range in density among stations was remarkably small (3,620 to 6,867 per two replicates, or 3,892,473-7,383,870 individuals per m^2). Meiofaunal abundance was positively correlated with percentage clay, in general. A cluster diagram showing abundance of major taxa and similarity between stations is provided as Attachment F. The meiofauna from Cruise Two are now being sorted; these results should be available within one to two months.

Box Core Variability

As one can see from the results described above, variability of biological data from the box cores taken on Cruise One appeared to be extremely low. Nonetheless, on-board observations suggested that some box cores may have lost animals due to wash-out. In an attempt to verify this, statistical comparisons were made between samples from the main sections of the box cores (seived for macroinfauna) and the meiofaunal tubes. The assumption of zero loss was made for meiofaunal tubes, since they were sealed by the top of the box core at the time of collection and thus resistant to wash-out, and were not seived until back in the laboratory.

Paired tests compared proportions in tubes *vs.* the main portion of the corresponding box cores for the three most abundant groups of macroinfaunal organisms: polychaetes, nematodes, and harpacticoids. Abundant groups were selected to avoid problems of rarefaction and high variability of uncommon species. Significant differences in proportions of abundant organisms between samples from the main part of a box core *vs.* the tubes from that core would suggest loss from the cores. Using this technique, it was determined that 7 of the 30 box core samples appeared to be "disturbed," i.e. had suffered significant losses in one or more of the three most abundant groups of organisms. The remaining 23 box core samples

were considered "undisturbed." The results of this test are provided as Attachment G. Similar tests will been performed on the box cores from Cruise Two; it is hoped that they will reveal fewer disturbed samples.

The subject of sample replication has arisen throughout this program, as part of an ongoing discussion of whether fewer replicates at more locations would result in a better characterization of the community than would high replication at fewer locations. In that light, LGL has used the meiofaunal data from Cruise One in a statistical sensitivity analysis, considering the actual number of replicates collected during this program and the power of tests to detect statistically significant differences. The results of the analysis are provided as Attachment H.

Power is defined as the likelihood of successfully detecting a statistically significant difference when it is, in fact, there. For tests performed at the usual $p = 0.05$ level of significance, if there were an actual mean difference in abundance between two stations equal to 67% (e.g. 100 individuals/m^2 at one station, 167/m^2 at another), and if 12 meiofaunal tubes were taken at each station (as on the Central Transect), there would be 95% likelihood of detecting that difference. If there were only 6 tubes taken at each station (as on the Eastern and Western transects), an actual mean difference would have to be 110% in order for the likelihood of detecting that difference to be 95%. At an 80% power level, mean differences in abundance must exceed 50% and 80%, respectively.

Fishes

The fishes collected by trawling on Cruise One included 223 specimens representing 27 families and 43 species. No fish were collected at the deepest station, despite the trawl being on the bottom for over 5 hours and having covered over 8 miles. More than 85% of the fishes were collected at the shallowest station (C1, depth approx. 320 m). The most abundant fishes were macrourids (in particular the blackfin grenadier, Coelorinchus caribbaeus), chloropthalmids, gadids, pleuronectids, and serranids. Fish observed in photographic transects have not yet been censused, but many clear shots were obtained, especially on Cruise 2.

Epifauna

Although most of the epifaunal invertebrates collected by trawling from both cruises are still in the hands of taxonomic specialists, all of the decapods from Cruise One have been identified. Approximately 34 decapods were in the samples, including at least one species not previously reported from the Gulf of Mexico. As for fishes, epifauna visible in remote photographs have not been identified but are well represented along with lebensspuren--traces of their activities--in the photographs.

Sediment Texture and Chemistry

Sediment samples from the central transect were highly homogeneous in texture, both within stations and between stations. All of the stations except for C4 (depth approximately 1300 m) had clay or silty clay sediment; C4 replicates were coarser and less homogeneous, consisting of sandy clay and silty clay. Sediment texture analyses from Cruise One are summarized in Attachment I.

Hydrocarbons from the Central Transect were relatively consistent and homogeneous, also. Compared to other areas of the Gulf of Mexico, the study sites were relatively pristine, with total aliphatic and aromatic hydrocarbons in sediment averaging about 40 ppm and ranging from about 15-107 ppm. Average values decreased somewhat with distance offshore, though the differences were not statistically significant. Variability in hydrocarbon concentrations between replicates also decreased at deeper stations. The distribution of aliphatic hydrocarbons suggested a mixed terrestrial and marine source of organic matter overprinted by low level petroleum hydrocarbons. In general, no single component exceeded 1 ppm, and most were in the 10-500 ppb range. Petroleum-based hydrocarbons were either absent or below the level of detectability in benthic organisms.

Large amounts of tar were collected in most trawls. It appears to be derived from the surface rather than from seeps, since it is highly weathered, and water samples collected immediately above the bottom had virtually no hydrocarbons present. Piston cores collected at the same

sites for another project showed an increase of up to three times in sediment hydrocarbon concentration with increasing sediment depth, indicating some upward natural migration.

Hydrography

Hydrography data have been used to determine water mass distribution over each station for Cruise One. A schematic illustration of water masses is presented as Attachment J. The shallowest station, C1, lay well above the oxygen minimum zone, near the boundary between Gulf Water and Tropical Atlantic Central Water. Station C2 lay in Antarctic Intermediate Water, above the nitrate and phosphate maxima and the salinity minimum. Stations C3, C4, and C5 lay in Gulf Deep Water.

SUMMARY

All field sampling for this contract has been completed successfully, with 100% of all contractually-required samples collected. Analysis of these samples is ahead of schedule, and data entry and interpretation are proceeding as laboratory results become available. The entire program is within budget. No major problems have been encountered, and the Final Reports is anticipated to be on time.

ATTACHMENT A: CONTINENTAL SLOPE PROJECT OBJECTIVES

- Determine abundance, structure, and distribution of animal communities on the continental slope of the Gulf of Mexico

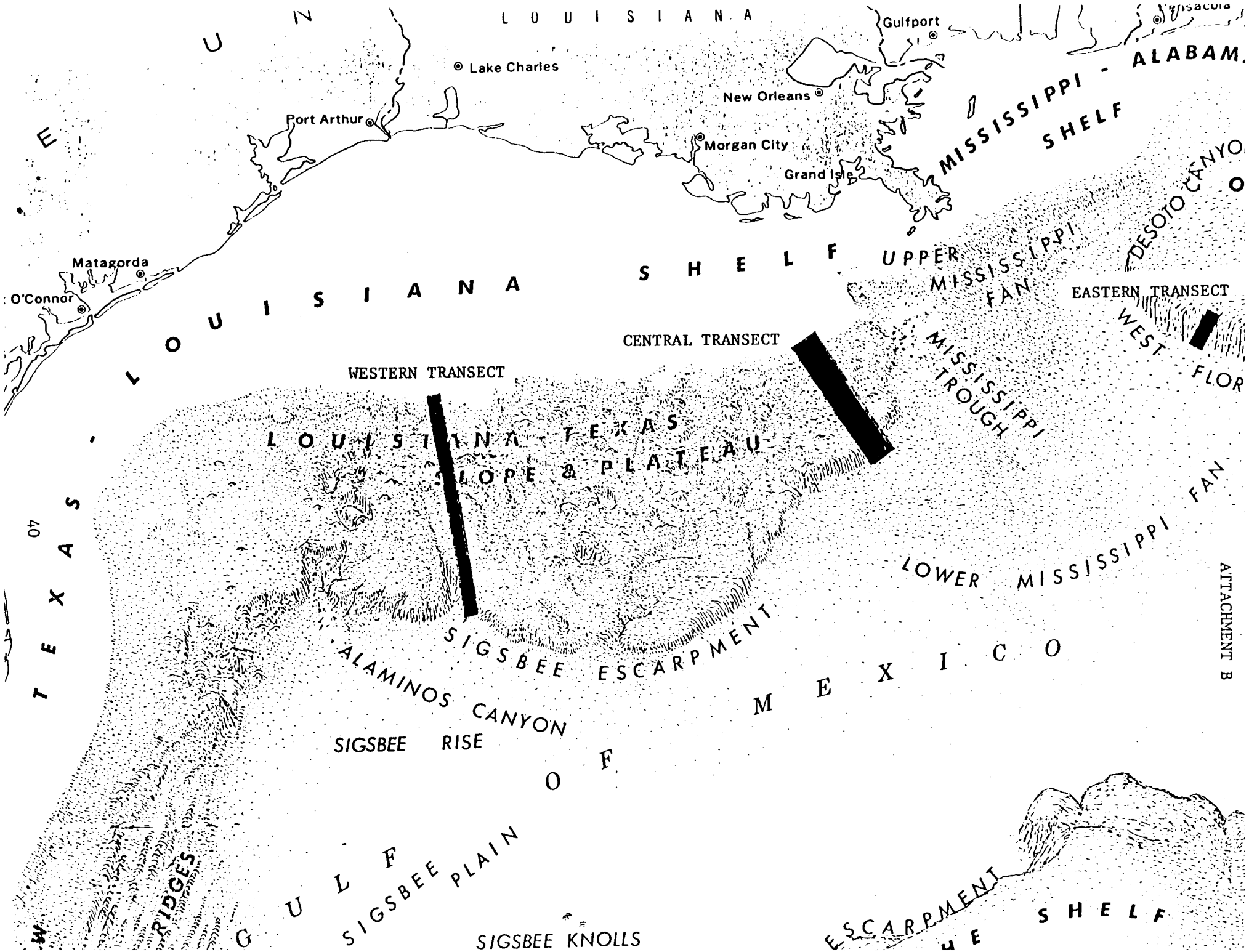
- Assess seasonal changes in animal communities in terms of abundance, structure, animal size, and reproductive state

- Determine hydrographic structure of water column, bottom conditions, and sedimentary characteristics of study sites

- Measure present levels of hydrocarbon contamination in sediments and animals prior to, and in anticipation of, petroleum resource development beyond the shelf-slope break

- Compare present ecological conditions with other areas and with published and unpublished data to produce a overview or synthesis

- Assess need for and type of future studies in the area, both for this program by ongoing refinement and for other studies which may follow



ATTACHMENT B

ATTACHMENT C: CONTINENTAL SLOPE PROJECT SAMPLE TYPES

- o Box cores dropped in yoked pairs and divided into Main Sample and Tubes. 6 reps/station (Central), 3 reps/station (East, West)

  Main Sample: Macroinfauna, analyzed for number, species, wet weight. Area on Cruise 1 = 569 cm^2/rep, Cruise 2 = 475 cm^2/rep.

  Tubes: 6 reps/box core, various uses. Area/rep = 9.3 cm^2.
  - Meiofauna: analyzed for number, major taxa, est. wet weight. 2 reps/box core worked, 2 reps/box core archived.
  - Sediment Texture: analyzed for grain size. 1 rep/box core
  - Sediment Chemisty: analyzed for TOC, carbonate carbon, carbon isotopes, HMW hydrocarbons. 1 rep/box core (except for carbon isotopes; 3/station on Central transect, 1/station on East & West)

- o Trawls for epifaunal invertebrates and fishes, 1/station/cruise. Trawl length, Cruise 1: 1-5 hours; Cruise 2: 1-2 hours depending on depth.
  - Epifaunal Invertebrates: analyzed for number, species, wet weight, size, HC (3 specimens/station/cruise)
  - Fishes: analyzed for number, species, wet weight, size, gut contents, HC (3 specimens/station/cruise x 3 organ types)

- o Photo Transects: analyzed for epifaunal invertebrates, fishes, and geological features. 1 transect/station, 800 frames taken, 8-sec intervals, 100 frames analyzed/station/cruise
  - Epifaunal Invertebrates: analyzed for number, species, size, lebensspuren
  - Fishes: analyzed for number, species, size, lebensspuren
  - Bottom: analyzed for visible geological features

- o Contaminants: analyzed as controls for HMW hydrocarbons. 2 samples each of lubrication oil, fuel, & bilge, on each Cruise

- o Hydrography: CTD casts, water bottles for nutrient, oxygen

ATTACHMENT D: CONTINENTAL SLOPE PROJECT, SAMPLE STATUS REPORT

CRUISE 1, NOVEMBER 1983 (CENTRAL TRANSECT ONLY, 5 STATIONS)

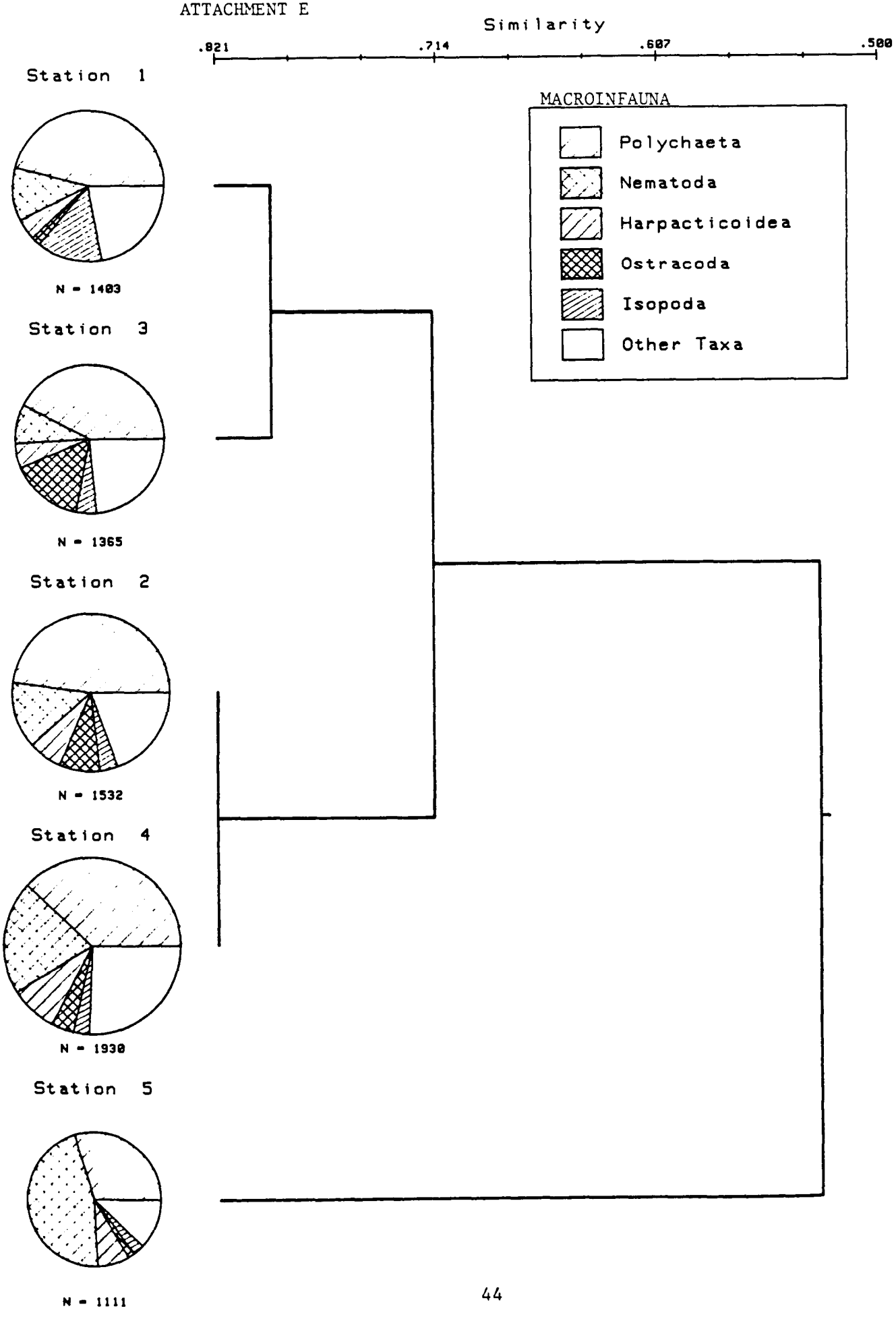
TYPE	REPS/STN	TOTAL REPS	% COLLECTED	SAMPLE STATUS
Box cores	6	30	100%	sort 100% complete, ID & voucher collection formation underway
Meiofauna tubes	12 (worked)	72	100%	ID 100% complete
	12 (archived)	72	100%	100% archived
Sed. tubes (texture)	1	5	100%	100% analyzed
Sed. tubes (chemistry)	1	5	100%	100% analyzed
Sed. tubes (C isotopes)	3	15	100%	100% analyzed
Hydrography	1	5	100%	100% analyzed
Trawls	1	5	100%	fish ID 100% complete; epifauna ID 25% complete; voucher collection formation underway
Photo transects	1	5	100%	altitude encoding 20% complete
Contaminants (6/cruise)			100%	100% analyzed

continued...

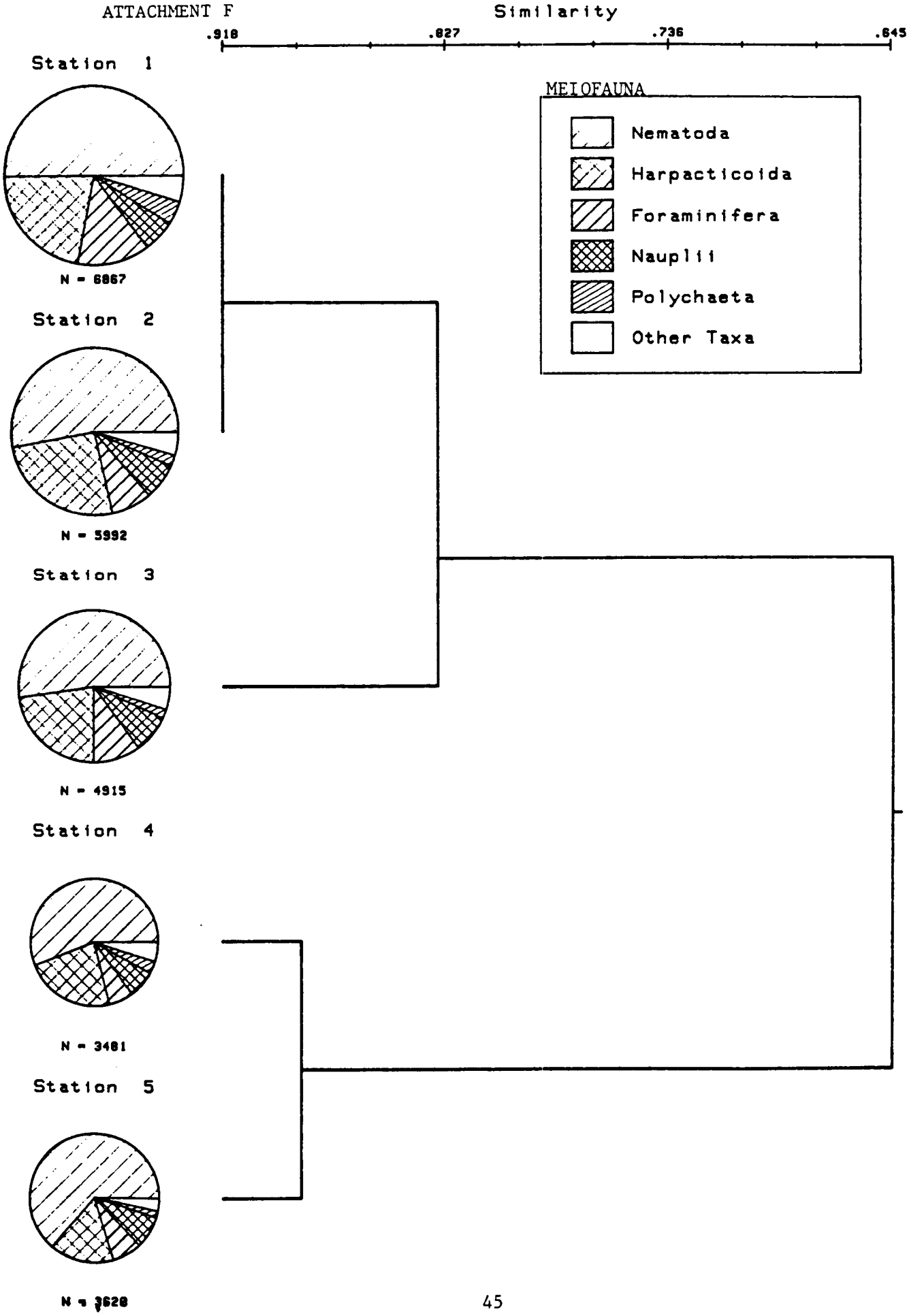
CRUISE 2, APRIL 1984 (WESTERN, CENTRAL, & EASTERN TRANSECTS, 15 STATIONS)

TYPE	REPS/STN	TOTAL REPS	% COLLECTED	SAMPLE STATUS
Box core	6 (C), 3 (W&E)	60	100%	20% sorted
Meiofauna tubes	12 (worked, C)	72	100%	analysis underway
	12 (arch., C)	72	100%	100% archived
	6 (worked, W&E)	60	100%	analysis underway
	6 (arch., W&E)	60	100%	100% archived
Sed. tubes (texture)	6 (C), 3 (W&E)	60	100%	to begin 7/84
Sed. tubes (chemistry)	6 (C), 3 (W&E)	60	100%	to begin 7/84
Sed. tubes (C isotopes)	3 (C), 1 (W&E)	25	100%	to begin 7/84
Hydrography	1	15	100%	100% analyzed
Trawls	1	15	100%	100% sorted; fish ID 25% complete; epifauna ID 10% complete; voucher collection formation underway
Photo transects	1	15	100%	to begin 7/84
Contaminants (6/cruise)			100%	100% analyzed

ATTACHMENT E



ATTACHMENT F



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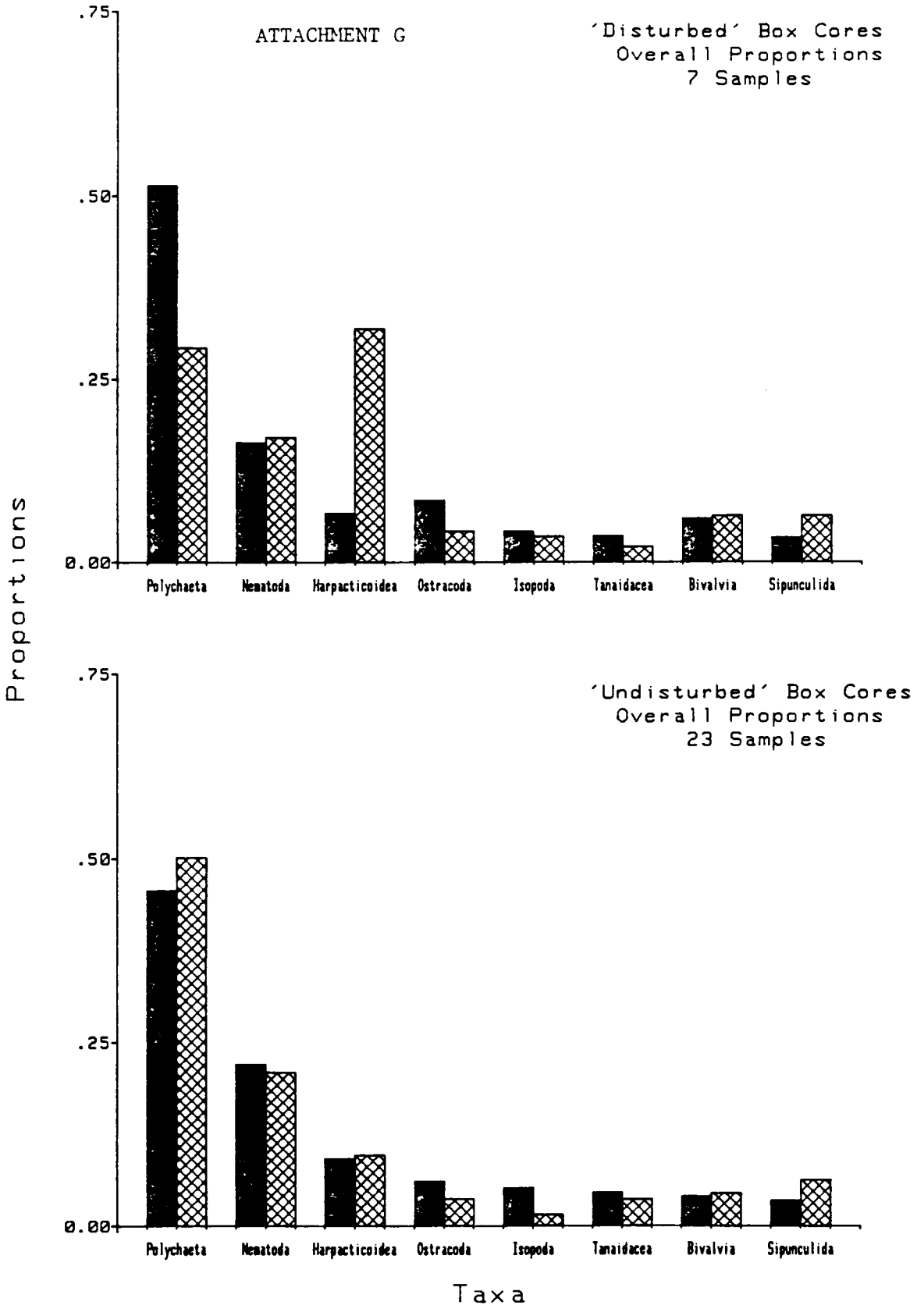
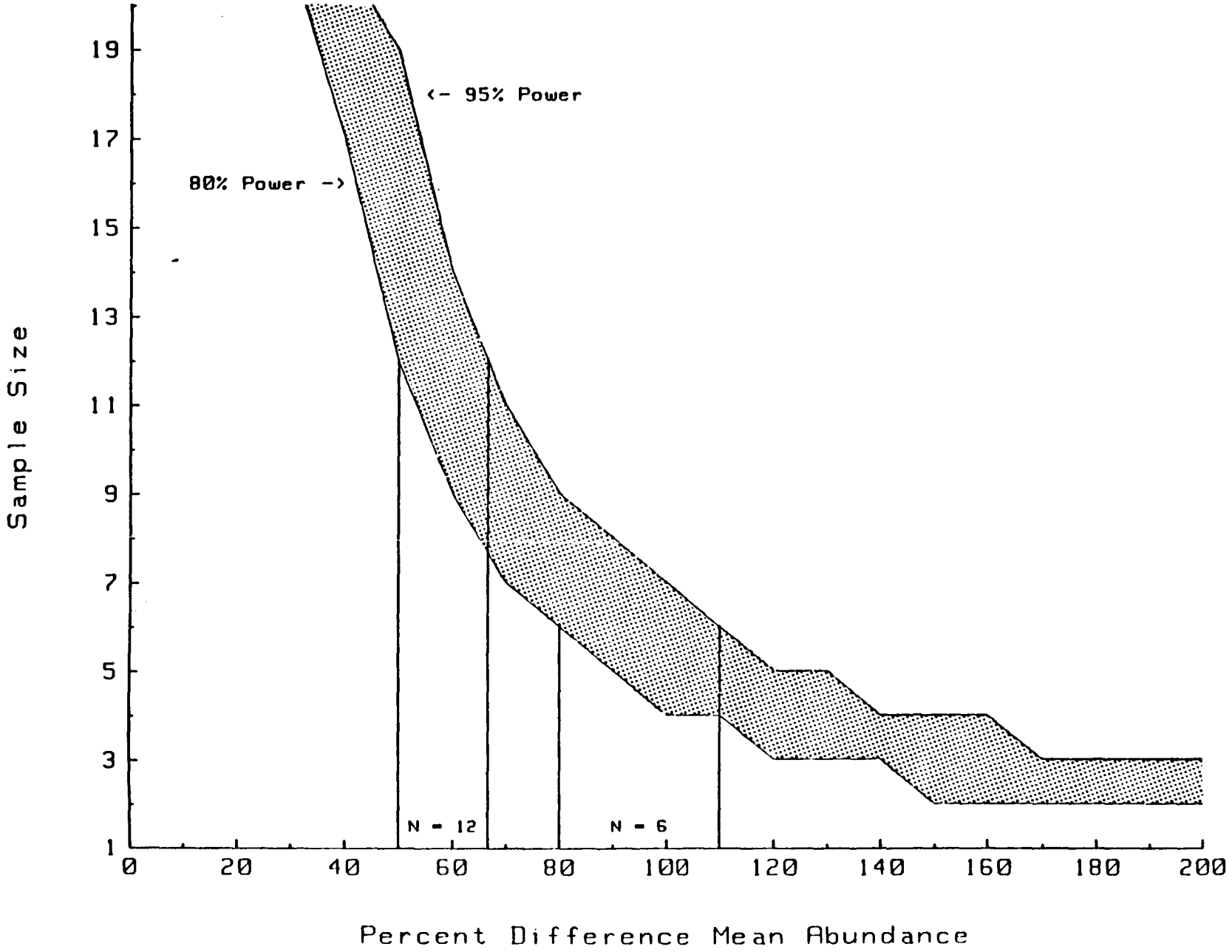
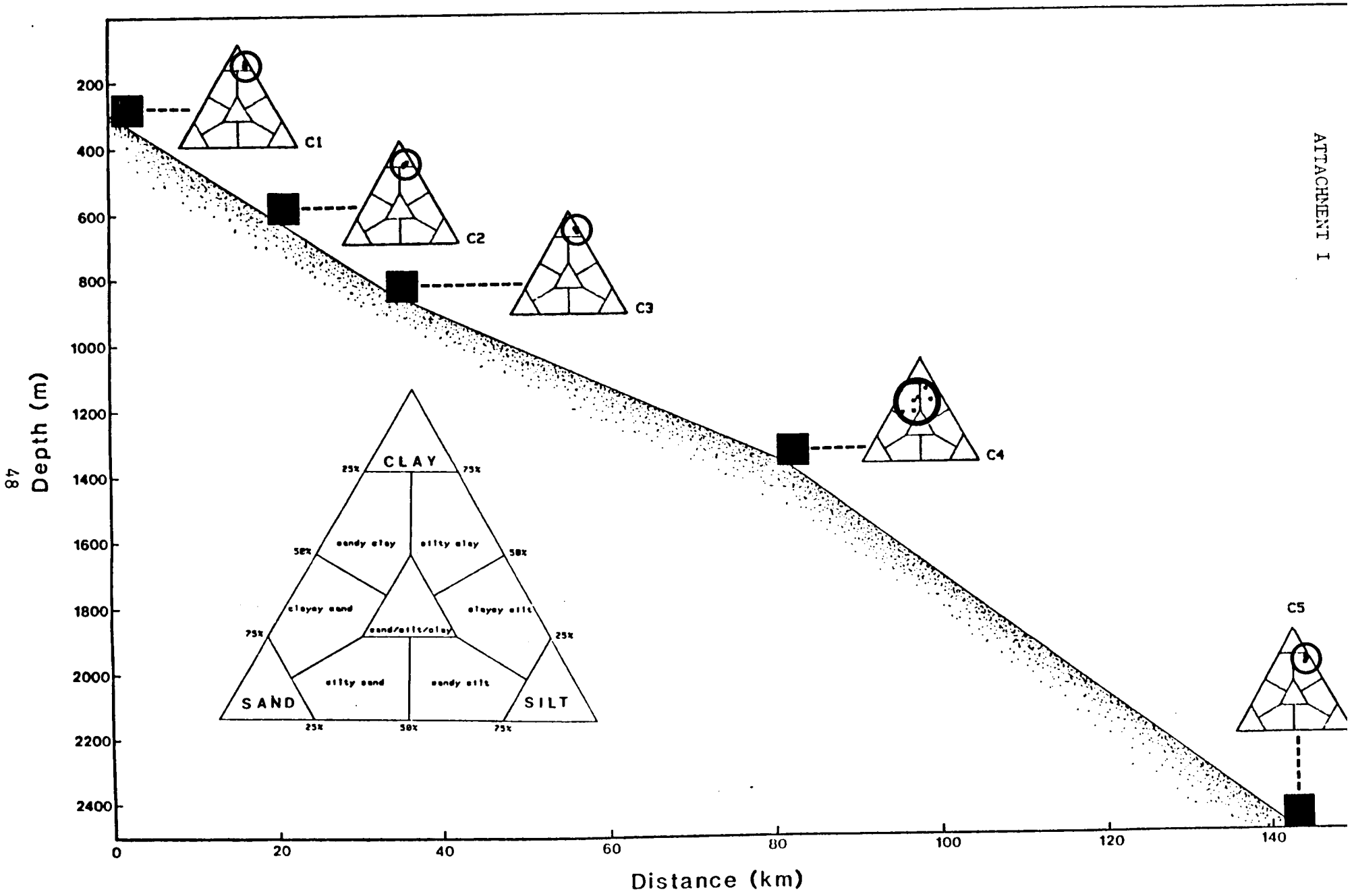


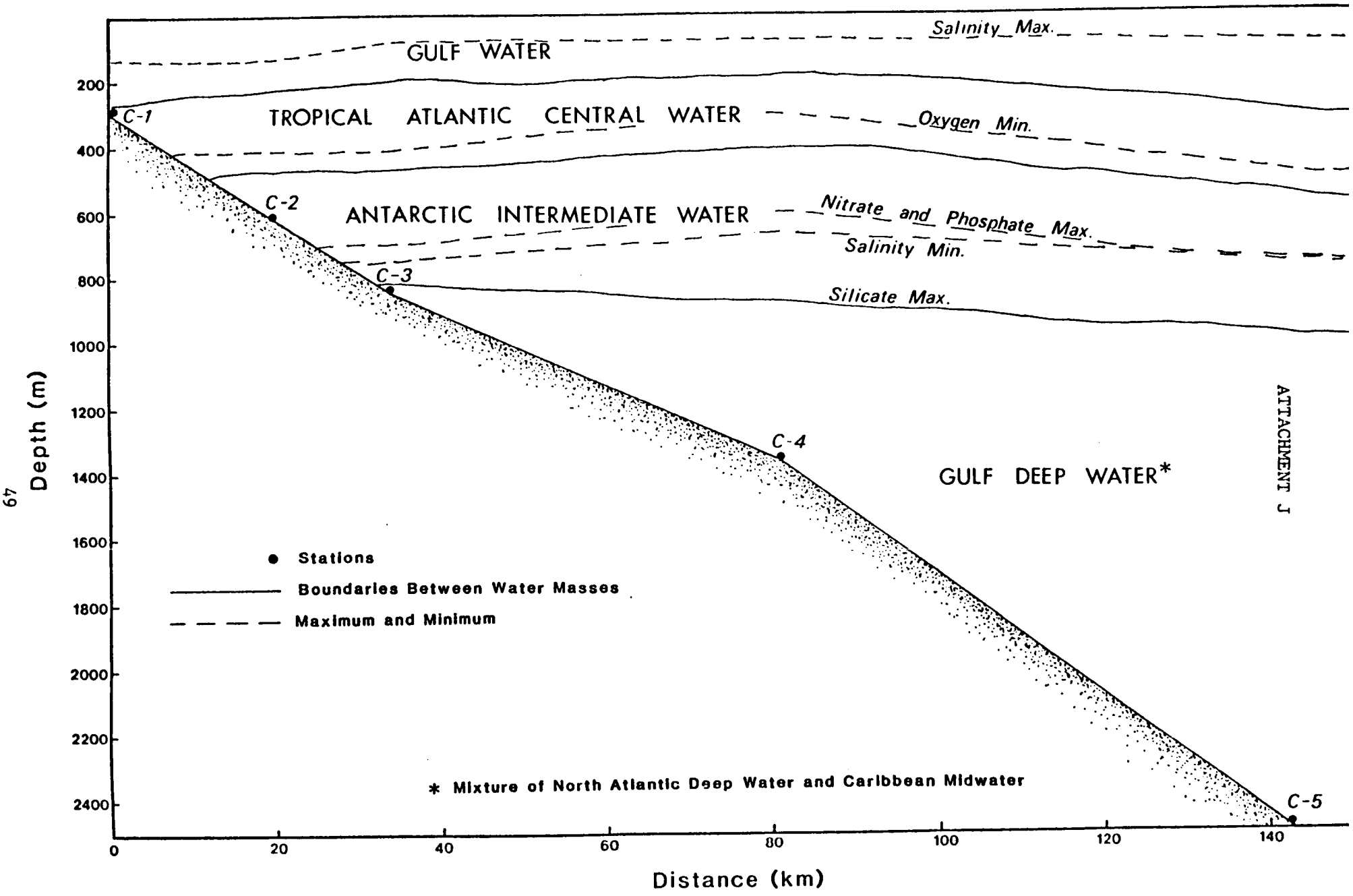
ATTACHMENT H

Sensitivity Analysis for T-Test (p = .05)





Sediment grain sizes at Cruise I sampling stations.



ATTACHMENT J

Distribution of water masses over Cruise I sampling stations.

OVERVIEW OF THE FLORIDA DEPARTMENT OF NATURAL RESOURCES BUREAU OF MARINE RESEARCH PROGRAM

Karen A. Steidinger, Chief
Bureau of Marine Research
Florida Department of Natural Resources
100 Eighth Ave. S.E.
St. Petersburg, FL 33701

The Department of Natural Resources is charged through state statute to develop and provide scientific data on marine resources for management purposes. These data and information are provided to the Governor and Cabinet, Legislature, state and federal fisheries commissions, other agencies, and the public. The Bureau of Marine Research Program is divided into eight major areas:

Fisheries Stock Assessment - to determine population abundance, migration and dispersal patterns, size at entry into the fishery, recruitment, fishing and natural mortality, and other aspects of selected species stocks for management recommendations;

Life History Studies - to identify developmental stages of certain fishes and invertebrates and to determine when and where they spawn, at what age they become reproductive, at what age they enter the fishery, sex ratios in nature, nursery areas for juveniles, and feeding strategies;

Benthic Community Studies - to (a) document, describe, and analyze assemblages of organisms by habitat type, depth zone, or area (e.g., West Florida Shelf), and (b) assess human influence on Florida's unique and irreplaceable coral reefs;

Coastal Hydrography and Red Tide Studies - to (a) predict outbreaks of red tide (toxic dinoflagellate blooms) via satellite remote sensing based on hydrographic features and the delineation of seeding areas, and (b) to correlate hydrographic features with fisheries, e.g., larval transport, recruitment, and migration patterns;

Habitat Characterization and Mitigation - to (a) develop new techniques for supplying young seagrasses and mangroves for coastal vegetation and habitat restoration or mitigation programs, and (b) document coastal habitat loss and land use changes over time and correlate to fisheries yield;

Culture and Rearing of Marine Animals - to (a) artifically spawn and rear selected species for life history and propagation data, and (b) refine culture technology for application to fisheries management.

Fisheries Statistics - to obtain recreational and commercial fisheries catch, area, effort, gear, and user data through licensing, trip tickets, and surveys for population assessment and trend analyses.

Endangered and Threatened Species - to (a) permit, coordinate, and review Florida marine turtle activities e.g., nest relocation, and (b)rear green turtles from eggs to yearlings, then tag and release reared stock to evaluate migratory routes, survival at sea, and success of such a "head start" program.

The program has a scientific and support staff of 83 full-time positions (1 July 1984) that is responsible for 35 major projects around the State. These projects are further divided into specific studies. Although the main geographical emphases is on Florida's territorial seas, offshore studies or collections are often needed because many coastal and estuarine resources are coupled to offshore systems and events.

Structurally, the Bureau is divided into five research sections: Botany and Technical Sciences, Experimental Culture and Physiology, Fisheries Statistics, Invertebrates, and Vertebrates. Intersectional studies or cooperative studies with outside agencies or individuals are often developed to utilize diverse expertise and maximize value and output, e.g. fisheries habitat characterization and restoration, larval fish recruitment, description of fisheries, trophic relationships, population and community analyses, and other activites. Specific Bureau studies on the West Florida Shelf include: (1) continued analyses of Hourglass fauna from 1965-1967 collections in 6 to 73m, (2) detection and prediction of red tides based on satellite imagery, (3) collection and curation of SEAMAP ichthyoplankton in cooperation with other agencies, and (4) life history, migration, and population studies of commercial and recreational fisheries species, e.g., king mackerel. Since the 1982 update on "Zones of Faunal Similarity Within the Hourglass Study Area" by Lyons and Camp, four additional Hourglass studies have been published and two are in press. Additional data continue to confirm and refine three faunal zones - Shoreward (6m), Shallow Shelf (18-37m), and Middle Shelf I (55-73m).

The presentation to the Minerals Management Service's Meeting will highlight major projects by research section. Anyone interested in further detail and publications can write the Bureau at the above address.

June 1984

UPDATE ON RED TIDE AND CIGUATERA STUDIES

Karen A. Steidinger, Chief
Bureau of Marine Research
Florida Department of Natural Resources
100 Eighth Ave. S.E.
St. Petersburg, FL 33701

The Department of Natural Resources has been involved in toxic dinoflagellate research since the 1950s because of resource impacts due to Ptychodiscus brevis (=Gymnodinium breve) red tides. In 1973, researchers suggested that P. brevis Florida red tides start 10-40 miles offshore and that there were sequential developmental stages to planktonic dinoflagellate blooms, i.e., initiation, growth, accumulation, and transport/termination. Based on these new interpretations of bloom dynamics and the importance of water masses and dinoflagellate life cycle strategies, research on blooms was redirected to concentrate on the geographic zones and environmental conditions associated with initiation, and possible benthic resting stages. Since 1973, offshore initiation and bloom dynamics of P. brevis red tides have been confirmed and shown to be associated with oceanic intrusions onto the West Florida Shelf. Life cycle studies have shown that P. brevis does produce sexual stages that have the potential to become benthic resting cells. Gonyaulax monilata, another toxic dinoflagellate which blooms in the Gulf of Mexico and causes fish kills, does produce benthic resting stages. These benthic cells, or hypnozygotes, act as resident populations. Once an area has planktonic blooms of a toxic dinoflagellate, blooms can recur due to "seed beds". The benthic cells have the capability of producing motile cells that inoculate the overlying water column and the motile cells at some stage in bloom development go through a sexual cycle to produce dormant benthic cells. Department research on red tides is directed toward prediction of P. brevis blooms based on offshore events using satellite and life cycle data.

Cases of ciguatera, a tropical fish poisoning causing human illness, have been documented from the Caribbean and southeast Florida. Ciguatera is also caused by toxic dinoflagellates. However, these dinoflagellates are bottom dwellers in the motile stage and can attach to benthic macroalgae and other substrates. The toxins are chemically similar to P. brevis toxins and are biomagnified through the food chain by transfer from herbivore to carnivore. Department biologists have been working in cooperation with other scientists in Florida to determine the identity of toxic species and their distribution patterns. In a multi-institutional proposal to study ciguatera in the Caribbean and Florida, Department biologists have suggested research to identify and evaluate transport mechanisms for inoculating new areas with ciguateric dinoflagellates,e.g., by boats, drift algae, and fecal material from herbivorous fishes.

12 June 1984

Population Dynamics of Stony Corals in Biscayne National Park Patch Reefs, Florida, USA

Walter C. Jaap

Florida Department of Natural Resources
Bureau of Marine Research

Twenty-four (2x2 m) quadrat sites on eight reefs (in depths of 1-4 m) were sampled (ground truth census and photodocumented) annually from 1978 to 1981. Six coral species were collected monthly for gonadal analysis during the same period.

Twenty-nine species were recorded, 23-26 each year. The five most abundant species (Millepora alcicornis, Porites astreoides, P. porites, Siderastrea siderea, and Agaricia agaricites) comprised 76.4 to 77.3 of the assemblage. Statistical analyses (parametric and non-parametric) reported that temporal change was significant for P. astreoides and M. alcicornis. Classification analyses (Czekanowski's quantitative coefficient) reported that temporal similarity ranged from 0.36 to 0.83; no pattern was detected.

Two sexual reproduction strategies were observed: P. porites and P. astreoides reproduce year round; Acropora cervicornis and A. palmata appear to be seasonal during spring and summer. Montastraea annularis rarely sexually reproduces.

Fragmentation recruitment is very significant for Acropora spp. Storms dislodge whole colonies, and/or fragment branches. Survival is quite high, and is mostly dependant upon the fragment's location in a favorable habitat.

Population dynamics in stony corals is complicated by fragmentation recruitment: loss or gain of individuals within an area is not necessarily mortality or recruitment. Spatial rearrangement of the habitat is significant. Change is more typical than constancy. Natural controls of temperature and wave forces are severe enough (frequency and magnitude), that highly diverse coral communities do not develop.

Community Structure of Stony Corals (Scleractinia and Milleporina) in Southeast Florida Reef Communities

Walter C. Jaap
Florida Department of Natural Resources
Bureau of Marine Research
100 8th Ave. SE
St. Petersburg, FL 33701 USA

The only shallow-water (1-40 m) coral reefs off continental North America are located in southeastern Florida where recent reef building is limited to the Florida Keys archipelago (24°30' - 25°30'N). Three types of reef communities are found in this region: bank, patch, and livebottom-hardgrounds.

Bank reefs are the most seaward and display a morphological-organism zonational pattern of reef flat, spur and groove, and forereef-buttress. Acropora palmata, Porites astreoides, and Millepora complanata dominate the shallow (<3 m) spur and groove habitat. Deeper (<6 m) habitats are dominated by A. palmata (with Agaricia agaricites on the vertical faces). The forereef often has low relief spur and groove formations seaward to a depth of <30 m. Montastraea annularis, A. agaricites, M. cavernosa, and Siderastrea siderea constitute 24% to 30% of the coral population. Seaward of the forereef small reef islands are isolated by sediments; Madracis mirabilis and Agaricia lamarcki are common in this habitat.

Patch reefs occur between the bank reefs and shore. Stony corals dominating these reefs include Montastraea annularis, Diploria strigosa, and Colpophyllia natans. Often the periphery of the patch reef is dominated by massive framework species, and the interior supports small ubiquitous species.

Livebottom habitats are found from a few meters offshore to depths of >40 m. Depth controls the species assemblage.

Classification analysis reveals high variability within habitat samples; temporal stability is higher in bank reefs than in patch or livebottom biocenoses. Species co-occurrence implies moderate similarity levels between the communities (0.60-0.75). Quantitative analyses show little similarity between bank reefs and the other reef communities (0.16-0.40). Patch reefs and livebottom communities exhibit moderate affinity (0.60-0.75) for each other.

Shallow habitat communities are controlled by meteorological-hydrological phenomena; deeper areas are biologically controlled by organism competition. Reef distribution is best explained by water quality, meteorological events, land mass configuration, and bottom topography.

TUSCALOOSA TREND REGIONAL DATA SEARCH AND SYNTHESIS STUDY

Prepared by:

BARRY A. VITTOR & ASSOCIATES, INC.
Mobile, Alabama

Prepared for:

MINERALS MANAGEMENT SERVICE
Gulf Regional OCS Office
Metairie, Louisiana

Ternary Meeting
Tampa, Florida

June 13, 1984

TUSCALOOSA TREND REGIONAL DATA SEARCH AND SYNTHESIS STUDY

Barry A. Vittor & Associates, Inc. (contractor)
Quantus, Inc. and Science Applications, Inc. - Oak Ridge (subcontractors)

Of current interest to oil and gas exploration in the northern Gulf of Mexico is the outer continental shelf area off southeastern Louisiana, Mississippi, and Alabama. The presence of the geologic feature, known as the Tuscaloosa Trend, extends from southern Louisiana into the offshore waters of the Chandeleur Islands, eastward to the DeSoto Canyon, and promises to be highly productive in terms of recoverable oil and natural gas reserves (Figure 1). The waters adjacent to the Chandeleur Islands and within Breton Sound, Mississippi Sound, and Mobile Bay also support a significant recreational and commercial fishery, which is of concern to the adjoining states. Because of industry interest and potential for future ecological impact by accelerated OCS oil and gas activities, the Tuscaloosa Trend region was selected by Minerals Management Service for a thorough environmental characterization and ecosystem modeling effort. The first year effort consists of a comprehensive survey of available data and literature which will be synthesized into report format, and in the identification of information/data gaps, and form the basis for development of an ecosystems model for management purposes.

Information Collection

Activities within the first four-month period involved computer-based literature searches, literature and data collections, interviews with researchers and managers within academic and government agencies, and the formulation of a conceptual ecosystem model.

Computerized bibliographic and data base search systems include National Marine Pollution Information System (NMPIS), National Technical Information Service (NTIS), Coastal Information Depository (CID) of the Center for Wetland

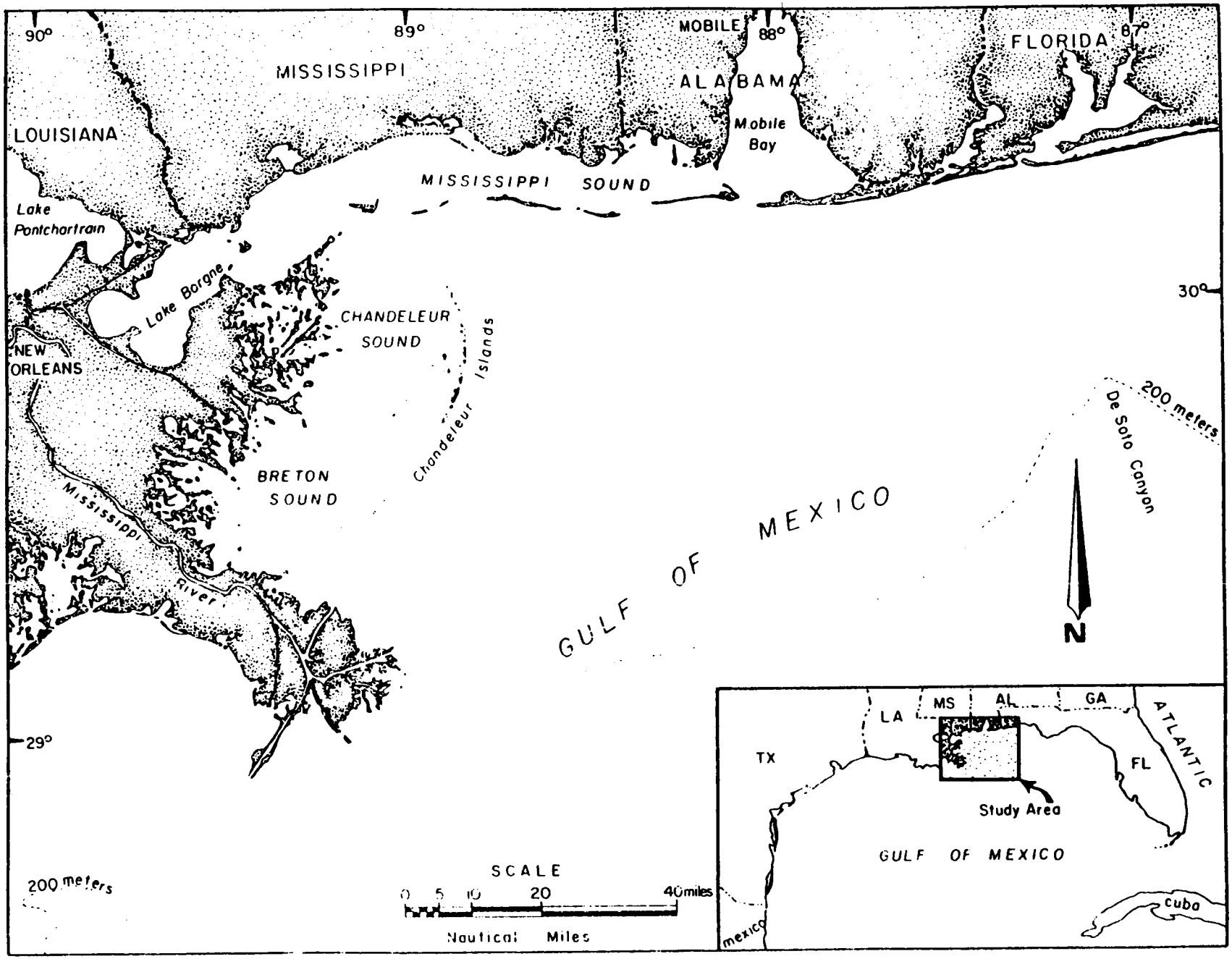


Figure 1 . The Tuscaloosa Trend study area.

Resources at Louisiana State University, National Environmental Data Referral System (NEDRES), Department of Energy (DOE) Energy Data Base, Oceanic Abstracts, Smithsonian Science Information Exchange (SSIE), BIOSIS bibliographies, and Ecology Abstracts. Approximately 2,000 citations were retrieved and cross-referenced. All citations were entered in the NEDRES format, while pertinent references also were annotated. A users guide consisting of forms and controlled vocabulary was compiled by Quantus, Inc. for the proper recording of literature and data base citations and annotations.

Manual collections of literature and data bases were conducted synoptically with interviews of researchers at institutions and persons in government agencies who are, or have been involved in environmental investigations within the study area. Over 75 persons have been interviewed and several hundred reference sources have been accessioned, annotated, and entered into the bibliographic database.

Information Review and Synthesis

Since February we have reviewed most of the literature collected and organized the synthesis into the following topical areas:

Physiography

Geology

Meteorology/Climatology

Physical Oceanography

Chemistry

Biology

Socioeconomics

The literature review activities have centered on establishing (1) functional relationships between and among the terrestrial freshwater, estuarine, and coastal/OCS subsystems and (2) their relationship to major sources of

inputs and outputs. In addition, gaps in the information base that relate to critical subsystem inter-relationships are being identified.

Conceptual Ecosystem Model

The conceptual modeling activities conducted by Dr. Comiskey (SAI) are directed towards understanding teh basic physical, chemical, geological, and biological processes and their functional relationships within the Tuscaloosa Trend study area. The model will assist in the information synthesis phase and provide direction for future data collection efforts.

In pursuit of this model development, a comprehensive evaluation of relevant historical and current ecosystem modeling and process-oriented research efforts was conducted. A considerable amount of information relevant to marine ecosystem modeling and current research activities has been acquired, much of which is outside the Tuscaloosa Trend area. This information has been synthesized with an initial draft of the model. The initial conceptualization is generic and draws heavily from the most appropriate aspects of existing models of the New York Bight ecosystem prepared for the Marine Ecosystems Analysis (MESA) Program Office of NOAA (Figure 2). This ecosystem was treated as an offshore area with upcoast, downcoast, estuarine, offshore and atmospheric boundaries. As such, the conceptualization can be directly applied to the Tuscaloosa Trend with only regional-specific modifications occurring within the hierarchical components.

The hierarchical model will contain the following three levels of organization:

Level 1. Whole Ecosystem

Level 2. Individual Subsystems, each being an expansion of a portion of the Level 1 model.

Physical

Sedimentological

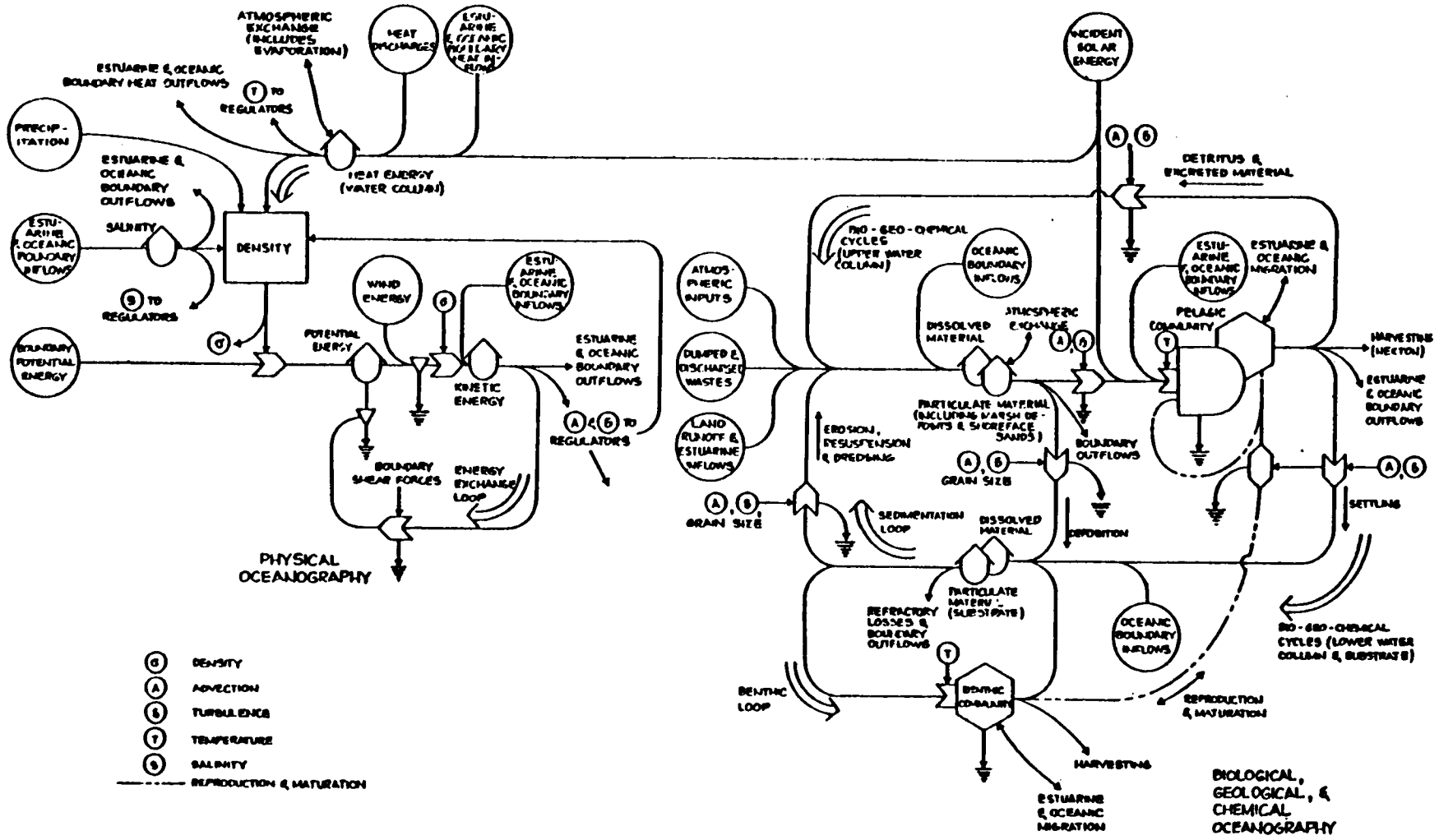


Figure 2. Level 1 preliminary conceptual representation of the Tuscaloosa Trend study area (from McLaughlin et al. 1975).

Biogeochemical

Ecological

Level 3. Specific applications, wherein any part of any Level 2 model can be expanded for detailed representation of a particular concern (i.e., migratory fisheries)

Each level representation is built upon the following model components:

Inputs and outputs

Compartments

- biotic
- abiotic

Processes

- physical
- chemical
- geological
- ecological

Regulators

Future effort in the Tuscaloosa Trend study will include synthesis reports, mapping, and refinement of the ecosystem models.

THE FLORIDA ECOLOGICAL ATLAS

by

J. Thomas Kunneke
Martel Laboratories, Inc.
7100 30th Avenue North
St. Petersburg, Florida 33710

THE FLORIDA ECOLOGICAL ATLAS

Martel Laboratories, under contract to the U.S. Fish and Wildlife Service and the Minerals Management Service, has recently completed map narratives and final map manuscripts for the Southwest Florida Ecological Atlas. Martel is presently producing draft map narratives and draft map manuscripts for the Northeast Gulf of Mexico Ecological Atlas. This effort will be completed in the fall of 1984. The atlases, which together make up the Florida Ecological Atlas Series, are generated at 1:100,000 scale. This is the most up to date map series produced at this scale for the Florida Gulf Coast and Keys.

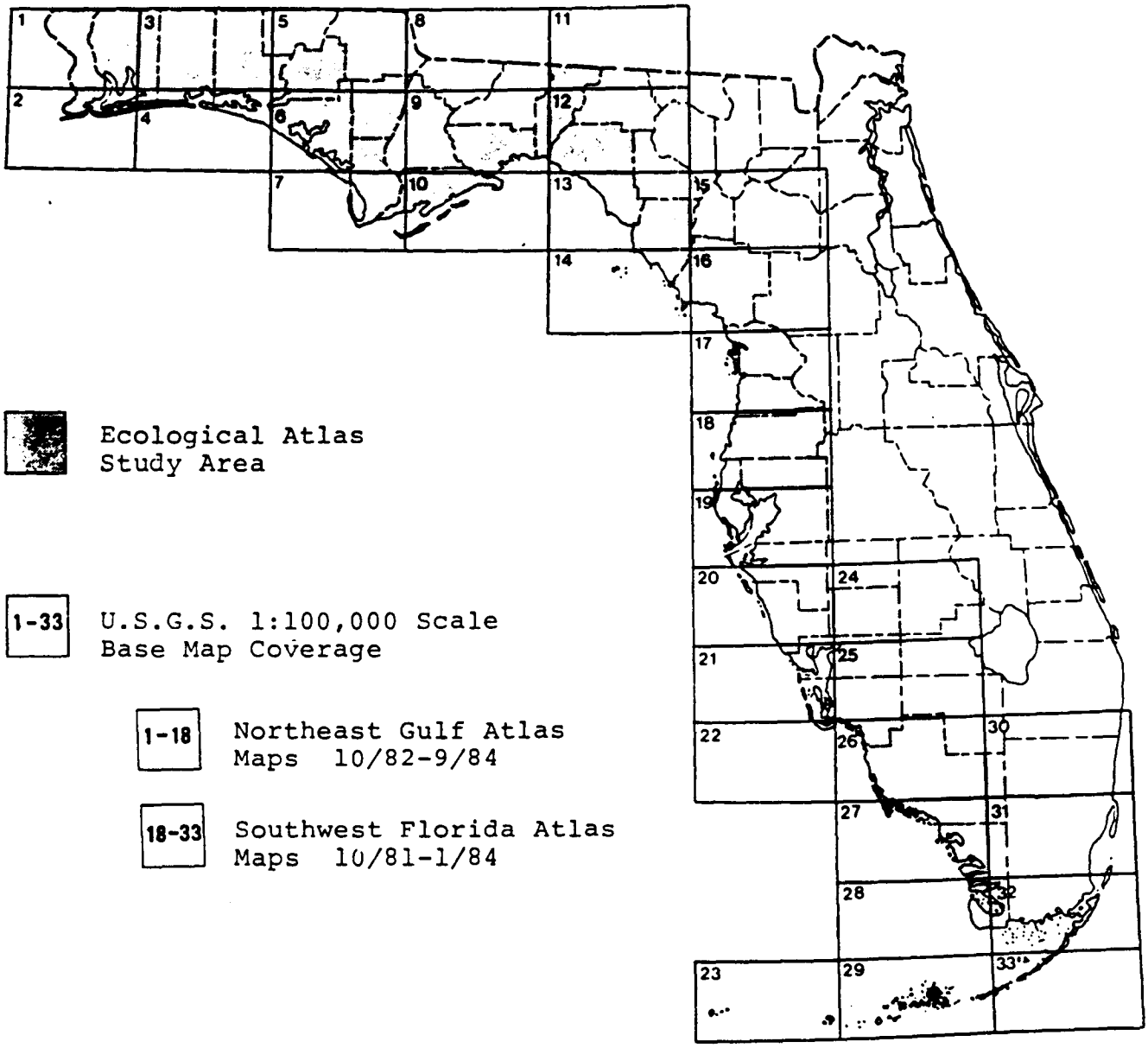
The Florida Ecological Atlas is being produced as part of the Southwestern Florida and Northeastern Gulf of Mexico Ecological characterization. The atlas consists of maps that depict resources and man's activities in the study area, such as habitats, land use practices, cultural activities, environmental alterations, and ecological processes. The atlas embraces the detailed habitat mapping study, the socioeconomic study and the environmental synthesis papers being conducted for the study area. In addition, mapped data and collateral information was acquired during the data collection phase of the study.

Results of this study, as specified by the Request for Proposal, will provide to the Minerals Management Service, the U.S. Fish and Wildlife Service, and other Federal agencies, the State of Florida, and local governments, ecological and socioeconomic information on coastal and onshore environments of the Florida Gulf Coast and Keys. This information will be used primarily for outer continental shelf (OCS) oil and gas leasing and development.

Secondly, results of the study will provide valuable guidance in the design of the Environmental Studies Program to address coastal and onshore environmental research needs. Lastly, the study will generate information that can be used during the leasing process (e.g. call for nominations, tract selection, EIS preparation, etc.) in assessing potentially important coastal and onshore resources and habitats that could be affected by OCS oil and gas activities.

INDEX MAP OF FLORIDA ECOLOGICAL ATLAS OVERLAYS

FLORIDA ECOLOGICAL ATLAS



A. Study Area

The study area is the Florida Gulf coastal region from Escambia County southeast to the Dade-Monroe County line, including all of the Florida Keys. The offshore area includes the region from the shoreline to the three-league line, and the inland area includes the following counties: Escambia, Santa Rosa, Okaloosa, Walton, Washington, Bay, Calhoun, Gulf, Franklin, Wakulla, Jefferson, Taylor, Dixie, Levy, Citrus, Hernando, Pasco, Pinellas, Hillsborough, Manatee, Sarasota, De Soto, Charlotte, Lee, Collier and Monroe. These counties are included in the following U.S. Geological Survey 1:100,000 scale topographic maps: Bay Minette, Pensacola, Crestview, Ft. Walton Beach, Marianna, Panama City, Port St. Joe, Bainbridge, Tallahassee, Carrabelle, Valdosta, Perry, Cross City, Cedar Key, Gainesville, Ocala, Inverness, Tarpon Springs, St. Petersburg, Sarasota, Arcadia, Charlotte Harbor, Ft. Myers, Sanibel, Naples, Ft. Lauderdale, Everglades City, Miami, Cape Sable, Homestead, Dry Tortugas, Key West and Islamorada.

B. Map Overlays

Each 1:100,000 scale base map will be covered by the following five topical overlays:

Overlay 1 - Biological Resources
Overlay 2 - Socioeconomic Features
Overlay 3 - Soils and Landforms
Overlay 4 - Oil, Gas and Mineral Resources
Overlay 5 - Hydrology and Climatology

Table 1 describes the topics and their method of portrayal on the atlas map overlays.

Table 1. Map overlay topics and corresponding methods of portrayal on the Florida Ecological Atlas.

Overlay	Topic		Method of Portrayal
Biological Resources	1.	Major Wetland Habitats	Map screens
	2.	Bird Nesting Sites	Map symbol by bird colony type
	3.	Threatened and Endangered Plant and Animal Species (Federal and State)	Map symbols and polygons
	4.	Artificial Reefs	Map symbol keyed to map narrative
	5.	Coral Reefs	Map polygons
	6.	Seagrass Beds	Map screens
	7.	Scallop and Oyster Beds	Map symbols and polygons
	8.	Shellfish Harvest Areas	Map polygons
	9.	Finfish Nursery and Harvest Areas	Map fish matrix
Socioeconomic Features	1.	National Marine and Estuarine Sanctuaries	Map boundaries
	2.	Artificial Fishing Reefs	Map screened polygons keyed to map narrative
	3.	Major Offshore Structures	Map symbols
	4.	Florida State Aquatic Preserves	Map boundaries and screens
	5.	National Parks	Map boundaries
	6.	National Wildlife Refuges	Map boundaries; listed in map narrative
	7.	State Wildlife Management Areas	Map boundaries; listed in map narrative
	8.	National Register of Historic Sites	Map symbol; listed in map narrative
	9.	National Natural Landmarks	Map symbol; listed in map narrative
	10.	National Audubon Society Sanctuary	Map boundaries; listed in map narrative
	11.	State Parks	Map boundaries
	12.	Recreational Beach Access Points	Map symbol
	13.	Florida Canoe Trails	Map symbols
	14.	Major Public Fishing Piers	Map symbol keyed to map narrative
	15.	Charter & Head Boat Locations	Map symbol; listed in map narrative
	16.	Boat Ramps and Marinas	Map symbols keyed to map narrative

Table 1 (continued).

Overlay	Topic		Method of Portrayal
	17.	Environmentally Endangered Lands	Map boundaries
	18.	Recreation Areas	Map symbol; listed in map narrative
	19.	Level I Land Use	Map polygons
	20.	Point Source Discharges (Municipal & Industrial)	Map symbols keyed to map narrative
	21.	Landfills	Map symbols; listed in map narrative
	22.	Dredge Spoil Sites	Map screens/ boundaries
	23.	Shipwrecks	Map symbol; listed in map narrative
	24.	Archaeological Sites	Map symbol w/number per township
	25.	Nature Conservancy Lands	Map boundaries
	26.	Military Lands	Map boundaries
Soils & Landforms	1.	Major Surface Landforms (physiographic regions)	Map polygons
	2.	General Soil Associations	Map polygons
	3.	Beach Erosion and Accretion Areas	Map symbol w/rates indicated
	4.	Faults	Map line symbol
	5.	High Energy Beaches	Map symbol
	6.	Active Dune Areas	Map symbol
	7.	Barrier Island	Map screen
Oil, Gas & Mineral Resources	1.	Pipelines	Map line symbol
	2.	Refineries	Map symbol
	3.	Drilling Sites	Map symbols
	4.	Mineral Resources	Map screened polygons

Table 1 (concluded).

Overlay	Topic		Method of Portrayal
Hydrology & Climatology	1.	Potentiometric Contour Map of the Floridan Aquifer	Map contour lines
	2.	Mean Annual Precipitation	Map contour lines
	3.	Mean Monthly Precipitation	Map narrative (isohyetal maps)
	4.	Precipitation Intensity and Cycles	Map narrative
	5.	NWS Climatological Stations	Map symbol keyed to map narrative
	6.	Annual Surface Wind Roses	Map diagrams
	7.	Offshore Surface Current Roses	Map diagrams
	8.	Hurricane Inundation Zone	Shown on map by storm intensity using map screens
	9.	Hurricane and Tropical Storm Probability	Map legend
	10.	Water Budgets of Hydrologic Units	Map narrative
	11.	U.S.G.S. Hydrologic Units	Map boundaries
	12.	U.S.G.S. Stream Gaging Stations	Map symbol with mean annual discharge & runoff
	13.	U.S.G.S. Stream Gage and Water Quality Station	Map symbol with mean annual discharge, runoff, and specific conductivity
	14.	Surface Water Quality	Map narrative matrix
	15.	U.S.G.S. Ground Water Observation & Water Quality Well	Map symbols
	16.	Florida Department of Environmental Regulation Fixed Water Quality Station	Map symbol
	17.	Water Use	Map narrative matrix

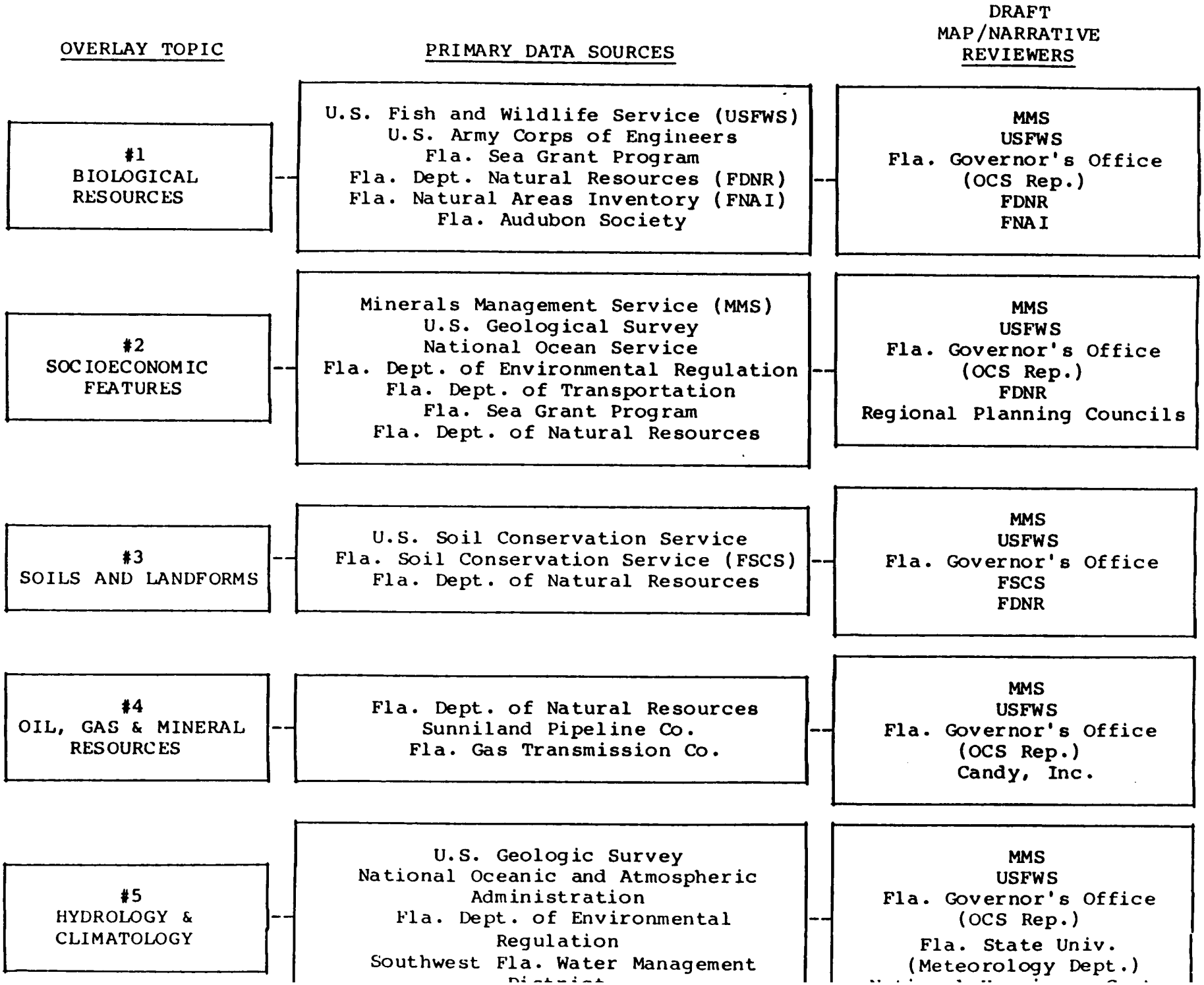
C. Map Narratives

Each atlas includes a comprehensive map narrative for each overlay type. The narratives are provided to describe more fully the methodology of data presentation employed on the atlas. They also provide additional information on atlas topics not included on the atlas maps.

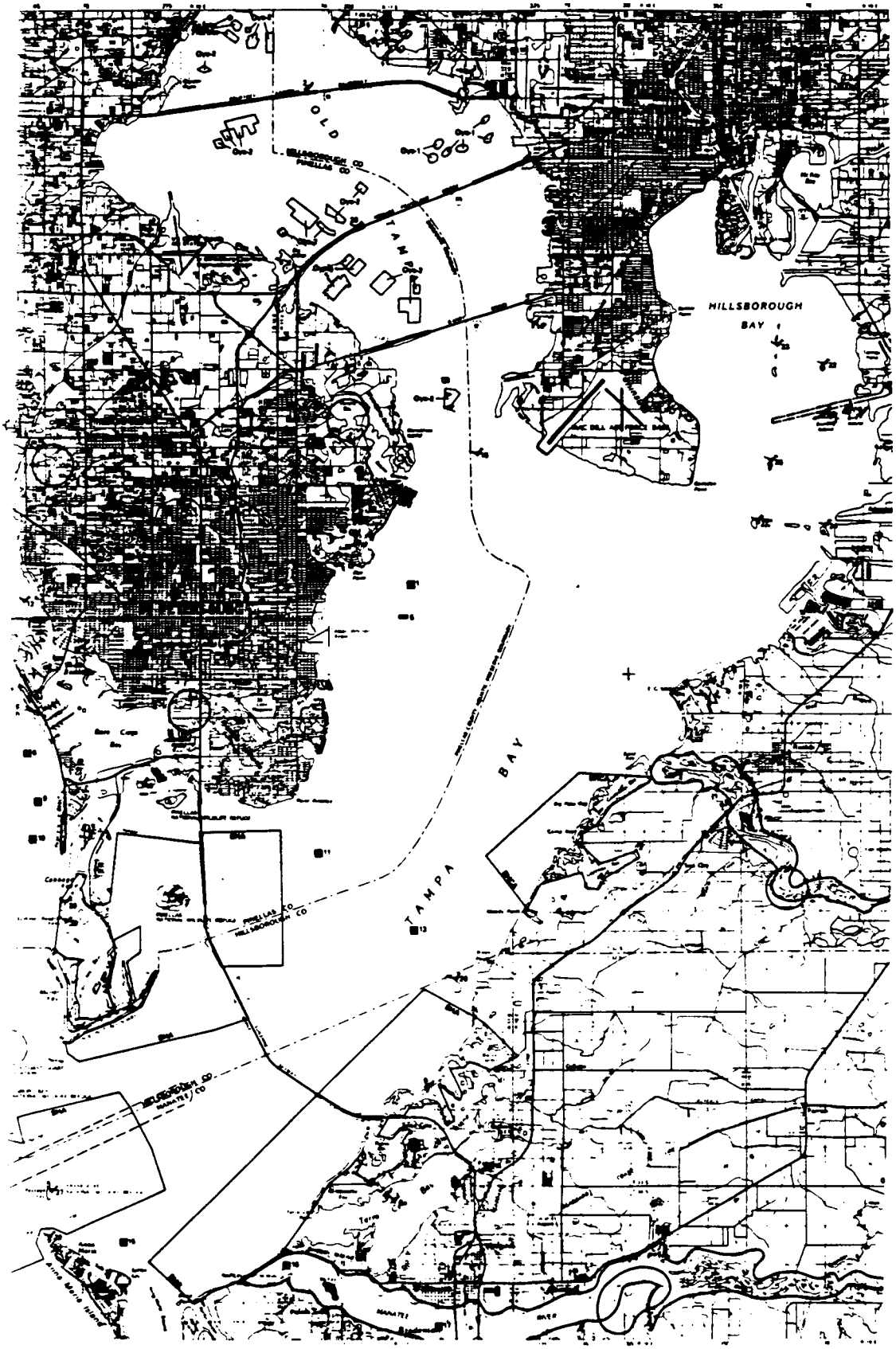
Some of the unique information presented in the atlas that has not been previously presented in map form is described below:

(1) Distribution of archaeological sites by township.
(2) Beach erosion and accretion areas.
(3) Active dune areas.
(4) Areas of hurricane inundation (by Saffir-Simpson Intensity Classification).
(5) Monthly isohyetal (rainfall) maps (presented in map narrative).
(6) Coastal surface current roses.
(7) Water budgets for all hydrologic units (presented in map narrative).

SW FLORIDA ECOLOGICAL ATLAS
PRIMARY SOURCES/TECHNICAL REVIEW CHART

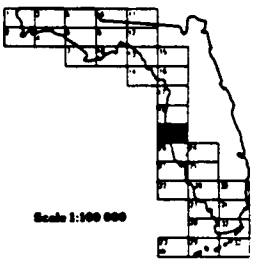

OVERLAY TOPIC
PRIMARY DATA SOURCES
DRAFT MAP/NARRATIVE REVIEWERS
#1 BIOLOGICAL RESOURCES
U.S. Fish and Wildlife Service (USFWS)
U.S. Army Corps of Engineers
Fla. Sea Grant Program
Fla. Dept. Natural Resources (FDNR)
Fla. Natural Areas Inventory (FNAI)
Fla. Audubon Society
MMS
USFWS
Fla. Governor's Office (OCS Rep.)
FDNR
FNAI
#2 SOCIOECONOMIC FEATURES
Minerals Management Service (MMS)
U.S. Geological Survey
National Ocean Service
Fla. Dept. of Environmental Regulation
Fla. Dept. of Transportation
Fla. Sea Grant Program
Fla. Dept. of Natural Resources
MMS
USFWS
Fla. Governor's Office (OCS Rep.)
FDNR
Regional Planning Councils
#3 SOILS AND LANDFORMS
U.S. Soil Conservation Service
Fla. Soil Conservation Service (FSCS)
Fla. Dept. of Natural Resources
MMS
USFWS
Fla. Governor's Office
FSCS
FDNR
#4 OIL, GAS & MINERAL RESOURCES
Fla. Dept. of Natural Resources
Sunniland Pipeline Co.
Fla. Gas Transmission Co.
MMS
USFWS
Fla. Governor's Office (OCS Rep.)
Candy, Inc.
#5 HYDROLOGY & CLIMATOLOGY
U.S. Geologic Survey
National Oceanic and Atmospheric Administration
Fla. Dept. of Environmental Regulation
Southwest Fla. Water Management
MMS
USFWS
Fla. Governor's Office (OCS Rep.)
Fla. State Univ. (Meteorology Dept.)

EXAMPLES OF MAP OVERLAYS



FLORIDA ECOLOGICAL ATLAS

BIOLOGICAL RESOURCES



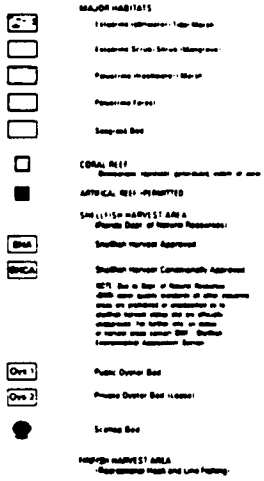
Scale 1:100 000

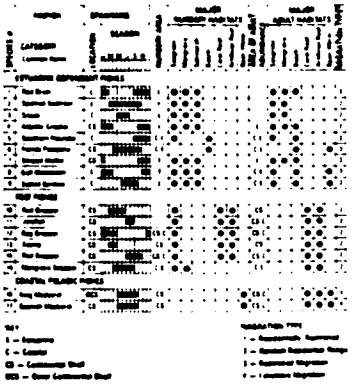
TOPICAL MAPS IN THIS ATLAS:
- A. BIOLOGICAL RESOURCES
- B. SOCIOECONOMIC FEATURES
- C. SOILS AND LANDFORMS
- D. OIL, GAS AND MINERAL RESOURCES
- E. HYDROLOGY AND CLIMATOLOGY

1983

Produced by U.S. Fish and Wildlife Service and Minerals Management Service

LEGEND





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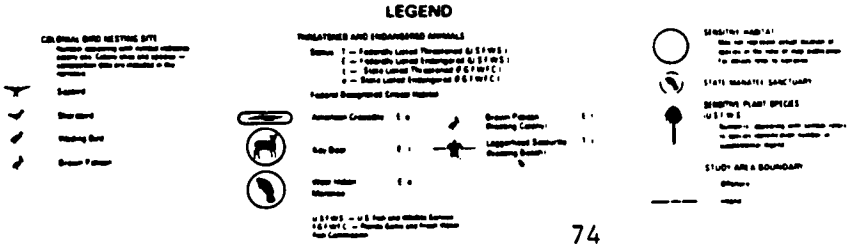
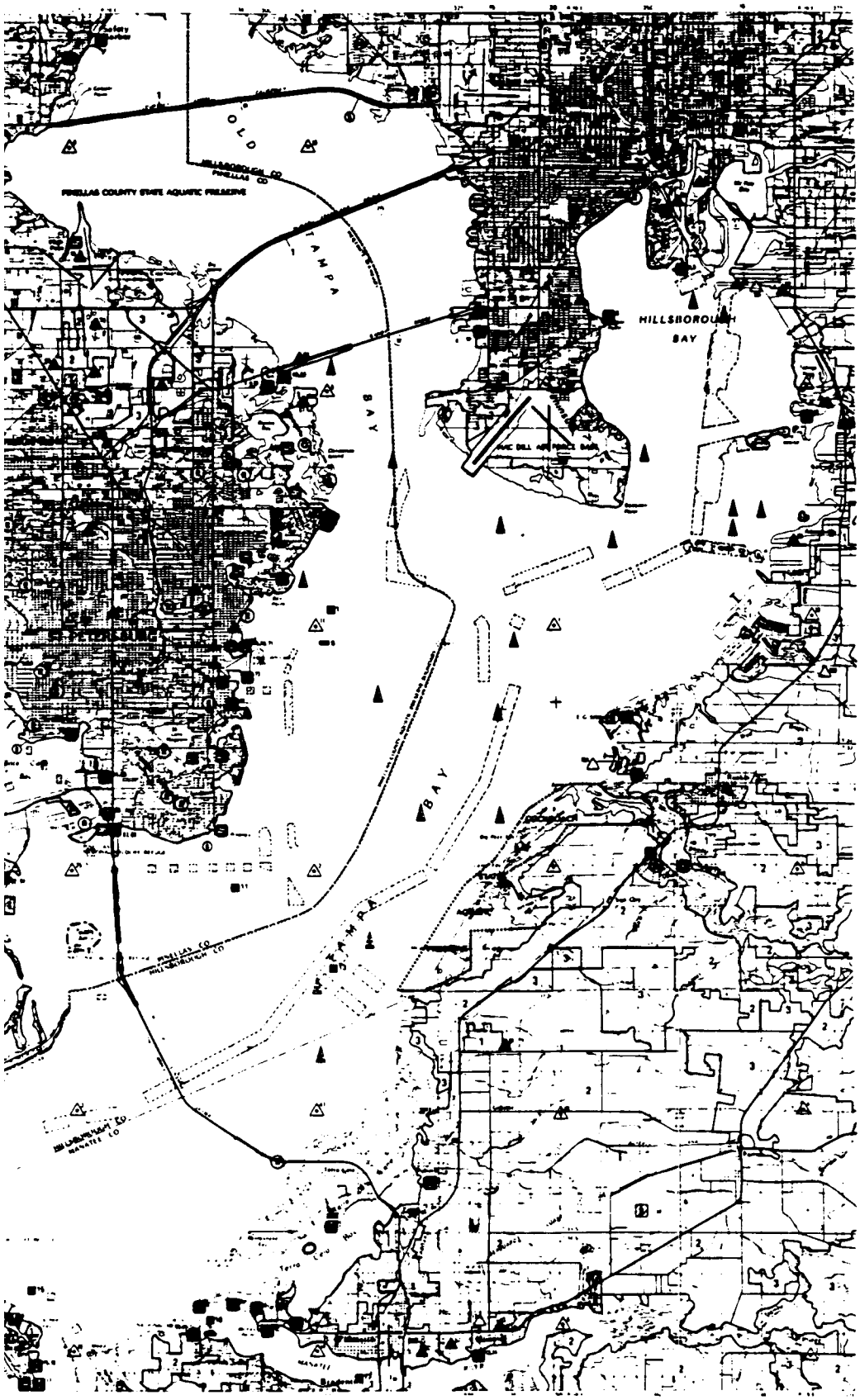


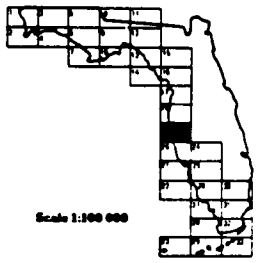


MAP B18 FWS/OBS-82 47

St. Petersburg

FLORIDA ECOLOGICAL ATLAS

SOCIOECONOMIC FEATURES



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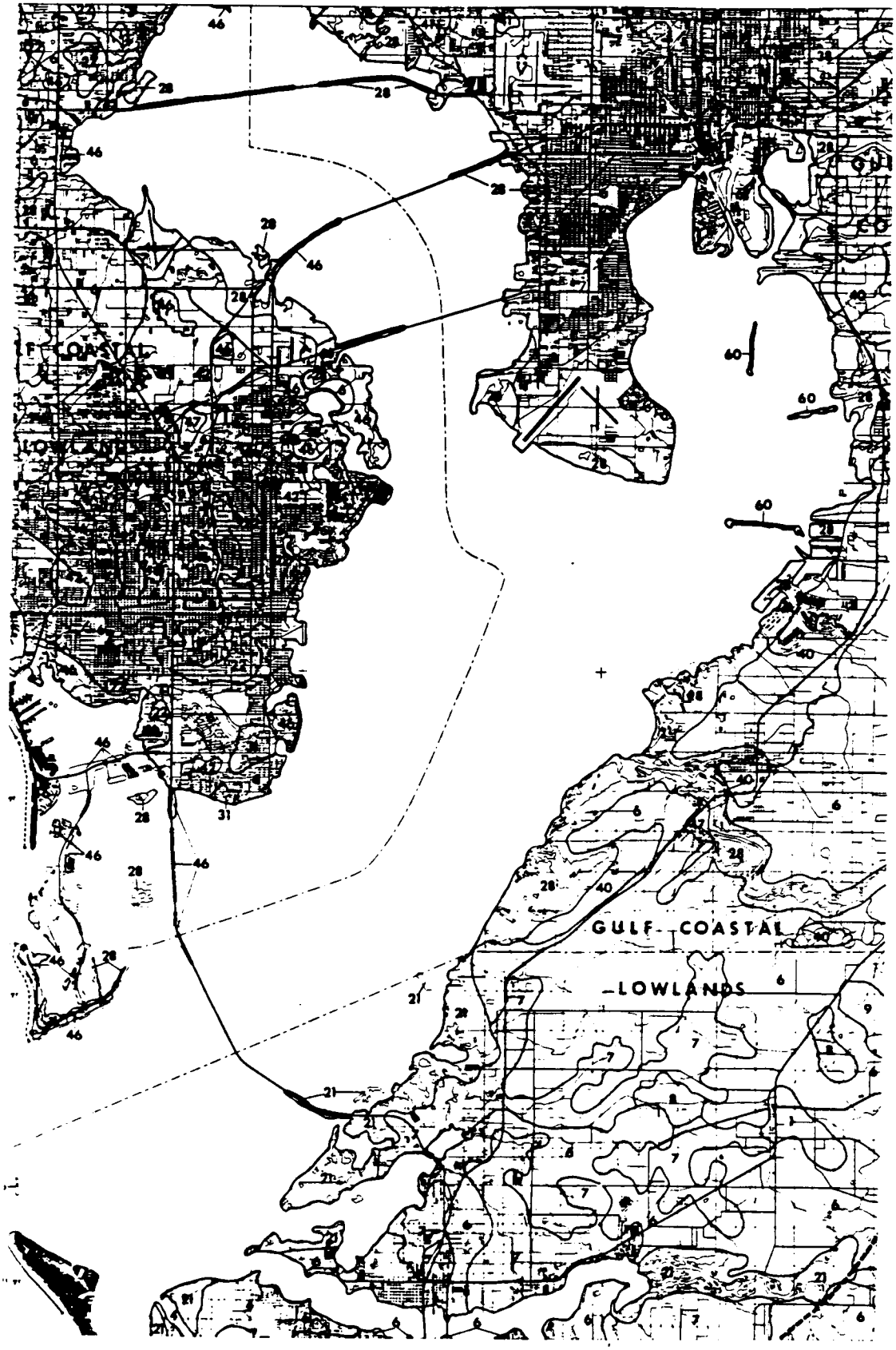
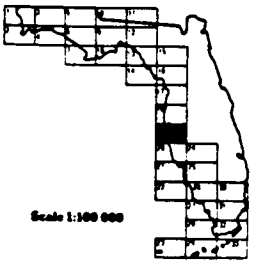


St. Petersburg

FLORIDA ECOLOGICA
ATLAS

SOILS AND LANDFORMS



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1982

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LEGEND

MAJOR SURFACE LANDFORMS

1-61 SOIL ASSOCIATIONS

BEACH EROSION AREA

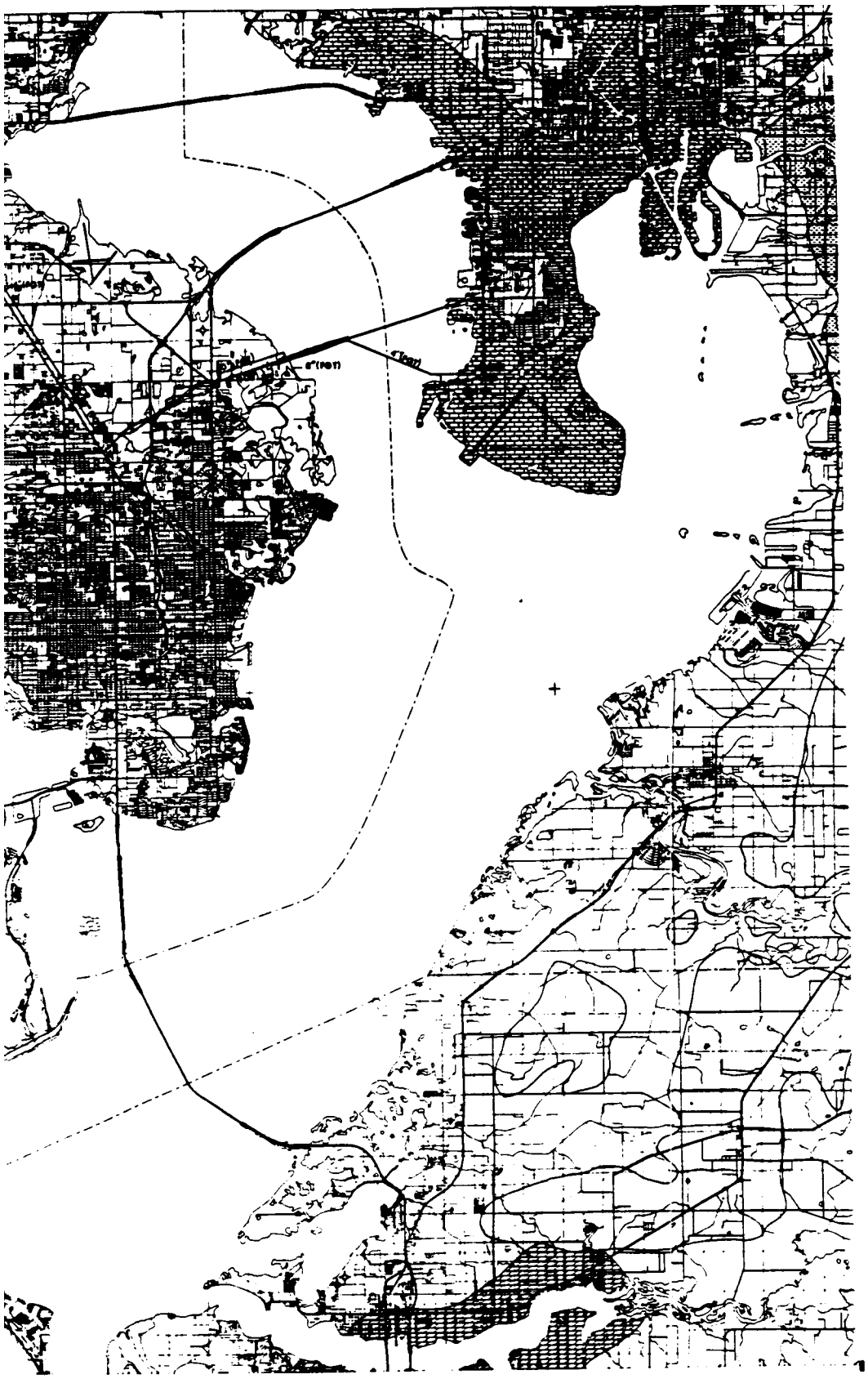
BEACH ACCRETION AREA

GULF BARRIER CHAIN

ACTIVE DUNE AREA

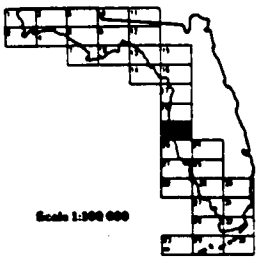
HIGH ENERGY BEACH

STUDY AREA BOUNDARY



FLORIDA ECOLOGICAL ATLAS

OIL, GAS AND MINERAL RESOURCES



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1988

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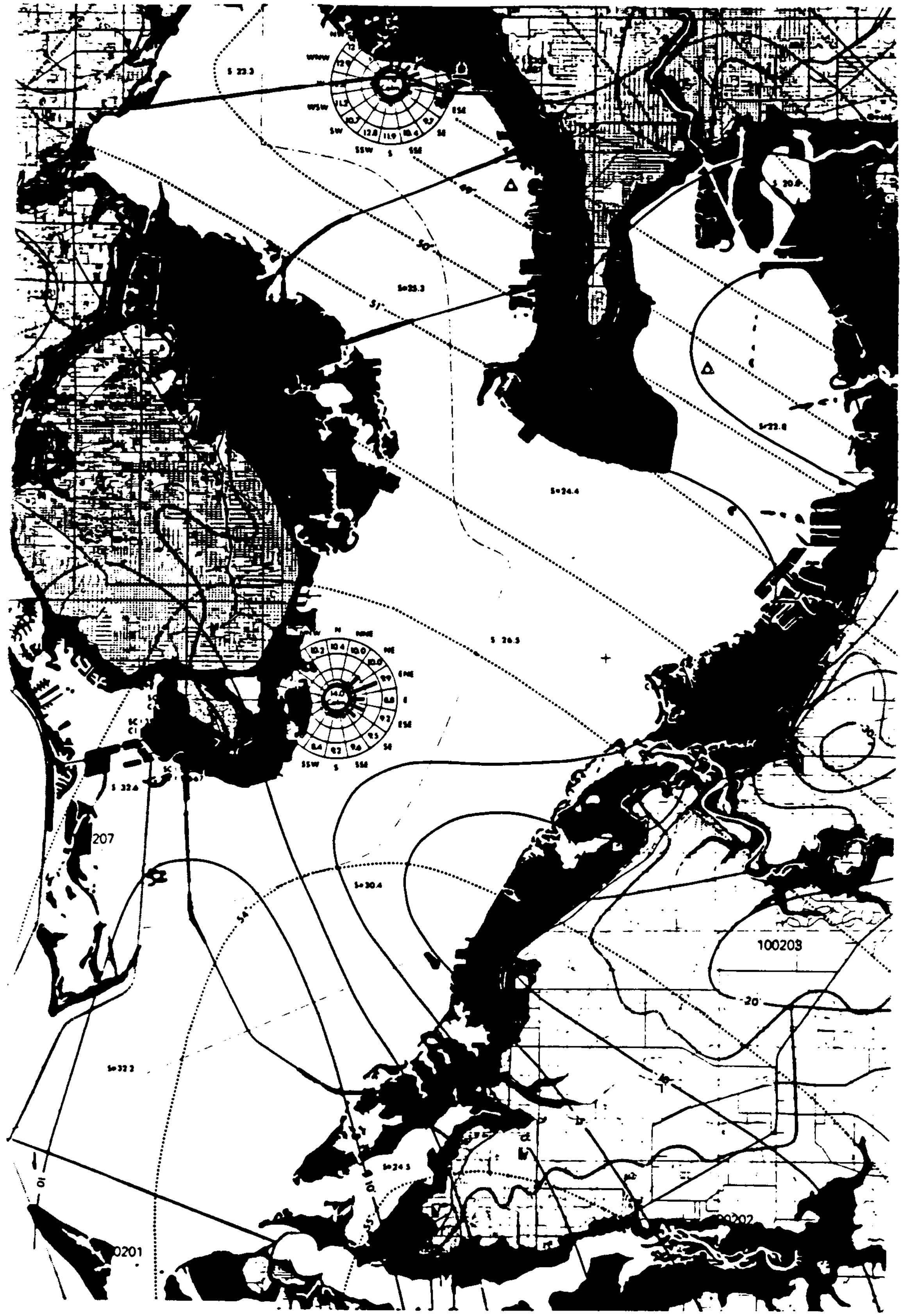
OIL AND GAS

SURFACE MINERAL RESOURCES



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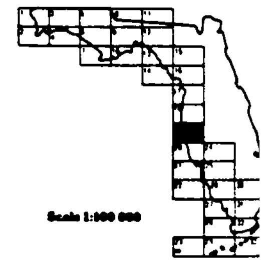
FLORIDA ECOLOGIC ATLAS

HYDROLOGY AND CLIMATO



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E. HYDROLOGY AND CLIMATOLOG

1982

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LEGEND

—— 50' —— POTENTIOMETRIC CONTOUR MAP OF THE FLORIDAN AQUIFER

······ 52" ······ MEAN ANNUAL ISOHYETAL (RAINFALL) CONTOUR MAP

NATIONAL WEATHER SERVICE 30-YEAR CLIMATOLOGICAL STATION

WIND ROSE STATION

OFFSHORE SURFACE CURRENT ROSE STATION

HURRICANE INUNDATION ZONES*

U.S. GEOLOGICAL SURVEY HYDROLOGIC UNIT BOUNDARIES*

LEGEND

U.S. GEOLOGICAL SURVEY STREAM GAGING STATION

U.S. GEOLOGICAL SURVEY GROUND WATER OBSERVATION AND WATER QUALITY WELL

MEAN ANNUAL COASTAL SALINITY

U.S. GEOLOGICAL SURVEY STREAM GAGE AND SURFACE WATER QUALITY STATION

STUDY AREA BOUNDARY

FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION SURFACE WATER QUALITY STATION

ABSTRACT

MMS/GULF OF MEXICO/PHYSICAL OCEANOGRAPHY PROGRAM

Evans Waddell
Science Applications, Inc.

In October 1982, Minerals Management Service initiated a multiyear physical oceanographic (PO) program in the Gulf of Mexico with a twofold objective:

1. Establish a data base that supports both an observational program as well as some of the requirements of a concurrent MMS funded numerical circulation modeling program,

2. Synthesize these data to develop a clearer understanding and definition of key circulatory patterns and associated physical processes.

Results of this study and the associated numerical modeling should provide a rational basis for management decisions relating to OCS oil and gas exploration and development, such as risk and impact assessment, operational procedures and standards, and transportation. The general approach and many elements of the present program design originated with a BLM convened and supported workshop held in May 1981, which brought together scientists (observationalists and modelers) with recent or relevant experience in the Gulf of Mexico.

The measurement portion of the MMS/Gulf of Mexico/PO study has the following phased regional emphasis:

- Years 1 & 2: Eastern Gulf/Loop Current
- Year 3 : Eastern Gulf/Western Gulf
- Year 4 : Gulf wide

Field activities during Program Year 1(PY 1) have been completed, successfully, with standard data products created and distributed to appropriate principal investigators for review and evaluation. PY 2 field measurements described below have been initiated.

Major PY 2 tasks include:

- Subsurface Current/Temperature/Pressure

  All moorings during PY 1 are being maintained. Two additional moorings have been placed on the 40 m and 3400 m isobaths on the main mooring transect. (Figure 1)

- Regional and Subregional Hydrographic Survey

  In May 1984, airplane and ship based observations were combined to resolve regional (Loop Current) and subregional (Loop Current boundary features) conditions and processes. Observations made include:

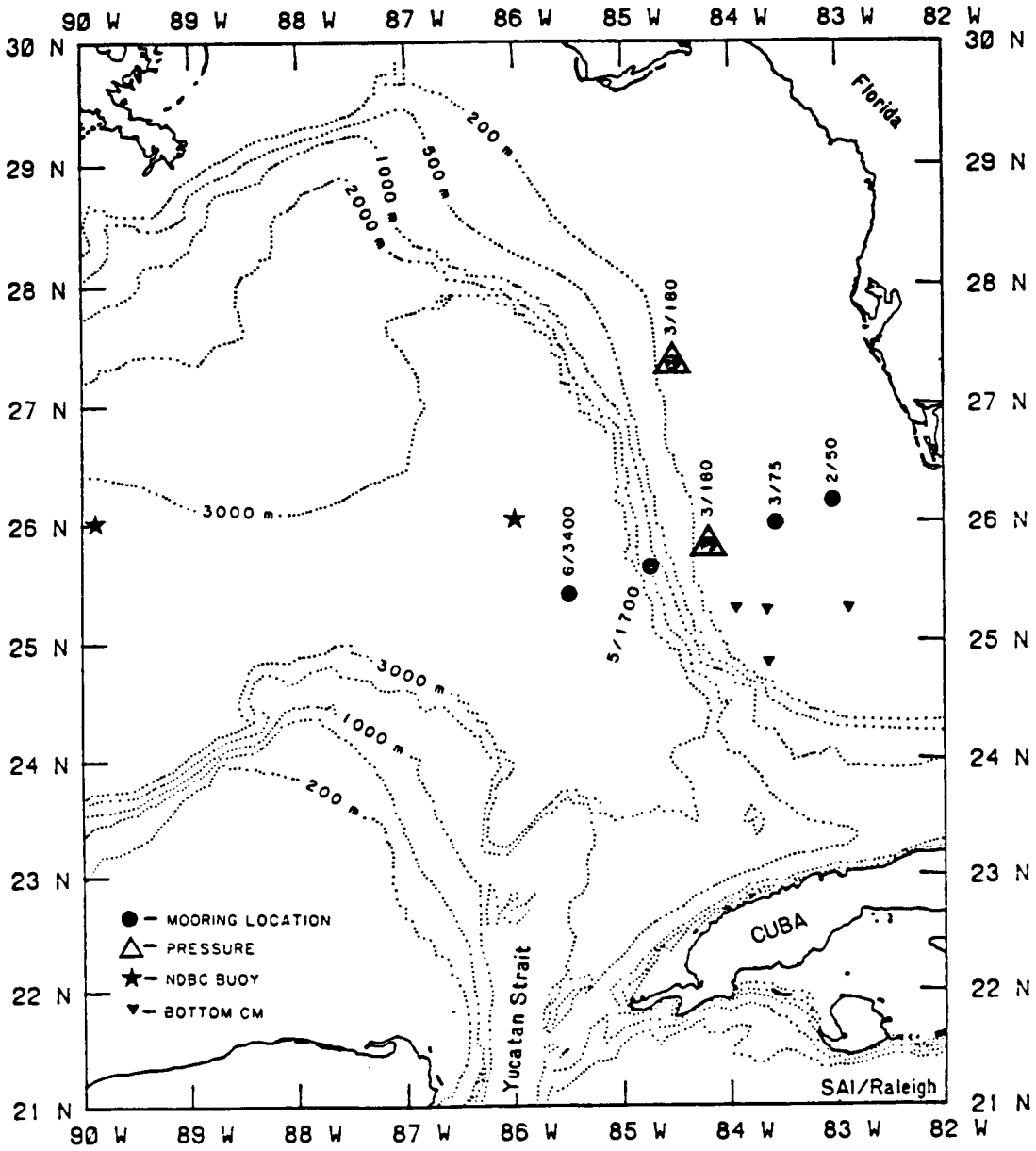


Figure 1. Mooring locations during Program Year 2.

- AXBT/AXCP profiles (Figure 2)
- CTD/XBT profiles (Figure 3)
- Amatec-straza current profiles (Figure 3)
- Ship-of-opportunity transects (Figure 4)
- Satellite imagery

This composite data set will be integrated to develop synoptic and time series characterizations of Loop Current Conditions.

- Satellite Imagery

  Provides relatively high frequency (weather permitting) documentation of sea surface temperature patterns which are often closely linked to circulation patterns. Historical data sets are being evaluated to develop statistics on Loop Current eddy trajectories and shapes.

- Surface Drifters

  Satellite surface drifters have been are being deployed in key circulatory features such as eddies. In April, an MMS mini-buoy was deployed by the R/V GYRE in an eddy shed in February/March (Figure 5). This is providing excellent information.

- Ship-of-Opportunity (SOOP) Program

  The PY 1 SOOP transects between New Orleans and Yucatan and the NMFS/SOOP line from the Dry Tortugas to approximately 27° N, 90° W will continue. MMS is coordinating with other federal agencies to establish additional cooperative arrangements which could substantially expand the SOOP temperature data available to the program.

Close coordination exists between the MMS/Gulf field and modeling studies to assure that needed data are available to support both programs. In particular, we have worked closely together to ensure availability of appropriate meteorological data from marine and coastal locations.

As presently defined, during PY 3 similar types of observations will be made according to a plan that has been defined generally. The goal is to make measurements that document the kinematics and dynamics of Loop Current eddies in the central and western Gulf both in deep/water and as the ring interacts with the continental slope.

Elements in PY 3 include subsurface current measurements ($\sim$ 5 moorings) on the slope on the western basin margin. Locations of moorings will depend on expected eddy trajectories. Two hydrographic cruises will be made on a "fast response" basis to document water mass and the density field associated with Loop Current eddies and related features. One cruise will probably measure conditions in deep water and the other as a ring abutts and interact with the continental slope.

Satellite imagery will help describe the eddy evolution as indicated by the sea surface temperature field as well as help track the eddy in support of hydrographic and subsurface current measurements. Surface drifters (possibly 4-8/year) will provide information on trajectories of surface-constrained, "tagged" water parcels both in and out of eddies. Analyses of these data

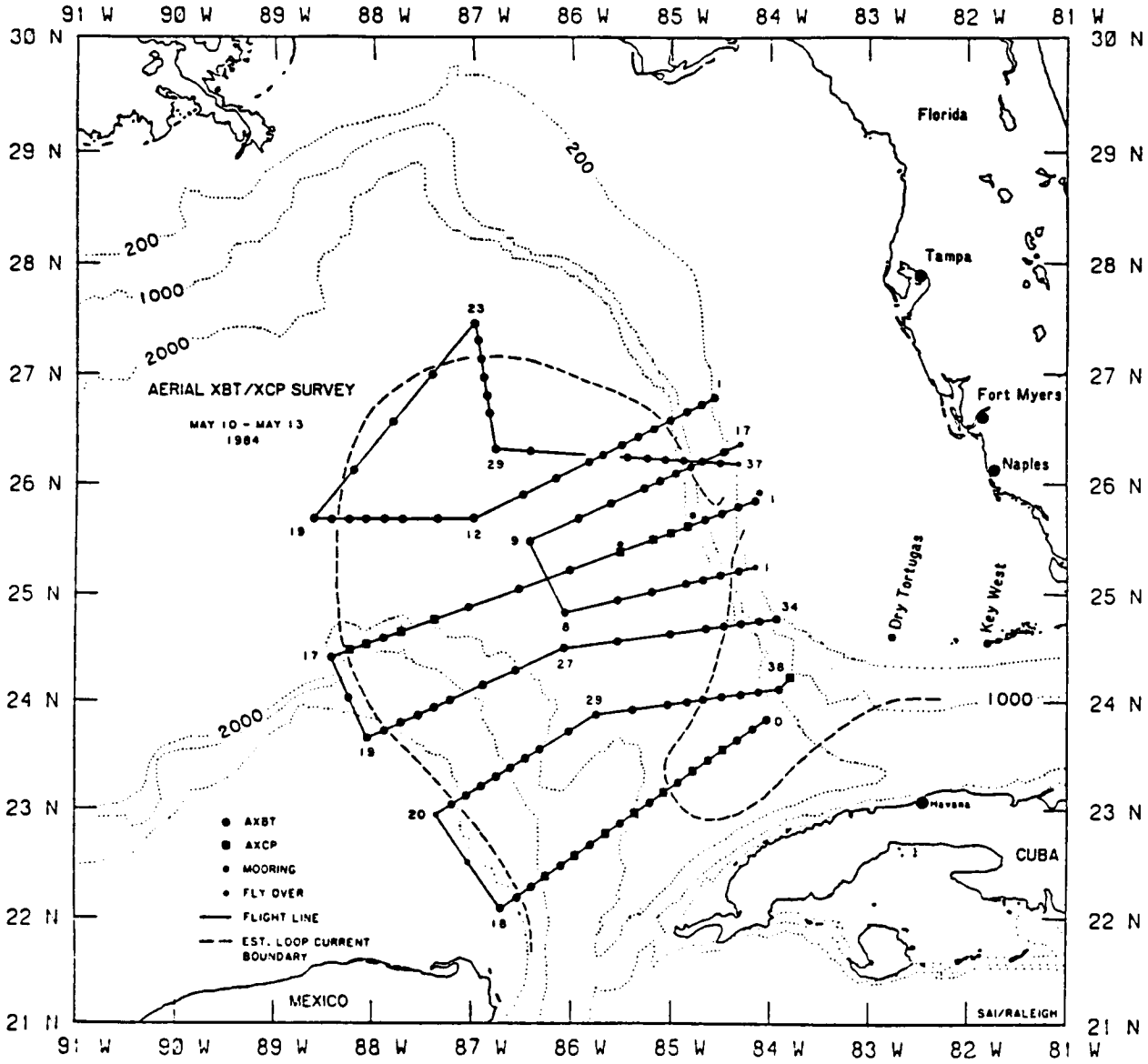


Figure 2. Aerial XBT/SCP sampling plan.

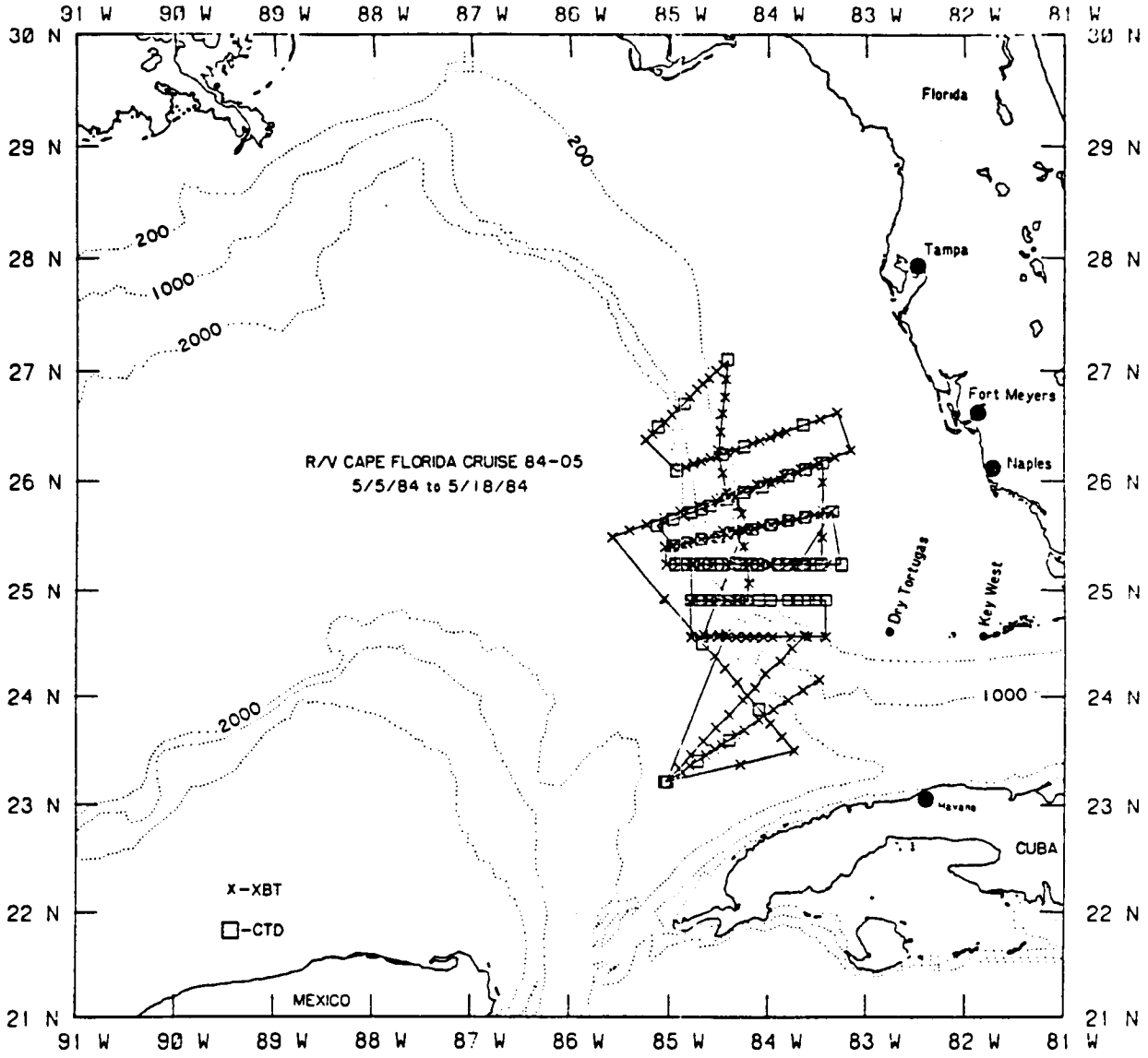


Figure 3. Ship-based hydrographic sampling plan. Many lines were repeated to provide time series and rigorous spatial coverage.

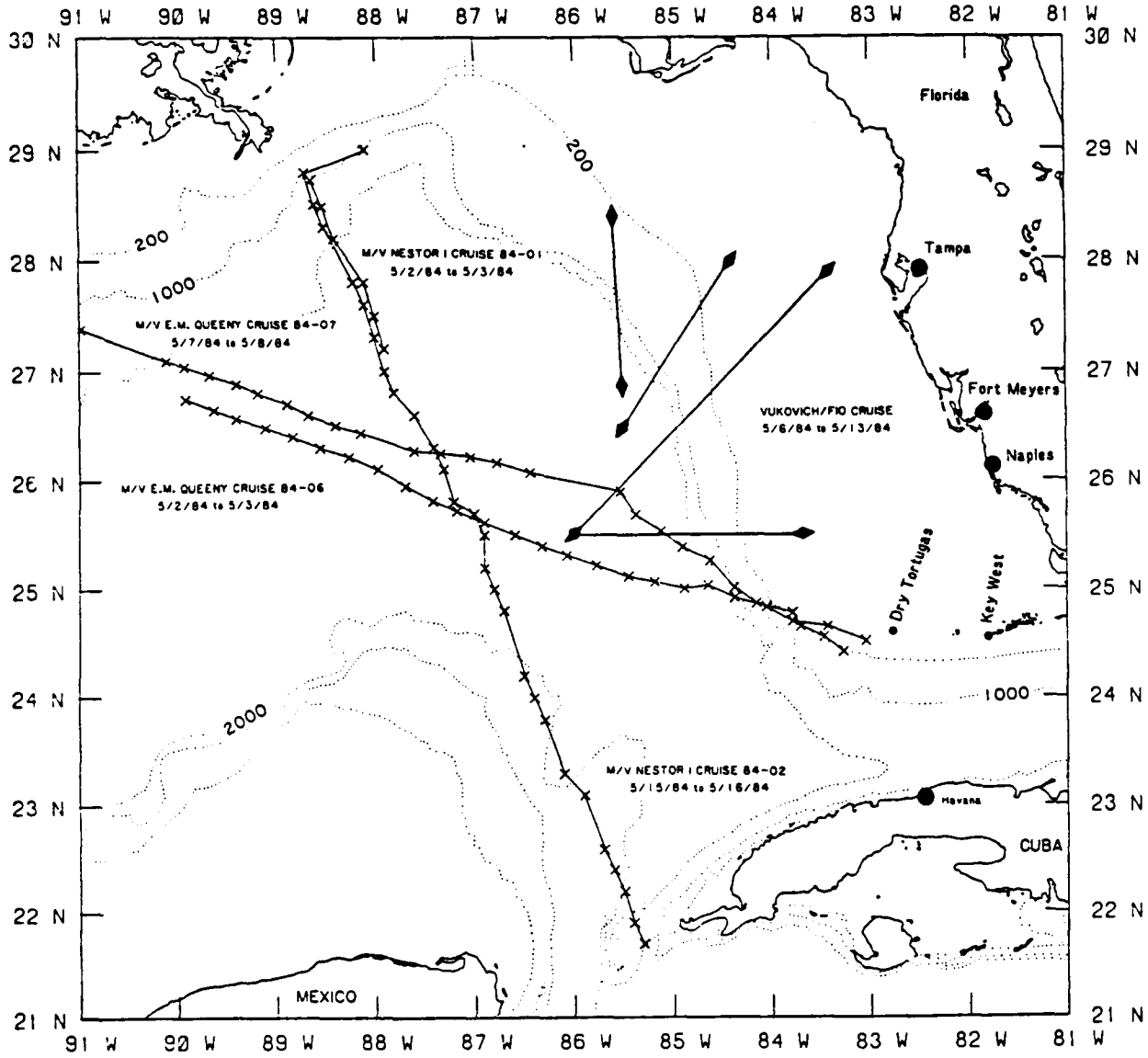


Figure 4. Ship of opportunity XBT transect lines. Vukovich/FIO lines were alternate XBT/CTD stations at 5 n.mi. spacing.

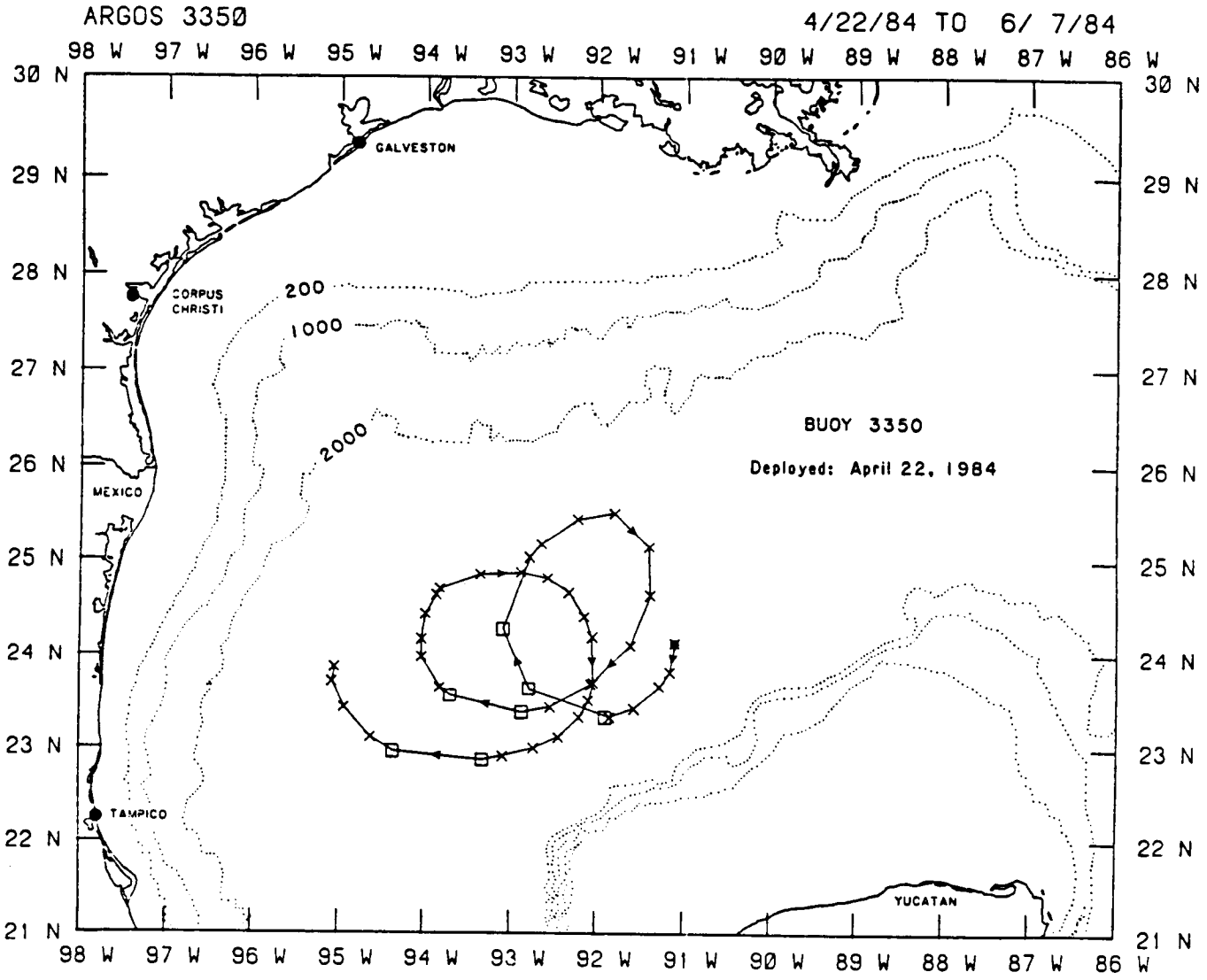


Figure 5. Buoy 3350 trajectory in a Loop Current eddy which was shed in February/March. "X's" are placed every day with boxes bracketing presently unavailable daily observation. These unavailable data will be obtained when ARGOS summary tapes are received. This trajectory comes from real-time access of the ARGOS computer.

will provide a better understanding and description of ring kinematics and dynamics. The buoys will also help define circulation in the central and western Gulf when no rings are present as well as provide assistance in locating rings in summer when an absence of sea-surface temperature gradients make it impossible to use remote thermal imagery.

The SOOP is expected to continue through all program years. It is hoped that in PY 2 or 3 an additional transect between New Orleans and Tampico/Vera Cruz can be added to those presently maintained.

Year 4 is to involve many of the same measurements such as selected current measurements; however, there will probably be a substantially expanded emphasis on several quasi synoptic "pictures" of the conditions and circulation in the deep Gulf. This effort will be closely coordinated with programs funded by several other federal agencies. A Year 5 may be necessary to allow time and support for a complete integration of results from all of the prior program years.

In support of this multiyear effort, the Environmental Studies Staff in the MMS/New Orleans office continues to encourage and seek cooperation with other programs and government agencies. This has resulted and continues to result in cost effective observations being available to support the MMS objectives. Several such cooperative efforts are presently in place, e.g. Louisiana State University, NOAA/NMFS, State of Florida and NOAA/AOML.

REFERENCES

Kirwan, A.D., Jr., W.J. Merrell, Jr., J.K. Lewis, R.E. Whitaker, 1984, Lagrangian Observations of an Anticyclonic Ring in the Western Gulf of Mexico, JGR, Vol. 89, No. C3, pp. 3417-3424.

Kirwan, A.D., Jr., W.J. Merrell, Jr., J.K. Lewis, R.E. Whitaker, R. Legeckis, 1984, A Model for the Analysis of Drifter Data with an Application to a Warm Core Ring in the Gulf of Mexico, JGR, Vol. 89, No. C3, pp. 3425-3438.

GULF OF MEXICO CIRCULATION MODELING STUDY

ALAN J. WALLCRAFT

JAYCOR

SUMMER TERNARY STUDIES MEETING

June 1984

INTRODUCTION

The Gulf of Mexico Circulation Modeling Study was started by MMS in October 1984 as an "extremely modest effort building on existing/ongoing modeling efforts in the Gulf of Mexico". The initial requirement was for an existing circulation model with capabilities approaching those required and the ability to deliver an "early simulation run". At the end of the four year program the requirement was for a circulation model of the entire Gulf with horizontal resolution approaching 10km, and vertical resolution (initially less important) approaching:

mixed layer:	1 - 10 m
thermocline:	10 m
deep layer:	100 m

with realistic bottom topography, coastline, and wind forcing, which must exhibit loop-current eddy shedding, and other known regional circulation features.

The Naval Ocean Research and Development Activity (NORDA) has been modeling the Gulf of Mexico since 1976. The first set of simulations were performed with an efficient high horizontal resolution circulation model, but over a rectangular region approximating the Gulf and with only highly idealised bottom topography. These demonstrated the viability of this approach and showed that the approximately annual Loop Current eddy shedding cycle could be obtained with fixed inflow transport through the Yucatan Straits and no wind forcing (Hurlburt and Thompson, 1980, J. Phys. Oceanogr. 10 pp 1611-1651). Later NORDA funded JAYCOR to extend the model to allow general coastline geometry, and to perform numerical simulations of Gulf circulation using this model with realistic coastline geometry, bottom topography, and forcing fields. Some comparisons of the results of preliminary simulations and observations in the Gulf are shown in figures 1, 2, and 3.

THE EXISTING NORDA/JAYCOR MODEL

This is a two layer, non-linear, hydrodynamic, free surface, semi-implicit, primitive equation ocean circulation model on a beta plane, with realistic coastline, and full scale bottom topography confined to the lower layer. Horizontal grid resolution is 0.2 degrees (20 by 22 km), with a upper layer rest depth of 200 m. The model is driven by inflow through the Yucatan Strait compensated by outflow through the Florida Strait, and/or by winds.

PROBLEMS WITH THE EXISTING MODEL

1) Only 0.2 degree horizontal grid resolution - need 0.1 degree.
2) Model is hydrodynamic - thermohaline circulation particularly important during fall and winter, and over shelf areas.
3) Crude representation of the vertical density profile - need mixed-layer physics.
4) Model has full scale bottom topography (which is essential for a good simulation), but the layer interface(s) must not intersect the bottom. Shallowest topography in model is at 500m.

MODEL DEVELOPMENT PLAN

YEAR 1

Use existing 2-layer 0.2 degree Gulf of Mexico model. Find "best" representation of coastline and bottom topography. Initially use seasonal wind forcing and constant inflow, later simulations will use winds based on 12 hourly NMC surface pressure analysis and time varying inflow.

Products:

Early delivery of a Gulf simulation without wind forcing, experiment #9 - delivered October 1983.
Wind data set based on NMC's 12 hourly global surface pressure analysis (1966 - 1980 or later), processing funded by NORDA.
Gulf simulation surface current data set selected as the "best" available simulation to date (October 1984), will be forced by "NMC" winds. Not all model experiments will be delivered. Gulf data set will be every 10 days for many eddy cycles (ten years or more) to capture the full Gulf circulation variability.

YEAR 2

Use 2-layer model, but on a 0.1 degree grid, and with lower eddy viscosity. Expect richer flow field, including wind induced flow instabilities. Some experiments will use 1-layer (reduced gravity) model, but all delivered simulations will have 2-layers.

Products:

One or more Gulf simulation surface current data sets, selected as the "best" available simulation to date (not all model experiments will be delivered). Data sets will be every 10 days for many eddy cycles (ten years or more) to capture the full Gulf circulation variability. At least one simulation will be delivered by June 1985.

YEAR 3

Develop 3-layer model with bulk thermodynamics. Densities in each layer will be allowed to change locally with time, under control of the equation of state and temperature equation added to model. Initially 0.2 degree simulations, later 0.1 degree grid will be used.

Expect to see thermohaline circulation and improved representation of permanent thermocline. Three layers also better resolve "hydrodynamic" circulation, and thinner upper layer increases accuracy of surface velocities.

Products:

One or more Gulf simulation surface current data sets, selected as the "best" available simulation to date (not all model experiments will be delivered). Data sets will be every 10 days for many eddy cycles (ten years or more) to capture the full Gulf circulation variability. At least one data set will also include sub-surface currents.

YEAR 4

Complete 0.1 degree 3-layer simulations. Then couple circulation model results to a mixed layer model (TOPS). TOPS is the Navy's operational mixed layer forecast model. Simplest version of TOPS is one dimensional, with 15+ fixed vertical levels covering upper 500m. It can accept geostrophic currents from any suitable source, the 3-layer model is suitable but the 2-layer (hydrodynamic) is not. Can use coarser grid for TOPS (0.2 or 0.4 degrees), possibly with finer coverage of selected regions (TOPS is 1-dimensional). It is applied only after spin-up of the circulation model.

This final coupled model will give detailed vertical density profiles, and greatly improve the simulation accuracy in shelf regions.

Products:

One or more Gulf simulation surface and sub-surface current data sets, selected as the "best" available simulation to date (not all model experiments will be delivered). Data sets will be every ten days for many eddy cycles (ten years or more) to capture the full Gulf circulation variability.
At the end of year 4 a fully documented FORTRAN code and user guide for the final model versions will be delivered. No earlier codes will be delivered, since they may not be in a suitable form for distribution.

OBSERVATIONAL DATA

A typical Gulf of Mexico simulation is ten or more years long, and will resolve dynamic features as small as 50 - 100 km across. The observational data base is orders of magnitude too sparse, both in time and in space, to be used directly in initialising or updating the simulation (except potentially at the Yucatan Straits).

The model is set up to match the gross physical parameters of the Gulf (coastline, topography, lat., long., density profile), and statistically correct external forcing is applied (wind stress, heat flux, and flow through the Yucatan Straits). It is expected that the simulated Gulf circulation will then exhibit all the features observed in the Gulf with the correct mean, variation about the mean, periodicity, magnitude, etc. . This expectation is backed up by the fact that quite gross approximations to the forcing functions (e.g. constant Yucatan inflow) produce "realistic" circulations.

The external forcing will be based on observational data and will therefore have a date associated with it. But this date cannot be applied to the simulated circulation because there is no data available to initialise the ocean model to exactly the ocean state existing at any one moment in time (i.e. the simulation is not a hindcast of the Gulf of Mexico). Most individual observations cannot therefore be compared directly to the model results. They can be used however to obtain detailed statistics on major circulation features, such as:

1) Loop Current penetration speed and distance with time.
2) Frequency and magnitude of loop current intrusion onto Florida Shelf.
3) Loop Current eddy shedding period, and position when shed.
4) Loop Current eddy rotation speed, size, and propagation speed and direction.
5) Characteristics of counter-rotating vortex pair and decaying eddies in Western Gulf.
6) Characteristics of wind driven features.

Identified data sources for direct comparison are:

1) Satellite altimeter based sea surface variability.
2) Drifting buoys.
3) Regular ship-of-opportunity tracks across the Gulf.
4) Long time series current meters.
5) Ship and aircraft hydrographic surveys that provide synoptic data for a region covering a circulation feature.
6) Surface drifters.

Sea surface variability from existing altimeter data is the only available Gulf wide verification field, see figures 4, 5 & 6. Near synoptic sea surface maps of the Gulf may later become available from the extended GEOSAT mission. Simulated drifter tracks can be generated by the ocean model for comparison with actual tracks. One very useful representation of regular ship track data is phase plots of the depth of a given isotherm against time, similar plots can be generated from model simulations, see figure 7. Current meters provide the most concrete verification data, but they are useful only in long time series linked to some knowledge of the state of the Gulf wide circulation at that time. Synoptic surveys can provide invaluable insights into characteristic circulation patterns, see figures 1 & 3.

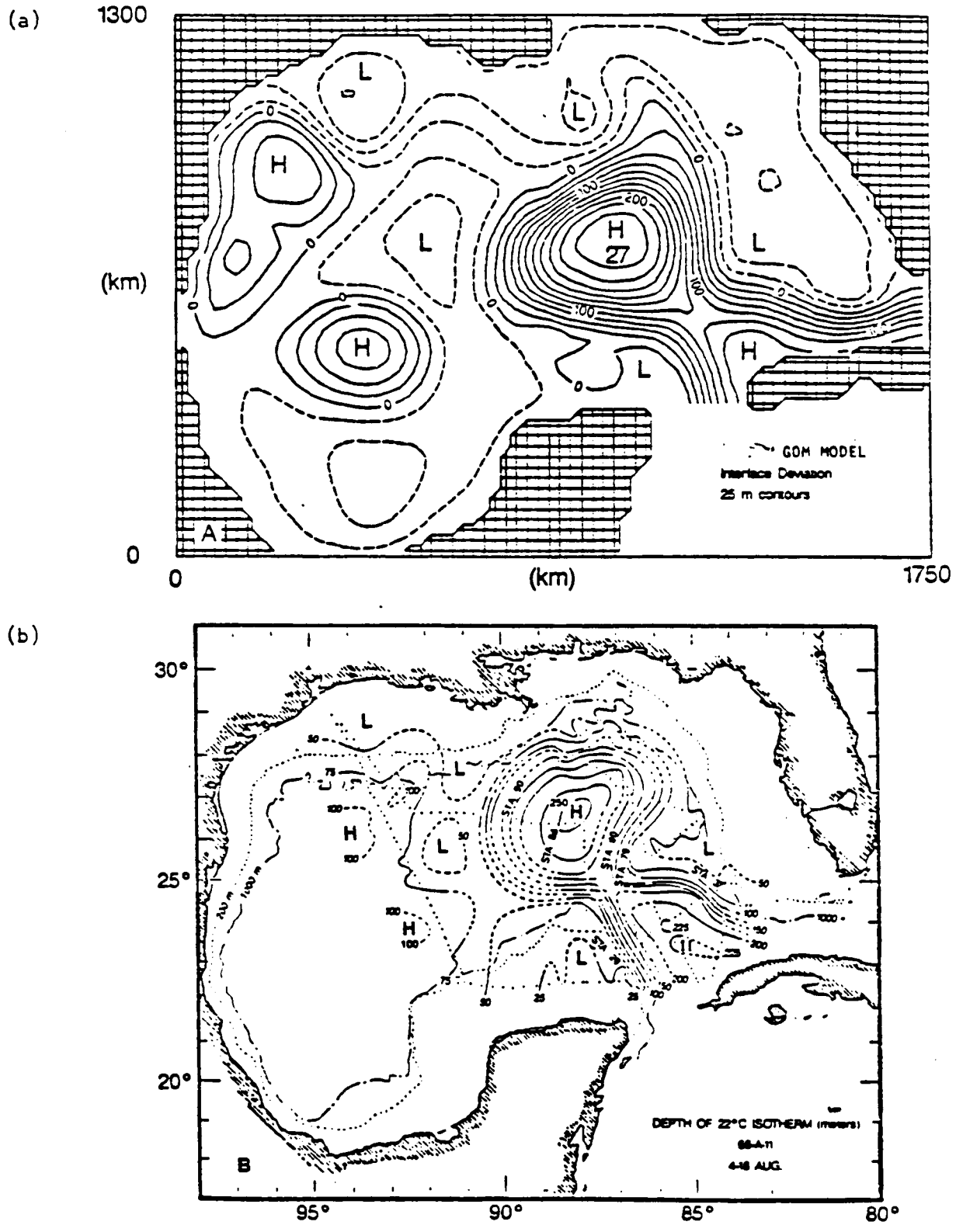


Figure 1 (a) Instantaneous view of the interface deviation in a two layer Gulf of Mexico model driven solely by inflow through the Yucatan Straits. The contour interval is 25 m with solid contours representing downward deviations. (b) Depth of the 22°C isothermal surface, 4-18 August 1966 from Leipper (1970). The contour interval is 25 m.

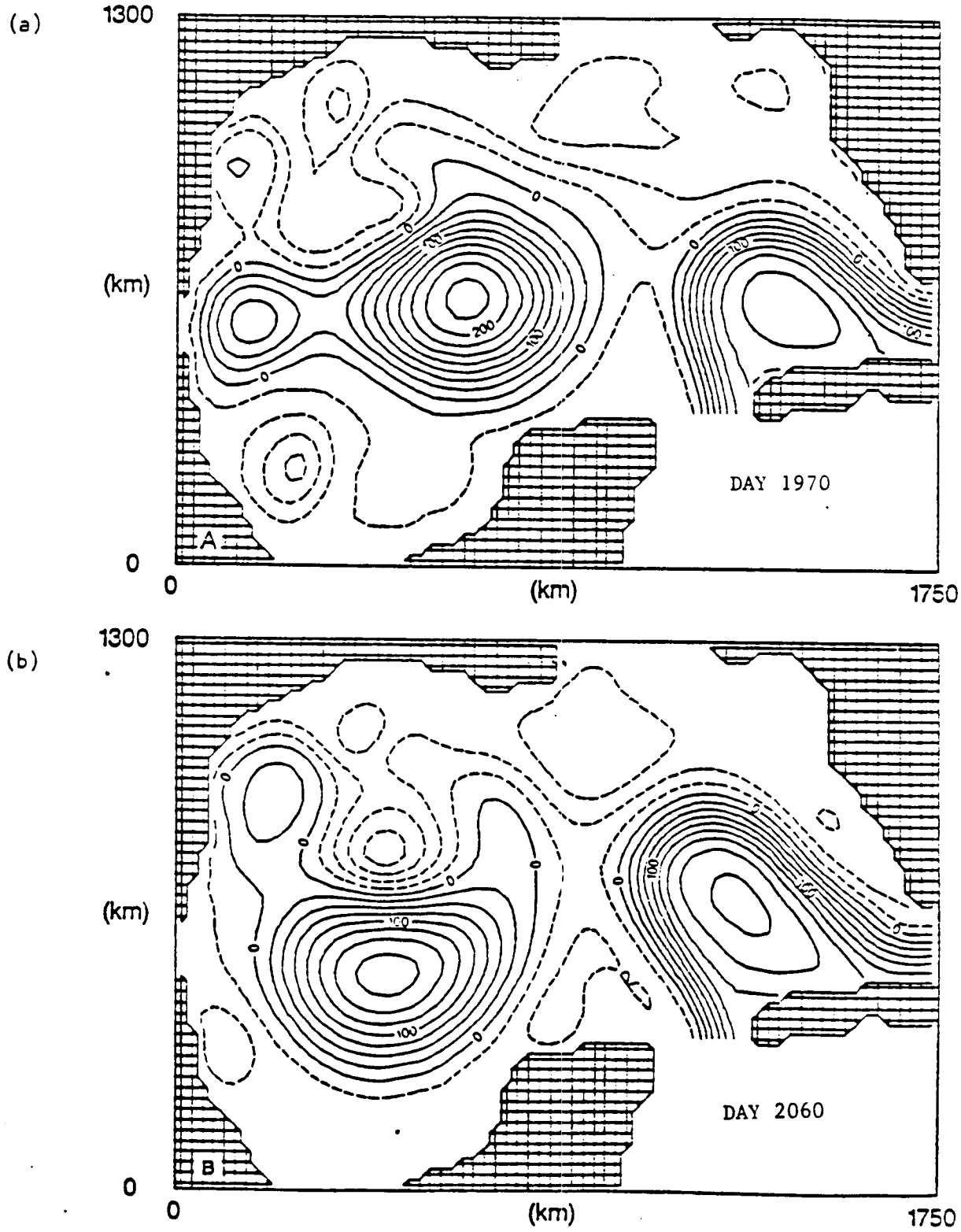


Figure 2 (a) Interface deviation from the simulation at day 1970 after an eddy has separated from the model Loop current and propagated westward. (b) Ninety days later the eddy at day 1970 has developed into a counter rotating vortex pair in the western Gulf. The cyclonic vortex is to the north and the anticyclonic to the south. The contour interval is 25 m.

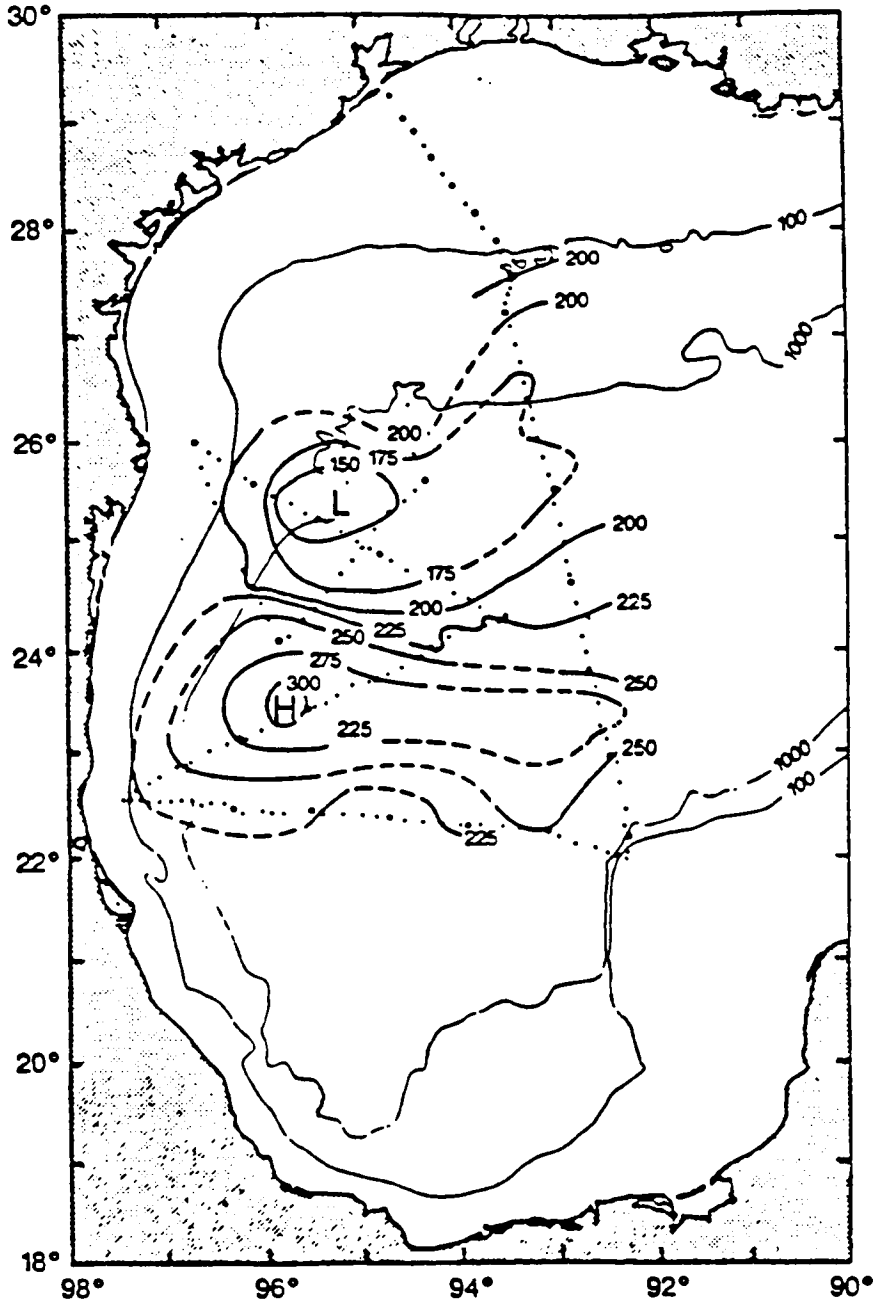


Figure 3 Counter-rotating vortex pair in the western Gulf of Mexico as shown by the depth of the 15°C isotherm in April 1978. The cyclonic vortex is to the north and the anticyclonic to the south. The contour interval is 25 m, from Merrell and Morrison (1981).

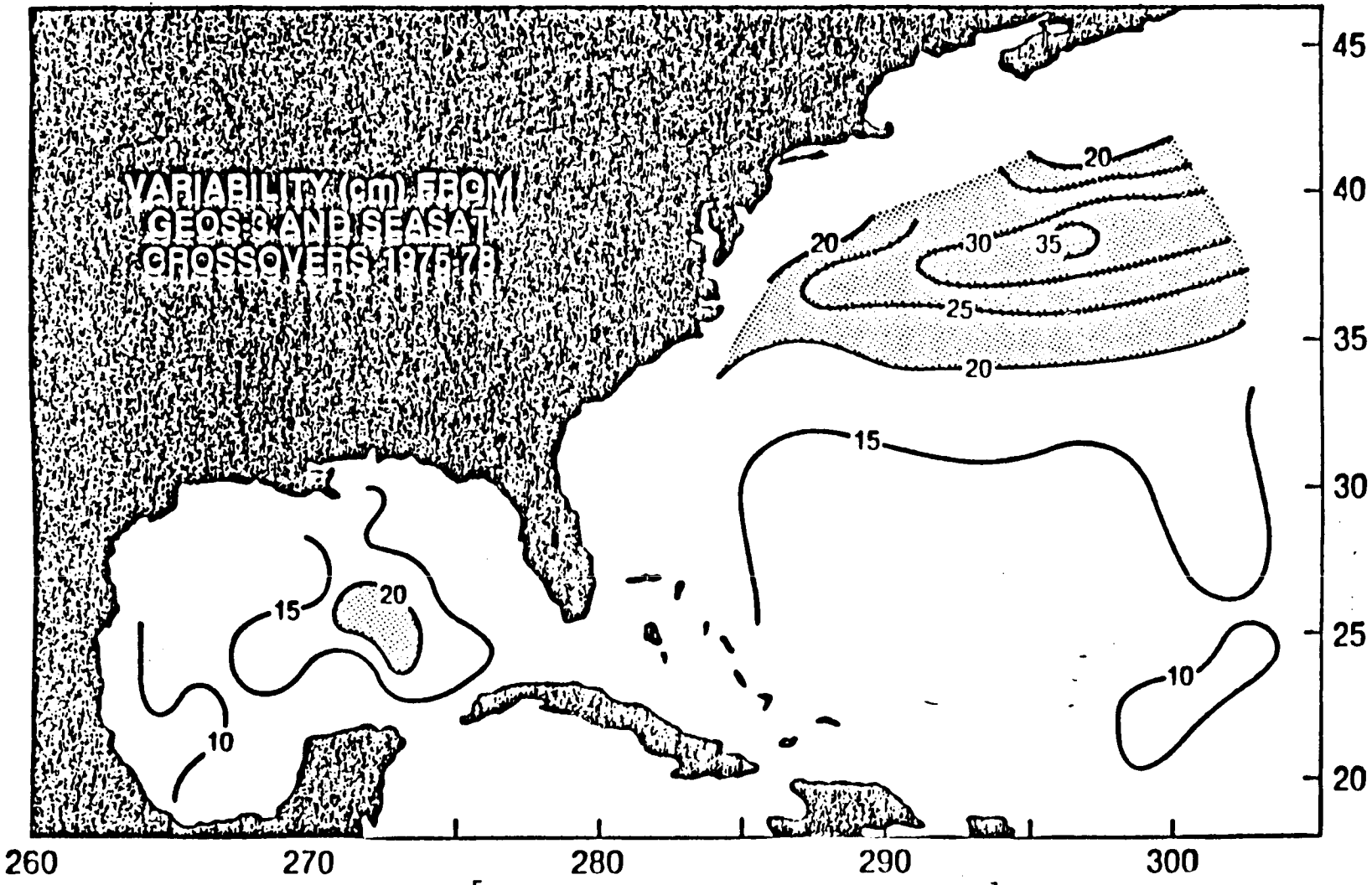


Figure 4

[from marsh, Cheney, and McCarthy (1984)]

SEA SURFACE VARIABILITY IN THE NORTHWEST ATLANTIC AND THE GULF OF MEXICO DERIVED FROM GEOS–3 AND SEASAT CROSSOVER DIFFERENCES

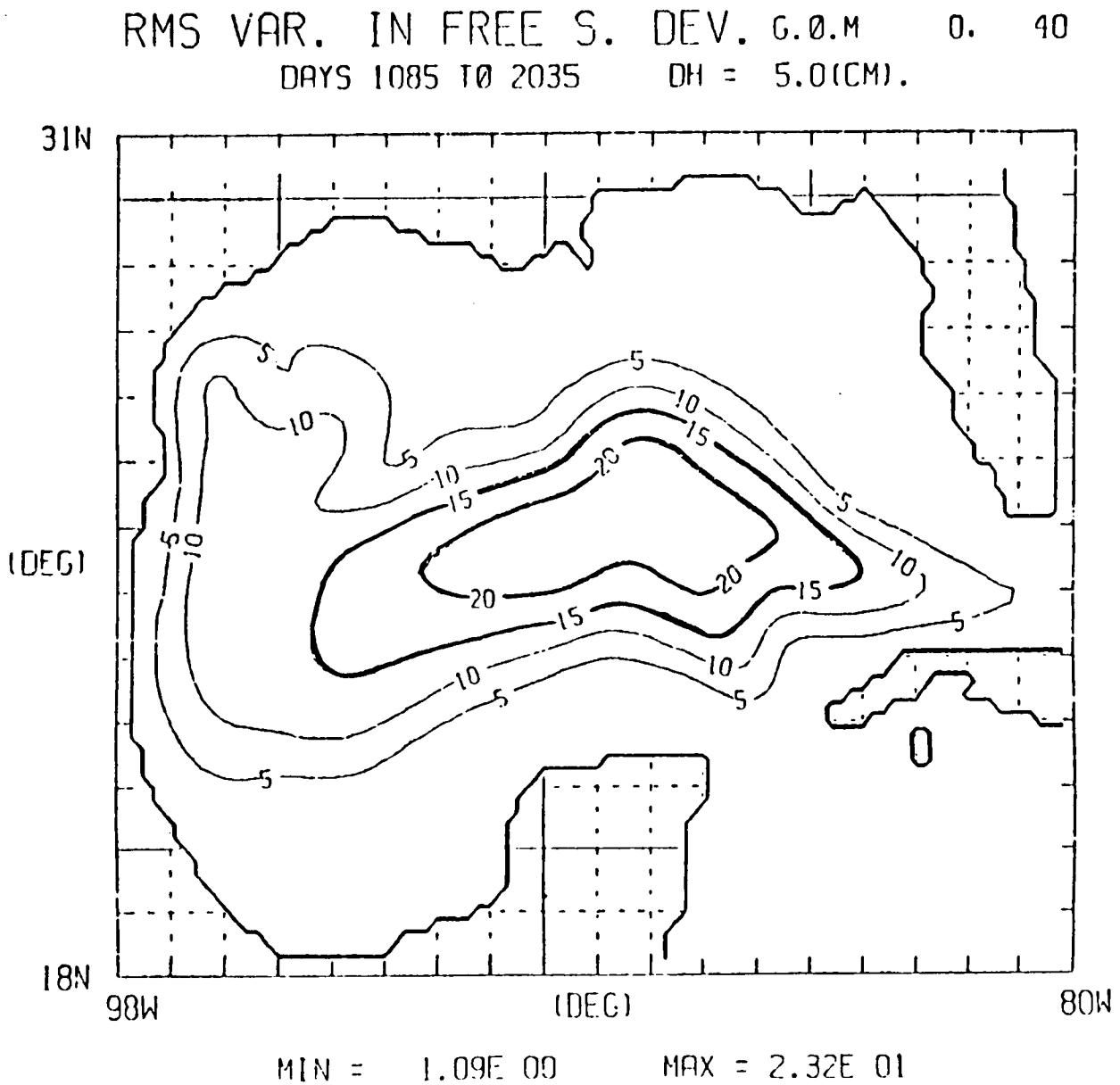

RMS VAR. IN FREE S. DEV. G.0.M 0. 40
DAYS 1085 T0 2035 DH = 5.0(CM).
31N
(DEG)
18N
98W
(DEG)
80W
MIN = 1.09E 00 MAX = 2.32E 01

Figure 5

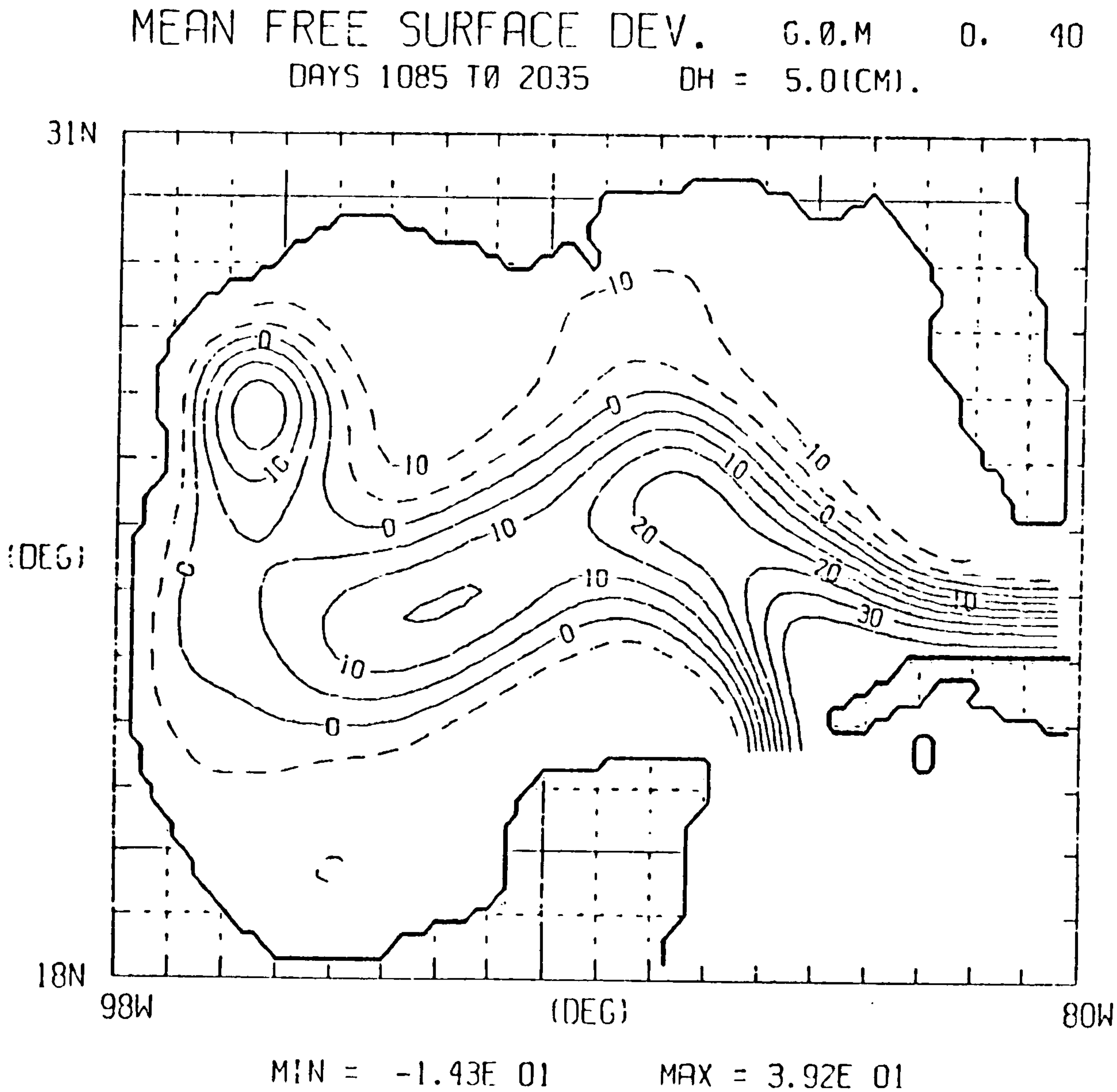
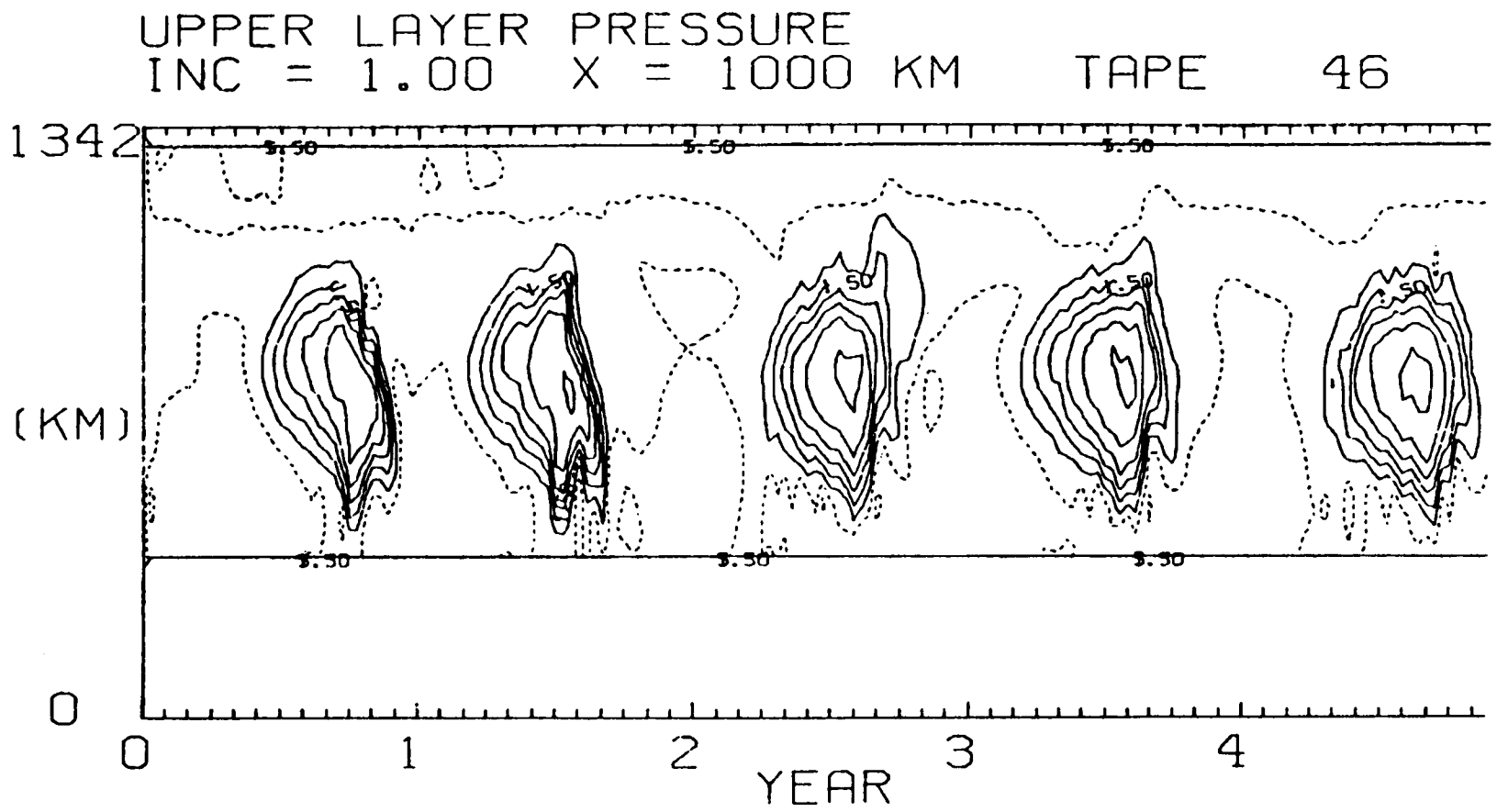

MEAN FREE SURFACE DEV. G.Ø.M 0. 40
DAYS 1085 TØ 2035 DH = 5.0(CM).
31N
18N
98W
(DEG)
80W
(DEG)
10
0
-10
20
30
MIN = -1.43E 01
MAX = 3.92E 01

Figure 6



CONTOUR FROM -2.5000 TO 7.5000 CONTOUR INTERVAL OF 1.0000 PT(3,3)= 0.98000E 09

3.0. List of Registered Attendees.

Minerals Management Services
Ternary Meeting
June 1984

ATTENDEES

Dr. Roger D. Anderson Gulf & So. Atl. Fisheries Dev.Foundation
5401 W. Kennedy Blvd., Suite 571 Tampa FL 33609

Dr. Robert M. Avent MMS GOM Regional Office

Mr. James Barkuloo U.S. Fish & Wildlife Service Ecological Services Division
1612 June Avenue Panama City FL 32405

Dr. William Behrens, Jr. Florida Institute of Oceanography
830 First St. South St. Petersburg FL 33701

Dr. Wayne D. Bock Bock-Soensuli Enterprises
8005 SW 52 Ave. Miami FL 33143

Dr. Murray Brown MMS GOM Regional Office

Dr. Larry Danek Environmental Science & Engineering
Box ESE Gainesville FL 32602

Mr. Richard Dawson U.S. National Park Service Everglades National Park
P.O. Box 279 Homestead FL 33030

Dr. Richard Defenbaugh MMS GOM Regional Office

Mr. Don Ekberg NOAA/NMFS Habitat Conservation Division
9450 Koger Blvd. St. Petersburg FL 33702

Mr. Doug Elvers MMS GOM Regional Office

Mr. Jerry Ford Florida A&M University College of Eng.Sci., Tech. & Agriculture
P.O. Box 338 Tallahassee FL 32307

Mr. John Gosdin State of Texas Office of the Governor
P.O. Box 13564 Austin TX 78711

Dr. Charles G. Groat Louisiana Geological Survey
P.O. Box G, University Station Baton Rouge LA 70893

Dr. Richard M. Hammer Continental Shelf Associates, Inc.
P.O. Box 3609 Tequesta FL 33458

Dr. Gregory Han General Oceanics, Inc.
1295 NW 163 St. Miami FL 33169

Mr. Walt Jaap Fla. Dept. of Natural Resources Marine Research Division
100 8th Ave., SE St. Petersburg FL 33701

r. Tom Kunneke Martel Laboratories, Inc.
00 30th Ave., N. St. Petersburg FL 33710

r. Dana Larson Exxon Co., USA Exploration Division
.O. Box 4279 Houston Texas 77210

r. George L. Lewbel LGL Ecological Research Assoc.,Inc.
110 Cavitt Street Bryan TX 77801

r. Andreas Mager NMFS Protected Species Mgnt. Branch
450 Koger Blvd. St. Petersburg FL 33702

r. Jim Martin Mobile Oil Expl. & Prod., SE Inc.
250 Poydras New Orleans LA 70113

s. Bethlyn McCloskey
113 Bissonet Dr. Metairie LA 70003

r. Rob Mink State Oil & Gas Board of Alabama Geophysics & Offshore Division
.O. Drawer O Tuscaloosa AL 35486

r. Donald R. Moore University of Miami Rosenstiel Sch. of Marine & Atmospheric Sci.
600 Rickenbacker Causeway Miami FL 33149

r. Allan J. Mueller U.S. Fish & Wildlife Service Ecological Services Division
7629 El Camino Real, Suite 211 Houston TX 77058

r. Thomas F. Palik Martel Laboratories
100 30th Ave, North St. Petersburg FL 33713

r. Richard Rezak Texas A&M University Dept. of Oceanography
College Station TX 77843

r. Murice Rinkel Florida Institute of Oceanography
830 1st Street South St. Petersburg FL 33701

r. Robert Rogers MMS GOM Regional Office

r. Cordell J. Roy National Park Service Everglades National Park
.O. Box 279 Homestead FL 33031

r. Tom Scott Florida Geological Survey - DNR Resource Management Division
903 W. Tennessee St. Tallahassee FL 32304

r. Kevin Shaw Barry Vittor & Associates
8100 Cottage Hill Road Mobile AL 36609

s. Lorna Sicarello U.S. Fish & Wildlife Service Ecological Services Division
1612 June Ave. Panama City FL 32405

r. Harry Sieverding MMS GOM Regional Office

Mr. Keith D. Spring Continental Shelf Associates, Inc.
P.O. Box 3609 Tequesta FL 33458

Dr. Karen Steidinger Fla. Dept. of Natural Resources Bureau of Marine Research

100 8th Ave. S.E. St. Petersburg FL 33701

Mr. J.E. Thomas
36 Greenbriar Drive Gulfport MS 39501

Ms. Deborah Tucker Executive Office of the Governor
The Capitol Tallahassee FL 32301

Ms. Virginia Van Sickle Louisiana State Geological Survey
P.O. Box 6 Baton Rouge LA 70893

Ms. Sandra Vargo Florida Institute of Oceanography
830 1st Street South St. Petersburg FL 33701

Ms. Cheryl Vaughan MMS GOM Regional Office

Mr. Syd Verinder MMS GOM Regional Office

Dr. Barry A. Vittor Barry Vittor & Associates
8100 Cottage Hill Road Mobile AL 36609

Dr. Evans Waddell Science Applications, Inc.
4900 Water's Edge Dr. Raleigh NC 27606

Dr. Alan Wallcraft Jaycor, Inc. c/o NORDA Modeling Branch, Code 323
NSTL Station MS 39529

Mr. Robert L. Whitman Mangrove Systems
P.O. Box 15759 Tampa FL 33684

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.