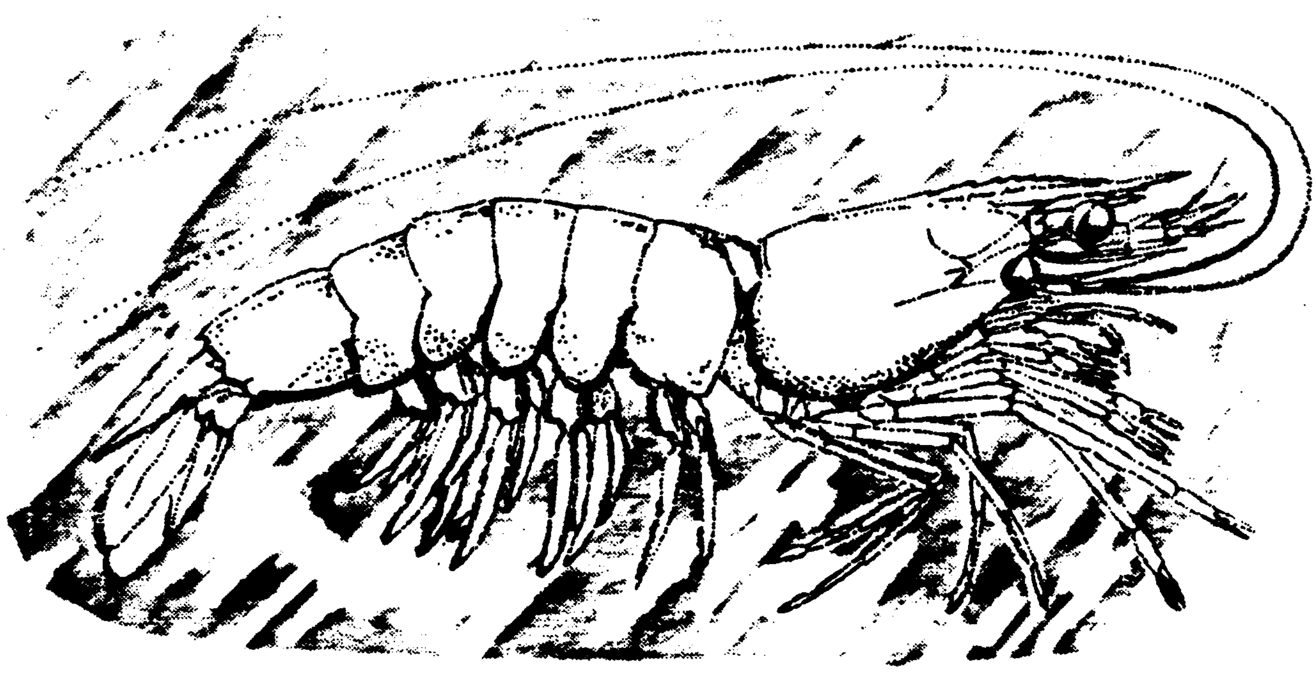
OCS STUDY
MMS 84-0033

PROCEEDINGS
WINTER TERNARY
GULF OF MEXICO STUDIES MEETING

February 1984



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

Proceedings: Winter Ternary

Gulf of Mexico Studies Meeting

February 14, 1984

New Orleans, Louisisna

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

Preface

This Proceedings volume is based on activities which occurred as part of the Winter Ternary Meeting held in New Orleans on February 14, 1984. Arrangements for the meeting were made by Science Applications, Inc. (SAI), Ms. Ellen Bivins (SAI) was responsible for coordinating meeting logistics and much of the coordination with MMS.

TABLE OF CONTENTS

1.0. Introduction

Ternary Meetings are held at regular intervals throughout the year as part of the planning and coordination activities of the Environmental Studies Group of the Minerals Management Service, Gulf of Mexico OCS Office. The goal of these meetings is to provide a forum at which various funded programs can keep both MMS personnel and other interested parties, such as the Technical Regional Working Group, up-to-date and aware of progress and insights being developed. It also provides a mechanism for exchange of information between programs. On occasion, speakers who may not be funded by MMS but who are involved in work having relevance to the MMS mission are invited to make presentations.

The present report provides information and abstracts for the Winter Ternary Meeting held at the MMS Building in New Orleans, LA in February 1984. Included is a Meeting Summary, Abstracts of Presentations, and finally a List of Attendees.

The program opened with a welcome and discussion of plans by Dr. E. Waddell. This was followed by Dr. M. Brown who provided an excellent summary of the meeting goals and objectives. There was a less extensive agenda for this meeting and all presentations listed in the Agenda (Figure 1) were completed in a day. The time available for each presentation was such that it fostered and encouraged considerable exchange and discussion.

Section 2.0 of these Proceeding are extended abstracts for the eight technical presentations. These abstracts are followed in Section 3 by a list of attendees.

AGENDA

MINERALS MANAGEMENT SERVICE

ENVIRONMENTAL STUDIES TERNARY MEETING

February 14, 1984

Metairie, LA

Time	Topic	Speaker
AM		
9:30	Welcome	E. Waddell (SAI)
9:40	Introductory Remarks	M. Brown (MMS)
9:50	Gulf Circulation Modeling	A. Wallcraft (Jaycor)
10:20	BREAK	
10:30	Physical Oceanography Study	E. Waddell (SAI)
11:00	West Florida Shelf Benthic/Sediment Interaction Study	L. Danek (ESE)
11:30	LUNCH	
PM		
1:00	Tuscaloosa Trend Study	K. Shaw (Barry Vittor Assoc.)
1:30	Continental Slope Study	B. Galloway (LGL)
2:00	Ecological Summary Mapping	R. Darnell (TAMU)
2:25	BREAK	
2:35	Nearshore Habitat Mapping Study	G. Wermund (University of Texas)
3:00	Coastal Characterizations	J. Johnston (U.S. Fish & Wildlife)
3:30	ADJOURN	

Figure 1.

2.0. Meeting Abstracts

2.1. Introduction

Presentations were generally organized so that programs discussed first had a physical orientation or a substantial element which could support physical oceanographic studies. Dr. Alan Wallcraft (JAYCOR) described the status of numerical modeling of deep Gulf circulation patterns. This was followed by Dr. E. Waddell (SAI) who discussed the Gulf physical oceanographic field measurements. Dr. L. Danek (Environmental Sciences and Engineering) described the recently initialed Benthic/Sediment Interaction Study which is a biologically directed study that contains considerable physical oceanographic measurements (e.g. currents, waves). This study provided a transition in program emphasis to biologically oriented studies which were described after a lunch break.

Mr. K. Shaw (Barry Vittor Assoc.) described the Tuscaloosa Trend Study. Dr. B. Galloway (LGL Assoc.) then described the Continental Slope Study. Dr. R. Darnell (TAMU) presented extensive slides describing the nearly completed Ecological Mapping Study. Dr. G. Wermund (U. of Texas) and the Texas representative to the Technical Regional Working Group described a long-term program of nearshore habitat mapping being conducted by the State of Texas. J. Johnston (USFW) described the Coastal Characterization Study which has been on-going for some time.

2.2. Extended Abstracts

GULF OF MEXICO
PHYSICAL OCEANOGRAPHY PROGRAM

Evans Waddell

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In October 1982, the MMS funded Gulf of Mexico (GOM), Physical Oceanography Study (POS) was initiated with the objective of developing an observational data base to be used in developing a clearer understanding of key circulation patterns and processes occurring in the study area. The results of this study are to facilitate effective risk and impact assessment as well as management decisions relating to OCS oil and gas activities. Toward these ends a multiyear program is being conducted.

Program Years 1 and 2 emphasize the Eastern GOM, while Year 3 will include studies in the western Gulf. Year 4 will have a Gulf-wide emphasis. During Years 1 and 2 major program elements include:

- subsurface current/temperature/pressure measurements
- regional and process oriented hydrography
- satellite thermal imagery
- satellite tracked drifting surface buoys
- Ship-of-Opportunity Program (SOOP)

Years 1 and 2 subsurface current moorings containing 22 current/temperature sensors are shown in Figure 1. The deepest mooring (3400 meters) was added at the beginning of Year 2. In Figure 1, the numbers adjacent to positions are the number of instruments and the water depth. This deployment pattern provides detailed information on the Loop Current and how this highly variable flow field interacts with and influences the adjacent slope and shelf. The final Year 1 current meter retrival has been completed successfully.

Two hydrographic cruises were conducted in Year 1 (Figures 2 and 3). In Year 2 an additional hydrographic survey will combine a regional scale air deployable, expendable bathythermograph (AXBT) survey with a subregional scale intensive ship based measurement of salinity, temperature, and nutrients. This is to be done in May 1984.

Satellite imagery will provide an independent verification of conditions during those portions of the year when surface thermal gradients exist. In addition imagery is being used to characterize statistically the Loop Current proper as well as boundary waves and filaments. Thermal imagery is only useful in the GOM from about late October to late May or early June.

Satellite tracked drifters have been deployed in two eddies during Year 1. One, released in 1982, functioned for approximately 13 months before ceasing transmission in September 1983. The second buoy, released in July 1983, appears to be entrained in an anticyclonic-cyclonic eddy system off the Mexican-Texas coast. It is hoped that a Loop Current eddy shed during late January to early February 1984, will be seeded with a buoy. The buoy is available for use when appropriate identifiers are received from Service Argos.

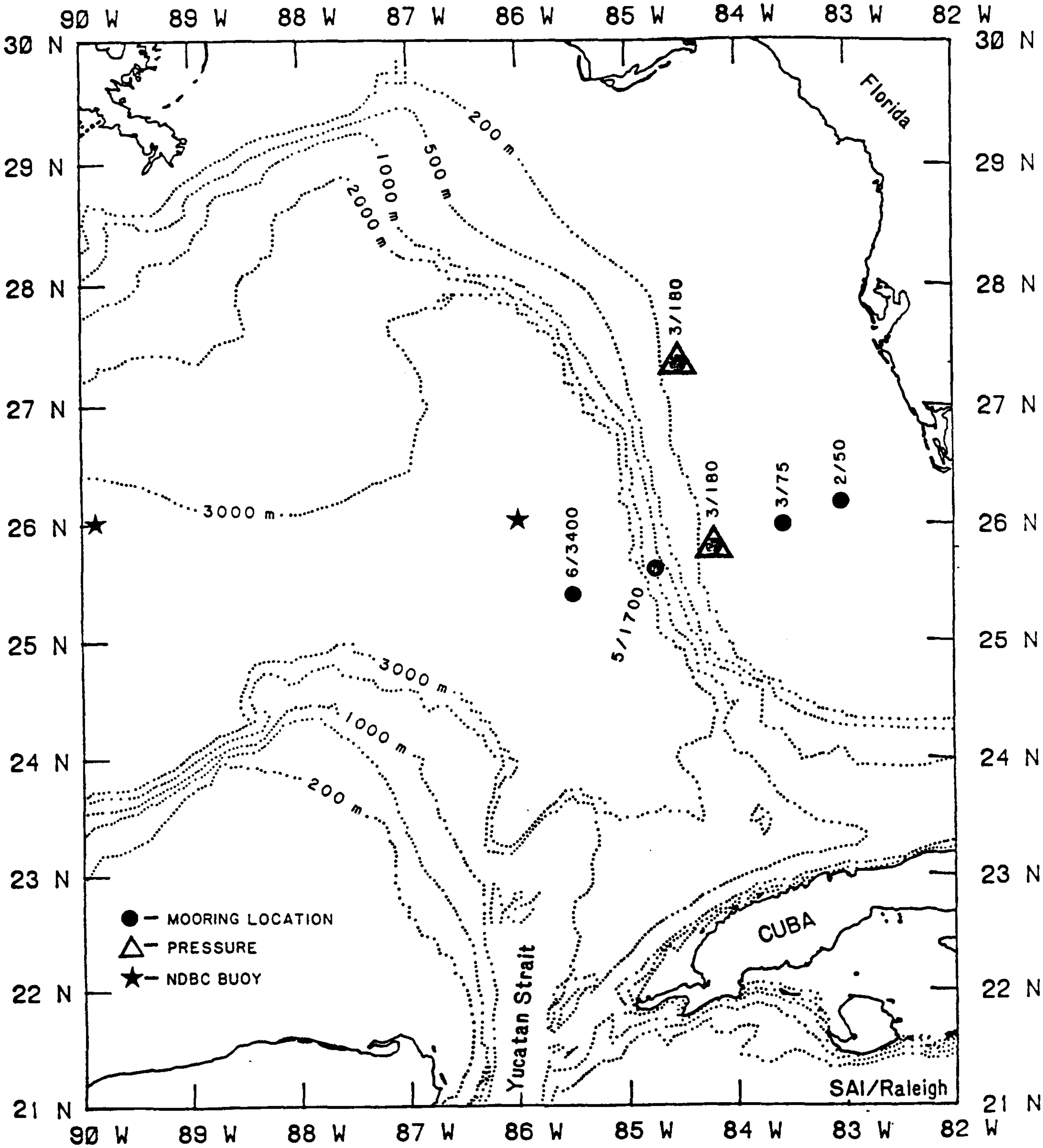


Figure 1. Map of subsurface moorings as of the beginning of Year 2 of the Physical Oceanography Study. Numbers adjacent to mooring positions indicate the number of instruments and the water depth.

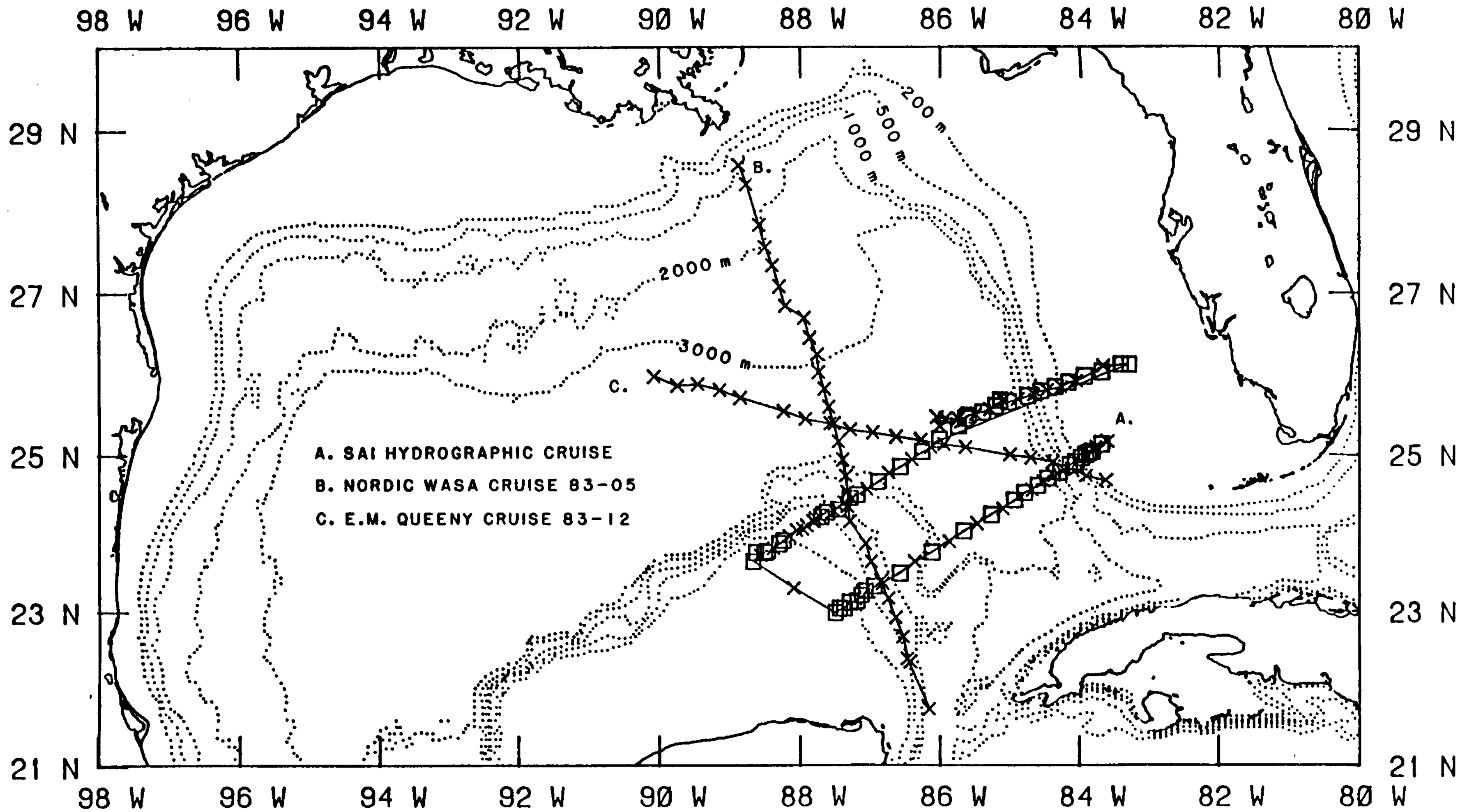


Figure 2a. Map showing March 1983 hydrographic cruise track and additional ship-of-opportunity, XBT transects. Both transects B and C are reoccupied regularly on a 10- and 15-day cycle, respectively. XBT stations are indicated by (X) and CTD casts by a square.

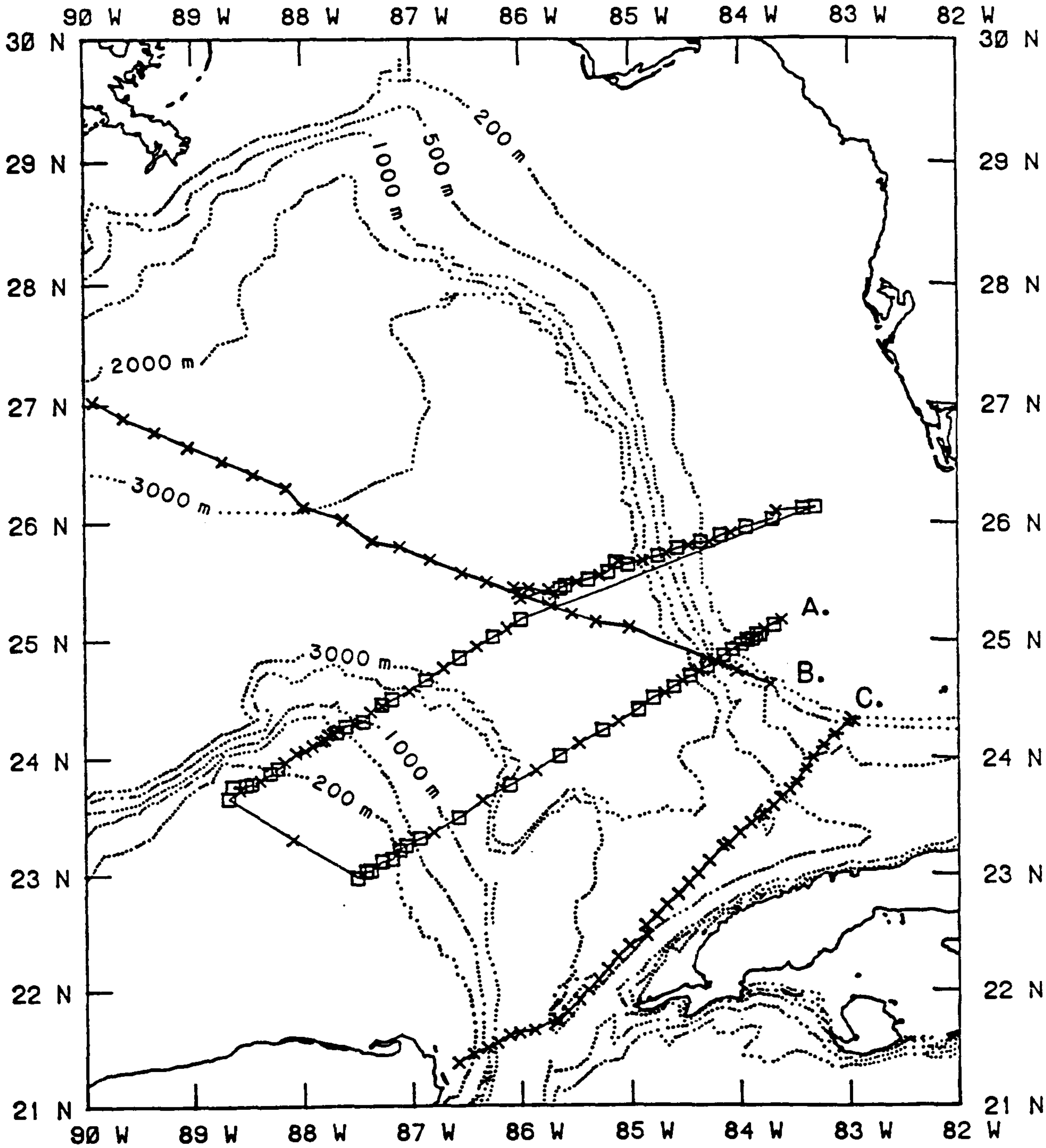


Figure 2b. March 1983 hydrographic cruise track and additional supplementary (XBT) data. Transect B is from the E.M. QUEENY, and Transect C was taken by R/V RESEARCHER using MMS-provided XBT's. XBT stations indicated by a cross (X) and CTD casts by a square.

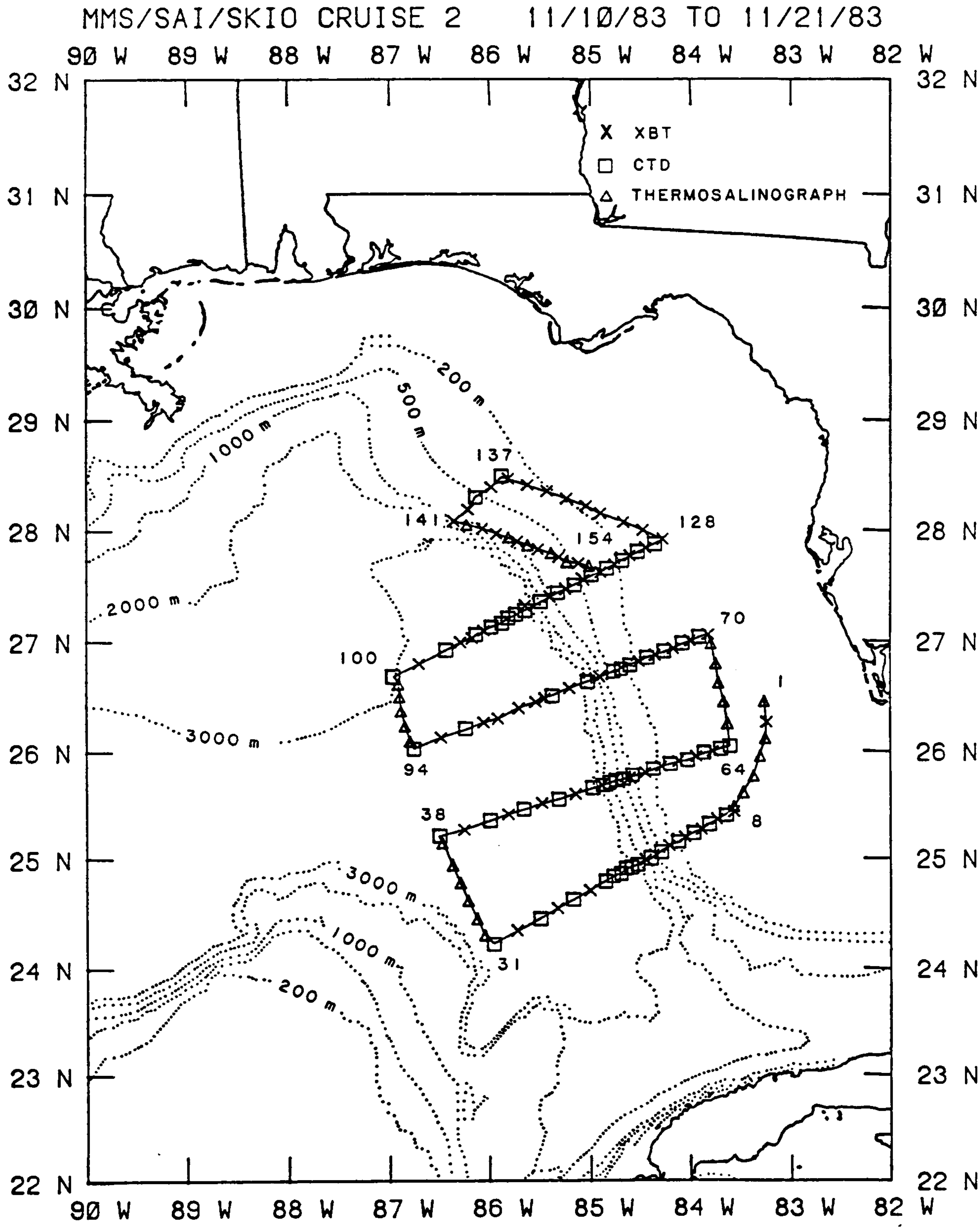


Figure 3. Cruise track and station location for the November 1983 hydrographic cruise. During this cruise, the general Loop Current eastern boundary is indicated by the tight spacing of CTD casts over and slightly seaward of the slope.

The SOOP is providing valuable information, except for a few periods of equipment malfunction. The line from New Orleans to the Yucatan Strait has produced excellent transect data on a 10- to 11-day interval (see NORDIC WASA transect in Figure 2). The temperature profiles taken on this transect combine with satellite imagery and supplementary data to help document the Loop Current eddy shedding sequence. XBT's have also been provided to other sources, e.g. NOAA/Atlantic Oceanographic Marine Laboratory, NOAA/NMFS and Florida Institute of Oceanography, so they can take and provide to this program systematic temperature profile data. It should be noted that the NORDIC WASA's crew has been exemplary in their support for this program. S. Cook of NOAA also provides SOOP data from the M/V QUEENY transects shown in Figure 2 on a 15-day interval.

Data analyses are proceeding on schedule. Basic analysis of current/temperature data has been completed on all available data. Initial hydrographic data from the March 1983 cruise is analyzed and data from the November cruise is being analyzed. Data products have been created for all SOOP data through December 1983. All buoy data received to date from NDBC has been plotted and detailed evaluation is under way.

GULF OF MEXICO CIRCULATION MODELING STUDY

Alan J. Wallcraft

JAYCOR
c/o NORDA
NSTL Station, MS 39529

"EXTREMELY MODEST EFFORT BUILDING ON EXISTING/ONGOING MODELING EFFORTS IN THE GULF OF MEXICO"

INITIALLY:

EXISTING CIRCULATION MODEL WITH CAPABILITIES APPROACHING THOSE REQUIRED. ABILITY TO DELIVER "EARLY SIMULATION RUN".

AT END OF 4 YEAR PROGRAM:

CIRCULATION MODEL OF 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. SIMULATING LOOP-CURRENT EDDY SHEDDING, AND KNOWN REGIONAL CIRCULATION FEATURES.

MODEL: NON-LINEAR, TWO LAYER, BETA-PLANE, FREE SURFACE, PRIMITIVE EQUATION, HYDRODYNAMIC, FULL SCALE BOTTOM TOPOGRAPHY (CONFINED TO LOWER LAYER).

REGION: 25 BY 25 KM OR 20 BY 22 KM (0.2 BY 0.2 DEGREE) GRID, REALISTIC GULF OF MEXICO COASTLINE AND BOTTOM TOPOGRAPHY. 200 M UPPER LAYER REST THICKNESS.

EXPERIMENTS:

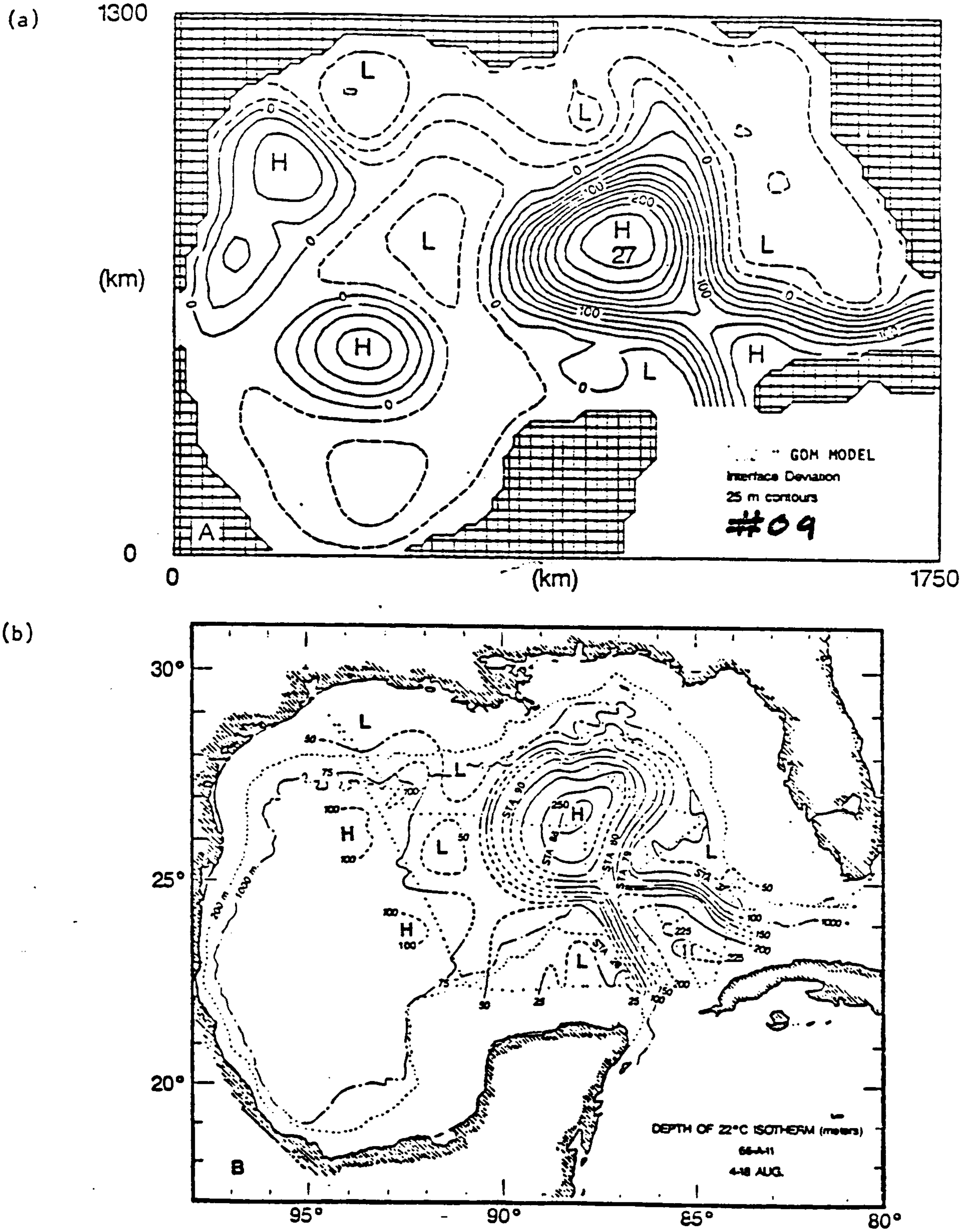
#09: CONSTANT YUCATAN STRAITS INFLOW FORCING
26 SV IN UPPER LAYER
4 SV IN LOWER LAYER
COMPENSATED BY OUTFLOW THROUGH FLORIDA STRAITS.
NO WIND FORCING, 25 BY 25 KM GRID.

#28: SAME AS #09, BUT ON A 20 BY 22 KM GRID.

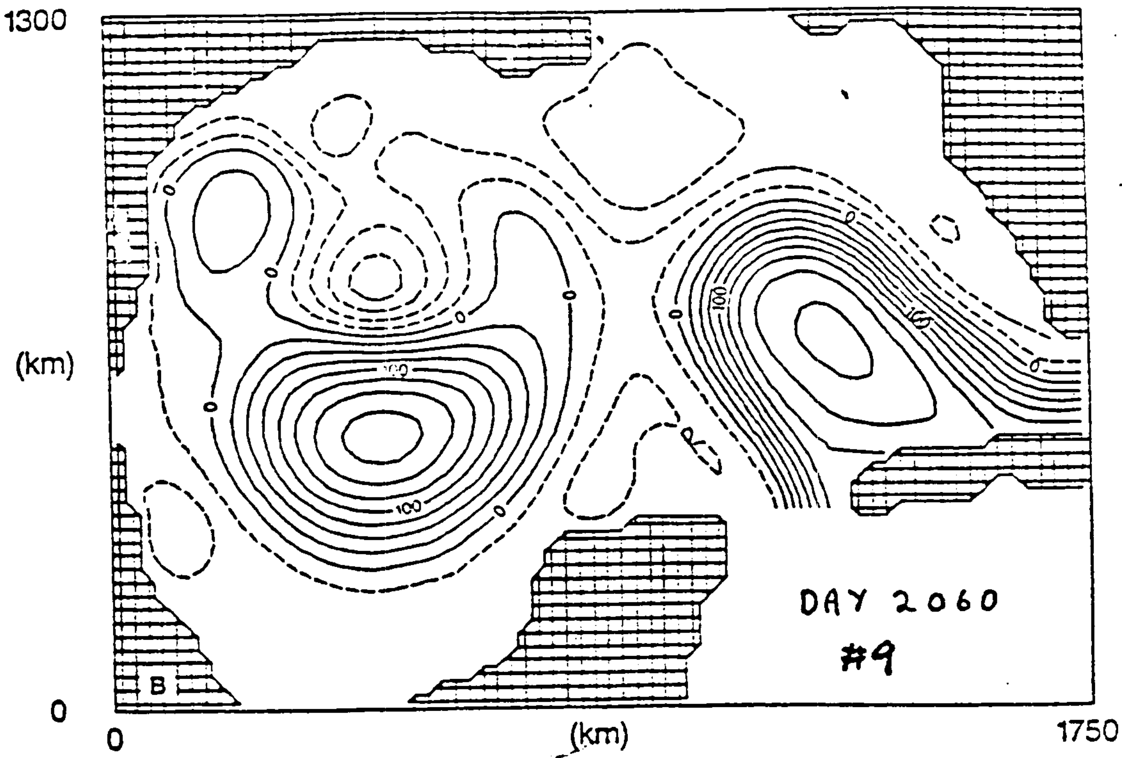
#31: NO INFLOW THROUGH YUCATAN STRAITS.
WIND FORCING, BASED ON SEASONAL CLIMATOLOGY.

#34: ADDED WIND FORCING TO #28 AT THE END OF YEAR 6
(STILL HAS 26/4 SV INFLOW).

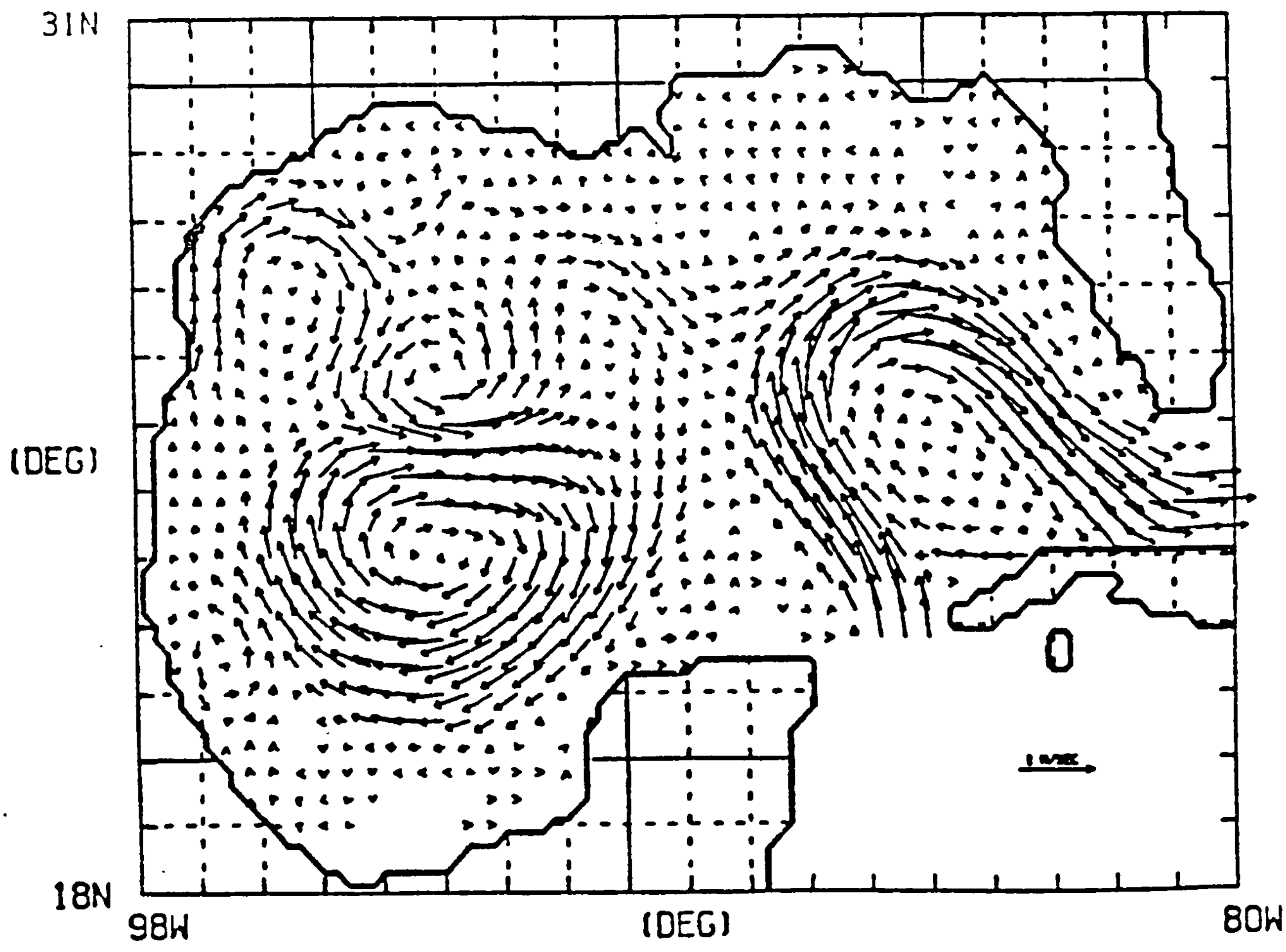
#09, #28, AND #31 START FROM REST AND ARE SPUN-UP TO STATISTICAL EQUILIBRIUM.



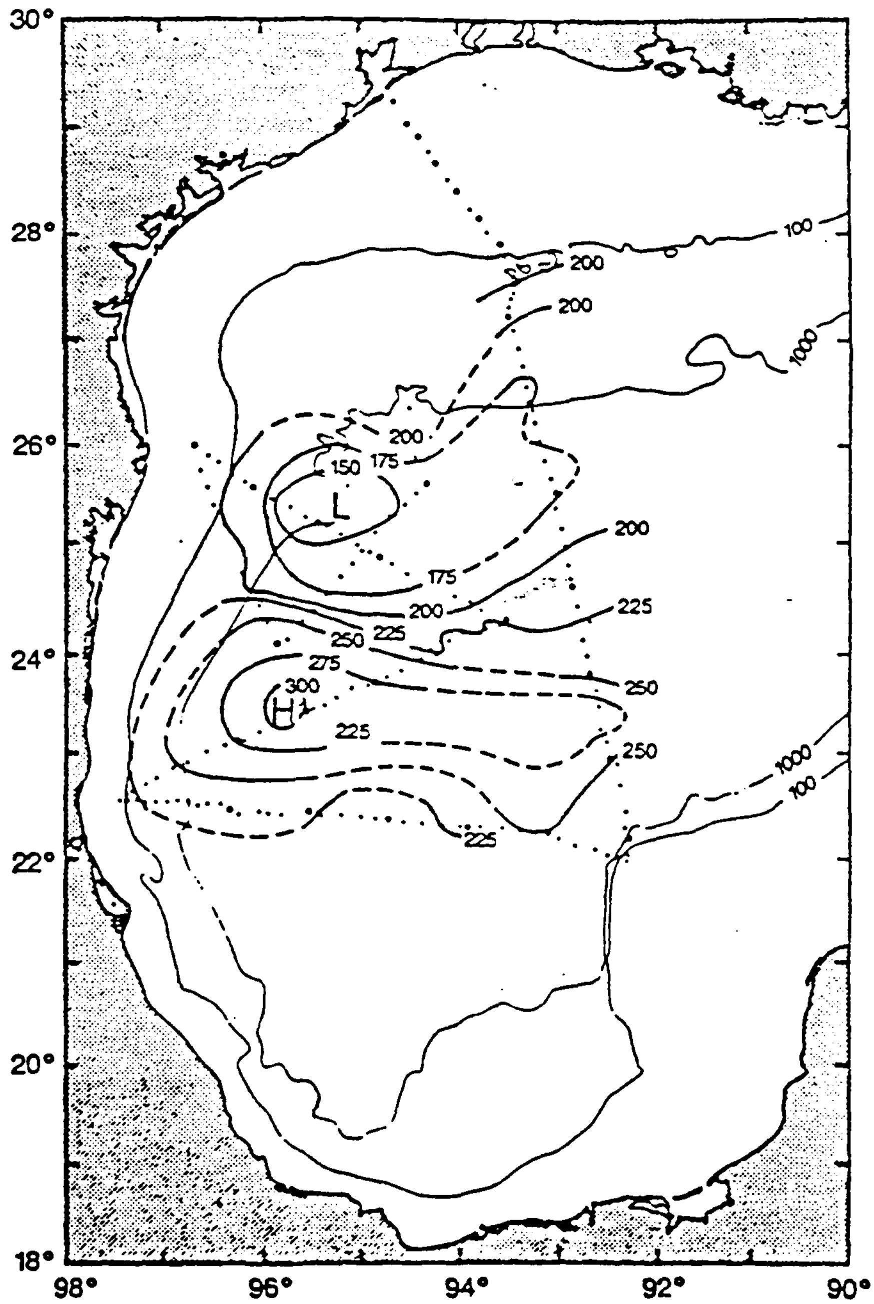
(a) Instantaneous view of the interface deviation in a two layer Gulf of Mexico model driven solely by inflow through the Yucatan Straits. The contour interval is 25 m with solid contours representing downward deviations. (b) Depth of the 22°C isothermal surface, 4-18 August 1966 from Leipper (1970).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



SURFACE CURRENTS G. ØF MEXICØ 0. 9
DAY = 2060

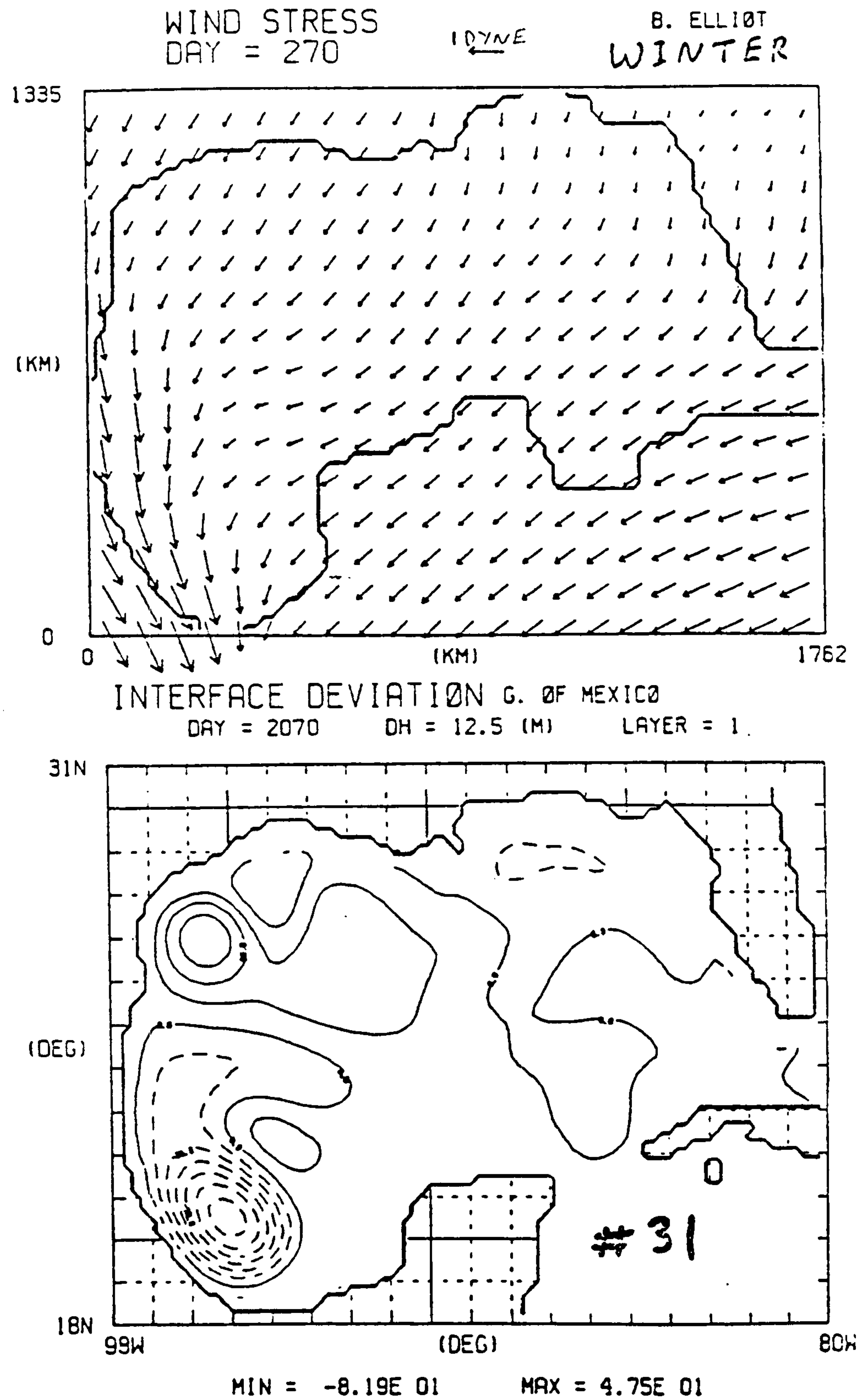


MAX PLØTED VECTØR = 1.05 (M/SEC)



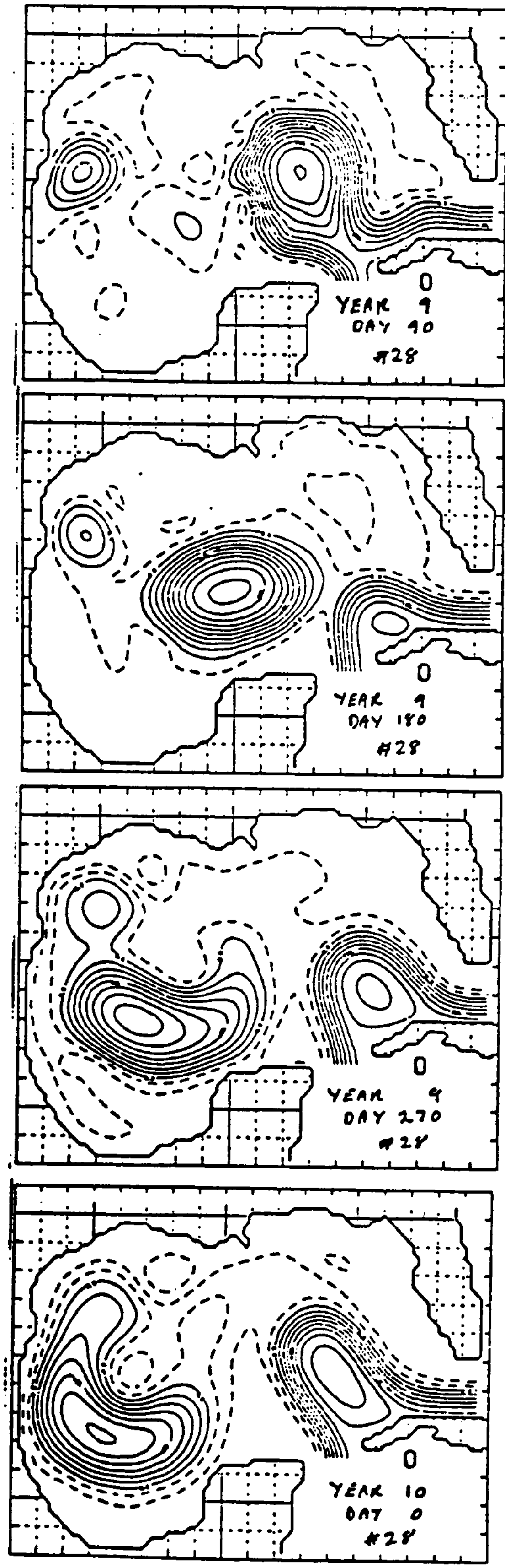
Counter-rotating vortex pair in the western Gulf of Mexico as shown by the depth of the 15°C isotherm in April 1978. The cyclonic vortex is to the north and the anticyclonic to the south. The contour interval is 25 m, from Merrell and Morrison (1981).

(a) (b)

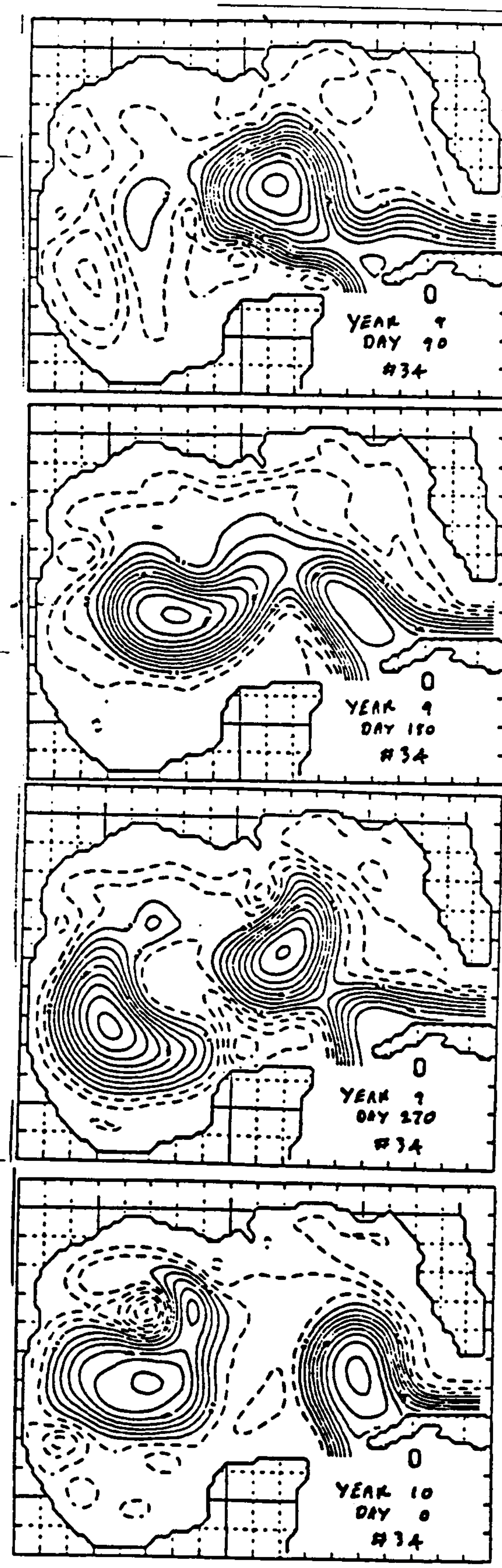


. Winter (a) vector plots of the seasonal climatological wind stresses from ship observations used to drive the model, based on Elliot (1979). Maximum wind stresses shown are about 1.5 dynes in the winter. (b) Corresponding steady state interface deviations from the wind driven model on a 0.2 degree grid. The contour interval is 12.5 m.

EVERY 90 DAYS

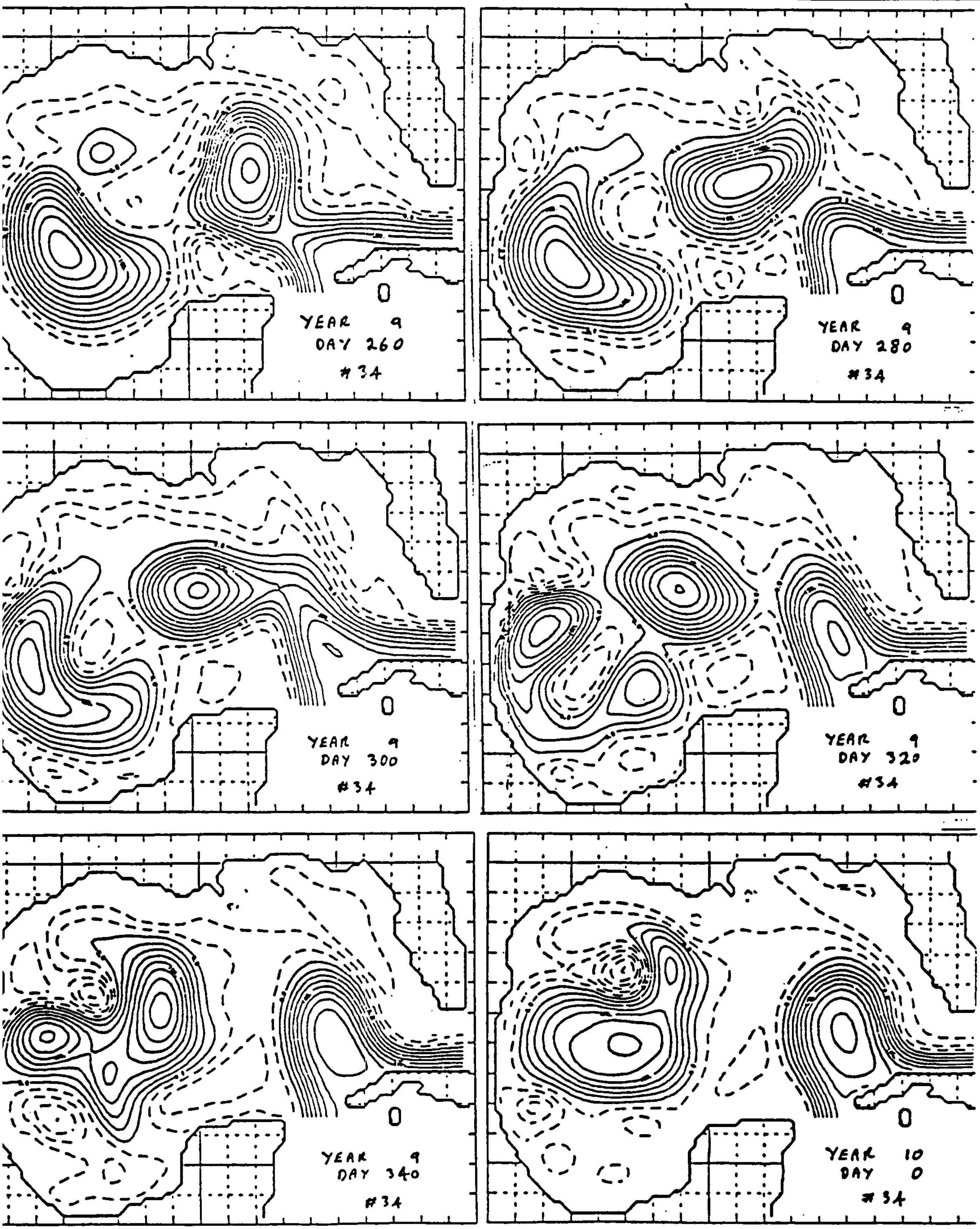


#28



#34

EVERY 20 DAYS



SUMMARY

1) A RELATIVELY SIMPLE 2-LAYER MODEL HAS PROVED REMARKABLY EFFECTIVE AT EXHIBITING 'GULF LIKE' CIRCULATION.

2) A QUASI-ANNUAL LOOP CURRENT EDDY SHEDDING PERIOD IS OBTAINED WITH CONSTANT INFLOW FORCING ONLY (NO WINDS).

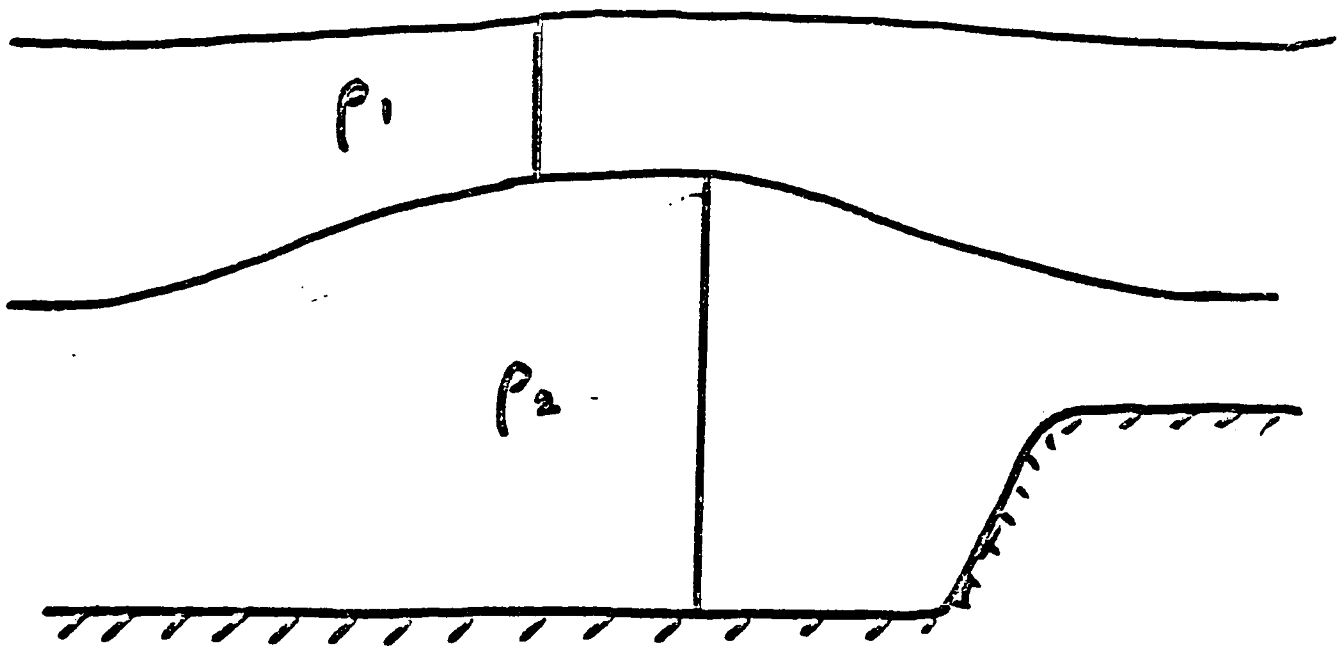
3) THE ADDITION OF WIND FORCING (STILL CONSTANT INFLOW) INCREASES THE VARIABILITY OF THE LOOP CURRENT SYSTEM, INCLUDING THE EDDY SHEDDING PERIOD AND EDDY PATH. AT TIMES THE WESTERN GULF CIRCULATION PATTERN CAN CHANGE VERY RAPIDLY IN THIS MODEL EXPERIMENT.

4) WINDS CAN DRIVE STRONG UPWELLING IN THE SOUTH-WEST GULF OVER THE WINTER AND SPRING. BUT LOOP EDDIES CAN EITHER INTENSIFY THE UPWELLING OR ALMOST TOTALLY MASK IT OUT.

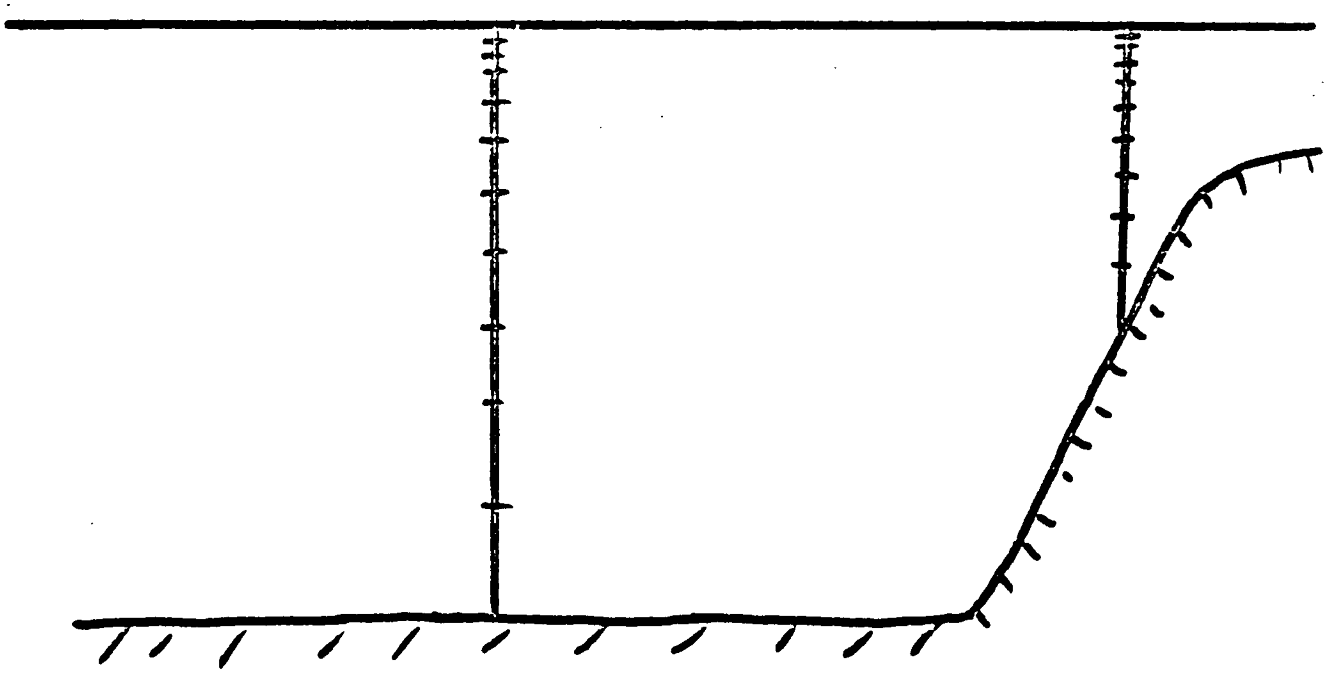
5) ALL EXPERIMENTS SHOW A PERSISTANT ANTI-CYCLONIC FEATURE IN THE NORTH-WEST GULF, BUT IT IS OVER THE (UNRESOLVED) CONTINENTAL SHELF.

VERTICAL REPRESENTATION

A) LAYERED



B) FIXED LEVELS



NOT TO SCALE, IDEALISED BOTTOM TOPOGRAPHY.

TWO APPROACHES TO "REALISM"

1) USE SIMPLEST POSSIBLE MODEL. MEASURE REALISM BY CLOSENESS OF RESULTS TO OBSERVED CIRCULATION.

LAYERED MODELS,

HIGHER HORIZONTAL RESOLUTION,

MANY (LONG) EXPERIMENTS,

SPUN UP FROM REST,

E.G. NORDA/JAYCOR MODEL.

2) USE MODEL INCORPORATING REALISTIC PHYSICS.

LEVEL TYPE MODELS (SIGMA-COORDINATES),

LOWER HORIZONTAL RESOLUTION,

FEWER (SHORT) EXPERIMENTS,

FROM IMPOSED INITIAL STATE,

E.G. DYNALYSIS MODEL.

GIVEN INFINITE RESOURCES LEVEL TYPE MODELS MAY BE SUPERIOR.

BUT 15 LEVEL MODEL TAKES:

ABOUT 60 TIMES AS MUCH C.P. TIME, AND

ABOUT 8 TIMES AS MUCH STORAGE AS A COMPARABLE 3 LAYER MODEL.

SO LEVEL TYPE MODELS CANNOT REALISTICALY SIMULATE THE GULF OF MEXICO ON AVAILABLE COMPUTERS (3-LAYER 10KM MODEL TAKES 2.65 CRAY-1 HOURS PER SIMULATION YEAR AND NEEDS 1.5M WORDS OF MEMORY).

PROBLEMS WITH EXISTING NORDA/JAYCOR MODEL

1) ONLY 0.2 DEGREE 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 GOOD SIMULATION). BUT THE LAYER INTERFACE(S) MUST NOT INTERSECT THE BOTTOM. SHALLOWEST TOPOGRAPHY IN MODEL IS AT 500M, I.E. SHELF AREAS NOT MODELLED ACCURATELY.

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 12HOURLY NMC SURFACE PRESSURE ANALYSIS, AND TIME VARYING INFLOW.

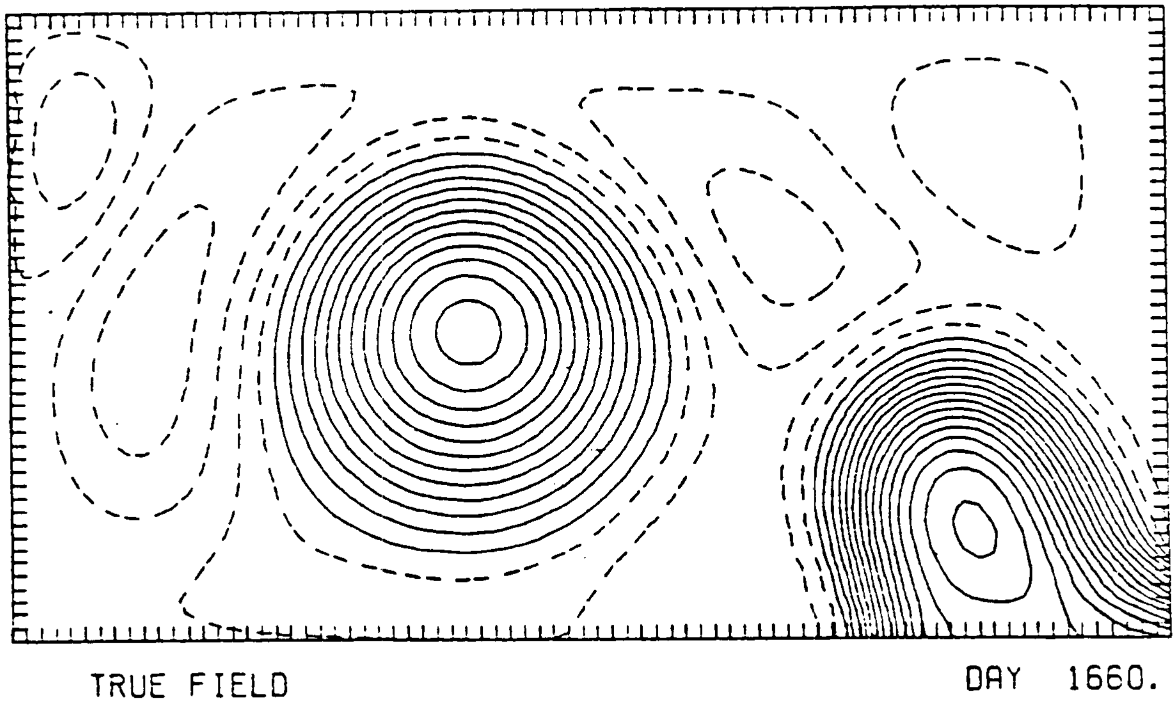
YEAR 2

USE 2-LAYER MODEL, BUT ON A 0.1 DEGREE GRID, AND WITH LOWER EDDY VISCOSITY.

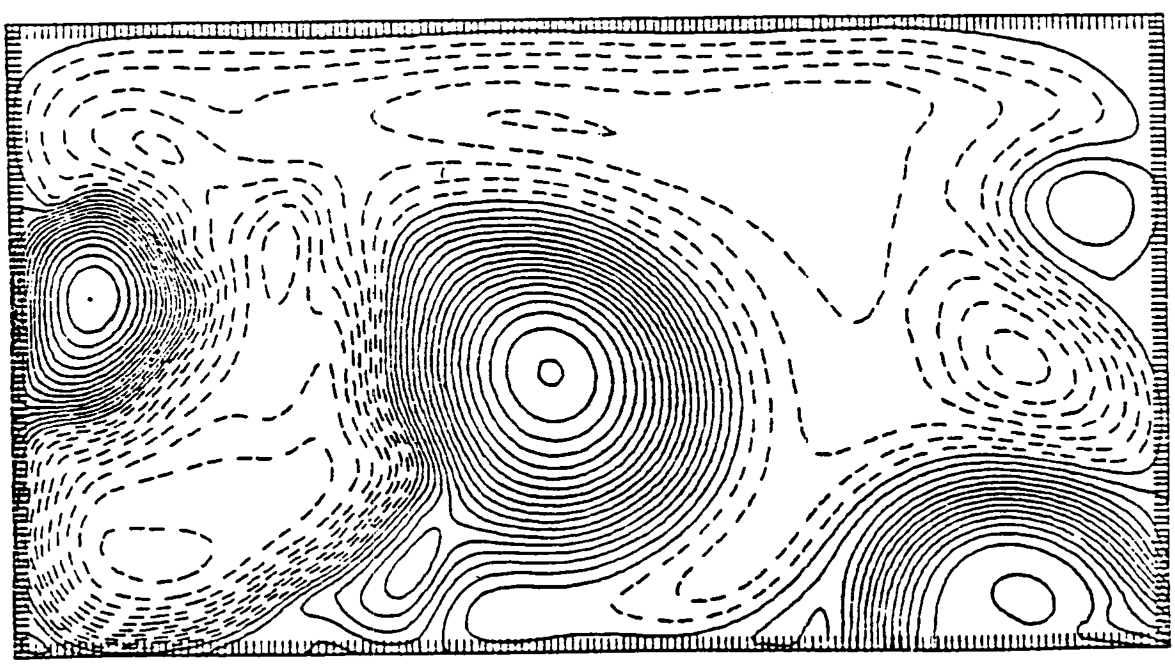
EXPECT RICHER FLOW FIELD, WIND INDUCED FLOW INSTABILITIES.

SOME EXPERIMENTS WILL USE 1-LAYER (REDUCED GRAVITY) MODEL, BUT ALL DELIVERED SIMULATIONS WILL HAVE 2-LAYERS.

(a)



(b)



Representative interface deviations from two very similar rectangular model simulations with identical inflow forcing, but (a) on a 20 km grid with A = 1,000 m^2/sec, and (b) on a 10 km grid with A = 100 m^2/sec. The contour interval is 10 m.

YEAR 3

DEVELOP 3-LAYER MODEL WITH BULK THERMODYNAMICS.

DENSITIES IN EACH LAYER ALLOWED TO CHANGE LOCALLY WITH TIME.

EQUATION OF STATE AND TEMPERATURE EQUATION ADDED TO MODEL.

INITIALLY 0.2 DEGREE SIMULATIONS, LATER 0.1 DEGREE GRID.

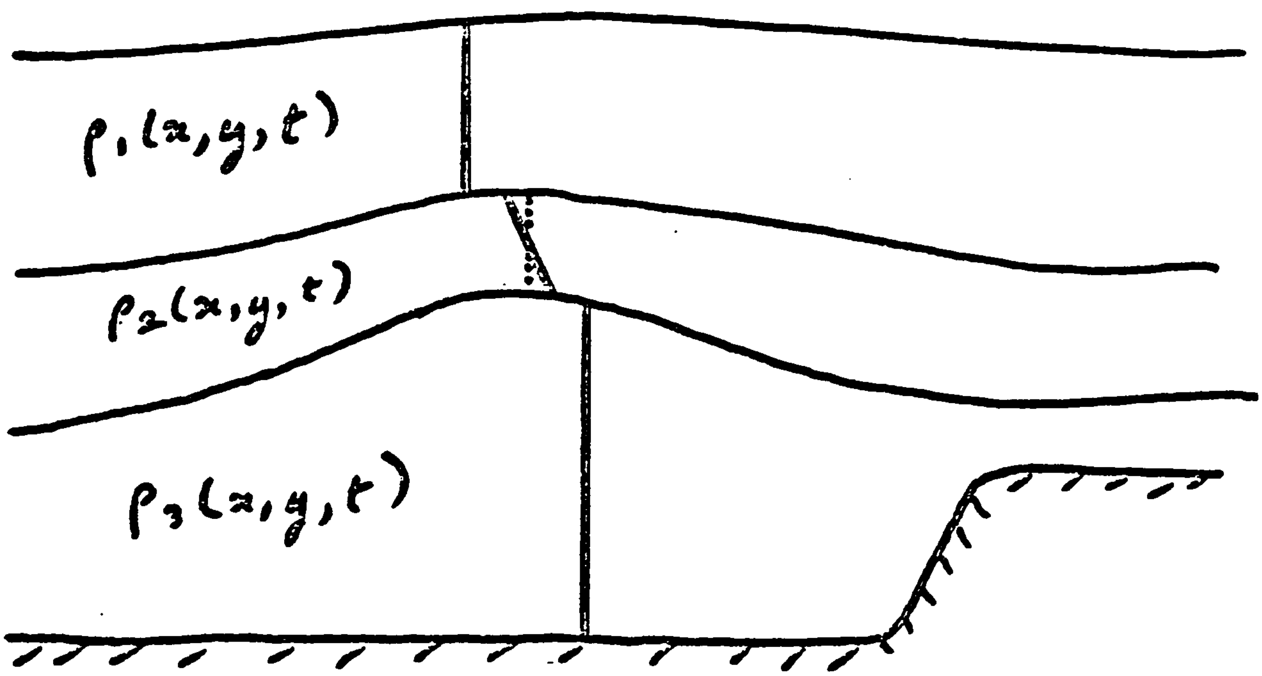
NEED HEAT FLUX FORCING.

IMPROVED REPRESENTATION OF PERMANENT TERMOCLINE.

INCLUSION OF THERMOHALINE CIRCULATION.

3 LAYERS BETTER RESOLVE "HYDRODYNAMIC" CIRCULATION.

THINNER UPPER LAYER INCREASES ACCURACY OF SURFACE VELOCITIES.



YEAR 4

COMPLETE 0.1 DEGREE 3-LAYER SIMULATIONS.

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.

CAN ACCEPT GEOSTROPHIC CURRENTS FROM ANY SUITABLE SOURCE:
3-LAYER MODEL IS SUITABLE, BUT 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).

TOPS IS APPLIED ONLY AFTER SPIN-UP OF CIRCULATION MODEL.

WILL GIVE DETAILED VERTICAL DENSITY PROFILES.

GREATLY IMPROVE THE SIMULATION ACCURACY IN SHELF REGIONS.

PRODUCTS

1) EARLY DELIVERY OF A GULF SIMULATION WITHOUT WIND FORCING. EXPERIMENT #9 - DELIVERED OCTOBER 1983.
2) WIND DATA SET BASED ON NMC'S 12 HOURLY SURFACE PRESSURE ANALYSIS.
3) ABOUT 3 GULF SIMULATION SURFACE CURRENT DATA SETS PER YEAR. SELECTED AS THE "BEST" AVAILABLE SIMULATION TO DATE (NOT ALL MODEL EXPERIMENTS WILL BE DELIVERED). DATA SETS WILL BE EVERY 10 DAYS FOR SEVERAL EDDY CYCLES (5 - 10 YEARS) TO CAPTURE THE FULL GULF CIRCULATION VARIABILITY.
4) SUB-SURFACE CURRENT DATA SETS FROM SOME OF THE LATER SIMULATIONS (MOSTLY IN YEARS 3 AND 4).
5) AT END OF YEAR 4 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.
6) ANNUAL PROGRESS REPORTS, ETC.

SOUTHWEST FLORIDA BENTHOS STUDY

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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

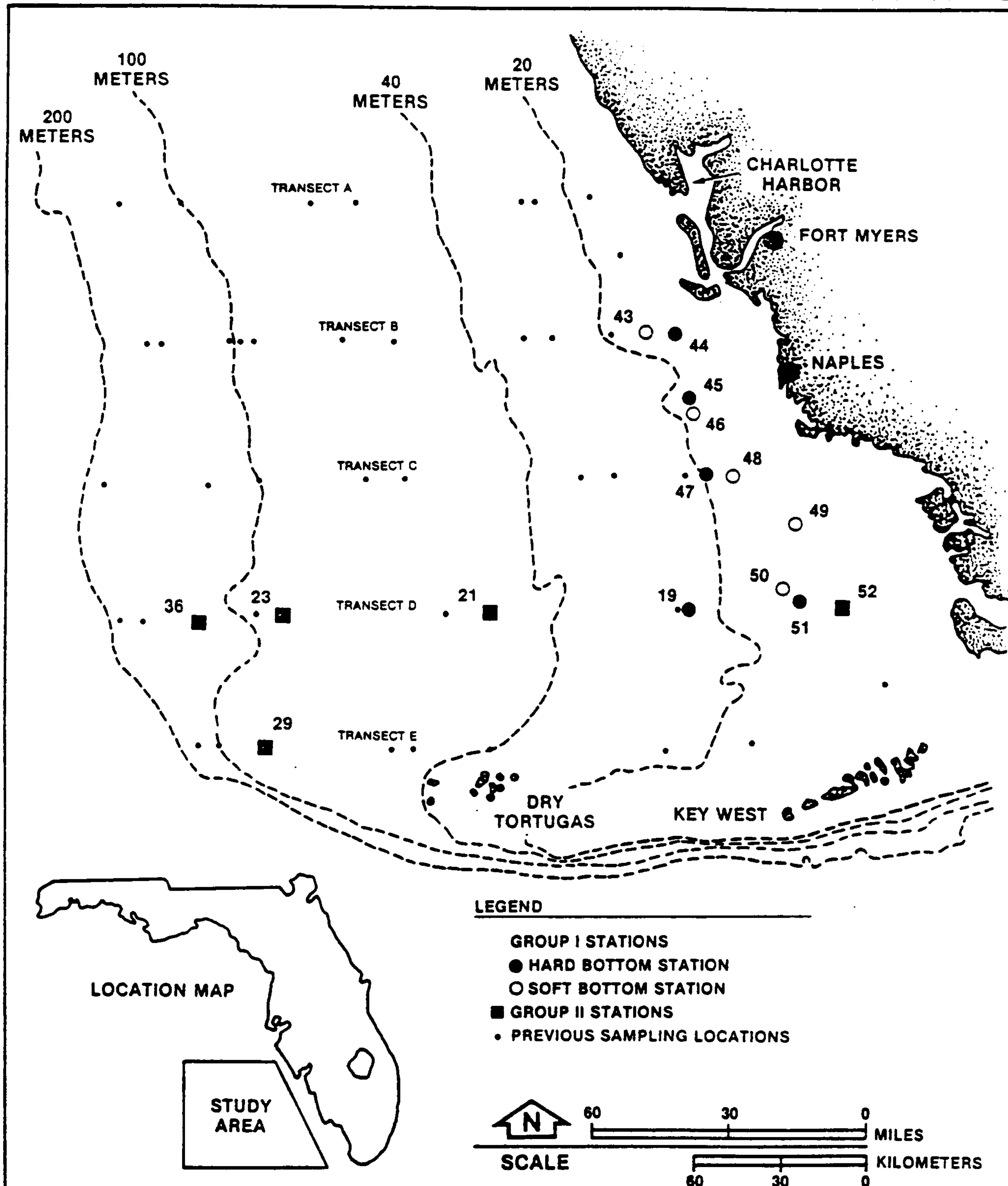

Figure 1
SOUTHWEST FLORIDA BENTHOS STUDY
SAMPLING LOCATIONS

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 are scheduled for four seasonal cruises, with sampling conducted at two mutually exclusive sets of stations. One set of stations (Group I) will be sampled during fall 1983 and spring 1984, and will consist 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 will essentially complete the seasonal baseline descriptive study of the inshore area in question.

Group II stations will 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. These station locations are presented in Figure 1. A summary of all field sampling to be completed during Year IV 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 15-minute intervals. The current data, in addition to defining the water current regime at the sites, will be used for sediment transport modeling. The

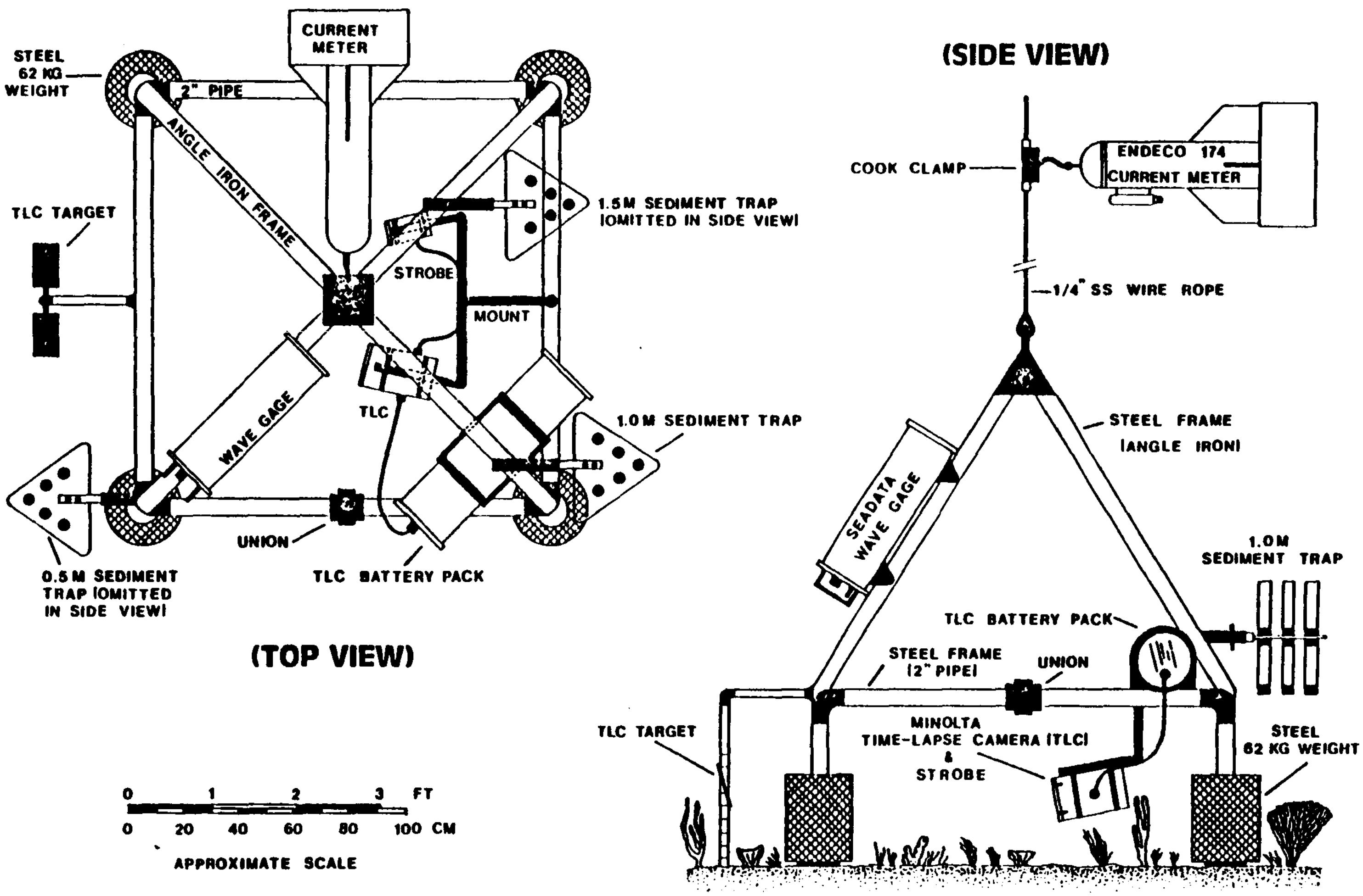

Figure 2
SCHEMATIC OF *IN SITU* SAMPLING ARRAYS
(SUBSTRATE PLATES NOT SHOWN)

SOURCE: ESE, 1983.

MINERALS MANAGEMENT SERVICE

Table 1. Southwest Florida Outer Continental Shelf Benthic Community Study Sampling Schedule for Year 4

Task	Sampling Dates DEC 83	MAR 84	MAY 84	JULY 84
Group I, Soft Bottom	(Station Numbers-43, 46, 48, 49, and 50)			
Infauna	X		X	
Hydrography*	X		X	
Sediments	X			
Group I, Hard Bottom	(Station Numbers-44, 45, 47, 51, and 19)			
Epifauna, UTV/BSP†	X		X	
Trawls	X		X	
Dredges	X		X	
Hydrography*	X		X	
Sediments	X			
Group II, Live Bottom	(Station Numbers-52, 21, 23, 29, and 36)			
Epifauna, UTV/BSP	X	X	X	X
Trawls	X	X	X	X
Dredges	X	X	X	X
Hydrography*	X	X	X	X
Sediments	X			
In Situ Array Servicing	X	X	X	X

* Includes shipboard meteorology, calibration casts, and continuous profiles of salinity, temperature, transmissivity, and dissolved oxygen.
† UTV/BSP--underwater television with benthic still photography.

Source: ESE, 1984.

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, are 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 are installed on each array to measure recruitment and growth rates. Eleven 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 are installed on two of the arrays (Stations 52 and 21 only) to document the wave climate and tidal fluctuations. 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

Since the program just began, there are no scientific results available at this time. The first cruise was conducted between December 5 and 18, 1983. All of the arrays were installed on schedule, and most of the remaining sampling was completed as planned. Because of adverse weather conditions, however, some of the sampling could not be completed and will be incorporated into a subsequent cruise. The next cruise is scheduled for March 2, 1984.

TUSCALOOSA TREND REGIONAL DATA SEARCH AND SYNTHESIS STUDY

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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. 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.

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. The next six-month period will emphasize information review and synthesis.

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 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 are being cross-referenced. All citations are entered in the NEDRES format, while pertinent references also are 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. To date, 75 persons have been interviewed and contact forms completed. Several hundred reference sources have been accessioned, annotated, and entered into the bibliographic database.

The conceptual modeling activities conducted by Dr. Comiskey (SAI) are directed towards understanding the 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 currently is being synthesized with an initial draft of the model expected in March. The initial conceptualization will be generic and will draw heavily from the most appropriate aspects of existing models with emphasis on those compartments unique or most important to the study area.

CONTINENTAL SLOPE ECOSYSTEMS

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LGL Ecological Research Associates, Inc. (LGL) is conducting for Minerals Management Service (MMS) a study of the continental slope of the northern Gulf of Mexico. The objectives of this study are:

1. To determine the abundance, structure, and distribution of animal communities in the deep-sea in the Gulf of Mexico.

2. To determine the hydrographic structure of the water column and bottom conditions at selected sites within the study area.

3. To determine and compare sedimentary character at selected sites within the study area.

4. To relate differences in biological communities to hydrographic, sedimentary, and geographic variables.

5. To assess seasonal changes in deep-sea biological communities in terms of abundance, structure, animal size, and reproductive state.

6. To measure present levels of hydrocarbon contamination in the deep-sea sediments and selected animals prior to, and in anticipation of, petroleum resource development beyond the shelf-slope break.

7. To compare the biological and non-biological character of the deep Gulf of Mexico with that of other temperate and subtropical deep-sea regions.

8. To assemble together and synthesize appropriate published and unpublished data with the results of this study, summarizing on a seasonal and spatial basis all biological, habitat and environmental observations and parameters. Relationships between biological and non-biological 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 syntheses and conclusions.

9. To conduct an effective quality assurance and quality control program which insures that all data acquired are accurate and repeatable within standards normally required for each type of observation, measurement, or determination.

10. To critically review, interpret, and analyze all observations and data acquired to redefine as necessary the research program in such a way as to avoid or minimize redundancy and to optimize the efficiency of all field, laboratory, and data management operations for future deep-sea studies sponsored by MMS in the Gulf of Mexico.

11. To assess the need for and determine the type of studies to be conducted in future program efforts.

The program is being managed by Dr. B.J. Gallaway of LGL, who along with Dr. W. Pequegnat is also in charge of the Synthesis/Planning Team (Fig. 1). The Synthesis Planning Team includes Drs. R. Hessler and R. Rosenblatt of Scripps; Drs. F. Grassle and R. Ballard of Deep Ocean Search and Survey; and Dr. L. Pequegnat, an independent consultant. Collectively, this team comprises the Scientific Advisory Committee and brings together some of the foremost and most active deep-sea researchers working in the Gulf of Mexico, the Atlantic Ocean and the Pacific Ocean. By means of bi-annual workshops, methods and approaches for this program

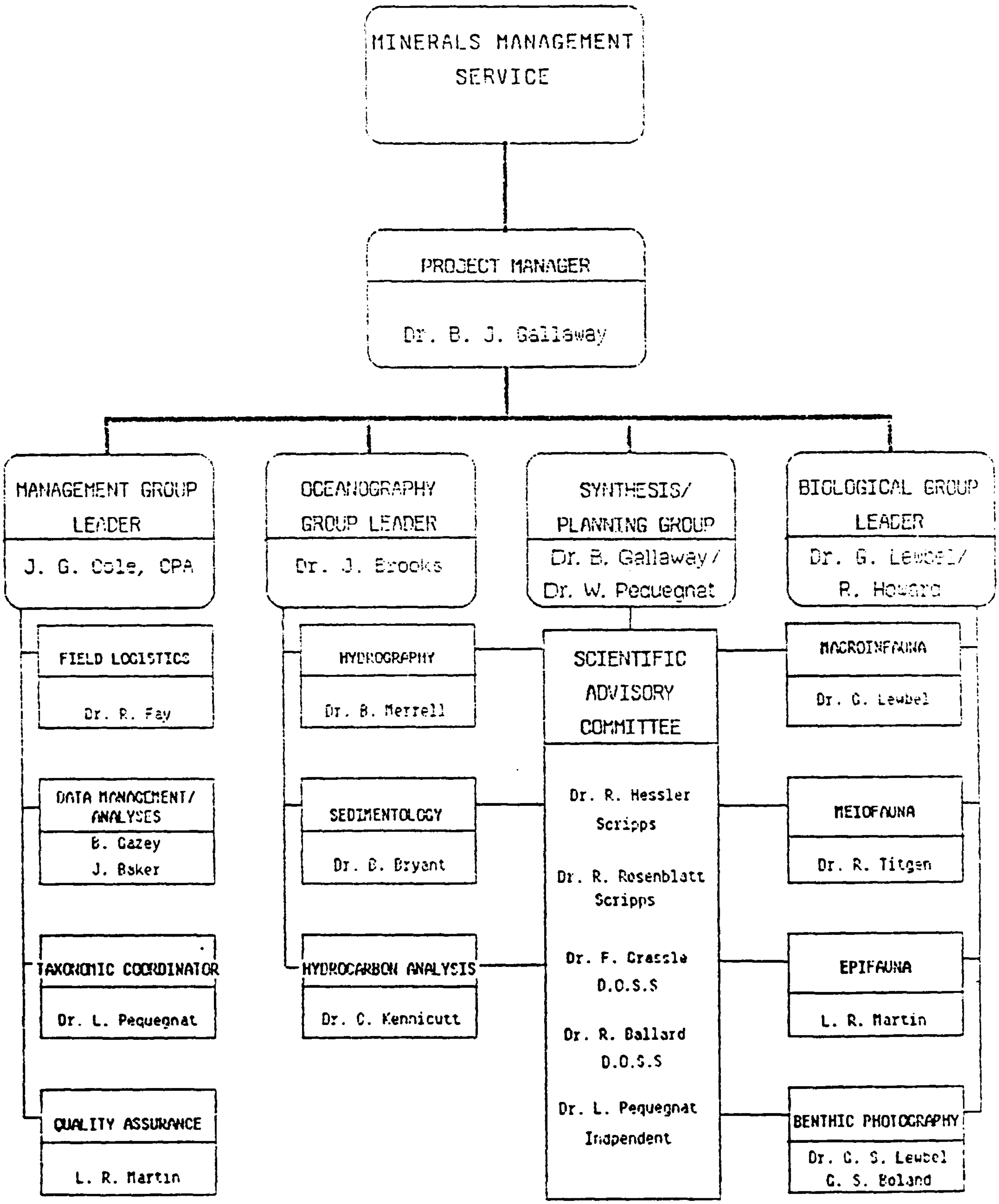

Figure 1. Organization chart.

are standardized with deep-sea studies which are active in other regions allowing direct comparability of results. Further, all parties involved gain in terms of interpreting the results in light of findings from other regions.

The study is divided into two major categories, the physical/chemical and biological components. Leading the physical/chemical group is Dr. Jim Brooks of Texas A&M University, the primary subcontractor to LGL. This relationship is of particular value to this program because (1) Dr. Brooks is conducting a similar deep-sea study of the Gulf Slope for the National Science Foundation (NSF); (2) the MMS study is compatible with the NSF study in terms of timing and scope such that the cruises during the first year can be piggybacked at considerable savings; (3) the data collected for the NSF program are not proprietary and thus can be used to supplement data obtained by the MMS study, thereby expanding the scope of the study at no cost to the Government; and (4) Texas A&M University's fully-equipped and staffed R/V Gyre is available for the first year's work. Hydrocarbon analyses are being conducted by Dr. C. Kennicutt of Texas A&M, with hydrography and sedimentology the responsibility of Drs. Merrell and Bryant, respectively.

The biological component of the study is led by Dr. G.S. Lewbel, also responsible along with Mr. R.L. Howard for the macroinfauna (Fig. 1). Meiofaunal analyses are the responsibility of Dr. R. Titgen; epifauna are the charge of Mr. L.R. Martin; and Mr. G.S. Boland is responsible along with Dr. Lewbel for the benthic photography sampling.

The first year of the program includes two cruises, the first of which has been successfully completed. Cruise I involved sampling five stations along a transect in the central Gulf of Mexico (Stations 6-10, Fig. 2). During Cruise II, Stations 1-15 will all be sampled (Fig. 2). Sampling includes STD casts and sampling of the water column (transmissometry profiles, dissolved oxygen, nutrients, salinity, POC and thermometry) by means of a 12-bottle Rosette sampler. Six replicates of sediment and infaunal samples are taken using a box corer 30 cm on a side. Box core samples are analyzed for meiofauna and macroinfauna, hydrocarbons, grain size, carbonate carbon, total organic carbon and carbon isotope analysis. Megafaunal samples are taken by trawling with a 25' otter trawl; selected samples are analyzed for hydrocarbon chemistry.

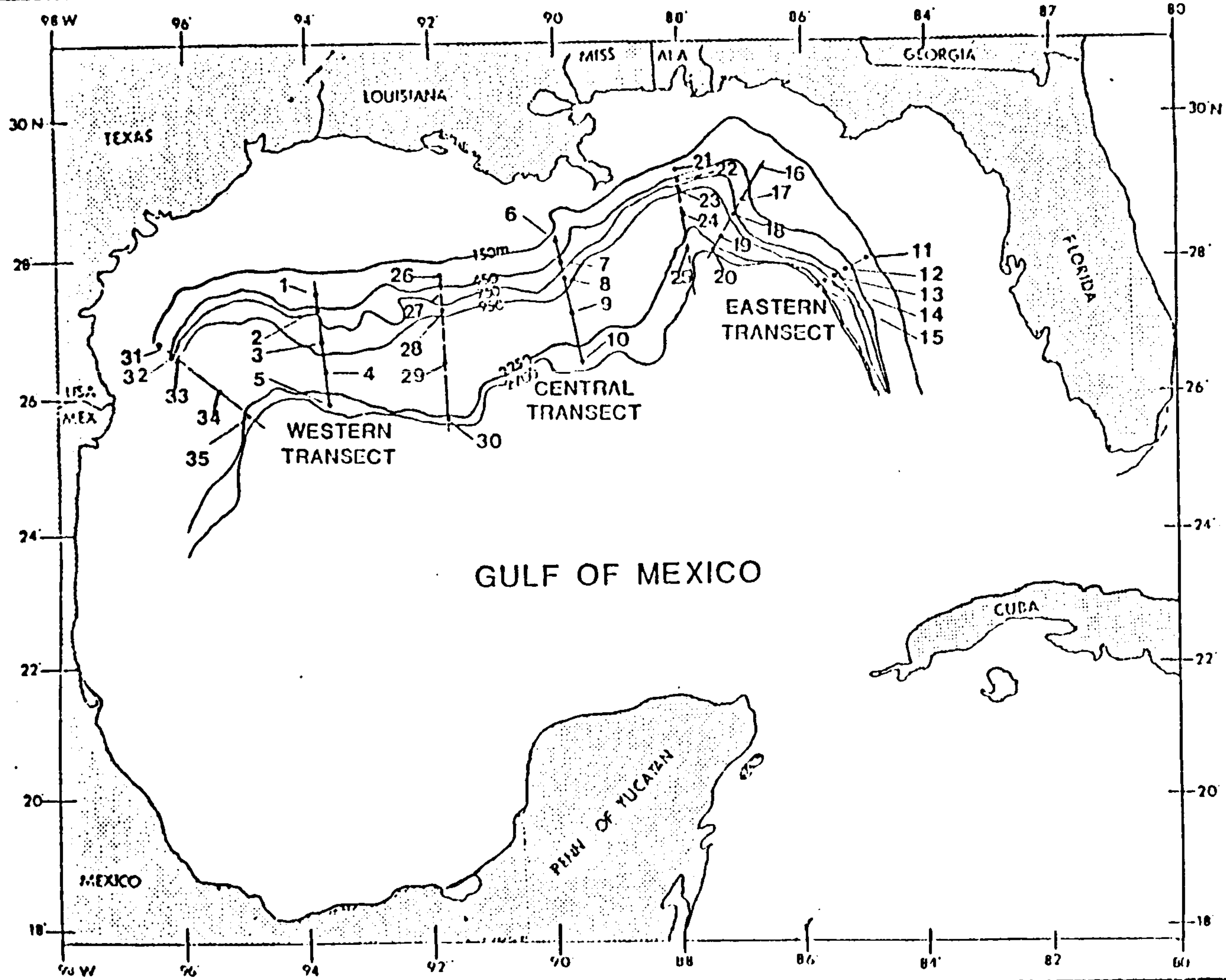

Figure 2. Proposed sampling transects (•—•—•). One station will be sampled in each of the five zones traversed. Candidate transects for study in subsequent years are shown by dashed lines (---).

The seafloor is also sampled photographically using the mini-ANGUS system developed at Woods Hole. Some 800 frames are shot at each station on each cruise. A total of 100 frames will be analyzed per site per season. Data records for each slide will include:

1. Numbers of individuals of benthic invertebrates, identified to the lowest possible taxon, to be converted to no./m^2,

2. Numbers of individuals of fishes, identified to the lowest possible taxon, to be converted to no./m^2,

3. Bedform (i.e. deviations from a flat bed generated by flow, alluvial channels, etc.), encoded from a reference list of typical geological bedform features,

4. Lebensspuren (i.e. sedimentary structures or traces left by living organisms), encoded from a reference list of typical shapes or types--e.g. tracks, cones, holes, etc.--and cross-referenced to species if known, to be converted into actual size or percentage cover if possible,

5. Sediment color, encoded by reference to a standardized set of color cards,

6. Man-made artifacts, encoded from a reference list of most likely subjects--e.g. paper, bottle, tire, plastic bit, others,

7. Terrigenous or near-shore materials, encoded from a reference list of most likely subjects--e.g. sea grass blades, tree limbs, mollusc shells, and

8. Distribution of indurated or consolidated bottom types, especially those capable of supporting attached epifauna, encoded from a reference list of typical geological

features--e.g. hard rock, cobbles, silt stone--and converted into percentage cover if possible.

Field methods and sampling results were illustrated at the meeting using slides. Preliminary results from the initial sorting of the meiofaunal samples into major groups were depicted using cluster analysis based upon relative abundance data (Fig. 3). Abundance decreased with depth. Nematodes and harpacticoids dominated in all samples, with nematodes becoming proportionately more abundant at the deeper stations (Fig. 3). Total counts of the meiofauna at each Station are shown by Table 1.

Total estimated density of meiofauna and macroinfauna (preliminary and incomplete data) based on sample analysis to date were compared to historical data for continental slopes. Assuming that the preliminary data are representative of what the completed analysis will show, the continental slope of the Gulf of Mexico would appear to be characterized by higher macroinfauna and somewhat lower meiofauna densities than appears typical of other slope systems (Fig. 4). Keep in mind, however, that our macroinfauna samples are sieved using 300 μ mesh sieves whereas much of the historical data were derived from samples sieved using a 500 μ mesh. Sieve size will be taken into account in future comparisons.

Overall. the project is somewhat ahead of the planned schedule and presently under budget. Cruise II will be conducted in April 1974. To date, no major problems have been encountered.

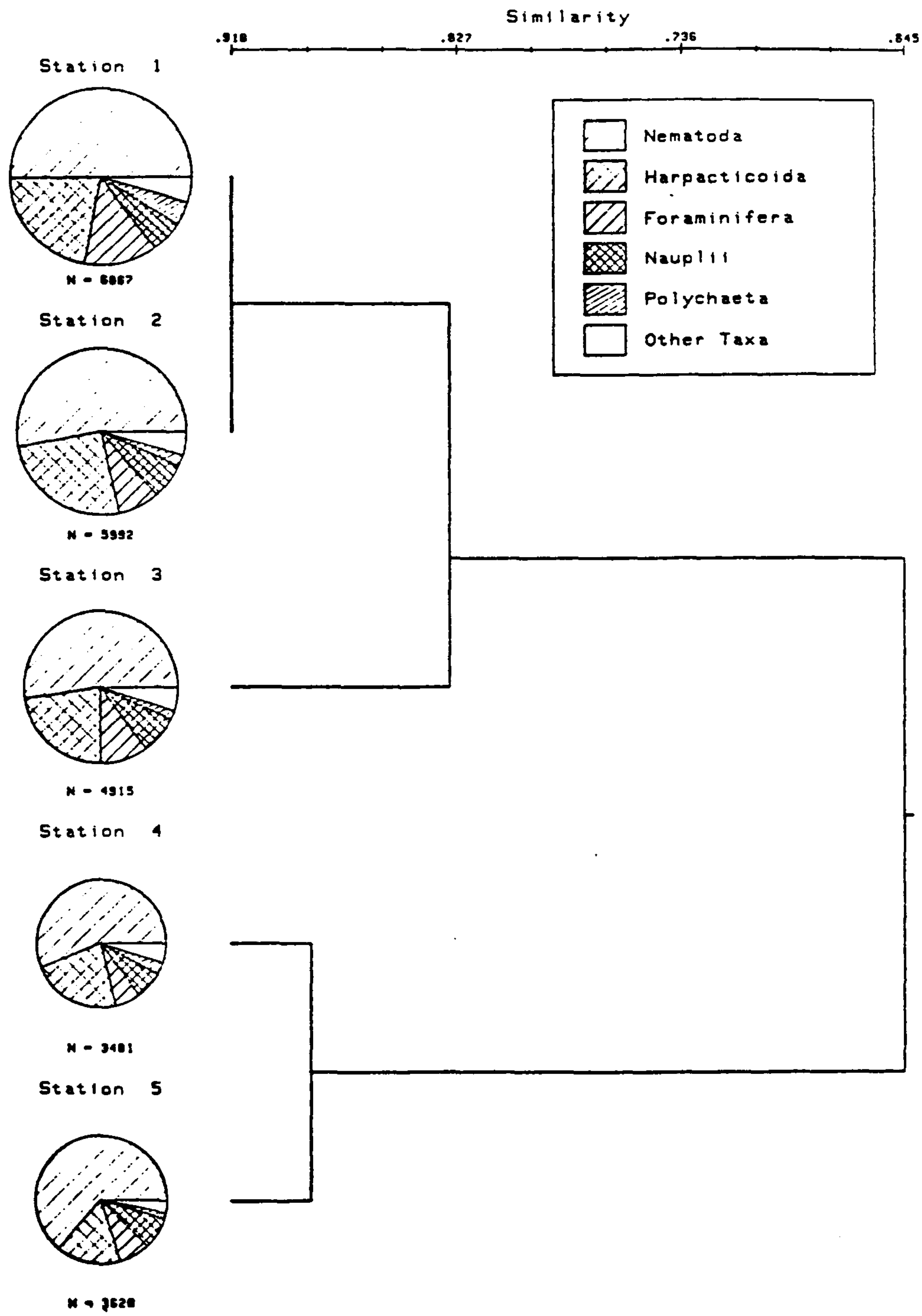

Figure 3. Meiofauna dendrogram showing relative abundance of major taxonomic groups at each station.

Table 1. Total counts by Station and Taxa: Meiofauna.

	Station					
Taxa	C1	C2	C3	C4	C5	Total
Nematoda	3443	3172	2572	1949	2304	13440
Harpacticoida	1506	1531	1117	797	582	5533
Foraminifera	899	465	488	216	268	2336
Nauplii	405	422	396	239	291	1753
Polychaeta	291	129	96	109	55	680
Ostracoda	124	135	113	73	44	489
Kinorhyncha	114	53	46	22	29	264
Unknown	15	14	16	11	15	71
Bivalvia	16	13	11	11	10	61
Unknown Crustacean	3	25	21	2	2	53
Isopoda	6	4	5	33	3	51
Copepoda	8	3	15	6	0	32
Tanaidacea	17	5	3	3	3	31
Amphipoda	2	13	1	0	0	16
Halacarida	0	1	1	4	7	13
Aplacophora	4	5	1	0	0	10
Gastropoda	6	0	2	0	1	9
Scaphopoda	1	1	2	4	1	9
Priapulida	0	0	0	0	4	4
Crustacea	0	0	3	1	0	4
Ophiuroidea	2	0	2	0	0	4
Cumacea	2	0	1	0	0	3
Tardigrada	0	1	1	0	1	3
Coelenterata	1	0	1	0	0	2
Sipunculida	1	0	0	0	0	1
Bryozoa	0	0	0	1	0	1
Oligochaeta	0	0	1	0	0	1
Scyphozoa Strobila	1	0	0	0	0	1
Total	6867	5992	4915	3481	3620	24875

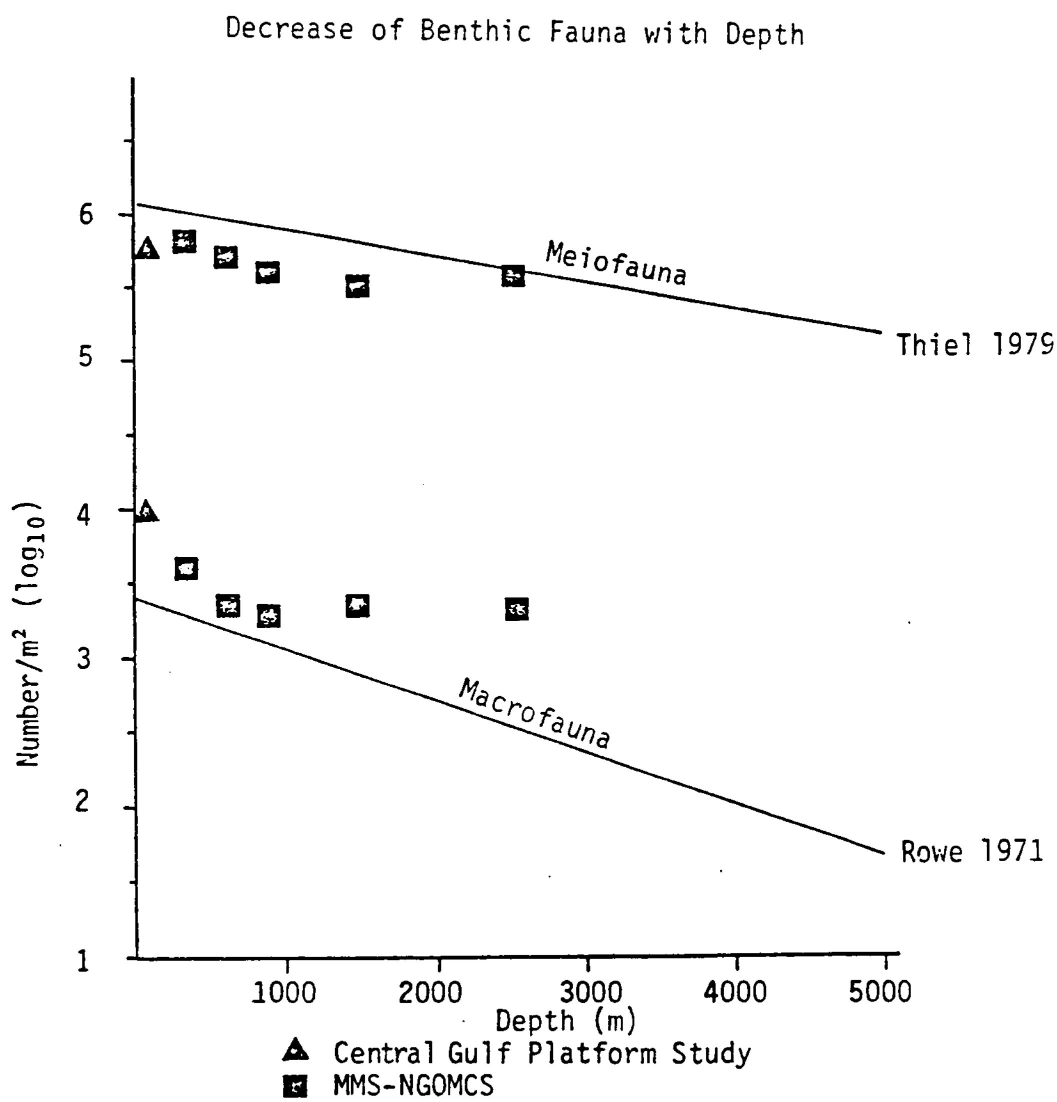

Figure 4. Densities of benthic organisms by depth.

ECOLOGICAL SUMMARY MAPPING

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Information concerning broader patterns of the distribution of biological resources of the Gulf of Mexico continental shelf have not previously been pulled together, analyzed, and displayed in a form suited to the purposes of management. To remedy this situation, the investigator was provided an IPA appointment with the Minerals Management Service to locate, acquire, analyze, and interpret existing biological data pertaining to the U.S. Gulf continental shelves from the Rio Grande to Key West, Florida.

The first phase of this study, covering the northwest Gulf shelf area from the Rio Grande to the Mississippi River, has been completed. The results were published in the following volume: NORTHWESTERN GULF SHELF BIO-ATLAS: A study of the Distribution of Demersal Fishes and Penaeid Shrimp of Soft Bottoms of the Continental Shelf from the Rio Grande to the Mississippi River Delta. U.S. Dept. Interior, Minerals Management Service, Open File Report 82-04. xii + 438 p., 22 Tables, 145 plates. (R.M. Darnell, R.E. Defenbaugh, and D. Moore, 1983). This report was based upon data derived from a five-year trawl survey of the demersal shelf fauna based upon monthly sampling transects throughout the area, carried out by the National Marine Fisheries Service. Over two million penaeid shrimp and fishes are represented in the data set. A single type of collecting gear was employed throughout, and tow speed and tow time were kept as constant as possible.

At the present time work is underway to produce a companion volume for the eastern Gulf shelf from the Mississippi River to the Florida Keys. Unfortunately, for this area no single, coherent, internally consistent data set exists. Therefore, it is necessary to combine data sets based upon different gear types and different sampling characteristics. To date, twelve trawl surveys have been located and the data have been acquisitioned, cleaned up, and placed into the computer. Together these provide seasonal coverage for most of the shelf, but some gaps remain. Data from the NMFS Fisheries Laboratory (based upon collections of M/V OREGON, OREGON II, and SILVER BAY) which have been requested should fill most of the remaining gaps. Formulas have been developed for the standardization of data bases with respect to gear type, towing speed, and towing time. A single standardized data base will be developed, and this will generate the information required for the analysis of the distribution patterns of eastern Gulf shelf fishes and shrimp. It is anticipated that the eastern Gulf volume will be completed within the next year.

NEARSHORE HABITAT MAPPING STUDY

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SUBMERGED LANDS OF TEXAS, CORPUS CHRISTI AREA:
SEDIMENTS, GEOCHEMISTRY, BENTHIC MACROINVERTEBRATES, AND ASSOCIATED WETLANDS

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Preface by W. L. Fisher

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Cartography
Barbara Hartmann, M. T. Bentley, David M. Ridner, and D. F. Scranton

1983

BUREAU OF ECONOMIC GEOLOGY
W. L. Fisher, Director
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Financial assistance was provided mainly by the General Land Office and the Governor's Budget and Planning Office of the State of Texas with grants under the Coastal Zone Management Act of 1972, as amended, administered by the Office of Coastal Zone Management, National Oceanic and Atmospheric Administration, United States Department of Commerce. Parts of the study were conducted in cooperation with the U.S. Geological Survey.

CONTENTS

FIGURES

TABLES

PLATES (in pocket)

ABSTRACT

Surface sediment textures, sediment geochemistry, and benthic fauna of the State-owned submerged lands were mapped and described using bottom samples collected at 1-mi (1.6-km) intervals from bays, estuaries, and lagoons, and the inner continental shelf. In addition, the distribution of wetlands in adjacent areas was mapped using color-infrared photographs taken in 1979.

Textural maps of the Corpus Christi area show that mud, with a mean grain size of between 5ϕ and 8ϕ, is the dominant sediment type in bay-estuary-lagoon and inner-shelf areas. Generally, muds occupy the deeper, central-bay areas of Corpus Christi, Aransas, and Copano Bays, whereas sandier sediments occur along the bay margins. Because Laguna Madre and Redfish Bay are shallow and have nearby sources of sand, the surface sediments there are dominantly sand. On the inner shelf, sand occupies the nearshore zone along the beach and shoreface. The sand grades seaward into muddy fine sand and then into mud deposited along much of the seaward perimeter of the study area. Shell represents only a minor fraction of shelf sediments but is abundant in some bay areas such as around oyster reefs. The distribution patterns of sediment types generally reflect different levels of wave and current energy controlled mostly by water depth.

Of approximately 30 major and trace elements analyzed, 12 were selected to show the concentrations of metals and other chemical components in the sediments. Selected were total organic carbon, barium, boron, calcium, chromium, copper, iron, lead, manganese, nickel, strontium, and zinc. Except for calcium and strontium, concentrations of these chemical elements correlate with sediment texture: concentrations are generally highest where fine-grained sediments (muds) are most abundant and lowest where sand is abundant. Most trace elements are more concentrated in shelf muds than in bay muds; exceptions are barium and zinc, which are more highly concentrated in bay sediments. These higher than normal concentrations are attributed to anthropogenic sources.

Benthic macroinvertebrates found in these sediments are primarily pelecypods, gastropods, crustaceans, and polychaetes. Species diversity is generally higher in sandier sediments, both in the bays and on the inner shelf. Within the bays, diversity values are generally higher in Redfish Bay and upper Laguna Madre, where marine grasses are extensive. The number of species at a sample site is generally higher in sandier sediments. This relationship occurs in both shelf and bay sediments, although bay sediments are highly variable. Using cluster analyses, three macroinvertebrate assemblages were delineated on the inner shelf and eight were delineated in the bays. Polychaetes were the dominant living organisms in both areas.

Wetlands bordering the submerged lands, and occurring in more inland areas, were classified primarily on the basis of vegetation and general moisture and salinity conditions. In the Corpus Christi area, 18 map units, including 3 marsh categories, were used to delineate wetlands. Major marsh units include salt-, brackish-, and fresh-water marshes, each subdivided into "high" and "low" categories according to moisture conditions and vegetation reflected in the 1979 photographs. Photographic analysis was confirmed by representative field observations and augmented by other available data. Wetlands mapped for this project were compared with those of the Environmental Geologic Atlas of the Texas Coastal Zone mapped on 1958-59 photographs. The comparison suggests that some changes, such as the spread of marine grasses, are in part related to compactional subsidence and relative sea-level rise.

Keywords: *assemblages, atlas, barrier islands, bathymetry, bays, benthonic taxa, coastal environment, Corpus Christi Bay, crustaceans, estuaries, geochemistry, grain size, inner shelf, invertebrates, lagoons, major elements, marine geology, marshes, minor elements, mollusks, Mustang Island, Nueces River, organic carbon, Padre Island, polychaetes, salt marshes, sampling, sediments, species diversity, statistical analysis, submerged lands, trace elements, trace metals, wetlands.*

Below are brief, introductory comments on the different analytical phases of the project, dealing with sediments, geochemistry, benthic macroinvertebrates, and wetlands. In-depth discussions of these topics, characterizing the submerged lands and associated wetlands in the Corpus Christi area, are found in later sections.

Sediments

Textural analyses provided the primary sediment data on the submerged lands. Analyses were performed by the Bureau of Economic Geology's Sedimentology Laboratory, except for samples from the southern half of the inner shelf

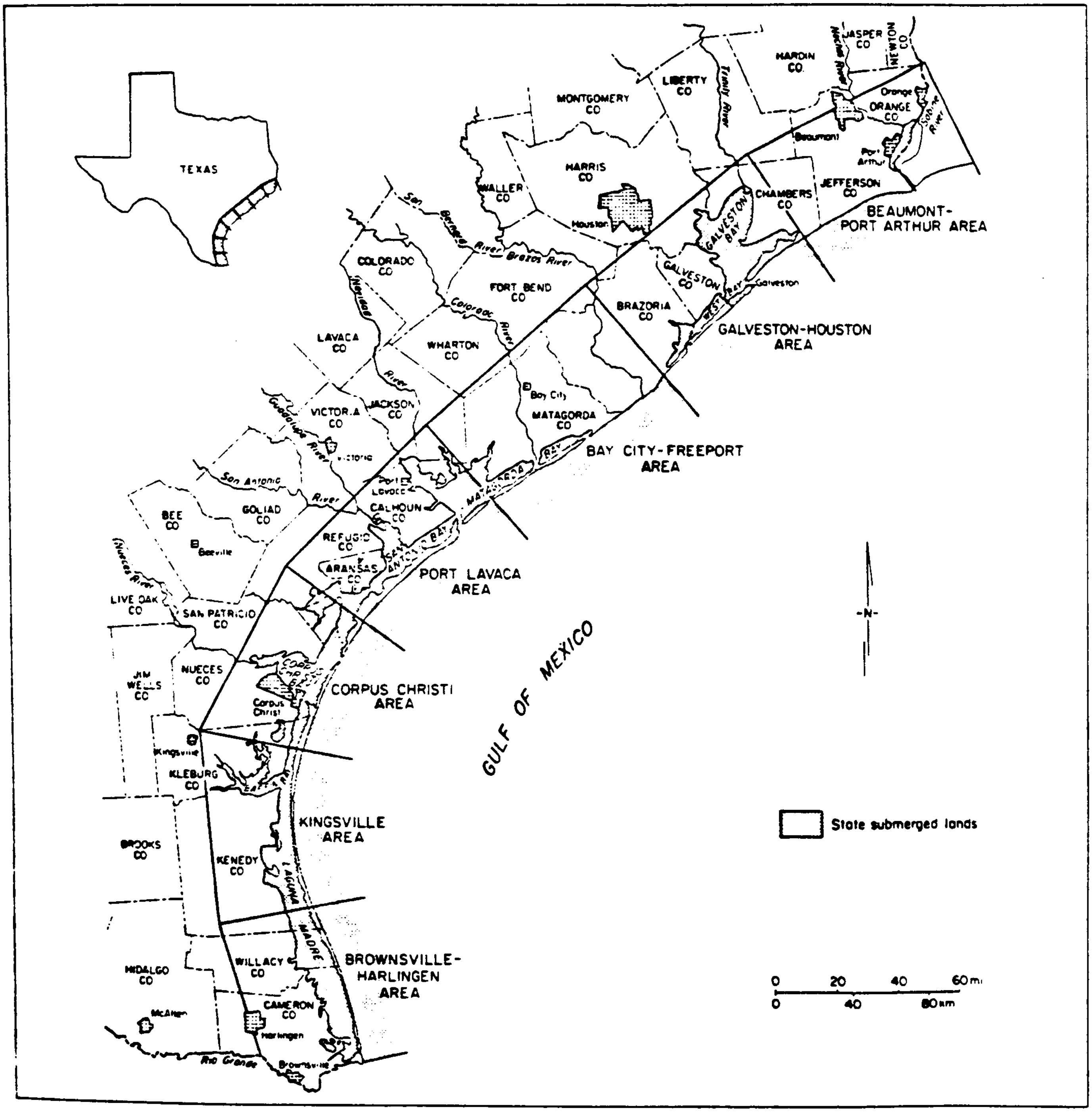

Figure 1. **Index map showing seven area maps that cover the submerged coastal lands of Texas (modified from McGowen and Morton, 1979, and Brown, 1972-80).**

GULF OF MEXICO ECOLOGICAL CHARACTERIZATION SUMMARY

J. Johnston

U.S. Fish & Wildlife

A. Mississippi Deltaic Plain Region

1. FWS/OBS-82/68 Ecological Models of the Mississippi Deltaic Plain Region: Data Collection and Presentation. Robert Costanza, et al. Louisiana State University, Baton Rouge, LA. March 1983. 342 pages. Availability A,C.[1]

2. FWS/OBS-82/69 Ecological Characterization of the Mississippi Deltaic Plain Region: A Narrative with Management Recommendations. Leonard M. Bahr, Jr., et al. Louisiana State University, Baton Rouge, LA. September 1983. 189 pages. Availability A,C.

3. FWS/OBS-81/16 Mississippi Deltaic Plain Region Ecological Characterization: An Ecological Atlas. Maps and Narrative. Donald Garofalo, Earth Satellite Corporation, Washington, DC. October 1982. 96 page text and 72 maps. Availability - Text Only - A, C.

   Full set of maps and text may be purchased from:

   Records Management Section　　Price - $50.00
   Minerals Management Service
   P.O. Box 7944
   Metairie, LA 70010

4. FWS/OBS-79/07 Mississippi Deltaic Plain Region Ecological Characterization: A Habitat Mapping Study. A User's Guide to the Habitat Maps. Karen M. Wicker. Coastal Environments, Inc. May 1980. 79 pages. Availability A.

   MAPS 79/07 Due to budgetary constraints, publication of the maps is limited. Copies are available for use, but cannot be loaned, at the following repositories:

   LOUISIANA

   National Coastal Ecosystems Team, Slidell, Louisiana
   Minerals Management Service, Metairie, Louisiana
   State of Louisiana Dept. of Natural Resources,
   　Coastal Management Section, Baton Rouge, Louisiana
   U.S. Army Corps of Engineers, New Orleans, Louisiana

[1]See back page for Availability information.

MISSISSIPPI

Bureau of Marine Resources, Long Beach, Mississippi
U.S. Army Corps of Engineers, Mobile, Alabama

Arrangements may be mde to purchase paper or acetate copies of specific maps from David DeBlanc. See MAPS 79/06 for address and phone information.

5. FWS/OBS-79/28 Mississippi Deltaic Plain Region Characterization Study. Brochure. June 1979. 8 pages. Availability A.

6. FWS/OBS-79/30 An Introduction to the Environmental Literature of the Mississippi Deltaic Plain Region. Johannes L. van Beek, et al. Coastal Environments, Inc. October 1981. 208 pages. Availability C. (NTIS PB82 161 621. PC A10/MF A01).

7. FWS/OBS-79/05 and 79/06 Mississippi Deltaic Plain Ecological Characterization: A Socioeconomic Study. Douglas K. Larson, et al. Willdan Assoc., March 1980.

   FWS/OBS-79/05 Vol. I - Synthesis Papers. Availability A, C. (NTIS PB80 198 468. PC A17/MF A01). 368 pages.

   FWS/OBS-79/06 Vol. II - Map Narratives. Availability C. (NTIS PB80 219 579. PC A06/MF A01). 112 pages.

   MAPS 79/06 Due to budgetary constraints, publication of the maps is limited. Copies are available for use, but cannot be loaned, at the following respositories:

LOUISIANA

National Coastal Ecosystems Team, Slidell, Louisiana
Minerals Management Service, Metairie, Louisiana
Louisiana State University Library (Government Documents Section), Baton Rouge, Louisiana
Nicholls State University Library, Thibodeaux, Louisiana
State of Louisiana, Dept. of Natural Resources, Coastal Management Section, Baton Rouge, Louisiana

MAPS FOR MISSISSIPPI ONLY

Gulf Coast Research Laboratory, Ocean Springs, Mississippi
Bureau of Marine Resources, Long Beach, Mississippi
University of Southern Mississippi Library (Government Documents Section), Hattiesburg, Mississippi

Arrangements may be made with the following office to purchase paper or acetate copies of specific maps:

David Deblanc
State of Louisiana Technology Transfer Office
Building 1100, Room 308
NSTL Station, MS 39529

(601) 688-3008 FTS 494-3008

B. Texas Barrier Islands Region

1. Texas Barrier Islands Region Ecological Characterization: A Habitat Mapping Study. 303-1:24,000 maps for the time periods 1956 and 1979. Total number is 606. For information on obtaining copies of maps contact Information Transfer Specialist, U.S. Fish and Wildlife Service (FWS), National Coastal Ecosystems Team (NCET), 1010 Gause Blvd., Slidell, LA 70458. Maps prepared by Texas A&M University and FWS.

2. Texas Barrier Islands Region Ecological Characterization: Narrative Report and Conceptual Models. In preparation by General Land Office of Texas, Austin, TX. Expected completion date is winter of 1984.

3. Texas Barrier Islands Region Ecological Characterization: An Ecological Atlas. 48 - 1:100,000 maps on biological resources, socioeconomic features, and oil and gas infrastructure. Atlas sent to Government Printing Office. For information on availability contact MMS or FWS/NCET. Atlas prepared by Texas A&M University.

4. FWS/OBS-81/32 Texas Barrier Islands Region Ecological Characterization: Environmental Synthesis Papers. Dale Shew, et al. Denver Wildlife Research Center, Belle Chasse, LA. September 1981. 413 pages. Availability A, C. (NTIS PB82 130 782. PC A18/MF A01).

5. FWS/OBS-80/19 Texas Barrier Islands Region Ecological Characterization: A Socioeconomic Study. Vol. 1: Synthesis Papers. Edward B. Liebow, et al. Willdan Associates. Phoenix, AZ and University of Texas at Austin. August 1980. 259 pages. Availability A, C.

6. FWS/OBS-80/20 Texas Barrier Islands Region Ecological Characterization: A Socioeconomic Study. Vol. 2: Data Appendix. Edward B. Liebow, et al. Willdan Associates, Phoenix, AZ and University of Texas at Austin. August 1980. 259 pages. Availability A, C.

C. Alabama Coastal Region Ecological Characterization

1. FWS/OBS- Alabama Coastal Region Ecological Characterization. Geological Survey of Alabama. University, Alabama.

   82/21 Volume 1 - Coastal Bibliography. June 1982. 408 pages. Availability A, C. (NTIS PB 83 180 661. PC A18/MF A01).

82/42 Volume 2 - A Synthesis of Environmental Data. June 1982. 346 pages. Availability A, C. (NTIS PB83 190 009. PC A16/MF A01).

81/41 Volume 3 - A Socioeconomic Study. October 1982. 367 pages. Availability A, C. (NTIS PB83 190 017. PC A17/MF A01).

2. Alabama Coastal Region Ecological Characterization: A Historical Habitat Mapping Study. 26-1:24,000 maps for the time period 1956. For information on obtaining copies of maps contact Information Transfer Specialist, U.S. Fish and Wildlife Service, National Coastal Ecosystems Team, 1010 Gause Blvd., Slidell, LA 70458. Maps prepared by Geological Survey of Alabama.

3. Alabama Coastal Region Ecological Characterization: A Habitat Mapping Study. 70-1:24,000 maps for the time period 1979. For information on obtaining copies of maps contact Information Transfer Specialist, U.S. Fish and Wildlife Service, National Coastal Ecosystems Team, 1010 Gause Blvd., Slidell, LA 70458. Maps prepared by FWS.

4. Alabama Coastal Region Ecological Characterization: An Ecological Atlas. 30-1:100,000 maps on soils, oil and gas infrastructure, socioeconomic features, biological resources, and climatology and hydrology. In preparation by Soil Systems Inc., Marietta, GA. Expected completion date is August of 1984.

5. Alabama Coastal Region Ecological Characterization: An Investigation on Shoreline and Wetland Changes and Sensitivity Mapping. Study being conducted by Geological Survey of Alabama and FWS. Expected completion date is November of 1984.

D. Panhandle and Southwest Florida Ecological Characterization

1. FWS/OBS-83/14 Florida Coastal Ecological Characterization: A Socioeconomic Study of the Southwestern Region. Carolyn O. French and John W. Parsons. U.S. Fish and Wildlife Service, Slidell, LA. August 1983. Availability A, C.

   Volume I - Text. 333 pages.
   Volume II - Part 1 Data Appendix. 295 pages.
   Volume II - Part 2 Data Appendix. 359 pages.
   Volume II - Part 3 Data Appendix. 196 pages.

2. FWS/OBS-83/15 Florida Coastal Ecological Characterization: A Socioeconomic Study of the Northwestern Region. Carolyn O. French and John W. Parsons. U.S. Fish and Wildlife Service, Slidell, LA August 1983. Availability A, C.

   Volume I - Text. 306 pages.
   Volume II - Part 1 Data Appendix. 309 pages.
   Volume II - Part 2 Data Appendix. 375 pages.

3. FWS/OBS-82/58.1 An Ecological Characterization of the Lower Everglades, Florida Bay, and the Florida Keys. N. Scott Schomer & Richard D. Drew, State of Florida, Dept. of Environmental Regulation, Tallahassee, FL. September 1982. 263 pages. Availability C. (NTIS PB83 141 978. PC A12/MF A01).

   Additional (11) papers on the various watersheds along the west coast are being prepared by State of Florida, Department of Environmental Regulation (DER) during FY84. During FY85, DER will complete preparation of Narrative Report and Conceptual Models for panhandle and southwest regions.

4. FWS/OBS-82/25 The Ecology of the Seagrasses of South Florida: A Community Profile. Joseph C. Zieman, University of Virginia, Charlottesville, VA. September 1982. 150 pages. Availability A, C. (NTIS PB83 140 574. PC A08/MF A01).

5. FWS/OBS-81/24 The Ecology of the Mangroves of South Florida: A Community Profile. William E. Odum, Carole C. McIvor and Thomas J. Smith, III. University of Virginia. (NTIS PB82 256 108. PC A08/MF A01).

6. The Ecology of Coral Reefs: A Community Profile by Walter Jaap, Ecology of Big Bend Seagrass Beds: A Community Profile by Richard Iverson, and The Ecology of Juncus Marsh: A Community Profile by Judy Stout will be completed in FY84.

7. FWS/OBS-81/50 Rare, Threatened, and Endangered Plant Species of Southwest Florida and Potential OCS Activity Impacts. Earl D. McCoy. University of South Florida, Tampa, FL. November 1981. 93 pages. Availability A, C. (NTIS PB82 182 452. PC A05/MF A01).

8. FWS/OBS-82/03 Rare, Threatened, and Endangered Vertebrates of Southwest Florida and Potential OCS Activity Impacts. Glen E. Woolfenden. University of South Florida, Tampa, FL. February 1983. 65 pages. Availability A, C. (NTIS PB83 250 811. PC A05/MF A01).

9. Florida Keys Seagrass and Coral Reef Inventory (1982). 6 volumes of 1:24,000 color photography with interpretative overlays. Copies housed at MMS, FWS, and State of Florida OCS office. Prepared by EPA.

10. Florida Big Bend Shoreline Seagrass Inventory (1982). 1:24,000 color photography with interpretative overlays. Copies housed at MMS, FWS, and State of Florida OCS office. Prepared by EPA.

11. Marine Grass Beds Inventory North Florida Coast (1980). 1:24,000 color photography with interpretative overlays. Copies housed at MMS, FWS, and State of Florida OCS office. Prepared by EPA.

12. Southwest Florida Ecological Atlas. 80 - 1:100,000 maps on soils, oil and gas infrastructure, socioeconomic features, biological

resources, and climatology and hydrology. Atlas sent to Government Printing Office. For information on availability contact MMS or FWS/NCET. Atlas prepared by Martel Laboratories, St. Petersburg, Fla.

13. Panhandle and Big Bend of Florida Ecological Atlas. 90 - 1:100,000 maps depicting same topics as Southwest Florida Ecological Atlas. Scheduled completion date is October of 1984. Atlas being prepared by Martel Laboratories, St. Petersburg, Fla.

14. Panhandle and Big Bend Habitat Mapping. FWS prepared 1:24,000 maps for the following areas and time periods - Panhandle (1979 - 217 maps), Panhandle (1956 - 21 maps), Southwest Florida (1972 - 105 wetland maps), and Charlotte Harbor (1980 - 20 maps). For information on availability of maps contact FWS/NCET.

25 January 1984

U.S. FISH AND WILDLIFE SERVICE
NATIONAL COASTAL ECOSYSTEMS TEAM

The reports listed on the attached publication list were produced by the National Coastal Ecosystems Project and most are available from the National Coastal Ecosystems Team. To obtain copies of any publication, check the availability code for each publication listed (Code = A, B, C, or P) and refer to the sources below. National Technical Information Service provides a choice of paper copy or microfiche, but does charge for publications. Prices are indicated by the codes following PC (paper copy) and MF (microfiche), respectively. The National Coastal Ecosystems Team will supply one copy free until our supply runs out, if the listing indicates the availability of Code A.

Current availability is indicated by:

Code A for: Information Transfer Specialist
U.S. Fish and Wildlife Service
Slidell Computer Complex
1010 Gause Boulevard
Slidell, LA 70458

Code B for: Information Transfer Coordinator
Division of Biological Services
U.S. Fish and Wildlife Service
Department of the Interior
Washington, DC 20240

Code C for: National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161

Code P for: Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402

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WETLAND CHANGES IN THE MISSISSIPPI RIVER ACTIVE DELTA (1956-1978)

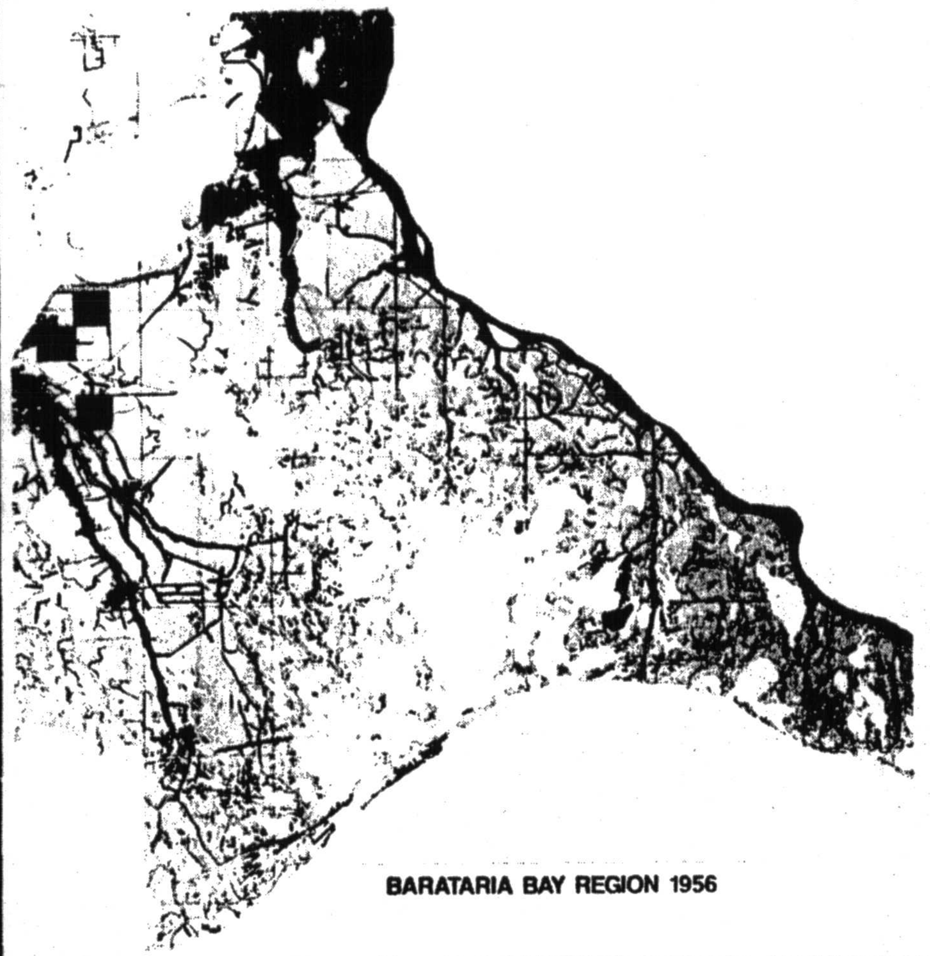
LEGEND

HABITAT TYPE	1956 ACREAGE	1978 ACREAGE	ACREAGE CHANGE	% CHANGE
MARSH	182,838	89,381	-93,457	-51%
FORESTED WETLAND	7,894	3,233	-4,661	-59%
UPLAND	3,362	6,915	+ 3,553	+ 106%
DREDGE DEPOSIT	3,057	11,369	+ 8,313	+ 272%

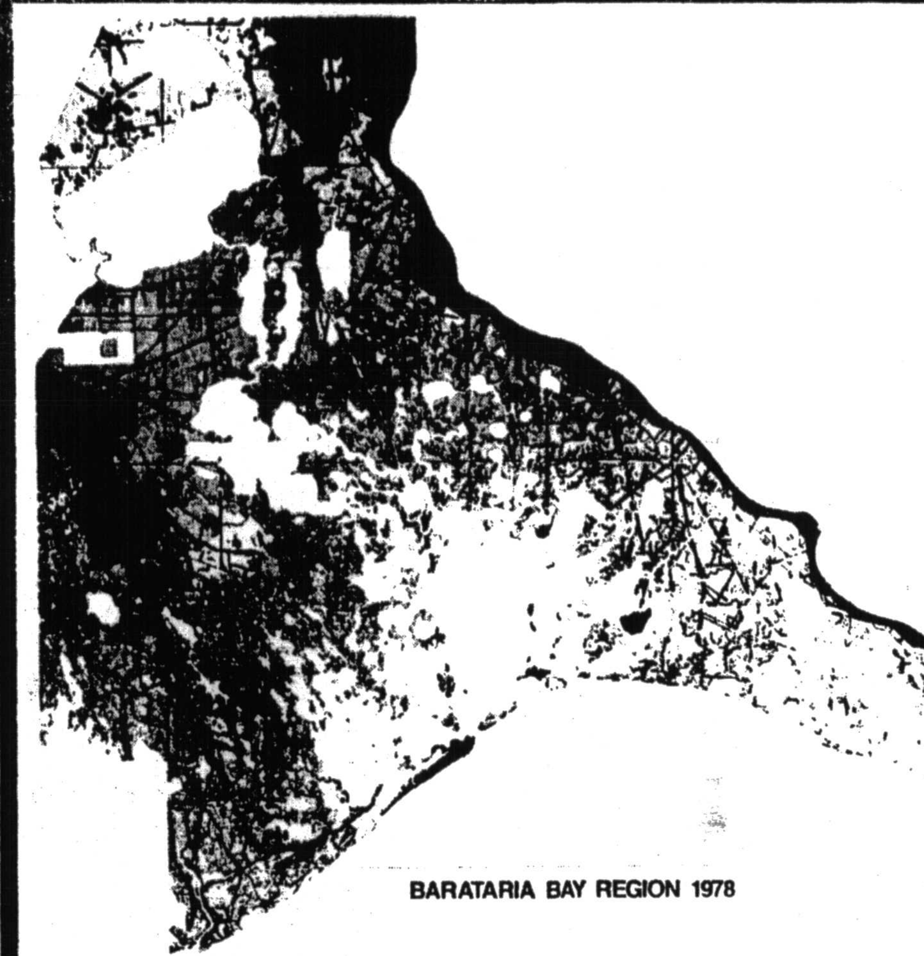
SCALE 1:90,000
25 0 25 50 75 100
MILES

U.S. FISH AND WILDLIFE SERVICE
NATIONAL COASTAL ECOSYSTEMS TEAM
SLIDELL, LOUISIANA

WETLAND CHANGES IN THE BARATARIA BAY REGION (1956-1978)



BARATARIA BAY REGION 1956



BARATARIA BAY REGION 1978

LEGEND

HABITAT TYPE	1956 ACREAGE	1978 ACREAGE	ACREAGE CHANGE	% CHANGE
MARSH	548,356	410,586	-137,770	-25%
FORESTED WETLAND	46,765	42,152	-4,613	-10%
UPLAND	39,392	61,947	+ 22,55 5	+ 57%
DREDGE DEPOSIT	10,896	24,420	+ 13,524	+ 124%

SCALE 1:150,000
0 10 20
MILES

U.S. FISH AND WILDLIFE SERVICE
NATIONAL COASTAL ECOSYSTEMS TEAM
SLIDELL, LOUISIANA

3.0. List of Attendees.

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The Department of the Interior Mission

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

The Minerals Management Service Mission

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

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

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