Proceedings

COAR
COPY

SUMMER TERNARY GULF OF MEXICO STUDIES MEETING
June 15-16, 1983, Corpus Christi, Texas

Prepared for

U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Region
Metairie, Louisiana

Under Contract No. 14-12-0001-29144

August 15, 1983

Woodward-Clyde Consultants

Consulting Engineers, Geologists and Environmental Scientists
P.O. Box 81848 San Diego, California 92138

60834

Proceedings

SUMMER TERNARY GULF OF MEXICO STUDIES MEETING June 15-16, 1983, Corpus Christi, Texas

Prepared for

U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Region
Metairie, Louisiana

Under Contract No. 14-12-0001-29144

August 15, 1983

Woodward-Clyde Consultants

Consulting Engineers, Geologists and Environmental Scientists
P.O. Box 81848 San Diego, California 92138

60834

This report was prepared for the Minerals Management Service under Contract Number 14-12-0001-29144. The report has not been reviewed by the Service, nor has it been approved for publication. Approval, when given, does not signify that the contents necessarily reflect the views and policies of the Service, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

PREFACE

The contents of this Proceedings Volume are based principally on notes taken during the general meeting session and expanded abstracts provided by speakers. Arrangements for the meeting were handled by Woodward-Clyde Consultants (WCC) under U.S. Department of the Interior, Minerals Management Service Contract, No. 14-12-0001-2144.

The Summer Ternary Gulf of Mexico Studies Meeting was held June 15 and 16, 1983, at the Corpus Christi Hilton Inn, Corpus Christi, Texas. Woodward-Clyde Consultants is pleased to acknowledge assistance received from Mary Macdonald (WCC, meeting coordination and arrangements); and the staff of the Corpus Christi Hilton Inn, all of whom made our task both easier and more enjoyable.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

In view of recently completed and proposed outer continental shelf federal lease offerings, environmental studies in the Gulf of Mexico region have taken on a special significance. As a means of providing a timely and effective mechanism for the transfer of current study data and information among different project investigators in this area, the New Orleans Outer Continental Shelf (OCS) Region Office of the Minerals Management Service (MMS) is sponsoring a series of regional studies meetings.

The first of these regional studies meetings was held in Tallahassee, Florida on October 15 and 16, 1981. The second meeting was held in Mobile, Alabama on May 12 and 13, 1982 and the third in Biloxi, Mississippi, on January 18 and 19, 1983. This report presents the proceedings of the fourth meeting, held in Corpus Christi, Texas, on June 15 and 16, 1983. More than 40 participants from local, state and federal government, regulatory agencies, universities and industry attended the meeting. A list of meeting participants, along with their professional affiliations, addresses and phone numbers is presented in Table 1 (pp. 2-5).

The Studies Meeting was called to order and a brief introduction by Dr. Robert Avent described Minerals Management Service goals for the meeting. Dr. Keith Macdonald (WCC) outlined details of the meeting program and logistics.

Dr. Richard Defenbaugh presented an excellent summary overview of the status of the Minerals Management Service, Gulf of Mexico OCS Environmental Studies Program. Printed copies of this presentation are available through the MMS Gulf of Mexico OCS Region Office in Metairie, Louisiana.

A number of general information fact sheets and brochures explaining the MMS Environmental Studies Program were made available to meeting participants. One of these was: Environmental Studies Program for the Gulf of Mexico: Quarterly Status Report, April, 1983. Another of these fact sheets, Environmental Studies Program for the Gulf of Mexico: Availability of Contract Studies Reports and Programmatic Documents, April, 1983, updated publications presently available from the MMS.

The U.S. Department of the Interior, Minerals Management Service OCS lease offering schedule entitled, "Final 5-Year Oil & Gas Leasing Schedule/Proposed Sale Dates" and dated July 21, 1982, is reproduced as Figure 1, (p.9) for general information.

Table 1. MEETING PARTICIPANTS

Name	Affiliation	Address/Phone
Avent, Robert M.	Minerals Management Service	P.O. Box 7944 Code-LE-4 Metairie, LA 70010 (504) 589-2445
Bates, Bert, Jr.	Sun Exploration and Production	Sun Tower Building Corpus Christi, Texas (512) 851-7000
Brown, Murray	Minerals Management Service	P.O. Box 7944 Code-LE-4 Metairie, LA 70010 (504) 589-2445
Caillouet, Charles	NOAA, National Marine Fisheries Service	Galveston Laboratory 4700 Avenue U Galveston, TX 77550 (409) 766-3525
Chmelik, Frank	Racal Geophysics, Inc.	10401 Westoffice Drive Houston, TX 77042 (713) 783-8220
Darnell, Rezneat	Texas A & M University	College Station, Texas (409) 845-5756
Dauterive, Les	Minerals Management Service	P.O. Box 7944 Code-LE-4 Metairie, LA 70010 (504) 837-4720
Defenbaugh, Richard	Minerals Management Service	P.O. Box 7944 Code-LE-4 (504) 589-2445
Dick, Michael	Texas Department of Water Resources	P.O. Box 13087 Capitol Station Austin, TX 78711 (512) 475-5516
Flint, Warren	University of Texas Marine Science Institute	U. of Texas Marine Lab Port Aransas, Texas (512) 888-3294
Foote, Richard Q.	Minerals Management Service	P.O. Box 6731 6300 Ocean Drive Corpus Christi, TX 78401 (512) 888-3294

Table 1. MEETING PARTICIPANTS (Continued)

Name	Affiliation	Address/Phone
Garrison, Louis E.	Minerals Management Service	P.O. Box 6732 6300 Ocean Drive Corpus Christi, TX 78401 (512) 888-3294
Gibson, William	Transco	P.O. Box 1396 Houston, TX 77351 (713) 729-3627
Hall, H. Dale	U.S. Fish & Wildlife Service	17629 El Camino Real Suite 211 Houston, TX 77058 (713) 229-3681
Hegen, Edward	Texas Parks and Wildlife Service	TPWD Marine Laboratory Rockport, Texas (512) 729-2328
Hill, Charles W., Jr.	Minerals Management Service	P.O. Box 7944 Code-LE-4 Metairie, LA 70010 (504) 837-3995
Holmes, Charles	Minerals Management Service	P.O. Box 6732 6300 Ocean Drive Corpus Christi, TX 78411 (512) 888-3294
Keney, Peggy	National Marine Fisheries Service	Environmental Division 4700 Avenue U Galveston, TX 77550 (409) 766-3699
Kindinger, Jack	Minerals Management Service	P.O. Box 6732 6300 Ocean Drive Corpus Christi, TX 78411 (512) 888-3294
King, Robert	National Park Service	9405 So. Padre Island Dr. Corpus Christi, TX 78418 (512) 933-8177
Kwok, Alan	Recal-Decca Survey	10401 Westoffice Drive Houston, TX 77042 (713) 783-8220
Lindstedt, Dianne	LGS - Baton Rouge	P.O. Box G University Station Baton Rouge, LA 70893 (504) 342-6754

Table 1. MEETING PARTICIPANTS (Continued)

Name	Affiliation	Address/Phone
Garrison, Louis E.	Minerals Management Service	P.O. Box 6732 6300 Ocean Drive Corpus Christi, TX 78401 (512) 888-3294
Gibson, William	Transco	P.O. Box 1396 Houston, TX 77351 (713) 729-3627
Hall, H. Dale	U.S. Fish & Wildlife Service	17629 El Camino Real Suite 211 Houston, TX 77058 (713) 229-3681
Hegen, Edward	Texas Parks and Wildlife Service	TPWD Marine Laboratory Rockport, Texas (512) 729-2328
Hill, Charles W., Jr.	Minerals Management Service	P.O. Box 7944 Code-LE-4 Metairie, LA 70010 (504) 837-3995
Holmes, Charles	Minerals Management Service	P.O. Box 6732 6300 Ocean Drive Corpus Christi, TX 78411 (512) 888-3294
Keney, Peggy	National Marine Fisheries Service	Environmental Division 4700 Avenue U Galveston, TX 77550 (409) 766-3699
Kindinger, Jack	Minerals Management Service	P.O. Box 6732 6300 Ocean Drive Corpus Christi, TX 78411 (512) 888-3294
King, Robert	National Park Service	9405 So. Padre Island Dr. Corpus Christi, TX 78418 (512) 933-8177
Kwok, Alan	Recal-Decca Survey	10401 Westoffice Drive Houston, TX 77042 (713) 783-8220
Lindstedt, Dianne	LGS - Baton Rouge	P.O. Box G University Station Baton Rouge, LA 70893 (504) 342-6754

Table 1. MEETING PARTICIPANTS (Continued)

Name	Affiliation	Address/Phone
Longley, William	General Land Office	1700 No. Congress Austin, TX 78701 (512) 475-1187
Macdonald, Keith B.	Woodward-Clyde Consultants	3489 Kurtz Street San Diego, CA 92110 (619) 224-2911
Mettee, Scott	Geologic Survey of Alabama	P.O Drawer O University, AL 35486 (205) 349-2852
Moseley, Joseph	Goldston Engineering, Inc.	Box 9668 Corpus Christi , TX 78408 (512) 854-0147
Nude, Floyd	U.S. Fish and Wildlife Service	17629 El Camino Real Suite 211 Houston, TX 77058 (713) 229-3681
McFarlen, James	Minerals Management Service	P.O. Box 7944 Code-LE-4 Metairie, LA 70010 (512) 888-3294
Rinkel, Murice O.	State of Florida OCS Representative	830 First Street South St. Petersburg, FL 33701 (813) 893-9106
Rogers, Robert	Minerals Management Service	P.O. Box 7944 Code-LE-4 Metairie, LA 70010 (504) 589-2445
Sieverding, H. P.	Minerals Management Service	P.O. Box 7944 Code-LE-4 Metairie, LA 70010 (512) 838-0755
Spiller, Samual F.	U.S. Fish and Wildlife Service	c/o CCSU Campus Box 338 6300 Ocean Drive Corpus Christie, TX 78412 (512) 888-3346
Stewart, Sharron	NACOA	102 Carnation Lake Jackson, TX 77566 (409) 297-6360
Smith, Melissa W.	U.S. Dept. of Energy	900 Commerce Road East New Orleans, LA 70123 (504) 734-4387

Table 1. MEETING PARTICIPANTS (Continued)

Name	Affiliation	Address/Phone
Tucker, Debby	State of Florida Governor's Office	The Capitol Tallahassee, FL 32301 (904) 488-5551
Volz, Chip	Texas Department of Water Resources	P.O. Box 13087 Capitol Station Austin, TX 78711 (512) 475-5516
Vukovich, Fred	Research Triangle Institute	P.O. Box 12194 Research Triangle Park North Carolina 27709 (919) 541-6000
Wells, Ronnie	Minerals Management Service	P.O. Box 6732 6300 Ocean Drive Corpus Christi, TX 78401 (512) 888-3294
Wermund, E. G.	Bureau of Economic Geology, Texas	University of Texas Austin, TX 78712 (512) 282-5222
Waddell, Evans	Science Applications Incorporated	4900 Waters Edge Drive Suite 255 Raleigh, North Carolina (919) 851-8356
Wolfe, John	CONOCO	P.O. Box 2197, Ste. 2710 Houston, TX 77001 (713) 965-2606

GULF OF MEXICO
Outer Continental
Shelf Region

MMS

MINERALS MANAGEMENT SERVICE
U.S. DEPARTMENT OF THE INTERIOR

Environmental
Studies
Information
Announcement

ENVIRONMENTAL STUDIES PROGRAM
FOR THE
GULF OF MEXICO

ENVIRONMENTAL STUDIES PROGRAM
OVERVIEW PRESENTATION

Summer Ternary Studies Meeting
Corpus Christi Hilton Inn
Corpus Christi, Texas
June 16, 1983

The Minerals Management Service, Imperial Office Building, Metairie, Louisiana 70010

GULF OF MEXICO
Outer Continental
Shelf Region

MMS

MINERALS MANAGEMENT SERVICE
U.S. DEPARTMENT OF THE INTERIOR

Environmental Studies Information Announcement

ENVIRONMENTAL STUDIES PROGRAM
FOR THE
GULF OF MEXICO

AVAILABILITY OF CONTRACT STUDIES REPORTS AND PROGRAMMATIC DOCUMENTS

APRIL 1983

Environmental Studies Section
Division of Leasing and Environment
Minerals Management Service
Gulf of Mexico OCS Region
U.S. Department of the Interior

The Minerals Management Service, Imperial Office Building, Metairie, Louisiana 70010

GULF OF MEXICO
Outer Continental
Shelf Region

MMS

MINERALS MANAGEMENT SERVICE
U.S. DEPARTMENT OF THE INTERIOR

Environmental Studies Information Announcement

ENVIRONMENTAL STUDIES PROGRAM
FOR THE
GULF OF MEXICO

QUARTERLY STATUS REPORT
APRIL, 1983

Environmental Studies Section
Division of Offshore Leasing, Environment, and Studies
Minerals Management Service
Gulf of Mexico OCS Region
U.S. Department of the Interior

The Minerals Management Service, Imperial Office Building, Metairie, Louisiana 70010

FINAL 5-YEAR OIL & GAS LEASING SCHEDULE

Proposed Sale Dates

U.S. Department of the Interior
Minerals Management Service

July 21, 1982

1982

RS – 2	August
71 Diapir Field	September
52 North Atlantic	October
69 Gulf of Mexico	October
57 Norton Basin	November

1983

*70 St..George Basin	February
76 Mid Atlantic	April
72 C. Gulf of Mexico	May
78 S. Atlantic	July
74 W. Gulf of Mexico	August
73 C. & N. California	September
79 E. Gulf of Mexico	November

1984

80 S. California	January
82 N. Atlantic	February
83 Navarin Basin	March
81 C. Gulf of Mexico	April
87 Diapir Field	June
84 W. Gulf of Mexico	July
88 Gulf of Alaska/Cook Inlet	October
89 St. George Basin	December

1985

90 S. Atlantic	January
85 Barrow Arch	February
92 N. Aleutian Basin	April
98 C. Gulf of Mexico	May
111 Mid Atlantic	June
102 W. Gulf of Mexico	August
91 C. & N. California	September
100 Norton Basin	October
94 E. Gulf of Mexico	November

1986

95 S. California	January
96 N. Atlantic	Febuary
107 Navarin Basin	March
104 C. Gulf of Mexico	April
97 Diapir Field	June
105 W. Gulf of Mexico	July
99 Kodiak	October
101 St. George Basin	December

1987

108 S. Atlantic	January
109 Barrow Arch	February
110 C. Gulf of Mexico	April
86 Shumagin	June

Secretary of the Interior

*The Department will consult with the Alaska Land Use Council following the issuance of the Proposed Notice of Sale.

Figure 1.

2. GENERAL SESSION

The remainder of the one day General Session consisted of ten oral presentations organized as indicated on the agenda that follows. Each presentation was followed by questions and discussion of pertinent issues.

We were particularly fortunate to hear presentations from four guest speakers not previously in attendance during this sequence of Studies Meetings. Mr. Ed Hegen of the Coastal Fisheries Branch, Texas Parks and Wildlife Department, Rockport, Texas, described ongoing studies being conducted by the Department within their Marine and Estuarine Research Program. Dr. Fred Vukovich of the Research Triangle Institute in North Carolina, described early results from the West Florida Physical Oceanography Program. Dr. Warren Flint, of the University of Texas Marine Laboratory at Port Aransas, outlined his research on the application of benthic process measurements to problems concerning drilling muds. Mr. William Longley of the Texas General Land Office in Austin presented an overview of the Texas Barrier Island Narrative Report.

Extended abstracts or fact sheets for seven of the ten presentations are included in the following section. The order of inclusion parallels the program agenda. The majority of these abstracts were reproduced, collated and available to participants at the time of the Studies Meeting. In some cases, additional figures or other materials were received during or subsequent to the meeting. All of these additional materials have been incorporated into the abstracts that follow.

MINERALS MANAGEMENT SERVICE
SUMMER TERNARY GULF OF MEXICO STUDIES MEETING

CORPUS CHRISTI HILTON INN
CORPUS CHRISTI, TEXAS

AGENDA

JUNE 15, 1983

5:30 P. M.	Registration and Reception

JUNE 16, 1983

8:00 A.M.	Late Registration
8:30 A.M.	Introduction Dr. Robert Avent, MMS, Gulf of Mexico OCS Regional Office, Metairie, Louisiana. Dr. Keith B. Macdonald, Woodward-Clyde Consultants, San Diego, California. Minerals Management Service Environmental Studies Programs. Dr. Richard Defenbaugh, MMS, Gulf of Mexico OCS Regional Office, Metairie, Louisiana. Texas Parks and Wildlife Department - Marine and Estuarine Research Programs. Mr. Ed Hegen, TPWD Marine Laboratory, Rockport, Texas. Minerals Management Service Geological Research in the Gulf of Mexico. Dr. Louis Garrison, MMS, Corpus Christi, Texas.
10:00 A.M.	Morning Break
10:30 A.M.	Introduction to Physical Oceanography. Dr. Murray Brown, MMS, Gulf of Mexico OCS Regional Office, Metairie, Louisiana. Gulf of Mexico Regional Physical Oceanography Program. Dr. Evans Waddell, Science Applications, Inc., Raleigh, North Carolina. West Florida Physical Oceanography Program. Dr. Fred Vukovich, Research Triangle Institute, Research Triangle, North Carolina.

	Application of Benthic Process Measurements to Problems Concerning Drilling Muds. Dr. Warren Flint, University of Texas Marine Laboratory, Port Aransas, Texas.
11:40 A.M.	Lunch
1:25 P.M.	Fishery Resources of the Northwestern Gulf Continental Shelf. Dr. Rezneat Darnell, Texas A & M University, College Station, Texas.
	Southwest Florida Shelf Studies. Dr. Keith Macdonald, Woodward-Clyde Consultants, San Diego, California.
2:30 P.M.	Afternoon Break
3:00 P.M.	Texas Barrier Island Ecological Atlas. Dr. Robert Rogers, MMS, Gulf of Mexico OCS Regional Office, Metairie, Louisiana.
	Texas Barrier Island Narrative Report. Mr. Bill Longley, Texas General Land Office, Austin, Texas.
4:10 P.M.	Final Remarks
	Adjournment

A B S T R A C T S

TEXAS PARKS AND WILDLIFE DEPARTMENT

MARINE AND ESTUARINE RESEARCH PROGRAM

Ed Hegen

Coastal Fisheries Branch
Texas Parks & Wildlife Department
P.O. Box 1707
Rockport, TX 78382

The coastal Fisheries Branch of the Texas Parks & Wildlife Department (TPWD) is responsible for managing the fishery resources of Texas' coastal waters out to 9 nautical miles in the Gulf of Mexico to prevent depletion or waste and to provide the most equitable and reasonable privilege for fishing opportunities and harvest. The Branch's goal is to develop and implement management plans for selected marine fisheries that include harvest regulations, resource stock enhancements and habitat enhancement based on the results of monitoring programs and the best scientific information available. These management plans are provided to the TPWD Division Directors, Executive Director and Commission and the Texas Governor and Legislature for evaluation and promulgation of management regulations and legislation.

Three broad objectives provide the framework for meeting the goals:

- Monitoring the marine fishery resources, harvests, environments and socio-economic characteristics.
- Evaluating and reporting on status of Texas marine fisheries.
- Maintaining and enhancing fishery resources, harvests, environments and user opportunities.

Coastal Fisheries annual budget exceeds $2.1 million, approximately 26% of which is acquired through Federal aid grants such as Dingell-Johnson, Public Law 88-309 and the Gulf of Mexico Fisheries Management Council. Long-term monitoring programs utilizing standardized procedures and gears (such as gill nets, bag seines and trawls) are conducted coastwide for finfish, shrimp, oysters, crabs, and both commercial and recreational harvests. Marine culture and enhancement, currently with red drum and striped bass, are done jointly with TPWD Inland Fisheries. Seafood marketing, an educational program to provide the consumer with high quality, wholesome seafood products, is done through interagency contract with Texas A&M University. The Gulf Coast Conservation Association cooperates with the Coastal Fisheries fish tagging and marine culture and enhancement programs.

SERIES PLAN FOR PHYSICAL OCEANOGRAPHY STUDIES: FY82-84

PROGRAM	YEAR	STUDY TITLE	MMS ID #	STUDY CLASS	SUMMARY OF RECENT ACTIVITY
CIRCULATION MODELLING	1983	Gulf of Mexico Circulation Model, I	G-271	Cancelled	The non-competitive procurement of this study was determined not to be justified by the Washington Office. Since initial program planning in May 1981, a number of modelling efforts, other than the OTEC model originally selected for MMS use, have been published or reported on. Their availability precludes sole-source procurement.
CIRCULATION MODELLING	1983	Gulf of Mexico Circulation Model, II	G-371	Planned	The procurement package for a competitive procurement is nearly complete. Transmittal to Washington prior to the deadline for new procurements is certain.
MEASUREMENTS & DATA SYNTHESIS	1982	MMS/NDBO Cooperative Drifting Buoy Program, I	29034	Active	The Final Report from NDBC's FY 81 deployment of three buoys has been receved, and has been submitted for distribution. Although MMS participated only in part of the costs of data analysis, NDBC has requested that we place it solely in the OCS Studies Program documentation for greater circulation and visibility. The second buoy will be deployed in 'Eddy G', near 27N 93W, in mid-July by the Air Force. The third buoy, which should arrive in July, will probably be placed in 'Eddy H', near 25N 95W, from a surface vessel.
MEASUREMENTS & DATA SYNTHESIS	1982	Gulf of Mexico Physical Oceanography, I	29158	Active	The March 7-22 hydrographic cruise was very detrimentally affected by the passage of several fronts. Although only very little time was totally lost, the data return consisted of only two very detailed long transects, mainly south of 26N latitude. Significantly, we were able to minimize time lost due to careful use of remote sensing products delivered via the GERAF system. The ship-of-opportunity program was begun in late April, using a vessel sailing the route from New Orleans to Yucatan. A vessel change in June has delayed the data somewhat. There is a good likelihood that the FIO hydrographic survey program in the Loop Current region will join the SOOP program, providing monthly transects in exchange for T-7 XBT's. There has been no response to our invitation to Texas A&M. The NMFS Seamap program has accepted ten cases of T-7's in return for data from a Gulf-wide CTD and XBT survey in April/May.
MEASUREMENTS & DATA SYNTHESIS	1983	Gulf of Mexico Physical Oceanography, II	G-304	Planned	The purchase request has been sent to Procurement Branch by Offshore Studies. The proposal is expected in mid- to late-July. The scope of work has been substantially altered as a result of a coordination meeting with NORDA on 10-11 May, to discuss cooperation with their upcoming GEOSAT ground truthing mission. The second year will now continue to study the eastern Gulf/Loop Current region, rather than moving on to the western Gulf. Additional current meters will be placed in the area of moving sand on the west Florida shelf (either by SAI or a new marine ecosystems contractor). Recent funding support for current measurements offshore Louisiana by ONR and a state agency opens the possibility that very useful data may be made available to our program. The MMS contractor has been asked to make additional measurements in this area that could complete or extend these other efforts. Discussions with NMFS/Pascagoula concerning possible cooperation in analyzing

SERIES PLAN FOR PHYSICAL OCEANOGRAPHY STUDIES: FY82-84

PROGRAM	YEAR	STUDY TITLE	MMS ID #	STUDY CLASS	SUMMARY OF RECENT ACTIVITY
					chemical samples they want to take offshore Louisiana had looked very promising, but the very short lead time did not allow further action.
MEASUREMENTS & DATA SYNTHESIS	1983	MMS/NMFS Ship-of-Opportunity Program, II	30034	Active	The Interagency Agreement has only recently been signed. During this fiscal year's effort, the shipboard gear has been upgraded to a digital controller, reducing eventual data management costs. Additionally, a second ship has been added to the line, approximately doubling the data return.
MEASUREMENTS & DATA SYNTHESIS	1983	MMS/NDBO Cooperative Drifting Buoy Program, II	6-376	Planned	Negotiations are under way for the continuation of drifting buoy deployment in eddy features in the Gulf. The scope of Year II calls for providing two additional buoys.
MEASUREMENTS & DATA SYNTHESIS	1983	NOAA/OSC GERAF Program	6-377	Cancelled	This effort was cancelled at the request of our Washington office, citing agency goals of eliminating support of programs of other agencies.
MEASUREMENTS & DATA SYNTHESIS	1983	Gulf of Mexico Satellite Altimetry, II	6-378	Cancelled	This planned study was cancelled in June, 1983 after discussions with the Naval Oceanographic Office concerning the estimated accuracy of the gravimetric geoid. At the present time, available data would support an RMS error of about 50 cm, compared to altimetry accuracy of 5-10 cm. This mismatch would probably severely limit the utility of altimetric measurements for the MMS program, and an indefinite hold has been placed on any efforts of this type.
MEASUREMENTS & DATA SYNTHESIS	1984	GOM Physical Oceanography, Year III	6-471	Proposed	This effort has been changed since initial program planning to consist of current measurements and hydrographic surveys in the western Gulf. Enthusiasm still exists for getting permission from Mexican authorities to allow moorings in areas subject to their claims of restriction, although our best knowledge is that this cannot be arranged. Project PI's have been asked to inquire informally about this matter, through their personal contacts. The MMS/TAMU/Mexican SOOP venture first offered by A&M still appears to be the only bright prospect for work south of 26N (hydrography or current meters). This Year III of our program would be the contemporary of the planned NORDA Geosat field mission, at least for the period of maximum Navy activity. We have discussed data sharing with NORDA, but details of availability remain sketchy.

GULF OF MEXICO REGIONAL PHYSICAL OCEANOGRAPHY PROGRAM

Dr. Evans Waddell

Science Applications, Inc.
Raleigh, North Carolina

Year I of the Gulf, Physical Oceanography Program, emphasizes characterization of physical oceanographic processes on or associated with deeper regions of the eastern Gulf. In this region, the Loop Current and related mechanisms are one of the major influences. The persistent Loop Current, which enters the Gulf basin through the Yucatan Straits and exits through the Florida Straits, can occupy a wide range of locations. This includes anywhere between flowing north toward the Alabama coast, curving eastward toward and then outward along the west Florida shelf, to going directly eastward from the Yucatan Straits to the Florida Straits.

Four major observational data bases are being used: (1) subsurface currents/temperature/pressure, Figure 1; (2) regional hydrography; (3) satellite thermal imagery; and (4) free drifting surface buoys released in major eddies. Additional supporting observations include an MMS funded ship of opportunity program (SOOP) as well as marine meteorological data, coastal water levels and winds, sea-surface temperature maps (NWS/Slidell) and ocean frontal maps (NESS/Miami). This multivariate data set will be integrated and synthesized by a team of scientists to provide a comprehensive understanding of circulation patterns.

Most data acquisition was initiated in January 1983. To date, one of two regional hydrographic cruises and the first of four quarterly subsurface instrument rotation cruises have been conducted. The next rotation cruise (late July, 1983) will retrieve Loop Current moorings. One drifting buoy was released in Eddy F in October 1982 and is still being tracked. An additional buoy is to be released in Eddy G in June 1983. The SOOP was initiated in April. A commercially operated vessel is maintaining an XBT transect from New Orleans to the Yucatan Straits on a ten-day schedule.

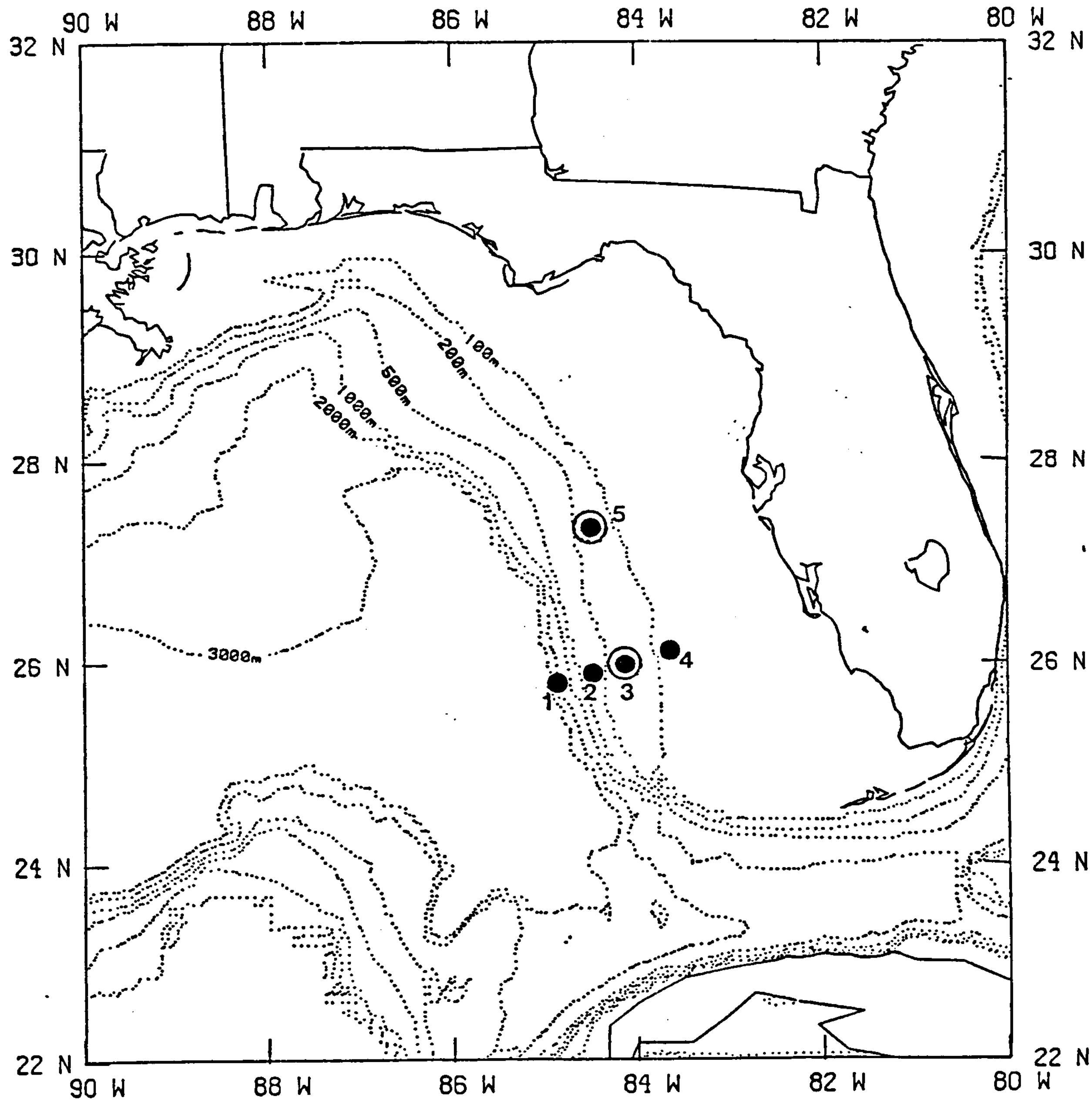


Figure 1. Location of subsurface current moorings. The deepest instrument on Moorings 3 and 5 will be a current velocity/ temperature/pressure sensor. All other instruments will provide current velocity/temperature.

Very preliminary indications are that near the west Florida shelf break, high-frequency (≈ 1 day) and low-frequency (≈ 10 days or greater) processes dominate circulation. The higher frequency motions appear to result from the combined influence of a strong diurnal tidal signal and quite vigorous inertial motion. Low-frequency motions seem to be associated with both meteorological frontal passage and wave-like features of the Loop Current boundary.

At present, plans for subsequent program years are being made. During Year 2, additional observations will be made in the eastern Gulf. As a result of this adjustment, studies concentrating on the western Gulf will begin in program Year 3.

APPLICATIONS OF BENTHIC PROCESS MEASUREMENT TO PROBLEMS CONCERNING DRILLING MUDS

R. Warren Flint

The University of Texas
Marine Science Institute
Port Aransas, Texas 78373

The Texas coast of the Gulf of Mexico is undergoing extensive coastal development. This area has large estuarine systems which, along with the coastal waters, support much of the nation's fisheries. These systems are susceptible to contamination by domestic, industrial, and agricultural wastes. Some parts of this coast are developed industrially, with large petrochemical centers. Chemical spills, long-term point source discharge of potentially toxic materials in low levels, and dredging of waterways associated with these industrial centers cause potential pollution problems to the coastal environment that can interfere with any level of ocosystem function. In addition, mechanized agriculture is widespread in this region with the use of large amounts of fertilizers and pesticides that can also create serious pollution problems. These problems will not lessen, because the Gulf coast is continuing to increase in population at a faster rate than other parts of the country.

The dispersal of pollutants into aquatic ecosystems has had far-reaching effects in recent years and is now creating numerous problems for environmental decision-makers on the Texas Gulf coast. The ever-present demand for increased natural resources (e.g. fisheries, energy), and the apparent incompatibility through exploitation of some of these, implicates the need for an understanding of the integration of processes involved in marine ecosystem functioning in this geographical area. We need to know how components such as the benthos, which by themselves are relatively easy to monitor, integrate into the total ecosystem picture. The benthos, as well as important fishery populations, are not entities within themselves, but rather are just one part of the overall coastal marine ecosystem as illustrated in the conceptual ecosystem scheme of Figure 1. They are involved not only in foodweb relationships but are also part of the overall cycling of other materials in the ecosystem. Consequently, total population production and maintenance of stocks depend upon all the processes that occur in the normal functioning of the coastal ecosystem.

To date, aquatic studies directed towards understanding the effect of pollutant dispersal into the environment have ranged from expensive multidisciplinary research programs that don't provide solid cause and effect information, to single species monitoring in the natural environment, to laboratory controlled 96 hr bioassays that determine mortality endpoints with no consideration for synergistic effects. It is becoming increasingly apparent that long-term subtle impacts are producing significant ecosystem degradation not measureable by these methodologies. These methodologies for measuring the environmental effects of pollutants no longer meet the demands of scientific inquiry or the legal mandates imposed upon environmental managers. Consequently, there is a definite need for the development of realistic monitoring strategies that are integrative, sensitive, and serve as subtle warning signs.

It is economically unfeasible to study an entire ecosystem and derive sufficient information toward understanding and managing that ecosystem to justify the expenditure. Therefore, in assessing the state and change of the ecosystem, either during natural functioning or during stress and disturbance, numerous design factors should be incorporated into a monitoring effort that focus upon components lower than the ecosystem level, such as communities or chemical cycling. These design factors must:

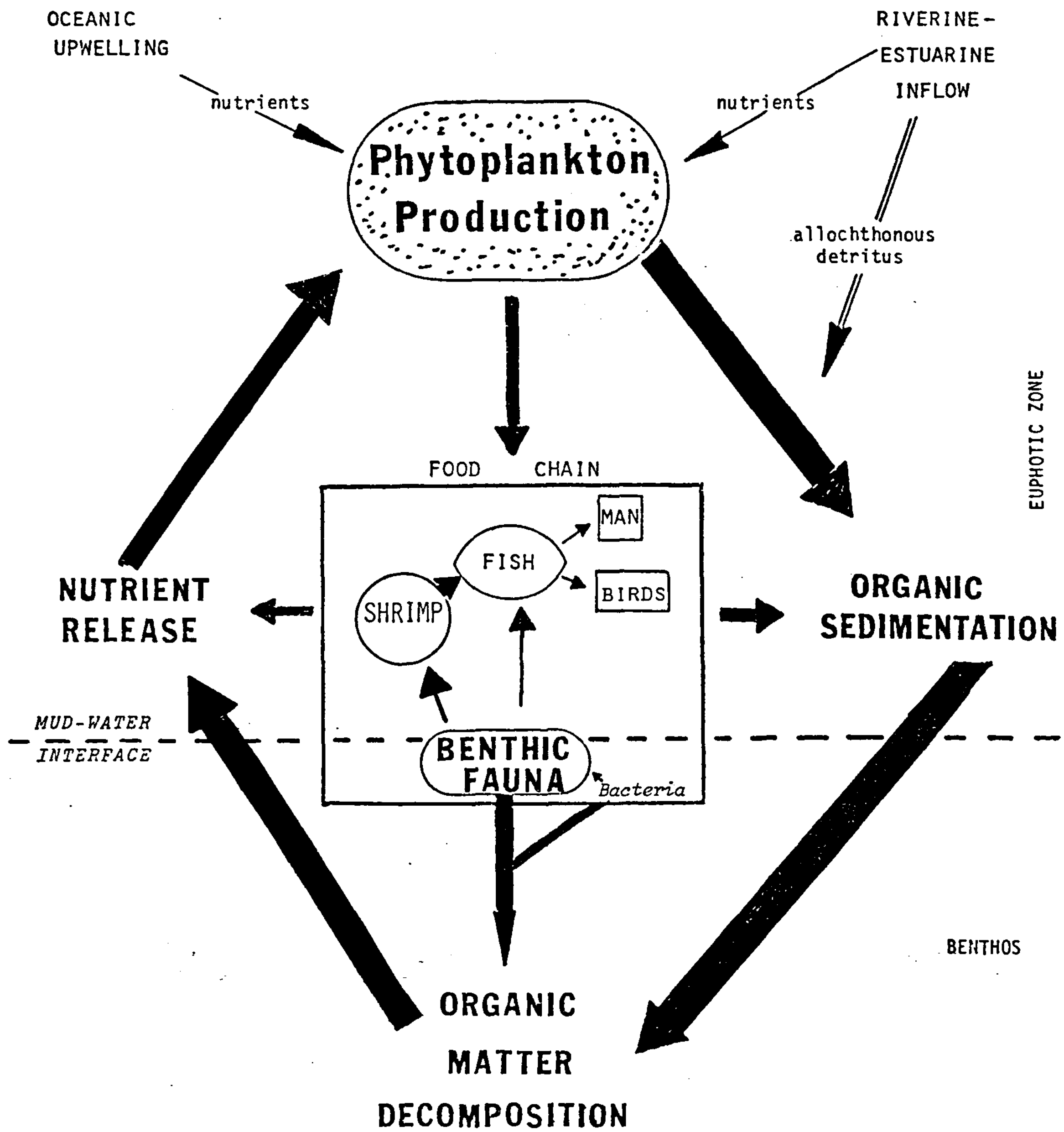


Figure 1. Conceptual model of marine coastal ecosystem function illustrating some of the more important processes such as nutrient cycling and foodweb energy transfer.

1) provide as much ecosystem information as possible,

2) emphasize ecosystem components that represent a "barometer" of environmental events,

3) contribute towards an integrated understanding of ecosystem function, and

4) minimize expenditure.

An example of developing an integrated understanding of how an ecosystem functions can be seen in Figure 2. Using all the information portrayed in this illustration an environmental manager can potentially make decisions concerning the conduct of activities that may be harmful to the environment so that these activities are performed during a time period of least probably impact to the ecosystem processes depicted (Figure 2).

One approach to monitoring and developing an understanding of ecosystem function in Texas coastal waters would be to focus upon the benthic habitat. The reasons for concentrating on the benthos are summarized in the theoretical model presented in Figure 3. This model illustrates hypotheses suggesting how the benthos functions under both natural environmental conditions as well as under periods of disturbance. Emphasis is placed upon the benthos here in order to gain a better understanding for ecosystem functioning because of its pivitol role in such factors as energy transfer through the production of carbon and nutrient recycling through such activities as bioturbation by the fauna inhabiting marine sediments. For example, Figure 4 illustrates data from a coastal Gulf of Mexico station that places the role of the benthos in perspective concerning carbon production and nutrient regeneation. The production of carbon by benthic fauna is approximately 1000 times more than Carbon production by penaeid shrimp in this same habitat. Benthic

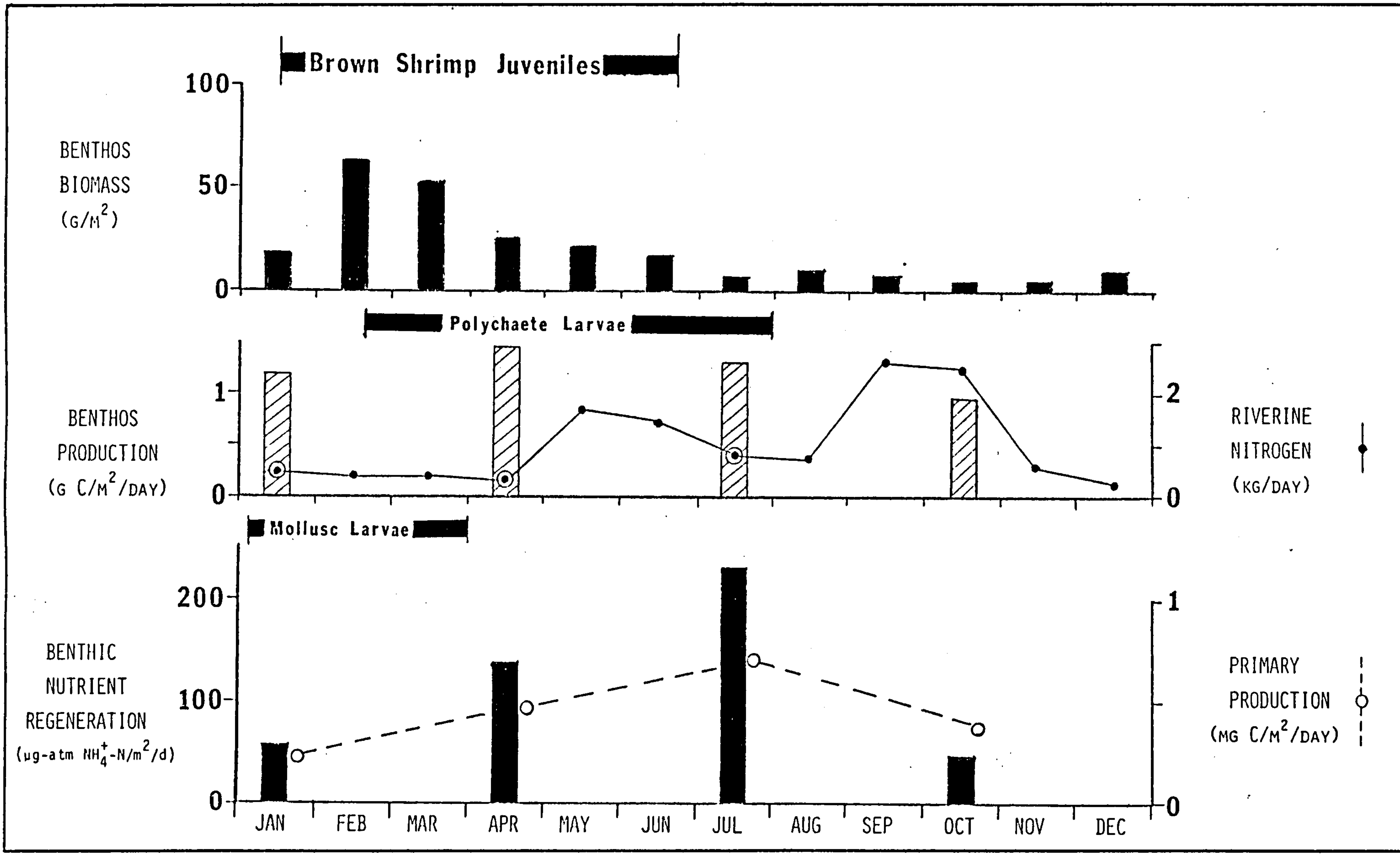


Figure 2. Data from the Corpus Christi Bay estuary on benthic standing stock, benthic production and nutrient regeneration, phytoplankton primary production, and riverine sources of nutrients to illustrate the process of developing and integrated picture of how an ecosystem functions.

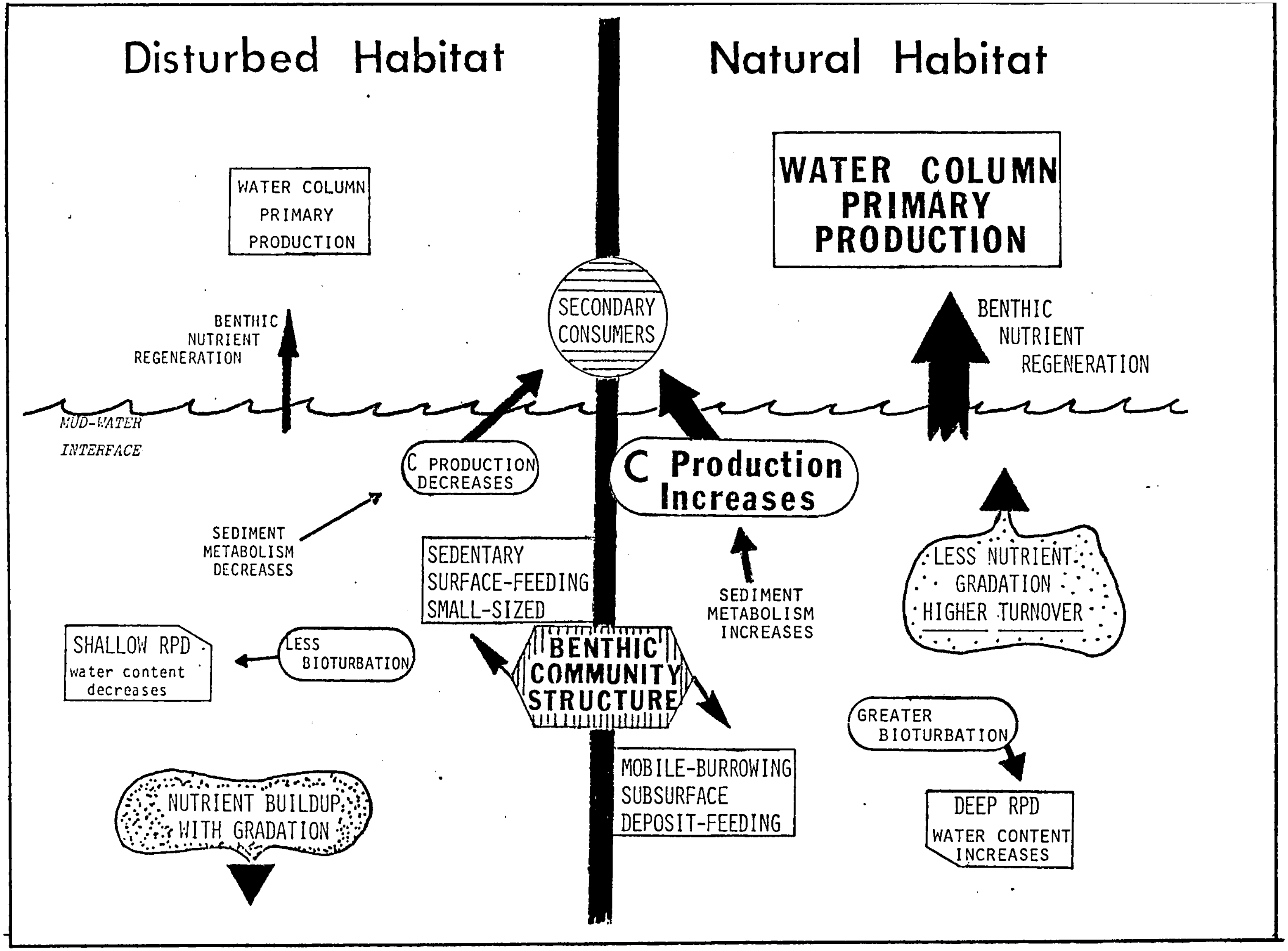


Figure 3. A theoretical model that combines a number of different hypothesized functions of the marine benthos to suggest how they operate under both natural conditions and a disturbance and how other aspects of the ecosystem, such as primary production, are related to these benthic processes.

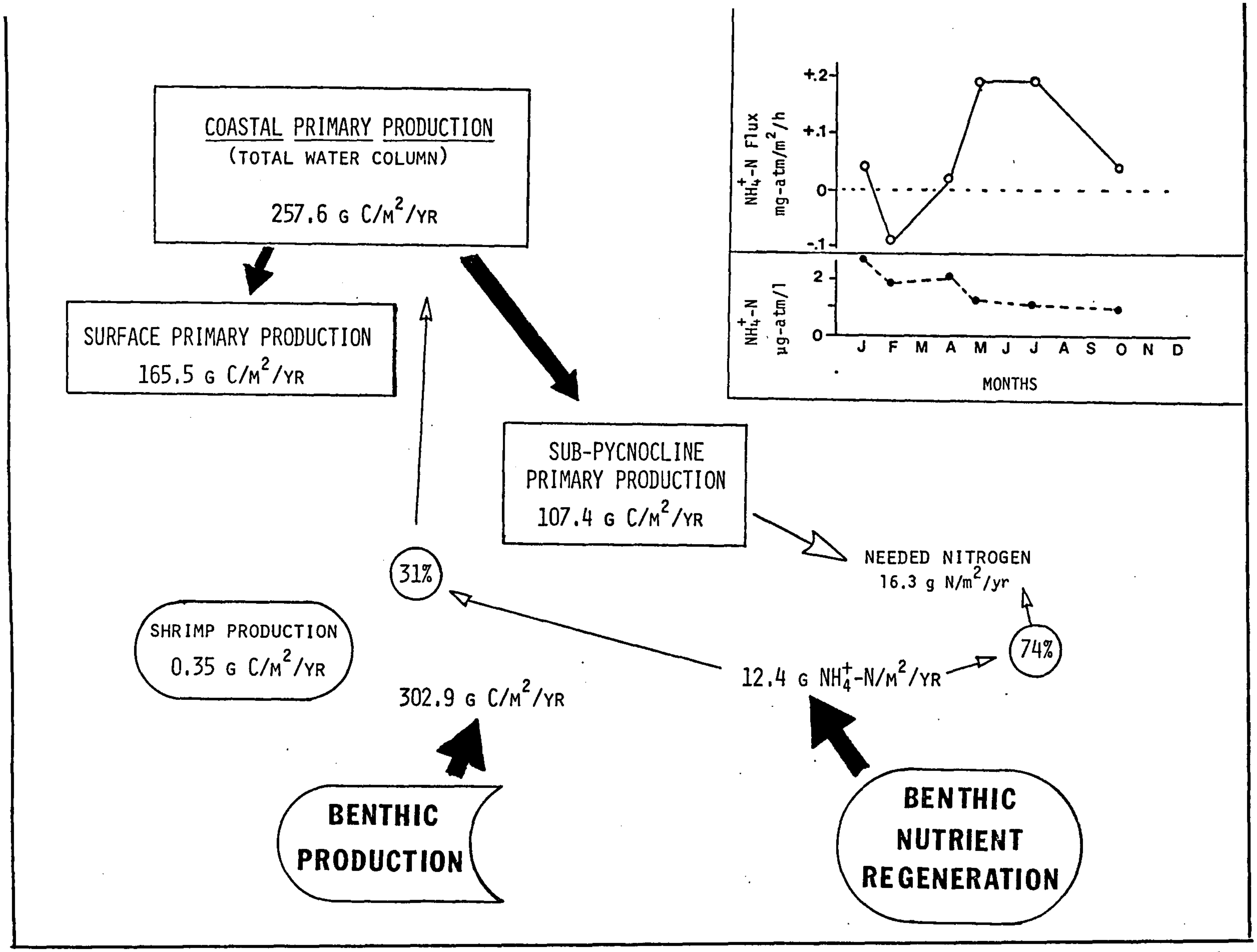


Figure 4. Measured annual primary productivity rates for phytoplankton at a coastal station in the northwestern Gulf of Mexico along with benthic secondary production rates and benthic nutrient regeneration rates. The upper right-hand corner illustrates the comparison between monthly rates of benthic nutrient regeneration and water column concentrations of nutrients potentially from other sources.

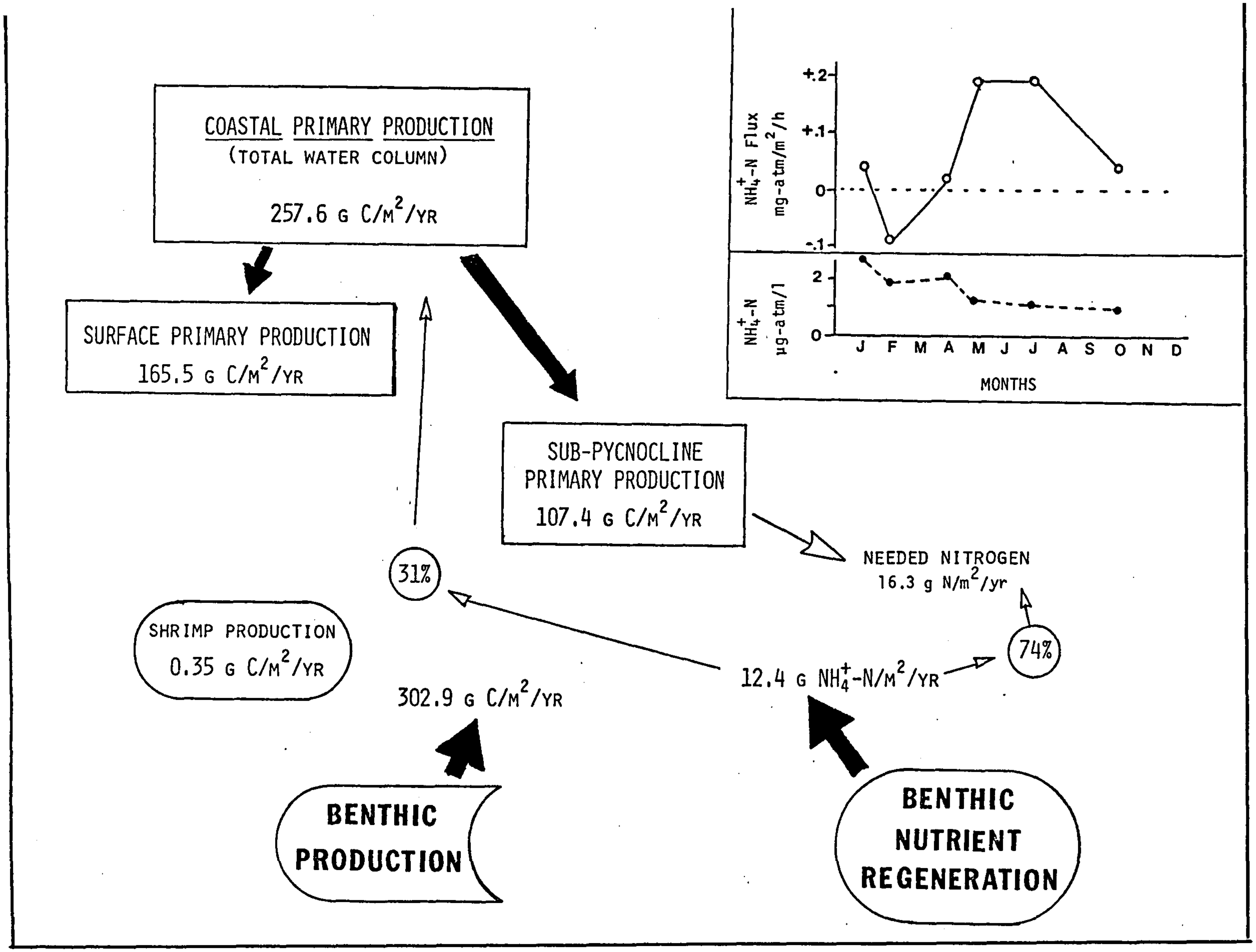


Figure 4. Measured annual primary productivity rates for phytoplankton at a coastal station in the northwestern Gulf of Mexico along with benthic secondary production rates and benthic nutrient regeneration rates. The upper right-hand corner illustrates the comparison between monthly rates of benthic nutrient regeneration and water column concentrations of nutrients potentially from other sources.

nutrient regeneration can supply between 31% and 74% of the total nitrogen required by phytoplankton populations for production in these waters. In addition, the annual cycle of nutrient regeneration rates (upper right hand corner of Figure 4) compared with nutrient concentrations in the surface waters from other sources, suggests that benthic nutrient regeneration becomes most important to the coastal waters during times of low nutrient contributions from other sources.

Recently laboratory and field experiments have been conducted on entire benthic species assemblages of the estuary in order to collect data for either proving or disproving the hypotheses presented in Figure 3. The results of these experiments indicate that the natural benthos, and the processes that these fauna play a role in regulating, are sensitive to disturbance and show significant changes after a perturbation to the sediment surface. In all cases studied so far, however, after the initial impact of the disturbance, both the faunal abundance and biomass readily recover and the process rates, such as sediment metabolism and nutrient regeneration, return to control levels after a short period of time (e.g. 60 days).

By designing a monitoring strategy focusing on the points covered above, the appropriate methodology may now be available for assessing <u>integrated</u> impacts to entire ecosystems, while minimizing the costs, by concentrating on key processes within the ecosystem. The example utilizing the marine benthos, assesses ecological change by evaluating community characteristics and relates the impact of this change to the ecosystem by measuring important processes that these benthic communities regulate. By concentrating on selected processes like nutrient regeneration, benthic metabolism, and secondary production rates, longterm fate of an ecosystem can be predicted, since these processes are all important to the integrated health of that ecosystem. There is no reason why these same methodologies can not be applied to such problems as the disposal of drilling muds in the coastal environment to determine:

1) if there is an effect to the environment from drilling mud disposal,

2) what processes are affected, and

3) how long before a return to normal after the impact.

For years the benthos has been studied by identifying, counting and weighing organisms, often to obtain the goal of assessing change to an environment from a disturbance. This data by itself does not contribute much to our knowledge concerning processes of the benthos. Other than obvious direct impacts, conclusions can not be drawn from these kinds of environmental assessments concerning integrated effects to the marine ecosystem from perturbation. Thus, the need exists to establish methodologies that provide data directly related to the integrated ecosystem picture (Figure 1), before we can determine the effects of impacts that are real and not simply assumed or implied by historical dogma and public emotion. A disturbance to an estuarine environment may change the actors in the community, but does it change the function of the community? This is an important question that must be considered in conducting environmental assessments.

OFFSHORE MAPPING OF THE ECOLOGICAL ZONATION OF BIOLOGICAL COMMUNITIES GULF OF MEXICO/OUTER CONTINENTAL SHELF

Rezneat M. Darnell
Department of Oceanography, Texas A&M University
College Station, TX 77843

Progressive human intrusion into the continental shelf has generated a need for detailed knowledge of the spatial and temporal distribution patterns of biological resources of the continental shelf environment. Under an IPA appointment with the U.S. Department of the Interior, Minerals Management Service, the author has completed the mapping of major biological resources of the shelf from the Rio Grande to the Mississippi River. This report is now in press.

Recognizable distribution patterns for the fishes and penaeid shrimp include the following:

- Depth distribution (nearshore, mid-shelf, outer shelf, and trans-shelf)
- Coastwise distribution (Louisiana dominant, central sector dominant, Texas dominant, and east-west sector dominant)
- Local aggregation (aggregation off passes, insularization off south Texas, and concentration near the mouths of the Rio Grande and Mississippi River)
- Seasonal distribution (seasonal peaks, expansion, rareness or absence, shifts in distribution or density).

In aggregate, the species distribution studies point to the following management implications:

- Need to maintain coastal wetland habitats,
- Need to maintain and protect special shelf habitats (species spawning grounds, tidal passes, reefs, areas associated with the mouths of rivers, and habitat of rare species.
- Need to maintain the integrity of local populations,
- Need for care in dumping dredged materials,
- Need for care in undertaking across-shelf channelization,
- Need to understand the effects of commercial trawling,
- Need to assess the sources, fates, and effects of major chemical pollutants,
- Need to understand cumulative and long-term impacts of petroleum-related activities,
- Need to understand functional dynamics of the shelf ecosystem.

Individuals and agencies concerned with these problems should avail themselves of the following publication when it appears: Northwestern Gulf Shelf Bio-Atlas. A Study of the Distribution of the Demersal Fishes and Penaeid Shrimp of Soft Bottoms of the Continental Shelf from the Rio Grande to the Mississippi River Delta. R. M. Darnell, R.E. Defenbaugh, and D.Moore. MMS Open File Report 84-04

SOUTHWEST FLORIDA SHELF ECOSYSTEMS STUDIES
AN INTRODUCTORY OVERVIEW AND HABITAT CHARACTERIZATIONS

Keith B. Macdonald
Woodward-Clyde Consultants
P. O. Box 81848, San Diego California 92138

Contract Nos. 14-12-0001-29142/29144

PROGRAM OVERVIEW

The Southwest Florida Shelf Ecosystems Study is a multiyear, multidisciplinary OCS environmental studies program. Years I and II of the program described and mapped the generalized distributions of seafloor substrates and benthic communities represented across the southwest Florida shelf. Year III examined the influence of Loop Current impingement on the southwest Florida shelf in relation to hydrographic characteristics and primary production. Year IV studies are presently being conducted to further refine and expand information obtained during the Year I and II programs. Specific goals include further, more detailed examination of "interesting areas" (pockmarks, pinnacles, algal nodules, *Agaricia* corals), expansion of knowledge into shallower areas (i.e., shoreward to the 10 m isobath), and quantitative evaluation of visual sampling techniques.

STATUS

The Year I program has been completed and final reports submitted to Minerals Management Service (MMS). All Year II field and laboratory work have also been completed. Final data analyses are awaiting submission of data corrections by the primary subcontractor. The Marine Habitat Atlas has been completed from combined first and second year data, reviewed by MMS, and final report copies are currently in press. The Year III program has also been completed and draft reports have been submitted. Year IV program work is presently underway.

YEARS I & II: HABITAT CHARACTERIZATIONS

Habitat characterizations of the southwest Florida OCS region were conducted during the first and second year study programs. Geophysical studies were used to identify and map the distribution of major substrate categories and benthic communities across the shelf. Underwater television and still camera observations were used to "ground-truth" the geophysical data, each data set contributing to more accurate and complete interpretation of the other.

The overall results of these characterization studies have been summarized in a two-volume Marine Habitat Atlas. Volume 1 contains index and summary maps at a scale of 1:500,000 and detailed maps and cross-sections of the survey transects at a scale of 1:48,000. Volume 2 is an interpretive report that discusses the field surveys, data analyses, and mapping procedures. Five substrate categories and nine benthic assemblages were described and mapped (Figures 1 and 2). Relationships between water depth, substrate types, and biological assemblages are summarized in Table

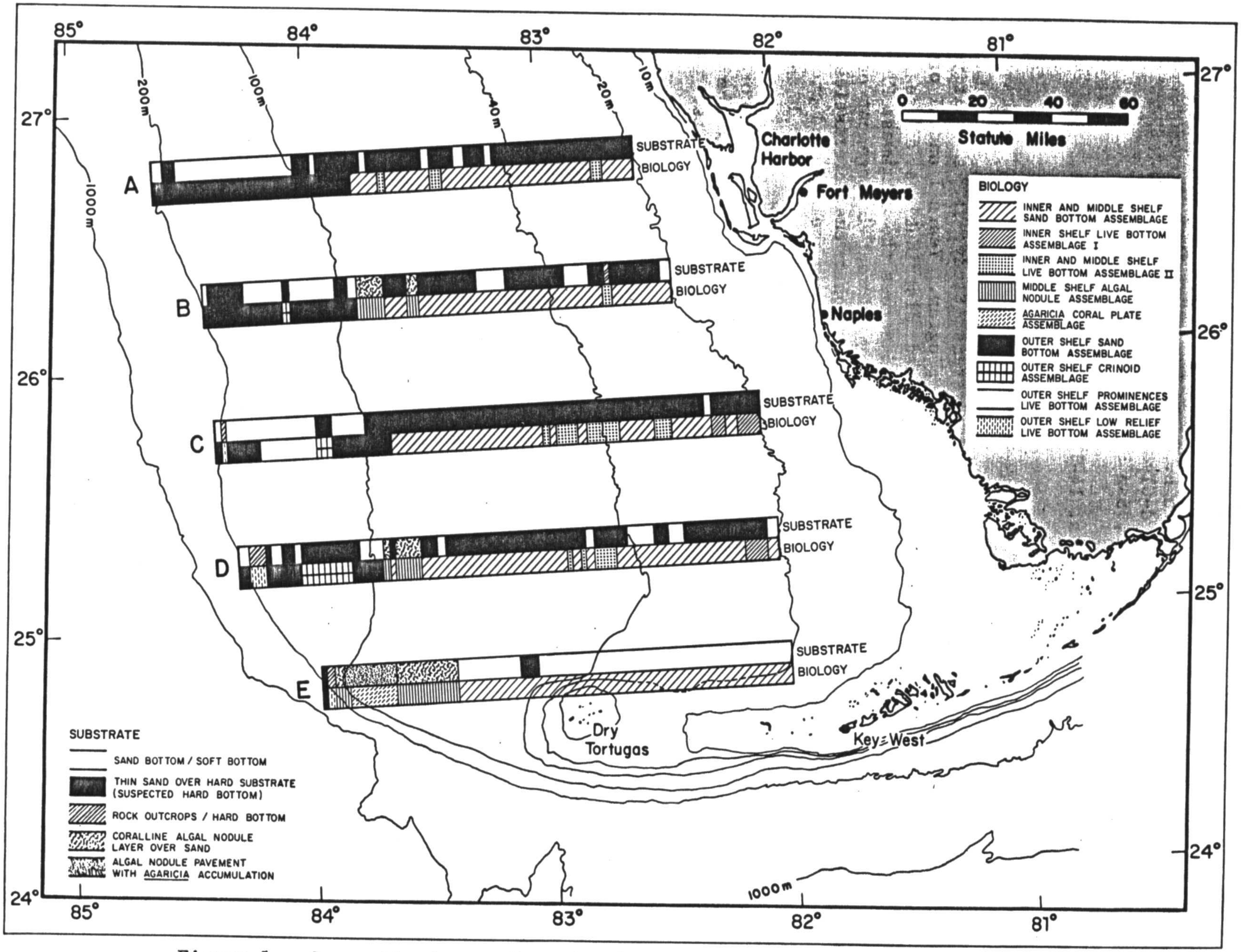


Figure 1. Generalized map of marine habitats along Transects A through E.

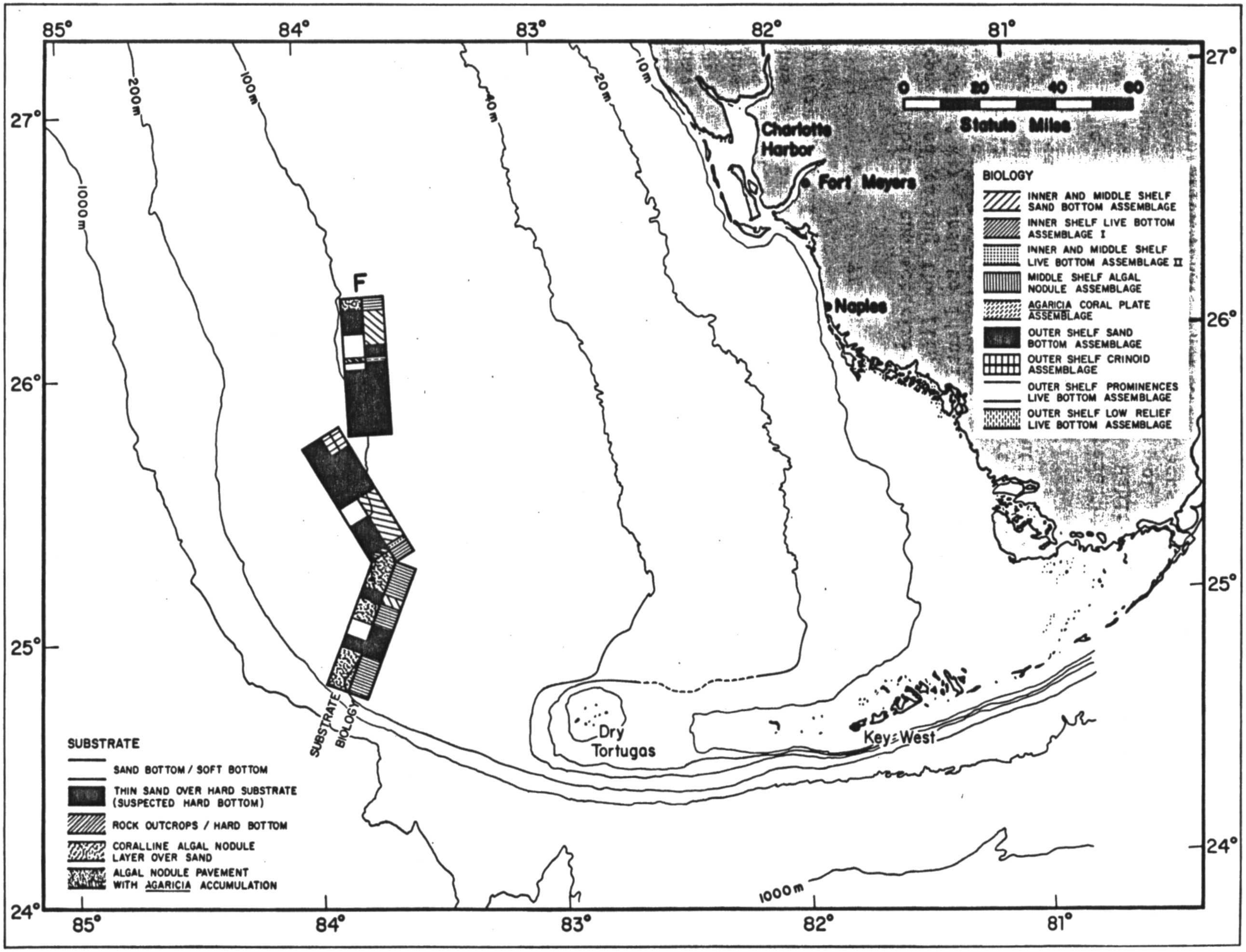


Figure 2. Generalized map of marine habitats along Transect F.

1. Brief descriptions of the substrates and assemblages categorized are presented below.

SUBSTRATE TYPES

Rock Outcrops/Hard Bottom

This bottom type includes local, continuous, bedrock outcrops; areas of scattered bedrock outcrops; partially buried bioherms and (dead) coral pinnacles. Rock areas are covered with distinctive indicator epibiota.

Thin Sand over Hard Substrate

Bottom type consists of extensive areas with a mobile, thin, sand or silt veneer overlying a hard substrate. The hard substrate may be bedrock, a calcrete layer, or calcareous rubble over softer sediment. This substrate predominates over much of the study area in 20 to 100 m water depths. Sparse populations of attached epifauna (gorgonians, sponges) are generally characteristic.

Sand Bottom/Soft Bottom

This substrate category consists of a "featureless" soft sediment bottom, with variable sediment composition and grain size. Bedforms, such as ripplemarks and sandwaves, areas of bioturbation, and soft bottoms covered with varying densities of green and brown algae may be present. Attached epibiota are generally absent in these areas.

Coralline Algal Nodule Layer over Sand

This bottom type represents soft bottom areas covered by a varying thickness of coralline algal growths, usually in the form of loose nodules.

Algal Nodule Pavement with Agaricia Accumulations

This bottom type represents areas with a fused pavement of coralline algal growths, coralline debris and corals. In many places encrusting coral (*Agaricia* spp.) plates accumulate and form a distinctive crust.

BIOLOGICAL ASSEMBLAGES

Inner and Middle Shelf Sand Bottom Assemblage

This assemblage is found in areas of sand bottom or with thin sand veneer in water depths ranging from 20 to 90 m. Predominant biota include algae, echinoids, asteroids, holothuroids, sea pens, and bryozoans.

Inner Shelf Live Bottom Assemblage I

This assemblage is found in water depths of 20 to 27 m where there is an exposed hard substrate. The average density of attached macrofauna is greater than one per m^2. Predominant biota include large gorgonians, sponges, hard corals, ascidians, hydrozoans, and algae.

Table 1. Relationships between water depth, substrate types, and biological assemblages.

Assemblage	Transect with Water Depth Range in Metres	Substrate Types[1]: Rock Outcrops/ Hard Bottom	Thin Sand over Hard Substrate	Sand Bottom/ Soft Bottom	Coralline Algal Nodule Layer over Sand	Algal Nodule Pavement with Agaricia Accumulations
Inner and Middle Shelf Sand Bottom	A (27-44)		X	X		
	B (20-81)		X	X		
	C (23-79)		X	X		
	D (20-88)		X	X		
	E (20-67)		X	X		
	F (77-98)		X	X		
Inner Shelf Live Bottom I	C (19-26)		X			
	D (22-26)		X			
Inner and Middle Shelf Live Bottom II	A (25-65)		X			
	B (31-33)	X	X			
	C (30-72)		X			
	D (43-53)		X			
	E (56-62)		X			
	F (78-93)	X	X			
Middle Shelf Algal Nodule	B (62-84)				X	
	D (76-93)				X	
	E (67-125)				X	
	F (73-89)				X	
Agaricia Coral Plate	E (69-90)					X
	F (79-85)					X
Outer Shelf Sand Bottom	A (74-212)		X	X		
	B (84-204)		X	X		
	C (79-200)		X	X		
	D (93-202)		X	X		
	E (180-205)		X			
	F (90-116)		X	X		
Outer Shelf Crinoid	B (98-167)		X			
	C (85-137)	X	X			
	D (117-142)		X			
	F (116-127)		X			
Outer Shelf Prominences	C (137-168)			X		
Outer Shelf Low-Relief	C (164-185)	X				
	D (127-178)	X				
	E (125-180)	X				
	F (91-115)	X				

[1] "X" indicates the occurrence of a given assemblage on a specified substrate. If a transect is not listed, it indicates the assemblage was not observed in that transect.

Inner and Middle Shelf Live Bottom Assemblage II

This assemblage is found in water depths of 25 to 71 m where there is an exposed hard substrate. This assemblage has a higher number of species of sponges and a lower biomass per unit area than assemblage "I". Predominant biota include sponges, hard corals, small gorgonians, ascidians, bryozoans, hydrozoans, and algae.

Middle Shelf Algal Nodule Assemblage

This assemblage is found in water depths of 62 to 108 m. The nodules are formed by the combination of coralline algae with sand, silt, and clay particles. Small sponges, corals, and other algae are also present.

Agaricia Coral Plate Assemblage

This assemblage is found in water depths of 64 to 90 m. Live hard corals, gorgonians, sponges, and algae live on a dead hard coral-coralline algae substrate.

Outer Shelf Sand Bottom Assemblage

This assemblage occurs in water depths of 74 to 200 m. It is distinguished by a lack of algae. Characteristic fauna include ophiuroids, asteroids, echinoids, sea pens, crinoids, crustaceans, anemones, and occasional sponges.

Outer Shelf Crinoid Assemblage

This assemblage occurs in water depths of 118 to 168 m. Large numbers of crinoids and small hexactinellid sponges occur on a coarse sand or rock rubble substrate.

Outer Shelf Prominences Live Bottom Assemblage

This assemblage occurs in water depths of 135 to 170 m where rock and coral pinnacles are found. The assemblage includes soft corals, crinoids, hard corals, hexactinellid sponges, and hydrozoans attached to the pinnacles.

Outer Shelf Low-Relief Live Bottom Assemblage

This assemblage occurs in water depths of 105 to 200 m where there is an exposed low-relief hard substrate or very thin sand veneer. Predominant biota includes small sponges, soft corals, crinoids, hard corals, and hydrozoans.

YEAR III: SOUTHWEST FLORIDA LOOP CURRENT EDDY SYSTEM

As depicted on the cover of the recently submitted draft final study report to the MMS (Figure 3), a Gulf of Mexico Loop Current eddy system consists of a relatively warm filament of Loop Current Water extending off the main body of the Loop Current front enclosing a cooler tongue of Continental Edge Water. Upwelling generally occurs beneath the cooler

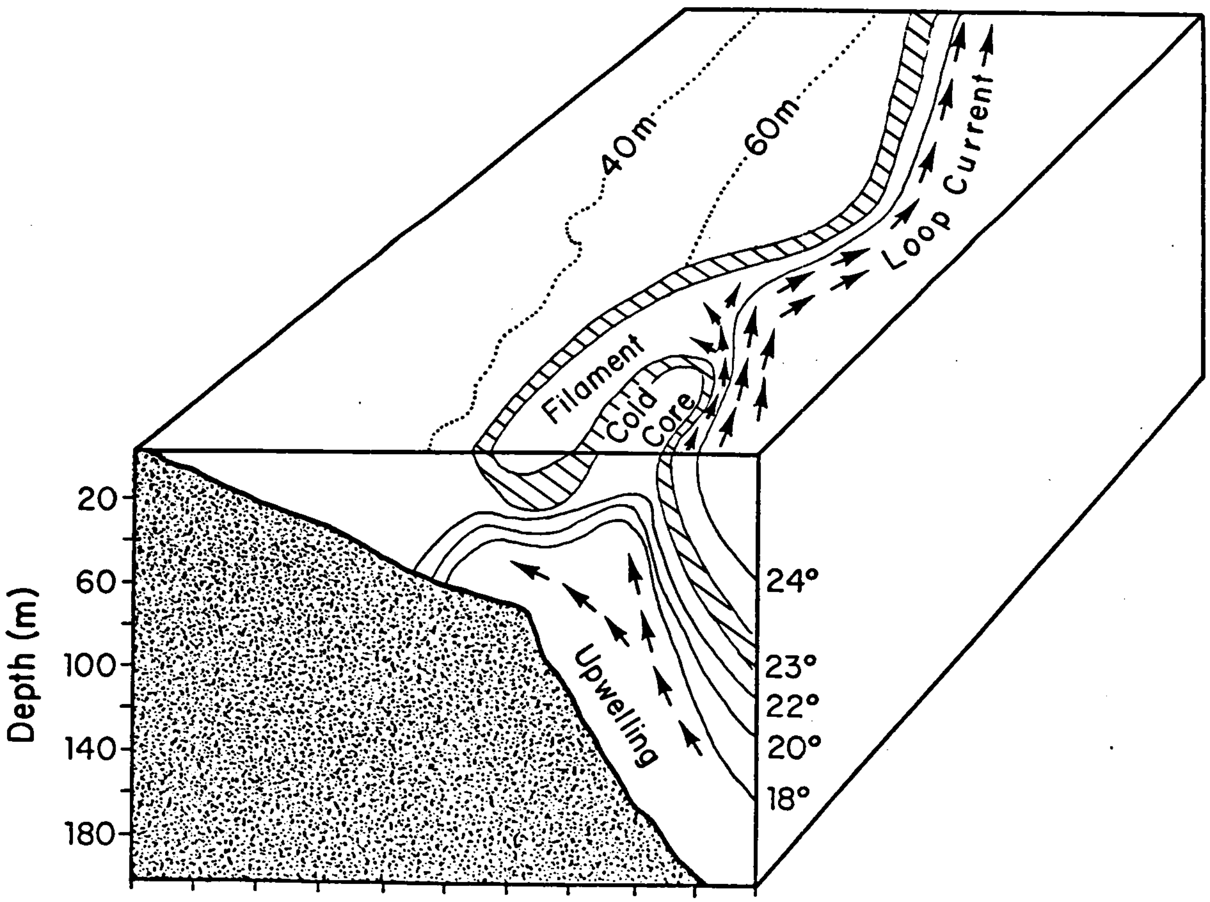
GULF OF MEXICO
OUTER CONTINENTAL
SHELF REGIONAL OFFICE

Volume 1

Southwest Florida Shelf Ecosystem Study Year 2 Modification

(Contract No. 14-12-0001-29144)

Final Report



March 18, 1983

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

Figure 3. Year III draft report cover.

water with entrainment occurring along the subsurface extent. The surface length scale of this phenomenon is on the order of 200 km, whereas the subsurface extent is shown to be at least 100 km. Closely associated with these upwelled waters are the subsurface nutrient entrainments which can extend to 10 to 30 m within the euphotic zone where primary production occurs. Waters affected by these eddies have exhibited primary production values about six times higher than uneffected waters.

During the first of a series of two 1982 data collection cruises in the southwest Florida shelf area to study these eddies, a number of the sampling transects passed through an eddy system. Section 6 in Figure 4 was typical of these transects. The density section in Figure 5 shows a doming of the sigma-t surfaces at the shelf break where the upwelling is noted. The associated nitrate (Figure 6) and chlorophyll a + phaeopigment a (Figure 7) demonstrate the transport of nutrients and phytoplankton into the euphotic zone where photosynthesis is occurring. The euphotic zone depth as determined by in-situ irradiance measurements was on the order of 70 m with little variability from station to station.

YEAR IV: SOUTHWEST FLORIDA SHELF REGIONAL BIOLOGICAL COMMUNITIES SURVEY

Keith D. Spring and David A. Gettleson
Continental Shelf Associates, Inc.
P.O. Box 3609, Tequesta, Florida 33458

The Southwest Florida Shelf Regional Biological Communities Survey was designed to answer questions arising from the first two years of the Southwest Florida Shelf Ecosystems Study and to expand the study area into nearshore regions. It was also decided to use several different methodologies of data collection to compare the reliability and usefulness of various methods in analyzing benthic habitats and communities.

The survey was divided into three cruises with the first being a remote sensing cruise collecting underwater television/still camera, side-scan sonar, subbottom profiler, and precision depth recorder data. The survey transects consisted of eastward extensions of the Southwest Florida Shelf Ecosystems Study Year I Transects B, C, and D to distances of 15, 15, and 31 nautical miles, respectively; a north-south tie-line between these extensions; north-south tie-lines between Transects A-E in 50 meters water depth; and a north-south tie-line between Transects C and E in approximately 150 meters water depth (Figure 8). Surface temperature and salinity data were collected every 5.4 nautical miles or once every hour (whichever generated the most measurements) during survey transects and steaming distances greater than 20 nautical miles. Vertical STD/DO and transmissivity profiles were made at the beginning and end of each survey transect.

Cruises II (Winter) and III (Summer) are biological sampling/hydrography cruises with Cruise III repeating Cruise II procedures. Ten soft bottom and five hard bottom sampling stations were selected in water depths of less than 20 meters based on observations made during Cruise I (Figure 9). The station selection criteria were to select stations that represented as many significantly different biological habitats as possible while providing a maximum geographical coverage of the study area.

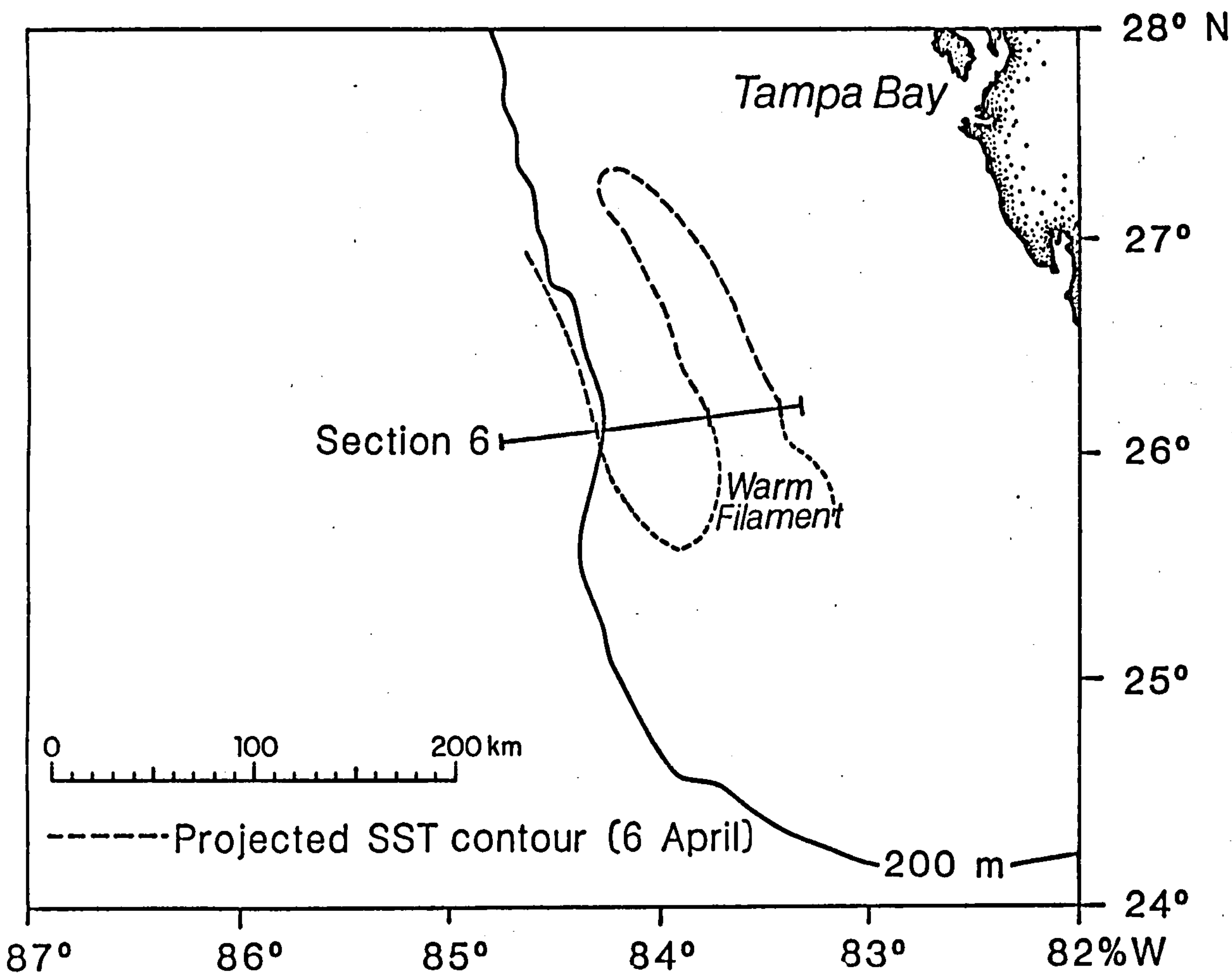


Figure 4. Loop Current eddy position relative to Transect 6.

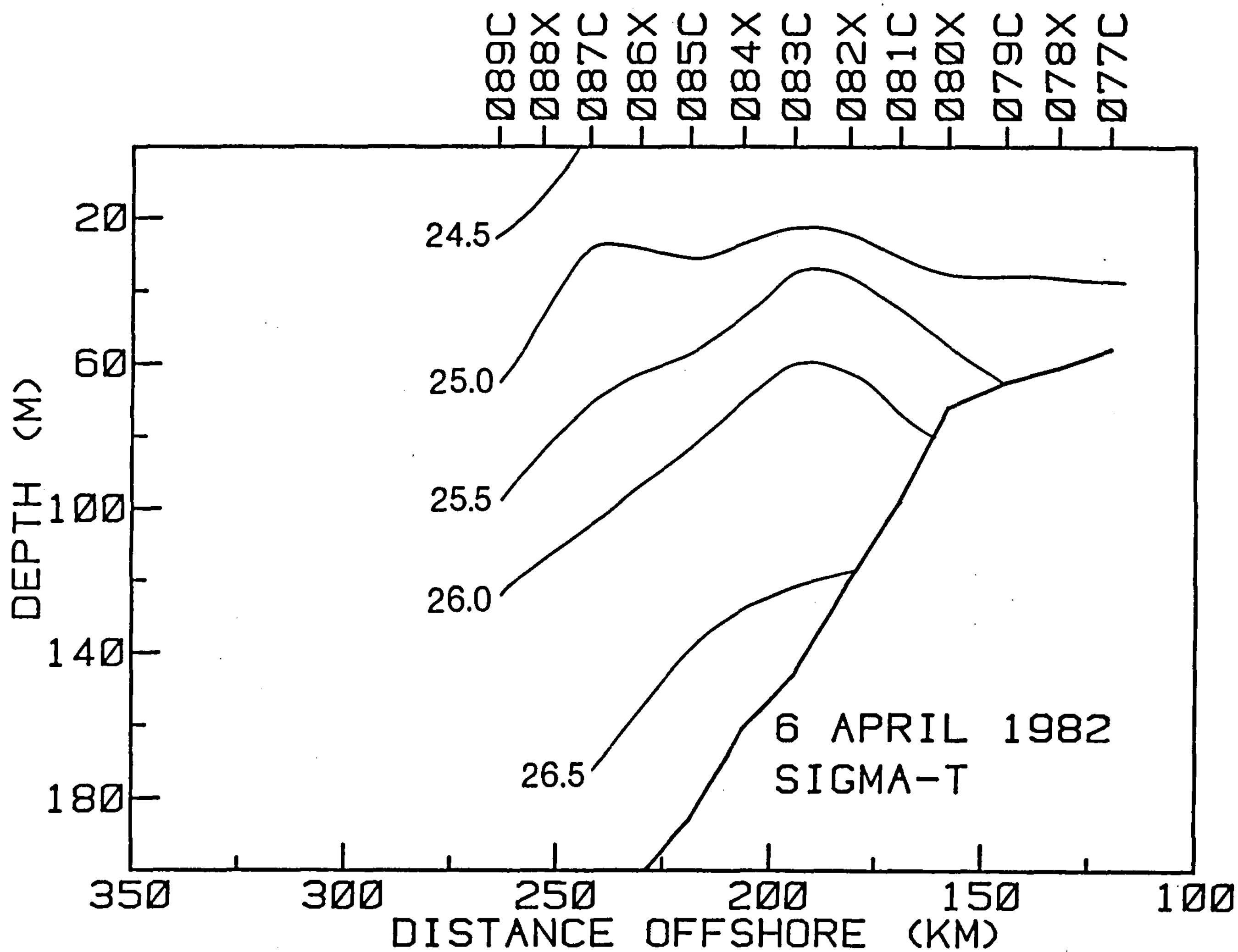


Figure 5. Cross section of sigma-t values at the shelf break on Transect 6.

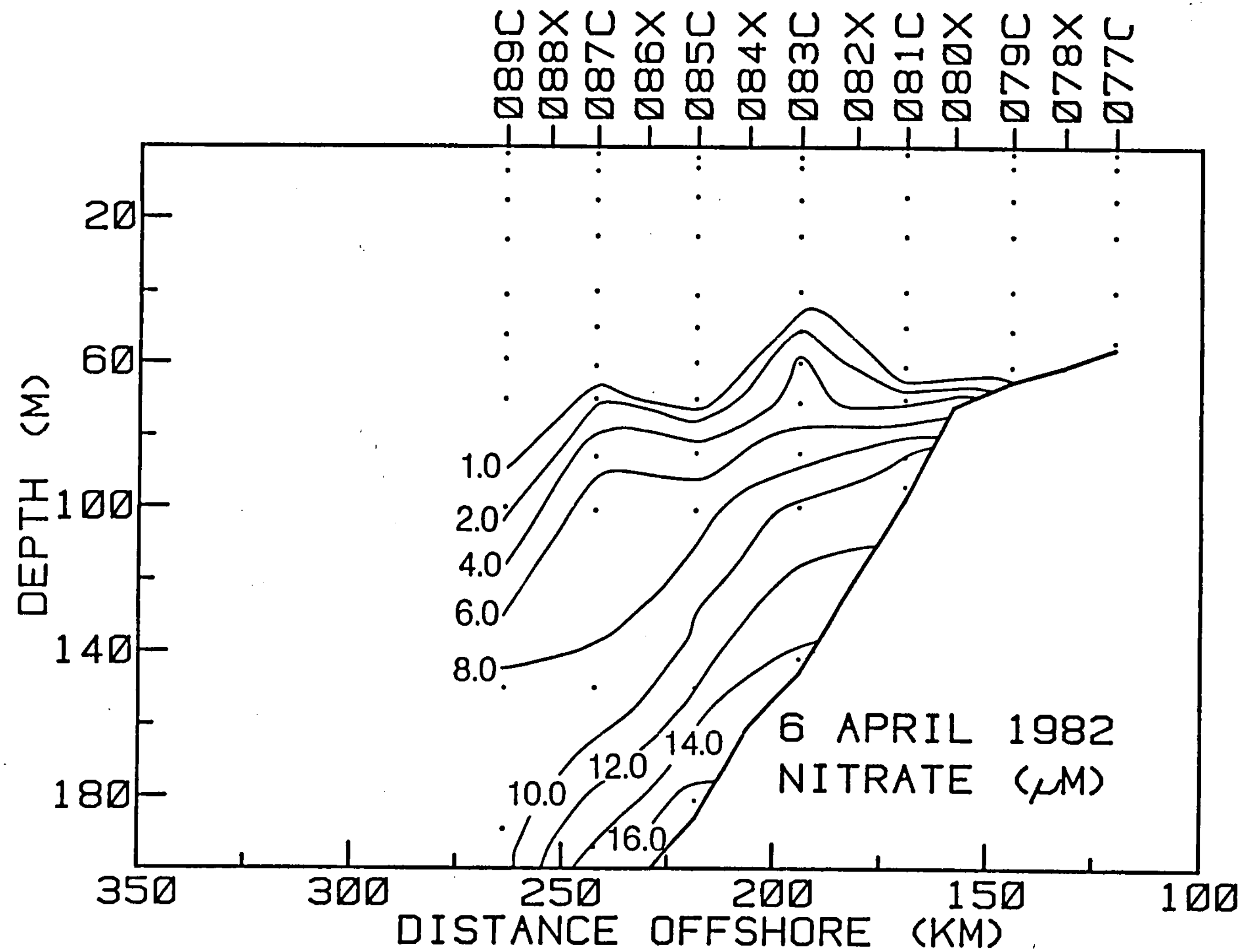


Figure 6. Cross section of Nitrate concentrations at the shelf break on Transect 6.

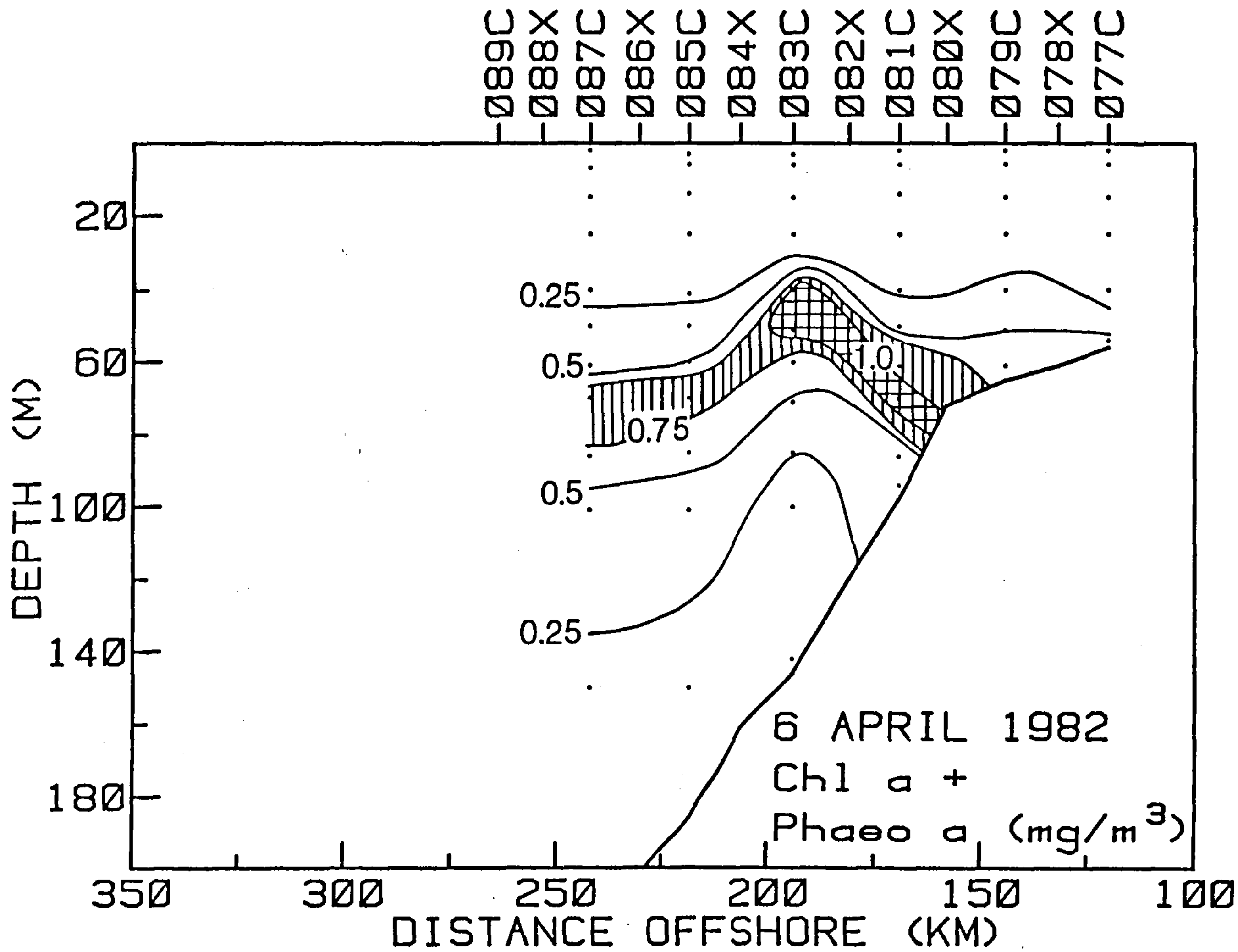


Figure 7. Cross section of combined chlorophyll-a and phaeopigment-a concentrations at the shelf break on Transect 6.

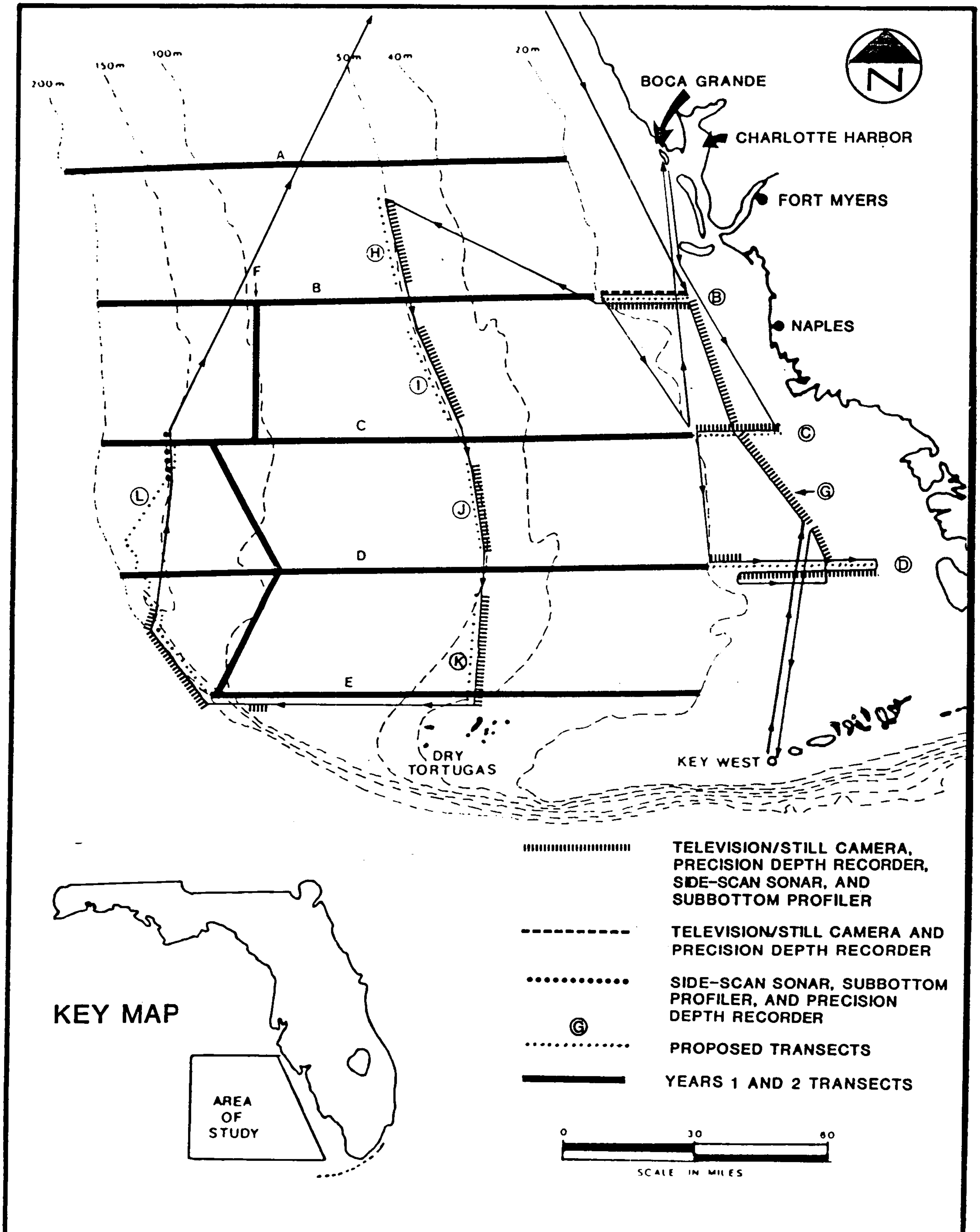


FIGURE 8. SOUTHWEST FLORIDA SHELF REGIONAL BIOLOGICAL COMMUNITIES SURVEY CRUISE I TRANSECTS.

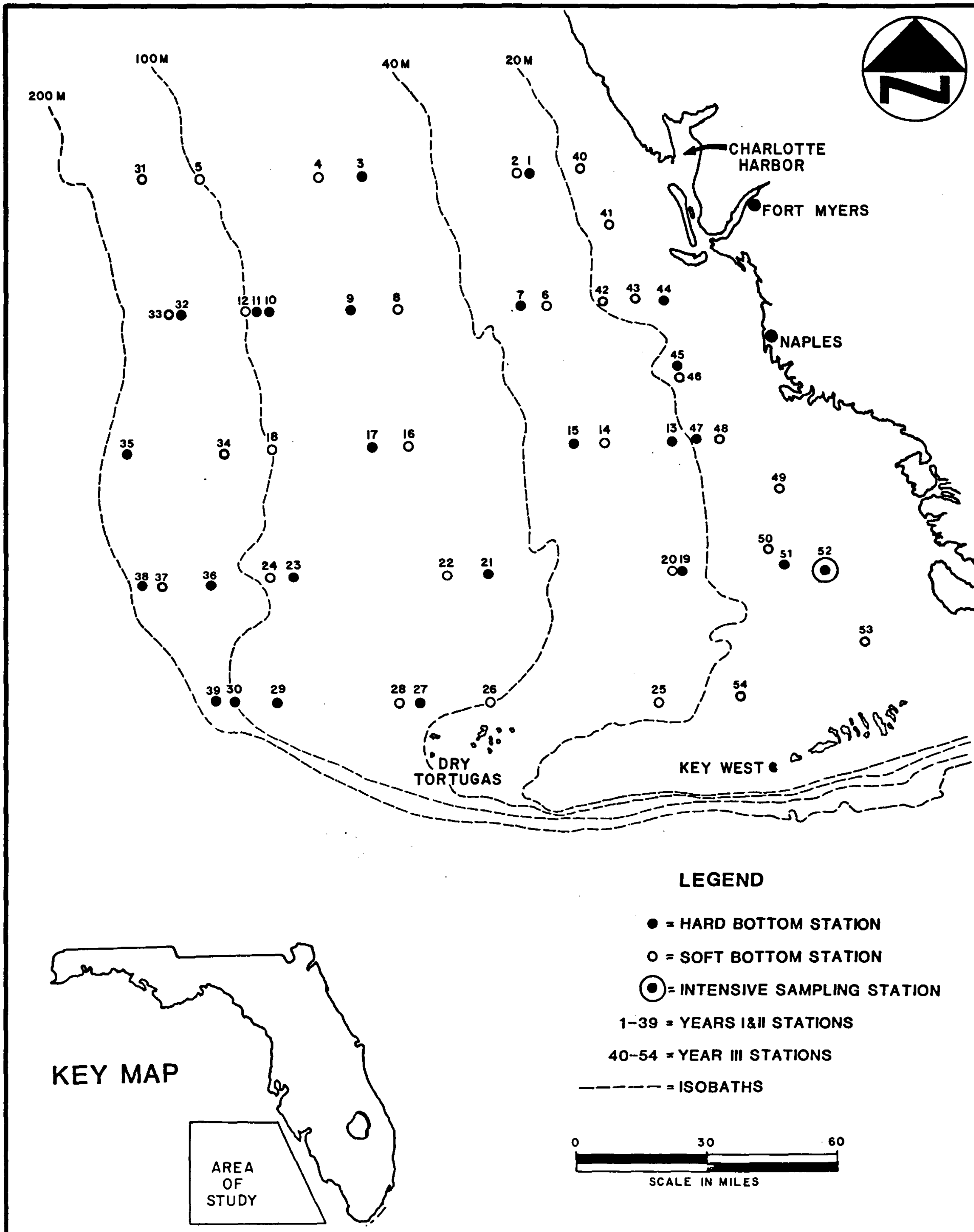


FIGURE 9. GEOGRAPHIC LOCATIONS OF ALL SOUTHWEST FLORIDA SHELF STUDIES BIOLOGICAL SAMPLING STATIONS.

Soft bottom station sampling consisted of the diver collection of 10 infaunal cores, three sediment grain size cores, and three hydrocarbon cores. An additional 50 infaunal cores and 15 sediment grain size cores were collected at an intensive sampling station (one of the hard bottom stations) to evaluate variations in soft bottom infauna with distance from hard bottom areas.

Hard bottom station sampling consisted of STD/DO and transmissivity profiles at each of the five stations, remote television/still camera data collections following techniques used during the first two years of this study, and dredge and trawl sample collections. All remote data collections were conducted at night at each hard bottom station and were repeated during daylight hours at the intensive sampling station to evaluate day-night differences. A sediment trap rack, supporting three replicate traps at two different heights above the sea floor and an acoustic pinger, was also deployed at each hard bottom station. In-situ recording thermographs were attached to the racks at the northern and southernmost stations. The traps and thermographs will be recovered during Cruise III. At each hard bottom station, divers randomly deployed thirty-five 0.5 m^2 quadrates on the bottom, photographed each, and collected all included epibiota to compare to remotely collected quantitative still photo data. Divers also recorded all fish species observed for comparison to remote visual observations.

STATUS OF ECOLOGICAL MODELS AND NARRATIVE REPORT FOR THE TEXAS BARRIER ISLAND REGION

WILLIAM L. LONGLEY

Texas General Land Office
Austin, Texas

PURPOSE

The Texas Barrier Island Region (TBIR) stretches from the eastern portion of Galveston Bay, Texas, to the Rio Grande on the Texas-Mexico border. The region extends inland approximately 40 miles, and offshore three leagues to the line of state-federal demarcation. The purpose of this study is to characterize the region by describing the natural systems it comprises and the interrelationships among system components. The products of the study will be a narrative report and a set of conceptual graphic system models depicting the TBIR at three scales: the entire region, hydrologic basins, and individual ecosystems. The models and the narrative are intended to describe the natural features and processes unique to the TBIR, to clarify the operation of manmade and natural systems, and to illustrate the effect of human systems on the natural environment. This approach provides a mechanism for the manipulation of data to predict the short- and long-term effects of system alteration by human activities or natural processes.

ORGANIZATION

A single model has been prepared depicting principal natural components and driving forces at the regional scale. Two models have been prepared at the basin scale. One depicts natural components and processes; the other is a socioeconomic model linked to the natural system model through a series of resource demands--requirements for material, energy, biota, landform, or space for economic activities. At the ecosystem scale, 25 models have been prepared to illustrate the functions in estuarine, marine, freshwater, upland, and man-managed ecosystems. Construction of the models required the defining of spatial and time scales; selecting components and driving functions; defining relations among components; and selecting appropriate graphic symbols to use in synthesizing the information in models.

The narrative report (in progress) will begin with a user's guide presenting background information and explaining the organization of this report. This will be followed by a discussion of the TBIR, describing the geologic development of the region and the pattern of variation of driving forces and components as illustrated by the regional model. The effects of human intervention will also be discussed.

A section on hydrologic basins will describe the 10 basins in the TBIR and the variations in patterns of driving forces and availability of materials that have resulted in the formation of three distinct basis types. The effects of man's activities, very noticeable at the basin level, will be discussed with reference to the basin system model. Each of the basins will be described in detail, and comparisons between basins will be made. The basin descriptions will include the pattern and area of basin ecosystems, principal driving forces and system components, and the pressure of resource demands in each basin.

The 25 ecosystem models will be briefly described with reference to corresponding units on maps prepared by Texas A&M University as part of another phase of the characterization project. A description of the appearance, location, important driving forces and system components, and typical flora and fauna will be given for each ecosystem.

SELECTED FIGURES FROM THE MODELLING AND NARRATIVE REPORTS

The user's guide will discuss patterns of variation such as the patterns of temperature change over various time periods shown in Figure 1.

The regional portion of the narrative report focuses upon forces and variables that continue to shape the region. One of these is surface hydrology. Figure 2 shows the patterns of circulation in the Gulf of Mexico over the seasons of the year. Figure 3 shows the average annual gulf currents. Other surface hydrologic features in this figure include reservoirs and impoundments in the TBIR, and isopleths of average annual rainfall minus potential evaportrans-piration.

Figure 4 illustrates the pattern of rainfall in the region. Summer rainfall is related to moisture from the gulf; other rainfall periods are associated with frontal movement from the north. Zones of rainfall convergence occur in areas where the shoreline is slightly convex with respect to the gulf. Figure 4 also shows a statistically significant relationship between percent rainfall and latitude for three seasons. In the upper coast a higher proportion of the rainfall occurs in the spring than along the lower coast; in summer and fall, just the reverse is true.

Figures 5,6, and 7 show population change in counties of the TBIR from 1850 to the present and projected to 2000. The rapid growth of population centers, especially Houston and Galveston, is apparent.

The arrangement and types of hydrologic basins are shown in Figure 8. Figure 9 is the generalized basin model. Some of the most important forces that influence the basin are upland and offshore weather patterns, water and sediment from rivers above the coastal plain, sediment from uplands above the coastal plain, tidal energy, and storms and flooding. Coupled with changes in sea level due to glaciation, this model illustrates the development of the basins and their present operation. The stick figures numbered 1 through 14 show the types of human interventions that occur in basins due to development and other human activities. Table 1 describes the kinds of human interventions illustrated on the diagram.

Figures 10 and 11 show hydrologic relations and salinity characteristics in the Galveston Bay estuary, one of the 10 basins described in detail. The socioeconomic model for basins is presented in Figure 12. The components of the coastal zone economy correspond with data topics covered in the socioeconomic characterization of the region. Each sector of the economy produces resource demands (bottom of the figure) that correspond to components in the ecosystem models.

Figures 13 through 18 are example models of lake, beach, bulkhead or jetty, coastal forest, salt marsh, and urban land ecosystems. Ecosystem models are useful for organizing and guiding environmental impact assessments, communicating understanding of system functions with permit applicants, and determining gaps in available information about ecosystems.

TABLE 1. Human interventions in hydrologic basins.

1. Man's effect upon the production of sediment from bedrock in uplands above the coastal plain—some activities may cause faster sediment formation while other activities may retard formation.

2. Modification of runoff quantity and pattern due to man's activities—for example, impermeable surfaces increase the quantity and rapidity of runoff.

3. Diversion of water for agricultural, residential, and manufacturing purposes--diversion may decrease the quantity of water flowing in the stream, change its yearly pattern of flow, or result in its return bypassing a section of the stream.

4. Control of flow in rivers above the coastal plain—damming the river may result in changes in quantity or pattern of flow of the river or stream.

5. Control of overbank flooding in the coastal plain--levees can control flooding in the coastal plain and protect property; however, they block the transport and deposition of sediment on the coastal plain.

6. Straightening and channelizing rivers, stream, and bayous--increases flow velocity and sediment load that may be transported.

7. Control of bank erosion on rivers—decreases sediment input from banks and upland.

8. Control of shoreline erosion by bulkheading—decreases sediment input and may increase wave energy in area.

9. Filling estuary--creation of dry land or subaqueous spoil decreases estuarine habitat.

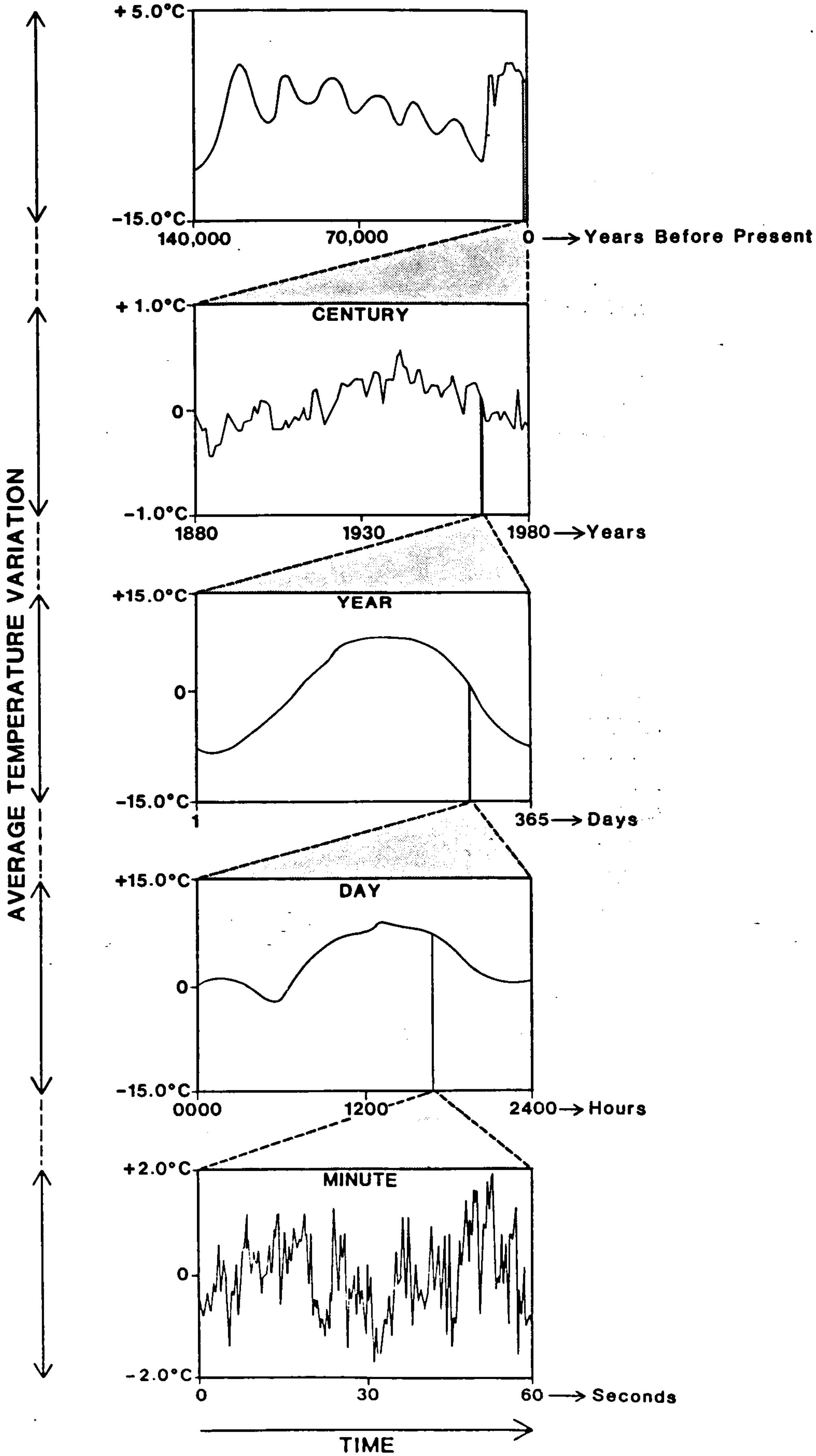
10. Change in current energy in estuary--linear channels connecting tidally influenced areas may increase current energy in estuary.

11. Stabilization of natural passes--passes designed to transmit current energy to minimize siltation.

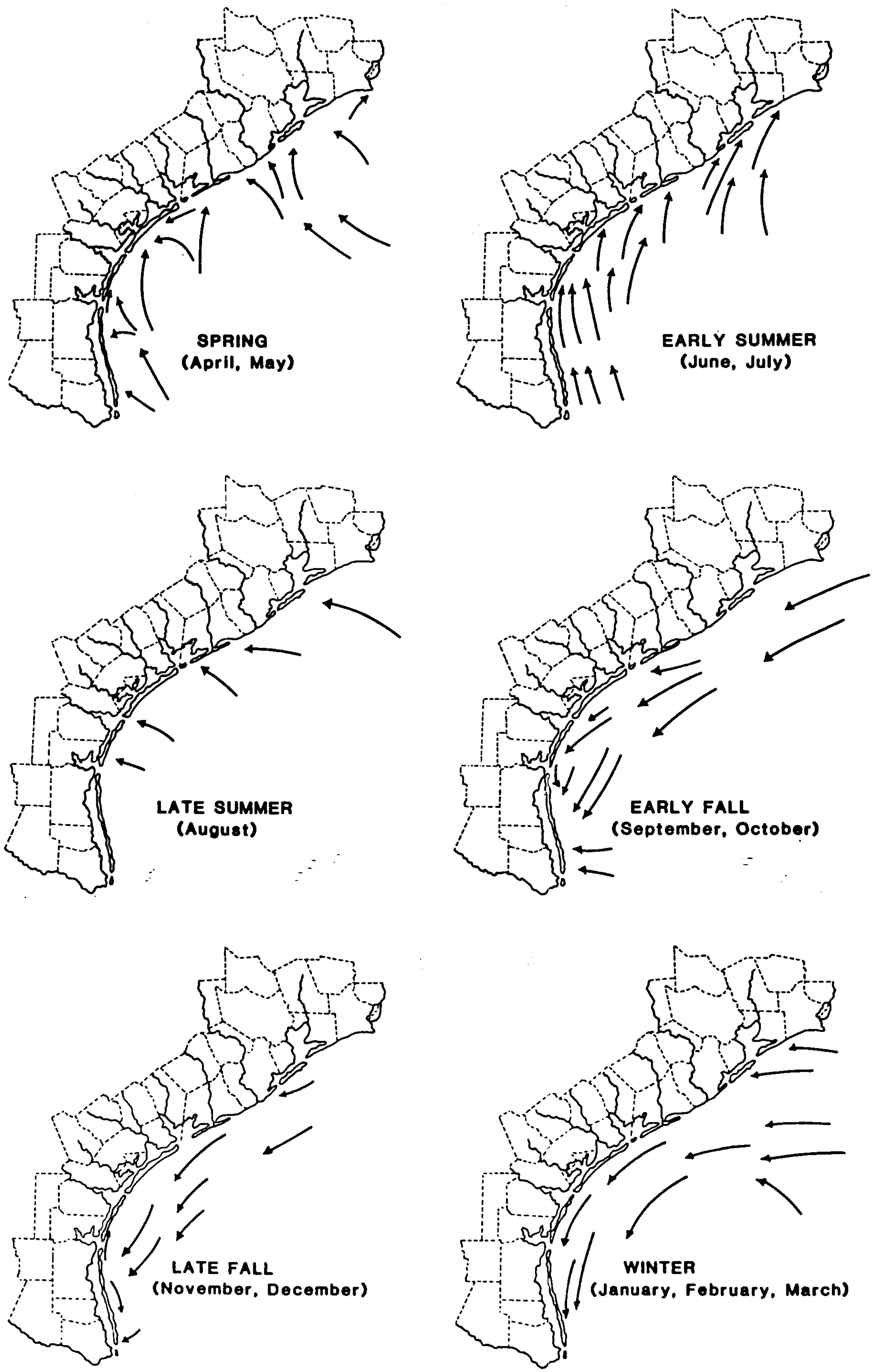
12. Change in longshore current patterns from man-made structures—structures like jetties designed to interrupt longshore current and sediment transport.

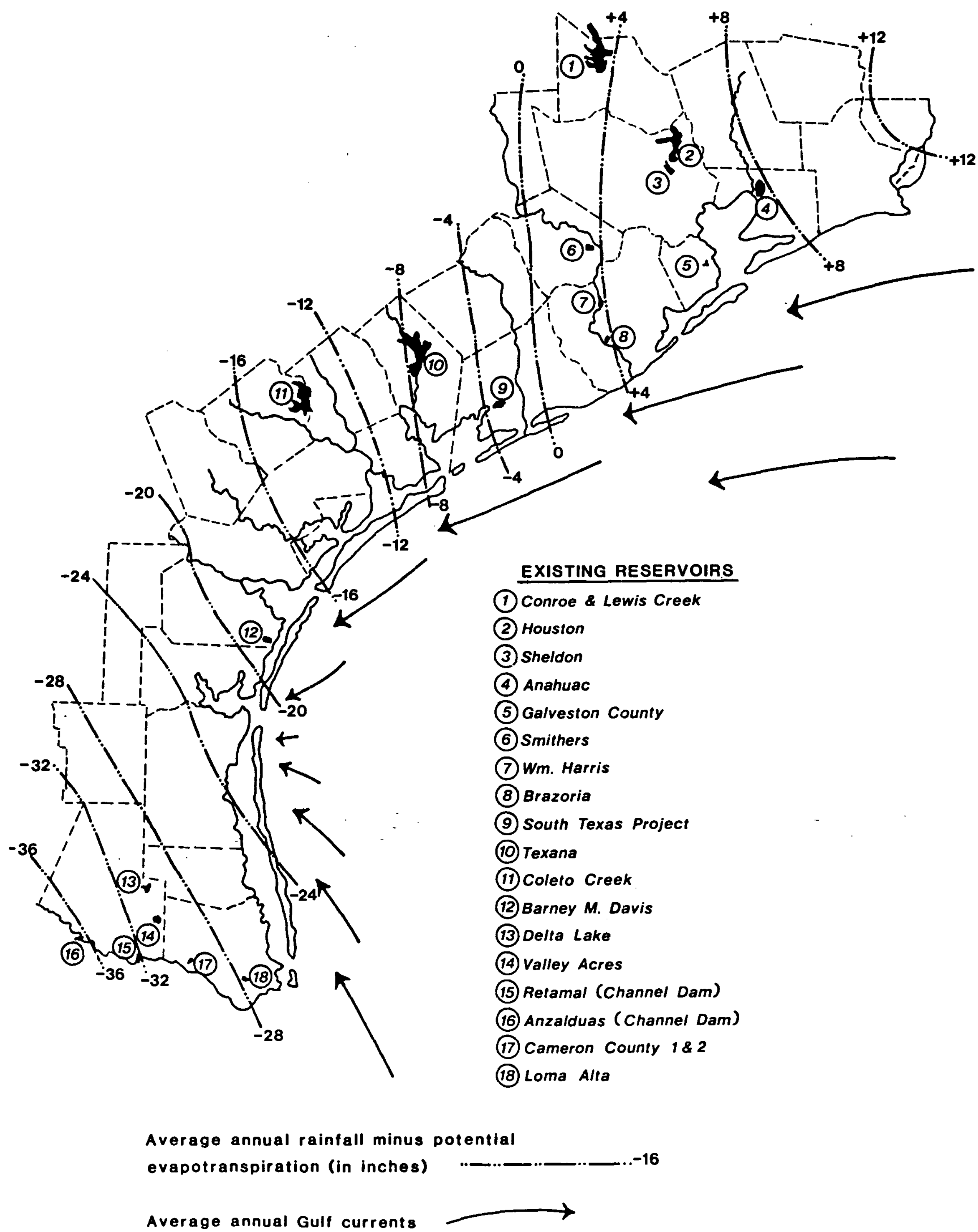
13. Activities in barrier island dunes—vehicular activity, fires, and grazing may increase eolian transport and decrease sediment supply on barriers.

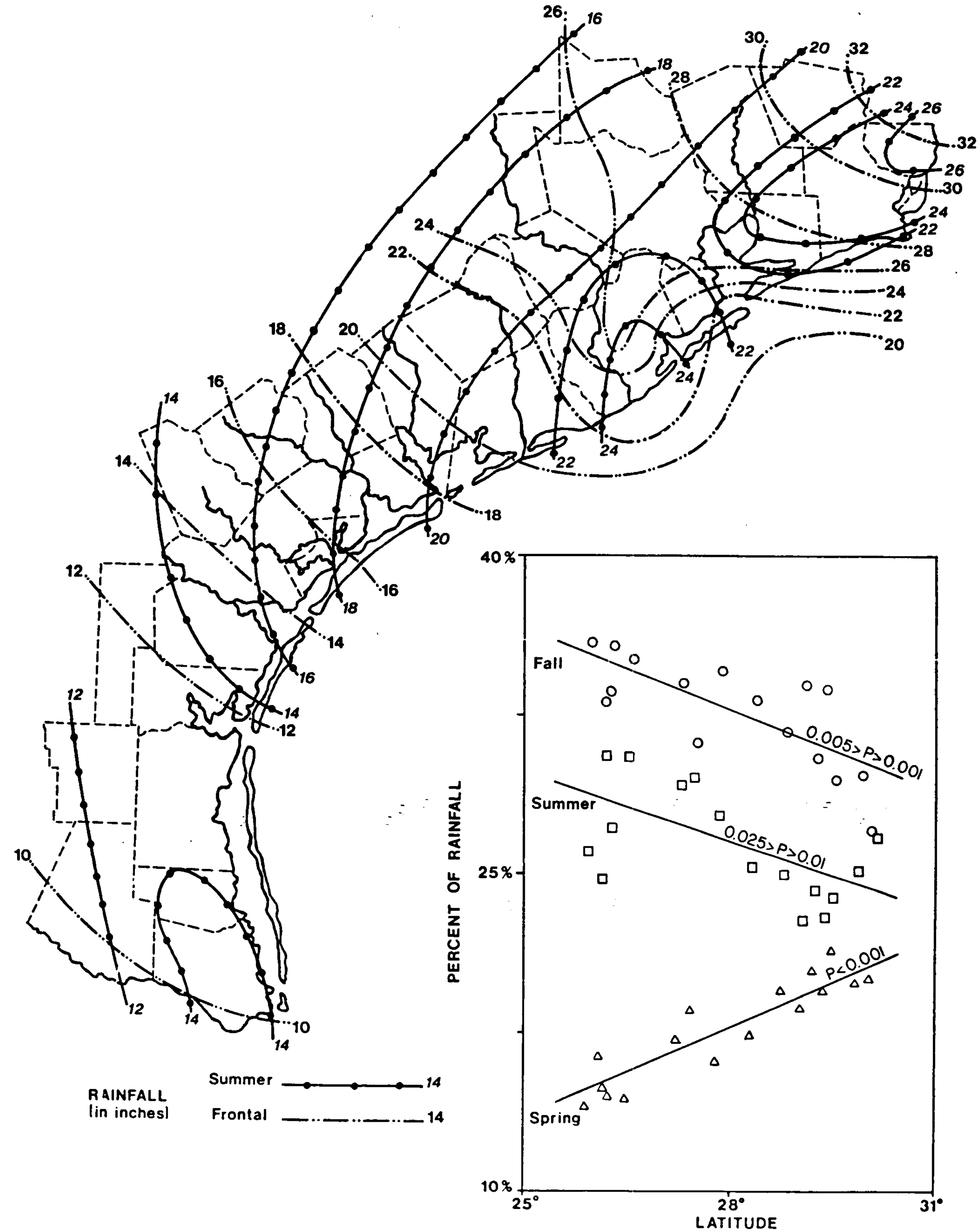
14. Decreased sediment input to the gulf from tidal rivers—upriver activities may decrease supply of sediment for barrier islands and peninsulas.

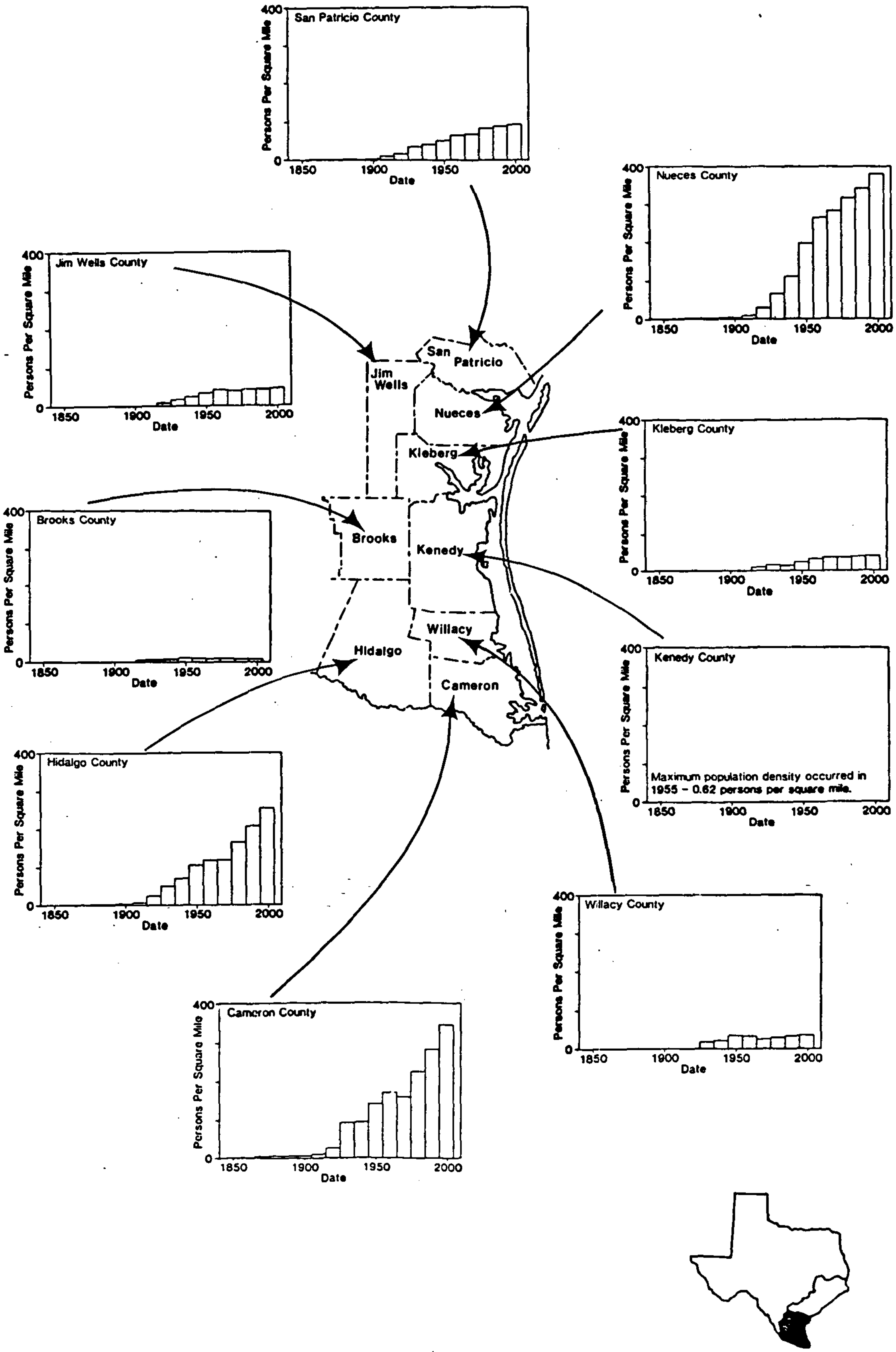


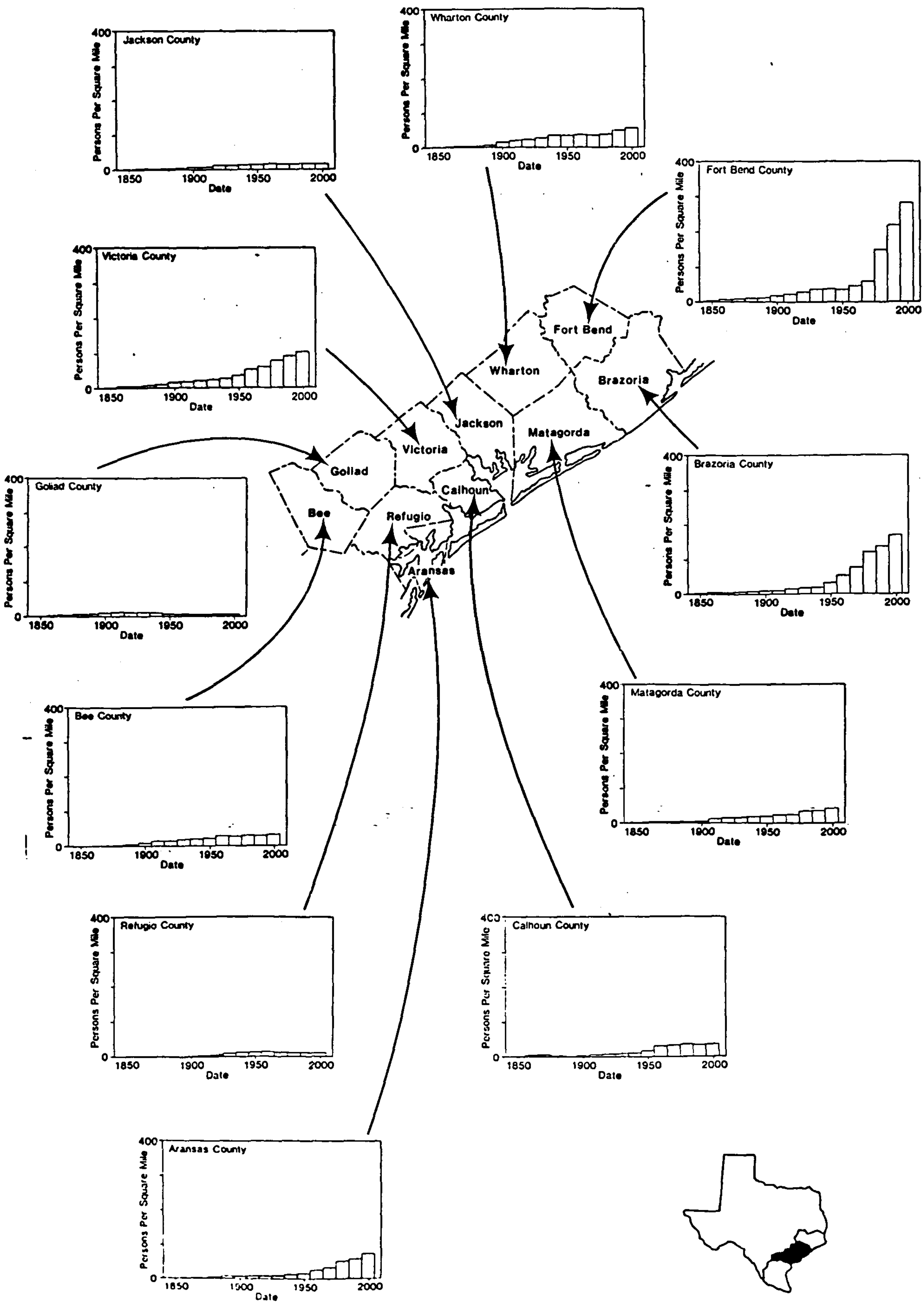
AVERAGE TEMPERATURE VARIATION
+ 5.0°C
-15.0°C
140,000
70,000
0 ⟶ Years Before Present
+ 1.0°C
CENTURY
0
-1.0°C
1880
1930
1980 ⟶ Years
+15.0°C
YEAR
0
-15.0°C
1
365 ⟶ Days
+15.0°C
DAY
0
-15.0°C
0000
1200
2400 ⟶ Hours
+2.0°C
MINUTE
0
-2.0°C
0
30
60 ⟶ Seconds
TIME


SPRING
(April, May)
EARLY SUMMER
(June, July)
LATE SUMMER
(August)
EARLY FALL
(September, October)
LATE FALL
(November, December)
WINTER
(January, February, March)


EXISTING RESERVOIRS
1 Conroe & Lewis Creek
2 Houston
3 Sheldon
4 Anahuac
5 Galveston County
6 Smithers
7 Wm. Harris
8 Brazoria
9 South Texas Project
10 Texana
11 Coleto Creek
12 Barney M. Davis
13 Delta Lake
14 Valley Acres
15 Retamal (Channel Dam)
16 Anzalduas (Channel Dam)
17 Cameron County 1 & 2
18 Loma Alta
+4
+8
+12
0
-4
-8
-12
-16
-20
-24
-28
-32
-36
Average annual rainfall minus potential evapotranspiration (in inches) -16
Average annual Gulf currents

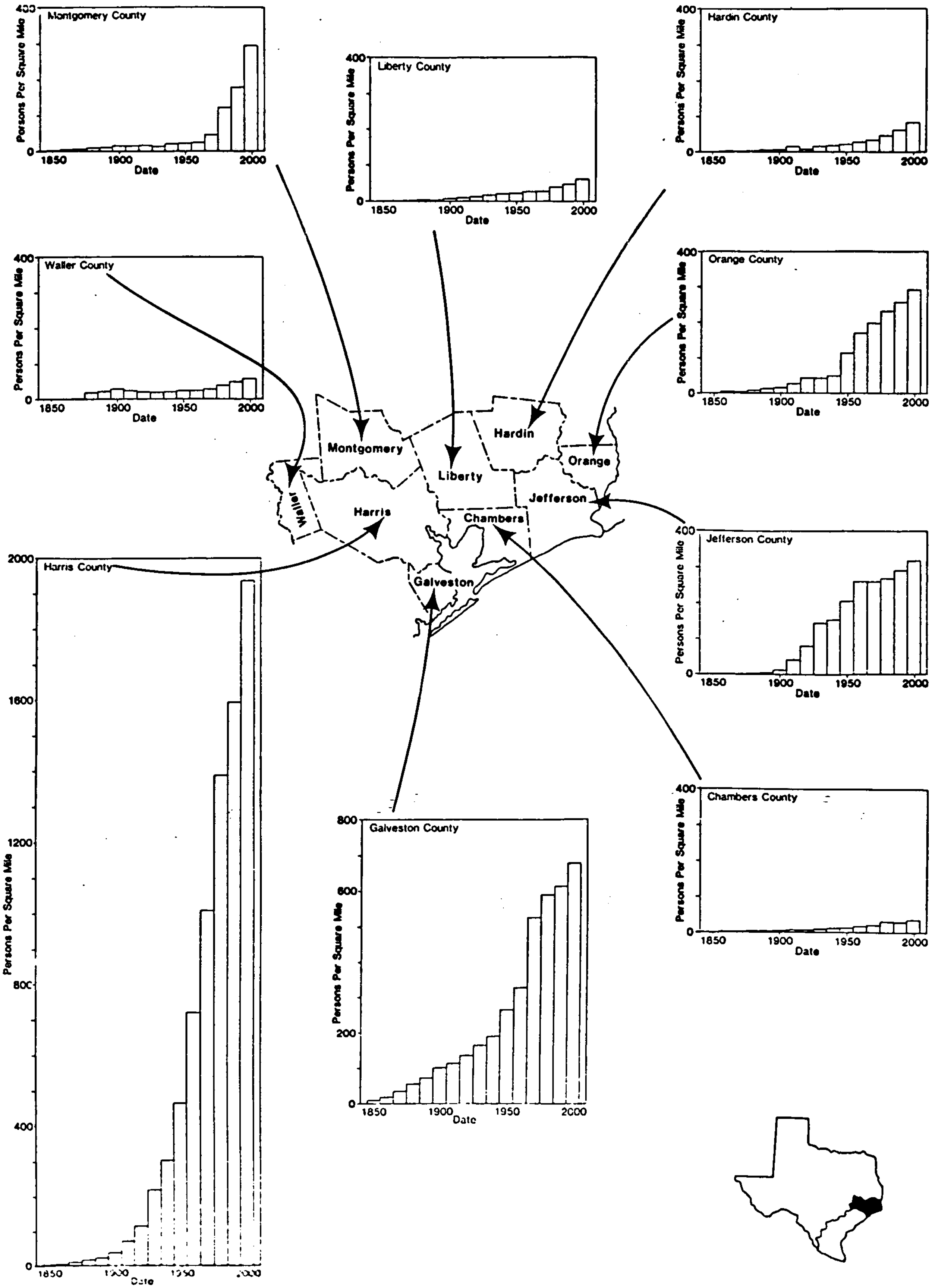

RAINFALL
(in inches)
Summer 14
Frontal 14
40%
25%
10%
PERCENT OF RAINFALL
Fall
0.005>P>0.001
Summer
0.025>P>0.01
Spring
P<0.001
25°
28°
31°
LATITUDE


San Patricio County
Nueces County
Jim Wells County
Kleberg County
Brooks County
Kenedy County
Maximum population density occurred in 1955 – 0.62 persons per square mile.
Hidalgo County
Willacy County
Cameron County
Persons Per Square Mile
Date
400
0
1850
1900
1950
2000
San Patricio
Jim Wells
Nueces
Kleberg
Brooks
Kenedy
Willacy
Hidalgo
Cameron



Jackson County
Wharton County
Fort Bend County
Victoria County
Goliad County
Brazoria County
Bee County
Matagorda County
Refugio County
Calhoun County
Aransas County
Persons Per Square Mile
Date
400
0
1850
1900
1950
2000
Fort Bend
Wharton
Brazoria
Jackson
Matagorda
Victoria
Goliad
Calhoun
Bee
Refugio
Aransas

FIGURE 7



Montgomery County
Liberty County
Hardin County
Waller County
Orange County
Jefferson County
Harris County
Chambers County
Galveston County
Persons Per Square Mile
Date
1850
1900
1950
2000
0
200
400
600
800
1200
1600
2000
Montgomery
Hardin
Liberty
Orange
Jefferson
Waller
Harris
Chambers
Galveston

FIGURE 8

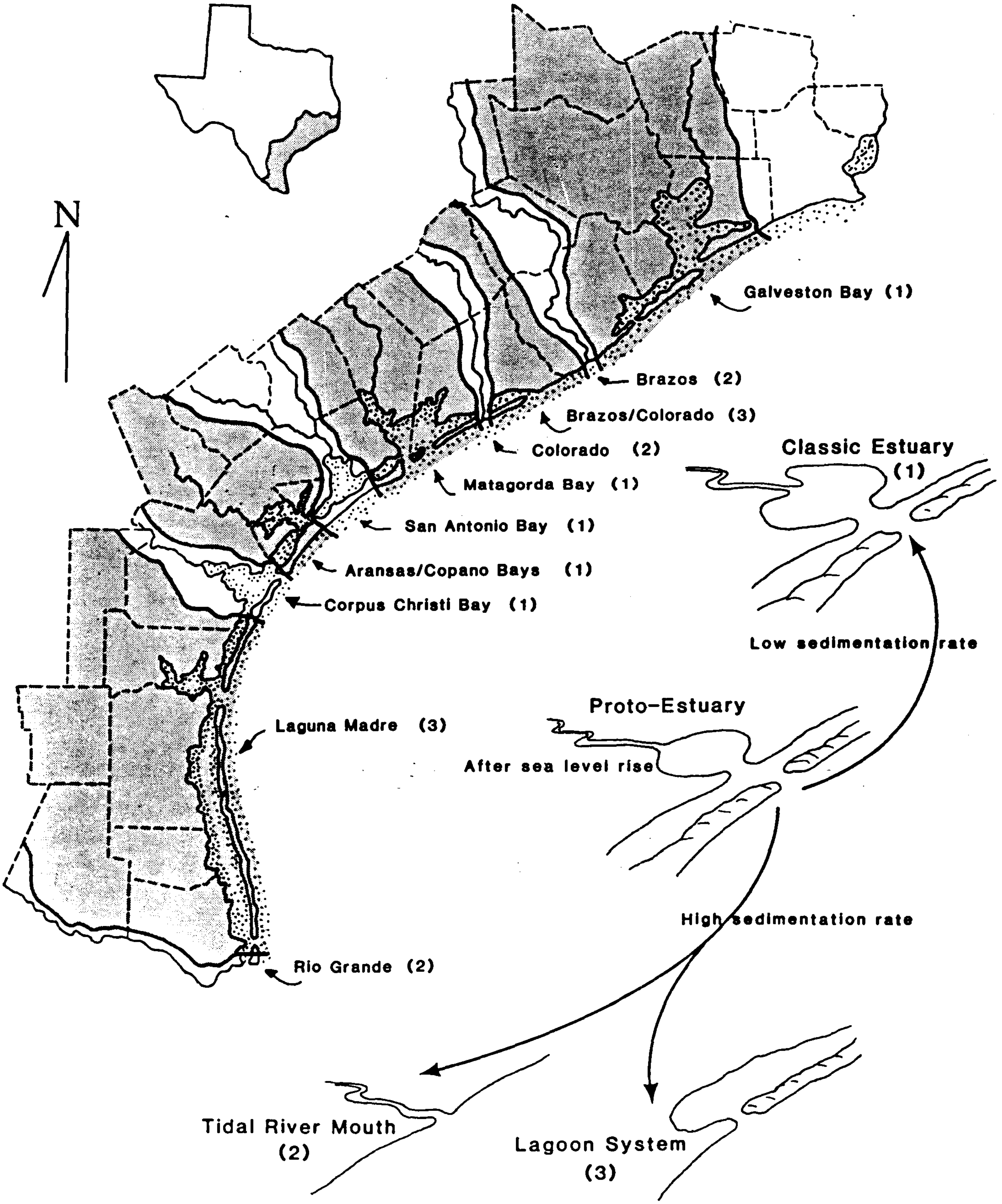
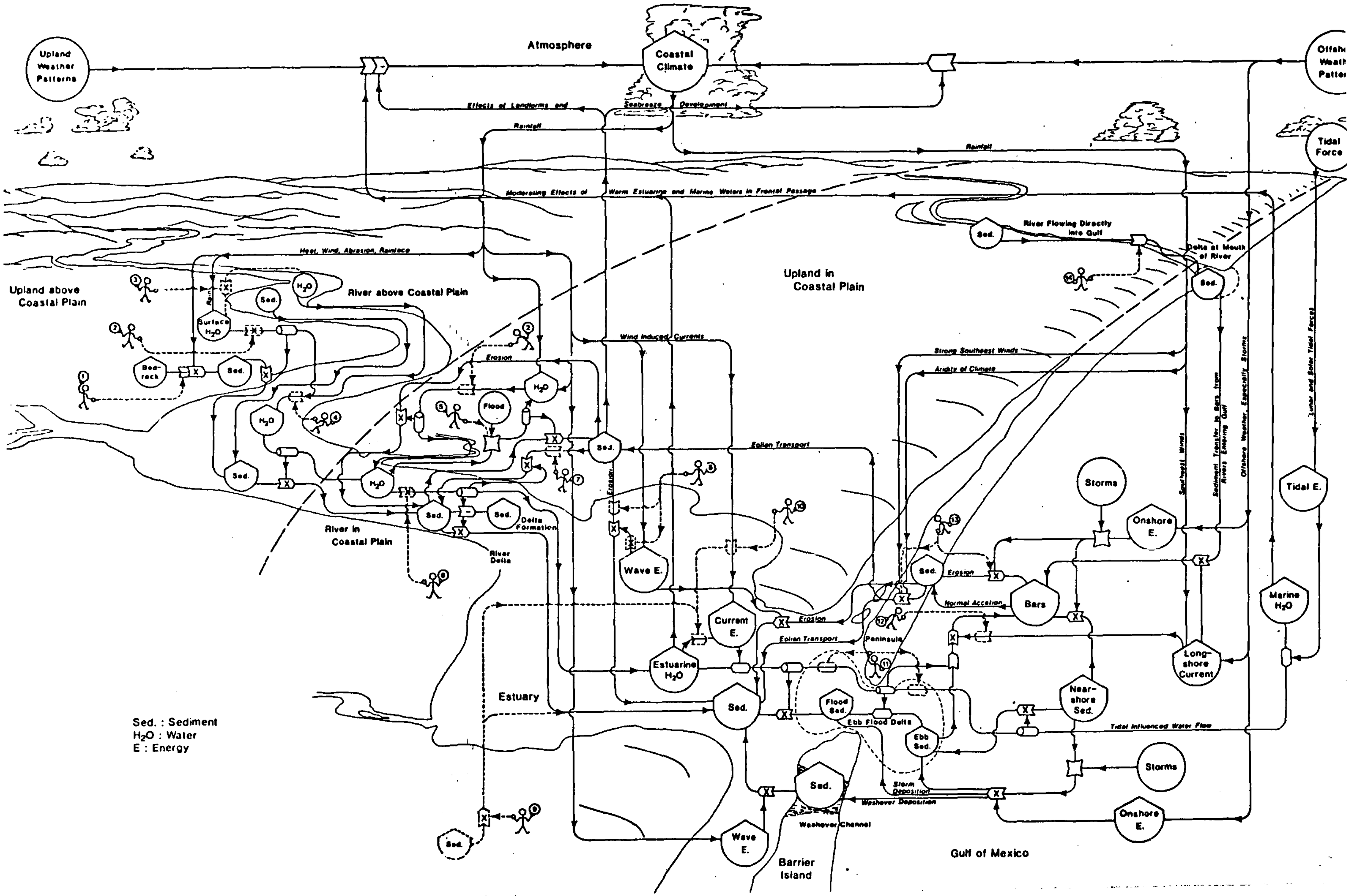
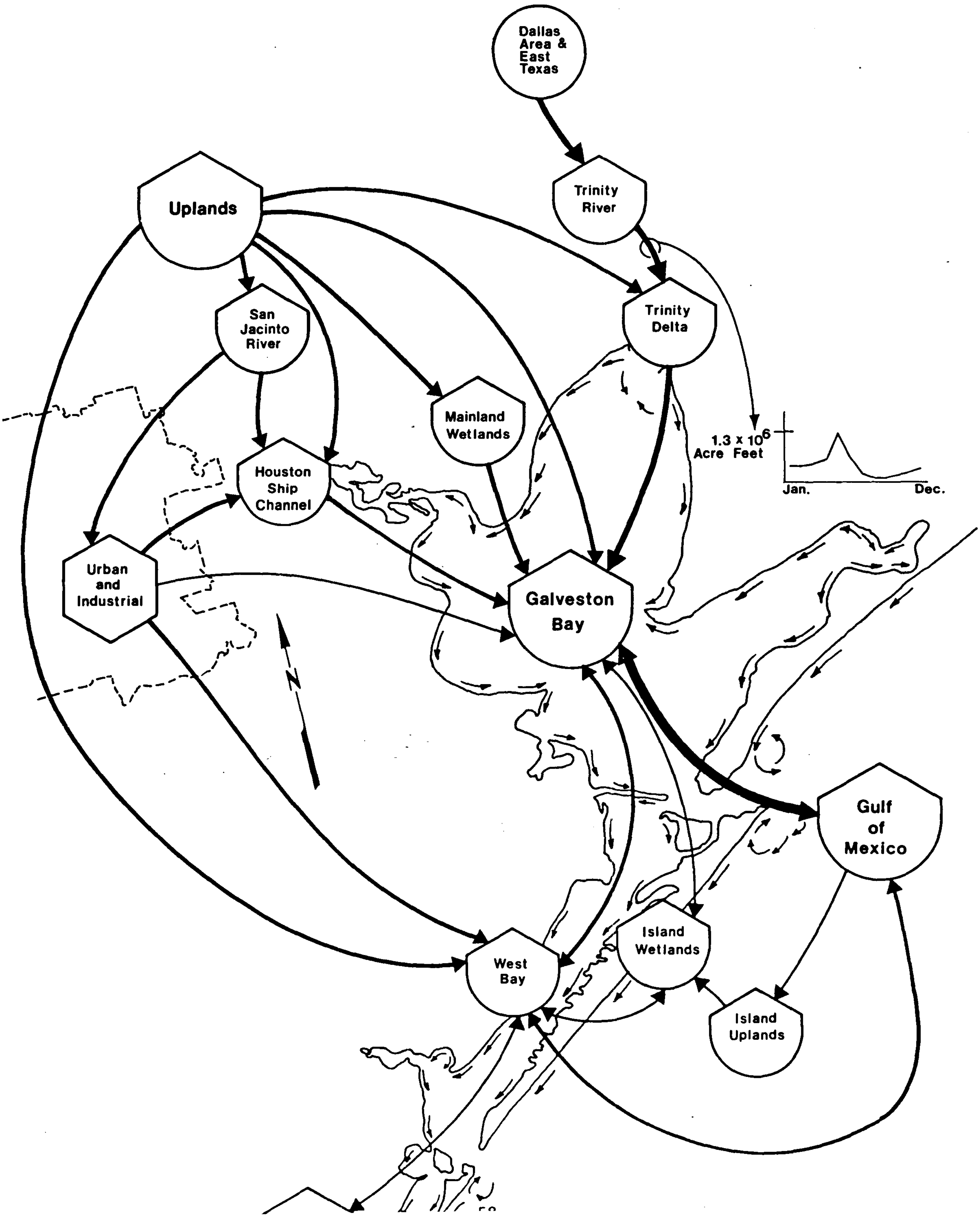

N
Galveston Bay (1)
Brazos (2)
Brazos/Colorado (3)
Colorado (2)
Matagorda Bay (1)
San Antonio Bay (1)
Aransas/Copano Bays (1)
Corpus Christi Bay (1)
Laguna Madre (3)
Rio Grande (2)
Classic Estuary
(1)
Low sedimentation rate
Proto-Estuary
After sea level rise
High sedimentation rate
Tidal River Mouth
(2)
Lagoon System
(3)

FIGURE 9



Upland Weather Patterns
Atmosphere
Coastal Climate
Effects of Landforms and Seabreeze Development
Rainfall
Moderating Effects of Warm Estuarine and Marine Waters in Frontal Passage
Heat, Wind, Abrasion, Rainface
Upland above Coastal Plain
River above Coastal Plain
Upland in Coastal Plain
River Flowing Directly into Gulf
Delta at Mouth of River
Tidal Force
Wind Induced Currents
Strong Southeast Winds
Aridity of Climate
Eolian Transport
Erosion
Flood
Surface H_2O
Bed-rock
Sed.
H_2O
Delta Formation
River in Coastal Plain
River Delta
Wave E.
Current E.
Estuarine H_2O
Estuary
Storms
Onshore E.
Bars
Normal Accretion
Peninsula
Long-shore Current
Near-shore Sed.
Marine H_2O
Tidal E.
Flood Sed.
Ebb Flood Delta
Ebb Sed.
Tidal Influenced Water Flow
Storm Deposition
Washover Deposition
Washover Channel
Barrier Island
Gulf of Mexico
Southeast Winds
Sediment Transfer to Bars from Rivers Entering Gulf
Offshore Weather, Especially Storms
Lunar and Solar Tidal Forces
Sed. : Sediment
H_2O : Water
E : Energy



Dallas Area & East Texas
Trinity River
Uplands
San Jacinto River
Trinity Delta
Mainland Wetlands
Houston Ship Channel
1.3 x 10^6 Acre Feet
Jan.
Dec.
Urban and Industrial
Galveston Bay
Gulf of Mexico
Island Wetlands
West Bay
Island Uplands

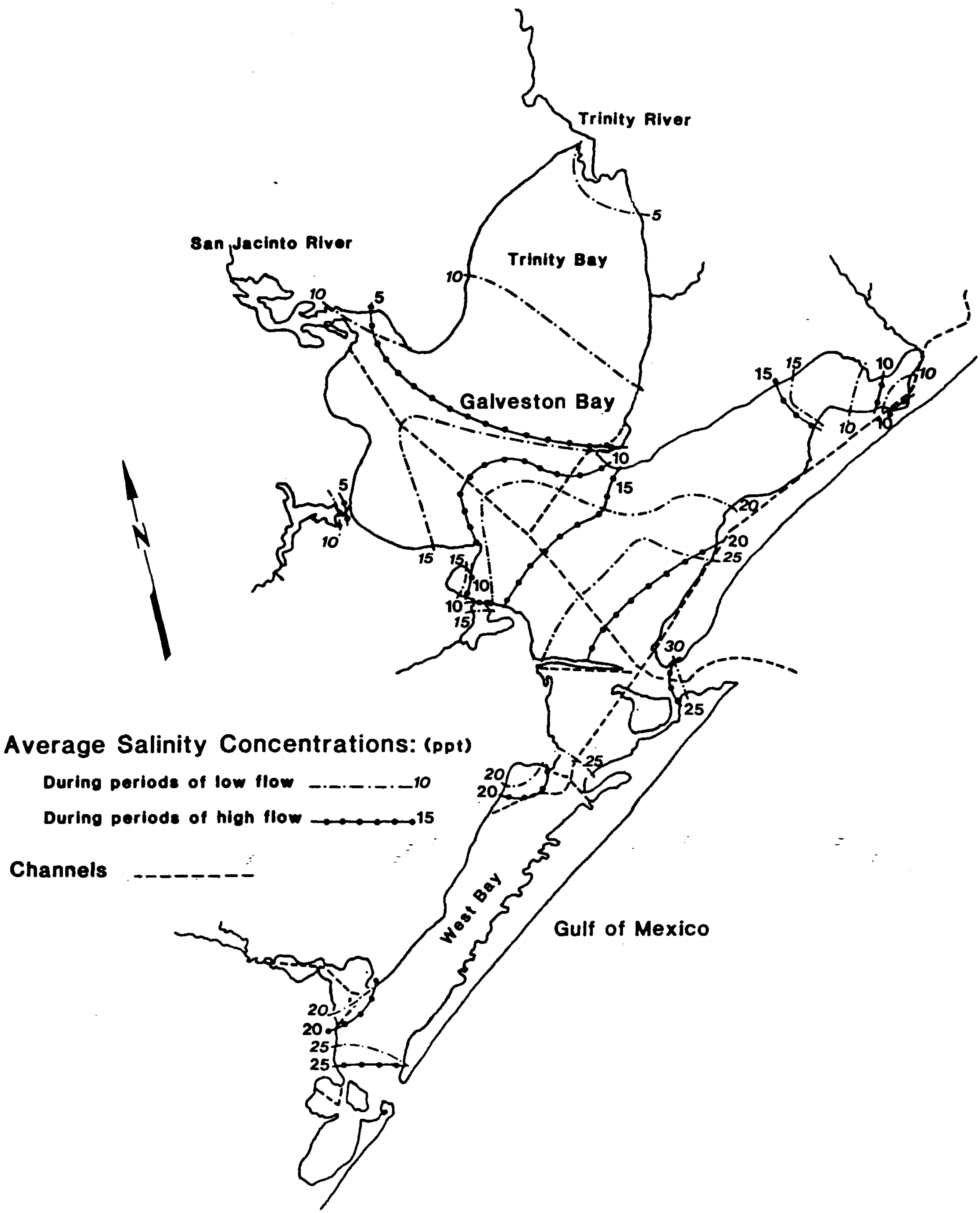
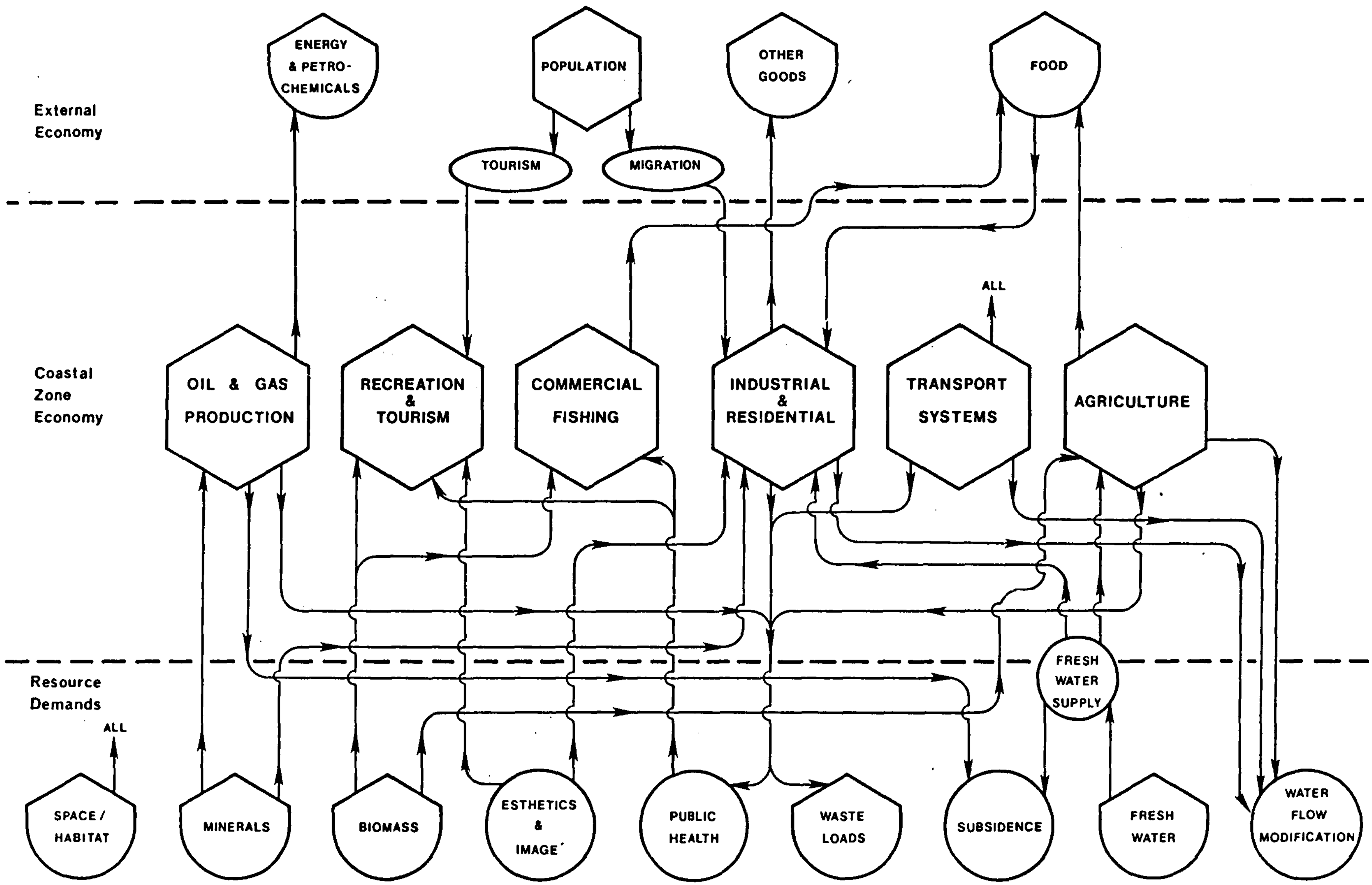
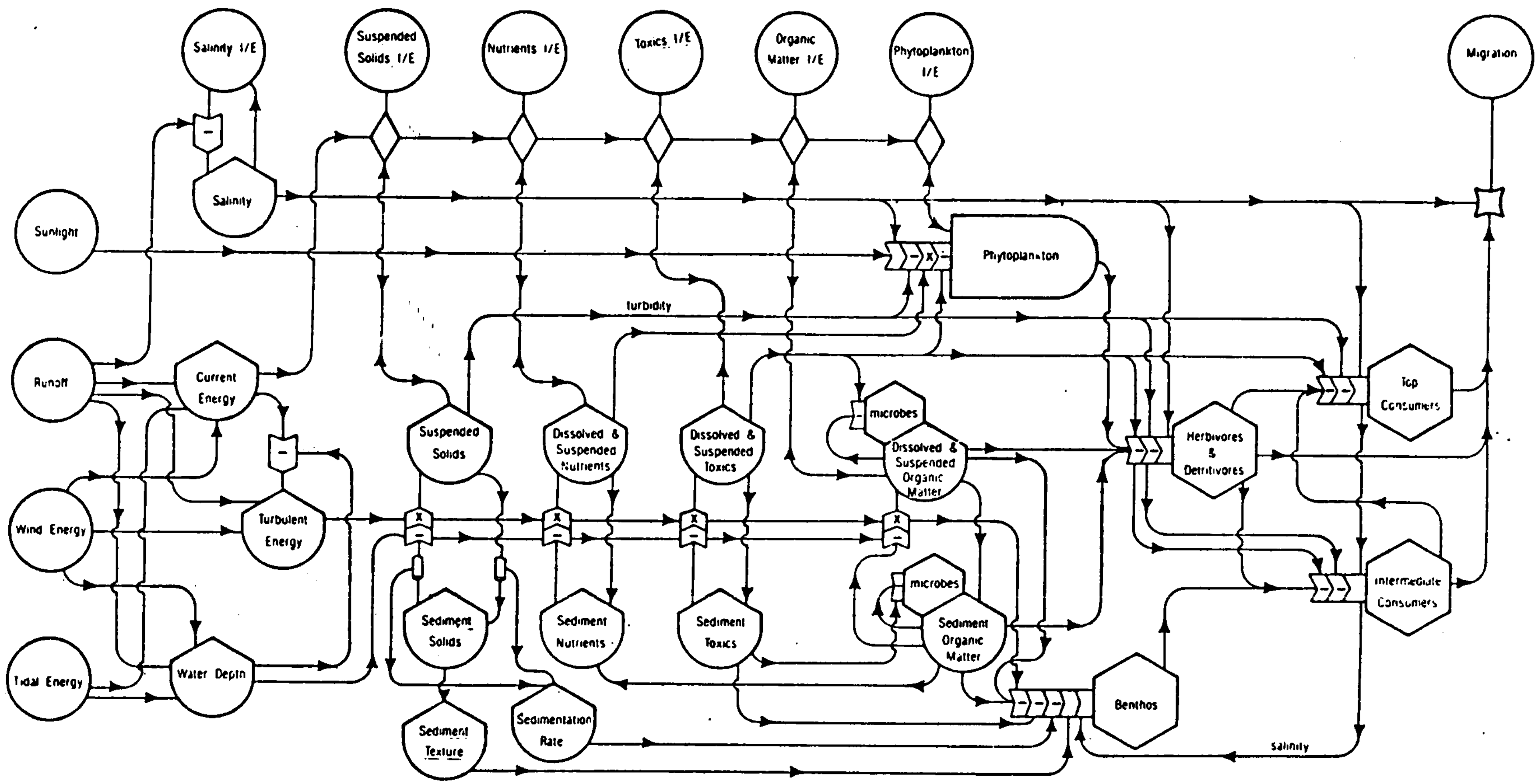

Trinity River
San Jacinto River
Trinity Bay
Galveston Bay
West Bay
Gulf of Mexico
N
Average Salinity Concentrations: (ppt)
During periods of low flow 10
During periods of high flow 15
Channels

FIGURE 12



External Economy
ENERGY & PETRO-CHEMICALS
POPULATION
OTHER GOODS
FOOD
TOURISM
MIGRATION
ALL
Coastal Zone Economy
OIL & GAS PRODUCTION
RECREATION & TOURISM
COMMERCIAL FISHING
INDUSTRIAL & RESIDENTIAL
TRANSPORT SYSTEMS
AGRICULTURE
FRESH WATER SUPPLY
Resource Demands
ALL
SPACE / HABITAT
MINERALS
BIOMASS
ESTHETICS & IMAGE
PUBLIC HEALTH
WASTE LOADS
SUBSIDENCE
FRESH WATER
WATER FLOW MODIFICATION

FIGURE 13



Salinity I/E
Suspended Solids I/E
Nutrients I/E
Toxics I/E
Organic Matter I/E
Phytoplankton I/E
Migration
Salinity
Sunlight
Phytoplankton
turbidity
Runoff
Current Energy
Top Consumers
microbes
Suspended Solids
Dissolved & Suspended Nutrients
Dissolved & Suspended Toxics
Dissolved & Suspended Organic Matter
Herbivores & Detritivores
Wind Energy
Turbulent Energy
Intermediate Consumers
Sediment Solids
Sediment Nutrients
Sediment Toxics
Sediment Organic Matter
Tidal Energy
Water Depth
Benthos
Sediment Texture
Sedimentation Rate
salinity

FIGURE 14

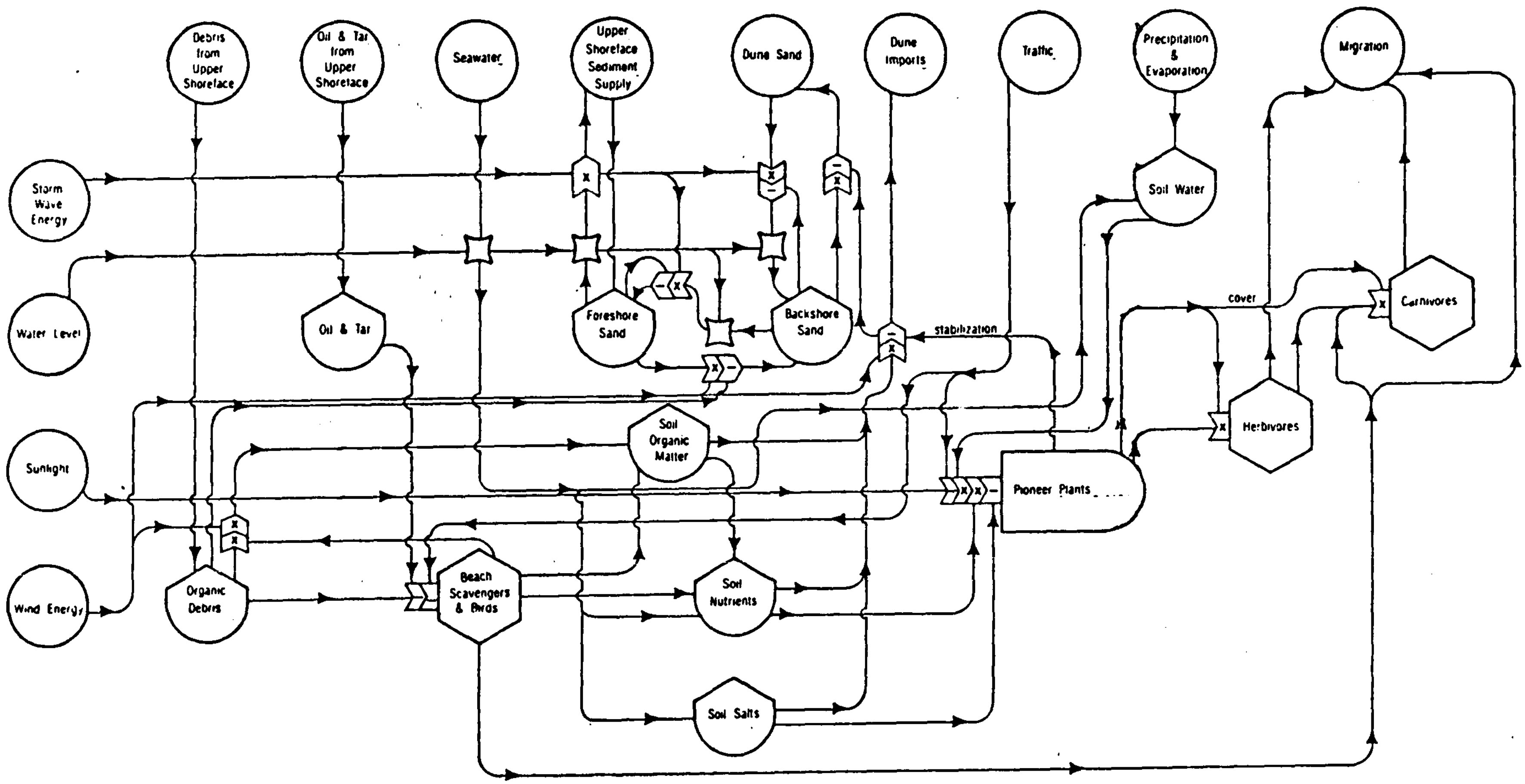
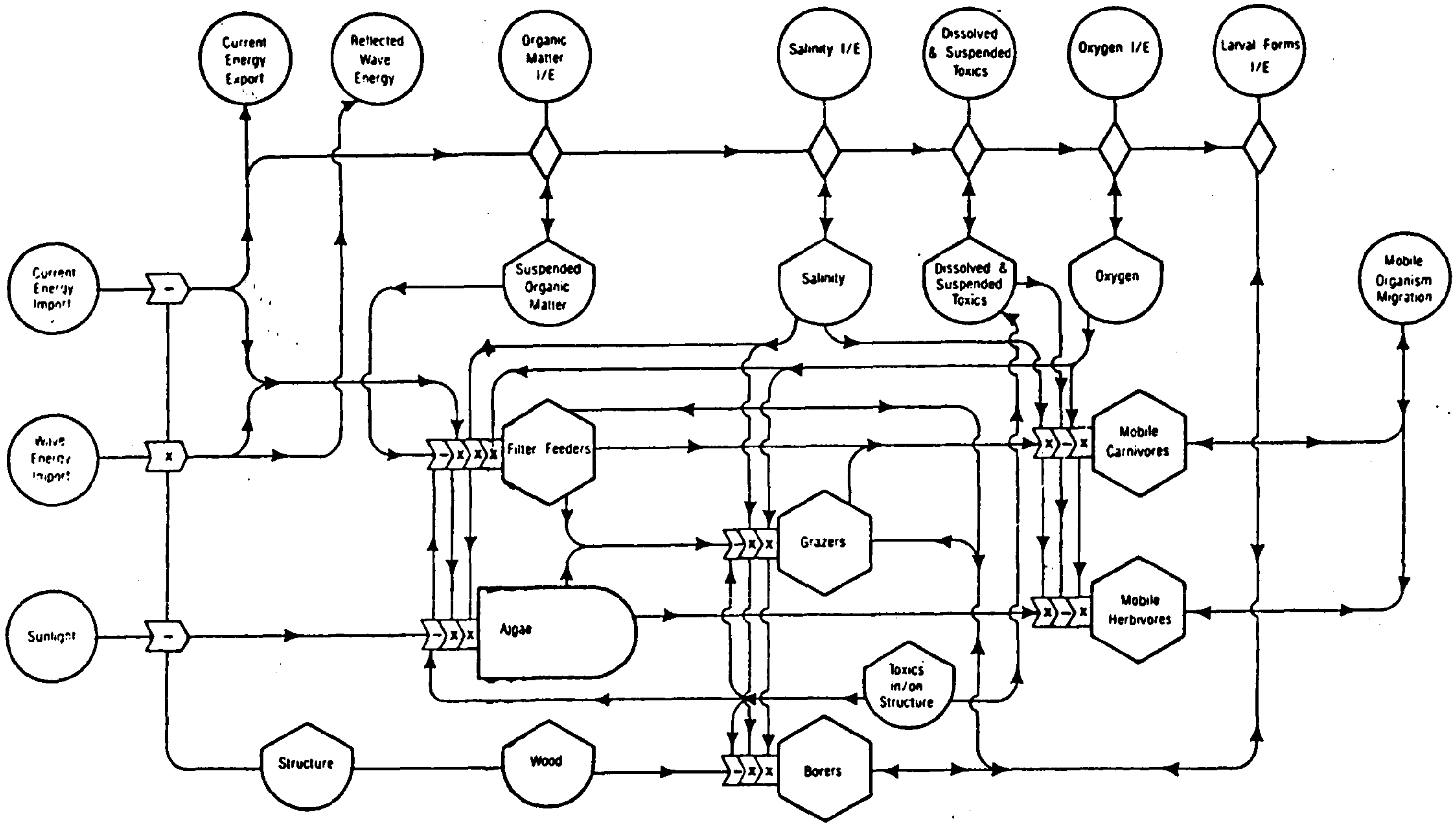
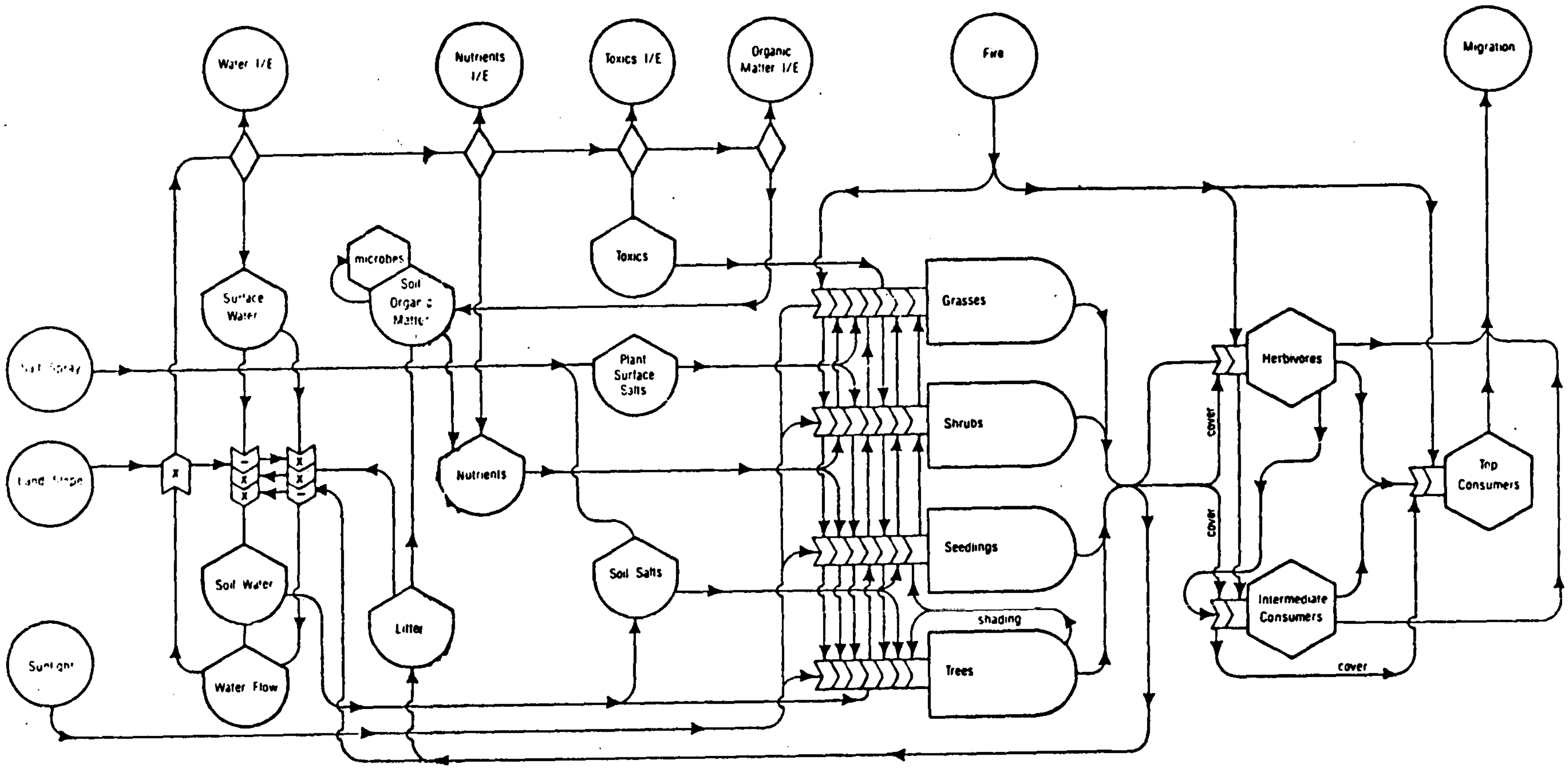

Debris from Upper Shoreface
Oil & Tar from Upper Shoreface
Seawater
Upper Shoreface Sediment Supply
Dune Sand
Dune Imports
Traffic
Precipitation & Evaporation
Migration
Storm Wave Energy
Soil Water
Water Level
Oil & Tar
Foreshore Sand
Backshore Sand
stabilization
cover
Carnivores
Sunlight
Soil Organic Matter
Herbivores
Pioneer Plants
Wind Energy
Organic Debris
Beach Scavengers & Birds
Soil Nutrients
Soil Salts

FIGURE 15



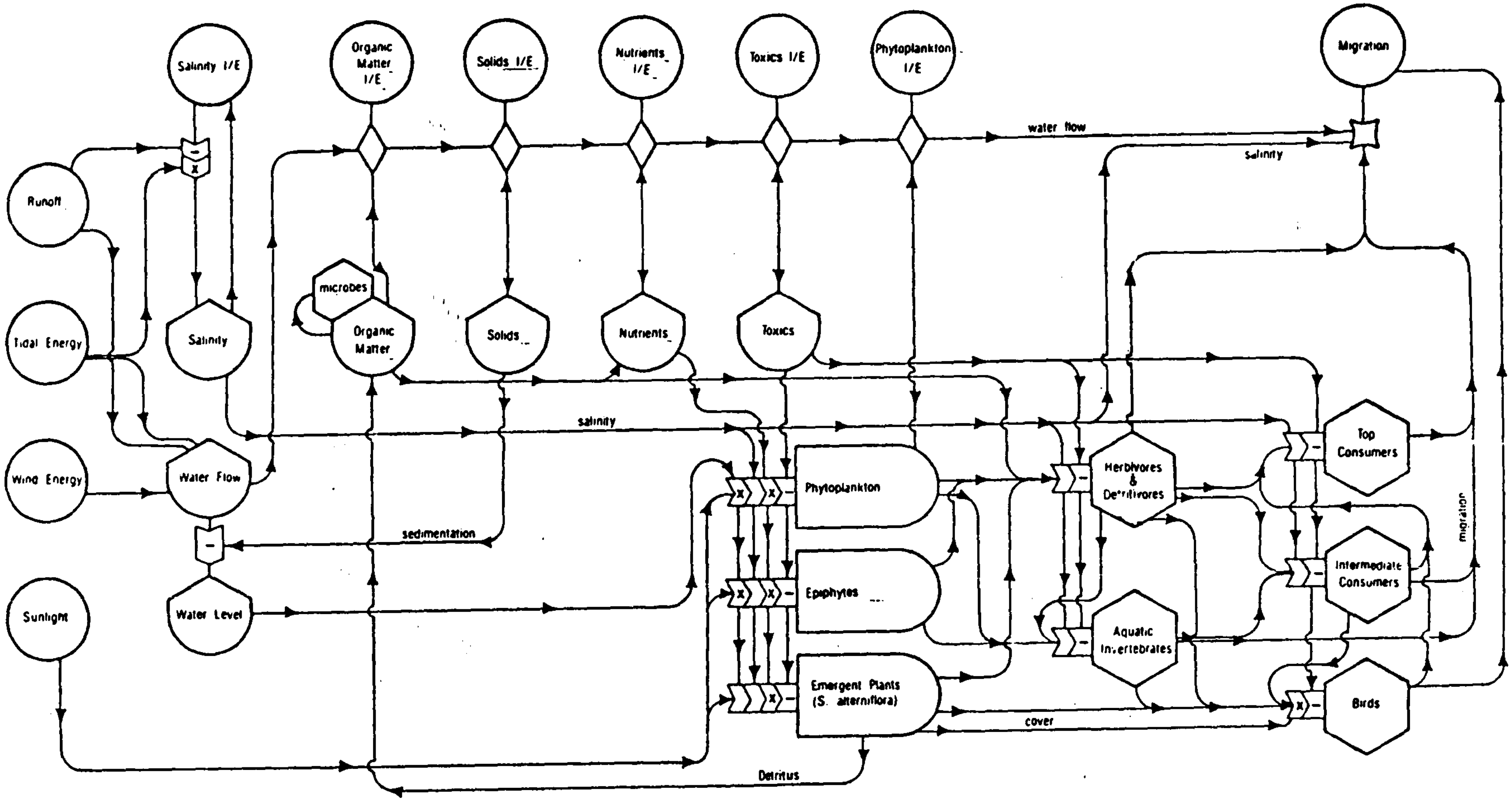
Current Energy Export
Reflected Wave Energy
Organic Matter I/E
Salinity I/E
Dissolved & Suspended Toxics
Oxygen I/E
Larval Forms I/E
Current Energy Import
Suspended Organic Matter
Salinity
Dissolved & Suspended Toxics
Oxygen
Mobile Organism Migration
Wave Energy Import
Filter Feeders
Mobile Carnivores
Grazers
Sunlight
Algae
Mobile Herbivores
Toxics in/on Structure
Structure
Wood
Borers

FIGURE 16



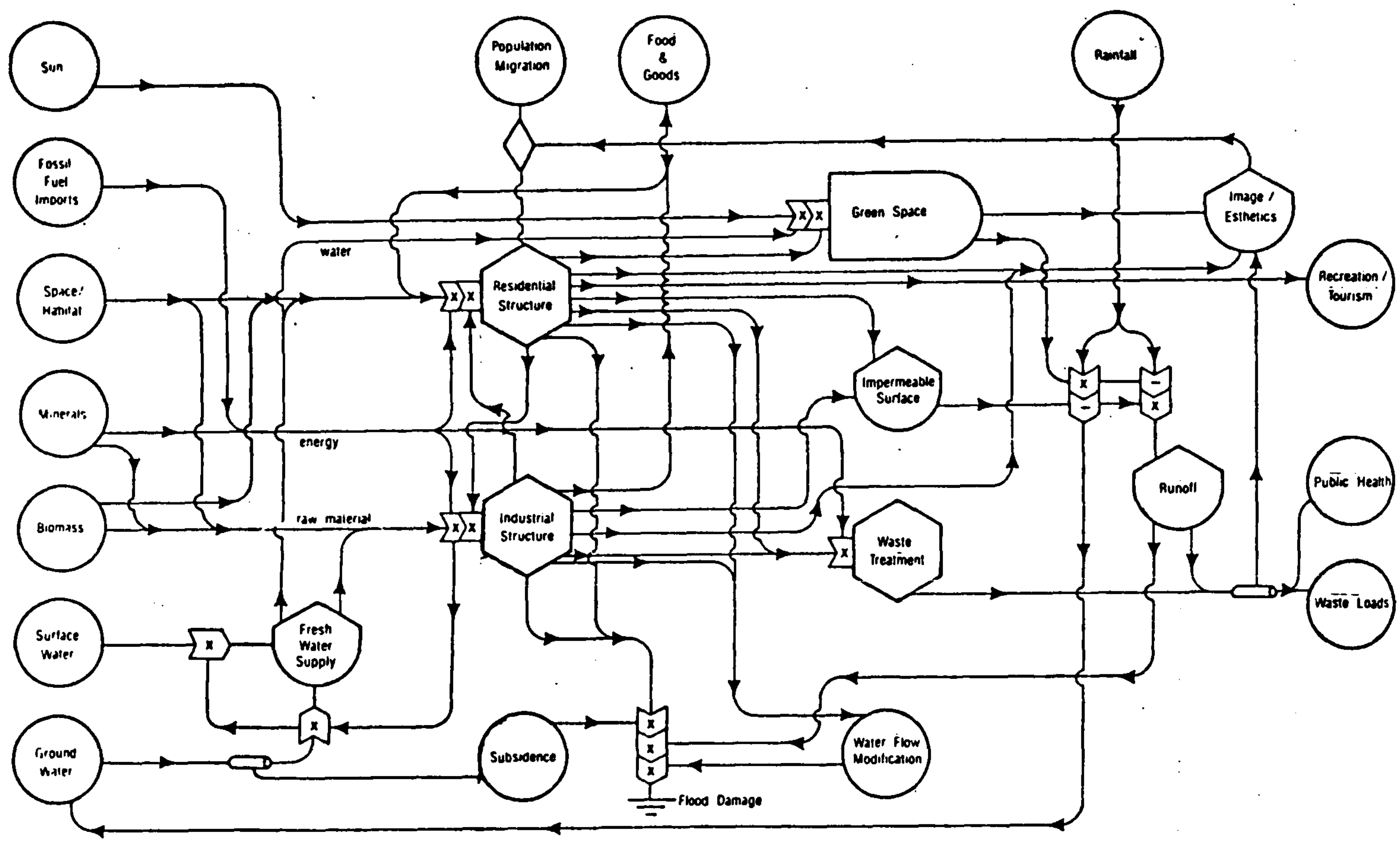
Water I/E
Nutrients I/E
Toxics I/E
Organic Matter I/E
Fire
Migration
microbes
Toxics
Soil Organic Matter
Surface Water
Plant Surface Salts
Grasses
Shrubs
Seedlings
Trees
Herbivores
Top Consumers
Intermediate Consumers
Nutrients
Soil Water
Soil Salts
Litter
Water Flow
shading
cover
cover
cover

FIGURE 17



Salinity I/E
Organic Matter I/E
Solids I/E
Nutrients I/E
Toxics I/E
Phytoplankton I/E
Migration
water flow
salinity
Runoff
Tidal Energy
Wind Energy
Sunlight
microbes
Organic Matter
Salinity
Solids
Nutrients
Toxics
Water Flow
Water Level
sedimentation
Phytoplankton
Epiphytes
Emergent Plants (S. alterniflora)
Herbivores & Detritivores
Aquatic Invertebrates
Top Consumers
Intermediate Consumers
Birds
migration
cover
Detritus

FIGURE 18


Sun
Fossil Fuel Imports
Space/ Habitat
Minerals
Biomass
Surface Water
Ground Water
Population Migration
Food & Goods
Raintall
Green Space
Image / Esthetics
Recreation / Tourism
water
energy
raw material
Residential Structure
Industrial Structure
Impermeable Surface
Runoff
Public Health
Waste Treatment
Waste Loads
Fresh Water Supply
Subsidence
Water Flow Modification
Flood Damage

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.